RICHCRAFT™ Group of Companies

April 2016

590 Rideau Street

Transportation Brief

Prepared by:

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590 Rideau Street

Transportation Brief

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April 21, 2016

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Table of Contents

List of Figures

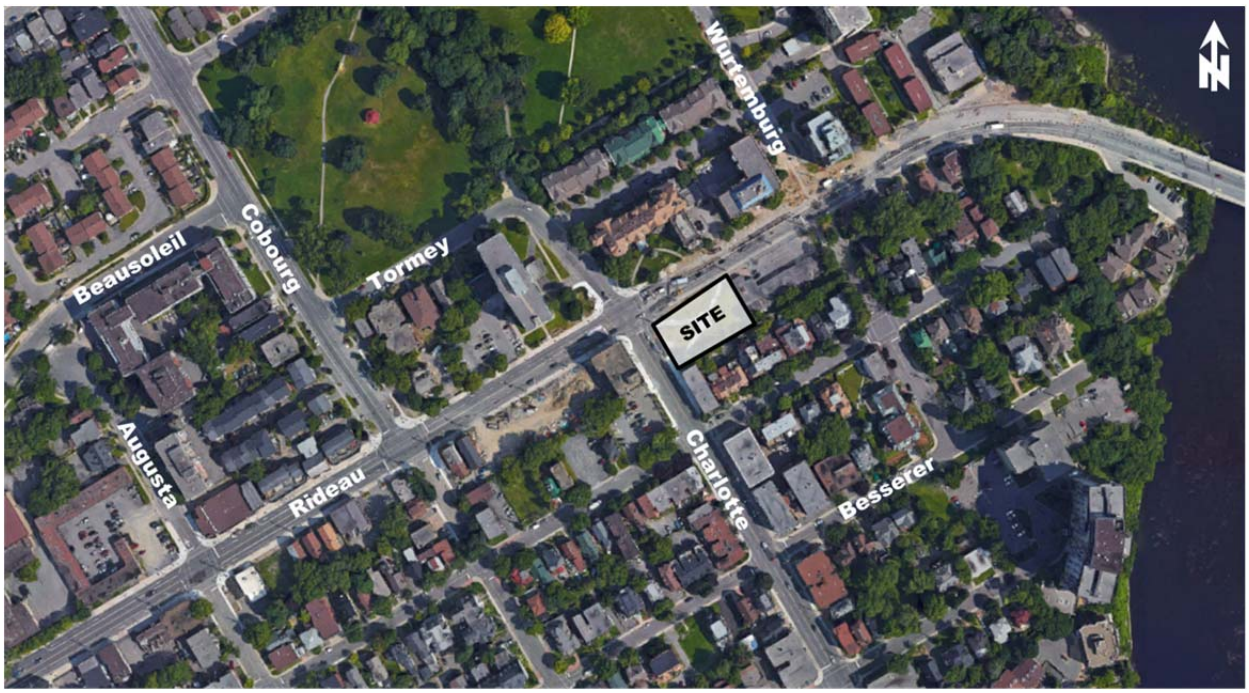
List of Tables

Appendices

1. Introduction

Richcraft is proposing a residential development consisting of 68 residential units and approximately 3,735 ft^2 of ground floor retail at the site municipally known as 590 Rideau Street. The subject site is located in the southeast quadrant of the Rideau/Charlotte intersection, which is currently a temporary park. Access to the site is proposed via a full movement driveway connection to Charlotte Street, located approximately 20 m south of Rideau Street. The site's local context is shown as Figure 1 and the proposed Site Plan is provided as Figure 2.

Figure 1: Local Context



Based on the ensuing trip generation and our review of the City's Transportation Impact Assessment Guidelines (TIA), the proposed development is projected to generate less than the City's 75 veh/h TIA threshold for requiring any traffic assessment. As such, no further traffic analysis is required. However, to assist in the application/review process, we have prepared this report that captures only the relevant transportation issues, which are as follows:

- Existing operational conditions at key adjacent intersections;
- Peak hour site traffic generation and assignment; and
- Site Plan issues including proposed parking supply and garage access/egress.

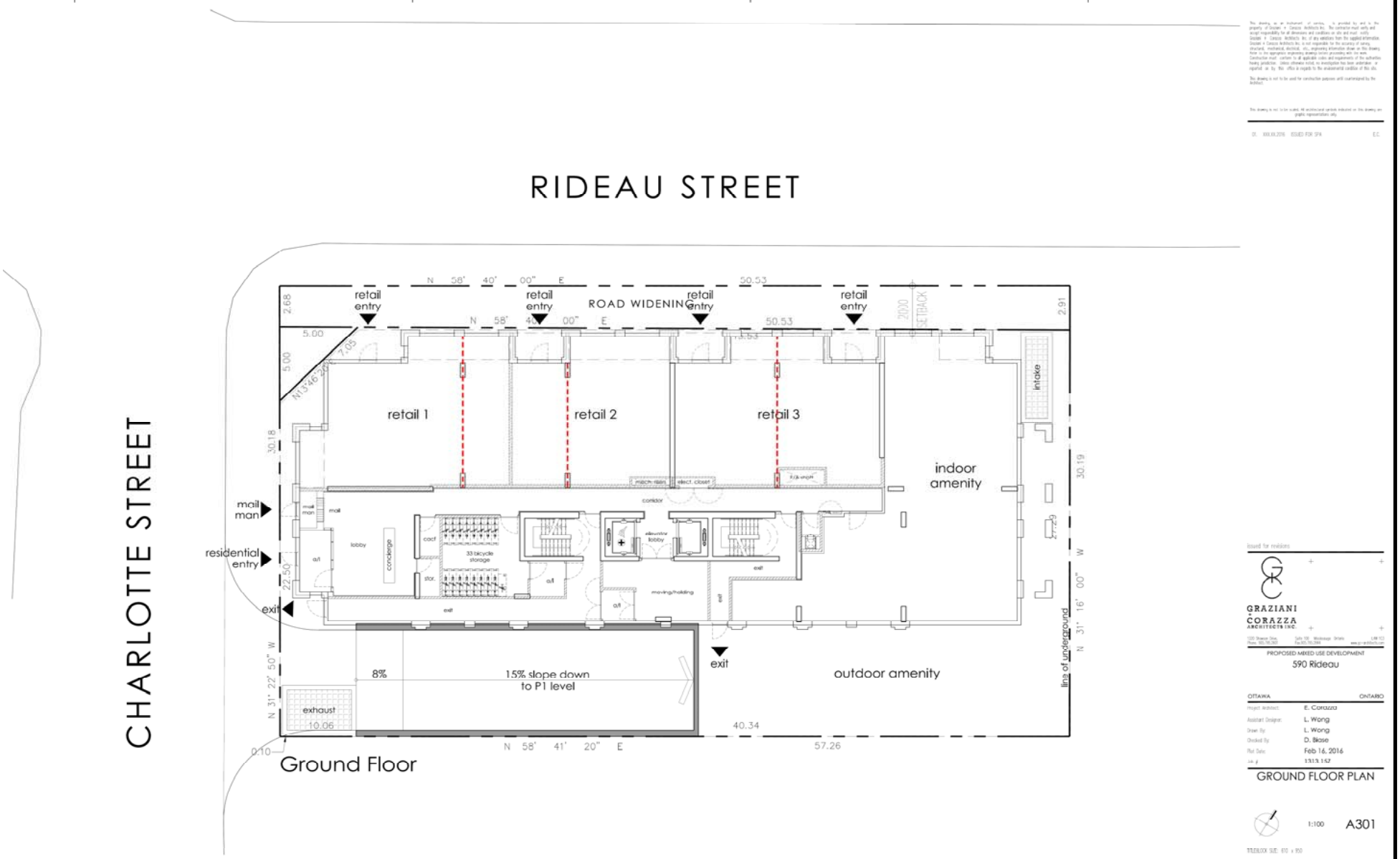


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Figure 2: Proposed Site Plan

2. Existing Conditions

2.1 Area Road Network

Rideau Street, within the vicinity of the site, is an east-west arterial roadway with transit priority lanes adjacent to the curb. It is also a designated truck route. It extends from Sussex Drive in the west to North River Road in the east, where it continues as Wellington Street and Montreal Road, respectively. Along the site's frontage, Rideau Street has a 26 m right-of-way (ROW), consisting of two vehicle travel lanes in each direction. The speed limit within the study area is 50 km/h.

Rideau Street, from Dalhousie Street east to Charlotte Street, was recently redesigned. The intent of the redesign was to provide a more "complete street" with emphasis on the provision of wider sidewalks, improved streetscaping and better accommodation of pedestrian and cyclists. At the same time, the transit accessibility, which characterizes Rideau Street, remains. These changes assist with achieving all the benefits related to active transportation, complete streets and a rejuvenated neighbourhood, but they do have some effect on vehicle movement within the area.

Charlotte Street is a major north-south collector roadway that extends from Laurier Avenue in the south to Tormey Street in the north. Its cross-section consists of two travel lanes in each direction south of Rideau Street and north of Stewart Street, and one travel lane in each direction north of Rideau Street and south of Stewart Street. On-street parking is permitted along both sides of the roadway with peak hour restrictions. The unposted speed limit is understood to be 50 km/h.

2.2 Pedestrian/Cycling Network

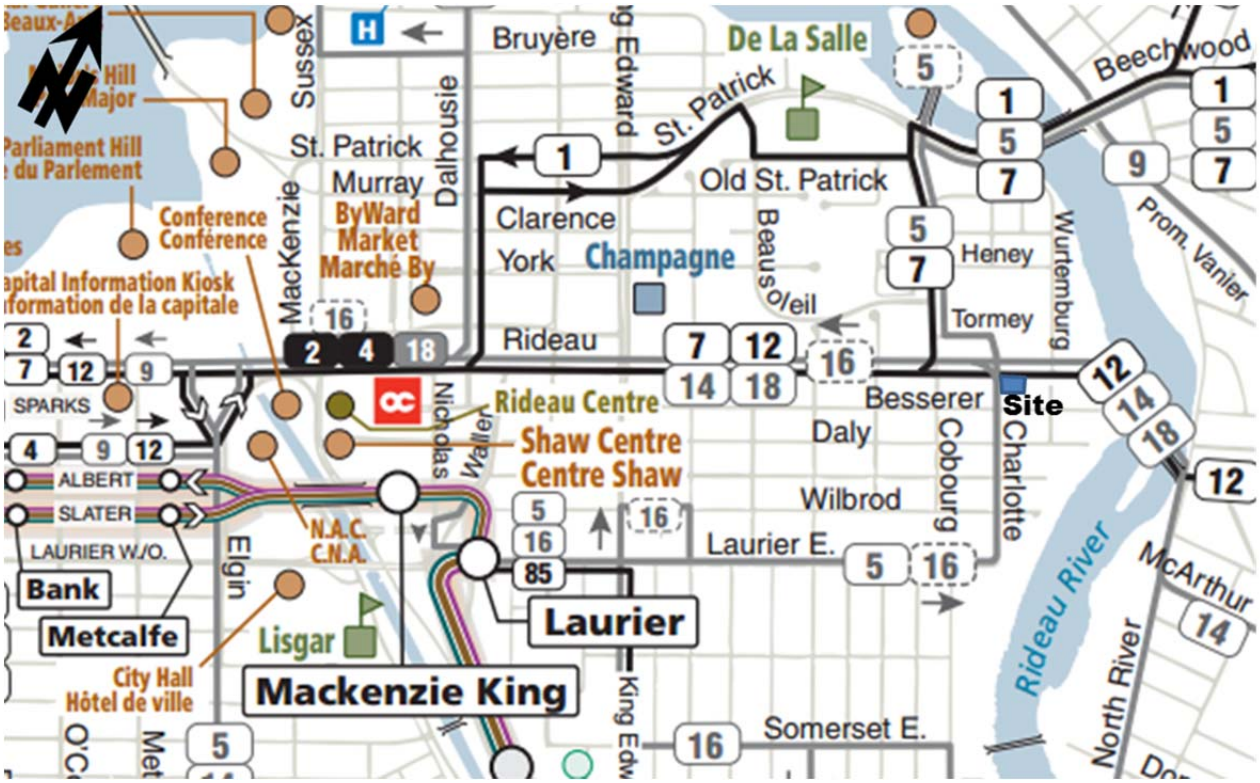
Sidewalk facilities within the vicinity of the site are provided along both sides of Rideau Street and Charlotte Street, connecting pedestrians to nearby transit stops, other adjacent development and recreational opportunities. With respect to cycling, bike facilities are currently limited to shared-use lanes along Rideau Street. The City's Cycling Plan indicates Rideau Street as a Spine Route and Charlotte Street as a Local Route.

2.3 Transit Network

Transit service within the vicinity of the site is currently provided by OC Transpo Regular Routes #5, 12, 14, 16 and 18, which provide frequent all-day service. Bus stops for these routes are located at the Rideau/Charlotte intersection, adjacent to the proposed development. Given the role of this section of Rideau Street as a transit priority corridor, and as it feeds directly to the downtown core and to the planned Rideau Centre LRT station, the number of peak period buses stopping at the bus stops adjacent to the subject site is significant.

The downtown area's LRT Confederation Line will be in operation in 2018, with a station at Rideau Centre (approximately 15 minute walking distance from the proposed site). In the interim, rapid transit service will continue to be provided via the Mackenzie King and Laurier Transitway Stations. Located approximately 1.5 kilometres west of the proposed development, the Mackenzie King and Laurier Transitway Stations provide convenient access to rapid transit routes along the Transitway.

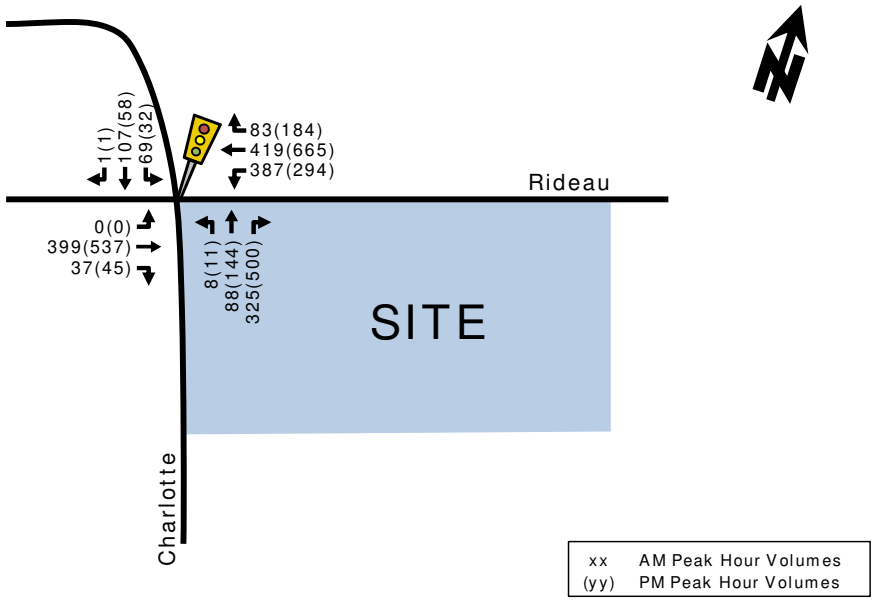
Figure 3: Existing Area Transit Network



2.4 Existing Intersection Operations

Illustrated as Figure 4, are the most recent weekday morning and afternoon peak hour traffic volumes obtained from the City of Ottawa for the Rideau/Charlotte intersection. Peak hour traffic volumes are included as Appendix A.

Figure 4: Existing Peak Hour Traffic Volumes



The following Table 1 provides a summary of existing traffic operations at the signalized study area intersection based on the SYNCHRO (V8) traffic analysis software. The subject Rideau/Charlotte intersection was assessed in terms of the volume-to-capacity (v/c) ratio and the corresponding Level of Service (LoS) for the critical movement(s). The subject intersection 'as a whole' was assessed based on a weighted v/c ratio and the SYNCHRO model output of existing conditions is provided within Appendix B.

Table 1: Existing Performance at Study Area Intersections

Intersection	Weekday AM Peak (PM Peak)					
	'Critical Movement'			'Intersection as a Whole'		
	LoS	max. v/c or avg. delay (s)	Movement	Delay (s)	LoS	v/c
Charlotte/Rideau	D(E)	0.86(0.97)	WBL(NBR)	25.3(32.0)	B(C)	0.62(0.71)
Note: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.						

As shown in Table 1, the Charlotte/Rideau intersection, 'as a whole', is currently operating at an acceptable LoS 'C' or better, with respect to the City of Ottawa operating standards of LoS 'D' or better (0.90 > v/c > 0.00). During the morning peak hour, the critical movement is the westbound left-turn movement which is currently operating at an acceptable LoS 'D'. During the afternoon peak hour, the northbound right-turn movement is noted as the 'critical movement' and is currently operating at capacity (LoS 'E'). The average queue length in the northbound right-turn lane is 77 m (approximately 11 cars) and the 95th percentile queue is 100 m (approximately 14 cars). This queue consistently spills back past Besserer Street. Field observations within study area confirm the above findings. However, according to the TIA guidelines, an intersection performance of LoS 'E' (i.e. a v/c less than 1.0) is considered acceptable, within the urban core. As such, the northbound right-turn 'critical movement' at the Rideau/Charlotte intersection is operating at an acceptable level of service during peak hours.

3. Demand Forecasting

3.1 Site Trip Generation

Appropriate trip generation rates for the proposed development consisting of 68 residential units and approximately 3,735 ft^2 of retail, were obtained from the 9th Edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual, which are summarized in Table 2.

Table 2: ITE Trip Generation Rates

Land Use	Data Source	Trip Rates	
		AM Peak	PM Peak
Mid-Rise Apartments	ITE 223	T = 0.30(du); T = 0.41(du) – 13.06	T = 0.39(du); T = 0.48(du) – 11.07
Specialty Retail	ITE 826	T = 1.36(X); T = 1.20(X) + 10.74	T = 2.71(X); T = 2.40(X) + 21.48
Notes: T = Average Vehicle Trip Ends *X = 1,000 ft^2 Gross Floor Area* *du = dwelling units* *Specialty Retail AM Peak is assumed to be 50% of the PM Peak*			

As ITE trip generation surveys only record vehicle trips and typically reflect highly suburban locations (with little to no access by travel modes other than private automobiles), adjustment factors appropriate to

the more urban study area context were applied to attain estimates of person trips for the proposed development. This approach is considered appropriate within the industry for urban infill developments.

To convert ITE vehicle trip rates to person trips, an auto occupancy factor and a non-auto trip factor were applied to the ITE vehicle trip rates. Our review of available literature suggests that a combined factor of approximately 1.3 is considered reasonable to account for typical North American auto occupancy values of approximately 1.15 and combined transit and non-motorized modal shares of less than 10%. As such, the person trip generation for the proposed site is summarized in Table 3.

Table 3: Modified Person Trip Generation

Land Use	Area	AM Peak (person trips/h)			PM Peak (person trips/h)		
		In	Out	Total	In	Out	Total
Mid-Rise Apartments	68 du	5	14	19	16	12	28
Specialty Retail	3,735 ft^2	11	9	20	17	23	40
Total 'New' Person Trips		**16**	**23**	**39**	**33**	**35**	**68**

Note: 1.3 factor to account for typical North American auto occupancy values of approximately 1.15 and combined transit and non-motorized modal shares of less than 10%

The person trips shown in Table 3 for the proposed site were then allocated using modal share values appropriate for the location and proximity to adjacent communities, employment, other shopping uses and transit availability. Modal share values for the proposed residential and retail developments are summarized in Tables 4 and 5, respectively, with the total site vehicle trip generation summarized in Table 6.

Table 4: Residential Modal Site Trip Generation

Travel Mode	Mode Share	AM Peak (person trips/h)			PM Peak (person trips/h)		
		In	Out	Total	In	Out	Total
Auto Driver	40%	2	6	8	7	5	12
Auto Passenger	10%	1	1	2	1	1	2
Transit	25%	1	3	4	4	3	7
Non-motorized	25%	1	4	5	4	3	7
Total Person Trips	100%	5	14	19	16	12	28
Total 'New' Auto Trips		**2**	**6**	**8**	**7**	**5**	**12**

Table 5: Retail Modal Site Trip Generation

Travel Mode	Mode Share	AM Peak (person trips/h)			PM Peak (person trips/h)		
		In	Out	Total	In	Out	Total
Auto Driver	25%	3	3	6	5	6	11
Auto Passenger	5%	1	1	2	1	2	3
Transit	10%	1	0	1	1	2	3
Non-motorized	60%	6	5	11	10	13	23
Total Person Trips	100%	11	9	20	17	23	40
Less 30% Pass-by		-1	-1	-2	-2	-2	-4
Total 'New' Auto Trips		**2**	**2**	**4**	**3**	**4**	**7**

Table 6: Total Site Vehicle Trip Generation

Travel Mode	AM Peak (veh/hr)			PM Peak (veh/hr)		
	In	Out	Total	In	Out	Total
Residential Trip Generation	2	6	8	7	5	12
Specialty Retail Trip Generation	3	3	6	5	6	11
Less Specialty Retail Pass-by (30%)	-1	-1	-2	-2	-2	-4
Total 'New' Auto Trips	**4**	**8**	**12**	**10**	**9**	**19**

As shown in Table 6, the resulting number of potential 'new' two-way vehicle trips for the proposed development is approximately 12 and 19 veh/h during the weekday morning and afternoon peak hours, respectively. This amount of traffic, which equates to approximately 1 new vehicle every 3 to 5 minutes, which is considered negligible in terms of traffic impact on the study area intersection.

However, given the proposed site driveway connection to Charlotte Street is located close to the Rideau/Charlotte intersection and given the northbound queueing experienced that this location, the following projected conditions analysis is provided.

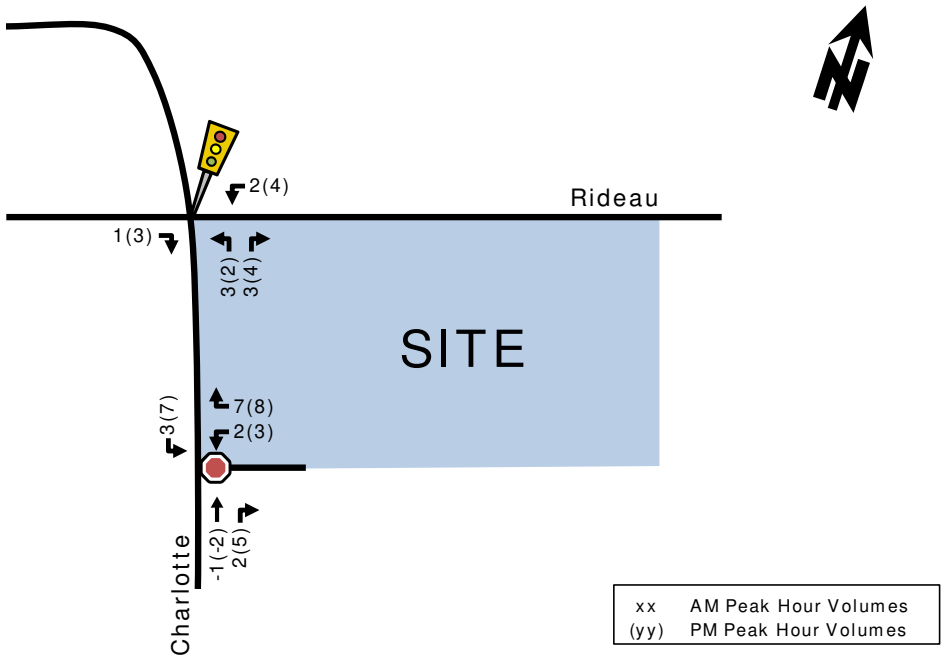
3.2 Vehicle Traffic Distribution and Assignment

Site-generated traffic distribution was based on the site's proximity to the downtown core and our knowledge of the surrounding area. The resultant distribution is outlined as follows:

- 40% to/from the west via Rideau Street;
- 30% to/from the east via Rideau Street; and
- 30% to/from the south via Charlotte Street.

Based on the above-noted distributions, 'new' site-generated trips were assigned to the study area and are illustrated as Figure 5.

Figure 5: 'New' Site-Generated Traffic Volumes

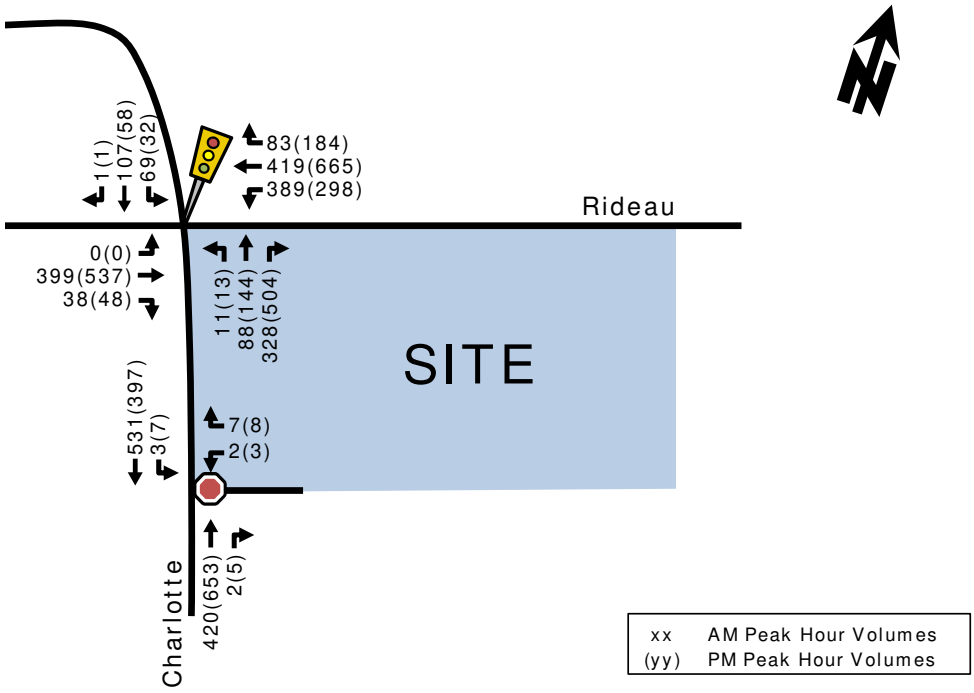


4. Future Traffic Operations

4.1 Projected Conditions at Full Site Development

Total projected volumes associated with the proposed development are illustrated in Figure 6. They were derived by superimposing 'new' site-generated volumes (Figure 5) onto existing traffic volumes (Figure 4).

Figure 6: Total Projected Peak Hour Traffic Volumes



The following Table 7 provides a summary of projected performances of study area intersections at full site occupancy. The SYNCHRO model output of projected conditions is provided within Appendix C.

Table 7: Projected Performance of Study Area Intersections

Intersection	Weekday AM Peak (PM Peak)					
	'Critical Movement'			'Intersection as a Whole'		
	LoS	max. v/c or avg. delay (s)	Movement	Delay (s)	LoS	v/c
Charlotte/Rideau	D(E)	0.86(0.98)	WBL(NBR)	25.4(32.6)	B(C)	0.62(0.72)
Charlotte/Site	B(B)	10.9(12.9)	WBL(WBL)	0.1(0.2)	-	-
Note: Analysis of signalized intersections assumes a PHF of 0.95 and a saturation flow rate of 1800 veh/h/lane.						

As shown in Table 7, with no signal timing plan modifications, the signalized study area intersection is projected to operate the similar to existing conditions, summarized in Table 1.

The site driveway connection to Charlotte Street is projected to operate with minimal on and off-site delays. However, the location of the site driveway to the adjacent Rideau/Charlotte intersection is approximately 20 m. Given the northbound queueing experienced today, southbound left-turning vehicles

accessing the site may be delayed if the northbound queue is blocking the site driveway. As such, signage advising drivers to 'not block the driveway' should be installed to allow southbound left-turning vehicles clear access to the site. Additionally, northbound vehicles wishing to access the site may be delayed during the afternoon peak hour given the northbound queues in the curb lane. However, this does not impact the existing operations of the roadway network. Overall, given the low traffic volumes accessing/egressing the site, the location of the site driveway connection to Charlotte Street is considered acceptable and signage should be installed reminding drivers to not block the access.

5. Site Plan Review

This section provides an overview of site access, parking requirements, pedestrian circulation and transit accessibility. The proposed Site Plan was previously illustrated as Figure 2.

Parking
A total of 34 residential parking spaces, 11 visitor parking spaces and 9 retail parking spaces are proposed to serve the subject site. This amount of parking satisfies the City's minimum By-Law requirement for Area B, identified in Schedule 1 of the City's Zoning By-Law. Parking spaces are noted as 5.2 m in length and 2.6 m in width, which meets the City's minimum By-Law requirements.

Site Circulation
With regard to on-site circulation, the proposed parking garage is laid out effectively, such that two-way traffic can be efficiently accommodated. The proposed drive aisle widths are noted as 6.7 m which meets the City's By-Law requirements.

The ramp providing access to the parking garage starts approximately 7 m (one car length) from the edge of the sidewalk (and approximately 5 m from the property line). A transition grade of 8% is provided for the first 3 m of the ramp which then increases to 15% grade. According to the Private Approach By-Law, a 2% transition grade (or less) is required for the first 9 m of the access measured from the property line. As such, the proposed ramp grades do not meet the City's Private Approach By-Law requirements. However, given there is approximately 7 m from the top of the ramp to the sidewalk there is sufficient space to store a single vehicle, giving both drivers and pedestrians good visibility and allowing vehicles to safely egress onto Charlotte Street. As such, the proposed ramp design is considered acceptable.

Access Requirements
Based on projected volumes and proximity to adjacent intersections, additional traffic control/auxiliary turn lanes are not required at the proposed driveway connection to Charlotte Street. Signage advising drivers to "not block the driveway" is recommended as there is significant queueing along the adjacent roadway at this location and vehicles accessing the site from the north will require a gap in the queue during peak times of the day.

The proposed site driveway connection to Charlotte Street is located approximately 20 m south of the Rideau/Charlotte intersection and is directly adjacent to the property line. According to the Private Approach By-Law, a residential building with 54 parking spaces should be 18 m from the nearest intersecting street line and at least 3 m from the property line. As such, the site driveway meets the required offset distance from Rideau Street, however, it does not meet the requirement of 3 m from the property line. The site driveway is offset as much as possible from Rideau Street and as a result is located close to the property line. There is currently a driveway connection to Charlotte Street providing access to the adjacent residential site to the south, however, this site has very low volumes

(approximately 12 vehicle parking spaces) and it is likely the driveway will be inaccessible with the construction of the subject site (the adjacent site has access to Besserer Street as well). Given the proposed site driveway will be the only driveway connection to Charlotte Street along this roadway block, there will be no vehicle conflicts as a result of driveways being too close in proximity. Therefore, the proposed location of the site driveway is considered acceptable.

Pedestrians/Transit
To connect pedestrians to transit service and other nearby employment, shopping and recreation opportunities, sidewalks are currently provided along both sides of all study area roadways. Bus stops are currently provided along Rideau Street adjacent to the site. As mentioned previously, OC Transpo service on Rideau Street is currently provided by regular (Black) Routes #7, 12, 14, 16 and 18.

Bicycles
A total of 35 bicycle parking spaces are proposed to serve the subject development. This amount of bicycle parking is sufficient with respect to the City's By-Law requirement. The location of the bicycle parking should be in a well-lit area close to the building's main entrance.

6. Findings and Recommendations

Based on the foregoing analysis of the proposed development, the following are the transportation-related findings and recommendations of this report.

- Rideau Street has recently been reconstructed from Dalhousie Street east to the Cummings Bridge. This reconstruction has improved the sidewalk and streetscape environment along the corridor, reduced pavement where considered appropriate and maintained or enhanced the transit and bicycle operating environments;

- The study area intersection adjacent to the site is currently operating 'as a whole' at an acceptable LoS 'C' or better during the weekday morning and afternoon peak hours;

- With regard to 'critical movements' at the study area intersection, they are noted as operating at an LoS 'E' or better during peak hours. The northbound queues at the Rideau/Charlotte intersection currently spill back past Besserer Street on average;

- The proposed development is projected to generate 'new' two-way vehicle volumes of approximately 12 and 20 veh/h during the weekday morning and afternoon peak hours, respectively. This equates to approximately 1 new vehicle every 3 to 5 minutes, and as such, the impact of the site-generated vehicles on the study area network is considered negligible;

- At full occupancy, the study area intersection 'as a whole', with no signal timing plan modifications, is projected to operate similar to existing conditions;

- The site driveway connection to Charlotte Street is located approximately 20 m south of Rideau Street and is projected to operate with acceptable delays. However, given the existing northbound queueing on Charlotte Street, drivers wishing to access the site from the south will be delayed in the existing queues;

- Signage advising drivers to 'not block the driveway' should be installed to allow southbound left-turning vehicles clear access to the site during times when northbound queues at the adjacent Rideau/Charlotte intersection spill back past the driveway;

- Given the low traffic generated by the proposed development, the location of the site driveway, close to the Rideau/Charlotte intersection, is considered acceptable;

- The site's driveway connection to Charlotte Street meet the City's Private Approach By-Law requirements and the ramp grades are considered acceptable; and

- The proposed vehicle/bicycle parking supply and dimensioning is noted as being sufficient with respect to the City's By-Law requirements.

Based on the foregoing, the proposed development fits well into the transportation context of the surrounding area, and its location and design serves to promote use of walking, cycling, and transit modes, thus supporting City of Ottawa policies, goals and objectives with respect to redevelopment, intensification and modal share.

Therefore, the proposed 590 Rideau residential development is recommended from a transportation perspective.

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Appendix A

Current Peak Hour Traffic Volumes

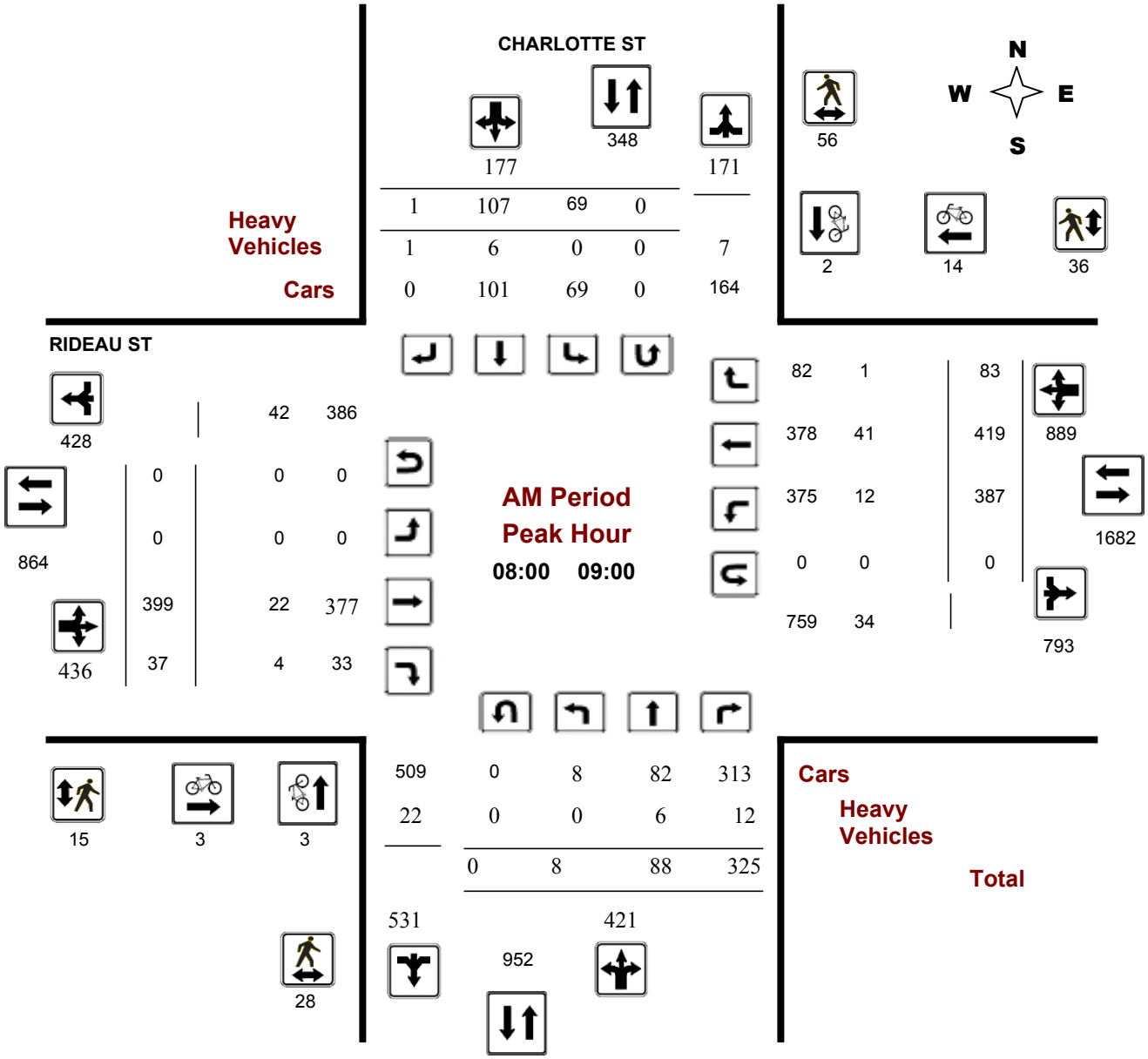
Public Works - Traffic Services

Turning Movement Count - Peak Hour Diagram

CHARLOTTE ST @ RIDEAU ST

Survey Date: Tuesday, December 01, 2015 **WO No:** 35847

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



Comments

Public Works - Traffic Services

Turning Movement Count - Peak Hour Diagram

CHARLOTTE ST @ RIDEAU ST

Survey Date: Tuesday, December 01, 2015 **WO No:** 35847

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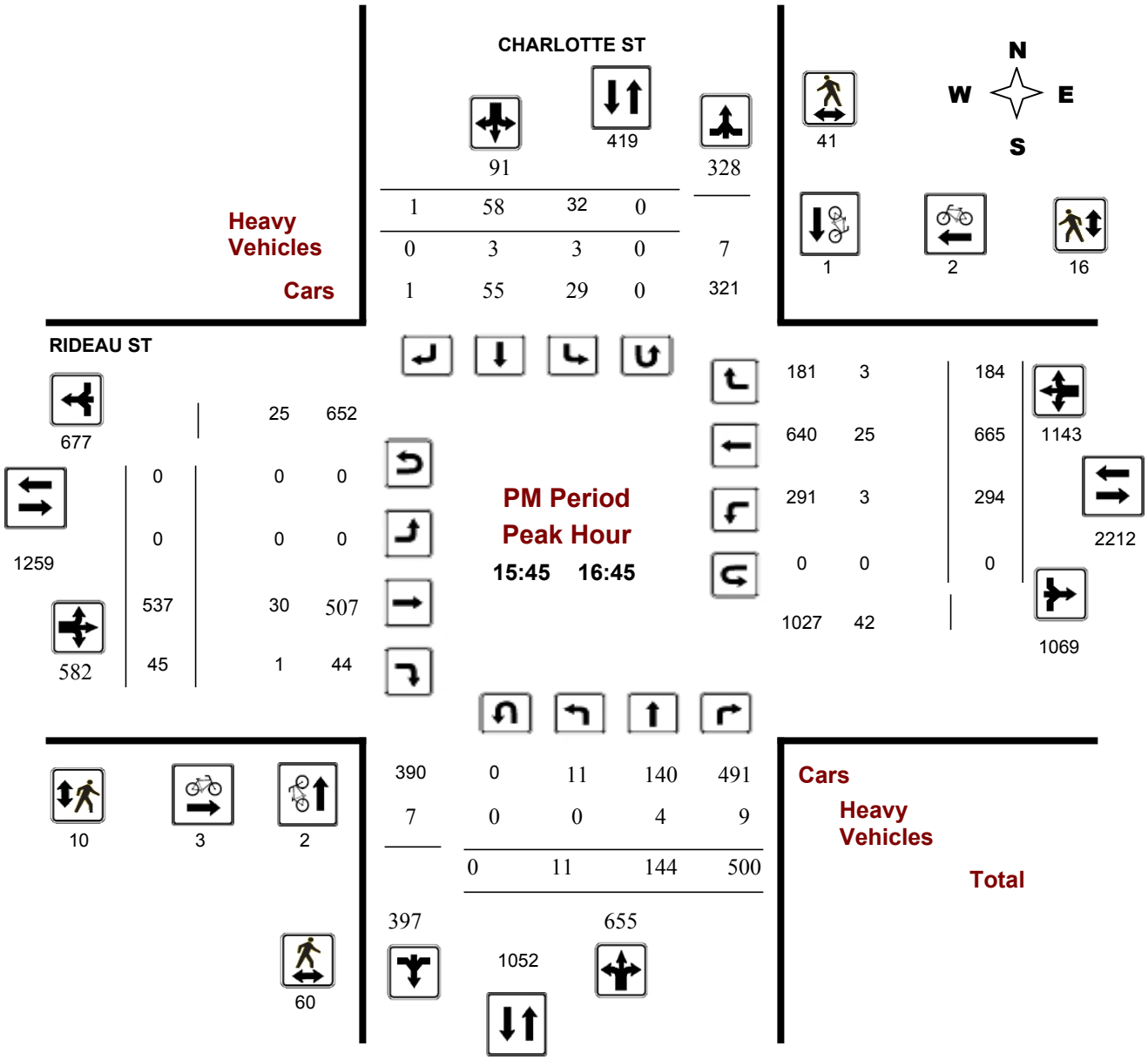


Comments

Appendix B

SYNCHRO Analysis: Existing Conditions

Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	ø3	ø7
Lane Configurations										
Volume (vph)	399	387	419	8	88	325	69	107		
Lane Group Flow (vph)	459	407	528	0	101	342	0	187		
Turn Type	NA	Prot	NA	Perm	NA	pm+ov	Perm	NA		
Protected Phases	2	1	6		8	1		4	3	7
Permitted Phases				8		8	4			
Detector Phase	2	1	6	8	8	1	4	4		
Switch Phase										
Minimum Initial (s)	10.0	5.0	10.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0
Minimum Split (s)	24.6	10.6	27.6	20.6	20.6	10.6	20.6	20.6	5.0	5.0
Total Split (s)	25.0	28.0	53.0	22.0	22.0	28.0	22.0	22.0	5.0	5.0
Total Split (%)	31.3%	35.0%	66.3%	27.5%	27.5%	35.0%	27.5%	27.5%	6%	6%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	2.0	2.0
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0		0.0		
Total Lost Time (s)	5.6	5.6	5.6		5.6	5.6		5.6		
Lead/Lag	Lead	Lag		Lag	Lag	Lag	Lag	Lag	Lead	Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	C-Max	Max	C-Max	None	None	Max	None	None	None	None
Act Effct Green (s)	25.2	22.4	53.2		14.6	37.0		14.6		
Actuated g/C Ratio	0.32	0.28	0.66		0.18	0.46		0.18		
v/c Ratio	0.44	0.86	0.46		0.32	0.50		0.71		
Control Delay	24.5	47.1	8.6		30.4	13.4		45.7		
Queue Delay	0.0	0.0	0.0		0.0	0.0		0.0		
Total Delay	24.5	47.1	8.6		30.4	13.4		45.7		
LOS	C	D	A		C	B		D		
Approach Delay	24.5		25.4		17.3			45.7		
Approach LOS	C		C		B			D		
Queue Length 50th (m)	28.8	58.4	31.8		13.2	28.4		26.5		
Queue Length 95th (m)	46.7	#105.9	64.9		26.1	37.8		#48.3		
Internal Link Dist (m)	147.8		140.3		114.4			68.8		
Turn Bay Length (m)										
Base Capacity (vph)	1046	474	1139		362	682		302		
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	0.44	0.86	0.46		0.28	0.50		0.62		

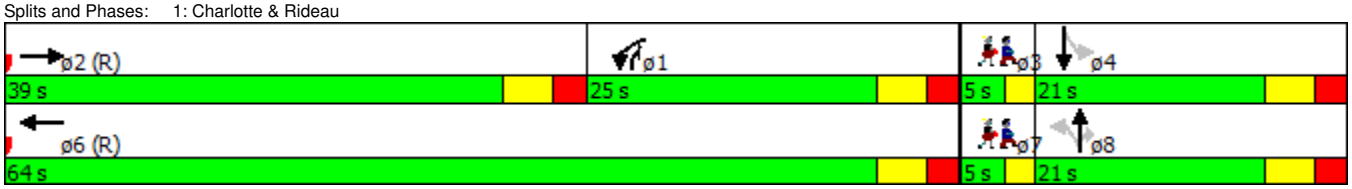
Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 80	
Offset: 28 (35%), Referenced to phase 2:EBT and 6:WBT, Start of Green	
Natural Cycle: 75	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.86	
Intersection Signal Delay: 25.3	Intersection LOS: C
Intersection Capacity Utilization 69.2%	ICU Level of Service C
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Charlotte & Rideau

Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	ø3	ø7
Lane Configurations										
Volume (vph)	537	294	665	11	144	500	32	58		
Lane Group Flow (vph)	612	309	894	0	164	526	0	96		
Turn Type	NA	Prot	NA	Perm	NA	pm+ov	Perm	NA		
Protected Phases	2	1	6		8	1		4	3	7
Permitted Phases				8		8	4			
Detector Phase	2	1	6	8	8	1	4	4		
Switch Phase										
Minimum Initial (s)	10.0	5.0	10.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0
Minimum Split (s)	24.6	10.6	27.6	20.6	20.6	10.6	20.6	20.6	5.0	5.0
Total Split (s)	39.0	25.0	64.0	21.0	21.0	25.0	21.0	21.0	5.0	5.0
Total Split (%)	43.3%	27.8%	71.1%	23.3%	23.3%	27.8%	23.3%	23.3%	6%	6%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	2.0	2.0
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0		0.0		
Total Lost Time (s)	5.6	5.6	5.6		5.6	5.6		5.6		
Lead/Lag	Lead	Lag		Lag	Lag	Lag	Lag	Lag	Lead	Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	C-Max	Max	C-Max	None	None	Max	None	None	None	None
Act Effct Green (s)	39.5	19.4	64.5		13.3	32.7		13.3		
Actuated g/C Ratio	0.44	0.22	0.72		0.15	0.36		0.15		
v/c Ratio	0.42	0.85	0.74		0.64	0.97		0.51		
Control Delay	19.3	56.3	13.1		47.8	57.5		44.0		
Queue Delay	0.0	0.0	0.0		0.0	0.0		0.0		
Total Delay	19.3	56.3	13.1		47.8	57.5		44.0		
LOS	B	E	B		D	E		D		
Approach Delay	19.3		24.2		55.2			44.0		
Approach LOS	B		C		E			D		
Queue Length 50th (m)	36.6	51.6	72.6		26.9	77.1		15.2		
Queue Length 95th (m)	57.6	#94.6	159.2		45.7	#98.5		29.8		
Internal Link Dist (m)	147.8		140.3		114.4			68.8		
Turn Bay Length (m)										
Base Capacity (vph)	1452	365	1216		297	541		221		
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	0.42	0.85	0.74		0.55	0.97		0.43		

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 45 (50%), Referenced to phase 2:EBT and 6:WBT, Start of Green	
Natural Cycle: 75	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.97	
Intersection Signal Delay: 32.0	Intersection LOS: C
Intersection Capacity Utilization 83.2%	ICU Level of Service E
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Charlotte & Rideau



Appendix C

SYNCHRO Analysis: Projected Conditions

Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	ø3	ø7
Lane Configurations										
Volume (vph)	399	389	419	11	88	328	69	107		
Lane Group Flow (vph)	460	409	528	0	105	345	0	187		
Turn Type	NA	Prot	NA	Perm	NA	pm+ov	Perm	NA		
Protected Phases	2	1	6		8	1		4	3	7
Permitted Phases				8		8	4			
Detector Phase	2	1	6	8	8	1	4	4		
Switch Phase										
Minimum Initial (s)	10.0	5.0	10.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0
Minimum Split (s)	24.6	10.6	27.6	20.6	20.6	10.6	20.6	20.6	5.0	5.0
Total Split (s)	25.0	28.0	53.0	22.0	22.0	28.0	22.0	22.0	5.0	5.0
Total Split (%)	31.3%	35.0%	66.3%	27.5%	27.5%	35.0%	27.5%	27.5%	6%	6%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	2.0	2.0
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0		0.0		
Total Lost Time (s)	5.6	5.6	5.6		5.6	5.6		5.6		
Lead/Lag	Lead	Lag		Lag	Lag	Lag	Lag	Lag	Lead	Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	C-Max	Max	C-Max	None	None	Max	None	None	None	None
Act Effct Green (s)	25.2	22.4	53.2		14.6	37.0		14.6		
Actuated g/C Ratio	0.32	0.28	0.66		0.18	0.46		0.18		
v/c Ratio	0.44	0.86	0.46		0.34	0.51		0.71		
Control Delay	24.5	47.6	8.7		30.7	13.4		45.7		
Queue Delay	0.0	0.0	0.0		0.0	0.0		0.0		
Total Delay	24.5	47.6	8.7		30.7	13.4		45.7		
LOS	C	D	A		C	B		D		
Approach Delay	24.5		25.7		17.5			45.7		
Approach LOS	C		C		B			D		
Queue Length 50th (m)	28.9	58.8	31.8		13.8	28.8		26.5		
Queue Length 95th (m)	46.8	#106.5	64.9		26.9	38.2		#48.5		
Internal Link Dist (m)	147.8		140.3		5.2			68.8		
Turn Bay Length (m)										
Base Capacity (vph)	1047	474	1138		357	683		301		
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	0.44	0.86	0.46		0.29	0.51		0.62		

Intersection Summary	
Cycle Length: 80	
Actuated Cycle Length: 80	
Offset: 28 (35%), Referenced to phase 2:EBT and 6:WBT, Start of Green	
Natural Cycle: 75	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.86	
Intersection Signal Delay: 25.4	Intersection LOS: C
Intersection Capacity Utilization 69.3%	ICU Level of Service C
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Charlotte & Rideau

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	2	7	420	2	3	531
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	2	7	442	2	3	559
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						29
pX, platoon unblocked						
vC, conflicting volume	729	222			444	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	729	222			444	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			100	
cM capacity (veh/h)	357	782			1112	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	9	295	149	189	373
Volume Left	2	0	0	3	0
Volume Right	7	0	2	0	0
cSH	618	1700	1700	1112	1700
Volume to Capacity	0.02	0.17	0.09	0.00	0.22
Queue Length 95th (m)	0.4	0.0	0.0	0.1	0.0
Control Delay (s)	10.9	0.0	0.0	0.2	0.0
Lane LOS	B			A	
Approach Delay (s)	10.9	0.0		0.1	
Approach LOS	B				

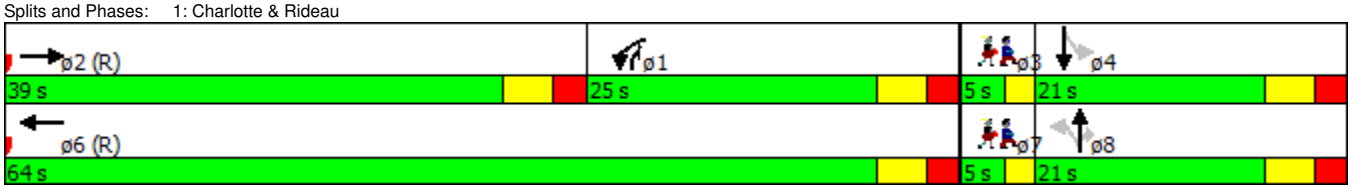
Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	27.7%	ICU Level of Service	A
Analysis Period (min)	15		

Projected PM
1: Charlotte & Rideau

Lane Group	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	ø3	ø7
Lane Configurations										
Volume (vph)	537	298	665	13	144	504	32	58		
Lane Group Flow (vph)	616	314	894	0	166	531	0	96		
Turn Type	NA	Prot	NA	Perm	NA	pm+ov	Perm	NA		
Protected Phases	2	1	6		8	1		4	3	7
Permitted Phases				8		8	4			
Detector Phase	2	1	6	8	8	1	4	4		
Switch Phase										
Minimum Initial (s)	10.0	5.0	10.0	10.0	10.0	5.0	10.0	10.0	1.0	1.0
Minimum Split (s)	24.6	10.6	27.6	20.6	20.6	10.6	20.6	20.6	5.0	5.0
Total Split (s)	39.0	25.0	64.0	21.0	21.0	25.0	21.0	21.0	5.0	5.0
Total Split (%)	43.3%	27.8%	71.1%	23.3%	23.3%	27.8%	23.3%	23.3%	6%	6%
Yellow Time (s)	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	2.0	2.0
All-Red Time (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	0.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0		0.0		
Total Lost Time (s)	5.6	5.6	5.6		5.6	5.6		5.6		
Lead/Lag	Lead	Lag		Lag	Lag	Lag	Lag	Lag	Lead	Lead
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	C-Max	Max	C-Max	None	None	Max	None	None	None	None
Act Effct Green (s)	39.4	19.4	64.4		13.4	32.8		13.4		
Actuated g/C Ratio	0.44	0.22	0.72		0.15	0.36		0.15		
v/c Ratio	0.42	0.86	0.74		0.65	0.98		0.50		
Control Delay	19.4	58.1	13.2		48.1	58.9		43.8		
Queue Delay	0.0	0.0	0.0		0.0	0.0		0.0		
Total Delay	19.4	58.1	13.2		48.1	58.9		43.8		
LOS	B	E	B		D	E		D		
Approach Delay	19.4		24.9		56.3			43.8		
Approach LOS	B		C		E			D		
Queue Length 50th (m)	37.0	52.5	73.0		27.3	78.1		15.2		
Queue Length 95th (m)	58.0	#96.4	159.2		46.4	#100.3		29.8		
Internal Link Dist (m)	147.8		140.3		18.0			68.8		
Turn Bay Length (m)										
Base Capacity (vph)	1455	365	1214		296	543		222		
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	0.42	0.86	0.74		0.56	0.98		0.43		

Intersection Summary	
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 45 (50%), Referenced to phase 2:EBT and 6:WBT, Start of Green	
Natural Cycle: 75	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 0.98	
Intersection Signal Delay: 32.6	Intersection LOS: C
Intersection Capacity Utilization 83.3%	ICU Level of Service E
Analysis Period (min) 15	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 1: Charlotte & Rideau



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	3	8	653	5	7	397
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	3	8	687	5	7	418
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (m)						42
pX, platoon unblocked						
vC, conflicting volume	914	346			693	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	914	346			693	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			99	
cM capacity (veh/h)	270	650			898	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	12	458	234	147	279
Volume Left	3	0	0	7	0
Volume Right	8	0	5	0	0
cSH	470	1700	1700	898	1700
Volume to Capacity	0.02	0.27	0.14	0.01	0.16
Queue Length 95th (m)	0.6	0.0	0.0	0.2	0.0
Control Delay (s)	12.9	0.0	0.0	0.5	0.0
Lane LOS	B			A	
Approach Delay (s)	12.9	0.0		0.2	
Approach LOS	B				

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	29.2%	ICU Level of Service	A
Analysis Period (min)	15		