



401 March Road Transportation Study

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Prepared for:

Starbank Developments 401 Corp.

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Executive Summary

A. Introduction

Starbank Developments 401 Corp. (Starbank) is currently undergoing the planning process for a proposed commercial plaza to be located at 401 March Road in the community of Kanata in the City of Ottawa. The site is located in the southwest quadrant of the intersection of March Road and Station Road / Carling Avenue. The proposed development includes the following:

- 2,400 square foot (SF) fast food restaurant with drive-through window (A&W);
- 2,695 SF coffee / doughnut shop with drive through window (Tim Horton's);
- 4,000 SF office building; and
- Gas station with 10 pumps including a convenience store and car wash.

The total proposed gross floor area is 13,995 SF, which includes the gas station and car wash. Please note that tenants have been indicated, but that may change.

Access to the plaza is proposed via three unsignalized driveways:

- One full movement driveway on Station Road opposite an existing driveway to the north;
- One right-in / right-out only driveway on March Road mid-way along the site frontage; and
- A right-out only driveway on March Road at the southerly limit of the site.

R.J. Burnside & Associates Limited (Burnside) was retained to prepare this Transportation Study for the purposes of a Zoning and Site Plan Application (Site Plan Control) as part of the development planning process. This study has been undertaken in accordance with the City of Ottawa's *Transportation Impact Assessment Guidelines (2006)*.

B. Conclusions

Intersection Operations

Under existing 2013 traffic conditions, study intersections are operating with excess capacity and will continue to do so under 2019 total traffic conditions with the development in place.

However, northbound queues on March Road during the AM Peak Hour appear to be currently reaching 302 m, which results in the queue extending through and south of the

signalized intersection to the commercial plaza on the south side of the tracks. This does not occur during any of the other peak hours. This length of queue has been observed in the field, but the traffic signal to the plaza to the south was also observed “metering” the queue. In other words, the queue appears to not regularly block the southerly traffic signal. Under 2019 conditions this queue is predicted to reach 346 m without the development. With signal timing optimization the queue is predicted to be shortened to 317 m under total conditions.

Based on our analysis, there are no required road improvements.

Site Plan Review

A truck access analysis, using a WB-20 truck design vehicle, was conducted for trucks accessing the proposed gas station for the purposes of refuelling the underground fuel tanks. The analysis illustrates that the proposed site and access configuration accommodates the WB-20 turning movements through the site. The analysis confirms the necessity of the two driveways on March Road for fuel truck access.

The on-site and off-site operations have been reviewed. It is our opinion that the site is well designed to accommodate and facilitate all modes of travel. The site design will also encourage non-vehicle modes by providing good integration with the external road network. Transit will continue to operate well within the vicinity of the site, with a stop provided along the frontage of the site on March Road. We do not anticipate the site to notably contribute to the potential for weaving, merging, or diverging concerns.

Proposed Driveways

The driveway locations and type were developed in consultation with City staff and comply with the Private Approach By-law 2003-447, with the exception of the throat width of the right-in / right-out only driveway on March Road. The By-law requires a maximum width of 9.0m at the property line. The proposed throat width is approximately 12 m. A variance may be required.

Parking Supply and Drive-Through

The proposed parking supply of 90 spaces for the development will exceed the Zoning By-law's requirements by 32 spaces. The Zoning By-law also requires a minimum of five (5) bicycle parking spaces, which will be provided.

The spaces provided for queuing for the car wash and restaurants either meet or exceed the By-law's requirements.

Transportation Demand Management

The site is currently well served by transit along its frontage, sidewalks on March Road and a bicycle lane on both sides of March Road. The following transportation demand management plan elements are proposed to be incorporated into the site:

- Internal sidewalk connections to the existing sidewalk network on March Road, which in turn will provide access to the existing transit routes in the neighbourhood.
- Pedestrian access in the form of paved walkways, marked pedestrian crossings, and wheelchair / stroller accessible ramps to be provided internally to facilitate the flow of pedestrians throughout the site.
- Areas designated for short-term bicycle parking will be clearly marked and located close to each building entrance. Bicycle parking will be protected from the elements by use of an overhead canopy, well lit and easily accessible. Access will be provided via the site's driveways and internal pedestrian pathways to the existing bicycle lanes on March Road.

In addition, the planned Bus Rapid Transit route along March Road, between Highway 417 and Maxwell Bridge Road, will further encourage walk-in traffic and a reduction in vehicle and parking demand.

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1.0 Introduction

1.1 Background

Starbank Developments 401 Corp. (Starbank) is currently undergoing the planning process for a proposed commercial plaza located at 401 March Road in the community of Kanata in the City of Ottawa. The site is located in the southwest quadrant of the intersection of March Road and Station Road / Carling Avenue. The site location is shown in **Figure 1**.

The proposed development includes the following:

- 2,400 square foot ("SF") fast food restaurant with drive-through window (A&W);
- 2,695 SF coffee / doughnut shop with drive through window (Tim Horton's);
- 4,000 SF office building; and
- Gas station with 10 pumps including a convenience store and car wash.

The total proposed gross floor area is 13,995 SF, which includes the gas station and car wash. Potential tenant names are shown for some uses; however, the tenants may change.

Access to the plaza is proposed via three unsignalized driveways:

- One full movement driveway on Station Road opposite an existing driveway to the north (west driveway to 413 March Road);
- One right-in / right-out only driveway on March Road mid-way along the site frontage; and
- A right-out only driveway on March Road at the southerly limit of the site.

R.J. Burnside & Associates Limited (Burnside) was retained to prepare this Transportation Study for the purposes of a Zoning and Site Plan Application (Site Plan Control) as part of the development planning process. This study has been undertaken in accordance with the City of Ottawa's *Transportation Impact Assessment Guidelines (2006)*. Under the guidelines, a Transportation Impact Study is required.

1.2 Scope of Work

The purpose of the study is to analyze intersection operations for the following scenarios:

- 2013 existing traffic conditions;

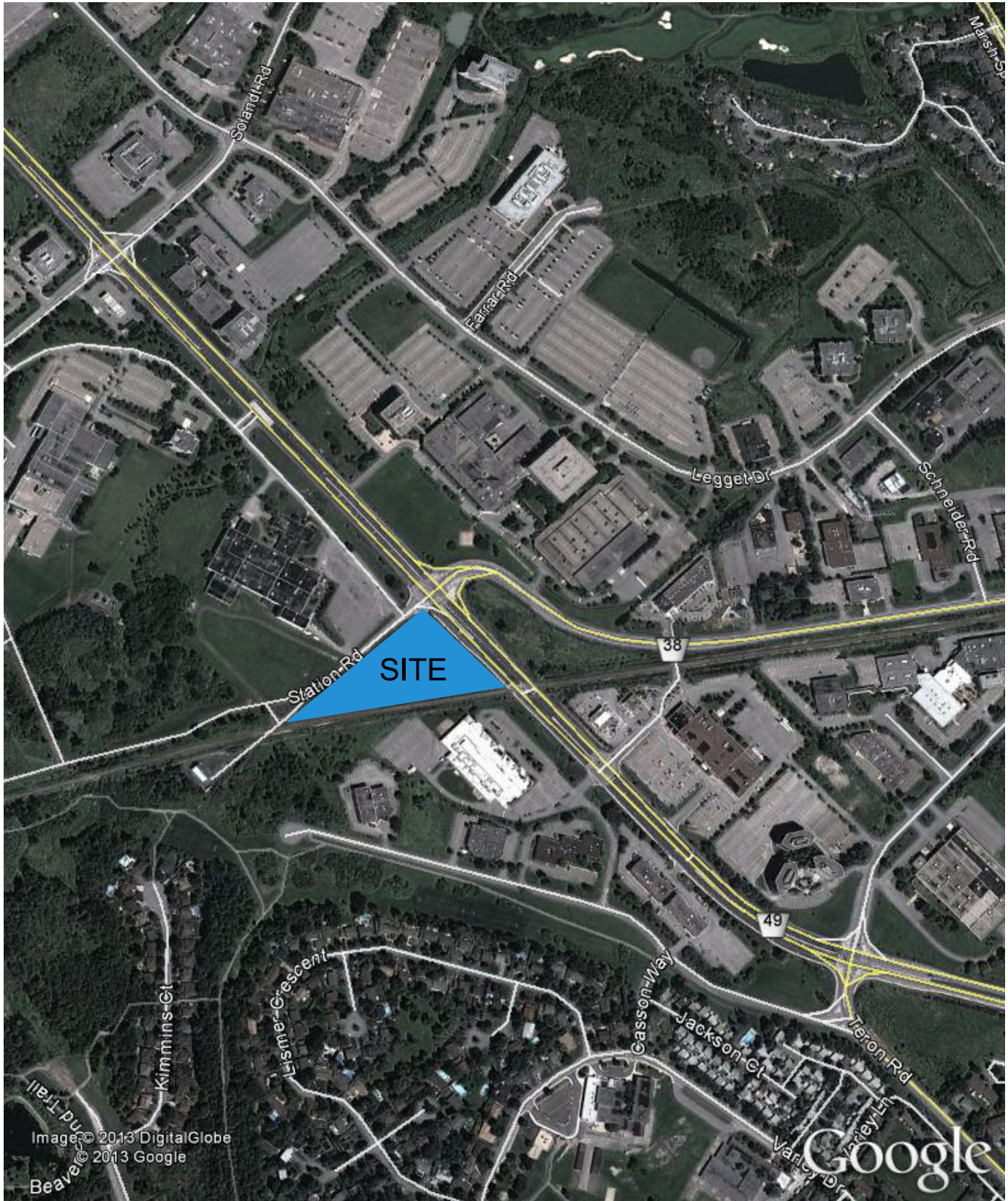


FIGURE 1
SITE LOCATION

N.T.S.

- 2019 (Buildout in 2014 +5years) background traffic conditions (includes yearly traffic growth + background developments); and
- 2019 total traffic conditions (Buildout in 2014 +5years, includes 2019 background traffic + proposed development traffic).

The weekday AM and PM, and Saturday midday peak hour operating conditions for the above scenarios was analyzed for the following intersections:

- March Road @ Station Road / Carling Avenue; and
- Proposed Site Driveways.

1.3 Study Methodology

The Transportation Study was completed using the following methodology:

- Reviewed the site plan and determine the proposed land uses.
- Collected existing traffic counts at the intersections of March Road and Carling Avenue / Station Road, and Station Road and an existing driveway.
- Analyzed existing intersection capacity and identified any infrastructure deficits, if any.
- Used a traffic growth rate to estimate background traffic volumes.
- Analyzed background traffic conditions and assess the capacity of the existing infrastructure, including method of traffic control, required to accommodate background traffic volumes.
- Projected future traffic generated by the proposed land use and assign to the future road network.
- Analyzed total traffic conditions and assess the capacity of the existing infrastructure, including method of traffic control, to accommodate combined traffic volumes.
- Reviewed truck movements through the site.
- Reviewed the parking requirements.
- Prepared a Transportation Demand Management (TDM) plan for the development.

1.4 Intersection Analysis Methodology

Intersection operations were assessed for the site driveways and intersections in the study area using the software program Synchro, Version 8, which employs methodology from the **Highway Capacity Manual (HCM2010)** published by the Transportation Research Board National Research Council.

The results of the analysis contained herein reflect the City of Ottawa's (City) criterion, which directly relates the volume to capacity (v/c) ratio of a signalized intersection to a level of service (LoS) rating. These relationships are summarized below:

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

Furthermore, the City of Ottawa's *Transportation Impact Assessment Guidelines (2006)* state that:

"The V/C ratio for an intersection is defined as the sum of equivalent volumes for all critical movements divided by the sum of capacities for all critical movements assuming that the V/C ratios for critical movements can be equalized. In cases where minimum pedestrian phase times prevent equalizing the level of service for critical movements, then the V/C ratio for the most heavily saturated critical movement should be considered as the V/C ratio for the intersection.

Intersection evaluations should identify:

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

Mitigation measures in the form of the addition of lane capacity and/or signal timing/ phasing adjustments will be required where V/C ratios for signalized intersections exceed 0.90, as defined above, except in the Urban Core, where 1.0 is acceptable."

2.0 Existing Conditions

2.1 Site Context

The site, triangular in shape, is located in the southwest quadrant of the intersection of March Road and Station Road / Carling Avenue in the community of Kanata, and is bound by Station Road to the north, March Road to the east, and a rail line to the south-west. March Road is a major north-south arterial within the community of Kanata and north of Highway 417. March Road connects with Highway 417 via an interchange approximately 3 km to the south.

The community of Kanata north of Highway 417 has three (3) distinct areas through which March Road traverses: a northerly residential area, a southerly residential area which borders the highway, and a central commercial-industrial area within which the subject site is located. This commercial-industrial area is bordered by the residential areas to the north and the south, and 'greenfields' and open space to the east and the west, as shown in **Figure 1**.

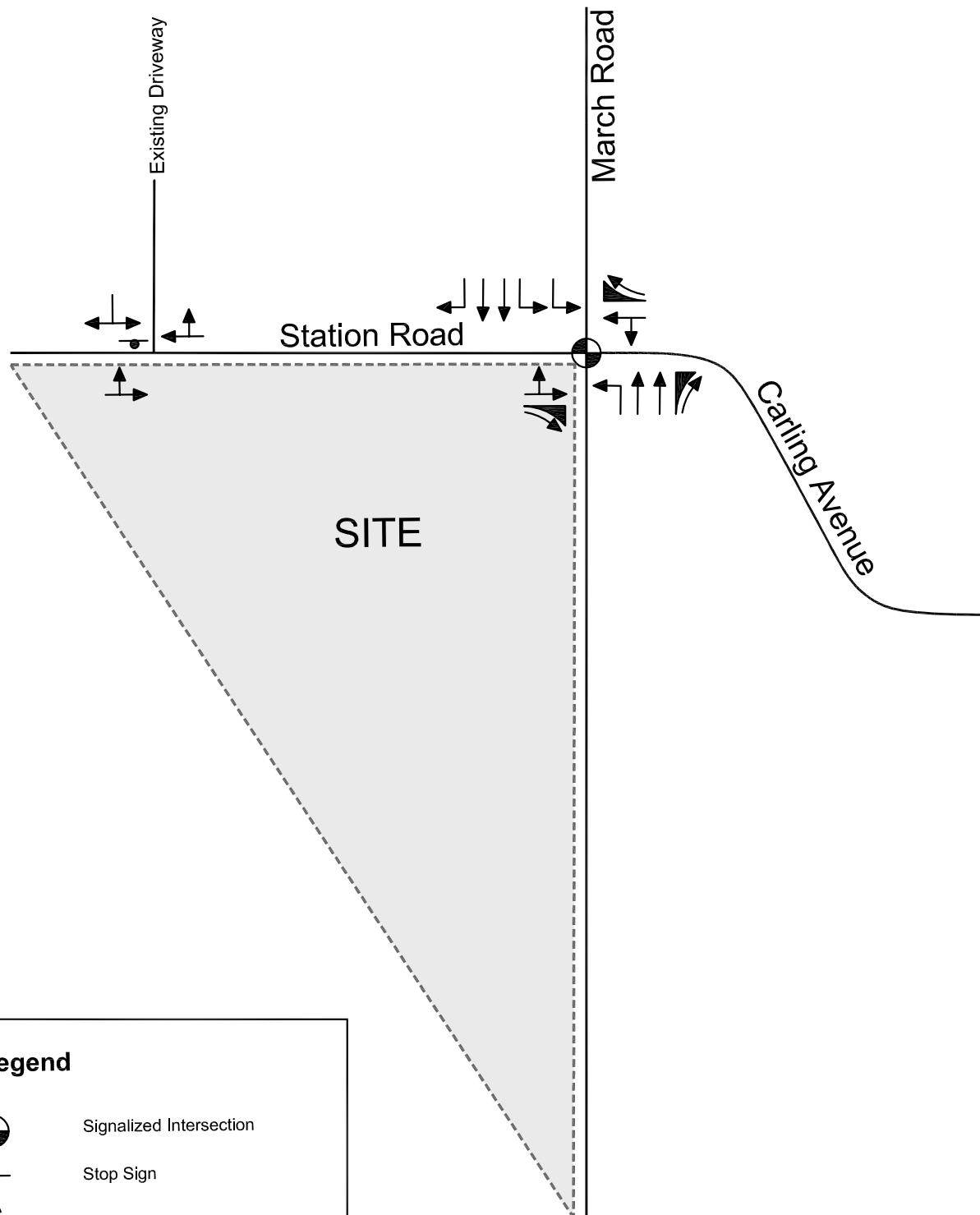
2.2 Existing Road Network

The road network is described below and is illustrated in **Figure 2**. All roads are under the jurisdiction of the City.

March Road	March Road is a north-south arterial with a 4 lane urban cross section with curb and gutter. The posted speed limit is 80 km/h. Bicycle lanes are provided on both sides. Parking is prohibited on both sides of the roadway. Sidewalks are provided on both sides of the road south of Carling Avenue/Station Road and only the east side north of there.
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Carling Avenue	Carling Avenue is an east-west arterial with a 2 lane rural cross section with paved shoulders and turn lanes provided at intersections. The posted speed limit is 60 km/h. Sidewalks or bicycle lanes are not provided. Parking is permitted on both sides of the roadway, except within the vicinity of March Road.
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Station Road	Station Road is an east-west local road with a 2 lane rural cross section with no shoulders. The assumed speed limit is 50 km/h. Sidewalks or bicycle lanes are not provided. There are no posted parking restrictions.
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Legend





-  Signalized Intersection
-  Stop Sign
-  Through
-  Channelized Right-turn

FIGURE 2
 EXISTING ROAD NETWORK

N.T.S.

2.3 Transit Service

OC Transpo operates three surface bus routes in the vicinity of the site, as summarized in **Table 1**. Bus stops are located on the southerly leg of March Road for both the northbound and southbound directions at Station Road / Carling Avenue.

Table 1: Transit Service Summary

Route #	Description	Operating Hours	Headway
#60	AM - Kanata to Downtown PM - Downtown to Kanata	Weekday Peak Periods	15 minutes
#93	Kanata North/LeBreton to Lincoln Fields	Weekdays 5:00:00 A.M. to 12:00 A.M. Weekends 6:30:00 A.M. to 12:00 A.M.	10 to 30 minutes 30 minutes
#181	AM - Herzberg Road to Eagleson Station PM - Eagleson Station to Herzberg Road	AM Departure – 7:35:00 A.M. PM Departure – 5:05:00 P.M.	2 Trips Daily

2.4 Existing Traffic Volumes

Traffic count data was collected for the study by the Traffic Information Group at the intersections of March Road and Carling Avenue / Station Road, and Station Road and an existing driveway to 413 March Road, which is anticipated to be opposite the proposed site's driveway. Traffic operations were observed during data collection to note any problems or potential concerns; however, no notable occurrences were observed. Details of the turning movement counts are summarized in **Table 2**. Existing traffic volumes are shown in **Figure 3**.

Table 2: Turning movement Count Summary

Date of Surveys	Periods	Times
Thursday, October 17, 2013	Weekday AM	4:00:00 P.M. to 6:00:00 P.M.
Friday, October 18, 2013	Weekday PM	7:00:00 A.M. to 9:00:00 A.M.
Saturday, October 19, 2013	Saturday Midday	11:00:00 A.M. to 3:00:00 P.M.

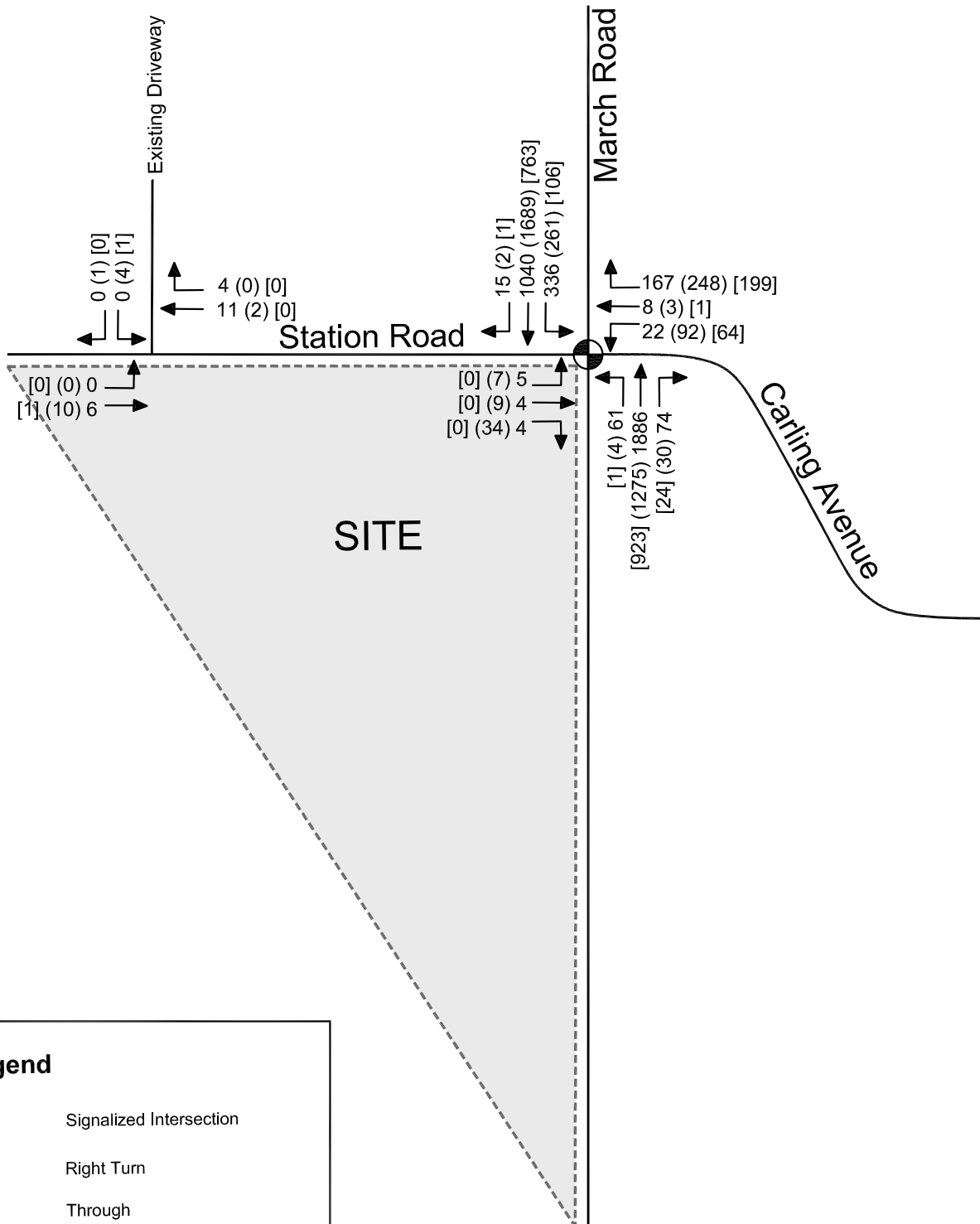


FIGURE 3
 EXISTING TRAFFIC VOLUMES

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2.5 Existing Traffic Operations

Existing traffic operations were assessed based on the existing traffic volumes shown in **Figure 3** and the existing road network shown in **Figure 2**. Existing operations are summarized in **Table 3** and **Table 4** for signalized and unsignalized intersections, respectively. Detailed Synchro reports are provided in **Appendix A**.

Table 3: Existing Signalized Intersection Operations

Intersection & Movement		Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Midday Peak Hour		
		LOS	v/c	95 th	LOS	v/c	95 th	LOS	v/c	95 th
March Road at Carling Avenue										
Overall		C	0.79		C	0.74		A	0.46	
Eastbound	Left - Through	A	0.08	7.6	A	0.10	10.9	A	0.00	0.0
	Right turn	A	0.00	0.0	A	0.02	0.0	A	0.00	0.0
Westbound	Left - Through	A	0.33	17.6	B	0.67	42.4	A	0.43	24.2
	Right turn	A	0.12	21.3	A	0.18	23.7	A	0.13	18.7
Northbound	Left turn	A	0.53	29.7	A	0.22	4.8	A	0.04	1.8
	Through	D	0.87	301.7	B	0.66	178.8	A	0.47	74.4
	Right turn	A	0.05	5.7	A	0.02	0.0	A	0.02	0.0
Southbound	Left turn	B	0.70	57.9	B	0.67	49.8	A	0.36	17.9
	Through	A	0.45	87.3	C	0.72	224.1	A	0.34	51.4
	Right turn	A	0.01	0.0	A	0.00	0.0	A	0.00	0.0

*Notes: v/c – volume to capacity ratio, LOS – level of service, 95th – 95th Percentile Queue in metres

Under existing conditions the signalized intersection of March Road and Carling Avenue is operating with excess capacity. All movements are operating with volume to capacity ratios of 0.87 or better, and with level of service D or better during all peak hours.

However, northbound queues during the AM Peak Hour appear to be currently reaching 301.7 m, which results in the queue extending through and south of the signalized intersection to the commercial plaza on the south side of the tracks. This does not occur during any of the other peak hours. This length of queue has been observed in the field, but the traffic signal to the plaza to the south was also observed “metering” the queue. In other words, the queue appears to not regularly block the southerly traffic signal.

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Table 4: Existing Unsignalized Intersection Operations

Intersection & Movement		Weekday AM Peak Hour		Weekday PM Peak Hour		Saturday Midday Peak Hour	
		LOS	95 th	LOS	95 th	LOS	95 th
Station Road at Existing Driveway to 413 March Road							
Southbound	Left-right	A	0.0	A	0.2	A	0.0

*Notes: LOS – level of service, 95th – 95th Percentile Queue in metres, only critical movements are shown.

All critical movements at the unsignalized intersection of Station Road and the existing driveway to 413 March Road, are operating with level of service A.

3.0 2019 Background Traffic Conditions

3.1 Planned Road Network / Transit Improvements

The City's Transportation Master Plan (TMP) proposes a new 6.25 kilometre long bus rapid transit (BRT) line along March Road between Highway 417 and Maxwell Bridge Road. An Environmental Assessment for the route was recently completed and the City plans on building the first phase, between Highway 417 and Solandt Road, by 2031. The balance of the route is planned for after 2031. However, funding for the project has yet to be confirmed and therefore it is assumed that implementation will not occur by the 2019 horizon year. Accordingly, this future BRT line has not been considered in the analysis.

3.2 Background Traffic Volumes

3.2.1 General Background Traffic Growth

Based on a review of historical traffic volumes along March Road, it was determined that historical traffic growth along March Road has been negative. This finding was also noted in the report **886 March Road McDonald's Transportation Study**, dated March 2013, prepared by HDR Corporation. However, a 1% per annum growth rate was applied in that study, which was accepted by the City. Therefore, we have applied a 1% per annum growth rate to all movements, except for movements to and from Station Road.

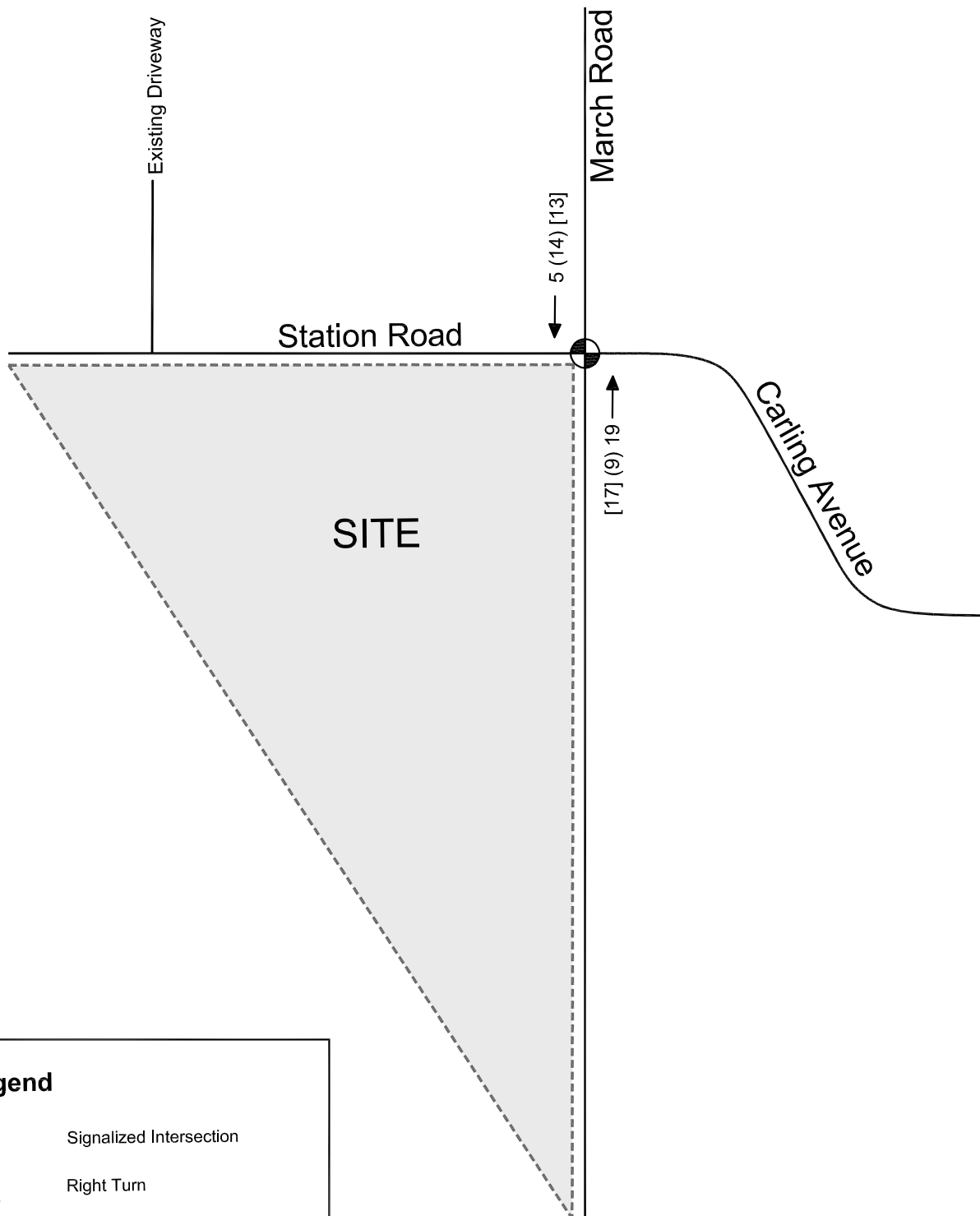
3.2.2 Background Development Traffic

One background development was identified for inclusion in this report based on a review of development applications available on the City's website. Site traffic volumes from the report **1131 Teron Road Transportation Impact Study**, dated March 27, 2012, prepared by D.J. Halpenny & Associates Ltd., were included in the background traffic projections and are shown in **Figure 4**.

The resulting 2019 background traffic volumes are shown in **Figure 5**.

3.3 Background Traffic Operations

Background traffic operations for 2019 were assessed based on the background traffic volumes as shown in **Figure 5** and the road network as shown in **Figure 2**. Background operations are summarized in **Table 5** and **Table 6** for signalized and unsignalized intersections, respectively. Detailed Synchro reports are provided in **Appendix B**.



Legend

Signalized Intersection

Right Turn

Through

Left Turn

00 (00) [00]

AM (PM) [Saturday]

Peak Hour Traffic Volumes

FIGURE 4
 BACKGROUND DEVELOPMENT TRAFFIC VOLUMES

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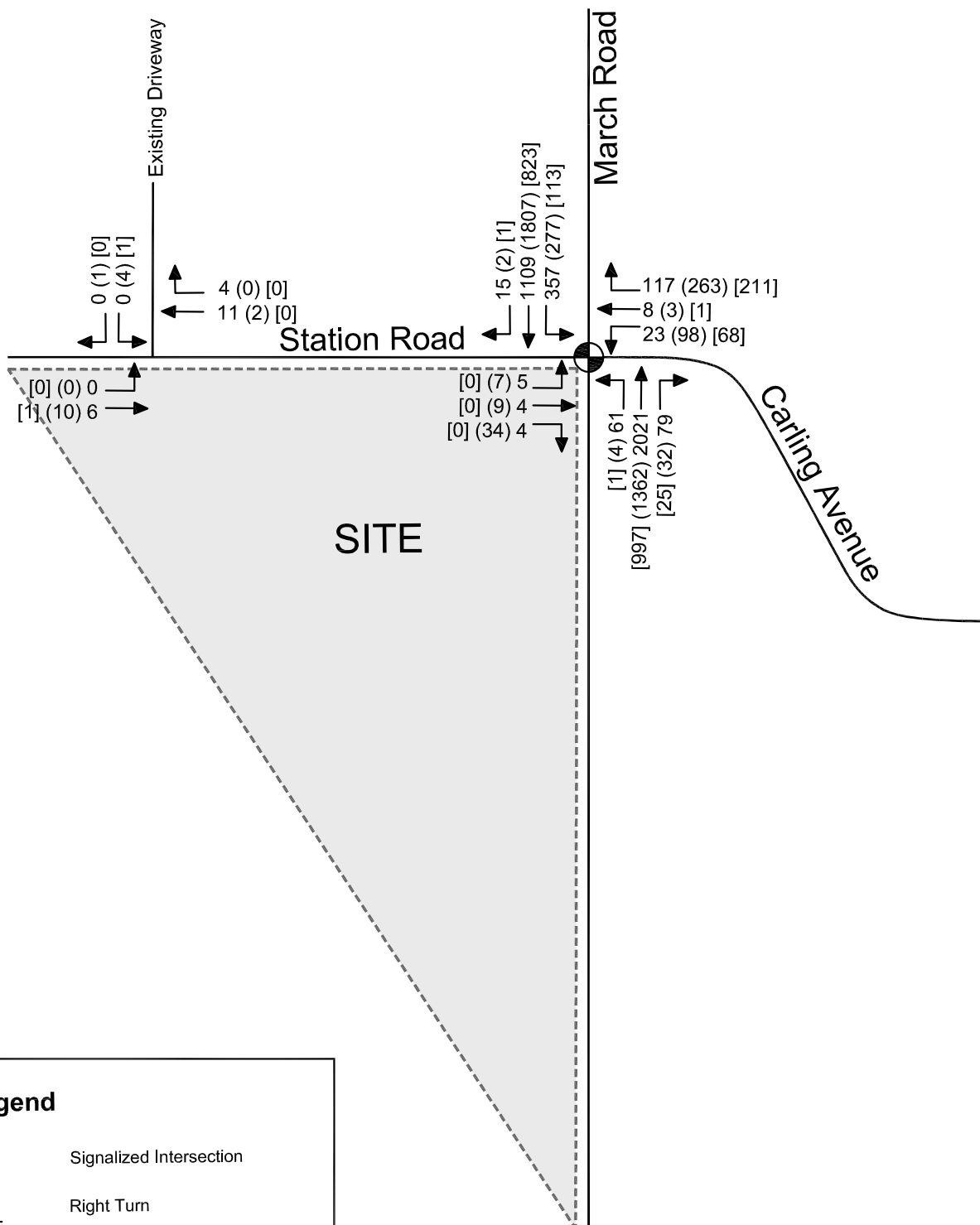


FIGURE 5
 2019 BACKGROUND TRAFFIC VOLUMES

N.T.S.

Table 5: Background Traffic Signalized Intersection Operations

Intersection & Movement		Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Midday Peak Hour		
		LOS	v/c	95 th	LOS	v/c	95 th	LOS	v/c	95 th
March Road @ Carling Avenue										
Overall		D	0.89		D	0.83		A	0.52	
Eastbound	Left - Through	A	0.14	7.7	A	0.09	10.8	A	0.00	0.0
	Right turn	A	0.00	0.0	A	0.02	0.0	A	0.00	0.0
Westbound	Left - Through	A	0.58	18.3	C	0.71	44.9	A	0.55	25.2
	Right turn	A	0.13	0.0	A	0.19	0.0	A	0.14	0.0
Northbound	Left turn	A	0.54	29.7	A	0.24	4.8	A	0.05	1.8
	Through	E	0.97	359.0	C	0.77	220.6	A	0.52	88.4
	Right turn	A	0.06	0.0	A	0.03	0.0	A	0.02	0.0
Southbound	Left turn	B	0.69	61.1	B	0.70	52.4	A	0.39	18.8
	Through	A	0.48	98.2	D	0.83	310.3	A	0.38	59.4
	Right turn	A	0.01	0.0	A	0.00	0.0	A	0.00	0.0

*Notes: v/c – volume to capacity ratio, LOS – level of service, 95th – 95th Percentile Queue in metres

Under 2019 background conditions, the signalized intersection of March Road and Carling Avenue will operate with excess capacity. All movements will operate with volume to capacity ratios of 0.94 or better and with level of service E or better during all peak hours. The weekday AM peak hour signal timing was optimized. The northbound through movement will be approaching capacity under background conditions.

However, the northbound queue during the AM Peak Hour is predicted to reach 359m by 2019, which is 57.3 m longer than under existing conditions. As noted previously, this results in the queue extending through and south of the signalized intersection to the commercial plaza on the south side of the tracks. This does not occur during any of the other peak hours.

Table 6: Background Traffic Unsignalized Intersection Operations

Intersection & Movement		Weekday AM Peak Hour		Weekday PM Peak Hour		Saturday Midday Peak Hour	
		LOS	95 th	LOS	95 th	LOS	95 th
Station Road at Existing Driveway to 413 March Road							
Southbound	Left-right	A	0.0	A	0.2	A	0.0

*Notes: LOS – level of service, 95th – 95th Percentile Queue in metres, only critical movements are shown.

Under 2019 background conditions all movements at the unsignalized intersection of Station Road and the existing driveway to 413 March Road will operate with level of service A.

4.0 Site Traffic

4.1 Site Plan

The proposed development consists of the following:

- 2,400 square foot ("SF") fast food restaurant with drive-through window (A&W);
- 2,695 SF coffee / doughnut shop with drive through window (Tim Horton's);
- 4,000 SF office building; and
- Gas station with 10 pumps including a convenience store and car wash.

The total proposed gross floor area is 13,995 SF, which includes the gas station and car wash. Although potential tenant names are provided, these could change.

Access to the plaza is proposed via three unsignalized driveways:

- One full movement driveway on Station Road opposite an existing driveway to the north;
- One right-in / right-out only driveway on March Road mid-way along the site frontage; and
- A right-out only driveway on March Road at the southerly limit of the site.

Under existing conditions the eastbound right-turn at the intersection of March Road and Carling Avenue / Station Road is channelized and is provided with a southbound acceleration lane which terminates approximately midway along the site frontage on March Road. Since there is a proposed driveway at this location, the acceleration lane would end at this proposed driveway. Thus, there would be no southbound acceleration lanes for the site driveways along March Road. We have assumed this configuration in our total conditions analysis. The site plan is shown in **Figure 6**. The site is expected to be occupied within 2014 with no phasing. A total of 93 parking spaces are proposed.

4.2 Site Traffic Generation

Trip generation for site traffic was based on information in the publication ***Trip Generation Manual, 9th Edition***, published by the Institute of Transportation Engineers (ITE). Land Use Codes used for each use as shown on **Figure 6** are summarized below in **Table 7**.

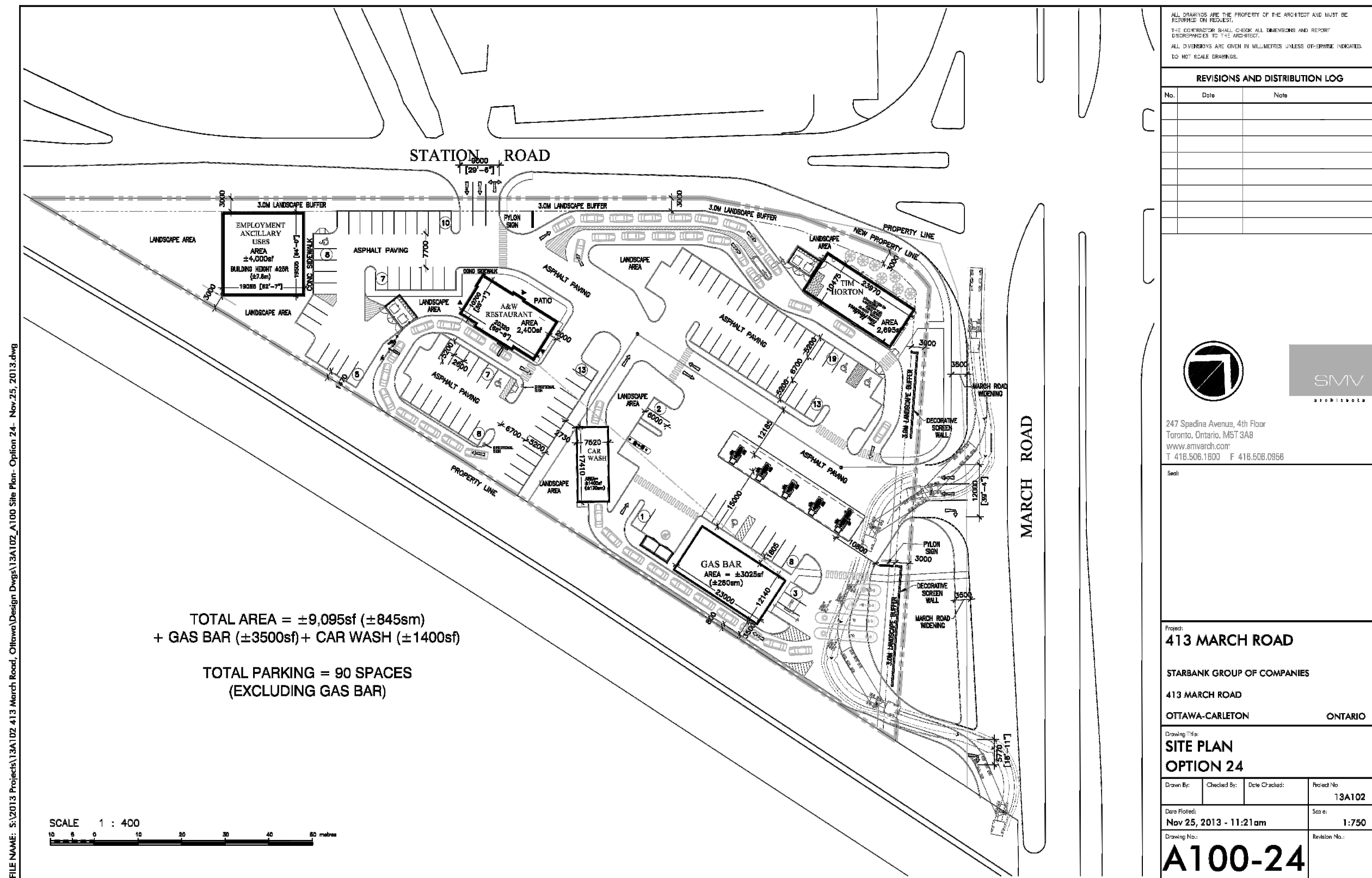
FIGURE 6
SITE PLAN

Table 7: ITE Trip Generation Land Uses

Component	ITE Land Use	ITE Code
A&W Restaurant	Food Restaurant With Drive-Through Window	LUC 934
Tim Horton's	Coffee / Doughnut Shop With Drive Through Window	LUC 937
Gas Bar	Gasoline / Service Station with Convenience Market and Car Wash	LUC 946
Employment Ancillary Uses	Single Tenant Office Building	LUC 715

*LUC – Land Use Code

New site trips and pass-by site trips were examined. Pass-by trips are trips that are already on the road network, stop at the site, and then continue en route to their destination. These trips are different from new trips, because the purpose of new trips is exclusively to visit the site. New trips plus pass-by trips result in total trips. Pass-by was not assumed for the office component. Pass-by percentages were based on ITE data provided in ***Trip Generation Manual, 9th Edition.***

Given the complementary nature of the plaza business-wise, it would be expected that there would be a considerable amount of interaction between the proposed uses. Interaction trips reduce the number of gross trips because it assumes that visitors to the plaza go to more than one of the on-site amenities, thus reducing the number of total trips. In order to provide a conservative approach to the traffic analysis, interaction trips have not been considered.

The projected site traffic generated by the proposed development, as well as pass-by assumptions, for each peak period, is summarized in **Table 8.**

Table 8: Site Traffic Generation

Land Use	Units	Weekday AM Peak Hour	Weekday PM Peak Hour	Saturday Midday Peak Hour
Food Restaurant With Drive-Through Window (LUC 934) – 2,400 SF				
Trip rate	veh / 1000 SF	45.42	32.50	59.17
Total trips		109	78	142
Inbound trips		56	41	72
Outbound trips		53	37	70
Pass-by trips (50%)	veh / h	-56	-40	-72
New trips		53	38	70
Inbound trips		28	21	36
Outbound trips		25	17	34

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Table 8: Site Traffic Generation Continued

Land Use	Units	Weekday AM Peak Hour	Weekday PM Peak Hour	Saturday Midday Peak Hour
Coffee / Doughnut Shop With Drive Through Window (LUC 937) – 2,695 SF				
Trip rate	veh / 1000 SF	100.56	42.67	75.32
Total trips		271	115	203
Inbound trips		138	58	102
Outbound trips		133	58	102
Pass-by trips (50%)	veh / h	-136	-58	-102
New trips		135	57	101
Inbound trips		70	29	51
Outbound trips		65	29	51
Gasoline / Service Station with Convenience Market and Car Wash (LUC 946) – 10 Fueling Positions				
Trip rate	veh / position	11.80	13.90	18.00
Total trips		118	139	180
Inbound trips		60	71	90
Outbound trips		58	68	90
Pass-by trips (60%)	veh / h	-72	-84	-108
New trips		46	55	72
Inbound trips		24	29	36
Outbound trips		22	26	36
Single Tenant Office Building (LUC 715) – 4,000 SF				
Trip rate	veh / 1000 SF	7.25	10.25	- *
Total trips		29	41	-
Inbound trips	veh / h	26	6	-
Outbound trips		3	35	-
Total Trip Generation – 13,995 SF				
Trip rate	veh / 1000 SF	37.66	26.66	39.30
Total trips		527	373	525
Inbound trips		280	176	264
Outbound trips		247	198	262
Pass-by trips		-264	-182	-282
Inbound trips	veh / h	-132	-91	-141
Outbound trips		-132	-91	-141
New trips		263	191	243
Inbound trips		148	85	123
Outbound trips		115	107	121

* It is assumed that there will be little to no traffic on weekends.

The projected net site traffic will be an additional 263, 191, and 243 new two-way trips during the weekday AM, PM, and Saturday midday peak hours, respectively.

4.3 Site Traffic Distribution and Assignment

The distribution of new site traffic was based on existing traffic patterns, the existing road network, and knowledge of the area. The projected distribution is summarized in **Table 9**.

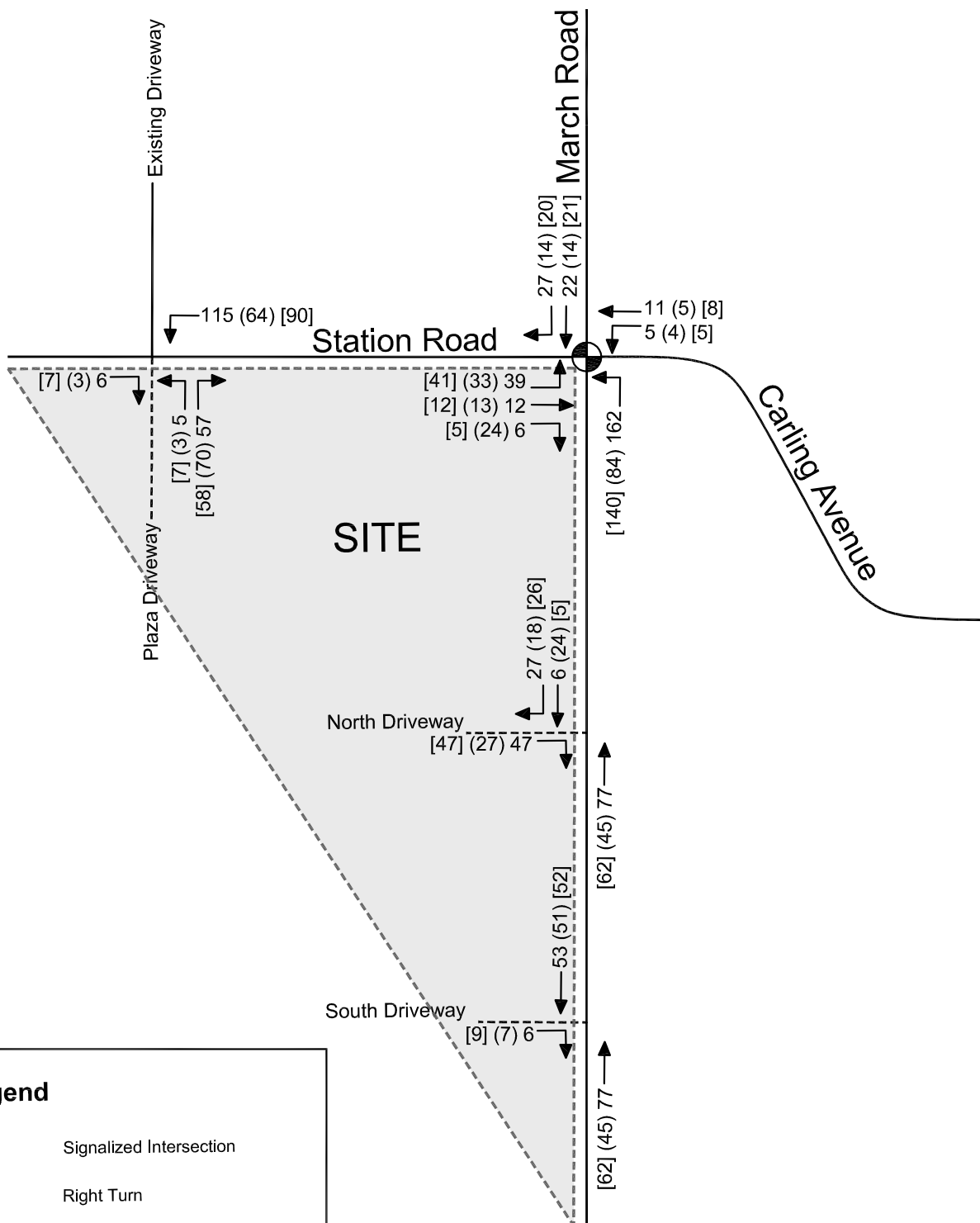
Table 9: Site Traffic Distribution

To/From	Via	Distribution	
		Commercial	Office
North	March Road	35%	25%
South	March Road	50%	60%
East	Carling Avenue	10%	15%
West	Station Road	5%	-
Total		100%	100%

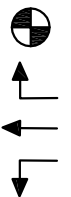
A separate distribution for new site trips was determined for the commercial uses and the office use. The commercial distribution assumed a potential catchment area for plaza customers based on the local area of the community of Kanata. For the office component, a higher distribution to/from the south and a lesser distribution to/from the north reflected the larger potential employment catchment area, which includes the entire City. Thus more employment traffic would plausibly use Highway 417 and Carling Avenue.

Commercial pass-by trips were distributed and assigned according to existing traffic patterns.

New site traffic volumes are shown in **Figure 7**, pass-by traffic volumes are shown in **Figure 8**, and the resulting total site trips are shown in **Figure 9**.



Legend



Signalized Intersection

Right Turn

Through

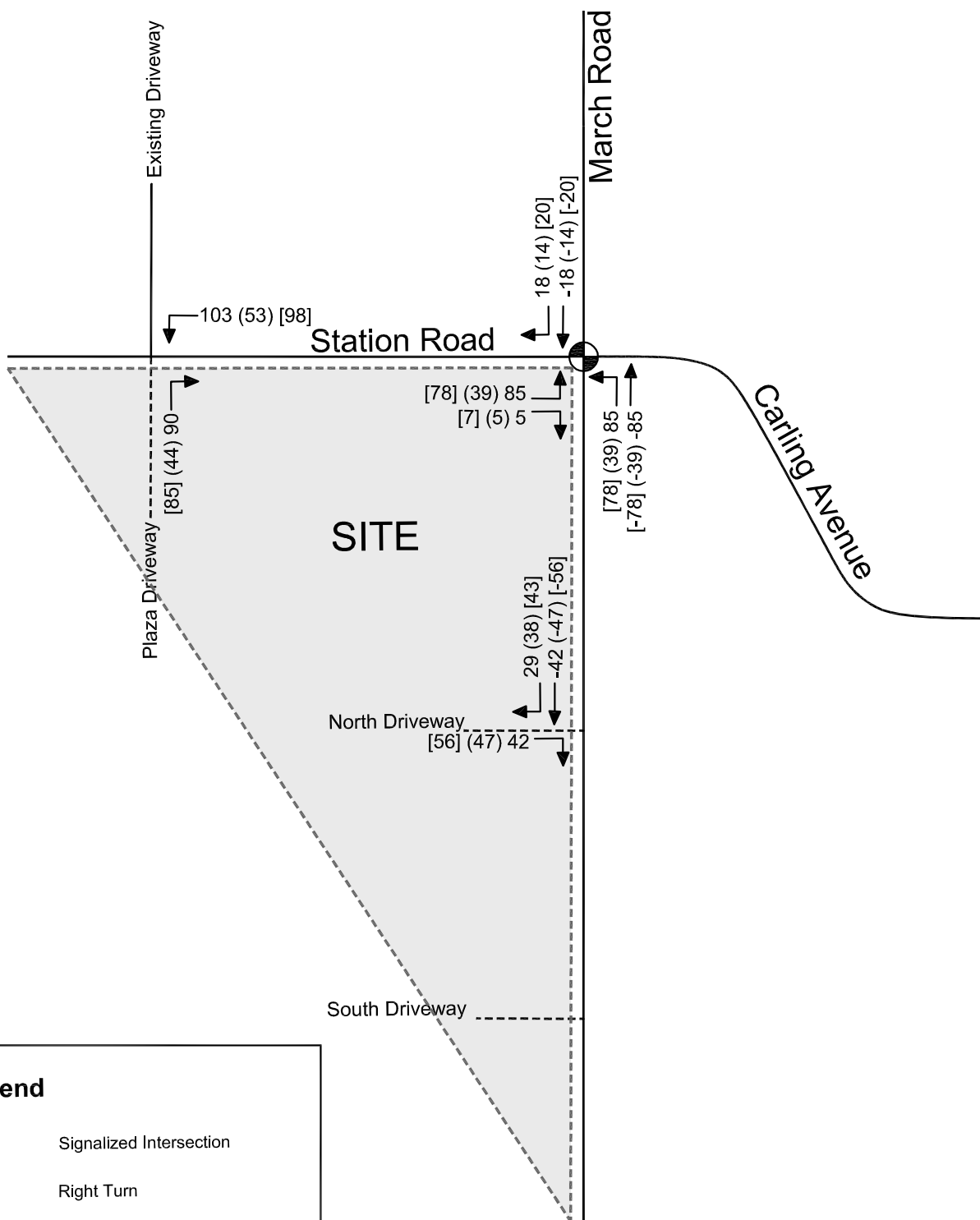
Left Turn

00 (00) [00]

AM (PM) [Saturday]
 Peak Hour Traffic Volumes

FIGURE 7
 NEW SITE TRAFFIC VOLUMES

N.T.S.



Legend





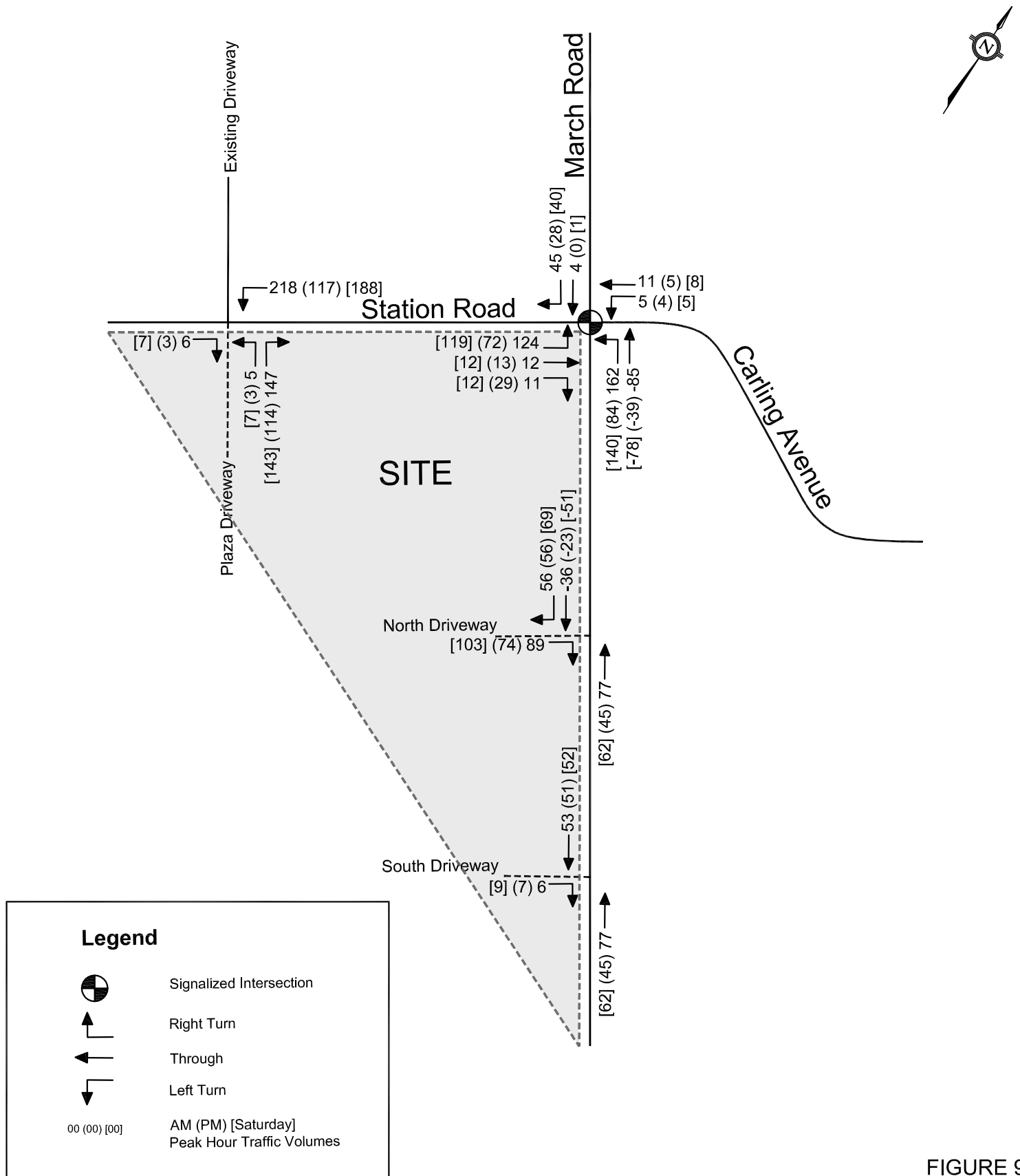
-  Signalized Intersection
-  Right Turn
-  Through
-  Left Turn
- 00 (00) [00] AM (PM) [Saturday]
Peak Hour Traffic Volumes

FIGURE 8
 PASS-BY SITE TRAFFIC VOLUMES

N.T.S.



N.T.S.

FIGURE 9
 TOTAL SITE TRAFFIC VOLUMES

5.0 2019 Total Traffic Conditions

Total traffic volumes are shown in **Figure 10**, which are comprised of background traffic volumes as shown in **Figure 5** plus the total site traffic volumes shown in **Figure 9**.

5.1 2019 Total Traffic Operations

Total traffic operations are summarized in **Table 10** and **Table 11** for signalized and unsignalized intersections, respectively. Detailed reports are provided in **Appendix C**.

Table 10: Total Traffic Signalized Intersection Operations

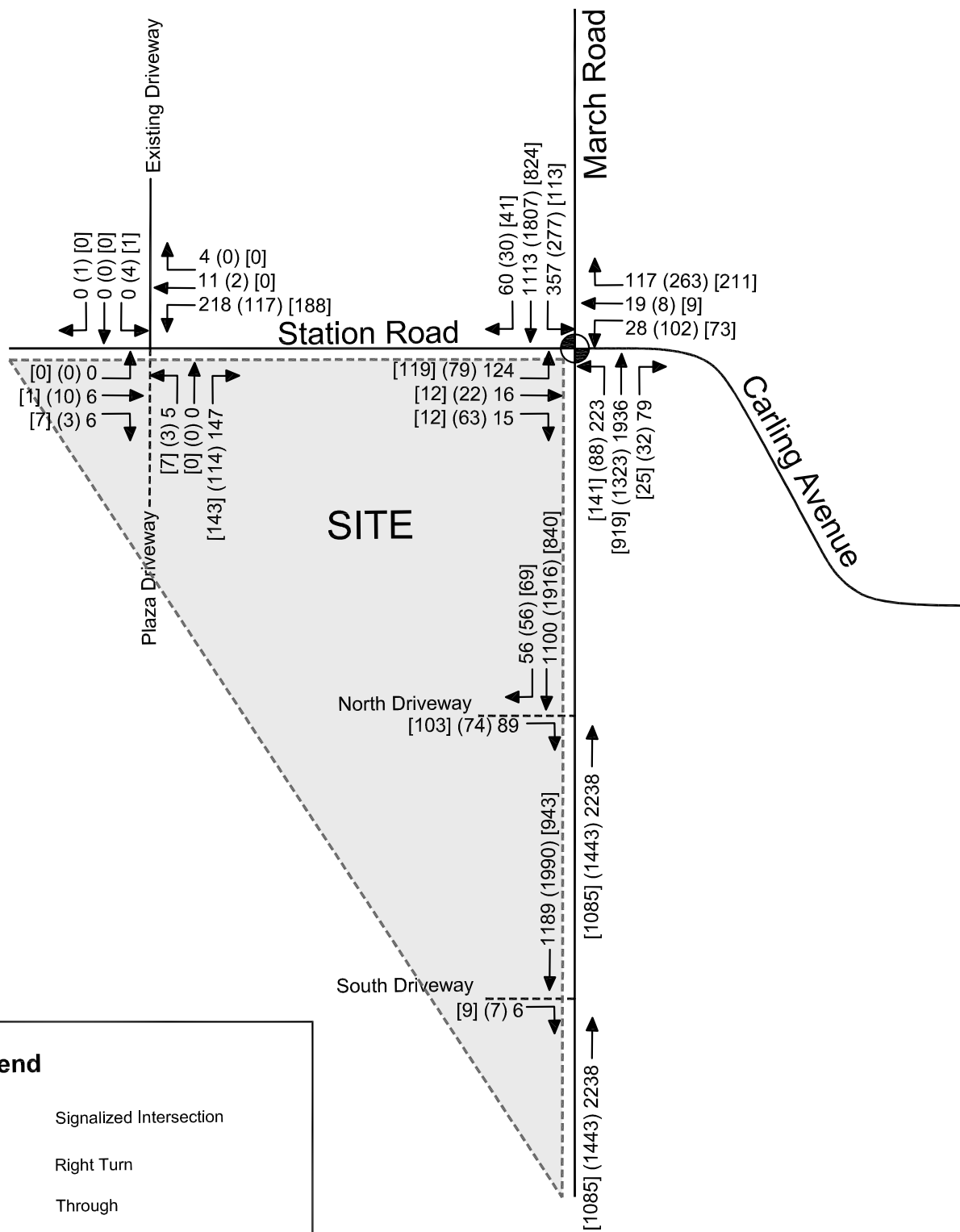
Intersection & Movement		Weekday AM Peak Hour			Weekday PM Peak Hour			Saturday Midday Peak Hour		
		LOS	v/c	95 th	LOS	v/c	95 th	LOS	v/c	95 th
March Road @ Carling Avenue										
Overall		E	0.96		E	0.92		B	0.61	
Eastbound	Left - Through	C	0.79	62.4	B	0.65	44.2	B	0.66	40.2
	Right turn	A	0.01	0.0	A	0.05	0.0	A	0.01	0.0
Westbound	Left - Through	A	0.34	24.1	C	0.78	48.8	A	0.45	26.9
	Right turn	A	0.13	0.0	A	0.19	0.0	A	0.14	0.0
Northbound	Left turn	C	0.80	86.8	B	0.63	46.9	B	0.62	44.4
	Through	E	0.99	340.4	C	0.76	207.1	A	0.54	94.1
	Right turn	A	0.06	0.0	A	0.03	0.0	A	0.02	0.0
Southbound	Left turn	E	0.96	104.1	C	0.72	52.3	A	0.39	18.8
	Through	B	0.65	166.9	E	0.95	334.3	A	0.53	89.3
	Right turn	A	0.05	0.0	A	0.02	0.0	A	0.03	0.0

*Notes: v/c – volume to capacity ratio, LOS – level of service, 95th – 95th Percentile Queue in metres

Under 2019 total conditions the signalized intersection of March Road and Carling Avenue will operate with excess capacity. All movements will operate with volume to capacity ratios of 0.99 or better, and with level of service E or better during all peak hours. The weekday AM peak hour signal timing was optimized.

With some signal timing optimization, the northbound queue during the AM Peak Hour, is predicted to drop to 340.4 m, which is 38.7 m longer than under existing conditions, but 18.6 m shorter than under 2019 background conditions.

Development traffic is only expected to contribute 3% of Total traffic volumes in the northbound queue. Therefore, background traffic growth is the main contributor to the lengthening of these queues.



Legend





-  Signalized Intersection
-  Right Turn
-  Through
-  Left Turn
- 00 (00) [00]** AM (PM) [Saturday]
Peak Hour Traffic Volumes

FIGURE 10
 TOTAL TRAFFIC VOLUMES

N.T.S.

401 March Road Transportation Study
December 2013

Table 11: Total Traffic Unsignalized Intersection Operations

Intersection & Movement		Weekday AM Peak Hour		Weekday PM Peak Hour		Saturday Midday Peak Hour	
		LOS	95 th	LOS	95 th	LOS	95 th
Station Road at Driveway							
Westbound	Left-through-right	A	7.0	A	3.0	A	5.3
Northbound	Left-through-right	A	5.1	A	3.3	A	4.9
Southbound	Left-through-right	A	0.0	A	0.4	A	0.2
March Road at North Driveway							
Eastbound	Right turn	A	3.1	A	4.6	A	3.2
March Road at South Driveway							
Eastbound	Right turn	A	0.2	A	0.4	A	0.3

*Notes: LOS – level of service, 95th – 95th Percentile Queue, only critical movements are shown.

Under 2019 total conditions all movements at unsignalized site driveways will operate with level of service A or better.

6.0 On-Site Design and Operations

A review was conducted of the site plan to assess the proposed configuration of driveways and parking lot layout from an operations perspective. The site plan appears to be well designed to accommodate vehicle, pedestrian, and cyclist movements throughout the site. Also reviewed were drive-through operations, parking requirements, truck access and transportation demand management measures.

6.1 Drive-Through Operations

We have reviewed the City of Ottawa Zoning By-law No. 2008-250 Part 4 – Parking, Queuing and Loading Provisions. The queuing requirements for each use are summarized below in **Table 12**.

Table 12: Drive-Through Facility Minimum Number of Queuing Spaces

By-law Land Use	Site Land Use	Required Spaces		Provided Spaces	
		Leading to	Leaving	Leading to	Leaving
Car Wash (conveyor or automatic type)	Car Wash	10 before/in each wash bay	1 after each wash bay (if a through bay)	10	3
Restaurant (with order board)	Tim Horton's	7 before/at order board	and a minimum total of 11	18	10
	A&W			7	5

*Note: According to the Zoning By-law, each queuing space must be 3 metres wide and at least 5.7 metres long.

The spaces provided for queuing for the car wash and restaurants either meet or exceed the By-law's requirements.

6.2 Proposed Driveways

The driveway locations and type were developed in consultation with City staff and comply with the Private Approach By-law 2003-447, with the exception of the throat width of the right-in / right-out only driveway on March Road. The By-law requires a maximum width of 9.0 m at the property line. The proposed throat width is approximately 12 m. A variance may be required.

6.3 Parking Supply Requirements

The City of Ottawa's Zoning By-law 2008-250 was reviewed for vehicle and bicycle parking requirements. Bicycle parking must be provided at a rate of 1 space per 250 m². Therefore, a minimum of 5 spaces is required. The By-Law's vehicle parking requirements are summarized in **Table 13**.

Table 13: Zoning By-law 2008-250 Vehicle Parking Requirements

Land Use	By-law Term	By-law Parking Rates	Floor Area (m ²)	Spaces Required
Tim Horton's Restaurant	Restaurant – Fast Food	10 spaces / 100 m ²	250	25
	Drive-Thru Credit	-20%	n/a	-5
A&W Restaurant	Restaurant – Fast Food	10 spaces / 100 m ²	223	23
	Drive-Thru Credit	-20%	n/a	-4
Convenience Mart	Convenience Store	3.4 spaces / 100 m ²	281	10
Gas Station with Drive-Thru Car Wash	Gas Bar and Car Wash	None required	n/a	0
Office	Office	2.4 spaces / 100 m ²	372	9
Totals			1,126 m ²	58
			Proposed Supply	90
			Difference	+32

Based on the Zoning By-law, there will be a surplus of 32 parking spaces.

6.4 Truck Access Analysis

A swept path analysis, using a WB-20 truck design vehicle, was conducted for trucks accessing the proposed gas station for the purposes of refuelling the underground tanks. It is anticipated that the truck will access the site via the northerly driveway on March Road, and exit via the southerly driveway on March Road. The swept path analysis is shown in **Figure 11**.

6.5 Traffic Demand Management Plan

6.5.1 Pedestrian Access

Pedestrian access in the form of paved walkways, marked pedestrian crossings, and wheelchair / stroller accessible ramps will be provided internally to facilitate the flow of pedestrians throughout the site. Sidewalks are currently provided on the March Road frontage. Internal pedestrian walkways will connect seamlessly with the sidewalk on March Road to facilitate pedestrian movement to and from the surrounding neighbourhoods.

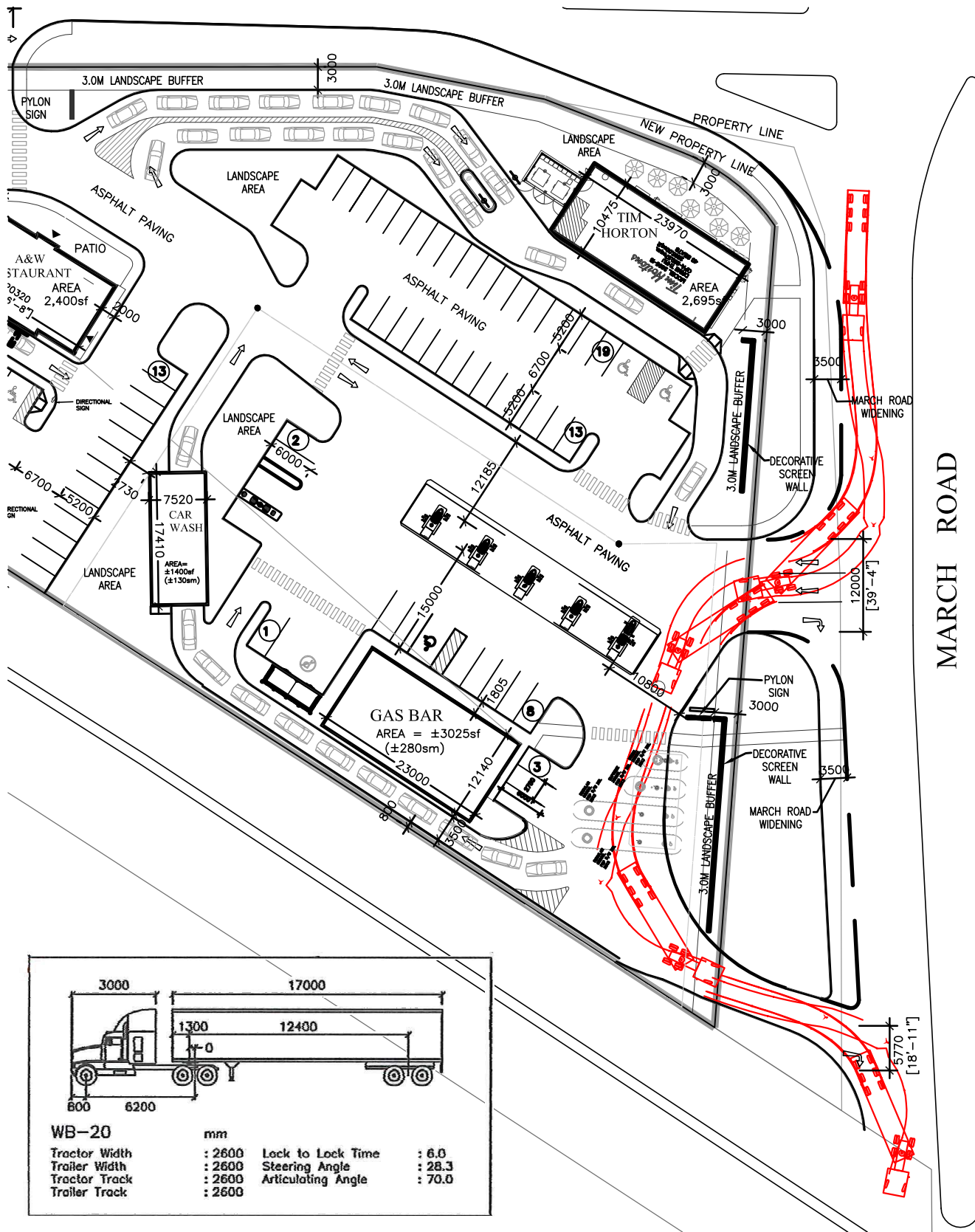


FIGURE 11
SWEEP PATH ANALYSIS

N.T.S.

6.5.2 Access to Local Transit

As discussed in Section 2.3, transit is available along March Road, which has sidewalks to which internal pedestrian access will be connected. In addition, a Bus Rapid Transit route is planned along March Road, between Highway 417 and Maxwell Bridge Road.

6.5.3 Bicycle Accommodation

Areas designated for short-term bicycle parking will be clearly marked and located close to each building entrance. Bicycle parking will be protected from the elements by use of an overhead canopy, well lit and easily accessible. Access will be provided via the site's driveways and internal pedestrian pathways to the existing bicycle lanes on March Road.

6.5.4 Implementation

We recommend concentrating on encouraging alternative modes of travel such as bicycling and walking, by providing good internal and external connectivity for these modes, and accommodation for bicycle parking.

7.0 Off-Site Design and Operations

7.1 System Operations and Safety

A high level review of traffic operations and safety was undertaken, in relation to the proposed plaza and its integration with the existing road network. Vehicle-pedestrian and vehicle-cycle conflicts, weaving, merging and diverging, corner clearances, sight-distances, and access conflicts have been reviewed.

7.1.1 Vehicle-Pedestrian & Vehicle-Cyclist Conflicts

Existing peak hour pedestrian and cyclist volumes at the intersection of March Road and Carling Avenue / Station Road are summarized in **Table 14**.

Table 14: Pedestrian & Cyclist Peak Hour Volumes - March Road at Station Road

Mode	Weekday AM Peak Hour	Weekday PM Peak Hour	Saturday Midday Peak Hour
Pedestrians	19	21	1
Cyclists	7	17	0

As shown, pedestrians and cyclists are currently using this intersection, and it is operating acceptably with the existing geometry and timing parameters (walk and flashing don't walk times). The development will undoubtedly increase these volumes.

Internal walkways leading to the sidewalks surrounding the property will provide access to the plaza from the surrounding roads to help minimize unexpected conflict points. Stop bars at driveways should be clearly marked.

Cyclist activity is in the area during the week, encouraged by the bicycle lanes provided along March Road. Cyclists operations would be expected to continue. The bicycle lane along March Road would be maintained.

7.1.2 Weaving & Merging & Diverging

The potential for weaving exists between the westbound left-turn movement at the intersection of March Road and Carling Avenue / Station Road, and the southbound right-turn movement at the North Driveway on March Road, when these turns are consecutively performed by the same vehicle. This may occur as the westbound left-turning vehicles must quickly merge to the right once they enter southbound traffic flow. Site traffic volumes show only 5, 4, and 5 vehicles performing this manoeuvre during the weekday AM, PM, and Saturday midday peak hours, respectively. These numbers are very low and represent less than 1 vehicle performing this manoeuvre every cycle. Due

to the low frequency we do not believe this will be a large concern. In addition, drivers have a choice to avoid this maneuver and continue westbound and access the site via the Station Road driveway.

Potential merging and diverging concerns may occur due to the channelized eastbound right-turn at the intersection of March Road and Carling Avenue / Station Road. This right-turn has a dedicated acceleration lane that currently extends more than half way down the easterly frontage of the site. However, the purpose of this lane appears to be to accommodate southbound buses along March Road while in layby at the 'far-side' bus stop on the southerly leg, rather than to functionally provide an acceleration lane for eastbound to southbound vehicles. The proposed site design will reduce the length of this lane; however, it would still be large enough to hold buses in layby. Because the purpose of the lane is to shelter buses while in layby, this would create no operational concerns since vehicles should still be able to yield and merge with southbound traffic safely.

7.1.3 Corner Clearances & Sight Distances

Based on a high-level review of the site plan and proposed driveways, we do not anticipate any concerns.

7.1.4 Access Conflicts

We do not anticipate any specific access conflicts.

7.2 Non-Auto Modes

It is evident that there is already notable pedestrian and cyclist activity in this area; particularly during weekdays. This is likely a result of the immediate area being largely commercial and employment driven. It is expected that the nearby employment land uses will generate walk-in trips to the plaza. In fact, it is expected that the planned Bus Rapid Transit route along March Road, between Highway 417 and Maxwell Bridge Road, will further encourage walk-in traffic as well as a reduction in vehicle and parking demand.

Bicycle lanes are provided along March Road and sidewalks are provided on both sides of March Road south of Station Road/Carling Avenue and on the east side, north of Station Road/Carling Avenue. We expect these factors to also encourage non-auto modes.

Transit is already provided directly in front of the site. We do not anticipate the site having any detrimental impact on transit operations. As discussed, a transit vehicle can

still be accommodated in layby along the frontage of the site even with the reduced lane length. Transit vehicles will stop directly in front of the site, at a location to which sidewalks will provide access directly into the site.

7.3 Community Impacts

The potential for neighbourhood infiltration is low because there are no nearby residential uses and the site is located at the intersection of two arterial roadways. However, infiltration is plausible to and from the west along Station Road. It is possible that employment uses to the north may use Station Road to access the site, rather than use March Road. However, Station Road is not paved west of March Road, and appears to be primarily used for maintenance access to the rail line and a hydro substation to the west. We believe this would discourage any infiltration or cut-through. In addition, existing volumes along Station Road are very low.

7.4 March Road Railway Crossing

Since the existing northbound queues at Carling Avenue / Station Road extend south of the railway crossing on March Road, consideration should be given to adding a “Do Not Stop Across Tracks” sign for north bound traffic mounted just south of the tracks.

8.0 Conclusions

8.1 Intersection Operations

Under existing 2013 traffic conditions, study intersections are operating with excess capacity and will continue to do so under 2019 total traffic conditions with the development in place.

However, northbound queues on March Road during the AM Peak Hour appear to be currently reaching 302 m, which results in the queue extending through and south of the signalized intersection to the commercial plaza on the south side of the tracks. This does not occur during any of the other peak hours. This length of queue has been observed in the field, but the traffic signal to the plaza to the south was also observed “metering” the queue. In other words, the queue appears to not regularly block the southerly traffic signal. Under 2019 conditions this queue is predicted to reach 346 m without the development. With signal timing optimization the queue is predicted to be shortened to 317 m under total conditions.

Based on our analysis, there are no required road improvements other than optimizing the weekday AM peak hour traffic signal cycle at the March Road / Station Road / Carling Avenue intersection, which would be required for 2019 background traffic operations in any case.

8.2 Site Plan Review

A truck access analysis, using a WB-20 truck design vehicle, was conducted for trucks accessing the proposed gas station for the purposes of refuelling the underground fuel tanks. The analysis illustrates that the proposed site and access configuration accommodates the WB-20 turning movements through the site. The analysis confirms the necessity of the two driveways on March Road for fuel truck access.

The on-site and off-site operations have been reviewed. It is our opinion that the site is well designed to accommodate and facilitate all modes of travel. The site design will also encourage non-vehicle modes by providing good integration with the external road network. Transit will continue to operate well within the vicinity of the site, with a stop provided along the frontage of the site on March Road. We do not anticipate the site to notably contribute to the potential for weaving, merging, or diverging concerns.

8.3 Proposed Driveways

The driveway locations and type were developed in consultation with City staff and comply with the Private Approach By-law 2003-447, with the exception of the throat

width of the right-in / right-out only driveway on March Road. The By-law requires a maximum width of 9.0m at the property line. The proposed throat width is approximately 12m. A variance may be required.

8.4 Parking and Drive-Through

The proposed parking supply of 90 spaces for the development will exceed the Zoning By-law's requirements by 32 spaces. The Zoning By-law also requires a minimum of 5 bicycle parking spaces, which will be provided. The spaces provided for queuing for the car wash and restaurants either meet or exceed the By-law's requirements.

8.5 Transportation Demand Management

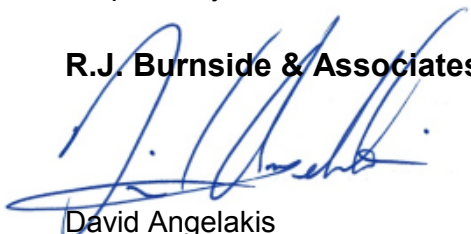
The site is currently well served by transit along its frontage, sidewalks on March Road and a bicycle lane on both sides of March Road. The following transportation demand management plan elements are proposed to be incorporated into the site:

- Internal sidewalk connections to the existing sidewalk network on March Road, which in turn will provide access to the existing transit routes in the neighbourhood.
- Pedestrian access in the form of paved walkways, marked pedestrian crossings, and wheelchair / stroller accessible ramps to be provided internally to facilitate the flow of pedestrians throughout the site.
- Areas designated for short-term bicycle parking will be clearly marked and located close to each building entrance. Bicycle parking will be protected from the elements by use of an overhead canopy, well lit and easily accessible. Access will be provided via the site's driveways and internal pedestrian pathways to the existing bicycle lanes on March Road.

In addition, the planned Bus Rapid Transit route along March Road, between Highway 417 and Maxwell Bridge Road, will further encourage walk-in traffic and a reduction in vehicle and parking demand.

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




















Appendix A

Existing Traffic Operations

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave











12/11/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	4	4	22	8	167	61	1886	74	336	1040	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.4	6.4		6.4	6.4	6.6	6.5	6.5	6.6	6.5	6.5
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		1.00	0.99		1.00	0.98	1.00	1.00	0.97	1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1522	919		1378	1441	1772	3579	1431	3506	3444	1243
Flt Permitted		0.84	1.00		0.78	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1315	919		1110	1441	1772	3579	1431	3506	3444	1243
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	5	4	4	23	8	172	63	1944	76	346	1072	15
RTOR Reduction (vph)	0	0	4	0	0	158	0	0	29	0	0	5
Lane Group Flow (vph)	0	9	0	0	31	14	63	1944	47	346	1072	10
Confl. Peds. (#/hr)	6		2	2		6	4		7	7		4
Confl. Bikes (#/hr)									6			1
Heavy Vehicles (%)	40%	0%	75%	46%	0%	11%	3%	2%	11%	1%	6%	27%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)		10.9	10.9		10.9	10.9	8.8	81.2	81.2	18.4	90.8	90.8
Effective Green, g (s)		10.9	10.9		10.9	10.9	8.8	81.2	81.2	18.4	90.8	90.8
Actuated g/C Ratio		0.08	0.08		0.08	0.08	0.07	0.62	0.62	0.14	0.70	0.70
Clearance Time (s)		6.4	6.4		6.4	6.4	6.6	6.5	6.5	6.6	6.5	6.5
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		110	77		93	120	119	2235	893	496	2405	868
v/s Ratio Prot							0.04	c0.54		c0.10	0.31	
v/s Ratio Perm		0.01	0.00		c0.03	0.01			0.03			0.01
v/c Ratio		0.08	0.00		0.33	0.12	0.53	0.87	0.05	0.70	0.45	0.01
Uniform Delay, d1		54.9	54.6		56.1	55.1	58.6	20.1	9.5	53.1	8.6	6.0
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.3	0.0		2.1	0.5	4.2	5.0	0.1	4.3	0.6	0.0
Delay (s)		55.3	54.6		58.2	55.6	62.8	25.0	9.6	57.4	9.2	6.0
Level of Service		E	D		E	E	E	C	A	E	A	A
Approach Delay (s)		55.1			56.0			25.6			20.8	
Approach LOS		E			E			C			C	
Intersection Summary												
HCM 2000 Control Delay		25.5										
HCM 2000 Volume to Capacity ratio		0.79										
Actuated Cycle Length (s)		130.0										
Intersection Capacity Utilization		90.5%										
Analysis Period (min)		15										
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

12/11/2013

										
Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	9	4	31	172	63	1944	76	346	1072	15
v/c Ratio	0.08	0.03	0.33	0.62	0.46	0.87	0.08	0.70	0.44	0.02
Control Delay	55.6	0.2	65.5	17.9	67.6	26.3	2.3	60.8	9.7	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	55.6	0.2	65.5	17.9	67.6	26.3	2.3	60.8	9.7	0.1
Queue Length 50th (m)	2.2	0.0	7.7	0.0	15.7	198.8	0.0	44.0	57.9	0.0
Queue Length 95th (m)	7.6	0.0	17.6	21.3	29.7	#301.7	5.7	57.9	87.3	0.0
Internal Link Dist (m)	105.8		201.6			100.1			300.6	
Turn Bay Length (m)		30.0		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	278	262	235	441	209	2235	924	502	2440	905
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.03	0.02	0.13	0.39	0.30	0.87	0.08	0.69	0.44	0.02

Intersection Summary

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

HCM Unsignalized Intersection Capacity Analysis

9: Station Rd & Plaza Dwy

12/11/2013




Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Volume (veh/h)	0	6	6	2	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.58	0.58	0.58	0.58	0.58	0.58
Hourly flow rate (vph)	0	10	10	3	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh						
Upstream signal (m)			130			
pX, platoon unblocked						
vC, conflicting volume	14				22	12
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	14				22	12
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1618				999	1074
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	10	14	0			
Volume Left	0	0	0			
Volume Right	0	3	0			
cSH	1618	1700	1700			
Volume to Capacity	0.00	0.01	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			6.7%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave











12/11/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↗	↘		↗	↘	↘	↗↗	↘	↗↗	↗↗	↘
Volume (vph)	7	9	34	92	3	248	4	1275	30	261	1689	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.4	6.4		6.4	6.4	6.6	6.5	6.5	6.6	6.5	6.5
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		1.00	0.97		1.00	0.98	1.00	1.00	0.97	1.00	1.00	0.96
Flpb, ped/bikes		1.00	1.00		0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.98	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1664	1592		1597	1605	1825	3544	1357	3471	3614	1564
Flt Permitted		0.86	1.00		0.72	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1470	1592		1205	1605	1825	3544	1357	3471	3614	1564
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	8	10	37	101	3	273	4	1401	33	287	1856	2
RTOR Reduction (vph)	0	0	32	0	0	236	0	0	13	0	0	1
Lane Group Flow (vph)	0	18	5	0	104	37	4	1401	20	287	1856	1
Confl. Peds. (#/hr)	1		7	7		1	5		8	8		5
Confl. Bikes (#/hr)			2			2			1			12
Heavy Vehicles (%)	29%	0%	0%	14%	0%	0%	0%	3%	17%	2%	1%	0%
Turn Type	Perm	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)		16.8	16.8		16.8	16.8	1.3	77.7	77.7	16.0	92.4	92.4
Effective Green, g (s)		16.8	16.8		16.8	16.8	1.3	77.7	77.7	16.0	92.4	92.4
Actuated g/C Ratio		0.13	0.13		0.13	0.13	0.01	0.60	0.60	0.12	0.71	0.71
Clearance Time (s)		6.4	6.4		6.4	6.4	6.6	6.5	6.5	6.6	6.5	6.5
Vehicle Extension (s)		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		189	205		155	207	18	2118	811	427	2568	1111
v/s Ratio Prot							0.00	0.40		c0.08	c0.51	
v/s Ratio Perm		0.01	0.00		c0.09	0.02			0.01			0.00
v/c Ratio		0.10	0.02		0.67	0.18	0.22	0.66	0.02	0.67	0.72	0.00
Uniform Delay, d1		49.9	49.4		54.0	50.5	63.8	17.4	10.7	54.5	11.2	5.4
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.2	0.0		10.9	0.4	6.2	1.6	0.1	4.1	1.8	0.0
Delay (s)		50.1	49.5		64.8	50.9	70.0	19.0	10.7	58.6	13.0	5.4
Level of Service		D	D		E	D	E	B	B	E	B	A
Approach Delay (s)		49.7			54.7			19.0			19.1	
Approach LOS		D			D			B			B	
Intersection Summary												
HCM 2000 Control Delay		22.8										
HCM 2000 Volume to Capacity ratio		0.74										
Actuated Cycle Length (s)		130.0										
Intersection Capacity Utilization		82.9%										
Analysis Period (min)		15										
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

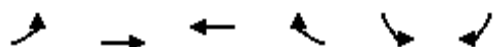
12/11/2013

										
Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	18	37	104	273	4	1401	33	287	1856	2
v/c Ratio	0.09	0.13	0.67	0.62	0.05	0.66	0.04	0.67	0.68	0.00
Control Delay	47.8	1.0	73.5	11.9	60.2	20.8	0.1	62.4	11.9	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.8	1.0	73.5	11.9	60.2	20.8	0.1	62.4	11.9	0.0
Queue Length 50th (m)	4.2	0.0	25.8	0.5	1.0	118.3	0.0	36.7	99.5	0.0
Queue Length 95th (m)	10.9	0.0	42.4	23.7	4.8	178.8	0.0	49.8	224.1	0.0
Internal Link Dist (m)	105.8		201.6			100.1			300.6	
Turn Bay Length (m)		30.0		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	312	405	255	554	272	2118	844	521	2714	1192
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.09	0.41	0.49	0.01	0.66	0.04	0.55	0.68	0.00
Intersection Summary										

HCM Unsignalized Intersection Capacity Analysis

9: Station Rd & Plaza Dwy

12/11/2013

























Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↰		↰	
Volume (veh/h)	0	10	2	0	4	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.62	0.62	0.62	0.62	0.62	0.62
Hourly flow rate (vph)	0	16	3	0	6	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)			130			
pX, platoon unblocked						
vC, conflicting volume	3				19	3
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3				19	3
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1632				1003	1086
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	16	3	8			
Volume Left	0	0	6			
Volume Right	0	0	2			
cSH	1632	1700	1019			
Volume to Capacity	0.00	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.2			
Control Delay (s)	0.0	0.0	8.6			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.6			
Approach LOS			A			
Intersection Summary						
Average Delay			2.5			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave

12/11/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	64	1	199	1	923	24	106	763	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					6.4	6.4	6.6	6.5	6.5	6.6	6.5	6.5
Lane Util. Factor					1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes					1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes					1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected					0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)					1778	1633	1825	3579	1488	3541	3614	1599
Flt Permitted					0.73	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)					1361	1633	1825	3579	1488	3541	3614	1599
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	0	68	1	212	1	982	26	113	812	1
RTOR Reduction (vph)	0	0	0	0	0	187	0	0	11	0	0	0
Lane Group Flow (vph)	0	0	0	0	69	25	1	982	15	113	812	1
Confl. Peds. (#/hr)									1	1		
Confl. Bikes (#/hr)									6			1
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	2%	8%	0%	1%	0%
Turn Type	Perm		Perm	Perm	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)					11.3	11.3	1.2	55.8	55.8	8.4	63.0	63.0
Effective Green, g (s)					11.3	11.3	1.2	55.8	55.8	8.4	63.0	63.0
Actuated g/C Ratio					0.12	0.12	0.01	0.59	0.59	0.09	0.66	0.66
Clearance Time (s)					6.4	6.4	6.6	6.5	6.5	6.6	6.5	6.5
Vehicle Extension (s)					3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)					161	194	23	2102	874	313	2396	1060
v/s Ratio Prot							0.00	c0.27		c0.03	c0.22	
v/s Ratio Perm					c0.05	0.02			0.01			0.00
v/c Ratio					0.43	0.13	0.04	0.47	0.02	0.36	0.34	0.00
Uniform Delay, d1					38.9	37.5	46.3	11.1	8.2	40.8	7.0	5.4
Progression Factor					1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2					1.8	0.3	0.8	0.7	0.0	0.7	0.4	0.0
Delay (s)					40.7	37.8	47.1	11.9	8.2	41.5	7.3	5.4
Level of Service					D	D	D	B	A	D	A	A
Approach Delay (s)		0.0			38.5			11.8			11.5	
Approach LOS		A			D			B			B	
Intersection Summary												
HCM 2000 Control Delay			15.1		HCM 2000 Level of Service					B		
HCM 2000 Volume to Capacity ratio			0.46									
Actuated Cycle Length (s)			95.0		Sum of lost time (s)					19.5		
Intersection Capacity Utilization			53.4%		ICU Level of Service					A		
Analysis Period (min)			15									
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

12/11/2013

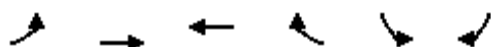





Lane Group	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	69	212	1	982	26	113	812	1
v/c Ratio	0.43	0.56	0.01	0.47	0.03	0.36	0.31	0.00
Control Delay	46.9	11.5	42.0	12.5	0.0	43.6	6.1	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.9	11.5	42.0	12.5	0.0	43.6	6.1	0.0
Queue Length 50th (m)	12.1	0.0	0.2	48.0	0.0	10.2	19.7	0.0
Queue Length 95th (m)	24.2	18.7	1.8	74.4	0.0	17.9	51.4	0.0
Internal Link Dist (m)	201.6			100.1			300.6	
Turn Bay Length (m)		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	395	624	219	2103	920	424	2598	1182
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	0.17	0.34	0.00	0.47	0.03	0.27	0.31	0.00
Intersection Summary								

HCM Unsignalized Intersection Capacity Analysis

9: Station Rd & Plaza Dwy

12/11/2013



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	1	0	0	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.50	0.50	0.50	0.50	0.58	0.50
Hourly flow rate (vph)	0	2	0	0	2	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)			130			
pX, platoon unblocked						
vC, conflicting volume	0				2	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				2	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1026	1091
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	2	0	2			
Volume Left	0	0	2			
Volume Right	0	0	0			
cSH	1636	1700	1026			
Volume to Capacity	0.00	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	8.5			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.5			
Approach LOS			A			
Intersection Summary						
Average Delay			3.9			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			




Appendix B

Background Traffic Operations

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰	↱	↰	↱	↱	↰	↱	↱
Volume (vph)	5	4	4	23	8	177	61	2021	79	357	1109	15
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		6.4	4.0		6.4	4.0	6.6	6.5	4.0	6.6	6.5	6.5
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		1.00	0.99		1.00	0.99	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1442	873		1301	1375	1679	3390	1372	3321	3262	1178
Flt Permitted		0.81	1.00		0.77	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1200	873		1046	1375	1679	3390	1372	3321	3262	1178
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	5	4	4	24	8	182	63	2084	81	368	1143	15
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	4
Lane Group Flow (vph)	0	9	4	0	32	182	63	2084	81	368	1143	11
Confl. Peds. (#/hr)	6		2	2		6	4		7	7		4
Confl. Bikes (#/hr)									6			1
Heavy Vehicles (%)	40%	0%	75%	46%	0%	11%	3%	2%	11%	1%	6%	27%
Turn Type	Perm	NA	Free	Perm	NA	Free	Prot	NA	Free	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		Free			Free			6
Actuated Green, G (s)		6.9	130.0		6.9	130.0	9.0	82.8	130.0	20.8	94.6	94.6
Effective Green, g (s)		6.9	130.0		6.9	130.0	9.0	82.8	130.0	20.8	94.6	94.6
Actuated g/C Ratio		0.05	1.00		0.05	1.00	0.07	0.64	1.00	0.16	0.73	0.73
Clearance Time (s)		6.4			6.4		6.6	6.5		6.6	6.5	6.5
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		63	873		55	1375	116	2159	1372	531	2373	857
v/s Ratio Prot							0.04	c0.61		c0.11	0.35	
v/s Ratio Perm		0.01	0.00		c0.03	0.13			0.06			0.01
v/c Ratio		0.14	0.00		0.58	0.13	0.54	0.97	0.06	0.69	0.48	0.01
Uniform Delay, d1		58.7	0.0		60.1	0.0	58.5	22.2	0.0	51.6	7.4	4.9
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1.0	0.0		14.7	0.2	5.1	12.8	0.1	3.9	0.7	0.0
Delay (s)		59.8	0.0		74.8	0.2	63.6	35.0	0.1	55.5	8.1	4.9
Level of Service		E	A		E	A	E	D	A	E	A	A
Approach Delay (s)		41.4			11.4			34.5			19.5	
Approach LOS		D			B			C			B	
Intersection Summary												
HCM 2000 Control Delay			27.6				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.89									
Actuated Cycle Length (s)			130.0				Sum of lost time (s)			19.5		
Intersection Capacity Utilization			97.0%				ICU Level of Service			F		
Analysis Period (min)			15									
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

12/17/2013



Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	9	4	32	182	63	2084	81	368	1143	15
v/c Ratio	0.09	0.00	0.37	0.13	0.48	0.94	0.06	0.69	0.46	0.02
Control Delay	56.1	0.0	68.0	0.2	68.5	31.6	0.1	58.6	8.9	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	56.1	0.0	68.0	0.2	68.5	31.6	0.1	58.6	8.9	0.0
Queue Length 50th (m)	2.2	0.0	8.0	0.0	15.7	~274.5	0.0	46.3	66.0	0.0
Queue Length 95th (m)	7.7	0.0	18.3	0.0	29.7	#359.0	0.0	61.1	98.2	0.0
Internal Link Dist (m)	105.8		201.6			100.1			300.6	
Turn Bay Length (m)		30.0		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	254	873	221	1375	198	2225	1372	531	2503	923
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.04	0.00	0.14	0.13	0.32	0.94	0.06	0.69	0.46	0.02

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

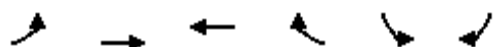
95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

HCM Unsignalized Intersection Capacity Analysis

9: Station Rd & Plaza Dwy

12/17/2013

























Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↱	↱		↱	
Volume (veh/h)	0	6	11	4	0	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.58	0.58	0.58	0.58	0.58	0.58
Hourly flow rate (vph)	0	10	19	7	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (m)			130			
pX, platoon unblocked						
vC, conflicting volume	26				33	22
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	26				33	22
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1601				986	1060
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	10	26	0			
Volume Left	0	0	0			
Volume Right	0	7	0			
cSH	1601	1700	1700			
Volume to Capacity	0.00	0.02	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS			A			
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			6.7%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	9	34	98	3	263	4	1362	32	277	1807	2
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		6.4	4.0		6.4	4.0	6.6	6.5	4.0	6.6	6.5	6.5
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		1.00	0.99		1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.96
Flpb, ped/bikes		1.00	1.00		0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.98	1.00		0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1576	1525		1513	1527	1729	3357	1303	3288	3424	1482
Flt Permitted		0.87	1.00		0.72	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1396	1525		1140	1527	1729	3357	1303	3288	3424	1482
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	8	10	37	108	3	289	4	1497	35	304	1986	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	1
Lane Group Flow (vph)	0	18	37	0	111	289	4	1497	35	304	1986	1
Confl. Peds. (#/hr)	1		7	7		1	5		8	8		5
Confl. Bikes (#/hr)			2			2			1			12
Heavy Vehicles (%)	29%	0%	0%	14%	0%	0%	0%	3%	17%	2%	1%	0%
Turn Type	Perm	NA	Free	Perm	NA	Free	Prot	NA	Free	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		Free			Free			6
Actuated Green, G (s)		17.9	130.0		17.9	130.0	1.3	75.5	130.0	17.1	91.3	91.3
Effective Green, g (s)		17.9	130.0		17.9	130.0	1.3	75.5	130.0	17.1	91.3	91.3
Actuated g/C Ratio		0.14	1.00		0.14	1.00	0.01	0.58	1.00	0.13	0.70	0.70
Clearance Time (s)		6.4			6.4		6.6	6.5		6.6	6.5	6.5
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		192	1525		156	1527	17	1949	1303	432	2404	1040
v/s Ratio Prot							0.00	0.45		c0.09	c0.58	
v/s Ratio Perm		0.01	0.02		c0.10	0.19			0.03			0.00
v/c Ratio		0.09	0.02		0.71	0.19	0.24	0.77	0.03	0.70	0.83	0.00
Uniform Delay, d1		49.0	0.0		53.6	0.0	63.9	20.6	0.0	54.0	13.7	5.8
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.2	0.0		14.2	0.3	7.0	3.0	0.0	5.1	3.4	0.0
Delay (s)		49.2	0.0		67.8	0.3	70.9	23.6	0.0	59.2	17.1	5.8
Level of Service		D	A		E	A	E	C	A	E	B	A
Approach Delay (s)		16.1			19.0			23.2			22.7	
Approach LOS		B			B			C			C	
Intersection Summary												
HCM 2000 Control Delay		22.4			HCM 2000 Level of Service			C				
HCM 2000 Volume to Capacity ratio		0.83										
Actuated Cycle Length (s)		130.0			Sum of lost time (s)			19.5				
Intersection Capacity Utilization		85.2%			ICU Level of Service			E				
Analysis Period (min)		15										
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

12/17/2013



Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	18	37	111	289	4	1497	35	304	1986	2
v/c Ratio	0.09	0.02	0.71	0.19	0.05	0.77	0.03	0.70	0.78	0.00
Control Delay	46.7	0.0	75.8	0.3	60.5	25.8	0.0	62.8	15.3	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.7	0.0	75.8	0.3	60.5	25.8	0.0	62.8	15.3	0.0
Queue Length 50th (m)	4.1	0.0	27.6	0.0	1.0	145.9	0.0	38.9	130.5	0.0
Queue Length 95th (m)	10.8	0.0	44.9	0.0	4.8	#220.6	0.0	52.4	#310.3	0.0
Internal Link Dist (m)	105.8		201.6			100.1			300.6	
Turn Bay Length (m)		30.0		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	296	1525	242	1527	258	1948	1303	499	2542	1119
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.06	0.02	0.46	0.19	0.02	0.77	0.03	0.61	0.78	0.00

Intersection Summary

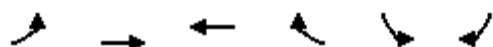
95th percentile volume exceeds capacity, queue may be longer.




Queue shown is maximum after two cycles.

HCM Unsignalized Intersection Capacity Analysis

9: Station Rd & Plaza Dwy

12/17/2013

























Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	10	2	0	4	1
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.62	0.62	0.62	0.62	0.62	0.62
Hourly flow rate (vph)	0	16	3	0	6	2
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)			130			
pX, platoon unblocked						
vC, conflicting volume	3				19	3
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3				19	3
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1632				1003	1086
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	16	3	8			
Volume Left	0	0	6			
Volume Right	0	0	2			
cSH	1632	1700	1019			
Volume to Capacity	0.00	0.00	0.01			
Queue Length 95th (m)	0.0	0.0	0.2			
Control Delay (s)	0.0	0.0	8.6			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.6			
Approach LOS			A			
Intersection Summary						
Average Delay			2.5			
Intersection Capacity Utilization			13.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	68	1	211	1	997	25	113	823	1
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)					6.4	4.0	6.6	6.5	4.0	6.6	6.5	6.5
Lane Util. Factor					1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes					1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.98
Flpb, ped/bikes					1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt					1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected					0.95	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)					1685	1547	1729	3390	1413	3354	3424	1515
Flt Permitted					0.73	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)					1289	1547	1729	3390	1413	3354	3424	1515
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	0	0	0	72	1	224	1	1061	27	120	876	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	73	224	1	1061	27	120	876	1
Confl. Peds. (#/hr)									1	1		
Confl. Bikes (#/hr)									6			1
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	2%	8%	0%	1%	0%
Turn Type	Perm		Free	Perm	NA	Free	Prot	NA	Free	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		Free			Free			6
Actuated Green, G (s)					9.8	95.0	1.2	57.0	95.0	8.7	64.5	64.5
Effective Green, g (s)					9.8	95.0	1.2	57.0	95.0	8.7	64.5	64.5
Actuated g/C Ratio					0.10	1.00	0.01	0.60	1.00	0.09	0.68	0.68
Clearance Time (s)					6.4		6.6	6.5		6.6	6.5	6.5
Vehicle Extension (s)					3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)					132	1547	21	2034	1413	307	2324	1028
v/s Ratio Prot							0.00	c0.31		c0.04	c0.26	
v/s Ratio Perm					c0.06	0.14			0.02			0.00
v/c Ratio					0.55	0.14	0.05	0.52	0.02	0.39	0.38	0.00
Uniform Delay, d1					40.5	0.0	46.3	11.1	0.0	40.7	6.6	4.9
Progression Factor					1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2					4.9	0.2	0.9	1.0	0.0	0.8	0.5	0.0
Delay (s)					45.5	0.2	47.3	12.0	0.0	41.5	7.0	4.9
Level of Service					D	A	D	B	A	D	A	A
Approach Delay (s)		0.0			11.3			11.8			11.2	
Approach LOS		A			B			B			B	
Intersection Summary												
HCM 2000 Control Delay			11.5		HCM 2000 Level of Service					B		
HCM 2000 Volume to Capacity ratio			0.52									
Actuated Cycle Length (s)			95.0		Sum of lost time (s)					19.5		
Intersection Capacity Utilization			57.1%		ICU Level of Service					B		
Analysis Period (min)			15									
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

12/17/2013

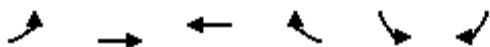





Lane Group	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	73	224	1	1061	27	120	876	1
v/c Ratio	0.46	0.14	0.01	0.51	0.02	0.39	0.34	0.00
Control Delay	47.7	0.2	42.0	13.1	0.0	43.9	6.1	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.7	0.2	42.0	13.1	0.0	43.9	6.1	0.0
Queue Length 50th (m)	12.8	0.0	0.2	56.3	0.0	10.8	22.9	0.0
Queue Length 95th (m)	25.2	0.0	1.8	88.4	0.0	18.8	59.4	0.0
Internal Link Dist (m)	201.6			100.1			300.6	
Turn Bay Length (m)		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	374	1547	207	2079	1413	402	2610	1182
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	0.20	0.14	0.00	0.51	0.02	0.30	0.34	0.00
Intersection Summary								

HCM Unsignalized Intersection Capacity Analysis

9: Station Rd & Plaza Dwy

12/17/2013



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	0	1	0	0	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.50	0.50	0.50	0.50	0.58	0.50
Hourly flow rate (vph)	0	2	0	0	2	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh						
Upstream signal (m)			130			
pX, platoon unblocked						
vC, conflicting volume	0				2	0
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0				2	0
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1636				1026	1091
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	2	0	2			
Volume Left	0	0	2			
Volume Right	0	0	0			
cSH	1636	1700	1026			
Volume to Capacity	0.00	0.00	0.00			
Queue Length 95th (m)	0.0	0.0	0.0			
Control Delay (s)	0.0	0.0	8.5			
Lane LOS			A			
Approach Delay (s)	0.0	0.0	8.5			
Approach LOS			A			
Intersection Summary						
Average Delay			3.9			
Intersection Capacity Utilization			13.3%	ICU Level of Service	A	
Analysis Period (min)			15			




Appendix C

Total Traffic Operations

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↰	↱		↰	↱	↰	↱	↱	↰	↱	↱
Volume (vph)	129	16	15	28	19	177	223	1936	79	357	1113	60
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		6.4	4.0		6.4	4.0	6.6	6.5	4.0	6.6	6.5	6.5
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		1.00	0.99		1.00	0.99	1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes		0.99	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00		0.97	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1669	1483		1388	1375	1695	3390	1372	3321	3262	1334
Flt Permitted		0.71	1.00		0.68	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1245	1483		969	1375	1695	3390	1372	3321	3262	1334
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	133	16	15	29	20	182	230	1996	81	368	1147	62
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	29
Lane Group Flow (vph)	0	149	15	0	49	182	230	1996	81	368	1147	33
Confl. Peds. (#/hr)	6		2	2		6	4		7	7		4
Confl. Bikes (#/hr)									6			1
Heavy Vehicles (%)	4%	0%	3%	46%	0%	11%	2%	2%	11%	1%	6%	12%
Turn Type	Perm	NA	Free	Perm	NA	Free	Prot	NA	Free	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		Free			Free			6
Actuated Green, G (s)		21.2	140.0		21.2	140.0	23.8	83.1	140.0	16.2	75.5	75.5
Effective Green, g (s)		21.2	140.0		21.2	140.0	23.8	83.1	140.0	16.2	75.5	75.5
Actuated g/C Ratio		0.15	1.00		0.15	1.00	0.17	0.59	1.00	0.12	0.54	0.54
Clearance Time (s)		6.4			6.4		6.6	6.5		6.6	6.5	6.5
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		188	1483		146	1375	288	2012	1372	384	1759	719
v/s Ratio Prot							c0.14	c0.59		0.11	0.35	
v/s Ratio Perm		c0.12	0.01		0.05	0.13			0.06			0.03
v/c Ratio		0.79	0.01		0.34	0.13	0.80	0.99	0.06	0.96	0.65	0.05
Uniform Delay, d1		57.3	0.0		53.1	0.0	55.8	28.1	0.0	61.6	22.9	15.2
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		20.1	0.0		1.4	0.2	14.3	18.3	0.1	34.8	1.9	0.1
Delay (s)		77.3	0.0		54.5	0.2	70.1	46.4	0.1	96.3	24.8	15.4
Level of Service		E	A		D	A	E	D	A	F	C	B
Approach Delay (s)		70.3			11.7			47.1			41.1	
Approach LOS		E			B			D			D	
Intersection Summary												
HCM 2000 Control Delay			43.9				HCM 2000 Level of Service				D	
HCM 2000 Volume to Capacity ratio			0.96									
Actuated Cycle Length (s)			140.0				Sum of lost time (s)			19.5		
Intersection Capacity Utilization			99.1%				ICU Level of Service			F		
Analysis Period (min)			15									
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

12/17/2013



Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	149	15	49	182	230	1996	81	368	1147	62
v/c Ratio	0.79	0.01	0.34	0.13	0.80	0.99	0.06	0.96	0.65	0.08
Control Delay	84.8	0.0	57.6	0.2	75.7	46.5	0.1	96.6	27.0	0.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	84.8	0.0	57.6	0.2	75.7	46.5	0.1	96.6	27.0	0.2
Queue Length 50th (m)	40.1	0.0	12.2	0.0	61.7	274.4	0.0	~53.4	117.2	0.0
Queue Length 95th (m)	62.4	0.0	24.1	0.0	86.8	#340.4	0.0	#104.1	166.9	0.0
Internal Link Dist (m)	105.8		201.6			63.1			300.6	
Turn Bay Length (m)		30.0		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	240	1483	186	1375	365	2012	1372	384	1759	779
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.62	0.01	0.26	0.13	0.63	0.99	0.06	0.96	0.65	0.08

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 Unsignalized Intersection Capacity Analysis

7: March Rd & North Driveway

12/17/2013



















Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↕↗	↕↗	↗
Volume (veh/h)	0	89	0	2238	1100	56
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	97	0	2433	1196	61
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					87	
pX, platoon unblocked	0.75	0.75	0.75			
vC, conflicting volume	2412	598	1257			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2219	0	685			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	88	100			
cM capacity (veh/h)	28	817	681			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	97	1216	1216	598	598	61
Volume Left	0	0	0	0	0	0
Volume Right	97	0	0	0	0	61
cSH	817	1700	1700	1700	1700	1700
Volume to Capacity	0.12	0.72	0.72	0.35	0.35	0.04
Queue Length 95th (m)	3.1	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	10.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A					
Approach Delay (s)	10.0	0.0		0.0		
Approach LOS	A					
Intersection Summary						
Average Delay			0.3			
Intersection Capacity Utilization			68.6%		ICU Level of Service	C
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

9: West Driveway/Plaza Dwy & Station Rd

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	6	6	218	11	4	5	0	147	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.58	0.58	0.92	0.58	0.58	0.58	0.58	0.58	0.92	0.58	0.58	0.58
Hourly flow rate (vph)	0	10	7	376	19	7	9	0	160	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)					130							
pX, platoon unblocked												
vC, conflicting volume	26			17			788	791	14	948	791	22
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	26			17			788	791	14	948	791	22
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			77			97	100	85	100	100	100
cM capacity (veh/h)	1601			1600			253	246	1066	169	246	1060
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	17	402	168	0								
Volume Left	0	376	9	0								
Volume Right	7	7	160	0								
cSH	1601	1600	916	1700								
Volume to Capacity	0.00	0.23	0.18	0.00								
Queue Length 95th (m)	0.0	7.0	5.1	0.0								
Control Delay (s)	0.0	7.5	9.8	0.0								
Lane LOS		A	A	A								
Approach Delay (s)	0.0	7.5	9.8	0.0								
Approach LOS			A	A								
Intersection Summary												
Average Delay			8.0									
Intersection Capacity Utilization			36.8%	ICU Level of Service		A						
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

12: March Rd & South Driveway

12/17/2013




Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations		↑	↑↑			↑↑
Volume (veh/h)	0	6	1189	0	0	2238
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	7	1292	0	0	2433
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (m)			158			
pX, platoon unblocked	0.76	0.76			0.76	
vC, conflicting volume	2509	646			1292	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2349	0			738	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			100	
cM capacity (veh/h)	23	819			652	
Direction, Lane #	EB 1	SE 1	SE 2	NW 1	NW 2	
Volume Total	7	646	646	1216	1216	
Volume Left	0	0	0	0	0	
Volume Right	7	0	0	0	0	
cSH	819	1700	1700	1700	1700	
Volume to Capacity	0.01	0.38	0.38	0.72	0.72	
Queue Length 95th (m)	0.2	0.0	0.0	0.0	0.0	
Control Delay (s)	9.4	0.0	0.0	0.0	0.0	
Lane LOS	A					
Approach Delay (s)	9.4	0.0		0.0		
Approach LOS	A					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			68.6%		ICU Level of Service	C
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↖	↗	↖	↕	↗	↖↗	↕	↗
Volume (vph)	79	22	63	102	8	263	88	1323	32	277	1807	30
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		6.4	4.0		6.4	4.0	6.6	6.5	4.0	6.6	6.5	6.5
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		1.00	0.99		1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.96
Flpb, ped/bikes		1.00	1.00		0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1684	1525		1528	1527	1729	3357	1303	3288	3424	1480
Flt Permitted		0.64	1.00		0.64	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1120	1525		1016	1527	1729	3357	1303	3288	3424	1480
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	87	24	69	112	9	289	97	1454	35	304	1986	33
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	13
Lane Group Flow (vph)	0	111	69	0	121	289	97	1454	35	304	1986	20
Confl. Peds. (#/hr)	1		7	7		1	5		8	8		5
Confl. Bikes (#/hr)			2			2			1			12
Heavy Vehicles (%)	5%	0%	0%	14%	0%	0%	0%	3%	17%	2%	1%	0%
Turn Type	Perm	NA	Free	Perm	NA	Free	Prot	NA	Free	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		Free			Free			6
Actuated Green, G (s)		19.9	130.0		19.9	130.0	11.6	73.8	130.0	16.8	79.0	79.0
Effective Green, g (s)		19.9	130.0		19.9	130.0	11.6	73.8	130.0	16.8	79.0	79.0
Actuated g/C Ratio		0.15	1.00		0.15	1.00	0.09	0.57	1.00	0.13	0.61	0.61
Clearance Time (s)		6.4			6.4		6.6	6.5		6.6	6.5	6.5
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		171	1525		155	1527	154	1905	1303	424	2080	899
v/s Ratio Prot							0.06	0.43		c0.09	c0.58	
v/s Ratio Perm		0.10	0.05		c0.12	0.19			0.03			0.01
v/c Ratio		0.65	0.05		0.78	0.19	0.63	0.76	0.03	0.72	0.95	0.02
Uniform Delay, d1		51.8	0.0		53.0	0.0	57.1	21.4	0.0	54.3	23.8	10.1
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		8.2	0.1		22.0	0.3	7.8	3.0	0.0	5.7	11.6	0.0
Delay (s)		60.0	0.1		75.0	0.3	65.0	24.4	0.0	60.0	35.5	10.2
Level of Service		E	A		E	A	E	C	A	E	D	B
Approach Delay (s)		37.0			22.3			26.3			38.3	
Approach LOS		D			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			32.6				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			130.0				Sum of lost time (s)			19.5		
Intersection Capacity Utilization			88.7%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

12/17/2013



Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	111	69	121	289	97	1454	35	304	1986	33
v/c Ratio	0.65	0.05	0.78	0.19	0.63	0.76	0.03	0.72	0.95	0.04
Control Delay	68.0	0.1	83.3	0.3	75.4	26.4	0.0	64.1	36.8	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	68.0	0.1	83.3	0.3	75.4	26.4	0.0	64.1	36.8	0.1
Queue Length 50th (m)	27.0	0.0	30.1	0.0	24.1	145.1	0.0	38.9	244.6	0.0
Queue Length 95th (m)	44.2	0.0	48.8	0.0	#46.9	207.1	0.0	53.3	#334.3	0.0
Internal Link Dist (m)	105.8		201.6			63.1			300.6	
Turn Bay Length (m)		30.0		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	237	1525	215	1527	164	1907	1303	490	2082	932
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.05	0.56	0.19	0.59	0.76	0.03	0.62	0.95	0.04

Intersection Summary

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

HCM Unsignalized Intersection Capacity Analysis

7: March Rd & North Driveway

12/17/2013



















Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↗↘	↗↘	↗
Volume (veh/h)	0	74	0	1443	1916	56
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	80	0	1568	2083	61
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					87	
pX, platoon unblocked	0.43	0.43	0.43			
vC, conflicting volume	2867	1041	2143			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2693	0	1027			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	83	100			
cM capacity (veh/h)	8	471	292			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	80	784	784	1041	1041	61
Volume Left	0	0	0	0	0	0
Volume Right	80	0	0	0	0	61
cSH	471	1700	1700	1700	1700	1700
Volume to Capacity	0.17	0.46	0.46	0.61	0.61	0.04
Queue Length 95th (m)	4.6	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	14.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	B					
Approach Delay (s)	14.2	0.0		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay		0.3				
Intersection Capacity Utilization		67.4%		ICU Level of Service		C
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

9: West Driveway/Plaza Dwy & Station Rd

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	10	3	117	2	0	3	0	114	4	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.62	0.62	1.00	0.62	0.62	0.62	0.62	0.62	0.92	0.62	0.62	0.62
Hourly flow rate (vph)	0	16	3	189	3	0	5	0	124	6	0	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)					130							
pX, platoon unblocked												
vC, conflicting volume	3			19			400	398	18	522	400	3
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3			19			400	398	18	522	400	3
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			88			99	100	88	98	100	100
cM capacity (veh/h)	1632			1597			509	476	1061	376	475	1086
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	19	192	129	8								
Volume Left	0	189	5	6								
Volume Right	3	0	124	2								
cSH	1632	1597	1019	433								
Volume to Capacity	0.00	0.12	0.13	0.02								
Queue Length 95th (m)	0.0	3.0	3.3	0.4								
Control Delay (s)	0.0	7.4	9.0	13.5								
Lane LOS		A	A	B								
Approach Delay (s)	0.0	7.4	9.0	13.5								
Approach LOS			A	B								
Intersection Summary												
Average Delay			7.8									
Intersection Capacity Utilization			27.8%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

12: March Rd & South Driveway

12/17/2013

























Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations		↑	↑↑			↑↑
Volume (veh/h)	0	7	1990	0	0	1443
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	8	2163	0	0	1568
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (m)			158			
pX, platoon unblocked	0.42	0.42			0.42	
vC, conflicting volume	2947	1082			2163	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2874	0			1004	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	98			100	
cM capacity (veh/h)	5	455			288	
Direction, Lane #	EB 1	SE 1	SE 2	NW 1	NW 2	
Volume Total	8	1082	1082	784	784	
Volume Left	0	0	0	0	0	
Volume Right	8	0	0	0	0	
cSH	455	1700	1700	1700	1700	
Volume to Capacity	0.02	0.64	0.64	0.46	0.46	
Queue Length 95th (m)	0.4	0.0	0.0	0.0	0.0	
Control Delay (s)	13.1	0.0	0.0	0.0	0.0	
Lane LOS	B					
Approach Delay (s)	13.1	0.0		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			68.1%		ICU Level of Service	C
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

1: March Rd & Station Rd/Carling Ave

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	119	12	12	73	9	211	141	919	25	113	824	41
Ideal Flow (vphpl)	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Total Lost time (s)		6.4	4.0		6.4	4.0	6.6	6.5	4.0	6.6	6.5	6.5
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.98
Flpb, ped/bikes		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1741	1547		1698	1547	1729	3390	1413	3354	3424	1515
Flt Permitted		0.68	1.00		0.64	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1244	1547		1143	1547	1729	3390	1413	3354	3424	1515
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	127	13	13	78	10	224	150	978	27	120	877	44
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	23
Lane Group Flow (vph)	0	140	13	0	88	224	150	978	27	120	877	21
Confl. Peds. (#/hr)									1	1		
Confl. Bikes (#/hr)									6			1
Heavy Vehicles (%)	0%	0%	0%	3%	0%	0%	0%	2%	8%	0%	1%	0%
Turn Type	Perm	NA	Free	Perm	NA	Free	Prot	NA	Free	Prot	NA	Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		Free			Free			6
Actuated Green, G (s)		16.2	95.0		16.2	95.0	13.3	50.6	95.0	8.7	46.0	46.0
Effective Green, g (s)		16.2	95.0		16.2	95.0	13.3	50.6	95.0	8.7	46.0	46.0
Actuated g/C Ratio		0.17	1.00		0.17	1.00	0.14	0.53	1.00	0.09	0.48	0.48
Clearance Time (s)		6.4			6.4		6.6	6.5		6.6	6.5	6.5
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		212	1547		194	1547	242	1805	1413	307	1657	733
v/s Ratio Prot							c0.09	c0.29		0.04	0.26	
v/s Ratio Perm		c0.11	0.01		0.08	0.14			0.02			0.01
v/c Ratio		0.66	0.01		0.45	0.14	0.62	0.54	0.02	0.39	0.53	0.03
Uniform Delay, d1		36.8	0.0		35.4	0.0	38.5	14.6	0.0	40.7	17.0	12.8
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		7.5	0.0		1.7	0.2	4.7	1.2	0.0	0.8	1.2	0.1
Delay (s)		44.3	0.0		37.1	0.2	43.1	15.8	0.0	41.5	18.2	12.9
Level of Service		D	A		D	A	D	B	A	D	B	B
Approach Delay (s)		40.6			10.6			18.9			20.7	
Approach LOS		D			B			B			C	
Intersection Summary												
HCM 2000 Control Delay			19.9		HCM 2000 Level of Service					B		
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			95.0		Sum of lost time (s)					19.5		
Intersection Capacity Utilization			62.8%		ICU Level of Service					B		
Analysis Period (min)			15									
c Critical Lane Group												

Queues

1: March Rd & Station Rd/Carling Ave

12/17/2013



Lane Group	EBT	EBR	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	140	13	88	224	150	978	27	120	877	44
v/c Ratio	0.66	0.01	0.45	0.14	0.62	0.54	0.02	0.39	0.53	0.06
Control Delay	51.1	0.0	41.5	0.2	49.4	17.3	0.0	43.9	20.0	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.1	0.0	41.5	0.2	49.4	17.3	0.0	43.9	20.0	0.1
Queue Length 50th (m)	24.3	0.0	14.7	0.0	26.0	58.4	0.0	10.8	57.0	0.0
Queue Length 95th (m)	40.2	0.0	26.9	0.0	44.4	94.1	0.0	18.8	89.3	0.0
Internal Link Dist (m)	105.8		201.6			63.1			300.6	
Turn Bay Length (m)		30.0		50.0	100.0		90.0	180.0		30.0
Base Capacity (vph)	361	1547	332	1547	252	1804	1413	402	1656	792
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.39	0.01	0.27	0.14	0.60	0.54	0.02	0.30	0.53	0.06

Intersection Summary

HCM Unsignalized Intersection Capacity Analysis

7: March Rd & North Driveway

12/17/2013



















Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗		↕↗	↕↗	↗
Volume (veh/h)	0	103	0	1085	840	69
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	112	0	1179	913	75
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (m)					87	
pX, platoon unblocked	0.83	0.83	0.83			
vC, conflicting volume	1503	457	988			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1192	0	571			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	88	100			
cM capacity (veh/h)	149	898	826			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	112	590	590	457	457	75
Volume Left	0	0	0	0	0	0
Volume Right	112	0	0	0	0	75
cSH	898	1700	1700	1700	1700	1700
Volume to Capacity	0.12	0.35	0.35	0.27	0.27	0.04
Queue Length 95th (m)	3.2	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	9.6	0.0	0.0	0.0	0.0	0.0
Lane LOS	A					
Approach Delay (s)	9.6	0.0		0.0		
Approach LOS	A					
Intersection Summary						
Average Delay		0.5				
Intersection Capacity Utilization		37.9%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

9: West Driveway/Plaza Dwy & Station Rd

12/17/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	1	7	188	0	0	7	0	143	1	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.50	0.50	1.00	0.62	0.50	0.50	0.62	0.62	0.92	0.58	0.62	0.50
Hourly flow rate (vph)	0	2	7	303	0	0	11	0	155	2	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)					130							
pX, platoon unblocked												
vC, conflicting volume	0			9			612	612	6	767	615	0
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	0			9			612	612	6	767	615	0
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			81			97	100	86	99	100	100
cM capacity (veh/h)	1636			1611			347	331	1077	235	330	1091
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	9	303	167	2								
Volume Left	0	303	11	2								
Volume Right	7	0	155	0								
cSH	1636	1611	943	235								
Volume to Capacity	0.00	0.19	0.18	0.01								
Queue Length 95th (m)	0.0	5.3	4.9	0.2								
Control Delay (s)	0.0	7.8	9.6	20.4								
Lane LOS		A	A	C								
Approach Delay (s)	0.0	7.8	9.6	20.4								
Approach LOS			A	C								
Intersection Summary												
Average Delay			8.3									
Intersection Capacity Utilization			33.9%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

12: March Rd & South Driveway

12/17/2013



Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations		↗	↖↖			↖↖
Volume (veh/h)	0	9	943	0	0	1085
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	10	1025	0	0	1179
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (m)			158			
pX, platoon unblocked	0.83	0.83			0.83	
vC, conflicting volume	1615	512			1025	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1335	10			626	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			100	
cM capacity (veh/h)	121	889			792	
Direction, Lane #	EB 1	SE 1	SE 2	NW 1	NW 2	
Volume Total	10	512	512	590	590	
Volume Left	0	0	0	0	0	
Volume Right	10	0	0	0	0	
cSH	889	1700	1700	1700	1700	
Volume to Capacity	0.01	0.30	0.30	0.35	0.35	
Queue Length 95th (m)	0.3	0.0	0.0	0.0	0.0	
Control Delay (s)	9.1	0.0	0.0	0.0	0.0	
Lane LOS	A					
Approach Delay (s)	9.1	0.0		0.0		
Approach LOS	A					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			37.5%		ICU Level of Service	A
Analysis Period (min)			15			