681 Yonge Condo
City of Barrie

Traffic Impact Study for
Queensgate Homes (Barrie) Inc.

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Executive Summary

This report summarizes the traffic impact study for the proposed mixed-use development located within the site municipally known as 681 – 685 Yonge Street, in the City of Barrie [City]. The report assesses the impact of traffic related to the development on the adjacent roadway and provides recommendations to accommodate this traffic in a safe and efficient manner.

The proposed residential development will have 176 residential apartment units and first floor commercial space (5,480 sq.ft.).

The proposed development will have a full-movement access driveway [Site Access] onto Ashford Drive, located across an existing driveway [School South Driveway] for the adjacent St. Peter's Catholic Secondary School [Secondary School].

The scope of this analysis includes a review of the following intersections:

- Ashford Drive & Madelaine Drive / Yonge Street; and
- Ashford Drive / Site Access & School South Driveway.

Conclusions

1. The proposed development is expected to generate 64 AM and 84 PM new peak hour trips in the study area.
2. Background traffic and pedestrian counts were commissioned for the existing intersection of Ashford Drive & Madelaine Drive / Yonge Street completed on Thursday, June 28th 2018.
3. An intersection operational analysis was completed at the study area intersections, using the existing (2019) and background (2029) traffic volumes, without the proposed development traffic. This enabled a review of existing and future traffic deficiencies that would be present without the influence of the proposed development.
4. The following improvement is recommended for the 2029 horizon year:

   Ashford Drive & Madelaine Drive / Yonge Street

   - Signal Timing Plan optimization.
5. An estimate of the amount of traffic that would be generated by the Subject Site was prepared and assigned to the study area streets and intersection.
6. An intersection operation analysis was completed under total (2029) traffic volumes with the proposed development operational at the study area intersections.
7. The following infrastructure improvement is recommended prior to occupancy of the proposed development:

   Ashford Drive

   - Adjust the existing pavement markings on Ashford Drive between Yonge Street and the Site Access to provide a TWLTL.
   - Construct a sidewalk along the west side of the road between the Site Access and Yonge Street.
8. Provide a pedestrian connection linking the proposed development to the sidewalk network on Yonge Street and the proposed sidewalk on Ashford Drive.

9. The proposed Site Access onto Ashford Drive will operate efficiently with stop control for eastbound movements. A single lane for ingress and egress movements will provide the necessary capacity to convey the traffic volume generated by the proposed development.
10. The sight distance available for the Site Access meets the minimum stopping sight distance requirements.
11. The proposed parking supply does not meet the City's Zoning By-law requirement; however, it is appropriate for the intended use.
12. In summary the proposed development will not cause any operational issues and will not add significant delay or congestion to the local roadway network.

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1 Introduction

1.1 Background

Queensgate Homes (Barrie) Inc. [the Client] is proposing a mixed-use development within the site municipally known as 681 – 685 Yonge Street, in the City of Barrie [City]. The proposed residential development will have 176 residential apartment units and first floor commercial space (5,480 sq.ft.).

The proposed development will have a full-movement access driveway [Site Access] onto Ashford Drive, located directly across from the existing driveway [School South Driveway] for the adjacent St. Peter's Catholic Secondary School [Secondary School].

The Developer has retained **JD Engineering Inc.** [JD Engineering] to prepare this traffic impact study in support of the proposed development.

1.2 Study Area

Figure 1 illustrates the location of the subject site and study area intersections, in relation to the surrounding area. The site plan provided by the Developer is included in **Appendix A.**

The subject site is bound by Ashford Drive to the east, Yonge Street to the south and existing residential developments to the north and west.

Through consultation with the City, the following intersections will be analysed as part of the study:

- Ashford Drive & Madelaine Drive / Yonge Street; and
- Ashford Drive / Site Access & School South Driveway.

Figure 1 – Proposed Site Location and Study Area

1.3 Study Scope and Objectives

The purpose of this study is to identify the potential impacts to traffic flow at the site access and on the surrounding roadway network. The study analysis includes the following tasks:

- Determine existing traffic volumes and circulation patterns;
- Estimate future traffic volumes if the proposed development was not constructed, including the impact of additional proposed developments in the area;
- Estimate the amount of traffic that would be generated by the proposed development and assign to the roadway network;
- Complete level-of-service [LOS] analysis of horizon year (without the proposed development) traffic conditions and identify operational deficiencies;
- Estimate the amount of traffic that would be generated by the proposed development and assign to the roadway network;
- Complete LOS analysis of horizon year (with the proposed development) traffic conditions and identify additional operational deficiencies;
- Identify improvement options to address operational deficiencies;
- Review the proposed configuration of the Site Access driveways;
- Review the proposed parking supply; and
- Document findings and recommendations in a final report.

1.4 Horizon Year and Analysis Periods

Traffic scenarios for the existing (2019) year and horizon years (2029) were selected for analysis of traffic operations in the study area. The weekday morning [AM] and afternoon [PM] peak hours have been selected as the analysis periods for this study.

2 Information Gathering

2.1 Street and Intersection Characteristics

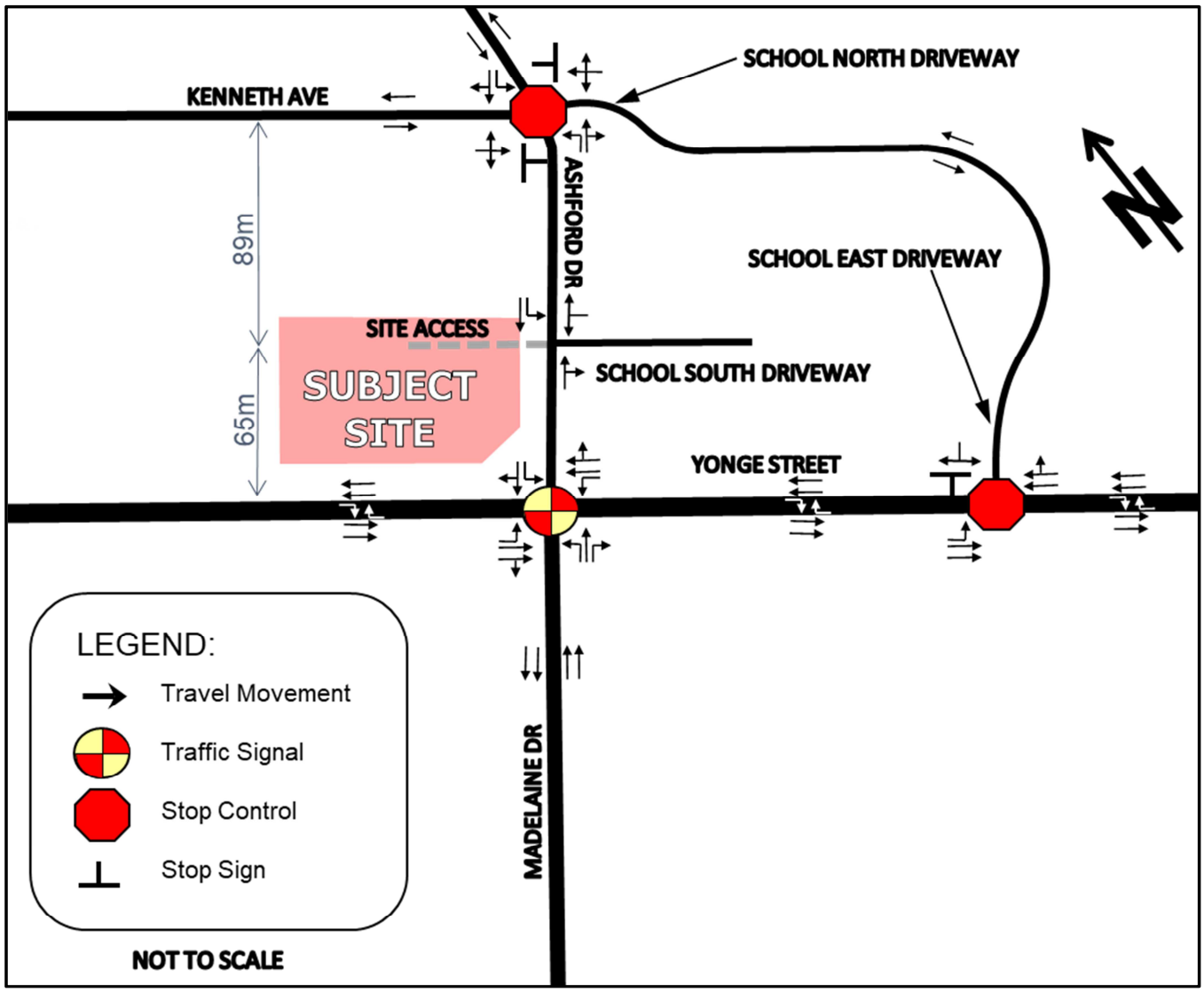
Yonge Street is a five-lane arterial road with an urban cross-section and sidewalks along both sides of the road. Yonge Street has a posted speed limit of 50km/h; however, the roadway is a school zone in the study area and has a posted speed limit of 40km/h during school hours (when school zone signs are flashing). Yonge Street is under jurisdiction of the City.

Madelaine Drive is a four-lane major collector road with an urban cross-section and sidewalks along both sides of the road. Madelaine Drive has a posted speed limit of 50km/h; however, the roadway is a school zone in the study area and has a posted speed limit of 40km/h school hours (when school zone signs are flashing). Madelaine Drive is under jurisdiction of the City.

Ashford Drive is a three-lane local road with an urban cross-section and a sidewalk on the east side. Ashford Drive has a posted speed limit of 40km/h. Ashford Drive is under jurisdiction of the City.

The existing intersection spacing and lane configuration within the study area is illustrated in **Figure 2.**

Figure 2 – Existing Intersection Lane Configuration within Study Area



2.2 Local Transportation Infrastructure Improvements

Based on the City's Multi-Modal Active Transportation Master Plan[1] (January 2014) [MMATMP] there are a number of planned road improvements within the study area. The following information is based on correspondence with City staff.

The following improvement is anticipated to be completed by 2021:

- Madelaine Drive – Road Rightsizing
  - Removal of an existing lane in each direction; and
  - Addition of a two way left turn lane [TWLTL] and painted on-street bicycle lanes.
- Yonge Street[2]
  - Addition of buffered bicycle lanes.
- Ashford Drive (from Yonge Street to Big Bay Point Road)
  - Construction of a bicycle boulevard[3].

The City's current capital budget does not identify any funds specifically for the above-noted infrastructure improvements. Based on our correspondence with the City related to this item, it is our understanding that the road rightsizing will occur in the near future. Consequently, in order to be conservative, the above-noted lane reductions have been applied to the existing (2019) traffic conditions. It is assumed that the intersection of Dean Avenue and Madelaine Drive will have an auxiliary left-turn storage lane and a shared through / right lane in each direction.

Based on the City's MMATMP, the following infrastructure improvement is anticipated to be completed by 2026. The property component of this infrastructure improvement is anticipated to commence by 2021, per the City's Capital Budget.

Bridge Construction

- Big Bay Point Road (north of study area)
  - Construction of a new 5-lane Highway 400 crossing connecting with Harvie Road.

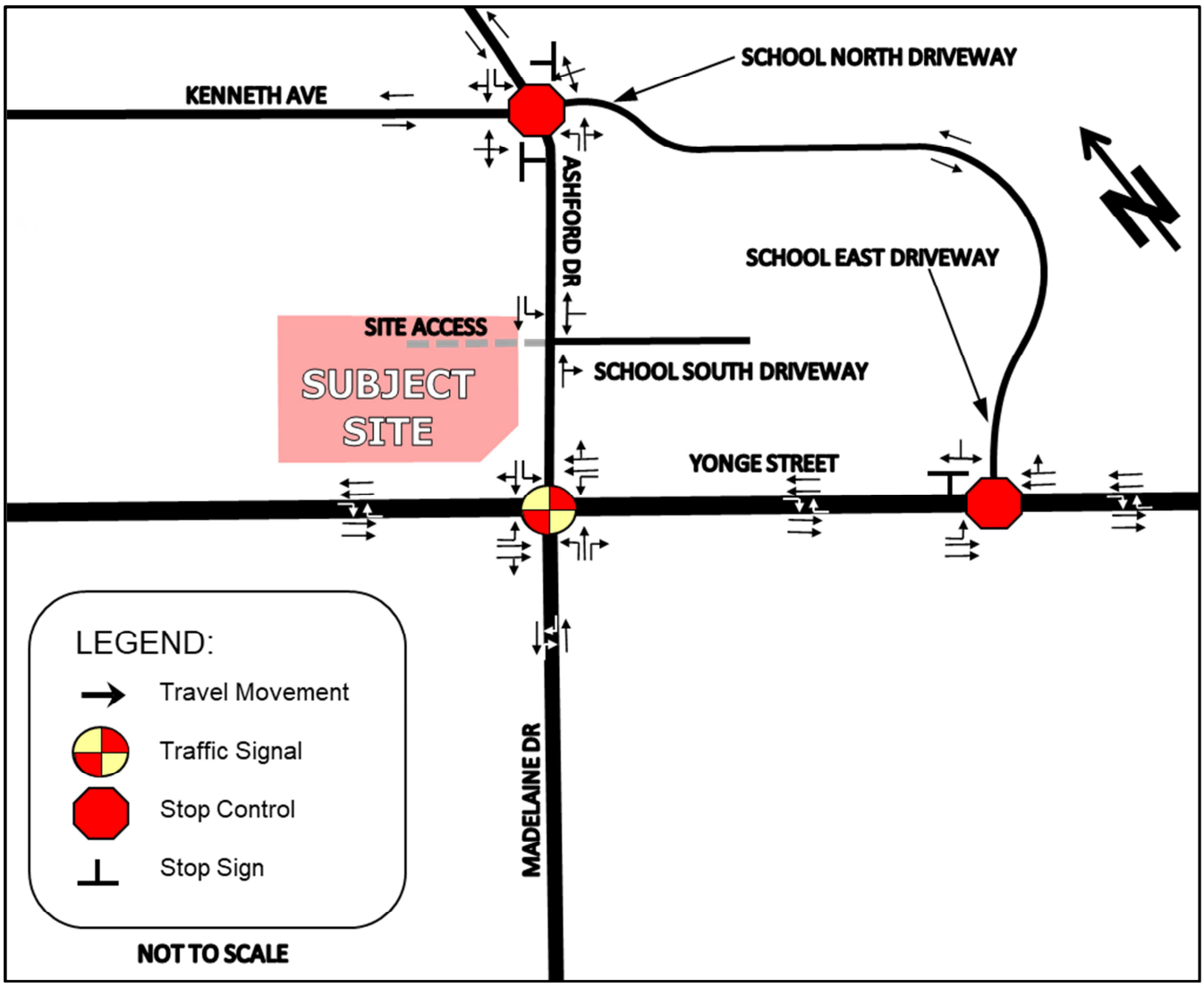
The assumed (2019) lane configuration within the study area can be seen in **Figure 3**.

[1] It is noted that a draft for the update to the City's MMATMP (dated April 2019) is available [Draft MMATMP Update]. Based on a review of the draft report there are no significant changes to the City's MMATMP are currently identified in the City's MMATMP Update, other than the recommended timing of the improvements.

[2] The Draft MMATMP Update recommends converting a lane in each direction along Young Street to a High-Occupancy Vehicle [HOV] lane by 2041. Since this improvement is planned in the 2041 horizon year, no adjustments regarding this improvement have been made. The Draft MMATMP Update also recommends cycle tracks rather than buffered bicycle lanes.

[3] The Draft MMATMP Update also recommends the construction of a sidewalk along the west side of Ashford Drive.

Figure 3 - Future Lane Configuration within Study Area



2.3 Transit Access

The subject site is serviced by Barrie Transit and GO transit. The 8A South (RVH / Yonge) and 8B North (Crosstown / Essa) bus route provides connections from the south limits to the north limits of the City on Yonge Street, within the study area. The 4A (East Bayfield) Route and 4B (South GO) Route provides connections from the southeast limits to the north limits of the City on Madelaine Drive and Ashford Drive, within the study area. The 68 Go Transit Route (Aurora GO) provides connections downtown in the City to the Town of Newmarket and Town of Aurora on Yonge Street, within the study area.

The 8A South bus route operates between 04:55 – 22:15 with weekday daytime service every 30 minutes, between 06:55 – 22:15 on Saturday with daytime service every 30 minutes and between 08:50 – 20:50 on Sunday with service every hour. The 8B North bus route operates between 05:00 – 24:00 with weekday daytime service every 30 minutes, between 07:30 – 24:00 on Saturday with

daytime service every 30 minutes and between 08:55 – 20:15 on Sunday with service every hour. The closest 8A South and 8B North bus stop is located on the southwest and northeast corner of the Ashford Drive & Madelaine Drive / Yonge Street intersection respectively.

The 4A bus route operates between 05:45 – 22:15 with weekday daytime service every 35 minutes, between 07:20 – 22:15 on Saturday with daytime service every 35 minutes and between 09:15 – 21:10 on Sunday with service every 65 minutes. The 4B bus route operates between 05:45 – 22:15 with weekday daytime service every 35 minutes, between 07:22 – 22:17 on Saturday with daytime service every 35 minutes and between 09:17 – 22:17 on Sunday with service every 65 minutes. The closest 4A and 4B bus stop is located on the northwest and southeast corner of the Ashford Drive / Kenneth Avenue intersection respectively.

The Aurora GO bus route operates between 08:46 – 20:56 with weekday daytime service every hour and between 06:40 – 20:31 on the weekend with daytime service every hour. The closest northbound and southbound bus stop is located in the northeast and southeast corner of the Ashford Drive & Madelaine Drive / Yonge Street intersection respectively.

2.4 Other Developments within Study Area

Based on discussions with the City and a review of the City's website the Yonge Street and Heritage Phase 3 developments are the only other developments that will impact the traffic in the study area.

A residential development is proposed on the site located north of Yonge Street, midblock between the Secondary School and the Barrie South GO station, east of the study area. The site is municipally known as 759 Yonge Street [Yonge Street Development]. Based on a concept plan by MHBC, dated April 2017 (attached in **Appendix B**), the Yonge Street Development will include 142 townhouse units, 242 stacked townhouse units, 192 back to back stacked townhouse units and 750 mid-rise units.

Arnel Corporation is proposing Phase 3 of the Heritage Square development, located at the southwest corner of the Ashford Drive & Madelaine Drive / Yonge Street intersection [Heritage Phase 3]. Based on a concept plan by Turner Fleischer Architects Inc., dated July 2013 (attached in **Appendix B**), the Heritage Phase 3 development will include eight buildings with commercial (50,838 sq.ft.) and restaurant / coffee shop (6,280 sq.ft.) space.

It is anticipated that both the Yonge Street Development and Heritage Phase 3 will be built-out and occupied by 2029.

2.4.1 Traffic Generation for Yonge Street Development

The traffic generated for the Yonge Street Development has been estimated based on the data provided in the Institute of Transportation Engineers [ITE] Trip generation Manual (10th Edition) [ITE Trip Generation Manual]. The following ITE land use has been applied to estimate the traffic from the Yonge Street Development:

- ITE land use #220 (Multifamily Housing (Low-Rise))
  - General Urban/Suburban Setting
- ITE land use #221 (Multifamily Housing (Mid-Rise))
  - General Urban/Suburban Setting

The AM and PM peak hour traffic generation for the Yonge Street Development does not exactly align with the AM and PM peak hour in the traffic counts; consequently, we have applied the peak hour of adjacent street traffic values provided in the ITE Trip Generation Manual.

The estimated trip generation from the Yonge Street Development is illustrated below in **Table 1**.

Table 1 – Estimated Traffic Generation of Yonge Street Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Multifamily Housing (Low-Rise) ITE Land Use: 220	142 units	15	52	67	51	30	81
Multifamily Housing (Mid-Rise) ITE Land Use: 221	1184 units	111	316	427	318	203	521
TOTAL TRIP GENERATION		126	368	494	369	233	602

In order to be conservative, no transportation modal split reduction has been applied to the above-noted traffic generation calculation.

2.4.2 Traffic Assignment for Yonge Street Development

The traffic assignment for the Yonge Street Development has been estimated based on the trip distribution calculated for the proposed development, as illustrated in **Table 11** in Section 4.2.

Figure 4 illustrates the traffic assignment by Yonge Street Development, in the AM and PM peak hour.

2.4.3 Traffic Generation for Heritage Phase 3

The traffic generated by Heritage Phase 3 has been estimated based on the data provided in the ITE Trip Generation Manual. The following ITE land use has been applied to estimate the traffic from Heritage Phase 3:

- ITE land use 820 (Shopping Centre)
  - General Urban/Suburban Setting
- ITE land use 934 (Fast-Food Restaurant with Drive-Through Window)
  - General Urban/Suburban Setting
- ITE land use 937 (Coffee/Donut Shop with Drive-Through Window)
  - General Urban/Suburban Setting

The estimated trip generation from Heritage Phase 3 is illustrated below in **Table 2**.

For the shopping centre traffic generator, the fitted curve equation for the peak hour of adjacent street traffic has been used in our calculation for the PM peak hour. The fitted curve equation for the AM peak hour of adjacent street traffic has a low R^2 value; consequently, we have applied the average rate in our calculation for the AM peak hour. For the purposes of this analysis, the more conservative AM peak hour of generator rate has been used in our calculation for the AM peak hour.

Table 2 - Estimated Traffic Generation of Heritage Phase 3

Land Use	Size*	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Shopping Centre ITE Land Use: 820	50,838 sq.ft.	118	100	218	158	172	330
Fast-Food Restaurant with Drive-Through Window ITE Land Use: 934	3,640 sq.ft.	74	72	146	62	57	119
Coffee/Donut Shop with Drive-Through Window ITE Land Use: 937	2,640 sq.ft.	120	115	235	57	58	115
TOTAL TRIP GENERATION		**312**	**287**	**599**	**277**	**287**	**564**
INTERNAL CAPTURE**		-22	-22	-44	-82	-82	-164
NET GENERATION		**290**	**265**	**555**	**195**	**205**	**400**
PASS-BY TRIPS (ITE Land Use: 820)***		0	0	0	-43	-43	-85
PASS-BY TRIPS (ITE Land Use: 934)****		-90	-90	-180	-38	-38	-76
TOTAL PRIMARY TRIPS		**200**	**175**	**375**	**114**	**124**	**239**

* The site plan did not provide a breakdown for each land-use; however, the statistics were assumed based off the location and size of the buildings and their drive-through lanes
** The internal capture rates has been calculated using the ITE Trip Generation Handbook. Internal capture reports are provided in **Appendix I**. It is noted internal capture rates were not available for the SAT peak hour consequently we have assumed the same rates as the PM peak hour during the SAT peak hour.
*** Commercial pass-by trips for the AM and PM peak hour are 0% and 34% respectively, according to the ITE data for ITE land use 820.
**** The ITE data provides a pass-by rate for weekday AM and PM peak hour (49% and 50% respectively), according to the ITE data for ITE land use 934. Since there is no available rate for ITE land use 937, we have assumed the ITE land use 934 pass-by rate for both land uses. For the purpose of this report, we have also decided to use a pass-by rate of 50% for all peak hours for both ITE land use 934 and 937.

No transportation modal split has been applied to the above-noted traffic generation calculation.

2.4.4 Traffic Assignment for Heritage Phase 3

For the purposes of this study it has been assumed that all primary traffic generated by Heritage Phase 3 will be new traffic and would not be in the study area if the development was not constructed.

The distribution of traffic for the Heritage Phase 3 is assumed to follow the distribution of the existing traffic volumes within the study area, obtained through the detailed turning movement counts outlined in Section 2.6.

Although there may be some internal capture between the Subject Site and Heritage Phase 3; however, for the purposes of this report we have conservatively assumed all traffic will be assigned to the external road network.

The estimated distribution of trips generated by Heritage Phase 3 is illustrated in **Table 3.**

Table 3 – Heritage Phase 3 Traffic Distribution

Scenario	Direction	Ingress / Egress Traffic Direction			
		East via Yonge Street	**West** via Yonge Street	**North** via Ashford Drive	**South** via Madelaine Drive
AM	In	37%	28%	16%	19%
	Out	28%	41%	17%	14%
PM	In	41%	36%	7%	16%
	Out	28%	38%	21%	13%

Using the above-noted traffic distribution pattern, the Heritage Phase 3 pass-by and primary traffic assignment was calculated for the AM and PM peak hour.

Figures 5 and **6** illustrate the pass-by and primary traffic assignment respectively for Heritage Phase 3.

Figure 7 illustrates the total adjacent traffic volumes (2029) for the AM and PM peak hour.

Figure 4 – Yonge Street Development (2029) Traffic Assignment

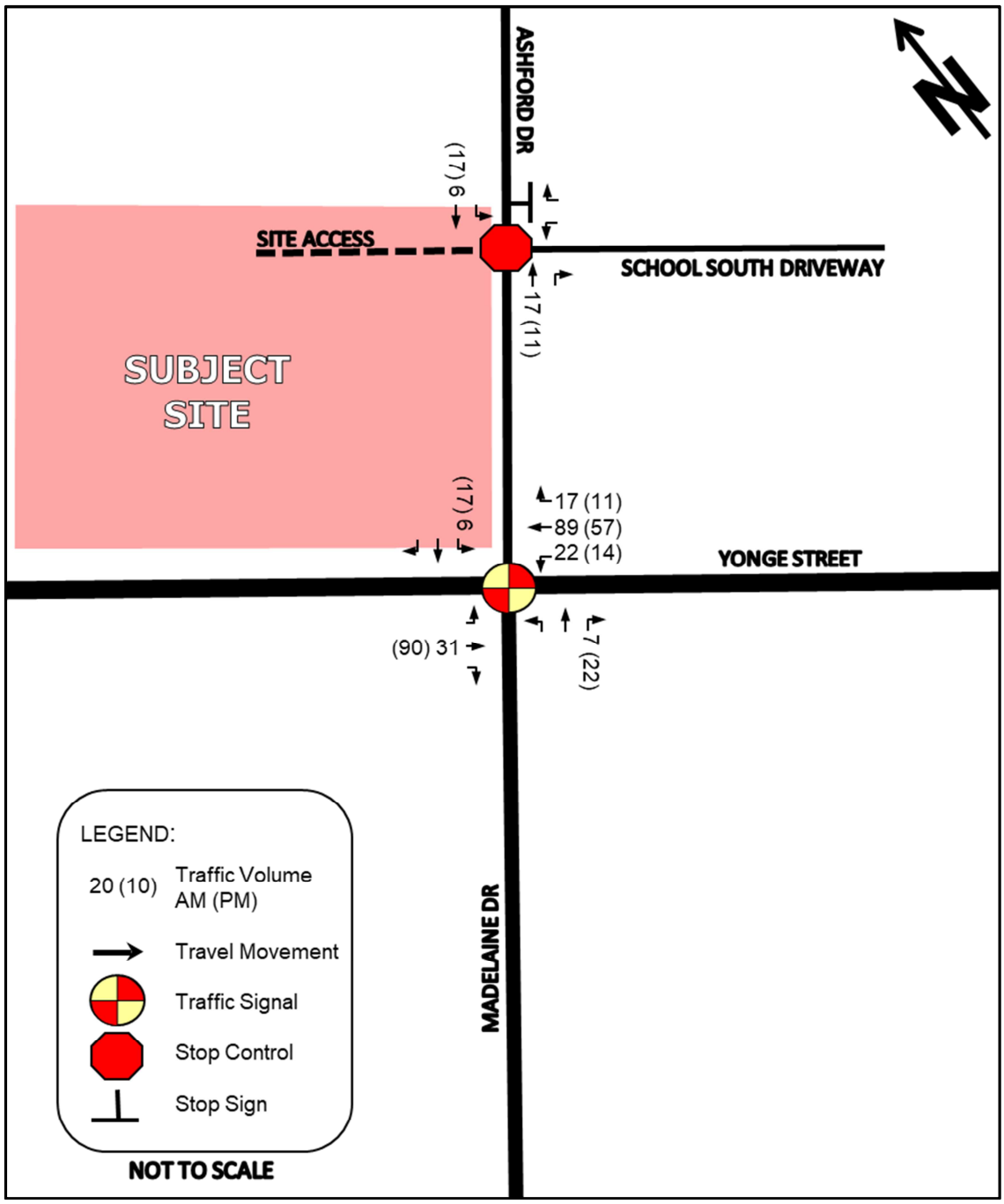


Figure 5 – Heritage Phase 3 (2029) Traffic Assignment Primary Trips

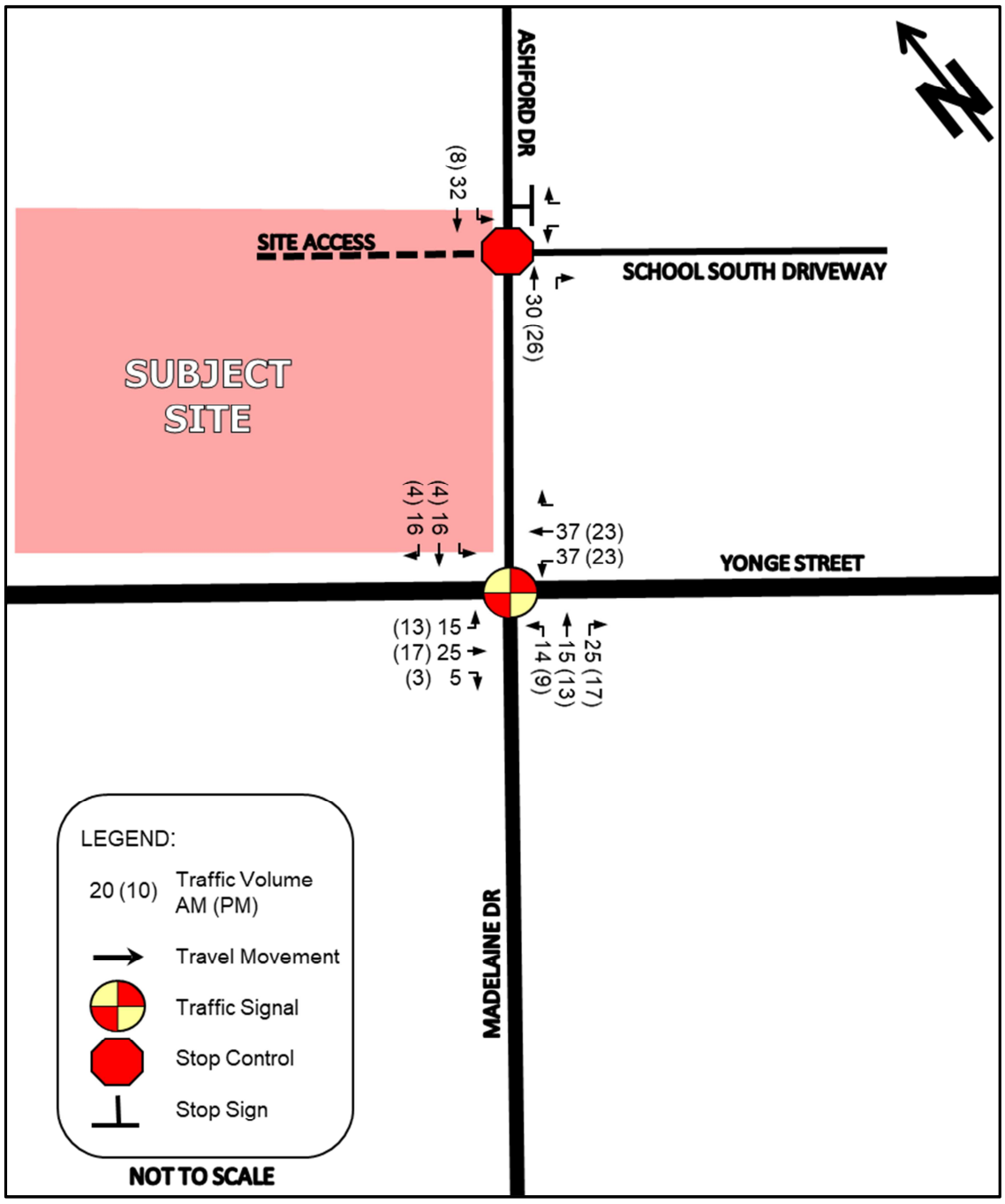


Figure 6 – Heritage Phase 3 (2029) Traffic Assignment Pass-by Trips

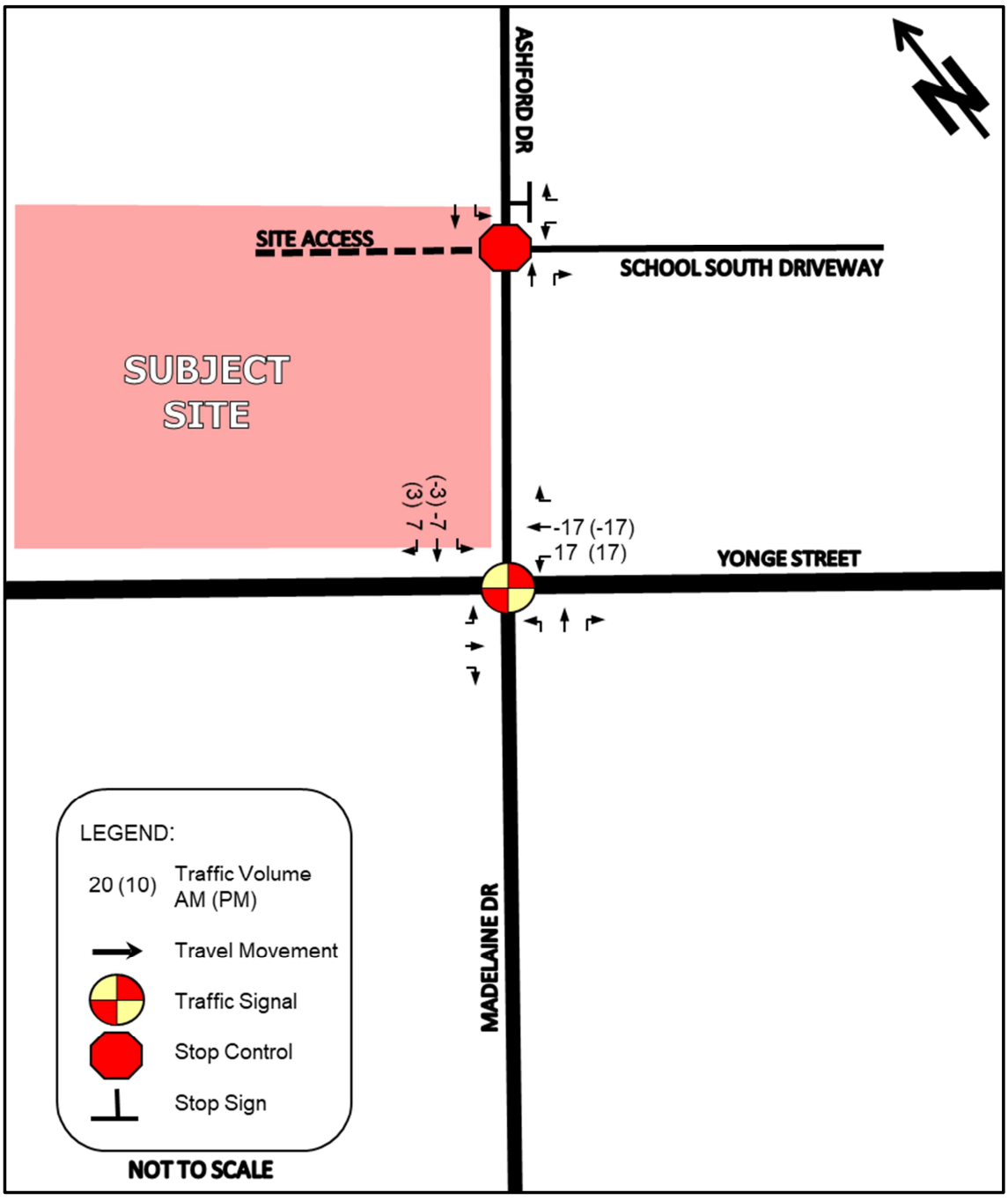
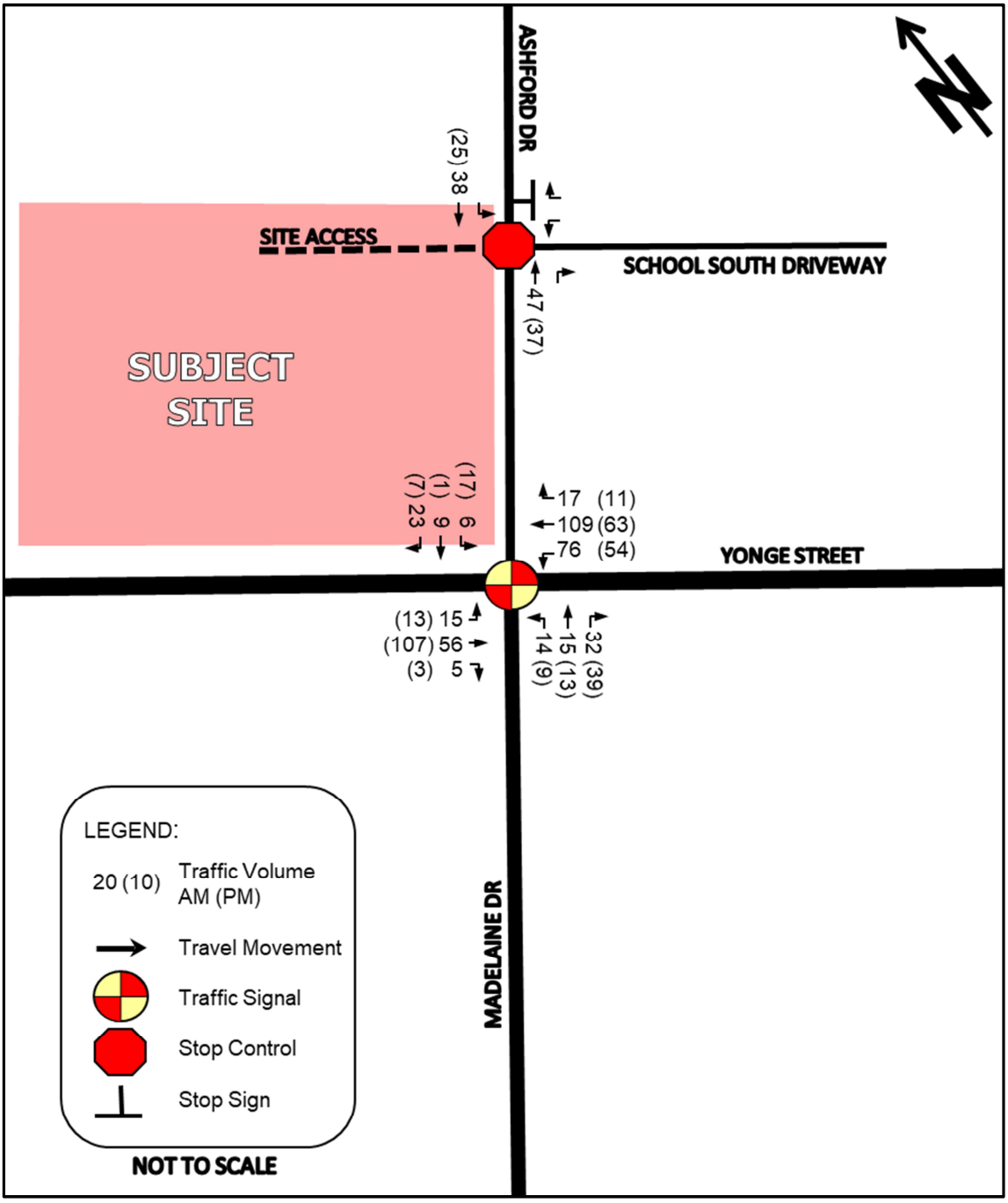


Figure 7 – Total Adjacent Traffic Volumes (2029)



2.5 Background Traffic Growth

In general, there is a significant amount of anticipated development planned within the annexed lands at the south end of the City, as well as intensification developments along the City's major corridors. Through our correspondence with the City Traffic Department, background traffic volumes generated by other developments outside the study area, have been estimated using the EMME travel demand model used in the MMATMP.

A 3.3% per annum background traffic growth rate has been calculated on Yonge Street and a 4.3% per annum background traffic growth rate has been calculated on Madelaine Drive and Ashford Drive, based on a comparison between 2011 and 2031 EMME traffic volume projections, as provided in the EMME model output.

2.6 Traffic Counts

Detailed turning movements traffic and pedestrian counts were retrieved from the City for the Ashford Drive & Madelaine Drive / Yonge Street intersection.

Table 4 summarizes the traffic count data collection information.

Table 4 - Traffic Count Data

Intersection (N-S Street / E-W Street)	**Count Date**	**AM Peak Hour**	**PM Peak Hour**	**Source**
Ashford Drive & Madelaine Drive / Yonge Street	Thursday, June 28th 2018	08:00 – 09:00	17:00 – 18:00	City

Detailed traffic count data can be found in **Appendix C**. The peak hours of traffic generation for the study area intersections generally aligned with the anticipated peak hour of traffic generation by the proposed development.

To determine the equivalent existing (2019) traffic volumes, the background traffic growth rate noted in Section 2.5 was applied.

Heavy vehicle percentages and pedestrian crossings from the traffic count data have also been included in the Synchro analysis.

Detailed turning movement traffic and pedestrian counts were not obtained for the Ashford Drive / School South Driveway intersection. Northbound and southbound volumes have been estimated based on the Ashford Drive & Madelaine Drive / Yonge Street intersection. The School South Driveway leads to a parking lot for the adjacent Secondary School.

For the purposes of this report we have estimated the traffic at the School South Driveway of the Secondary School based on an on-site review of traffic at the driveway and parking lot. The parking lot has a total of 25 parking spaces. Within the parking lot, there are eight parking spaces designated for Secondary School office staff, eight parking spaces are designated for the daycare and the remaining nine spaces are general visitor parking spaces.

The Secondary School produces a significant peak in traffic volume at the School South Driveway in the 30 minute period around 08:00 (school drop-off period) and 14:00 (school pick-up period). Based on the traffic counts completed by JD Engineering on Monday March 26th, 2018, 45 vehicles ingress and egress at the School South Driveway between 13:45 – 14:45. For the purpose of this report, we have assumed the same volume of traffic will be generated during the school drop-off period. We

have also assumed the school drop-off period to generally align with the AM peak hour and the school pick-up period to generally align with the PM peak hour, to be conservative[4].

The distribution of traffic at the School South Driveway is expected to be proportionate to the existing and planned residential development in the area. The distribution was selected based on the probable route of travel between the residential areas and the proposed development, assuming that people will select their route primarily based on travel time.

Table 5 illustrates the estimated distribution of traffic generated by the Secondary School as it relates to the surrounding residential development.

Table 5 – Secondary School Residential Capture Distribution

Travel Direction (to/from)	Percentage of Total Residential Capture
Painswick	50%
Bayshore Estates	50%
TOTAL	**100%**

Table 6 illustrates the estimated distribution of ingress and egress traffic for the Secondary School respectively, based on the above-noted assumptions.

Table 6 – Secondary School Trip Distribution

Travel Direction (to/from)	Percentage of Total Traffic Capture
North via Ashford Drive	45%
South via Ashford Drive	55%
TOTAL	**100%**

Figure 8 illustrates the existing (2019) AM and PM peak hour traffic volumes in the study area.

2.7 Horizon Year Traffic Volumes

In addition to the adjacent development traffic volumes (outlined in Section 2.4), the background (2029) traffic volumes were estimated for the AM and PM peak hour by applying the background traffic growth rates discussed in Section 2.5 to the existing traffic volumes.

Figure 9 illustrates the background (2029) AM and PM peak hour traffic volumes in the study area.

[4] The school pick-up period occurs approximately three hour ahead of the afternoon commuter peak hour.

Figure 8 – Existing (2019) Traffic Volumes

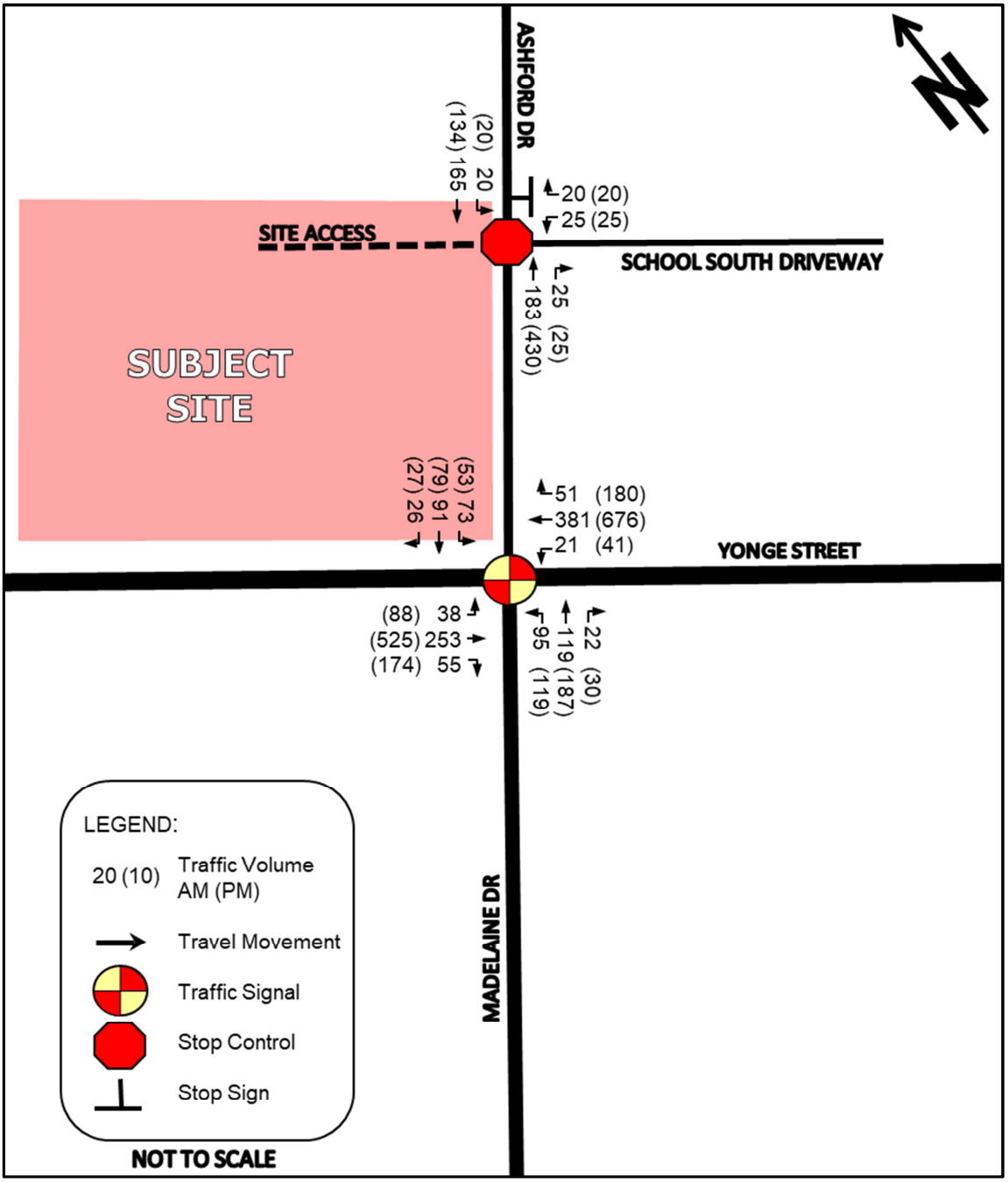
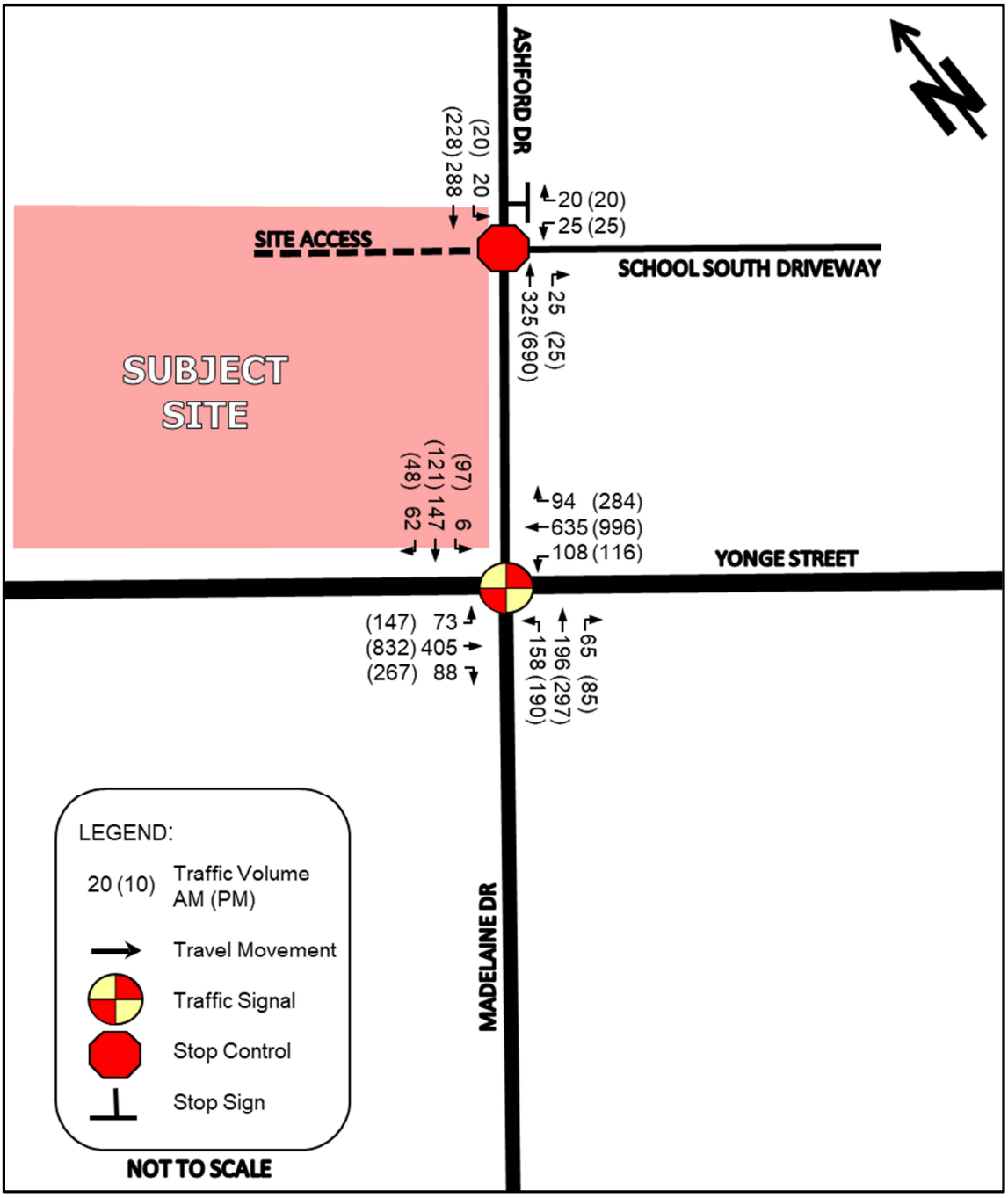


Figure 9 – Background (2029) Traffic Volumes



3 Intersection Operation without Proposed Development

3.1 Intersection Capacity Analysis Criteria

Intersection performance was measured using the traffic analysis software, Synchro 10, a deterministic model that employs Highway Capacity Manual and Intersection Capacity Utilization methodologies for analysing intersection operations. These procedures are accepted by provincial and municipal agencies throughout North America.

Synchro 10 enables the study area to be graphically defined in terms of streets and intersections, along with their geometric and traffic control characteristics. The user is able to evaluate both signalized and unsignalized intersections in relation to each other, thus not only providing level of service for the individual intersections, but also enabling an assessment of the impact the various intersections in a network have on each other in terms of spacing, traffic congestion, delay, and queuing.

Individual turning movements with a volume-to-capacity [V/C] ratio of 0.85 or greater are considered to be critical movements and have been highlighted in the LOS tables.

The intersection operations were also evaluated in terms of the LOS. LOS is a common measure of the quality of performance at an intersection and is defined in terms of vehicular delay. This delay includes deceleration delay, queue move-up time, stopped delay, and acceleration delay. LOS is expressed on a scale of A through F, where LOS A represents very little delay (i.e. less than 10 seconds per vehicle) and LOS F represents very high delay (i.e. greater than 50 seconds per vehicle for a stop sign controlled intersection and greater than 80 seconds per vehicle for a signalized intersection).

The LOS criteria for signalized and stop sign controlled intersections are shown in **Table 7**. A description of traffic performance characteristics is included for each LOS.

Table 7 – Level of Service Criteria for Intersections

LOS	LOS Description	Control Delay (seconds per vehicle)	
		Signalized Intersections	**Stop Controlled Intersections**
A	Very low delay; most vehicles do not stop (**Excellent**)	less than 10.0	less than 10.0
B	Higher delay; more vehicles stop (**Very Good**)	between 10.0 and 20.0	between 10.0 and 15.0
C	Higher level of congestion; number of vehicles stopping is significant, although many still pass through intersection without stopping **(Good**)	between 20.0 and 35.0	between 15.0 and 25.0
D	Congestion becomes noticeable; vehicles must sometimes wait through more than one red light; many vehicles stop (**Satisfactory**)	between 35.0 and 55.0	between 25.0 and 35.0
E	Vehicles must often wait through more than one red light; considered by many agencies to be the limit of **acceptable** delay	between 55.0 and 80.0	between 35.0 and 50.0
F	This level is considered to be unacceptable to most drivers; occurs when arrival flow rates exceed the capacity of the intersection (**Unacceptable**)	greater than 80.0	greater than 50.0

3.2 Existing (2019) Intersection Operation

The results of the LOS analysis under existing (2019) traffic volumes during the AM and PM peak hours can be found below in **Table 8**. The infrastructure improvements noted in Section 2.2 and existing traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in **Appendix D**.

Table 8 - Existing (2019) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95% Queue (m)		V/C	Delay (s)	LOS	95% Queue (m)	
				Model	Actual				Model	Actual
Ashford Drive & Madelaine Drive / Yonge Street (signalized)	0.28	22.3	C	-	-	0.52	26.5	C	-	-
EBL	0.09	14.6	B	10	30	0.34	17.0	B	19	30
EBTR	0.22	18.5	B	-	-	0.50	23.6	C	-	-
WBL	0.05	16.0	B	7	60	0.14	16.8	B	10	60
WBTR	0.31	20.4	C	-	-	0.65	28.2	C	-	-
NBL	0.21	23.1	C	27	30	0.27	24.8	C	34	30
NBT	0.26	30.0	C	41	-	0.40	33.2	C	63	-
NBR	0.02	27.7	C	0	30	0.02	29.3	C	0	30
SBL	0.18	25.3	C	22	78	0.15	27.5	C	18	78
SBTR	0.25	31.2	C	-	-	0.24	33.4	C	-	-

The results of the LOS analysis indicate that the Ashford Drive & Madelaine Drive / Yonge Street intersection is operating within the typical design limits noted in Section 3.1.

The anticipated queue for northbound left movements will exceed the storage length; however, vehicles will queue into the future TWLTL road improvement, consequently there are no issues with the existing northbound queue.

It is noted, during the Secondary School pick-up period there are vehicles stopped along the west side along Ashford Drive. Based on a review of on-site conditions, during the Secondary School pick-up period there are typically around eight vehicles standing along the west side of Ashford Drive. The City should consider replacing the no-parking signs on Ashford Drive with no stopping signs, in order to redirect the vehicles currently using this area to the Painswick Park parking lot.

It is noted, during the Secondary School drop-off and pick-up periods there are a significant number of pedestrian movements crossing the School South Driveway. This result in temporary queuing for vehicles entering the School South Driveway, which is larger than what is calculated in the Synchro model. It is recommended the City continue to prioritize active transportation, in order to minimize the number of private vehicle trips at the Secondary School. Furthermore, the Secondary School could redirect the student pick-up from this parking lot to the existing Painswick Park parking lot.

No infrastructure improvements are recommended within the study area.

3.3 Background (2029) Intersection Operation

The results of the LOS analysis under background (2029) traffic volumes during the AM and PM peak hours can be found below in **Table 9**. Existing intersection geometry has been utilized for this scenario. Signal timing improvements are recommended at the Ashford Drive & Madelaine Drive / Yonge Street intersection in the PM peak hour, which have been adjusted to optimize the utilization of the proposed intersection geometry. Detailed output of the Synchro analysis can be found in **Appendix E**.

Table 9 – Background (2029) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95% Queue (m)		V/C	Delay (s)	LOS	95% Queue (m)	
				Model	Actual				Model	Actual
Ashford Drive & Madelaine Drive / Yonge Street (signalized)	0.49	26.8	C	-	-	0.79	36.1	D	-	-
EBL	0.25	17.5	B	17	30	0.78	48.7	D	64	30
EBTR	0.39	24.0	C	-	-	0.71	29.1	C	-	-
WBL	0.27	15.2	B	24	60	0.51	20.2	C	25	60
WBTR	0.53	25.0	C	-	-	0.83	34.6	C	-	-
NBL	0.44	28.6	C	42	30	0.62	44.3	D	64	30
NBT	0.49	37.2	D	69	-	0.79	58.2	E	119	-
NBR	0.05	32.4	C	0	30	0.06	40.4	D	8	30
SBL	0.32	26.5	C	32	78	0.46	36.1	D	35	78
SBTR	0.48	36.5	D	65	-	0.42	42.9	D	63	-

The results of the LOS analysis indicate that the Ashford Drive & Madelaine Drive / Yonge Street intersection is operating within the typical design limits noted in Section 3.1.

The anticipated queue for northbound left and eastbound left turning movements at the Ashford Drive & Madelaine Drive / Yonge Street intersection will exceed the existing storage length; however, vehicles will queue into a TWLTL, consequently there are no issues with the existing northbound left and eastbound left queue.

The anticipated queue for the southbound through-right movement at the Ashford Drive & Madelaine Drive / Yonge Street intersection will extend past the Ashford Drive / School South Driveway intersection in both peak periods; however, since vehicles will queue past this intersection for a short period of time at the end of the southbound phase there are no issues with the anticipated southbound queue.

The anticipated queue for the northbound thru queue will extend beyond the west driveway of the existing residential development at the southeast corner of the Ashford Drive & Madelaine Drive / Yonge Street intersection [Dean & Madelaine Development] (80 metres) during the PM peak hour; however, vehicles will only queue past this intersection for a short period of time at the end of the northbound phase and the Dean & Madelaine Development has an alternative access onto Dean Avenue; consequently, there are no issues with the anticipated northbound queue.

As noted in Section 3.2, during the Secondary School drop-off and pick-up periods there are a significant number of pedestrian movements crossing the School South Driveway. This result in temporary queuing for vehicles entering the School South Driveway, which is larger than what is calculated in the Synchro model. It is recommended the City continue to prioritize active transportation, in order to minimize the number of private vehicle trips at the Secondary School. Furthermore, the Secondary School could redirect the student pick-up from this parking lot to the existing Painswick Park parking lot.

No infrastructure improvements are recommended within the study area.

4 Proposed Development Traffic Generation and Assignment

4.1 Traffic Generation

The traffic generation for the subject site has been based on the ITE *Trip Generation* data. The ITE is a well-recognized agency throughout North America and has completed numerous studies to identify trip rates associated with various types of developments including retail, residential, recreational, institutional, industrial, and office.

The following ITE land uses have been applied to estimate the traffic from the proposed:

- ITE land use #231 (Mid-Rise Residential with 1st-Floor Commercial)
  - o Dense multi-use urban setting

The average peak hour of generator was applied for the AM and PM peak hour. The peak hour of generator provides a more conservative estimation for the anticipated traffic.

It is noted that the proposed mixed-use development will be located in an urban / suburban setting; however, based on the small sample size provided for the urban / suburban setting in the ITE data the dense multi-use urban location setting has been applied, which has a more conservative traffic generation rate, in this case.

The estimated trip generation for the proposed development is illustrated below in **Table 10.**

Table 10 – Estimated Traffic Generation of Proposed Development

Land Use	Size	AM Peak Hour			PM Peak Hour		
		IN	OUT	TOTAL	IN	OUT	TOTAL
Mid-Rise Residential with 1st-Floor Commercial ITE Land Use: 231	176 units[5]	26	38	64	40	44	84

In order to be conservative, no transportation modal split reduction has been applied to the above-noted traffic generation calculation.

4.2 Traffic Assignment

For the purposes of this study, it has been assumed that all traffic generated by the proposed development will be new traffic and would not be in the study area if the development was not constructed.

The ITE data provides the anticipated percentage of new traffic entering and exiting during the peak hour. Beyond the local area the distribution of traffic from the subject site has been estimated based on the 2016 TTS data for traffic zone 8529 (excerpt attached as **Appendix G**).

[5] The traffic volumes calculated in Table 10 and applied in the traffic analysis are based on a previous version to the site plan which included 181 residential units; which would generate a marginally higher traffic volume than the proposed 176 residential units.

The above-noted methodology provides an estimate of the distribution of ingress trips. We have assumed that the distribution of egress trips will follow the inverse of the ingress traffic distribution. For each of the individual areas identified in the TTS data, we have selected the probable route of travel, assuming that people will select their route primarily based on travel time.

Table 11 summarizes the trip distribution for the proposed development.

Table 11 – Proposed Development Traffic Distribution Summary

Travel Direction (to/from)	Percent of Total Traffic Generation
East via Yonge Street	12%
West via Yonge Street	24%
North via Ashford Drive	5%
South via Madelaine Drive	59%
Total	**100%**

Figure 10 illustrates the traffic assignment for the proposed development.

4.3 Total Horizon Year Traffic Volumes with the Proposed Development

For the total (2029) horizon year traffic volumes, the proposed development traffic was added to the background (2029) traffic volumes. The resulting total (2029) horizon year traffic volumes for the AM and PM peak hour is illustrated in **Figure 11**.

Figure 10 – Traffic Assignment for Proposed Development

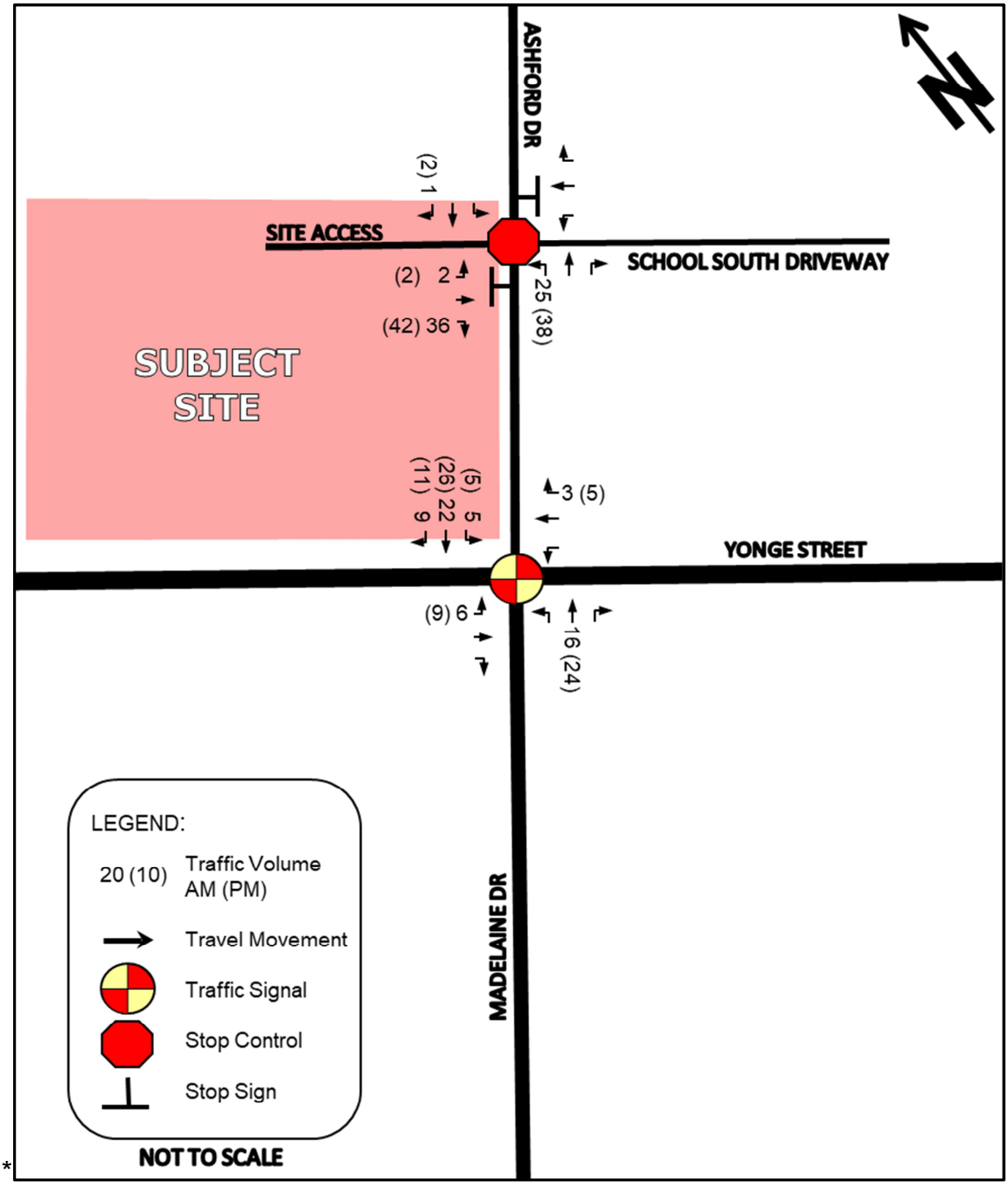
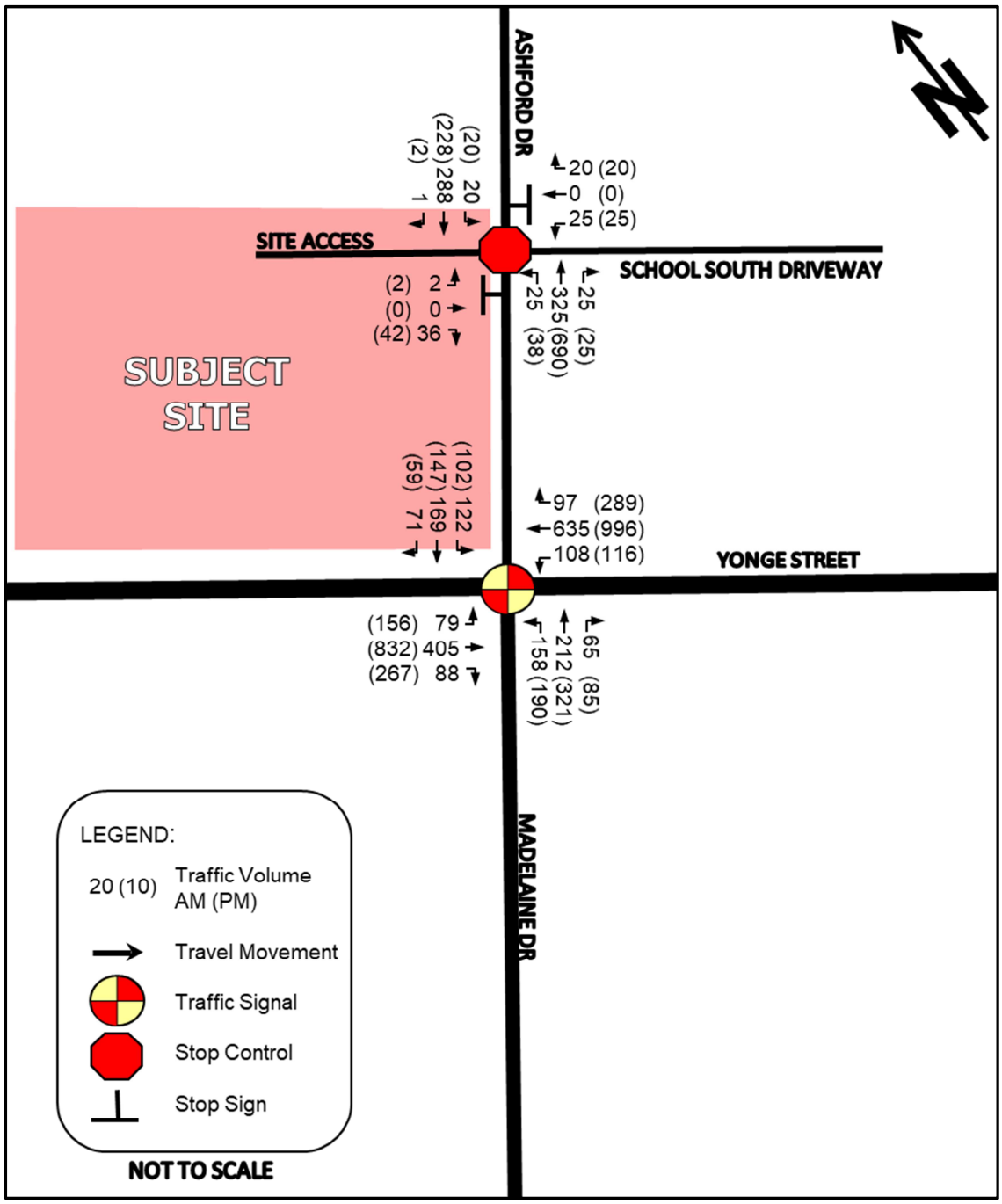


Figure 11 – Total (2029) Traffic Volumes



5 Intersection Operation with Proposed Development

5.1 Total (2029) Intersection Operation

The results of the LOS analysis under total (2029) traffic volumes during the AM and PM peak hours can be found below in **Table 12**. The signal timing improvements noted in Section 3.3 have been utilized for this scenario. It is recommended that the existing pavement marking on Ashford Drive are adjusted to provide a TWLTL between Yonge Street and the Site Access, to accommodate northbound left turning movements into the Site Access. Detailed output of the Synchro analysis can be found in **Appendix F**.

Table 12 – Total (2029) LOS

Location (N-S Street / E-W Street)	Weekday AM Peak Hour					Weekday PM Peak Hour				
	V/C	Delay (s)	LOS	95% Queue (m)		V/C	Delay (s)	LOS	95% Queue (m)	
				Model	Actual				Model	Actual
Ashford Drive & Madelaine Drive / Yonge Street (signalized)	0.52	27.4	C	-	-	0.82	38.2	D	-	-
EBL	0.26	17.7	B	18	30	0.84	60.2	E	73	30
EBTR	0.39	24.2	C	-	-	0.71	29.7	C	-	-
WBL	0.27	15.4	B	24	60	0.51	20.8	C	25	60
WBTR	0.53	25.2	C	-	-	0.84	35.6	D	-	-
NBL	0.47	29.0	C	42	30	0.68	48.0	D	64	30
NBT	0.53	38.1	D	74	-	0.84	63.2	E	138	-
NBR	0.05	32.5	C	0	30	0.06	40.3	D	8	30
SBL	0.34	26.5	C	34	36	0.52	37.3	D	37	36
SBTR	0.56	38.1	D	76	-	0.51	44.1	D	77	-
Ashford Drive / Site Access & School South Driveway (unsignalized)	-	1.7	A	-	-	-	1.6	A	-	-
EB	0.06	10.5	B	-	-	0.07	1.7	B	-	-
WB	0.09	12.5	B	-	-	0.14	4.0	C	-	-
NBL	0.02	8.0	A	1	10	0.03	0.8	A	1	10
SBL	0.02	8.3	A	1	26	0.03	9.8	A	1	26

The results of the LOS analysis indicate that all intersections in the study area is operating within the typical design limits noted in Section 3.1.

The anticipated queue for southbound left turning movements at the Ashford Drive & Madelaine Drive / Yonge Street intersection will marginally exceed the proposed storage length; however, there is sufficient space to accommodate the back-to-back left turn queues for the southbound left turn queue at the Ashford Drive & Madelaine Drive / Yonge Street intersection and northbound left turn queue at the Site Access, consequently no operational issues are anticipated.

The anticipated queue for northbound left and eastbound left turning movements at the Ashford Drive & Madelaine Drive / Yonge Street intersection will exceed the existing storage length; however, vehicles will queue into a TWLTL, consequently there are no issues with the existing northbound left and eastbound left queue.

The anticipated queue for the southbound through-right movement at the Ashford Drive & Madelaine Drive / Yonge Street intersection will temporarily extend past the Ashford Drive / Site Access & School South Driveway intersection in both peak periods; however, since vehicles will queue past this

intersection for a short period of time at the end of the southbound phase, there are no issues with the anticipated southbound queue.

The anticipated queue for the northbound through-right movement at the Ashford Drive & Madelaine Drive / Yonge Street intersection will extend beyond the west driveway of the Dean & Madelaine Development (80 metres) during the PM peak hour; however, vehicles will only queue past this intersection for a short period of time at the end of the northbound phase and the Dean & Madelaine Development has an alternative access onto Dean Avenue; consequently, there are no issues with the anticipated northbound queue.

As noted in Section 3.2, during the Secondary School drop-off and pick-up periods there are a significant number of pedestrian movements crossing the School South Driveway. This result in temporary queuing for vehicles entering the School South Driveway, which is larger than what is calculated in the Synchro model. It is recommended the City continue to prioritize active transportation, in order to minimize the number of private vehicle trips at the Secondary School. Furthermore, the Secondary School could redirect the student pick-up from this parking lot to the existing Painswick Park parking lot.

A review of the need for additional auxiliary right turn lanes at the Ashford Drive / Site Access & School South Driveway intersection was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, additional auxiliary right turn lanes are not recommended.

Based on the Ontario Traffic Manual Book 12 *Signal Justification*, traffic signals are not warranted at the Ashford Drive / Site Access & School South Driveway intersection (results are provided in **Appendix H**).

No infrastructure improvements are recommended within the study area.

5.2 Site Access

The Site Access will operate efficiently as a full-movement access, with one-way stop control for eastbound movements. A single eastbound and westbound lane for the Site Access will provide the necessary capacity to service the proposed development.

The proposed spacing between the Site Access and Yonge Street and the Site Access and Kenneth Avenue are greater than suggested minimum corner clearance requirements for a driveway as identified in the Transportation Association of Canada *Design Guide for Canadian Roads* (2017) [TAC Guidelines] Figure 8.8.2 (Suggested Minimum Corner Clearances to Accesses or Public Lanes at Major Intersections) – 15 metres for signalized and unsignalized condition.

Consequently, there no issues with the location of the proposed Site Access driveways.

5.3 Sight Distance Review

A review of the available sight distance for the proposed Site Access was completed as part of this analysis.

The sight distance north of the Site Access is greater than the minimum stopping sight distance requirements as identified in the TAC Guidelines for a design speed of 50km/h (65 metres).

The sight distance south of the Site Access ends at the Ashford Drive & Madelaine Drive / Yonge Street intersection and is less than the minimum stopping sight distance requirements as identified in

the TAC Guidelines for a design speed of 50km/h (65 metres); however there are no concerns with the sight distance as vehicles turning onto Ashford Drive will be turning at much slower speeds.

Consequently, there are no issues with the sight distance for the proposed Site Access driveway.

5.4 Active Transportation Review

There is currently no dedicated cycling infrastructure or trail network adjacent to the proposed development. Cyclists from the subject site would be required to share the existing road network with all other users.

As noted in Section 2.2, dedicated bicycle infrastructure is planned for Madelaine Drive, Yonge Street and Ashford Drive. The bicycle lane network will connect to the existing and proposed major active transportation pathways on Big Bay Point Road and on Mapleview Drive East. It is recommended that the City continue to prioritize active transportation along these corridors, in order to provide the necessary transportation network capacity to accommodate the anticipated future transportation demands in the study area.

It is recommended a sidewalk be constructed along the west side of Ashford Drive from the Site Access to the existing sidewalk at the northwest corner of the Ashford Drive & Madelaine Drive / Yonge Street intersection, to improve pedestrian connectivity. With this improvement the proposed development will connect into the sidewalk network on the adjacent streets and provide pedestrian access throughout the City.

A direct pedestrian connection to the existing sidewalk on Yonge Street is also recommended.

5.5 Parking Review

The proposed parking supply for the subject site is lower than the parking requirements specified in the City Zoning By-law Number 2009-141. The proposed parking breakdown is provided in **Table 13.**

Table 13 - Zoning By-law Parking Requirements

Category	Zoning By-Law Section	Parking Standard	Size	Parking	
				Required	Provided
Residential Parking	5.4.4.1	1.0 spaces per dwelling unit	176 units	176	141 resident (0.80/unit) 29 visitor (0.165/unit)
Commercial Parking	4.6.2.3 (b)	1 space per 24 sq.m. of gross floor area	5,480 sq.ft. (509 sq.m.)	21	22
TOTAL PARKING				**197 Spaces**	**192 Spaces**
Accessibility Parking	4.6.4	1 plus 3% of the total number of parking spaces provided in the parking area	-	7 Spaces	7 Spaces

The proposed development is seven parking spaces short of the zoning by-law requirement for resident parking and one parking space short of the zoning by-law requirement for commercial parking.

The City has plans for a high order transit route and enhanced active transportation infrastructure (buffered bike lanes) along Yonge Street, adjacent to the subject site. The site is also well position

related to local amenities (schools, daycare, commercial and parks). Consequently, the subject site provides a good opportunity for units intended to support a car-free lifestyle.

5.6 Construction Parking

Based on our correspondence with the design team for this project, the Developer is committed to the following arrangement for construction parking:

The parking of construction vehicles and vehicles owned by staff and subcontractors employed by the Developer will be formally directed (in writing where possible) to avoid parking on municipal streets surrounding the subject site and avoid parking within private parking lots surrounding the subject site, without consent from the owner of the parking lots.

6 Summary

Queensgate Homes (Barrie) Inc. retained **JD Engineering** to prepare this traffic impact study in support of the proposed mixed-use development located municipally at 681 – 685 Yonge Street in the City of Barrie [City]. The site plan provided by the Developer is included in **Appendix A.** This chapter summarizes the conclusions and recommendations from the study.

1. The proposed development is expected to generate 64 AM and 84 PM new peak hour trips in the study area.
2. Background traffic and pedestrian counts were commissioned for the existing intersection of Ashford Drive & Madelaine Drive / Yonge Street completed on Thursday, June 28th 2018.
3. An intersection operational analysis was completed at the study area intersections, using the existing (2019) and background (2029) traffic volumes, without the proposed development traffic. This enabled a review of existing and future traffic deficiencies that would be present without the influence of the proposed development.
4. The following improvement is recommended for the 2029 horizon year:

   Ashford Drive & Madelaine Drive / Yonge Street

   - Signal Timing Plan optimization.
5. An estimate of the amount of traffic that would be generated by the Subject Site was prepared and assigned to the study area streets and intersection.
6. An intersection operation analysis was completed under total (2029) traffic volumes with the proposed development operational at the study area intersections.
7. The following infrastructure improvement is recommended prior to occupancy of the proposed development:

Ashford Drive

- Adjust the existing pavement markings on Ashford Drive between Yonge Street and the Site Access to provide a TWLTL.
- Construct a sidewalk along the west side of the road between the Site Access and Yonge Street.

8. Provide a pedestrian connection linking the proposed development to the sidewalk network on Yonge Street and the proposed sidewalk on Ashford Drive.
9. The proposed Site Access onto Ashford Drive will operate efficiently with stop control for eastbound movements. A single lane for ingress and egress movements will provide the necessary capacity to convey the traffic volume generated by the proposed development.
10. The sight distance available for the Site Access meets the minimum stopping sight distance requirements.
11. The proposed parking supply does not meet the City's Zoning By-law requirement; however, it is appropriate for the intended use.
12. In summary the proposed development will not cause any operational issues and will not add significant delay or congestion to the local roadway network.

Appendix A – Site Plan

Appendix C –
Traffic Count Data

TRANS-PLAN
transportation engineering

Turning Movement Count Diagram

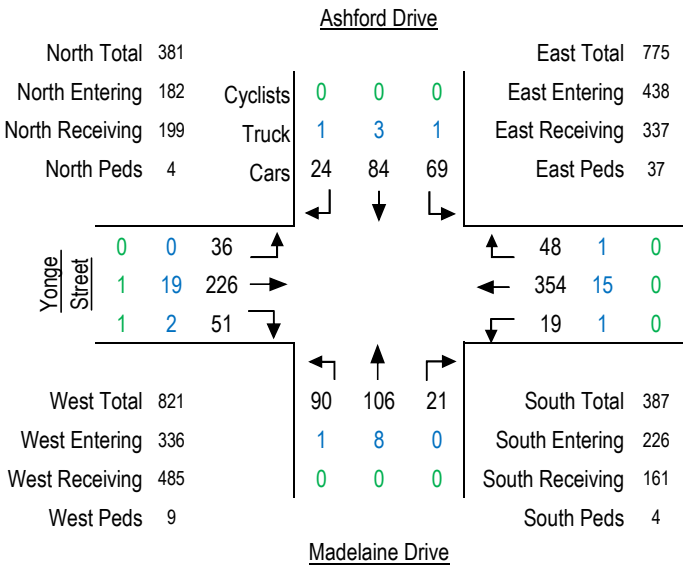
Intersection: Yonge Street & Ashford Drive / Madeleine Drive

Intersection ID:

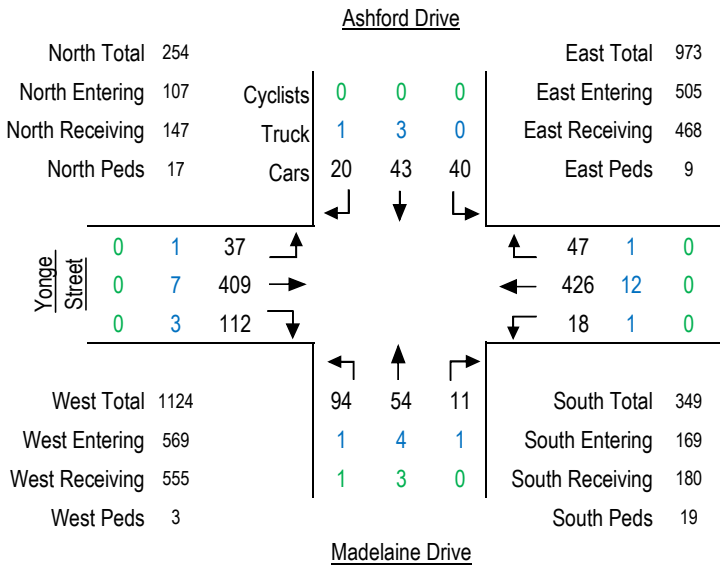
Municipality: Barrie, Ontario

Date: Thursday June 28, 2018

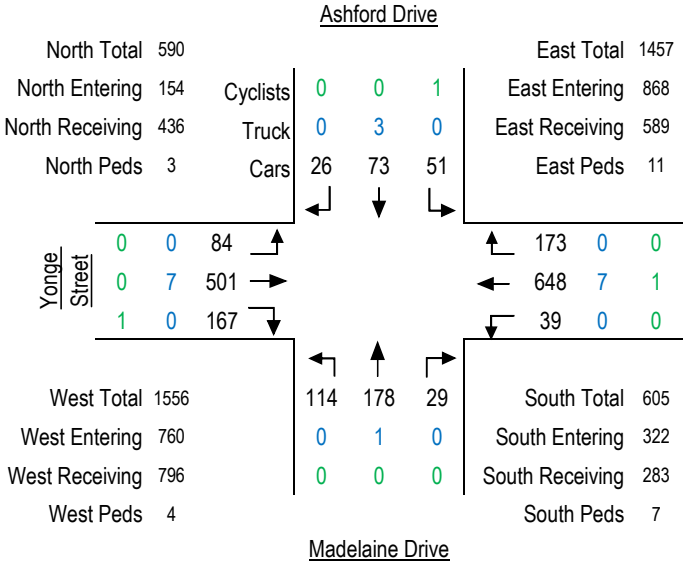
AM Peak Hour: 8:00 to 9:00



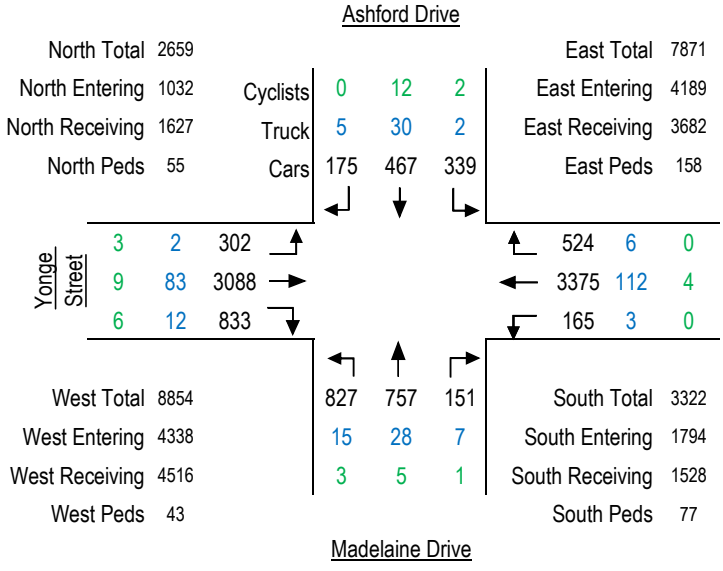
MD Peak Hour: 12:45 to 13:45



PM Peak Hour: 17:00 to 18:00



Total 8-Hour Count



Trans-Plan Transportation Inc.

Site ID Code:
Intersection Location: Yonge Street & Ashford Drive / Madeleine Drive
Municipality: Barrie, Ontario
Count Date: Thursday June 28, 2018
Weather and Temperature: Sunny, 20C
Surveyor: TP

AM	NORTH APPROACH											EAST APPROACH											SOUTH APPROACH											WEST APPROACH											Grand Total
	CAR			TRUCKS			CYCLISTS			Peds	Total	CAR			TRUCKS			CYCLISTS			Peds	Total	CAR			TRUCKS			CYCLISTS			Peds	Total	CAR			TRUCKS			CYCLISTS			Peds	Total	
	L	T	R	L	T	R	L	T	R			L	T	R	L	T	R	L	T	R			L	T	R	L	T	R	L	T	R			L	T	R	L	T	R	L	T	R			
7:00	14	8	0	0	0	0	0	0	0	0	22	0	49	5	0	3	0	0	1	0	1	59	17	7	3	0	0	0	0	0	0	2	29	4	56	9	1	1	0	0	0	0	0	71	181
7:15	13	16	6	0	0	0	0	0	0	1	36	2	48	4	0	3	0	0	0	0	0	57	17	13	3	1	1	0	0	0	0	1	36	10	71	14	0	3	0	0	0	0	0	98	227
7:30	14	12	2	0	1	2	0	2	0	0	33	1	80	10	0	6	0	0	0	0	0	97	21	6	2	0	1	0	0	0	0	0	30	7	59	9	0	5	0	0	0	0	0	80	240
7:45	15	9	3	0	0	0	0	0	0	0	27	3	74	6	0	4	0	0	0	0	0	87	13	14	4	0	0	0	0	0	0	0	31	10	48	10	0	2	0	0	1	0	0	71	216
8:00	19	12	3	0	1	0	0	0	0	1	36	3	98	6	0	6	0	0	0	0	0	113	22	16	5	0	3	0	0	0	0	0	46	7	66	10	0	4	1	0	1	0	1	90	285
8:15	15	15	3	0	0	1	0	0	0	0	34	4	91	11	0	3	0	0	0	0	2	111	25	15	6	1	2	0	0	0	0	1	50	12	55	11	0	8	0	0	0	1	0	87	282
8:30	14	24	8	1	1	0	0	0	0	2	50	7	86	21	0	2	0	0	0	0	30	146	24	43	6	0	1	0	0	0	0	0	74	13	50	12	0	3	0	0	0	0	3	81	351
8:45	21	33	10	0	1	0	0	0	0	1	66	5	79	10	1	4	1	0	0	0	5	105	19	32	4	0	2	0	0	0	0	3	60	4	55	18	0	4	1	0	0	0	5	87	318
MD																																													
11:00	9	15	3	0	1	0	0	0	0	1	29	6	96	10	0	3	0	0	0	0	0	115	28	14	8	0	2	0	0	0	0	1	53	1	88	17	0	2	0	0	0	0	1	109	306
11:15	3	9	6	0	1	0	0	0	0	1	20	1	95	6	0	6	2	0	0	0	0	110	19	15	3	0	1	0	1	0	0	5	44	4	95	34	0	4	0	0	0	0	3	140	314
11:30	7	16	5	0	1	0	0	0	0	1	30	6	73	10	0	6	1	0	0	0	1	97	26	18	3	0	1	2	0	0	0	1	51	4	83	13	0	0	1	0	0	0	1	102	280
11:45	5	11	9	0	0	0	0	0	0	1	26	6	101	4	0	5	0	0	1	0	2	119	25	21	7	1	1	0	0	0	0	4	59	8	90	18	0	2	0	0	0	0	2	120	324
12:00	3	14	9	0	1	0	0	0	0	3	30	3	98	5	0	6	0	0	0	0	1	113	33	18	6	0	0	0	0	0	0	1	58	12	85	24	0	2	0	0	1	1	1	126	327
12:15	10	5	8	0	0	0	0	0	0	2	25	2	88	11	0	3	0	0	0	0	0	104	26	21	6	1	1	1	0	0	0	1	57	12	101	24	0	2	1	0	1	0	2	143	329
12:30	6	16	3	0	0	0	0	0	0	2	27	2	114	5	0	2	0	0	0	0	2	125	28	16	3	1	0	0	0	0	0	2	50	6	111	38	0	1	2	0	0	0	1	159	361
12:45	8	13	3	0	1	0	0	0	0	0	25	5	95	13	0	4	0	0	0	0	0	117	20	10	5	0	1	0	0	1	0	5	42	6	119	22	0	4	1	0	0	0	0	152	336
13:00	13	7	7	0	1	1	0	0	0	1	30	4	119	8	1	5	1	0	0	0	1	139	29	14	2	1	1	0	0	2	0	3	52	9	94	36	1	1	1	0	0	0	1	143	364
13:15	12	11	3	0	1	0	0	0	0	14	41	4	99	9	0	3	0	0	0	0	1	116	24	11	2	0	1	1	0	0	0	4	43	6	91	28	0	2	0	0	0	0	0	127	327
13:30	7	12	7	0	0	0	0	0	0	2	28	5	113	17	0	0	0	0	0	0	7	142	21	19	2	0	1	0	1	0	0	7	51	16	105	26	0	0	1	0	0	0	2	150	371
13:45	10	13	4	0	0	0	0	0	0	0	27	5	70	15	0	3	0	0	0	0	1	94	26	14	4	0	0	0	0	0	0	5	49	4	120	20	0	7	0	0	0	0	5	156	326
PM																																													
15:00	7	21	5	0	2	0	0	0	0	1	36	10	114	23	0	5	0	0	0	0	21	173	24	34	4	2	2	0	1	0	1	1	69	13	117	26	0	3	0	0	4	0	4	167	445
15:15	6	23	3	0	0	1	0	2	0	9	44	4	124	10	0	3	0	0	0	0	28	169	24	27	8	0	1	0	0	0	0	4	64	3	122	39	0	3	2	0	0	2	1	172	449
15:30	15	7	5	1	3	0	1	5	0	3	40	7	118	17	1	3	0	0	1	0	13	160	23	24	4	0	0	0	0	2	0	3	56	4	111	31	0	3	0	0	0	1	1	151	407
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16:00	10	13	7	0	2	0	0	3	0	5	40	4	124	23	0	4	0	0	0	0	2	157	29	21	5	0	0	0	0	0	0	3	58	4	129	29	0	1	0	0	0	0	0	163	418
16:15	8	14	8	0	2	0	0	0	0	0	32	3	114	18	0	3	0	0	0	0	6	144	38	26	7	1	1	0	0	0	0	2	75	8	119	31	0	1	0	0	0	0	4	163	414
16:30	10	17	6	0	1	0	0	0	0	0	34	6	115	16	0	1	0	0	0	0	1	139	38	37	5	0	0	0	0	0	0	2	82	9	120	47	0	0	0	3	1	0	0	180	435
16:45	8	16	7	0	1	0	0	0	0	1	33	12	136	34	0	4	1	0	0	0	2	189	35	39	3	0	2	1	0	0	0	2	82	16	113	33	0	4	0	0	0	0	1	167	471
17:00	12	24	4	0	0	0	0	0	0	1	41	8	162	54	0	0	0	0	0	0	6	230	28	48	8	0	0	0	0	0	0	2	86	21	135	54	0	3	0	0	0	1	0	214	571
17:15	17	15	8	0	1	0	0	0	0	0	41	11	194	50	0	0	0	0	0	0	3	258	32	56	5	0	0	0	0	0	0	1	94	19	123	42	0	1	0	0	0	0	0	185	578
17:30	10	17	8	0	1	0	1	0	0	0	37	12	145	31	0	5	0	0	0	0	0	193	24	38	7	0	1	0	0	0	0	3	73	25	118	40	0	2	0	0	0	0	2	187	490
17:45	12	17	6	0	1	0	0	0	0	2	38	8	147	38	0	2	0	0	1	0	2	198	30	36	9	0	0	0	0	0	0	1	76	19	125	31	0	1	0	0	0	0	2	178	490

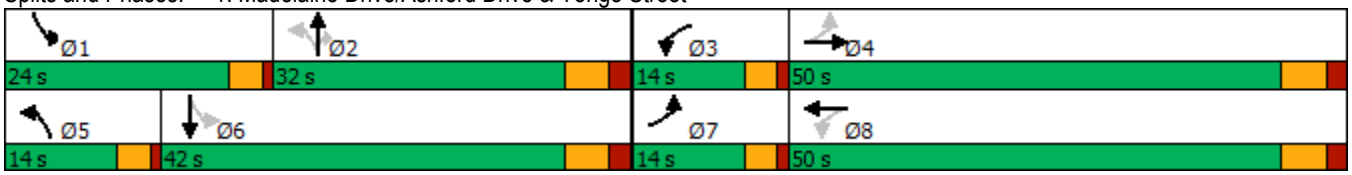
Appendix D –
Synchro Analysis Output –
Existing Traffic Volumes

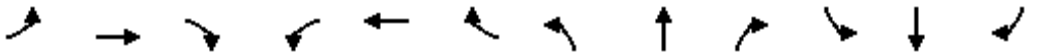
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	38	253	21	381	95	119	22	73	91
Future Volume (vph)	38	253	21	381	95	119	22	73	91
Lane Group Flow (vph)	40	328	22	459	101	127	23	78	125
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	7	4	3	8	5	2		1	6
Permitted Phases	4		8		2		2	6	
Detector Phase	7	4	3	8	5	2	2	1	6
Switch Phase									
Minimum Initial (s)	7.0	44.0	7.0	44.0	7.0	26.0	26.0	7.0	26.0
Minimum Split (s)	11.0	50.0	11.0	50.0	11.0	35.0	35.0	11.0	35.0
Total Split (s)	14.0	50.0	14.0	50.0	14.0	32.0	32.0	24.0	42.0
Total Split (%)	11.7%	41.7%	11.7%	41.7%	11.7%	26.7%	26.7%	20.0%	35.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max	None	Max	None	None	None	None	None
v/c Ratio	0.08	0.22	0.04	0.31	0.20	0.25	0.04	0.16	0.27
Control Delay	12.6	16.8	12.3	19.9	21.6	32.9	0.1	21.2	30.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.6	16.8	12.3	19.9	21.6	32.9	0.1	21.2	30.5
Queue Length 50th (m)	4.0	17.7	2.2	33.8	14.0	22.3	0.0	10.7	20.0
Queue Length 95th (m)	9.5	33.2	6.1	48.5	26.1	40.8	0.0	21.1	37.3
Internal Link Dist (m)		304.2		229.3		244.5			45.0
Turn Bay Length (m)	30.0		60.0		30.0		30.0	36.0	
Base Capacity (vph)	521	1501	579	1485	510	505	530	606	635
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.08	0.22	0.04	0.31	0.20	0.25	0.04	0.13	0.20

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 101.9
Natural Cycle: 110
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Madelaine Drive/Ashford Drive & Yonge Street





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	38	253	55	21	381	51	95	119	22	73	91	26
Future Volume (vph)	38	253	55	21	381	51	95	119	22	73	91	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.95	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.98	1.00	
Frt	1.00	0.97		1.00	0.98		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1803	3260		1716	3408		1778	1776	1532	1747	1770	
Flt Permitted	0.44	1.00		0.55	1.00		0.63	1.00	1.00	0.68	1.00	
Satd. Flow (perm)	830	3260		1000	3408		1188	1776	1532	1243	1770	
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)	40	269	59	22	405	54	101	127	23	78	97	28
RTOR Reduction (vph)	0	14	0	0	8	0	0	0	17	0	9	0
Lane Group Flow (vph)	40	314	0	22	451	0	101	127	6	78	116	0
Confl. Peds. (#/hr)	4		4	4		4	9		37	37		9
Heavy Vehicles (%)	0%	8%	4%	5%	4%	2%	1%	7%	0%	1%	3%	4%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	50.7	46.5		47.7	45.0		37.8	29.0	29.0	34.2	27.2	
Effective Green, g (s)	50.7	46.5		47.7	45.0		37.8	29.0	29.0	34.2	27.2	
Actuated g/C Ratio	0.48	0.44		0.45	0.43		0.36	0.28	0.28	0.33	0.26	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	438	1440		471	1457		476	489	422	437	457	
v/s Ratio Prot	c0.00	0.10		0.00	c0.13		c0.02	c0.07		0.01	0.07	
v/s Ratio Perm	0.04			0.02			0.06		0.00	0.05		
v/c Ratio	0.09	0.22		0.05	0.31		0.21	0.26	0.02	0.18	0.25	
Uniform Delay, d1	14.6	18.1		15.9	19.9		22.9	29.7	27.7	25.1	30.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.3		0.0	0.6		0.2	0.3	0.0	0.2	0.3	
Delay (s)	14.6	18.5		16.0	20.4		23.1	30.0	27.7	25.3	31.2	
Level of Service	B	B		B	C		C	C	C	C	C	
Approach Delay (s)		18.1			20.2			27.0			29.0	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	22.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.28		
Actuated Cycle Length (s)	105.2	Sum of lost time (s)	20.0
Intersection Capacity Utilization	79.3%	ICU Level of Service	D
Analysis Period (min)	15		

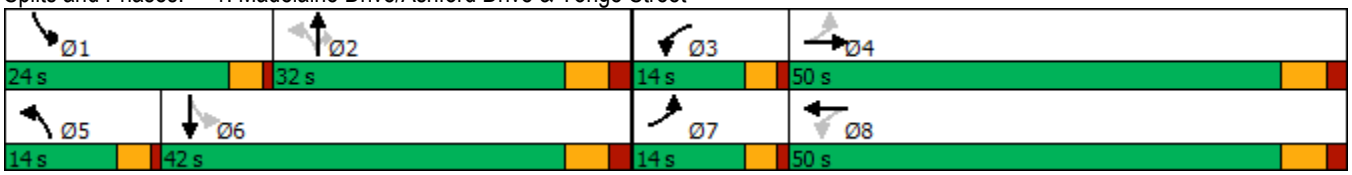
c Critical Lane Group

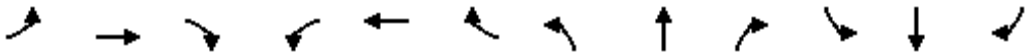
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	88	525	41	676	119	187	30	53	79
Future Volume (vph)	88	525	41	676	119	187	30	53	79
Lane Group Flow (vph)	96	760	45	931	129	203	33	58	115
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	7	4	3	8	5	2		1	6
Permitted Phases	4		8		2		2	6	
Detector Phase	7	4	3	8	5	2	2	1	6
Switch Phase									
Minimum Initial (s)	7.0	44.0	7.0	44.0	7.0	26.0	26.0	7.0	26.0
Minimum Split (s)	11.0	50.0	11.0	50.0	11.0	35.0	35.0	11.0	35.0
Total Split (s)	14.0	50.0	14.0	50.0	14.0	32.0	32.0	24.0	42.0
Total Split (%)	11.7%	41.7%	11.7%	41.7%	11.7%	26.7%	26.7%	20.0%	35.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max	None	Max	None	None	None	None	None
v/c Ratio	0.34	0.50	0.13	0.65	0.27	0.39	0.06	0.14	0.26
Control Delay	15.4	22.4	12.8	27.6	23.9	36.2	0.2	22.5	31.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.4	22.4	12.8	27.6	23.9	36.2	0.2	22.5	31.4
Queue Length 50th (m)	10.0	61.1	4.5	83.6	18.6	37.4	0.0	8.0	18.2
Queue Length 95th (m)	18.2	80.7	10.0	109.1	33.1	62.6	0.0	17.3	34.9
Internal Link Dist (m)		304.2		229.3		244.5			45.0
Turn Bay Length (m)	30.0		60.0		30.0		30.0	36.0	
Base Capacity (vph)	311	1529	401	1427	488	516	531	558	599
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.50	0.11	0.65	0.26	0.39	0.06	0.10	0.19

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 107.8
Natural Cycle: 110
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Madelaine Drive/Ashford Drive & Yonge Street





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	88	525	174	41	676	180	119	187	30	53	79	27
Future Volume (vph)	88	525	174	41	676	180	119	187	30	53	79	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	1.00		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.99	1.00	
Frt	1.00	0.96		1.00	0.97		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	3425		1804	3451		1801	1881	1576	1795	1768	
Flt Permitted	0.17	1.00		0.29	1.00		0.62	1.00	1.00	0.60	1.00	
Satd. Flow (perm)	328	3425		550	3451		1172	1881	1576	1132	1768	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	96	571	189	45	735	196	129	203	33	58	86	29
RTOR Reduction (vph)	0	24	0	0	19	0	0	0	24	0	11	0
Lane Group Flow (vph)	96	736	0	45	912	0	129	203	9	58	104	0
Confl. Peds. (#/hr)	3		7	7		3	4		11	11		4
Heavy Vehicles (%)	0%	1%	0%	0%	1%	0%	0%	1%	0%	0%	4%	0%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	55.8	47.4		50.6	44.8		39.0	29.6	29.6	33.4	26.8	
Effective Green, g (s)	55.8	47.4		50.6	44.8		39.0	29.6	29.6	33.4	26.8	
Actuated g/C Ratio	0.51	0.43		0.46	0.41		0.36	0.27	0.27	0.31	0.24	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	280	1483		320	1413		471	508	426	385	433	
v/s Ratio Prot	c0.03	0.21		0.01	c0.26		c0.02	c0.11		0.01	0.06	
v/s Ratio Perm	0.15			0.06			0.07		0.01	0.04		
v/c Ratio	0.34	0.50		0.14	0.65		0.27	0.40	0.02	0.15	0.24	
Uniform Delay, d1	16.2	22.4		16.6	25.9		24.4	32.6	29.3	27.3	33.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.7	1.2		0.2	2.3		0.3	0.5	0.0	0.2	0.3	
Delay (s)	17.0	23.6		16.8	28.2		24.8	33.2	29.3	27.5	33.4	
Level of Service	B	C		B	C		C	C	C	C	C	
Approach Delay (s)		22.8			27.7			29.8			31.4	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	109.4	Sum of lost time (s)	20.0
Intersection Capacity Utilization	87.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

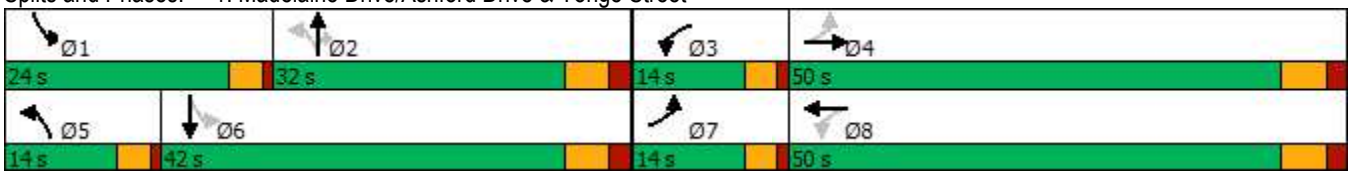
Appendix E –
Synchro Analysis Output –
Background Traffic Volumes

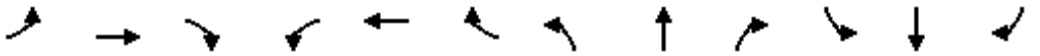
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	73	405	108	635	158	196	65	117	147
Future Volume (vph)	73	405	108	635	158	196	65	117	147
Lane Group Flow (vph)	78	525	115	776	168	209	69	124	222
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	7	4	3	8	5	2		1	6
Permitted Phases	4		8		2		2	6	
Detector Phase	7	4	3	8	5	2	2	1	6
Switch Phase									
Minimum Initial (s)	7.0	44.0	7.0	44.0	7.0	26.0	26.0	7.0	26.0
Minimum Split (s)	11.0	50.0	11.0	50.0	11.0	35.0	35.0	11.0	35.0
Total Split (s)	14.0	50.0	14.0	50.0	14.0	32.0	32.0	24.0	42.0
Total Split (%)	11.7%	41.7%	11.7%	41.7%	11.7%	26.7%	26.7%	20.0%	35.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max	None	Max	None	None	None	None	None
v/c Ratio	0.22	0.40	0.27	0.53	0.42	0.49	0.15	0.30	0.50
Control Delay	14.5	23.8	14.8	25.4	26.6	41.2	0.7	24.2	37.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.5	23.8	14.8	25.4	26.6	41.2	0.7	24.2	37.0
Queue Length 50th (m)	8.1	41.4	12.2	66.8	25.2	40.8	0.0	18.1	39.8
Queue Length 95th (m)	16.7	59.9	23.2	94.3	41.8	68.3	0.0	31.7	64.9
Internal Link Dist (m)		304.2		229.3		244.5			45.0
Turn Bay Length (m)	30.0		60.0		30.0		30.0	36.0	
Base Capacity (vph)	382	1320	448	1467	406	428	470	513	584
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.20	0.40	0.26	0.53	0.41	0.49	0.15	0.24	0.38

Intersection Summary

Cycle Length: 120
Actuated Cycle Length: 109.8
Natural Cycle: 110
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Madelaine Drive/Ashford Drive & Yonge Street





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	73	405	88	108	635	94	158	196	65	117	147	62
Future Volume (vph)	73	405	88	108	635	94	158	196	65	117	147	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.95	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.99	1.00	
Frt	1.00	0.97		1.00	0.98		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1804	3260		1718	3402		1781	1776	1529	1763	1746	
Flt Permitted	0.27	1.00		0.38	1.00		0.50	1.00	1.00	0.49	1.00	
Satd. Flow (perm)	521	3260		684	3402		946	1776	1529	914	1746	
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)	78	431	94	115	676	100	168	209	69	124	156	66
RTOR Reduction (vph)	0	14	0	0	9	0	0	0	52	0	14	0
Lane Group Flow (vph)	78	511	0	115	767	0	168	209	17	124	208	0
Confl. Peds. (#/hr)	4		4	4		4	9		37	37		9
Heavy Vehicles (%)	0%	8%	4%	5%	4%	2%	1%	7%	0%	1%	3%	4%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	51.5	44.9		55.9	47.1		36.2	26.5	26.5	37.8	27.3	
Effective Green, g (s)	51.5	44.9		55.9	47.1		36.2	26.5	26.5	37.8	27.3	
Actuated g/C Ratio	0.47	0.41		0.50	0.43		0.33	0.24	0.24	0.34	0.25	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	318	1322		427	1447		382	425	366	392	430	
v/s Ratio Prot	0.01	0.16		c0.02	c0.23		c0.04	0.12		0.03	c0.12	
v/s Ratio Perm	0.10			0.11			0.11		0.01	0.08		
v/c Ratio	0.25	0.39		0.27	0.53		0.44	0.49	0.05	0.32	0.48	
Uniform Delay, d1	17.1	23.2		14.9	23.6		27.8	36.3	32.4	26.0	35.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.9		0.3	1.4		0.8	0.9	0.1	0.5	0.9	
Delay (s)	17.5	24.0		15.2	25.0		28.6	37.2	32.4	26.5	36.5	
Level of Service	B	C		B	C		C	D	C	C	D	
Approach Delay (s)		23.2			23.7			33.2			32.9	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	26.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	110.7	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

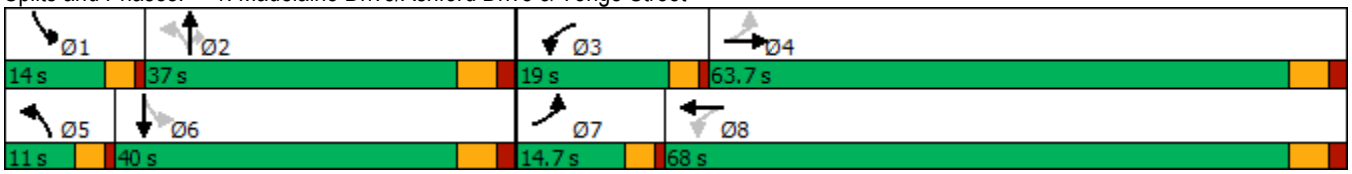
c Critical Lane Group

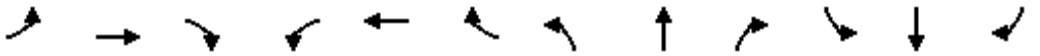
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	147	832	116	996	190	297	85	97	121
Future Volume (vph)	147	832	116	996	190	297	85	97	121
Lane Group Flow (vph)	160	1194	126	1392	207	323	92	105	184
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	7	4	3	8	5	2		1	6
Permitted Phases	4		8		2		2	6	
Detector Phase	7	4	3	8	5	2	2	1	6
Switch Phase									
Minimum Initial (s)	7.0	44.0	7.0	44.0	7.0	26.0	26.0	7.0	26.0
Minimum Split (s)	11.0	50.0	11.0	50.0	11.0	35.0	35.0	11.0	35.0
Total Split (s)	14.7	63.7	19.0	68.0	11.0	37.0	37.0	14.0	40.0
Total Split (%)	11.0%	47.6%	14.2%	50.9%	8.2%	27.7%	27.7%	10.5%	29.9%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max	None	Max	None	None	None	None	None
v/c Ratio	0.78	0.71	0.50	0.84	0.59	0.79	0.21	0.45	0.43
Control Delay	51.8	29.5	18.6	34.7	43.4	63.1	4.1	36.8	42.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.8	29.5	18.6	34.7	43.4	63.1	4.1	36.8	42.4
Queue Length 50th (m)	24.0	125.2	13.7	164.8	41.9	83.8	0.0	20.0	39.3
Queue Length 95th (m)	#64.0	172.0	24.5	208.3	63.8	119.0	7.7	34.3	62.8
Internal Link Dist (m)		304.2		229.3		244.5			45.0
Turn Bay Length (m)	30.0		60.0		30.0		30.0	36.0	
Base Capacity (vph)	212	1670	323	1665	349	449	468	244	471
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.75	0.71	0.39	0.84	0.59	0.72	0.20	0.43	0.39

Intersection Summary

Cycle Length: 133.7
Actuated Cycle Length: 129.9
Natural Cycle: 110
Control Type: Semi Act-Uncoord
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Madelaine Drive/Ashford Drive & Yonge Street





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	147	832	267	116	996	284	190	297	85	97	121	48
Future Volume (vph)	147	832	267	116	996	284	190	297	85	97	121	48
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.96		1.00	0.97		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	3427		1805	3444		1801	1881	1572	1803	1760	
Flt Permitted	0.07	1.00		0.12	1.00		0.57	1.00	1.00	0.22	1.00	
Satd. Flow (perm)	127	3427		235	3444		1086	1881	1572	420	1760	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	160	904	290	126	1083	309	207	323	92	105	132	52
RTOR Reduction (vph)	0	21	0	0	19	0	0	0	72	0	11	0
Lane Group Flow (vph)	160	1173	0	126	1373	0	207	323	20	105	173	0
Confl. Peds. (#/hr)	3		7	7		3	4		11	11		4
Heavy Vehicles (%)	0%	1%	0%	0%	1%	0%	0%	1%	0%	0%	4%	0%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	72.9	62.6		71.9	62.1		35.2	28.2	28.2	39.8	30.5	
Effective Green, g (s)	72.9	62.6		71.9	62.1		35.2	28.2	28.2	39.8	30.5	
Actuated g/C Ratio	0.56	0.48		0.55	0.48		0.27	0.22	0.22	0.31	0.23	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	204	1651		248	1646		332	408	341	227	413	
v/s Ratio Prot	c0.06	0.34		0.04	c0.40		c0.03	c0.17		c0.03	0.10	
v/s Ratio Perm	0.38			0.24			0.14		0.01	0.11		
v/c Ratio	0.78	0.71		0.51	0.83		0.62	0.79	0.06	0.46	0.42	
Uniform Delay, d1	31.1	26.5		18.6	29.4		40.7	48.1	40.3	34.6	42.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	17.7	2.6		1.6	5.1		3.6	10.1	0.1	1.5	0.7	
Delay (s)	48.7	29.1		20.2	34.6		44.3	58.2	40.4	36.1	42.9	
Level of Service	D	C		C	C		D	E	D	D	D	
Approach Delay (s)		31.4			33.4			50.9			40.4	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	36.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	129.9	Sum of lost time (s)	20.0
Intersection Capacity Utilization	94.0%	ICU Level of Service	F
Analysis Period (min)	15		

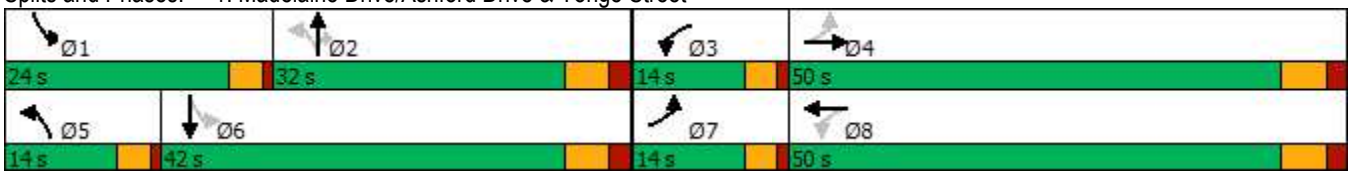
c Critical Lane Group

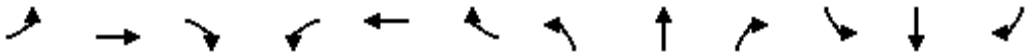
Appendix F –
Synchro Analysis Output –
Total Traffic Volumes

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	79	405	108	635	158	212	65	122	169
Future Volume (vph)	79	405	108	635	158	212	65	122	169
Lane Group Flow (vph)	84	525	115	779	168	226	69	130	256
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	7	4	3	8	5	2		1	6
Permitted Phases	4		8		2		2	6	
Detector Phase	7	4	3	8	5	2	2	1	6
Switch Phase									
Minimum Initial (s)	7.0	44.0	7.0	44.0	7.0	26.0	26.0	7.0	26.0
Minimum Split (s)	11.0	50.0	11.0	50.0	11.0	35.0	35.0	11.0	35.0
Total Split (s)	14.0	50.0	14.0	50.0	14.0	32.0	32.0	24.0	42.0
Total Split (%)	11.7%	41.7%	11.7%	41.7%	11.7%	26.7%	26.7%	20.0%	35.0%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max	None	Max	None	None	None	None	None
v/c Ratio	0.24	0.40	0.27	0.53	0.45	0.53	0.15	0.33	0.57
Control Delay	14.8	23.9	14.9	25.6	27.3	42.5	0.7	24.5	39.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	14.8	23.9	14.9	25.6	27.3	42.5	0.7	24.5	39.3
Queue Length 50th (m)	8.8	41.5	12.3	67.7	25.2	44.8	0.0	19.0	47.5
Queue Length 95th (m)	17.9	60.2	23.4	95.1	41.8	74.0	0.0	33.1	75.5
Internal Link Dist (m)		304.2		229.3		244.5			45.0
Turn Bay Length (m)	30.0		60.0		30.0		30.0	36.0	
Base Capacity (vph)	379	1319	448	1461	377	426	469	501	583
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.22	0.40	0.26	0.53	0.45	0.53	0.15	0.26	0.44

Intersection Summary
Cycle Length: 120
Actuated Cycle Length: 110
Natural Cycle: 110
Control Type: Semi Act-Uncoord

Splits and Phases: 1: Madelaine Drive/Ashford Drive & Yonge Street

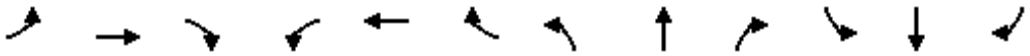




Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	79	405	88	108	635	97	158	212	65	122	169	71
Future Volume (vph)	79	405	88	108	635	97	158	212	65	122	169	71
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	0.95	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	0.99	1.00	
Frt	1.00	0.97		1.00	0.98		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1804	3260		1718	3400		1782	1776	1528	1766	1746	
Flt Permitted	0.27	1.00		0.38	1.00		0.45	1.00	1.00	0.46	1.00	
Satd. Flow (perm)	515	3260		685	3400		837	1776	1528	851	1746	
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)	84	431	94	115	676	103	168	226	69	130	180	76
RTOR Reduction (vph)	0	14	0	0	9	0	0	0	53	0	14	0
Lane Group Flow (vph)	84	511	0	115	770	0	168	226	16	130	242	0
Confl. Peds. (#/hr)	4		4	4		4	9		37	37		9
Heavy Vehicles (%)	0%	8%	4%	5%	4%	2%	1%	7%	0%	1%	3%	4%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	51.6	44.9		55.8	47.0		36.2	26.5	26.5	38.2	27.5	
Effective Green, g (s)	51.6	44.9		55.8	47.0		36.2	26.5	26.5	38.2	27.5	
Actuated g/C Ratio	0.47	0.40		0.50	0.42		0.33	0.24	0.24	0.34	0.25	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	317	1319		426	1440		355	424	365	381	432	
v/s Ratio Prot	0.02	0.16		c0.02	c0.23		c0.04	0.13		0.03	c0.14	
v/s Ratio Perm	0.11			0.11			0.11		0.01	0.08		
v/c Ratio	0.26	0.39		0.27	0.53		0.47	0.53	0.05	0.34	0.56	
Uniform Delay, d1	17.2	23.3		15.0	23.8		28.0	36.8	32.5	26.0	36.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	0.9		0.3	1.4		1.0	1.3	0.1	0.5	1.7	
Delay (s)	17.7	24.2		15.4	25.2		29.0	38.1	32.5	26.5	38.1	
Level of Service	B	C		B	C		C	D	C	C	D	
Approach Delay (s)		23.3			24.0			34.0			34.2	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	110.9	Sum of lost time (s)	20.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	0	36	25	0	20	25	325	25	20	288	1
Future Volume (Veh/h)	2	0	36	25	0	20	25	325	25	20	288	1
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	39	27	0	22	27	353	27	22	313	1
Pedestrians		9			37							
Lane Width (m)		3.6			3.6							
Walking Speed (m/s)		1.2			1.2							
Percent Blockage		1			3							
Right turn flare (veh)												
Median type								TWLTL			TWLTL	
Median storage veh)								2			2	
Upstream signal (m)								69				
pX, platoon unblocked	0.88	0.88		0.88	0.88	0.88				0.88		
vC, conflicting volume	796	838	322	854	824	404	323			417		
vC1, stage 1 conf vol	366	366		458	458							
vC2, stage 2 conf vol	429	471		396	367							
vCu, unblocked vol	700	748	322	766	733	255	323			270		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)	6.1	5.5		6.1	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	100	100	95	94	100	97	98			98		
cM capacity (veh/h)	485	452	713	451	460	673	1228			1114		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	41	49	27	380	22	314
Volume Left	2	27	27	0	22	0
Volume Right	39	22	0	27	0	1
cSH	697	530	1228	1700	1114	1700
Volume to Capacity	0.06	0.09	0.02	0.22	0.02	0.18
Queue Length 95th (m)	1.5	2.4	0.5	0.0	0.5	0.0
Control Delay (s)	10.5	12.5	8.0	0.0	8.3	0.0
Lane LOS	B	B	A		A	
Approach Delay (s)	10.5	12.5	0.5		0.5	
Approach LOS	B	B				

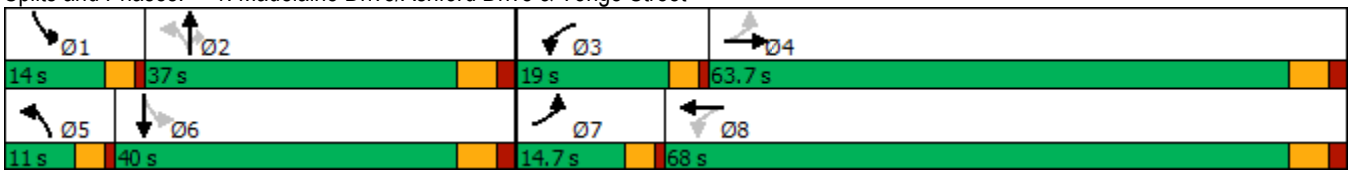
Intersection Summary				
Average Delay	1.7			
Intersection Capacity Utilization	36.7%	ICU Level of Service		A
Analysis Period (min)	15			

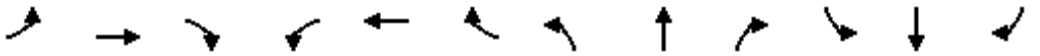
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Configurations									
Traffic Volume (vph)	156	832	116	996	190	321	85	102	147
Future Volume (vph)	156	832	116	996	190	321	85	102	147
Lane Group Flow (vph)	170	1194	126	1397	207	349	92	111	224
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA
Protected Phases	7	4	3	8	5	2		1	6
Permitted Phases	4		8		2		2	6	
Detector Phase	7	4	3	8	5	2	2	1	6
Switch Phase									
Minimum Initial (s)	7.0	44.0	7.0	44.0	7.0	26.0	26.0	7.0	26.0
Minimum Split (s)	11.0	50.0	11.0	50.0	11.0	35.0	35.0	11.0	35.0
Total Split (s)	14.7	63.7	19.0	68.0	11.0	37.0	37.0	14.0	40.0
Total Split (%)	11.0%	47.6%	14.2%	50.9%	8.2%	27.7%	27.7%	10.5%	29.9%
Yellow Time (s)	3.0	4.0	3.0	4.0	3.0	4.0	4.0	3.0	4.0
All-Red Time (s)	1.0	2.0	1.0	2.0	1.0	2.0	2.0	1.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	6.0	4.0	6.0	6.0	4.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Recall Mode	None	Max	None	Max	None	None	None	None	None
v/c Ratio	0.83	0.72	0.50	0.85	0.65	0.84	0.21	0.51	0.52
Control Delay	61.1	29.9	19.1	35.7	46.7	67.8	4.1	39.1	45.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	61.1	29.9	19.1	35.7	46.7	67.8	4.1	39.1	45.2
Queue Length 50th (m)	29.0	131.3	14.5	173.3	41.9	92.0	0.0	21.2	49.9
Queue Length 95th (m)	#72.4	172.0	24.5	209.7	63.8	#137.8	7.7	36.1	76.8
Internal Link Dist (m)		304.2		229.3		244.5			45.0
Turn Bay Length (m)	30.0		60.0		30.0		30.0	36.0	
Base Capacity (vph)	208	1663	320	1652	317	446	466	225	468
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.82	0.72	0.39	0.85	0.65	0.78	0.20	0.49	0.48

Intersection Summary

Cycle Length: 133.7
Actuated Cycle Length: 130.7
Natural Cycle: 110
Control Type: Semi Act-Uncoord
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Madelaine Drive/Ashford Drive & Yonge Street





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	156	832	267	116	996	289	190	321	85	102	147	59
Future Volume (vph)	156	832	267	116	996	289	190	321	85	102	147	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.96		1.00	0.97		1.00	1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	3427		1805	3442		1802	1881	1572	1804	1759	
Flt Permitted	0.06	1.00		0.12	1.00		0.50	1.00	1.00	0.18	1.00	
Satd. Flow (perm)	121	3427		232	3442		939	1881	1572	345	1759	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	170	904	290	126	1083	314	207	349	92	111	160	64
RTOR Reduction (vph)	0	21	0	0	19	0	0	0	72	0	11	0
Lane Group Flow (vph)	170	1173	0	126	1378	0	207	349	20	111	213	0
Confl. Peds. (#/hr)	3		7	7		3	4		11	11		4
Heavy Vehicles (%)	0%	1%	0%	0%	1%	0%	0%	1%	0%	0%	4%	0%
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2		2	6		
Actuated Green, G (s)	73.1	62.6		71.9	62.0		35.8	28.8	28.8	40.6	31.2	
Effective Green, g (s)	73.1	62.6		71.9	62.0		35.8	28.8	28.8	40.6	31.2	
Actuated g/C Ratio	0.56	0.48		0.55	0.47		0.27	0.22	0.22	0.31	0.24	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	202	1641		246	1632		303	414	346	212	419	
v/s Ratio Prot	c0.07	0.34		0.04	0.40		c0.04	c0.19		c0.04	0.12	
v/s Ratio Perm	c0.40			0.24			0.15		0.01	0.12		
v/c Ratio	0.84	0.71		0.51	0.84		0.68	0.84	0.06	0.52	0.51	
Uniform Delay, d1	34.3	27.0		19.0	30.1		41.8	48.8	40.2	35.0	43.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	25.8	2.7		1.8	5.5		6.2	14.4	0.1	2.3	1.0	
Delay (s)	60.2	29.7		20.8	35.6		48.0	63.2	40.3	37.3	44.1	
Level of Service	E	C		C	D		D	E	D	D	D	
Approach Delay (s)		33.5			34.4			55.1			41.8	
Approach LOS		C			C			E			D	

Intersection Summary			
HCM 2000 Control Delay	38.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	130.7	Sum of lost time (s)	20.0
Intersection Capacity Utilization	94.6%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	0	42	25	0	20	38	686	25	20	238	2
Future Volume (Veh/h)	2	0	42	25	0	20	38	686	25	20	238	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	46	27	0	22	41	746	27	22	259	2
Pedestrians		4			11							
Lane Width (m)		3.6			3.6							
Walking Speed (m/s)		1.2			1.2							
Percent Blockage		0			1							
Right turn flare (veh)												
Median type								TWLTL			TWLTL	
Median storage veh)								2			2	
Upstream signal (m)								69				
pX, platoon unblocked	0.78	0.78		0.78	0.78	0.78				0.78		
vC, conflicting volume	1158	1174	264	1202	1162	770	265			784		
vC1, stage 1 conf vol	308	308		852	852							
vC2, stage 2 conf vol	850	866		349	309							
vCu, unblocked vol	1059	1080	264	1116	1064	560	265			578		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)	6.1	5.5		6.1	5.5							
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	94	91	100	95	97			97		
cM capacity (veh/h)	282	296	772	302	316	409	1295			774		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	48	49	41	773	22	261
Volume Left	2	27	41	0	22	0
Volume Right	46	22	0	27	0	2
cSH	720	342	1295	1700	774	1700
Volume to Capacity	0.07	0.14	0.03	0.45	0.03	0.15
Queue Length 95th (m)	1.7	4.0	0.8	0.0	0.7	0.0
Control Delay (s)	10.4	17.3	7.9	0.0	9.8	0.0
Lane LOS	B	C	A		A	
Approach Delay (s)	10.4	17.3	0.4		0.8	
Approach LOS	B	C				

Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	53.6%	ICU Level of Service	A	
Analysis Period (min)	15			

Appendix G –
Transportation Tomorrow Survey Excerpt

Thu Mar 21 2019 12:11:22 GMT-0400 (Eastern Daylight Time) - Run Time: 2165ms	Thu Mar 21 2019 12:13:12 GMT-0400 (Eastern Daylight Time) - Run Time: 2104ms
Cross Tabulation Query Form - Trip - 2016 v1.1 Row: 2006 GTA zone of household - gta06_hhld Column: Planning district of destination - pd_dest	Cross Tabulation Query Form - Trip - 2016 v1.1 Row: 2006 GTA zone of household - gta06_hhld Column: 2006 GTA zone of destination - gta06_dest
Filters: (2006 GTA zone of household - gta06_hhld In 8529); and (Start time of trip - start_time In 700 - 900); and Trip purpose of destination - purp_dest In W	Filters: (2006 GTA zone of household - gta06_hhld In 8529); and (Start time of trip - start_time In 700 - 900); and Trip purpose of destination - purp_dest In W (Planning district of destination - pd_dest In 81)
Trip 2016 ROW : gta06_hhld COLUMN : pd_dest	ROW : gta06_hhld COLUMN : gta06_dest

TTS Cross Tabulation

Cross Tabulation Query Form - Trip - 2016 v1.1

Filter Variables

2006 GTA zone of hous... × | Planning district of desti... × | (Optional) Table Attribute

Group Attributes

Row Grouping | Column Grouping | Table Grouping

Grouping file: Choose File No file chosen

Filter Selection +

2006 GTA zone of household | In | 8529

And

Start time of trip | In | 700 - 900

And

Trip purpose of destination | In | W

Add | Delete

Output

Comma-delimited table | Column format | Expansion Factor On | Click to Select Load | Load

Execute Query | Select All | Save As

```
Tue May 14 2019 12:32:39 GMT-0400 (Eastern Daylight Time) - Run Time: 1952ms

Cross Tabulation Query Form - Trip - 2016 v1.1

ROW: 2006 GTA zone of household - gta06_hhld
Column: Planning district of destination - pd_dest


Filters:
2006 GTA zone of household - gta06_hhld In 8529
and
Start time of trip - start_time In 700 - 900
and
Trip purpose of destination - purp_dest In W

Trip 2016
ROW : gta06_hhld
COLUMN : pd_dest
  gta06_hhld     pd_dest      total
        8529          11         28
        8529          27         48
        8529          28         31
        8529          29         43
        8529          31         93
        8529          32          9
        8529          33         87
        8529          35         18
        8529          36         56
        8529          38         23
        8529          81        850
        8529          82        139
```

8529	83	68
8529	84	59
8529	86	21
8529	130	29
8529	132	31
8529	136	22
8529	141	14

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TTS Cross Tabulation

Cross Tabulation Query Form - Trip - 2016 v1.1

Filter Variables

2006 GTA zone of hous... × | 2006 GTA zone of desti... × | (Optional) Table Attribute

Group Attributes

Row Grouping | Column Grouping | Table Grouping

Grouping file: Choose File No file chosen

Filter Selection +

2006 GTA zone of household | In | 8529

And

Start time of trip | In | 700 - 900

And

Trip purpose of destination | In | W

And

Planning district of destination | In | 81,

Add | Delete

Output

Comma-delimited table | Column format | Expansion Factor On | Click to Select Load | Load

Execute Query | Select All | Save As

```
Tue May 14 2019 12:35:14 GMT-0400 (Eastern Daylight Time) - Run Time: 2234ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: 2006 GTA zone of household - gta06_hhld
Column: 2006 GTA zone of destination - gta06_dest


Filters:
2006 GTA zone of household - gta06_hhld In 8529
and
Start time of trip - start_time In 700 - 900
and
Trip purpose of destination - purp_dest In W
and
Planning district of destination - pd_dest In 81,

Trip 2016
ROW : gta06_hhld
COLUMN : gta06_dest
  gta06_hhld  gta06_dest      total
        8529        8501        129
        8529        8504         14
        8529        8509         53
        8529        8514        112
        8529        8521         50
```

8529	8523	33
8529	8524	206
8529	8527	213
8529	8530	14
8529	8531	27

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Appendix H –
OTM Signal Justification Sheets

Justification No. 7 - 2029 Total Traffic (Critical Case)

Ashford Drive / Site Access & School South Driveway

Justification	Description		Compliance			Signal Warrant	Underground Provisions Warrant
			Sectional		Entire %		
		Rest. Flow	Numerical	%			
1. Minimum Vehicluar Volume	A. Vehicle volume, all aproaches (average hour)	720	465	65%	17%	NO	NO
	B. Vehicle volume, along minor streets (average hour)	170	43	25%		NO	NO
2. Delay to cross traffic	A. Vehicle volume, major street (average hour)	720	408	57%	12%	NO	NO
	B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour)	75	14	18%		NO	NO

Appendix I –
ITE Internal Capture Sheets

NCHRP 684 Internal Trip Capture Estimation Tool			
Project Name:	681 Yonge Condo	**Organization:**	JD Engineering
Project Location:	681 - 685 Yonge Street, Barrie, ON	**Performed By:**	Allister Aresta
Scenario Description:	Heritage Phase 3 Development	**Date:**	May 14th, 2019
Analysis Year:		**Checked By:**	John Northcote
Analysis Period:	**AM Street Peak Hour**	**Date:**	May 14th, 2019

Table 1-A: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips[3]		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail				218	118	100
Restaurant				381	194	187
Cinema/Entertainment				0		
Residential				0		
Hotel				0		
All Other Land Uses[2]				0		
				599	312	287

Table 2-A: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.[4]	% Transit	% Non-Motorized	Veh. Occ.[4]	% Transit	% Non-Motorized
Office						
Retail	1.00	0%	0%	1.00	0%	0%
Restaurant	1.00	0%	0%	1.00	0%	0%
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-A: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-A: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		13	0	0	0
Restaurant	0	9		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	0	0	0		0
Hotel	0	0	0	0	0	

Table 5-A: Computations Summary

	Total	Entering	Exiting
All Person-Trips	599	312	287
Internal Capture Percentage	7%	7%	8%
External Vehicle-Trips[5]	555	290	265
External Transit-Trips[6]	0	0	0
External Non-Motorized Trips[6]	0	0	0

Table 6-A: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	N/A	N/A
Retail	8%	13%
Restaurant	7%	5%
Cinema/Entertainment	N/A	N/A
Residential	N/A	N/A
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.

[2]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.

[3]Enter trips assuming no transit or non-motorized trips (as assumed in ITE *Trip Generation Manual*).

[4]Enter vehicle occupancy assumed in Table 1-A vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be made to Tables 5-A, 9-A (O and D). Enter transit, non-motorized percentages that will result with proposed mixed-use project complete.

[5]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A.

[6]Person-Trips

*Indicates computation that has been rounded to the nearest whole number.

Project Name:	681 Yonge Condo
Analysis Period:	**AM Street Peak Hour**

Table 7-A: Conversion of Vehicle-Trip Ends to Person-Trip Ends

Land Use	Table 7-A (D): Entering Trips			Table 7-A (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	0	0	1.00	0	0
Retail	1.00	118	118	1.00	100	100
Restaurant	1.00	194	194	1.00	187	187
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.00	0	0	1.00	0	0
Hotel	1.00	0	0	1.00	0	0

Table 8-A (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	29		13	0	14	0
Restaurant	58	26		0	7	6
Cinema/Entertainment	0	0	0		0	0
Residential	0	0	0	0		0
Hotel	0	0	0	0	0	

Table 8-A (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		38	45	0	0	0
Retail	0		97	0	0	0
Restaurant	0	9		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	20	39	0		0
Hotel	0	5	12	0	0	

Table 9-A (D): Internal and External Trips Summary (Entering Trips)

Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0	0	0	0
Retail	9	109	118	109	0	0
Restaurant	13	181	194	181	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	0	0	0	0	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses[3]	0	0	0	0	0	0

Table 9-A (O): Internal and External Trips Summary (Exiting Trips)

Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0	0	0	0
Retail	13	87	100	87	0	0
Restaurant	9	178	187	178	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	0	0	0	0	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses[3]	0	0	0	0	0	0

[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-A

[2]Person-Trips

[3]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator

*Indicates computation that has been rounded to the nearest whole number.

NCHRP 684 Internal Trip Capture Estimation Tool			
Project Name:	681 Yonge Condo	**Organization:**	JD Engineering
Project Location:	681 - 685 Yonge Street, Barrie, ON	**Performed By:**	Allister Aresta
Scenario Description:	Heritage Phase 3 Development	**Date:**	May 14th, 2019
Analysis Year:		**Checked By:**	John Northcote
Analysis Period:	**PM Street Peak Hour**	**Date:**	May 14th, 2019

Table 1-P: Base Vehicle-Trip Generation Estimates (Single-Use Site Estimate)

Land Use	Development Data (*For Information Only*)			Estimated Vehicle-Trips[3]		
	ITE LUCs[1]	Quantity	Units	Total	Entering	Exiting
Office				0		
Retail				330	158	172
Restaurant				234	119	115
Cinema/Entertainment				0		
Residential				0		
Hotel				0		
All Other Land Uses[2]				0		
				564	277	287

Table 2-P: Mode Split and Vehicle Occupancy Estimates

Land Use	Entering Trips			Exiting Trips		
	Veh. Occ.[4]	% Transit	% Non-Motorized	Veh. Occ.[4]	% Transit	% Non-Motorized
Office						
Retail	1.00	0%	0%	1.00	0%	0%
Restaurant	1.00	0%	0%	1.00	0%	0%
Cinema/Entertainment						
Residential						
Hotel						
All Other Land Uses[2]						

Table 3-P: Average Land Use Interchange Distances (Feet Walking Distance)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office						
Retail						
Restaurant						
Cinema/Entertainment						
Residential						
Hotel						

Table 4-P: Internal Person-Trip Origin-Destination Matrix*

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	0		35	0	0	0
Restaurant	0	47		0	0	0
Cinema/Entertainment	0	0	0		0	0
Residential	0	0	0	0		0
Hotel	0	0	0	0	0	

Table 5-P: Computations Summary

	Total	Entering	Exiting
All Person-Trips	564	277	287
Internal Capture Percentage	29%	30%	29%
External Vehicle-Trips[5]	400	195	205
External Transit-Trips[6]	0	0	0
External Non-Motorized Trips[6]	0	0	0

Table 6-P: Internal Trip Capture Percentages by Land Use

Land Use	Entering Trips	Exiting Trips
Office	N/A	N/A
Retail	30%	20%
Restaurant	29%	41%
Cinema/Entertainment	N/A	N/A
Residential	N/A	N/A
Hotel	N/A	N/A

[1]Land Use Codes (LUCs) from *Trip Generation Manual*, published by the Institute of Transportation Engineers.

[2]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator.

[3]Enter trips assuming no transit or non-motorized trips (as assumed in ITE *Trip Generation Manual*).

[4]Enter vehicle occupancy assumed in Table 1-P vehicle trips. If vehicle occupancy changes for proposed mixed-use project, manual adjustments must be made

[5]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P.

[6]Person-Trips

*Indicates computation that has been rounded to the nearest whole number.

Estimation Tool Developed by the Texas A&M Transportation Institute - Version 2013.1

Project Name:	681 Yonge Condo
Analysis Period:	**PM Street Peak Hour**

Table 7-P: Conversion of Vehicle-Trip Ends to Person-Trip Ends

Land Use	Table 7-P (D): Entering Trips			Table 7-P (O): Exiting Trips		
	Veh. Occ.	Vehicle-Trips	Person-Trips*	Veh. Occ.	Vehicle-Trips	Person-Trips*
Office	1.00	0	0	1.00	0	0
Retail	1.00	158	158	1.00	172	172
Restaurant	1.00	119	119	1.00	115	115
Cinema/Entertainment	1.00	0	0	1.00	0	0
Residential	1.00	0	0	1.00	0	0
Hotel	1.00	0	0	1.00	0	0

Table 8-P (O): Internal Person-Trip Origin-Destination Matrix (Computed at Origin)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		0	0	0	0	0
Retail	3		50	7	45	9
Restaurant	3	47		9	21	8
Cinema/Entertainment	0	0	0		0	0
Residential	0	0	0	0		0
Hotel	0	0	0	0	0	

Table 8-P (D): Internal Person-Trip Origin-Destination Matrix (Computed at Destination)

Origin (From)	Destination (To)					
	Office	Retail	Restaurant	Cinema/Entertainment	Residential	Hotel
Office		13	2	0	0	0
Retail	0		35	0	0	0
Restaurant	0	79		0	0	0
Cinema/Entertainment	0	6	4		0	0
Residential	0	16	17	0		0
Hotel	0	3	6	0	0	

Table 9-P (D): Internal and External Trips Summary (Entering Trips)

Destination Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0	0	0	0
Retail	47	111	158	111	0	0
Restaurant	35	84	119	84	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	0	0	0	0	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses[3]	0	0	0	0	0	0

Table 9-P (O): Internal and External Trips Summary (Exiting Trips)

Origin Land Use	Person-Trip Estimates			External Trips by Mode*		
	Internal	External	Total	Vehicles[1]	Transit[2]	Non-Motorized[2]
Office	0	0	0	0	0	0
Retail	35	137	172	137	0	0
Restaurant	47	68	115	68	0	0
Cinema/Entertainment	0	0	0	0	0	0
Residential	0	0	0	0	0	0
Hotel	0	0	0	0	0	0
All Other Land Uses[3]	0	0	0	0	0	0

[1]Vehicle-trips computed using the mode split and vehicle occupancy values provided in Table 2-P

[2]Person-Trips

[3]Total estimate for all other land uses at mixed-use development site is not subject to internal trip capture computations in this estimator

*Indicates computation that has been rounded to the nearest whole number.