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**Project Report**

H-353437

Date: October 4, 2017

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From: John Pham, P.Eng.

cc: Terry Kelly, P.Eng.  
Joseph De Luca, P.Eng.  
John Hemingway, P.Eng., PTOE**City of Barrie  
Improvements for Bryne Drive, Harvie Road and Essa Road****Traffic Analysis for Essa Road****1. Introduction****1.1 Purpose**

The purpose of this report is to provide initial results for the analysis of traffic operations for Essa Road, from Maplevue Drive to Coughlin Road. Intersection turning movement forecasts for horizon years 2021 and 2031 are presented along with a capacity and level of service analysis to define road and intersection lane configuration and traffic control requirements.

**1.2 Study Area**

The Study Area for this segment of Essa Road is bounded by the intersection of Essa Road and Maplevue Drive to the south, and the intersection of Essa Road and Coughlin Road to the north, as shown in **Figure 1-1**.

**1.3 Planning Horizons**

The base year for the analysis is 2017, consistent with the availability of traffic data. Forecast traffic conditions are considered for two planning horizons: a medium-term horizon of 2021 and a long-term horizon of 2031.

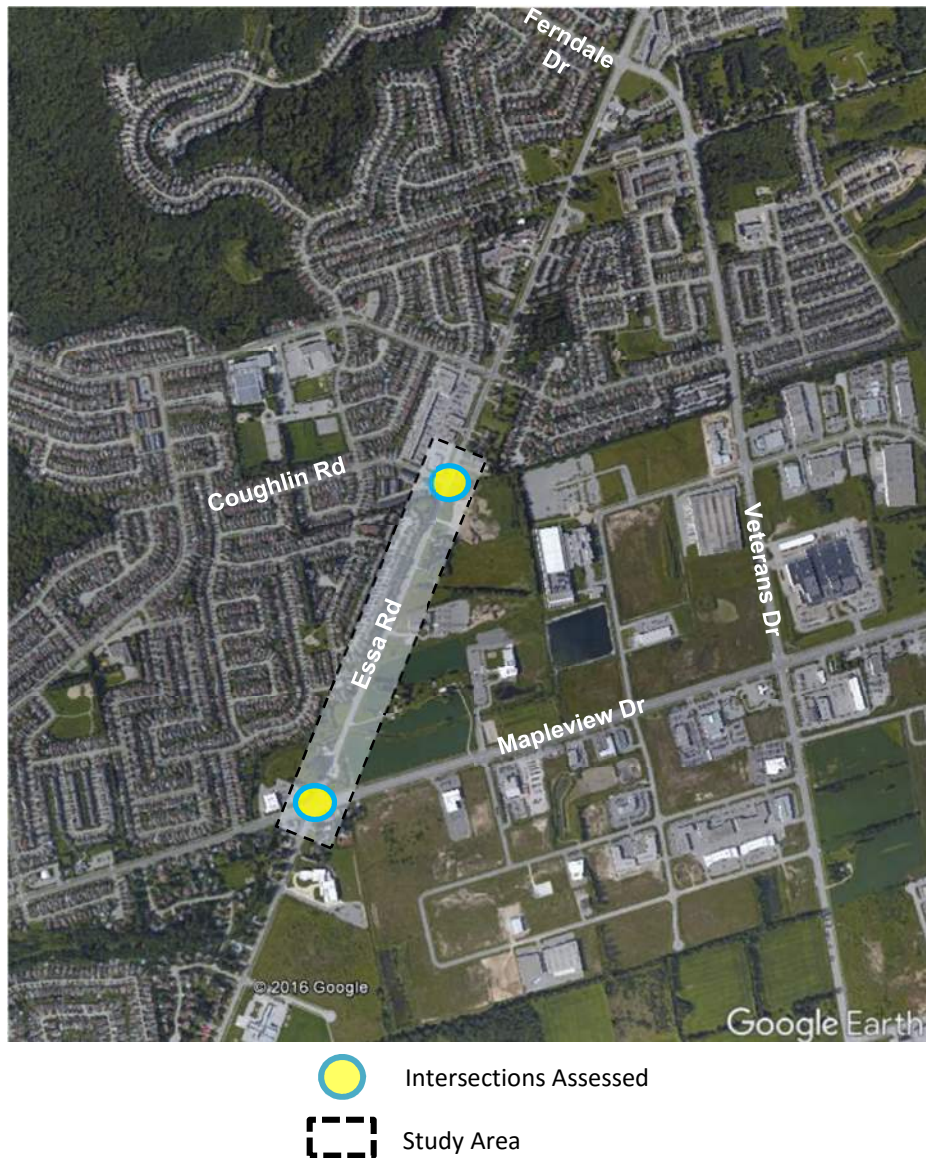


Figure 1-1 Study Area

## 2. Study Area Planning Context

### 2.1 Multi-Modal Active Transportation Master Plan – January 2014

The City of Barrie's Multi-Modal Active Transportation Master Plan (MMATMP), part of six Infrastructure Master Plans that describe improvements necessary to accommodate forecasted growth for Barrie to 2031, offers a roadmap to an acceptable transportation network to serve future needs of the City. The Master Plan reviews all modes of transportation, examines existing transportation infrastructure and identifies current deficiencies, including areas of traffic congestion and locations where active transportation facilities should be provided.

The MMATMP identifies the Essa Road corridor as an Intensification Area, which refers to areas with planned higher densities, active transportation and transit-oriented development. In the MMATMP’s 2031 preferred road network, Essa Road has been identified for widening to three lanes<sup>1</sup>, from Mapleton Avenue located in the north of the Study Area to south of Salem Road, south Mapleview Drive.

### 3. Existing Transportation Network

This section describes the existing transportation network in and around the Study Area and provides an assessment of existing conditions along Essa Road.

#### 3.1 Existing Road Geometry

##### 3.1.1 Lane Configuration

**Figure 3-1** illustrates the existing lane configuration and intersection traffic control of roads and intersections within the Study Area.

Essa Road is a two-lane major arterial road running in a generally north-south direction connecting between County Road 27 and Mapleview Drive in the south, to an interchange with Highway 400 and farther north, ending at an intersection with Tiffin Street, near the Barrie GO Station. The length of Essa Road within the Study Area from Mapleview Drive to Coughlin Road is approximately 1.0 km. In this section the roadway has a rural cross section with a maximum speed limit of 60 km/h as per the City of Barrie By-Law 2002-191.

##### 3.1.2 Transit Services

Barrie Transit operates the following bus routes within the Study Area.

1. Routes 7A and 7B operate along Essa Road within the study limits, connecting Bell Farm Road to the north of the Study Area with Park Place to the east of the Study Area.

The MMATMP does not identify or recommend any additional future transit routes along this section of Essa Road up to the 2031 planning horizon.

##### 3.1.3 Active Transportation

There is a noticeable lack of active transportation facilities along the section of Essa Road in the Study Area.

The MMATMP, in Figures ES-2 and ES-3, identifies several active transportation measures to be undertaken to provide an integrated pathway network. The following measures are proposed through the Study Area:

1. Provision of sidewalks along Essa Road, between Ferndale Drive to the north and County Road 27 to the south of the Study Area.
2. Provision of buffered bicycle lanes along Essa Road, between Ferndale Drive to the north and County Road 27 to the south of the Study Area.

<sup>1</sup> Section 7.3 Road Network – City Road Improvements. MMATMP.

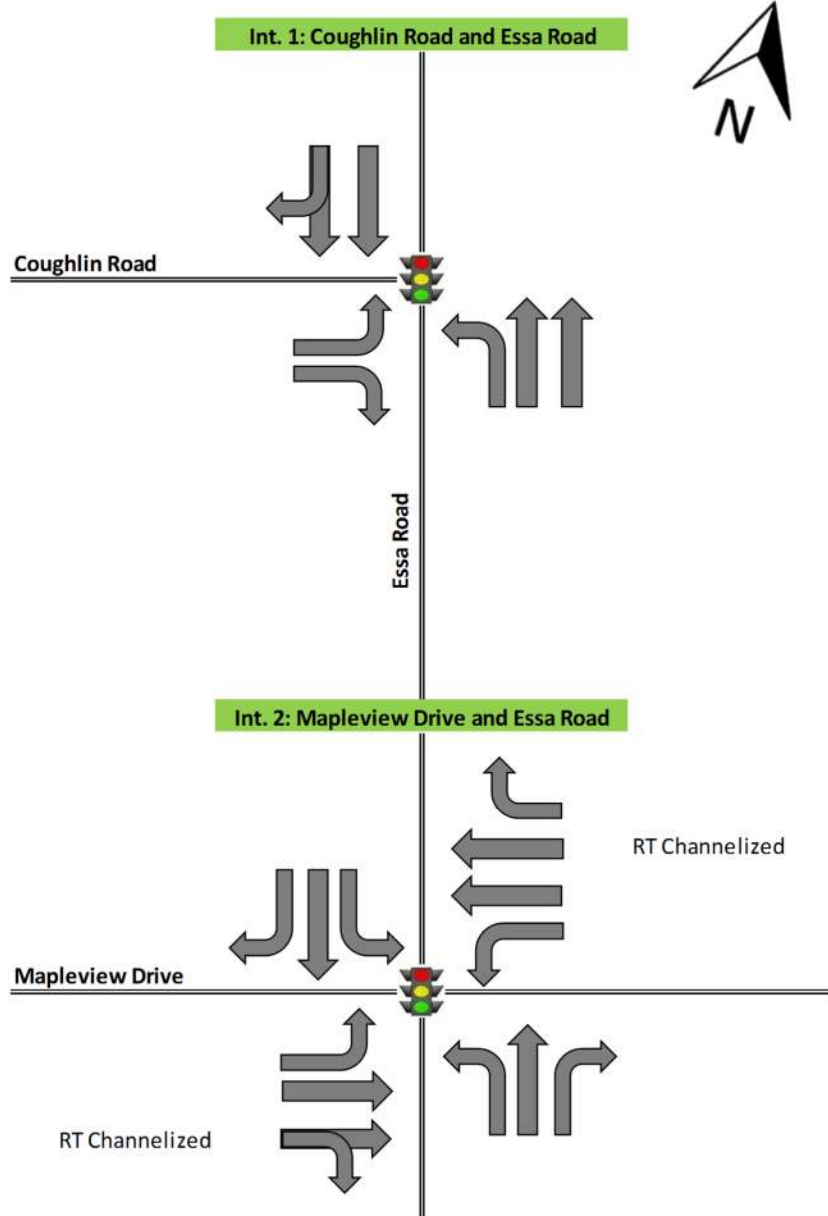


Figure 3-1 Existing Lane Configuration

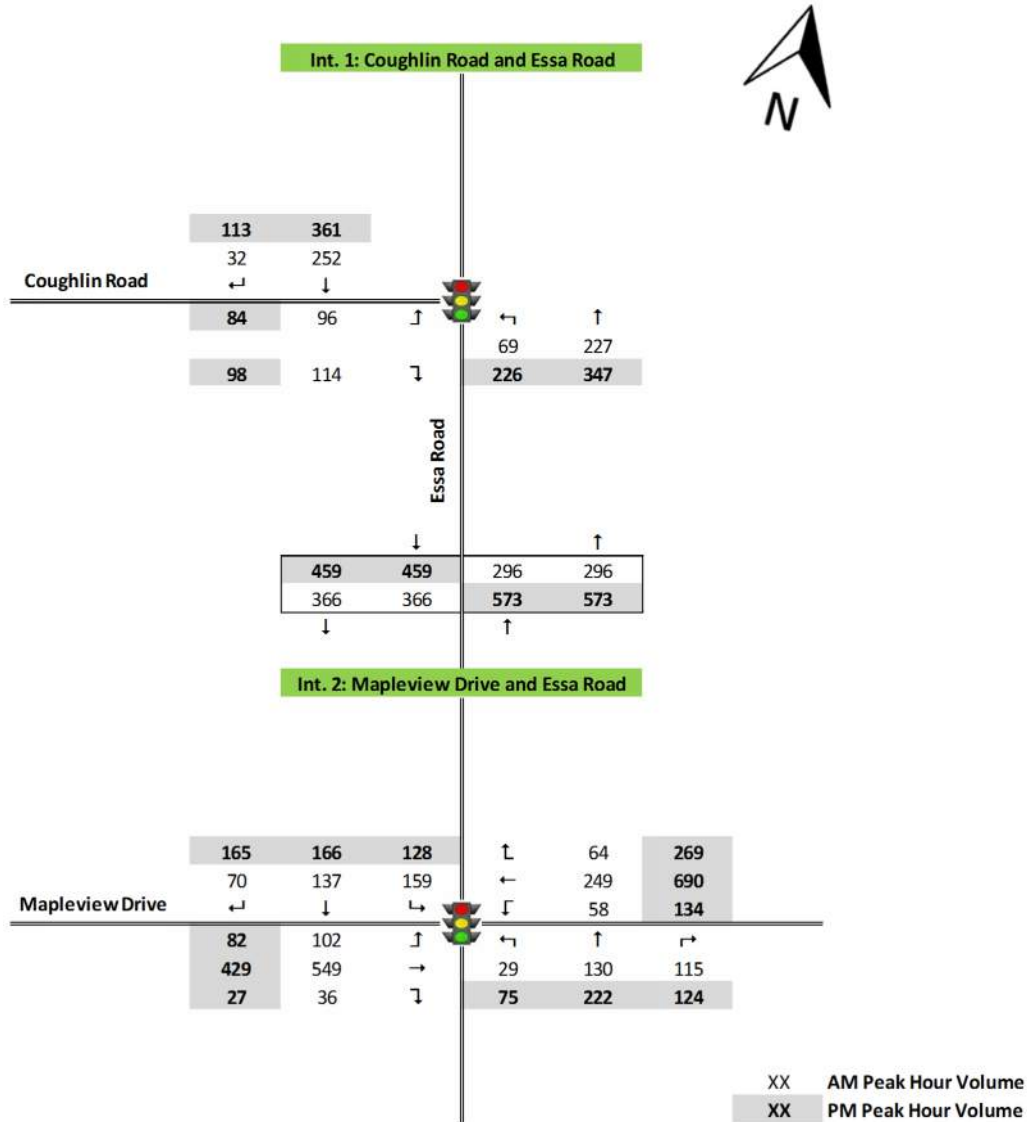
### 3.2 Existing Traffic Volumes

Traffic volumes provided by the City of Barrie for the existing road network were used as the basis to complete the analysis of existing conditions (see **Table 3-1**). A 2017 base year was considered for the traffic analysis using traffic counts provided by the City. Turning movement count information collected at the intersection of Mapleview Drive and Essa Road in 2015 was adjusted to 2017 using a 2% p.a. growth assumption. An annual growth rate of 2% was selected based on discussions with the City of Barrie and a review of growth shown in the City's EMM model outputs. The basis for the assumed 2% annual traffic growth rate in the Study Area is provided in **Section 4.1.1**. Traffic volumes in the Study Area road network were

then balanced to remove any differences in link volumes. **Figure 3-2** provides a summary of the balanced 2017 traffic volumes. The traffic data is included in **Appendix A** of this report.

**Table 3-1: Turning Movement Counts for the Study Area**

Location	Date Collected
Coughlin Road and Essa Road	February 9, 2017
Mapleview Drive and Essa Road	July 5, 2015



**Figure 3-2 Existing Traffic Volumes**

### 3.3 2017 Midblock Analysis

For midblock sections, the quality of service was characterized based on the volume-to-capacity (v/c) ratio for each road section. The v/c ratio provides a measure of traffic volume

demand to available capacity, with an at-capacity condition represented by a v/c ratio of 1.00 (i.e., volume demand equals theoretical capacity). For this planning level analysis, a **v/c ratio of 0.85 or less was deemed an acceptable level of operation** for midblock locations. The City of Barrie’s Urban Design Manual (Revised October 2014) indicates that road segments with v/c ratios exceeding this threshold should be considered as candidates for remedial action.

The midblock v/c ratios were calculated by dividing the traffic link volume by the theoretical capacity for the subject link (i.e., the maximum hourly flow rate at which vehicles can be expected to traverse the section of roadway within a given time period under prevailing roadway, traffic and control conditions). A theoretical lane capacity based on the adjusted road classification in the MMATMP<sup>2</sup> was used in the analysis.

Essa Road, is designated as a two-lane Arterial Road<sup>3</sup>, with an adjusted lane capacity of 750 vehicles-per-hour.

**Table 3-2** shows the AM and PM peak direction midblock volumes and volume-to-capacity (v/c) ratios for traffic on key roads based on the available 2017 midblock and intersection traffic counts. **The results indicate that there is sufficient capacity along Essa Road to accommodate existing traffic demand with one basic travel lane in each direction.**

**Table 3-2 – Existing Conditions Midblock Capacity Analysis**

Section	AM Peak Direction Volume (vph)	AM Volume-to-Capacity Ratio (v/c)	PM Peak Direction Volume (vph)	PM Volume-to-Capacity Ratio (v/c)
<b>Essa Road (750 vph/l)</b>				
Mapleview Drive to Coughlin Road	370	0.49	575	0.77

### 3.4 2017 Intersection Operational Analysis

A capacity and level of service analysis was completed for the two signalized intersections within the Study Area using Synchro 9 traffic analysis software, which implements methodologies defined in the Highway Capacity Manual (HCM). The City of Barrie Synchro Guidelines for using Synchro and SimTraffic were followed in conducting the traffic analysis.

Capacity is assessed based on the volume-to-capacity (v/c) ratio, which is the ratio of demand flow rate to the available capacity at the intersection. The v/c ratio provides an estimate of capacity utilization based on the specific geometry and traffic control at an intersection. A v/c ratio equal to or greater than 1.0 indicates an approach that is operating above capacity and where long vehicle delays are occurring.

Operations are defined by the concept of level of service (LOS). LOS is a key measure of effectiveness for both signalized and unsignalized intersections and is based on the average

<sup>2</sup> City of Barrie Multi-modal Active Transportation Mater Plan, Appendix H - Table 1-3.

<sup>3</sup> City of Barrie Multi-modal Active Transportation Mater Plan, Figure 2-1 Roadways Classification Existing 2011.

stopped delay per vehicle, in seconds. It is a qualitative measure of the ability of the intersection (or individual movement) to accommodate traffic demand. For signalized intersections, the tabulated LOS is for the intersection as a whole. The LOS criteria as defined in the HCM for each type of intersection control are summarized in **Table 3-3**.

**Table 3-3: Intersection Level of Service Criteria for Automobile Mode<sup>4</sup>**

Level of Service	Average Control Delay per Vehicle (s/veh)	Average Control Delay per Vehicle (s/veh)
	Signalized Intersections	Unsignalized Intersections
A (Free Flow)	=< 10	=< 10
B	> 10 - 20	> 10 – 15
C	> 20 - 35	> 15 - 25
D	> 35 - 55	> 25 - 35
E (Capacity)	> 55 - 80	> 35 - 50
F (Forced Flow)	> 80	> 50

**Table 3-4** provides the overall Level of Service (LOS) and Control Delay at each intersection in the Study Area during AM and PM peak hours based on the existing traffic conditions. For intersection analysis, critical movements are those that are defined to be at or below the level for which operations are deemed to be satisfactory from a planning perspective and would normally be indicative of a traffic problem that needs attention. For the purpose of this analysis, a Level of Service lower than LOS D and Volume-to-Capacity (v/c) ratio higher than 0.85 were used to identify critical movements. Under existing conditions, no critical movements are present at either intersection.

The detailed Synchro reports are provided in **Appendix B**.

Under existing conditions, both intersections operate at acceptable levels on an overall basis during the peak hours. All turning movements at the two intersections operate at LOS D or better, with low delays and minimal queuing.

<sup>4</sup> Highway Capacity Manual, 4th Edition (HCM 2000), Transportation Research Board, Chapter 16: Signalized Intersections, Exhibit 16-2

**Table 3-4 Existing Intersection Operations**

<b>Existing 2017 Conditions</b>									
<b>Signalized Intersections</b>									
<b>Intersection</b>	<b>Movement</b>	<b>AM Peak Hour</b>				<b>PM Peak Hour</b>			
		<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>	<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>
Essa Road and Coughlin Road	<b>Overall</b>	<b>B</b>	<b>12</b>	<b>0.20</b>	<b>-</b>	<b>B</b>	<b>12</b>	<b>0.40</b>	<b>-</b>
	EBL	C	33	0.46	27	D	37	0.48	27
	EBR	C	30	0.08	13	C	34	0.07	11
	NBL	A	5	0.13	8	A	5	0.37	20
	NBT	A	4	0.10	10	A	4	0.15	16
	SBT	A	5	0.14	12	B	10	0.25	32
Essa Road and Mapleview Drive	<b>Overall</b>	<b>C</b>	<b>25</b>	<b>0.48</b>	<b>-</b>	<b>C</b>	<b>27</b>	<b>0.58</b>	<b>-</b>
	EBL	C	21	0.33	22	C	25	0.46	18
	EBT	C	33	0.67	71	C	31	0.55	57
	WBL	C	25	0.40	13	C	22	0.49	28
	WBT	C	30	0.42	31	C	34	0.74	91
	WBR	C	27	0.05	0	C	26	0.18	18
	NBL	C	21	0.09	11	C	26	0.25	23
	NBT	C	23	0.26	36	C	29	0.48	59
	NBR	C	21	0.08	12	C	24	0.12	15
	SBL	B	15	0.35	32	B	17	0.35	26
	SBT	B	14	0.19	30	B	16	0.20	35
SBR	B	13	0.07	3	B	16	0.12	9	

### 3.5 2017 Daily Traffic and Daily Truck Traffic Analysis

The Annual Average Daily Traffic (AADT) and Annual Average Daily Truck Traffic (AADTT) volumes were estimated along Essa Road in the Study Area, under existing traffic conditions, using the 2017 traffic volumes. The PM peak hour volumes were generally found to be the higher of the peak hour volumes. A factor was used to convert the PM peak hour volumes to daily volumes at midblock sections. To develop this factor, 24-hour Automatic Traffic Recorder (ATR) data for the sections of Essa Road between Bryne Drive and Loggers Run, and between Bryne Drive and Fairview Road, as provided by the City of Barrie, were used. These sections of Essa Road are located approximately 1.9km and 2.6km north of the Study Area respectively, but are assumed to be representative of the trends in daily traffic volumes in the Study Area. The ATR data was collected on Essa Road between Bryne Drive and Loggers Run on Tuesday, August 24, 2010 and between Bryne Drive and Fairview Road on Tuesday, October 21, 2008. The data showed that 8% of total daily traffic occurred in the PM peak hour. As such, a factor of 0.08 was used to calculate the AADT for Essa Road within the Study Area. The ATR data also showed a 45%-55% split in total daily traffic between the northbound and southbound directions. This directional split was used to find the directional daily traffic volumes.

A similar approach was taken for the side streets along Bryne Drive in the Study Area:

- A factor of 0.08 and directional split of 49%-51% between eastbound and westbound directions were used to calculate AADT on Mapleview Drive, based on ATR data along Mapleview Drive between Veterans Drive and Bryne Drive.



- Since AADT data was unavailable on Coughlin Road, a factor of 0.08, as used for Essa Road and Mapleview Drive in the Study Area, and a 50%-50% directional split were assumed.

To estimate the AADTT, the existing percentage of heavy vehicles in the main street through movements at the intersections of Essa Road with Coughlin Road and with Mapleview Drive were reviewed. In both peak hours and both directions of travel, the percentage of heavy vehicles in the through movements along the Essa Road corridor ranged from 1% to 3%. As such, it was assumed that in the Study Area 2% of the daily traffic volume is comprised of truck traffic. The assumed truck percentage was applied to the AADT volumes to estimate the number of trucks on each roadway section.

For the side streets, the approach taken to determine AADTT volumes was consistent with that for Essa Road. It was assumed that 2% of daily traffic along Mapleview Drive and Coughlin Road is composed of truck traffic in the Study Area.

**Figure 3-3** illustrates the 2017 two-way AADT and AADTT volumes for along Essa Road. Directional AADT and AADTT volumes are provided in **Figure 3-4**.

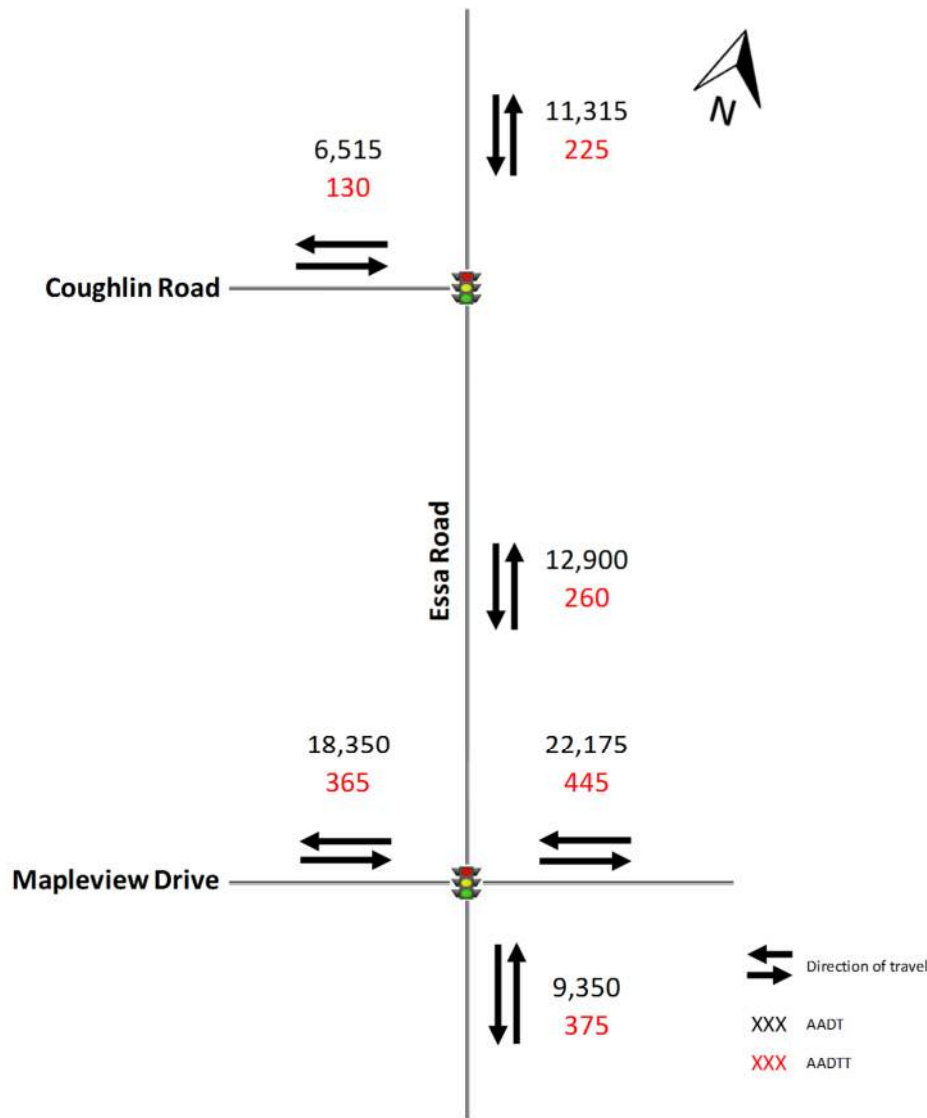


Figure 3-3 Existing AADT and AADTT (Two-Way)

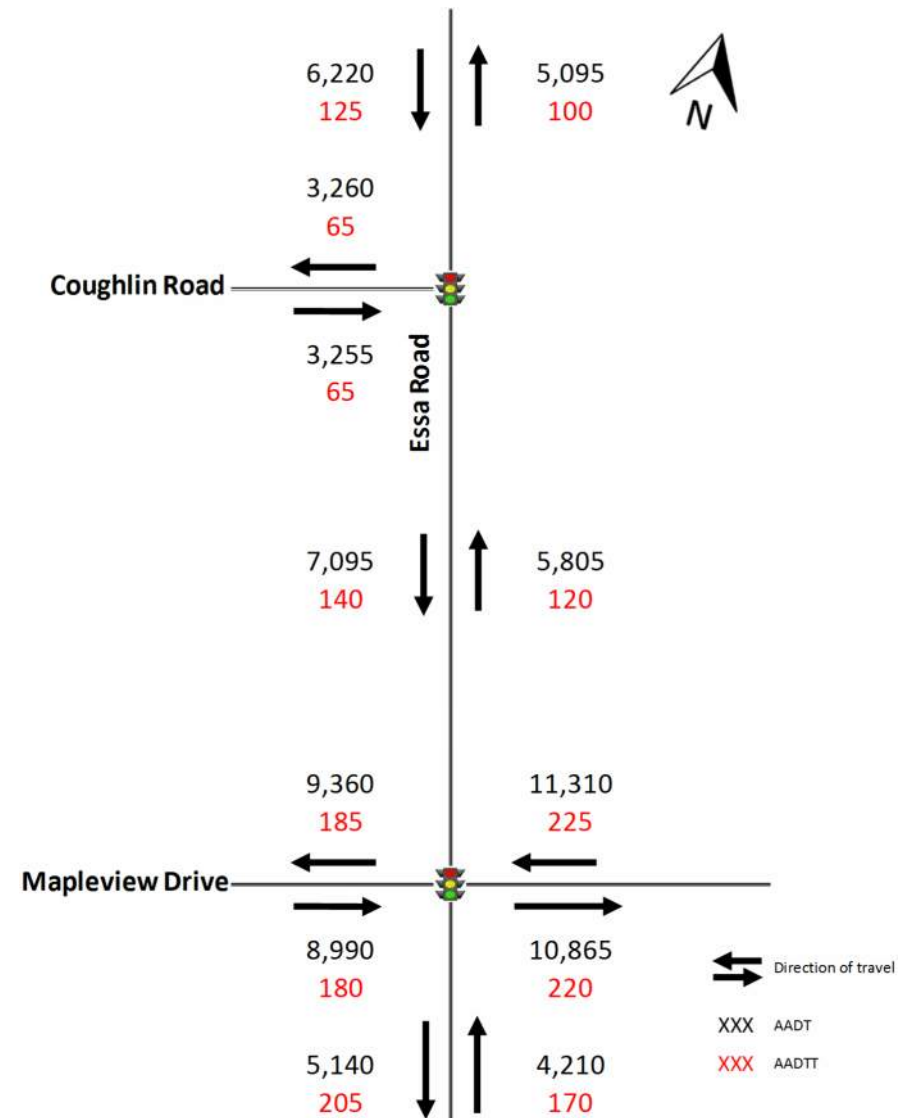


Figure 3-4 Existing AADT and AADTT (By Direction)

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### 3.6 Traffic Safety Review

#### 3.6.1 Road Segment and Intersection Collision Review

The City of Barrie provided collision information for the period between 2012 to 2016 for the following locations within the Study Area:

Road Segment:

- Essa Road between Mapleview Drive and Coughlin Road

Intersections:

- Essa Road and Mapleview Drive
- Essa Road and Coughlin Road

Based on a review of the historical collision data a total of 96 collisions occurred in the Study Area: 77 at the two intersections and 19 along the segment of Essa Road. The majority (80%) of collisions occurred at the intersection of Essa Road and Mapleview Drive. A summary of the average collision frequencies are presented in **Table 3-5**.

**Table 3-5 Average Collision Frequencies based on Historic Data (2012-2016)**

Location Along Essa Road	Non-fatal Injury Collisions	Property Damage (PDO)	Total Collisions	Average Collision Rate (/yr)
<b>Intersections</b>				
Mapleview Drive	8	57	65	13.0
Coughlin Road	1	11	12	2.4
<b>Subtotal</b>	<b>9</b>	<b>68</b>	<b>77</b>	<b>15.4</b>
<b>Road Segment</b>				
Mapleview Drive and Coughlin Road	3	16	19	3.8
<b>Total</b>	<b>12</b>	<b>84</b>	<b>96</b>	<b>-</b>

#### Collision Severity

- The collisions in the Study Area were reported as Non-Fatal Injury or Property Damage Only (PDO) collisions. A number of collisions were also reported to be of “Unknown” severity and were considered to be PDO collisions in this review.
- Most of the collisions were PDO collisions (88%).
- Of the total 12 Non-Fatal Injury collisions in the Study Area, 8 collisions occurred at the intersection of Essa Road and Mapleview Drive, 1 collision occurred the intersection of Essa Road and Coughlin Road and 3 collisions occurred at the midblock section.

#### Collision Impact Types

- The collision impact types included angle (T-bone), rear-end, sideswipe, turning movement and single motor vehicle type collisions.

- Majority of the collisions at the intersections (61%) were rear-end collisions and a higher proportion of them occurred at the intersection of Essa Road and Mapleview Drive.
- Most of the collisions at the midblock section (37%) were rear-end collisions as well, followed by turning movement type collisions (26%) and sideswipe collisions (16%).

Rear end collisions are the predominant collision type, which may be indicating issues with roadway sightlines, speeding, distracted driving, poor road surface friction and insufficient gap allowance by drivers.

Conditions of Surroundings

- Majority of the collisions (71%) were under clear conditions, with the road surface being dry. 20 collisions were reported under rainy conditions, 15 of which occurred at the intersection of Essa Road and Mapleview Drive, and the remaining 5 along the midblock section.
- Most collisions (71%) occurred under daylight conditions, during or between the morning, midday and afternoon peak periods.

**3.6.2 Potential for Safety Improvements**

The available road segment and intersection collision data were used to develop Potential for Safety Improvement (PSI) indices at locations along Essa Road in the Study Area with the greatest potential for safety improvements.

The PSI index is a measure of excess collision frequency, above the expected value, that might be reduced through safety improvements.

Predicted Collisions: The predictive models in the *Highway Safety Manual 2010* were used to estimate the average frequency of collisions by crash severity (Fatal and Injury, and PDO). The HSM prediction methodology is based on regression models of crash data collected at similar sites. This methodology relies on selecting a Safety Performance Factor (SPF) for the road segment or intersection type and adjusting it for site-specific conditions such as the presence of on-street parking, by means of a Crash Modification Factor (CMF) or a Calibration Factor for local jurisdiction conditions.

Expected Collisions: The expected collision frequency is a more statistically reliable measure because it is based on the predicted collision frequency, as well as actual historical data collected at the specific location(s). Since observed collision data were available for the locations along Bryne Drive in the Study Area, the EB Method was applied to combine predicted collisions with the observed collision from 2012 to 2016 to derive the expected number of collisions.

The PSI at each location was found as the difference between the expected and predicted number of collisions. Locations with positive PSI values have a potential for safety improvement; the larger the positive value, the greater the potential. Likewise, negative values have limited potential for improvement because the expected number of collisions is less than the predicted number of collisions. The results of the PSI analysis along Essa Road in the Study Area, are summarized in **Table 3-6**.

The intersection of Essa Road and Mapleview Drive has high PSI values, especially for PDO collisions. The segment of Essa Road between Mapleview Drive and Coughlin Road also exhibits positive PSI values. The results indicate a significant potential for safety improvement at the intersections and along Essa Road in the Study Area. As identified earlier, rear-end collisions are the most dominant type of collision observed in the Study Area.

Countermeasures for rear-end collisions at signalized intersections include providing left turn phasing and adequate signal timing, reducing approach speeds and improving lighting and visibility.

**Table 3-6 Potential for Safety Improvements in the Study Area**

Intersection	Fatal/Injury				PDO				Total			
	<i>Observed</i>	<i>Predicted</i>	<i>Expected</i>	<i>PSI</i>	<i>Observed</i>	<i>Predicted</i>	<i>Expected</i>	<i>PSI</i>	<i>Observed</i>	<i>Predicted</i>	<i>Expected</i>	<i>PSI</i>
<b>Road Segment</b>												
Essa Road from Mapleview Drive to Coughlin	3	2.2	2.6	<b>0.5</b>	16.0	5.8	14.3	<b>8.5</b>	19	7.9	17.5	<b>9.6</b>
<b>Intersections</b>												
Essa Road at Mapleview Drive	8	6.20	7.4	<b>1.2</b>	57	10.5	48.7	<b>38.2</b>	65	16.7	58.6	<b>41.9</b>
Essa Road at Coughlin Road	1	2.50	1.86	-0.6	11	4.30	8.37	<b>4.1</b>	12	6.80	10.40	<b>3.6</b>

## **4. Future Transportation Operations**

### **4.1 Traffic Forecast**

The future transportation operations were assessed using forecast traffic volumes for 2021 and 2031.

#### **4.1.1 Background Traffic Growth**

The City provided EMME model outputs of forecast traffic volumes for 2016, and the 2021 and 2031 horizon years which include infrastructure improvements to the northeast of the Study Area – Harvie Road extension and future partial interchange with Highway 400, and the Bryne Drive extension. The volumes from the EMME model outputs along the section of Essa Road in the Study Area were found to be lower than the forecasts based on a 2% per annum (p.a.) growth rate applied to existing traffic data collected by the City in 2015 and 2017.

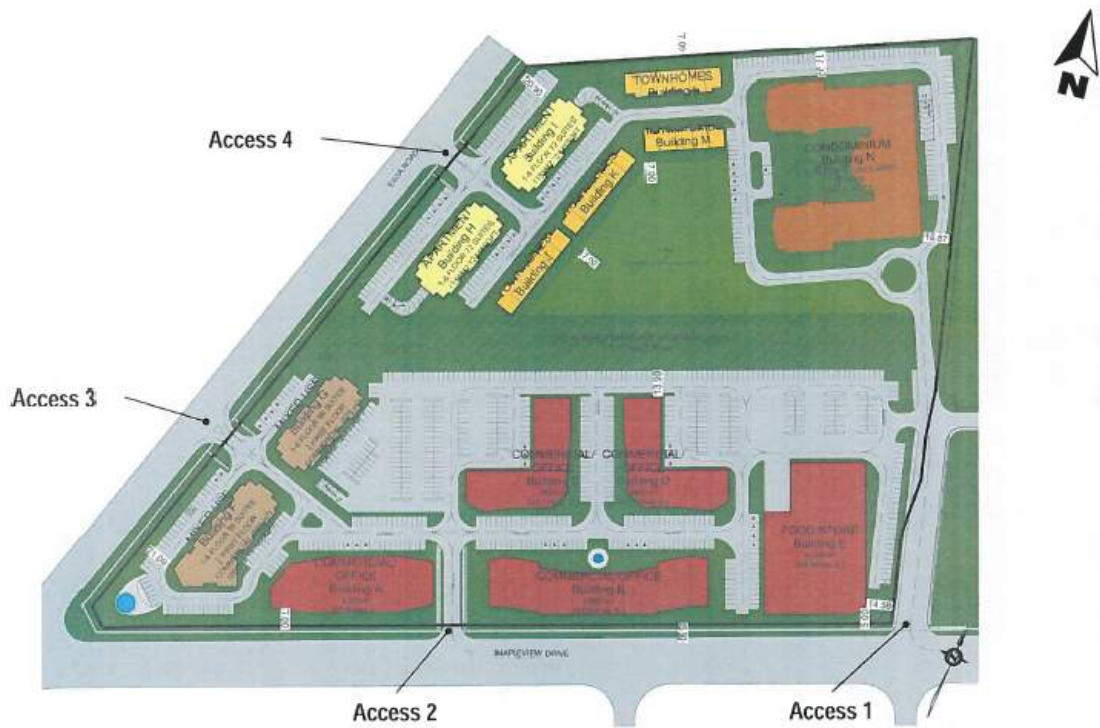
As noted earlier, based on discussions with the City of Barrie the typical background growth rate in the vicinity of the Study Area was assumed to be 2%. The average growth rate between 2016 EMME forecasts to 2021 and 2031 were found to be 1.7% p.a. and 1.6% p.a. respectively, which are close to the assumed 2% growth rate of background traffic. As such, the traffic volumes at the existing intersections of Essa Road with Coughlin Road and Mapleview Drive were grown using the 2% growth rate to 2021 and 2031.

#### **4.1.2 Messa Village Development**

Messa Village is a proposed mixed-use development in the northeast quadrant of the intersection of Mapleview Drive and Essa Road, slated for full-build out in 2019. Four access points will be provided for the proposed development:

- 2 full accesses along Mapleview Drive east of Essa Road (Access 1 and 2)
- One Right-In-Right-Out (RIRO) access on Essa Road located approximately 115m north of the intersection with Mapleview Drive, with stop control on the exit (Access 3)
- One full access Essa Road located approximately 365m north of the intersection with Mapleview Drive (Access 4)

The site layout for the proposed development is shown in **Figure 4-1**.



**Figure 4-1 Messa Village Site Layout**

The lands on which the Messa Village is to be developed are currently agricultural land uses. The proposed development will feature a number of residential and commercial land uses, including office and retail. The number of vehicle trips expected to be generated by the development was determined in the *Functional Servicing and Preliminary Stormwater Management Report for Messa Village* using vehicle trip generation rates published by the Institute of Transportation Engineers (ITE) in the ITE Trip Generation Manual (8<sup>th</sup> Edition). In the report, the trip generation rates were applied to the various land use components and sizes in the development for the weekday PM peak hour, and for the Saturday peak hour in lieu of the weekday AM peak hour due to the expected commercial component of the development. These trips were distributed and assigned to each access point and the Study Area intersections.

For the purposes of completing the capacity and operations analysis along Essa Road for the weekday PM peak hour, the additional site-generated trips at the intersection of Maplevue Drive and Essa Road were extracted from the report and added to the background traffic in 2021 and 2031. For the weekday AM peak hour, trips were generated using trip rates from the ITE Trip Generation Manual, and assigned based on the proportions by which trips in the Saturday peak hour were assigned in the Messa Village report. Details of the Messa Village site development trip generation and assignment are shown in **Appendix C**.

**Figures 4-2 and 4-3** provide a summary of forecasted traffic volumes for the 2021 and 2031 horizon years. Based on these traffic forecasts, operations and capacity analyses were completed for midblock road sections and intersections within the Study Area.



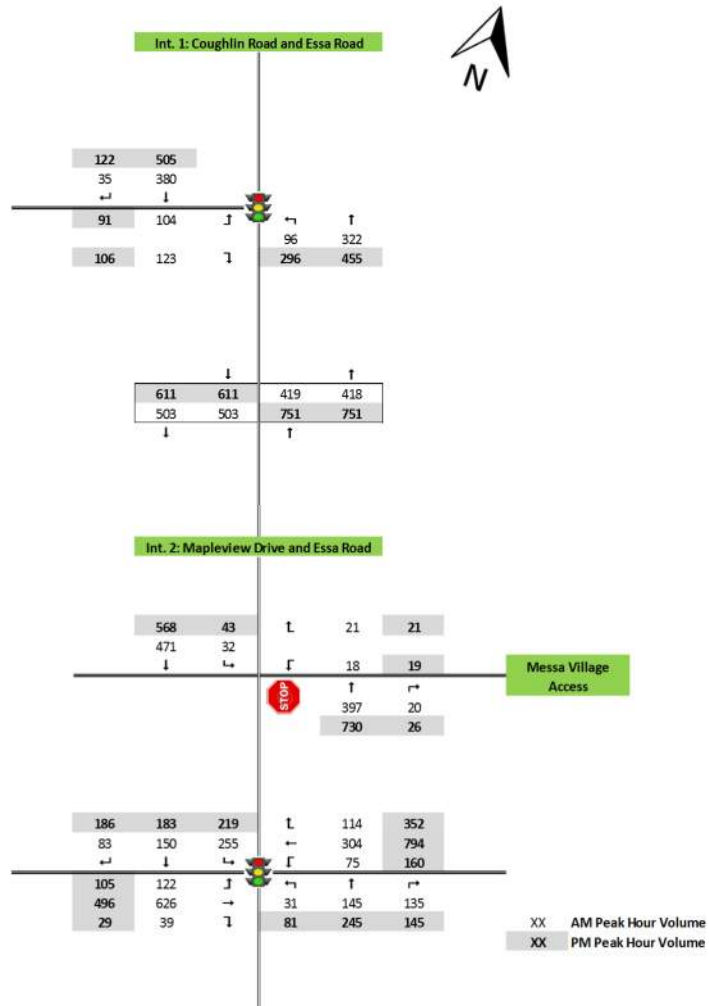


Figure 4-2 2021 Forecast Traffic Volumes

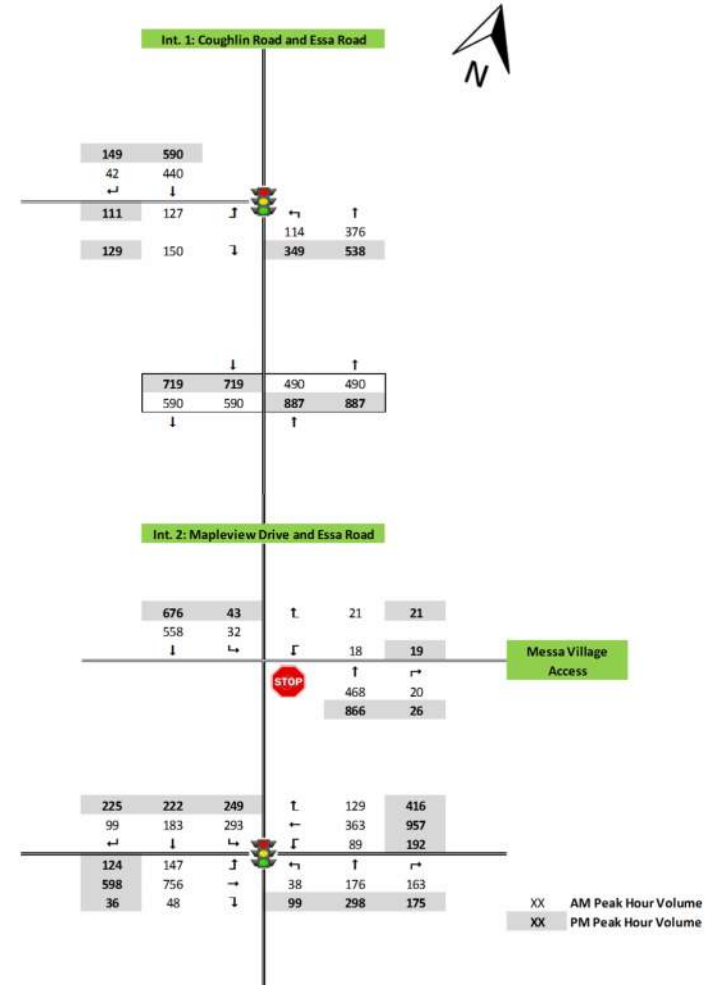


Figure 4-3 2031 Forecast Traffic Volumes

## 4.2 Future Midblock Analysis

### 4.2.1 2021 Midblock Analysis

#### 4.2.1.1 Without Roadway Widening

Assuming that Essa Road will remain as a two-lane arterial road in 2021, the results of the midblock capacity analysis under the 2021 forecast traffic conditions are summarized in **Table 4-1**.

**Table 4-1 2021 Midblock Capacity Analysis without Widening**

Section	AM Peak Direction Volume (vph)	AM Volume-to-Capacity Ratio (v/c)	PM Peak Direction Volume (vph)	PM Volume-to-Capacity Ratio (v/c)
<b>Essa Road (750 vph/l)</b>				
Mapleview Drive to Coughlin Road	505	0.67	750	1.00

In the 2021 horizon year, based on the forecasted traffic volumes, it is expected that Essa Road, between Mapleview Drive and Coughlin Road, **will operate at effective capacity in the PM peak hour, indicating a need for improvements.**

#### 4.2.1.2 Widening to 3-lanes

With a widening of Essa Road to three lanes (one through traffic lane and one two-way left turn lane) between Mapleview Drive and Coughlin Road, as identified in the MMATMP, it is expected that under 2021 forecast traffic conditions the road section will operate within effective capacity. **However, in the PM Peak hour, the section will operate at a v/c above 0.85, as shown in Table 4-2, indicating that further improvement is needed.**

**Table 4-2 2021 Midblock Capacity Analysis with Widening (3 Lanes)**

Section	AM Peak Direction Volume (vph)	AM Volume-to-Capacity Ratio (v/c)	PM Peak Direction Volume (vph)	PM Volume-to-Capacity Ratio (v/c)
<b>Essa Road (850 vph/l)</b>				
Mapleview Drive to Coughlin Road	505	0.59	750	0.88

#### 4.2.1.3 Widening to 5-lanes

The MMATMP identified a 3-lane cross section for Essa Road, from Mapleton Avenue to Salem Road, as the preferred option for the 2031 horizon. However, following the completion of the MMATMP, a number of development proposals have been received for lands along Essa Road. In addition, Essa Road has recently been widened to 5 lanes in 2016 between Mapleton Drive and Coughlin Road.

Based on the City's request to re-evaluate the MMTATMP's recommendations for Essa Road within the Study Area and consider the merit of a 5-lane cross section, a midblock capacity analysis was completed under 2021 forecast traffic conditions. With a 5-lane cross section,

Essa Road between Mapleview Drive and Coughlin Road **will operate within effective capacity**, as shown in **Table 4-3**.

**Table 4-3 2021 Midblock Capacity Analysis with Widening (5 lanes)**

Section	AM Peak Direction Volume (vph)	AM Volume-to-Capacity Ratio (v/c)	PM Peak Direction Volume (vph)	PM Volume-to-Capacity Ratio (v/c)
<b>Essa Road (850 vph/l)</b>				
Mapleview Drive to Coughlin Road	505	0.30	750	0.44

It should be noted that the MMATMP recommends the widening of Essa Road in the Study Area to 5 lanes in the 2051 horizon year.

#### 4.2.2 2031 Midblock Analysis

##### 4.2.2.1 Without Roadway Widening

Under 2031 forecast traffic conditions if Essa Road remains as a two-lane arterial road between Mapleview Drive and Coughlin Road, the midblock section of the road will **exceed effective capacity in the PM peak hour**, as shown in **Table 4-4**.

**Table 4-4 2031 Midblock Capacity Analysis without Widening**

Section	AM Peak Direction Volume (vph)	AM Volume-to-Capacity Ratio (v/c)	PM Peak Direction Volume (vph)	PM Volume-to-Capacity Ratio (v/c)
<b>Essa Road (750 vph/l)</b>				
Mapleview Drive to Coughlin Road	590	0.79	885	1.18

##### 4.2.2.2 Widening to 3-lanes

With the preferred 3-lane widening improvements along Essa Road between Mapleview Drive and Coughlin Road as identified in the MMATMP, it is expected that under 2031 forecast traffic conditions the road section **will operate at effective capacity in the PM peak hour** as shown in **Table 4-5**.

**Table 4-5 2031 Midblock Capacity Analysis with Widening (3 lanes)**

Section	AM Peak Direction Volume (vph)	AM Volume-to-Capacity Ratio (v/c)	PM Peak Direction Volume (vph)	PM Volume-to-Capacity Ratio (v/c)
<b>Essa Road (850 vph/l)</b>				
Mapleview Drive to Coughlin Road	590	0.69	885	1.04

##### 4.2.2.3 Widening to 5-lanes

Based on the City's request to re-evaluate the MMTATMP's recommendations for Essa Road within the Study Area and consider the merit of a 5-lane cross section, a midblock capacity

analysis was completed under 2031 forecast traffic conditions. With a 5-lane cross section, Essa Road between Mapleview Drive and Coughlin Road **will operate within effective capacity**, as shown in **Table 4-6**.

**Table 4-6 2031 Midblock Capacity Analysis with Widening (5 lanes)**

Section	AM Peak Direction Volume (vph)	AM Volume-to-Capacity Ratio (v/c)	PM Peak Direction Volume (vph)	PM Volume-to-Capacity Ratio (v/c)
<b>Essa Road (850 vph/l)</b>				
Mapleview Drive to Coughlin Road	590	0.35	885	0.52

It should be noted that the MMATMP recommends the widening of Essa Road in the Study Area to 5 lanes in the 2051 horizon year.

### 4.3 Future Intersection Operations

As part of the future operations analysis, intersections in the Study Area road network were analyzed using the forecasted traffic volumes for the 2021 and 2031 horizon years. The analysis for each horizon year evaluates the operations of the road network with the proposed widening improvements. In the Synchro models for both 2021 and 2031 peak conditions, a 1900 vehicle per hour per lane (v/h/l) saturation flow rate was used in accordance with the City of Barrie Synchro and SimTraffic guidelines; a peak hour factor of 1.00 was applied to all movements in the 2031 horizon year. Detailed Synchro reports are provided in **Appendix D** and **Appendix E**.

Lane configurations and the need for auxiliary lanes at signalized intersections were identified on the basis of the operational assessment of the 2021 and 2031 traffic and network conditions using SimTraffic outputs (average of five simulation runs) and based on Transportation Association Canada (TAC) Geometric Design Guide for Canadian Roads (Chapter 2.3).

#### 4.3.1 2021 Intersection Analysis

##### 4.3.1.1 Without Roadway Widening

For the 2021 scenario, the existing configurations of the signalized intersections of Essa Road at Mapleview Drive and Coughlin Road were analyzed using 2021 forecast traffic volumes.

The Messa Village development is expected to be complete by 2021 with a full access at Essa Road. This access was analysed as an unsignalized intersection with stop control on the exit lane from the development. The northbound and southbound movements on Essa Road were assumed to move freely.

**Table 4-7** summarizes the results of the analysis.

**Table 4-7 2021 Intersection Operations**

2021 Horizon Year Conditions									
Signalized Intersections									
Intersection	Movement	AM Peak Hour				PM Peak Hour			
		LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)	LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)
Essa Road and Coughlin Road	<b>Overall</b>	<b>B</b>	<b>10</b>	<b>0.21</b>	<b>-</b>	<b>B</b>	<b>11</b>	<b>0.47</b>	<b>-</b>
	EBL	C	33	0.40	28	D	38	0.37	29
	EBR	C	31	0.08	14	D	35	0.07	14
	NBL	A	5	0.14	10	A	5	0.46	21
	NBT	A	4	0.13	12	A	4	0.17	17
	SBT	A	5	0.17	15	B	11	0.30	40
Essa Road and Mapleview Drive	<b>Overall</b>	<b>C</b>	<b>25</b>	<b>0.54</b>	<b>-</b>	<b>C</b>	<b>27</b>	<b>0.59</b>	<b>-</b>
	EBL	C	21	0.29	24	C	25	0.46	21
	EBT	C	33	0.69	77	C	31	0.55	60
	WBL	C	24	0.34	16	C	21	0.46	31
	WBT	C	29	0.36	35	C	34	0.75	95
	WBR	C	27	0.07	10	C	26	0.22	19
	NBL	C	22	0.08	11	C	25	0.21	24
	NBT	C	23	0.23	37	C	28	0.40	61
	NBR	C	22	0.09	13	C	24	0.09	13
	SBL	B	15	0.43	48	B	17	0.43	41
	SBT	B	14	0.17	30	B	16	0.21	36
SBR	B	13	0.05	8	B	15	0.12	12	
Unsignalized Intersections									
Intersection	Movement	AM Peak Hour				PM Peak Hour			
		LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)	LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)
Essa Road and Messa Village Access	<b>Overall</b>	<b>B</b>	<b>1</b>	<b>0.61</b>	<b>-</b>	<b>D</b>	<b>1</b>	<b>0.75</b>	<b>-</b>
	WBLR	B	14.8	0.10	2	D	26	0.19	5
	NBTR	-	0.0	0.25	0	-	0	0.44	0
	SBLT	A	0.8	0.03	1	A	1	0.05	1

The impact of the traffic growth to 2021 is expected to be minimal at the intersections of Essa Road with Mapleview Drive and Coughlin Road. Both intersections will continue to operate at acceptable levels on an overall basis during the peak periods. All turning movements at the two intersections will also continue to operate at LOS D or better, with low delays and short queues.

Traffic operation at the unsignalized intersection of Essa Road and Messa Village Access is expected to be satisfactory, with low overall delay and v/c ratio, and with no turning movement operating worse than at LOS D.

**4.3.1.2 3-Lane Roadway Widening**

When Essa Road is widened to 3 lanes, with one lane in each direction and a Two-way Left Turn Lane (TWLTL), the approach lane configurations remain the same at the intersection of Essa Road and Mapleview Drive, and Essa Road and Coughlin Road. Traffic operations analysis shows that the addition of the two-way left turn lane is expected to improve the operation of turning movements at the unsignalized intersection of Essa Road with the Messa

Village Access. The turning movements at this intersection will operate at LOS C or better. Results are summarized in **Table 4-8**.

**Table 4-8 2021 Intersection Operations with 3-Lane Widening**

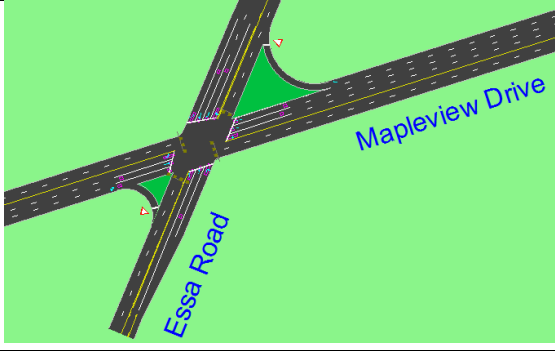
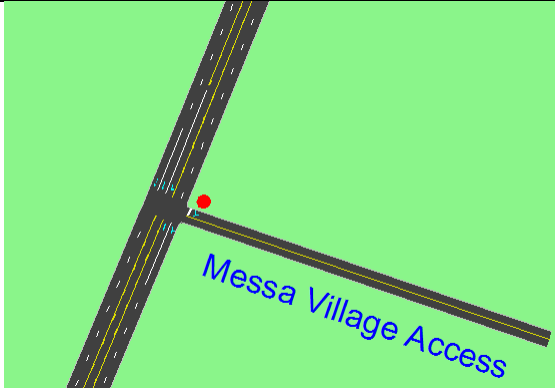

2021 Horizon Year Conditions - 3 Lane widening									
Signalized Intersections									
Intersecti on	Movement	AM Peak Hour				PM Peak Hour			
		LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)	LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)
Essa Road and Coughlin Road	<b>Overall</b>	<b>B</b>	<b>10</b>	<b>0.21</b>	<b>-</b>	<b>B</b>	<b>11</b>	<b>0.47</b>	<b>-</b>
	EBL	C	33	0.40	28	D	38	0.37	29
	EBR	C	31	0.08	14	D	35	0.07	14
	NBL	A	5	0.14	10	A	5	0.46	21
	NBT	A	4	0.13	12	A	4	0.17	17
	SBT	A	5	0.17	15	B	11	0.30	40
Essa Road and Mapleview Drive	<b>Overall</b>	<b>C</b>	<b>25</b>	<b>0.54</b>	<b>-</b>	<b>C</b>	<b>27</b>	<b>0.59</b>	<b>-</b>
	EBL	C	21	0.29	24	C	25	0.46	21
	EBT	C	33	0.69	77	C	31	0.55	60
	WBL	C	24	0.34	16	C	21	0.46	31
	WBT	C	29	0.36	35	C	34	0.75	95
	WBR	C	27	0.07	10	C	26	0.22	19
	NBL	C	22	0.08	11	C	25	0.21	24
	NBT	C	23	0.23	37	C	28	0.40	61
	NBR	C	22	0.09	13	C	24	0.09	13
	SBL	B	15	0.43	48	B	17	0.43	41
	SBT	B	14	0.17	30	B	16	0.21	36
SBR	B	13	0.05	8	B	15	0.12	12	
Unsignalized Intersections									
Intersecti on	Movement	AM Peak Hour				PM Peak Hour			
		LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)	LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)
Essa Road and Messa Village Access	<b>Overall</b>	<b>B</b>	<b>1</b>	<b>0.37</b>	<b>-</b>	<b>C</b>	<b>1</b>	<b>0.50</b>	<b>-</b>
	WBLR	B	12	0.07	2	C	15	0.10	3
	NBTR	-	0	0.25	0	-	0	0.44	0
	SBLT	A	8	0.28	1	A	10	0.33	1

#### 4.3.1.3 5-Lane Roadway Widening

Widening of Essa Road to a 5-lane cross section will result in changes in the lane configuration at some approaches of the Study Area intersections as shown in **Table 4-9**.

- A southbound through lane will be added at the intersection of Essa Road and Mapleview Drive.
- A lane in each of the northbound and southbound directions will be added at the intersection of Essa Road and the Messa Village access; the center TWLTL will accommodate a southbound left turn lane with the required storage length.

**Table 4-9 Intersection Lane Configuration under 5-Lane Widening**

Intersection	Configuration
Essa Road and Mapleview Drive	
Essa Road and Messa Village Access	
Essa Road and Coughlin Road	

The addition of a through lane in each direction on Essa Road and a center TWLTL will result in a very minor improvement to traffic operations for through movements at the signalized intersection of Essa Road with Mapleview Drive. Overall, the intersections will continue to operate at a LOS C or better with low delays and v/c ratios as shown in **Table 4-10**.

The operations at the unsignalized intersection of Essa Road with Messa Village access will be better under the 5-lane cross section of Essa Road than under both the existing conditions and the 3-lane cross section.

**Table 4-10 2021 Intersection Operations with 5-Lane Widening**

<b>2021 Horizon Year Conditions - 5 Lane widening</b>									
<b>Signalized Intersections</b>									
<b>Intersection</b>	<b>Movement</b>	<b>AM Peak Hour</b>				<b>PM Peak Hour</b>			
		<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>	<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>
Essa Road and Coughlin Road	<b>Overall</b>	<b>B</b>	<b>10</b>	<b>0.21</b>	<b>-</b>	<b>B</b>	<b>9</b>	<b>0.49</b>	<b>-</b>
	EBL	C	33	0.40	28	D	38	0.38	28
	EBR	C	31	0.08	14	D	36	0.07	14
	NBL	A	5	0.14	10	A	9	0.51	40
	NBT	A	4	0.13	12	A	4	0.17	17
	SBT	A	5	0.17	15	A	4	0.24	21
Essa Road and Mapleview Drive	<b>Overall</b>	<b>C</b>	<b>25</b>	<b>0.54</b>	<b>-</b>	<b>C</b>	<b>27</b>	<b>0.59</b>	<b>-</b>
	EBL	C	21	0.29	24	C	25	0.46	21
	EBT	C	33	0.69	77	C	31	0.55	60
	WBL	C	24	0.34	16	C	21	0.46	31
	WBT	C	29	0.36	35	C	34	0.75	95
	WBR	C	27	0.07	10	C	26	0.22	19
	NBL	C	22	0.08	11	C	25	0.21	24
	NBT	C	23	0.23	37	C	28	0.40	61
	NBR	C	22	0.09	13	C	24	0.09	13
	SBL	B	15	0.43	48	B	17	0.43	41
	SBT	B	13	0.09	15	B	16	0.11	17
SBR	B	13	0.05	8	B	15	0.12	12	
<b>Unsignalized Intersections</b>									
<b>Intersection</b>	<b>Movement</b>	<b>AM Peak Hour</b>				<b>PM Peak Hour</b>			
		<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>	<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>
Essa Road and Messa Village Access	<b>Overall</b>	<b>B</b>	<b>1</b>	<b>0.28</b>	<b>-</b>	<b>B</b>	<b>1</b>	<b>0.38</b>	<b>-</b>
	WBLR	B	11	0.06	1	B	13	0.08	2
	NBTR	-	0	0.16	0	-	0	0.29	0
	SBL	A	8	0.03	1	A	10	0.05	1
	SBT	-	0	0.14	0	-	0	0.17	0

### 4.3.2 2031 Intersection Analysis

#### 4.3.2.1 Without Roadway Widening

For the 2031 scenario, the existing configurations of the signalized intersections of Essa Road at Mapleview Drive and Coughlin Road were analyzed using 2031 forecast traffic volumes. The unsignalized intersection of Essa Road and the Messa Village Access was also analysed with stop control on the exit leg from the development.

**Table 4-11** summarizes the results of the analysis.



**Table 4-11 2031 Intersection Operations**

<b>2031 Horizon Year Conditions</b>									
<b>Signalized Intersections</b>									
<b>Intersection</b>	<b>Movement</b>	<b>AM Peak Hour</b>				<b>PM Peak Hour</b>			
		<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>	<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>
Essa Road and Coughlin Road	<b>Overall</b>	<b>B</b>	<b>11</b>	<b>0.25</b>	<b>-</b>	<b>B</b>	<b>12</b>	<b>0.59</b>	<b>-</b>
	EBL	C	34	0.47	34	D	39	0.45	35
	EBR	C	31	0.10	15	D	36	0.08	15
	NBL	A	5	0.18	13	A	7	0.60	27
	NBT	A	5	0.15	15	A	4	0.21	21
	SBT	A	5	0.20	19	B	12	0.37	54
Essa Road and Mapleview Drive	<b>Overall</b>	<b>C</b>	<b>27</b>	<b>0.64</b>	<b>-</b>	<b>C</b>	<b>31</b>	<b>0.72</b>	<b>-</b>
	EBL	C	20	0.36	29	C	25	0.51	25
	EBT	D	35	0.78	96	C	32	0.61	73
	WBL	C	25	0.45	19	C	24	0.60	37
	WBT	C	29	0.39	42	D	43	0.89	129
	WBR	C	27	0.08	13	C	27	0.26	21
	NBL	C	24	0.10	13	C	28	0.28	29
	NBT	C	26	0.30	44	C	32	0.52	74
	NBR	C	24	0.11	14	C	26	0.15	19
	SBL	B	18	0.52	55	C	20	0.57	46
	SBT	B	16	0.21	36	B	18	0.26	43
SBR	B	14	0.06	9	B	17	0.14	13	
<b>Unsignalized Intersections</b>									
<b>Intersection</b>	<b>Movement</b>	<b>AM Peak Hour</b>				<b>PM Peak Hour</b>			
		<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>	<b>LOS</b>	<b>Delay(s)</b>	<b>V/C</b>	<b>95<sup>th</sup> Queue (m)</b>
Essa Road and Messa Village Access	<b>Overall</b>	<b>C</b>	<b>1</b>	<b>0.66</b>	<b>-</b>	<b>E</b>	<b>2</b>	<b>0.81</b>	<b>-</b>
	WBRL	C	17	0.11	3	E	39	0.27	8.0
	NBTR	-	0	0.29	0	-	-	0.52	0.0
	SBLT	A	1	0.03	1	A	2	0.06	1.4

With 2031 traffic forecasts, the signalized intersections along Essa Road continue to perform at overall LOS C or better with low delays.

The unsignalized intersection at the Messa Village Access experiences some congestion in the PM peak hour, as the westbound movements exiting Messa Village are required to stop, find an acceptable gap in the free-flowing northbound and southbound movements along Essa Road to complete the respective maneuvers. There are higher volumes of north-south traffic on Essa Road in 2031, providing fewer acceptable gaps and causing the westbound left and right turn (WBRL) movement to operate as a critical movement at a LOS E.

**4.3.2.2 3-Lane Roadway Widening**

When Essa Road is widened to 3 lanes, with one lane in each direction and a center TWLTL, the approach lane configurations remain the same at the intersections of Essa Road and Mapleview Drive, and Essa Road and Coughlin Road. Under the 2031 traffic forecasts, the traffic conditions in the study network will continue to be acceptable with all intersections operating with LOS D or better. With the 3-lane cross section, the operations at the

intersection of Essa Road and Messa Village Access will be better than under existing road configuration, with turning movements operating at LOS C or better in both peak hours

**Table 4-12 2031 Intersection Operations with 3-Lane Widening**

2031 Horizon Year Conditions - 3 Lane Widening									
Signalized Intersections									
Intersection	Movement	AM Peak Hour				PM Peak Hour			
		LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)	LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)
Essa Road and Coughlin Road	<b>Overall</b>	<b>B</b>	<b>11</b>	<b>0.25</b>	<b>-</b>	<b>B</b>	<b>12</b>	<b>0.59</b>	<b>-</b>
	EBL	C	34	0.47	34	D	39	0.45	35
	EBR	C	31	0.10	15	D	36	0.08	15
	NBL	A	5	0.18	13	A	7	0.60	27
	NBT	A	5	0.15	15	A	4	0.21	21
	SBT	A	5	0.20	19	B	12	0.37	54
Essa Road and Mapleview Drive	<b>Overall</b>	<b>C</b>	<b>27</b>	<b>0.64</b>	<b>-</b>	<b>C</b>	<b>31</b>	<b>0.72</b>	<b>-</b>
	EBL	C	20	0.36	29	C	25	0.51	25
	EBT	D	35	0.78	96	C	32	0.61	73
	WBL	C	25	0.45	19	C	24	0.60	37
	WBT	C	29	0.39	42	D	43	0.89	129
	WBR	C	27	0.08	13	C	27	0.26	21
	NBL	C	24	0.10	13	C	28	0.28	29
	NBT	C	26	0.30	44	C	32	0.52	74
	NBR	C	24	0.11	14	C	26	0.15	19
	SBL	B	18	0.52	55	C	20	0.57	46
	SBT	B	16	0.21	36	B	18	0.26	43
SBR	B	14	0.06	9	B	17	0.14	13	
Unsignalized Intersections									
Intersection	Movement	AM Peak Hour				PM Peak Hour			
		LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)	LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)
Essa Road and Messa Village Access	<b>Overall</b>	<b>B</b>	<b>1</b>	<b>0.39</b>	<b>-</b>	<b>C</b>	<b>1</b>	<b>0.57</b>	<b>-</b>
	WBLR	B	13	0.08	2	C	18	0.13	3
	NBTR	-	0	0.29	0	-	0	0.52	0
	SBL	A	9	0.03	1	B	10	0.06	1
	SBT	-	0	0.33	0	-	0	0.40	0

#### 4.3.2.3 5-Lane Roadway Widening

Widening of Essa Road to a 5-lane cross section will result in the changes of the intersection lane configurations as discussed in **Section 4.3.1.3** and shown in **Table 4-9**. With 2031 traffic forecasts, the study network intersections are expected to operate at LOS C or better and with low overall delays.

**Table 4-13 2031 Intersection Operations with 5-Lane Widening**

2031 Horizon Year Conditions - 5 Lane Widening									
Signalized Intersections									
Intersection	Movement	AM Peak Hour				PM Peak Hour			
		LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)	LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)
Essa Road and Coughlin Road	<b>Overall</b>	<b>B</b>	<b>12</b>	<b>0.24</b>	<b>-</b>	<b>B</b>	<b>11</b>	<b>0.64</b>	<b>-</b>
	EBL	D	39	0.51	37	D	38	0.45	33
	EBR	C	35	0.10	16	D	35	0.08	15
	NBL	A	5	0.18	13	B	14	0.68	71
	NBT	A	4	0.15	16	A	4	0.21	21
	SBT	A	5	0.19	20	A	5	0.28	27
Essa Road and Mapleview Drive	<b>Overall</b>	<b>C</b>	<b>27</b>	<b>0.64</b>	<b>-</b>	<b>C</b>	<b>31</b>	<b>0.72</b>	<b>-</b>
	EBL	C	20	0.36	29	C	25	0.51	25
	EBT	D	35	0.78	96	C	32	0.61	73
	WBL	C	25	0.45	19	C	24	0.60	37
	WBT	C	29	0.39	42	D	43	0.89	129
	WBR	C	27	0.08	13	C	27	0.26	21
	NBL	C	24	0.10	13	C	28	0.28	29
	NBT	C	26	0.30	44	C	32	0.52	74
	NBR	C	24	0.11	14	C	26	0.15	19
	SBL	B	18	0.52	55	C	20	0.57	46
	SBT	B	15	0.11	18	B	17	0.14	21
SBR	B	14	0.06	9	B	17	0.14	13	
Unsignalized Intersections									
Intersection	Movement	AM Peak Hour				PM Peak Hour			
		LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)	LOS	Delay(s)	V/C	95 <sup>th</sup> Queue (m)
Essa Road and Messa Village Access	<b>Overall</b>	<b>B</b>	<b>1</b>	<b>0.30</b>	<b>-</b>	<b>B</b>	<b>1</b>	<b>0.41</b>	<b>-</b>
	WBLR	B	11	0.06	2	B	15	0.10	2
	NBTR	-	0	0.18	0	-	0	0.34	0
	SBL	A	9	0.03	1	B	10	0.06	1
	SBT	-	0	0.16	0	-	0	0.20	0

#### 4.4 Queuing Assessment, Storage Lane Requirements

An analysis of storage lane requirements for left and right turning lanes was completed for the intersections within the Study Area assuming a **5-lane** cross section of Essa Road. Storage lengths were reviewed and recommended based on the average of five (5) simulation runs from SimTraffic, as specified in the project Terms of Reference. This is to ensure that the turning lanes are sufficiently long to accommodate the 95<sup>th</sup> percentile vehicle queues expected to accumulate during the peak periods of the **2031** design year conditions. It is noted that the design of left and right turn auxiliary lanes should also incorporate these storage lengths and sufficient parallel lane lengths to satisfy deceleration length requirements that are in accordance with the design speed selected for the roadway.

**Table 4-14** displays the results of the analysis, comparing results from Synchro and SimTraffic, and the final recommended storage lengths for all turning movements. Detailed SimTraffic reports are provided in **Appendix F**.

**Table 4-14 Required Storage Lengths**

Intersection	Movement	Synchro 95 <sup>th</sup> Queue (m) AM (PM)	SimTraffic 95 <sup>th</sup> Queue (m) AM (PM)	Recommended Storage Length (m)
Essa Road and Coughlin Road	EBL	37 (33)	42 (39)	45
	EBR	16 (15)	33 (20)	35
	NBL	13 (71)	31 (79)	80
	NBT	16 (21)	25 (118)	-
	SBT	20 (27)	38 (80)	-
	SBTR	20 (27)	18 (35)	-
Essa Road and Mapleview Drive	EBL	29 (25)	32 (34)	35
	EBT	96 (73)	101 (95)	-
	EBTR	96 (73)	88 (86)	-
	WBL	19 (37)	24 (41)	45
	WBT	42 (130)	52 (101)	-
	NBL	13 (29)	8 (26)	30
	NBT	44 (74)	37 (60)	-
	NBR	14 (19)	19 (13)	25
	SBL	55 (46)	81 (42)	85
	SBT	18 (21)	13 (14)	-
Essa Road and Messa Village Access	SBR	9 (13)	4 (29)	30
	WBLR	11 (15)	6 (16)	25
	SBL	9 (10)	3 (12)	25

**4.5 Future Daily Traffic and Daily Truck Traffic Analysis.**

The AADT and AADTT were estimated along Essa Road under horizon year traffic conditions using the 2021 and 2031 traffic forecasts. The same factor of 0.08 was used to convert the projected PM peak hour volumes to daily volumes at midblock sections along Essa Road in the Study Area. It was assumed that 2% of daily traffic volume is comprised of truck traffic, similar to the assumptions for the existing traffic composition. The assumed truck percentage was applied to the 2021 and 2031 AADT volumes to estimate the number of trucks on the roadway section.

2021 and 2031 AADT and AADTT volumes on the side streets, Coughlin Road and Mapleview Drive, were determined by applying the same assumptions used in the existing conditions.

**Figure 4-4** and **Figure 4-5** illustrate the 2021 two-way and directional AADT and AADTT volumes along Essa Road respectively.

**Figure 4-6** and **Figure 4-7** illustrate the 2031 two-way and directional AADT and AADTT volumes along Essa Road respectively.

c

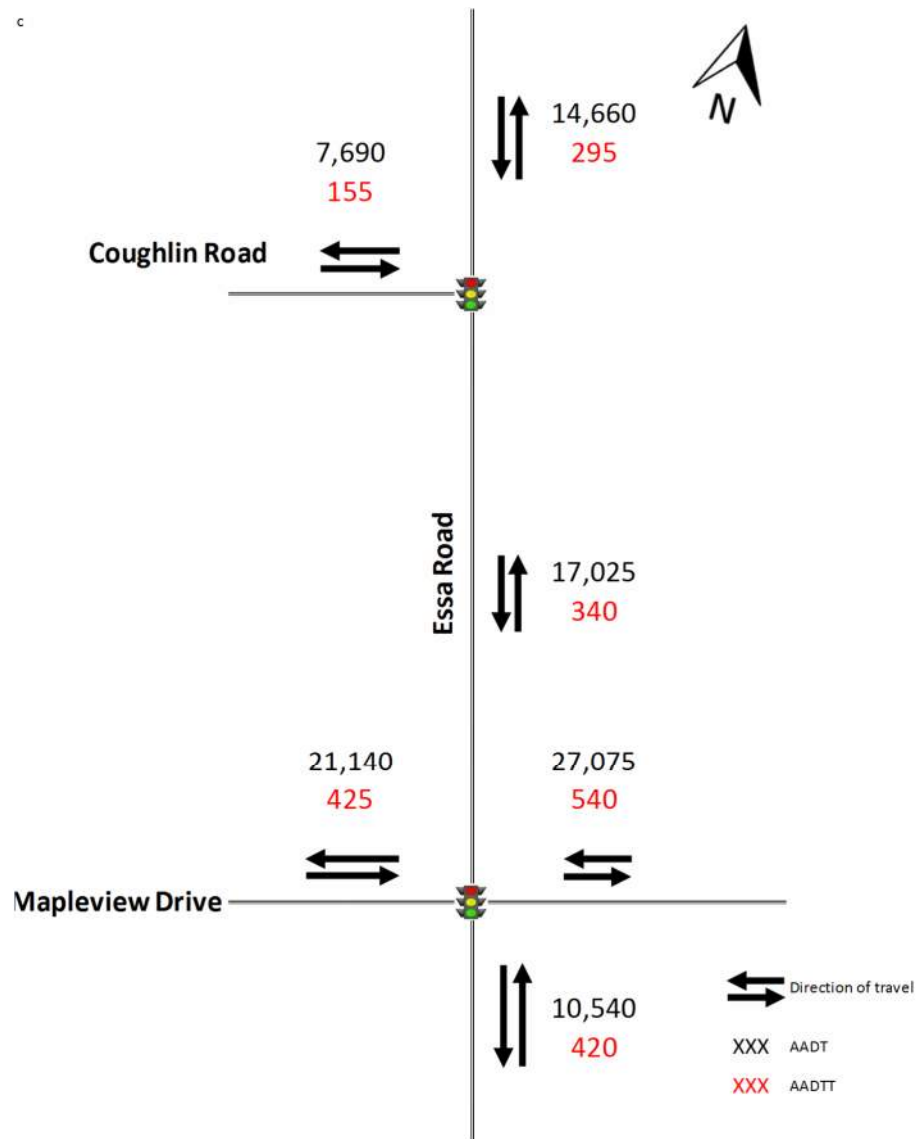


Figure 4-4 2021 AADT and AADTT (Two-Way)

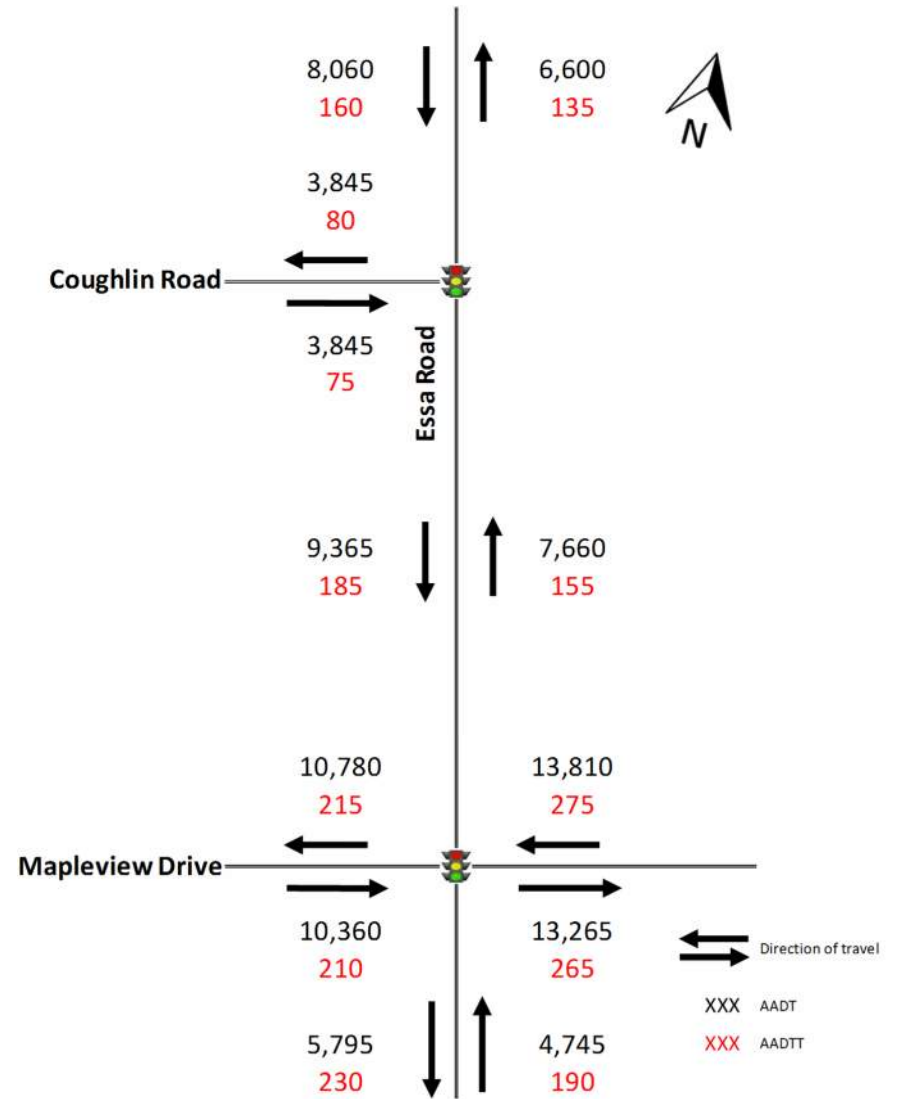


Figure 4-5 2021 AADT and AADTT (By Direction)

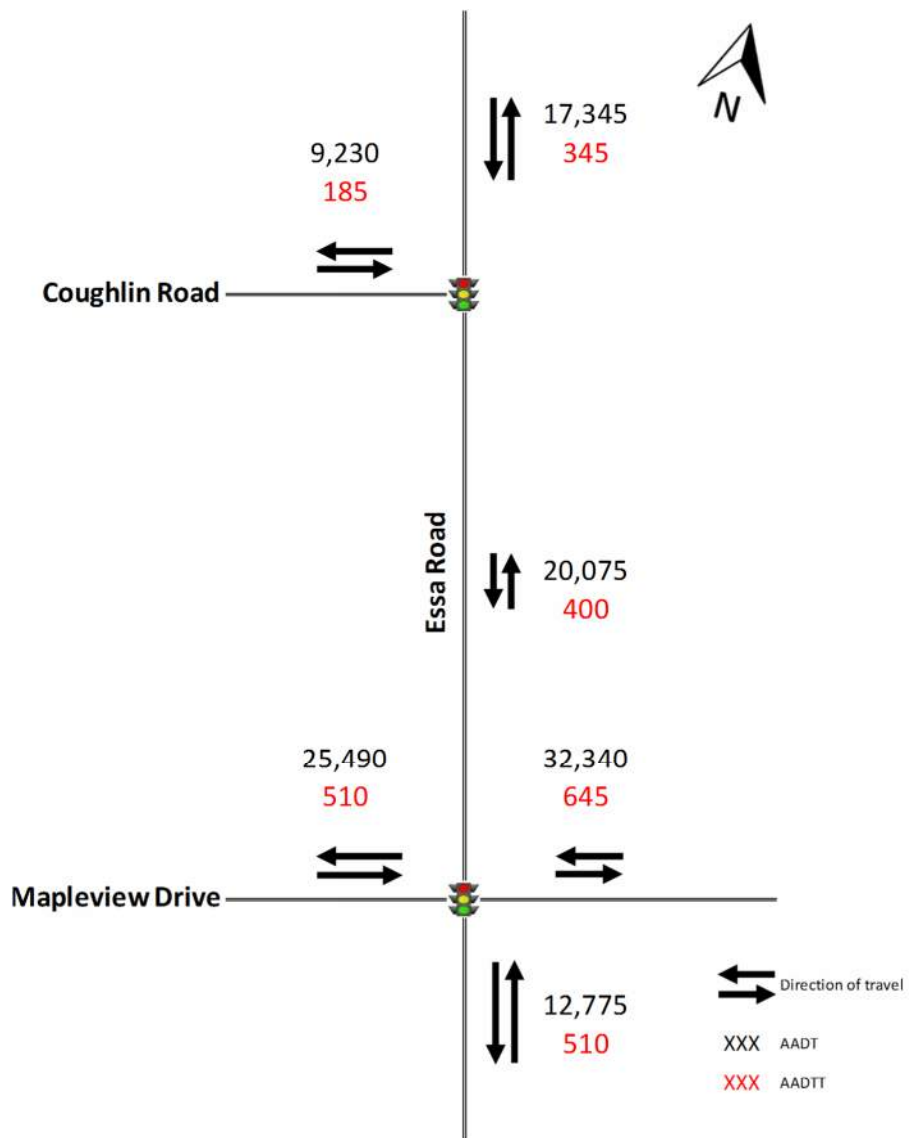


Figure 4-6 2031 AADT and AADTT (Two-Way)

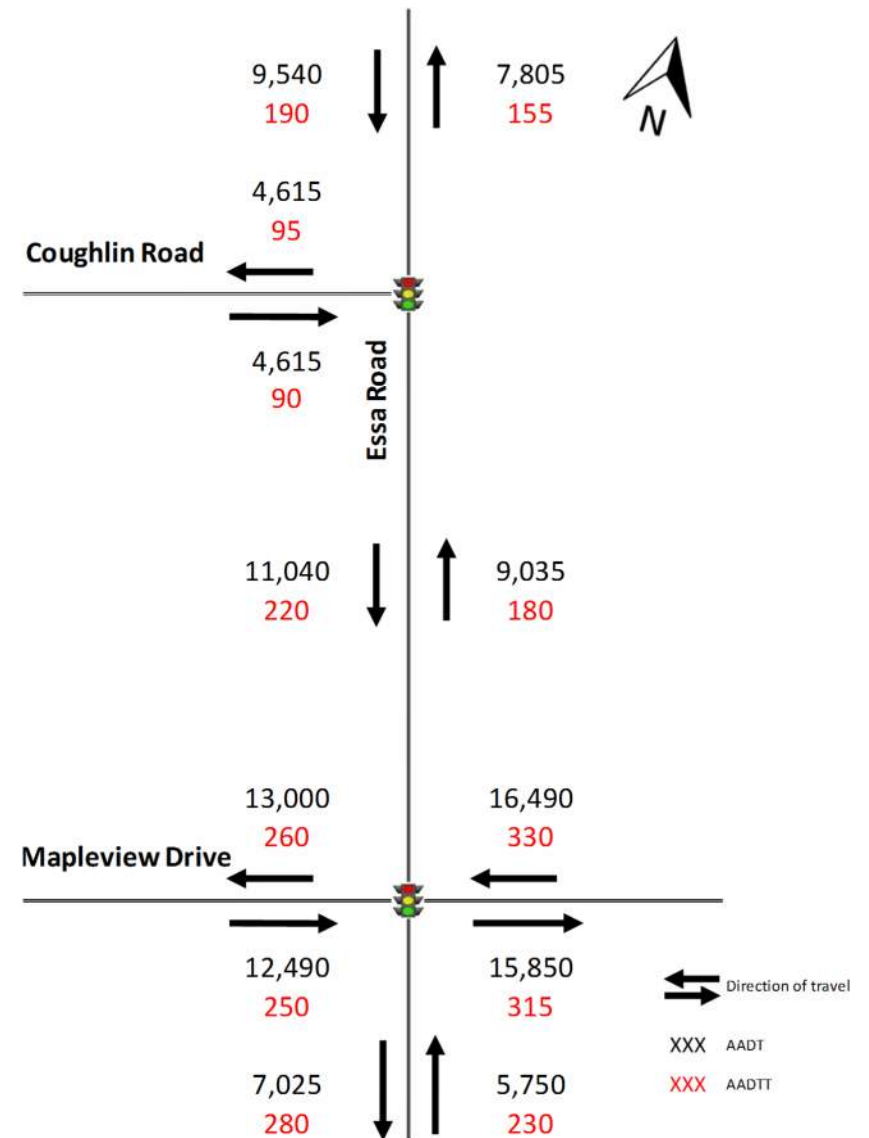


Figure 4-7 2031 AADT and AADTT (By Direction)

## 4.6 Road Improvement and Safety Impacts

An assessment of the impacts on safety along Essa Road between Maplevue Drive and Coughlin Road was completed by identifying the Crash Modification Factors (CMFs) associated with the proposed widening of Essa Road to 5 lanes. A CMF is defined as the factor by which the expected crash frequency is changed due to a modification in roadway design or traffic control. CMFs were determined using the information published in the *CMF Clearinghouse*<sup>5</sup> website, which includes CMFs for a wide variety of roadway treatments from multiple studies.

The following factors provide an indication of the expected changes in overall crash experience due to the improvements proposed for Essa Road in the Study Area:

### (1) Converting Two-Lane Roadway to 5 Lanes

Although the *CMF Clearinghouse* does not list CMFs for directly converting a two-lane undivided roadway to 5 lanes, it provides CMFs for converting a two-lane roadway to 4 lanes, and for converting 4-lane roadway to 5 lanes.

#### a. Two-Lane Roadway to 4 Lanes

**Table 4-15** shows the CMFs for converting a 2 lane roadway to a 4 lane roadway. The average CMFs were calculated based on this data as follows:

CMF (All Severity Type) = 0.56

CMF (PDO) = 0.46

CMF (Fatal/Non-fatal Injury) = 0.52

The average CMFs indicate that there is a potential to reduce PDO collisions by 54% and fatal and non-fatal injury collisions by 48% by converting a roadway from 2 lanes to 4 lanes.

**Table 4-15 Crash Modification Factors for Converting Two-Lane Roadway to 4 Lanes**

CMF	CRF (%)	Crash Type	Crash Severity	Area Type	Reference
0.34	65.88	All	All	Urban	<a href="#">Ahmed et al., 2015</a>
0.71	28.79	All	All	Rural	<a href="#">Ahmed et al., 2015</a>
0.69	30.88	All	Property damage only (PDO)	Rural	<a href="#">Ahmed et al., 2015</a>
0.55	45.13	All	Fatal, Serious injury, Minor injury	Rural	<a href="#">Ahmed et al., 2015</a>
0.35	64.89	All	Property damage only (PDO)	Urban	<a href="#">Ahmed et al., 2015</a>
0.37	63.27	All	Fatal, Serious injury, Minor injury	Urban	<a href="#">Ahmed et al., 2015</a>

<sup>5</sup> <http://www.cmfclearinghouse.org/index.cfm>

CMF	CRF (%)	Crash Type	Crash Severity	Area Type	Reference
0.47	53.36	All	All	Urban	<a href="#">Ahmed et al., 2015</a>
0.71	28.59	All	All	Rural	<a href="#">Ahmed et al., 2015</a>

**b. 4-Lane Roadway to 5 Lanes**

**Table 4-16** shows the CMFs for converting a 4-lane roadway to a 5 lanes. The average CMFs were calculated based on this data as follows:

CMF (All Severity Type) = 0.44

CMF (PDO) = 0.45

CMF (Fatal/Non-fatal Injury) = 0.49

The average CMFs indicate that there is a potential to reduce PDO collisions by 55% and fatal and non-fatal injury collisions by 51% by converting a roadway from 4 lanes to 5 lanes.

**Table 4-16 Crash Modification Factors for Converting 4-Lane Roadway to 5 Lanes**

CMF	CRF (%)	Crash Type	Crash Severity	Area Type	Reference
0.45	55	All	All	Urban	<a href="#">Sun et al., 2012</a>
0.43	57	All	All	Suburban	<a href="#">Sun et al., 2012</a>
0.38	62	All	Property damage only (PDO)	Urban	<a href="#">Sun et al., 2012</a>
0.51	49	All	Property damage only (PDO)	Suburban	<a href="#">Sun et al., 2012</a>
0.49	51	All	Serious injury, Minor injury	Urban	<a href="#">Sun et al., 2012</a>

**(2) Installation of left-turn lane**

**Table 4-17** shows the CMFs for installing a left turn lane. The average CMFs were calculated based on this data as follows:

CMF (All Severity Type) = 0.83

CMF (PDO) = 0.80

CMF (Fatal/Non-fatal Injury) = 0.72

The average CMFs indicate that there is a potential to reduce PDO collisions by 20% and fatal and non-fatal injury collisions by 28% by adding a left-turn lane at the northbound approach at Essa Road and Coughlin Road.



**Table 4-17 Crash Modification Factors for Installing Left-turn Lane**

CMF	CRF (%)	Crash Type	Crash Severity	Area Type	Reference
0.75	25.2	All	All	All	Srinivasan et al., 2014
0.92	7.6	All	All	All	Srinivasan et al., 2014
0.88	12.4	All	All	All	Srinivasan et al., 2014
0.57	43.4	All	Fatal, Serious injury, Minor injury	All	Srinivasan et al., 2014
0.80	20.1	All	Fatal, Serious injury, Minor injury	All	Srinivasan et al., 2014
0.74	25.6	All	Fatal, Serious injury, Minor injury	All	Srinivasan et al., 2014
0.41	58.8	Rear End	All	All	Srinivasan et al., 2014
0.56	44.5	Rear End	All	All	Srinivasan et al., 2014
0.49	50.6	Rear End	All	All	Srinivasan et al., 2014
1.02	-2	Other	All	All	Srinivasan et al., 2014
0.88	12.1	Other	All	All	Srinivasan et al., 2014
0.92	8.4	Other	All	All	Srinivasan et al., 2014
1.09	-8.6	Other	All	All	Srinivasan et al., 2014
1.02	-1.6	Other	All	All	Srinivasan et al., 2014
1.05	-4.6	Other	All	All	Srinivasan et al., 2014
0.79	21	All	Fatal, Serious injury, Minor injury	Urban	El-Basyouny and Sayed, 2011
0.80	20	All	Property damage only (PDO)	Urban	El-Basyouny and Sayed, 2011

Overall, the safety impacts of the widened roadway along Essa Road are satisfactory. Improvements such as widening the roadway from 2 lanes to 5 lanes and adding a northbound left-turn lane at the intersection of Essa Road and Coughlin Road, may reduce collisions along the roadway. It should be noted however, that widening the roadway by adding a through lane in each direction could also contribute to increased traffic speeds on Essa Road. There is an opportunity to encourage drivers to maintain the posted speed limit by means of incorporating countermeasures in the design phase, such as traffic lanes with reduced widths and raised island treatments where applicable.

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## 5. Summary of Findings

Based on this analysis, midblock section improvements and the corresponding changes to intersection lane configurations are recommended to accommodate the projected 2021 and 2031 traffic conditions on Essa Road within the Study Area. The specific improvements required are summarized below. The need and timing for the identified improvements should be monitored as traffic volumes increase.

### 5.1 2017 Existing Conditions

#### Midblock Capacity

- Essa Road, from Mapleview Drive to Coughlin Road, is operating at acceptable levels.

#### Intersection Operations

- All intersections are operating at acceptable levels on an overall basis.

### 5.2 2021 Future Conditions

#### Midblock Capacity

- Based on the forecasted traffic volumes it is expected that Essa Road from Mapleview Drive to Coughlin Road will be operating at effective capacity in the PM peak hour under the existing road configuration.
- With 3-lane widening, the mid-block section will approach effective capacity with a v/c ratio of 0.88 in the PM peak hour, which is above the acceptable threshold of 0.85.
- **Widening Essa Road to 5 lanes improves mid-block traffic operations** and results in v/c ratio of 0.44 in the PM peak hour which is within the acceptable threshold.

#### Intersection Operations

- Under existing road configuration, the signalized intersections of Essa Road with Mapleview Drive and Coughlin Road are expected to operate at acceptable conditions at overall LOS C or better and with low delays in both the AM and PM peak hours.
- The unsignalized intersection of Essa Road with the access into the proposed Messa Village development will be built by 2021. This intersection will perform at acceptable LOS D or better in the peak hours.
- Widening of Essa Road to 3 lanes will improve the operations at the intersection of Essa Road and Messa Village access.
- With 5-lane widening, a number of lane configuration improvements will be made to the intersections including:
  - Addition of southbound through lane at the intersection of Essa Road and Mapleview Drive
  - Addition of a lane in each of the northbound and southbound directions at the intersection of Essa Road and the Messa Village access

- Addition of a southbound left turn only lane with adequate storage length accommodated by the center TWLTL at the intersection of Essa Road and the Messa Village Access
- Widening of Essa Road to 5 lanes will further improve all intersection operations.
- Overall, the safety impacts of the widened roadway along Essa Road are satisfactory.

### 5.3 2031 Future Conditions

#### Midblock Capacity

- Based on the forecasted traffic volumes it is expected that Essa Road from Mapleview Drive to Coughlin Road will be operating at effective capacity in the PM peak hour under the existing road configuration and with 3-lane widening.
- **Widening Essa Road to 5-lanes will improve mid-block traffic operations** and result in v/c ratio of 0.52 in the PM peak hour, which is within the acceptable threshold.

#### Intersection Operations

- Under existing road configuration, the signalized intersections of Essa Road with Mapleview Drive and Coughlin Road are expected to operate at acceptable conditions with overall LOS C or better and low delays in both the AM and PM peak hours.
- Under existing road configuration, the unsignalized intersection of Essa Road with the access into the proposed Messa Village development will be built by 2021. At this intersection, the westbound left and right turn turns exiting the Messa Village development will operate at LOS E due to the fewer acceptable gaps in the northbound-southbound traffic along Essa Road.
- Widening of Essa Road to 3 lanes will improve the operations at the intersection of Essa Road and Messa Village access.
- Widening of Essa Road to 5-lanes will further improve intersection operations at the unsignalized intersection at the Messa Villa access, which will perform at LOS B or better.
- Based on SimTraffic analysis, required storage lengths for the left and right auxiliary lanes at the intersections are identified to accommodate the projected 2031 traffic (refer to **Table 4-14**).
- Overall, the safety impacts of the widened roadway along Essa Road are satisfactory.

## **6. Conclusions**

The traffic analysis in this report indicates that no improvements along Essa Road within the Study Area are required under existing conditions.

In the 2021 planning horizon:

- Widening Essa Road to 5 lanes, with two lanes in each direction and a center TWLTL, is required to support projected traffic volumes, including traffic generated from the proposed Messa Village development.
- With 5-lane widening, the existing lane configurations and the traffic operations at the intersections of Essa Road with Mapleview Drive and with Coughlin Road will be improved. The new unsignalized intersection of Essa Road with the full access to Messa Village is also expected to operate well with the widened cross section of Essa Road.

In the 2031 planning horizon:

- The 5-lane cross section of Essa Road is sufficient to support projected traffic volumes in the Study Area.
- All Study Area intersections are expected to operate at acceptable levels and no further improvements are needed to accommodate projected demand.

## **Appendices**

Appendix A Existing Turning Movement Counts

Appendix B Synchro Results – 2017 Analysis

Appendix C Messa Village Development Traffic Forecast

Appendix D Synchro Results - 2021 Analysis

Appendix E Synchro Results - 2031 Analysis

Appendix F SimTraffic Results - 2031 Analysis

**Appendix A**  
**Existing Traffic Data**

DRAFT

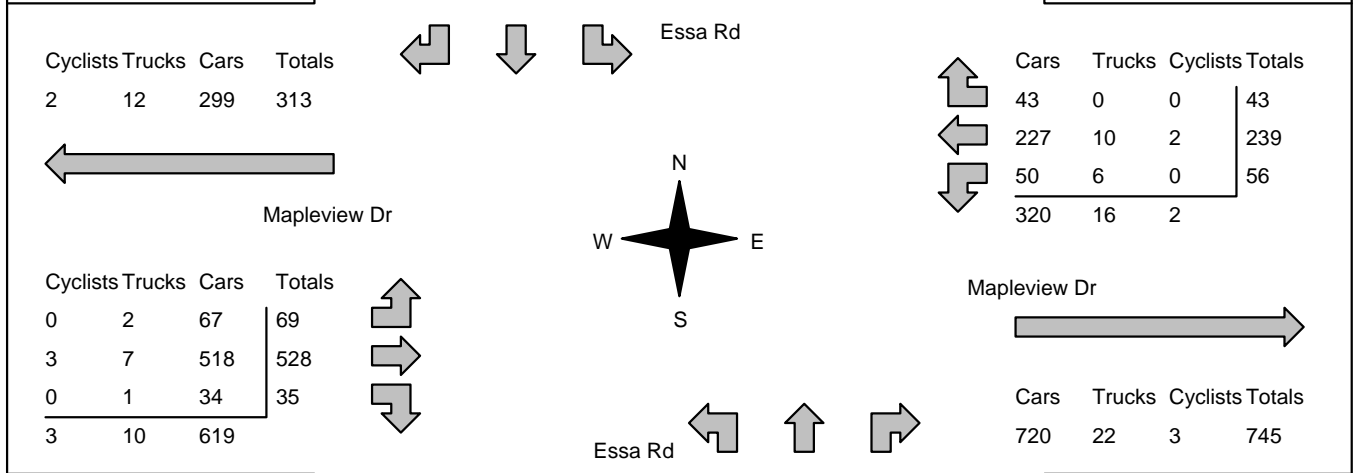
# Accu-Traffic Inc.

<b>Morning Peak Diagram</b>	<b>Specified Period</b> <b>From:</b> 7:00:00 <b>To:</b> 9:00:00	<b>One Hour Peak</b> <b>From:</b> 8:00:00 <b>To:</b> 9:00:00
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<b>Municipality:</b> Barrie <b>Site #:</b> 1500200003 <b>Intersection:</b> Mapleview Dr & Essa Rd <b>TFR File #:</b> 1 <b>Count date:</b> 7-Jul-15	<b>Weather conditions:</b>  <b>Person counted:</b> <b>Person prepared:</b> <b>Person checked:</b>
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<b>** Signalized Intersection **</b>	<b>Major Road:</b> Mapleview Dr runs W/E
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North Leg Total: 442 North Entering: 243 North Peds: 1 Peds Cross: ☒	<table style="margin: auto;"> <tr><td>Cyclists</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>Trucks</td><td>1</td><td>4</td><td>3</td><td>8</td></tr> <tr><td>Cars</td><td>45</td><td>87</td><td>103</td><td>235</td></tr> <tr><td>Totals</td><td>46</td><td>91</td><td>106</td><td></td></tr> </table>	Cyclists	0	0	0	0	Trucks	1	4	3	8	Cars	45	87	103	235	Totals	46	91	106		<table style="margin: auto;"> <tr><td>Cyclists</td><td>0</td></tr> <tr><td>Trucks</td><td>5</td></tr> <tr><td>Cars</td><td>194</td></tr> <tr><td>Totals</td><td>199</td></tr> </table>	Cyclists	0	Trucks	5	Cars	194	Totals	199	East Leg Total: 1083 East Entering: 338 East Peds: 0 Peds Cross: ☒
Cyclists	0	0	0	0																											
Trucks	1	4	3	8																											
Cars	45	87	103	235																											
Totals	46	91	106																												
Cyclists	0																														
Trucks	5																														
Cars	194																														
Totals	199																														



Peds Cross: ☒ West Peds: 3 West Entering: 632 West Leg Total: 945	<table style="margin: auto;"> <tr><td>Cars</td><td>171</td></tr> <tr><td>Trucks</td><td>11</td></tr> <tr><td>Cyclists</td><td>0</td></tr> <tr><td>Totals</td><td>182</td></tr> </table>	Cars	171	Trucks	11	Cyclists	0	Totals	182	<table style="margin: auto;"> <tr><td>Cars</td><td>27</td><td>84</td><td>99</td><td>210</td></tr> <tr><td>Trucks</td><td>1</td><td>3</td><td>12</td><td>16</td></tr> <tr><td>Cyclists</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>Totals</td><td>28</td><td>87</td><td>111</td><td></td></tr> </table>	Cars	27	84	99	210	Trucks	1	3	12	16	Cyclists	0	0	0	0	Totals	28	87	111		Peds Cross: ☒ South Peds: 4 South Entering: 226 South Leg Total: 408
Cars	171																														
Trucks	11																														
Cyclists	0																														
Totals	182																														
Cars	27	84	99	210																											
Trucks	1	3	12	16																											
Cyclists	0	0	0	0																											
Totals	28	87	111																												

**Comments**

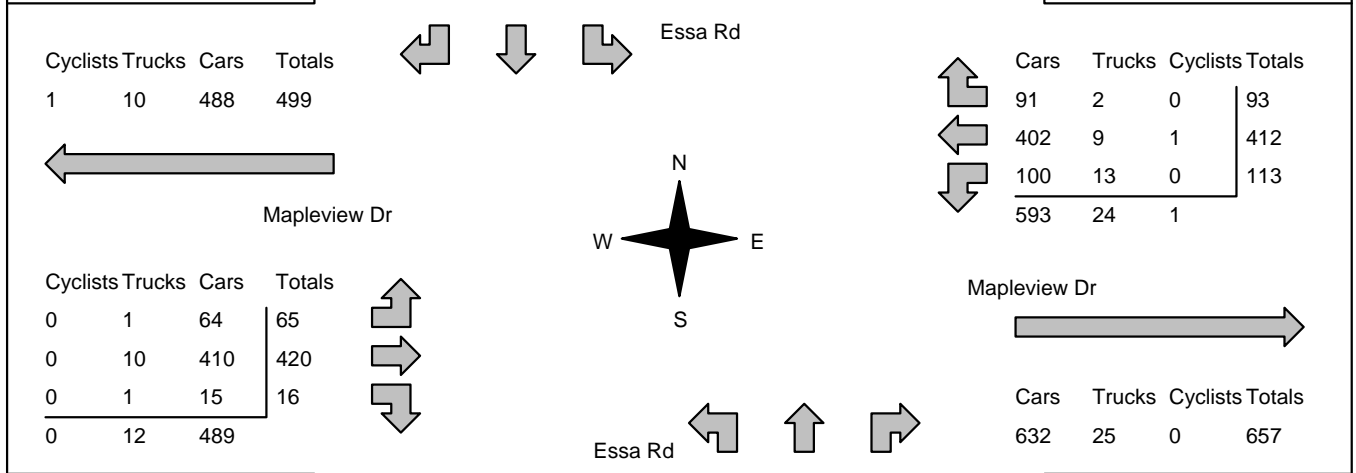
# Accu-Traffic Inc.

<b>Mid-day Peak Diagram</b>	<b>Specified Period</b> <b>From:</b> 11:00:00 <b>To:</b> 14:00:00	<b>One Hour Peak</b> <b>From:</b> 12:15:00 <b>To:</b> 13:15:00
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<b>Municipality:</b> Barrie <b>Site #:</b> 1500200003 <b>Intersection:</b> Mapleview Dr & Essa Rd <b>TFR File #:</b> 1 <b>Count date:</b> 7-Jul-15	<b>Weather conditions:</b>  <b>Person counted:</b> <b>Person prepared:</b> <b>Person checked:</b>
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<b>** Signalized Intersection **</b>	<b>Major Road:</b> Mapleview Dr runs W/E
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North Leg Total: 549 North Entering: 310 North Peds: 1 Peds Cross: ☒	<table style="border-collapse: collapse; margin: auto;"> <tr><td>Cyclists</td><td>0</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>Trucks</td><td>1</td><td>5</td><td>5</td><td>11</td></tr> <tr><td>Cars</td><td>62</td><td>124</td><td>112</td><td>298</td></tr> <tr style="border-top: 1px solid black;"><td>Totals</td><td>63</td><td>130</td><td>117</td><td></td></tr> </table>	Cyclists	0	1	0	1	Trucks	1	5	5	11	Cars	62	124	112	298	Totals	63	130	117		<table style="border-collapse: collapse; margin: auto;"> <tr><td>Cyclists</td><td>0</td></tr> <tr><td>Trucks</td><td>4</td></tr> <tr><td>Cars</td><td>235</td></tr> <tr style="border-top: 1px solid black;"><td>Totals</td><td>239</td></tr> </table>	Cyclists	0	Trucks	4	Cars	235	Totals	239	East Leg Total: 1275 East Entering: 618 East Peds: 1 Peds Cross: ☒
Cyclists	0	1	0	1																											
Trucks	1	5	5	11																											
Cars	62	124	112	298																											
Totals	63	130	117																												
Cyclists	0																														
Trucks	4																														
Cars	235																														
Totals	239																														



Peds Cross: ☒ West Peds: 1 West Entering: 501 West Leg Total: 1000	<table style="border-collapse: collapse; margin: auto;"> <tr><td>Cars</td><td>239</td></tr> <tr><td>Trucks</td><td>19</td></tr> <tr><td>Cyclists</td><td>1</td></tr> <tr style="border-top: 1px solid black;"><td>Totals</td><td>259</td></tr> </table>	Cars	239	Trucks	19	Cyclists	1	Totals	259	<table style="border-collapse: collapse; margin: auto;"> <tr><td>Cars</td><td>24</td><td>80</td><td>110</td><td>214</td></tr> <tr><td>Trucks</td><td>0</td><td>1</td><td>10</td><td>11</td></tr> <tr><td>Cyclists</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr style="border-top: 1px solid black;"><td>Totals</td><td>24</td><td>81</td><td>120</td><td></td></tr> </table>	Cars	24	80	110	214	Trucks	0	1	10	11	Cyclists	0	0	0	0	Totals	24	81	120		Peds Cross: ☒ South Peds: 3 South Entering: 225 South Leg Total: 484
Cars	239																														
Trucks	19																														
Cyclists	1																														
Totals	259																														
Cars	24	80	110	214																											
Trucks	0	1	10	11																											
Cyclists	0	0	0	0																											
Totals	24	81	120																												

Comments



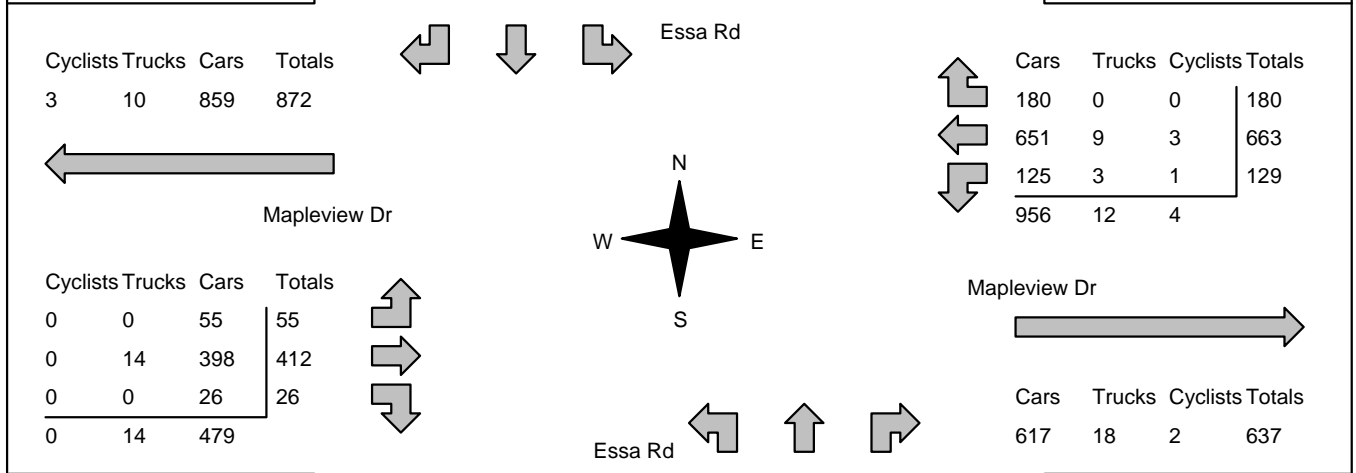
# Accu-Traffic Inc.

<b>Afternoon Peak Diagram</b>	<b>Specified Period</b> <b>From:</b> 15:00:00 <b>To:</b> 18:00:00	<b>One Hour Peak</b> <b>From:</b> 16:30:00 <b>To:</b> 17:30:00
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<b>Municipality:</b> Barrie <b>Site #:</b> 1500200003 <b>Intersection:</b> Mapleview Dr & Essa Rd <b>TFR File #:</b> 1 <b>Count date:</b> 7-Jul-15	<b>Weather conditions:</b>  <b>Person counted:</b> <b>Person prepared:</b> <b>Person checked:</b>
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<b>** Signalized Intersection **</b>	<b>Major Road:</b> Mapleview Dr runs W/E
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North Leg Total: 763 North Entering: 380 North Peds: 0 Peds Cross: ☒	<table style="width: 100%; border-collapse: collapse;"> <tr><td>Cyclists</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>Trucks</td><td>1</td><td>0</td><td>0</td><td>1</td></tr> <tr><td>Cars</td><td>136</td><td>137</td><td>106</td><td>379</td></tr> <tr><td>Totals</td><td>137</td><td>137</td><td>106</td><td></td></tr> </table>	Cyclists	0	0	0	0	Trucks	1	0	0	1	Cars	136	137	106	379	Totals	137	137	106		↑	Cyclists 2 Trucks 2 Cars 379 Totals 383	East Leg Total: 1609 East Entering: 972 East Peds: 1 Peds Cross: ☒
Cyclists	0	0	0	0																				
Trucks	1	0	0	1																				
Cars	136	137	106	379																				
Totals	137	137	106																					



Peds Cross: ☒ West Peds: 2 West Entering: 493 West Leg Total: 1365	<table style="width: 100%; border-collapse: collapse;"> <tr><td>Cars</td><td>288</td></tr> <tr><td>Trucks</td><td>3</td></tr> <tr><td>Cyclists</td><td>1</td></tr> <tr><td>Totals</td><td>292</td></tr> </table>	Cars	288	Trucks	3	Cyclists	1	Totals	292	↓	<table style="width: 100%; border-collapse: collapse;"> <tr><td>Cars</td><td>72</td><td>144</td><td>113</td><td>329</td></tr> <tr><td>Trucks</td><td>0</td><td>2</td><td>4</td><td>6</td></tr> <tr><td>Cyclists</td><td>0</td><td>2</td><td>2</td><td>4</td></tr> <tr><td>Totals</td><td>72</td><td>148</td><td>119</td><td></td></tr> </table>	Cars	72	144	113	329	Trucks	0	2	4	6	Cyclists	0	2	2	4	Totals	72	148	119		Peds Cross: ☒ South Peds: 3 South Entering: 339 South Leg Total: 631
Cars	288																															
Trucks	3																															
Cyclists	1																															
Totals	292																															
Cars	72	144	113	329																												
Trucks	0	2	4	6																												
Cyclists	0	2	2	4																												
Totals	72	148	119																													

**Comments**

# Accu-Traffic Inc.

## Total Count Diagram

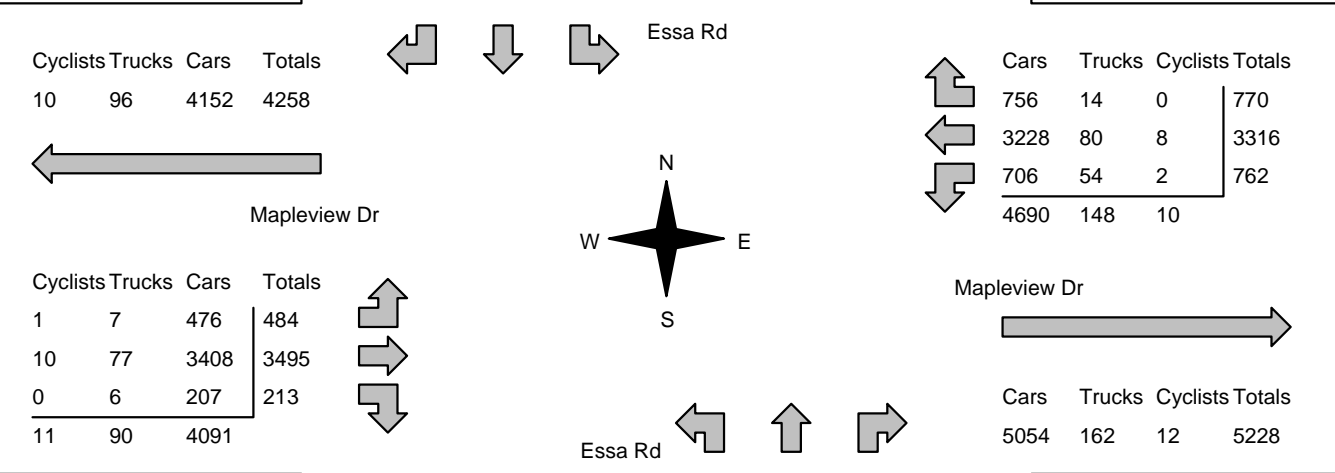
**Municipality:** Barrie  
**Site #:** 1500200003  
**Intersection:** Mapleview Dr & Essa Rd  
**TFR File #:** 1  
**Count date:** 7-Jul-15

**Weather conditions:**  
  
**Person counted:**  
**Person prepared:**  
**Person checked:**

**\*\* Signalized Intersection \*\***

**Major Road:** Mapleview Dr runs W/E

North Leg Total: 4400 North Entering: 2311 North Peds: 11 Peds Cross: ☒	<table border="1" style="border-collapse: collapse; margin: auto;"> <tr><td>Cyclists</td><td>2</td><td>3</td><td>0</td><td>5</td></tr> <tr><td>Trucks</td><td>10</td><td>16</td><td>24</td><td>50</td></tr> <tr><td>Cars</td><td>616</td><td>832</td><td>808</td><td>2256</td></tr> <tr><td>Totals</td><td>628</td><td>851</td><td>832</td><td></td></tr> </table>	Cyclists	2	3	0	5	Trucks	10	16	24	50	Cars	616	832	808	2256	Totals	628	851	832		<table border="1" style="border-collapse: collapse; margin: auto;"> <tr><td>Cyclists</td><td>4</td></tr> <tr><td>Trucks</td><td>43</td></tr> <tr><td>Cars</td><td>2042</td></tr> <tr><td>Totals</td><td>2089</td></tr> </table>	Cyclists	4	Trucks	43	Cars	2042	Totals	2089	East Leg Total: 10076 East Entering: 4848 East Peds: 9 Peds Cross: ☒
Cyclists	2	3	0	5																											
Trucks	10	16	24	50																											
Cars	616	832	808	2256																											
Totals	628	851	832																												
Cyclists	4																														
Trucks	43																														
Cars	2042																														
Totals	2089																														



Peds Cross: ☒ West Peds: 10 West Entering: 4192 West Leg Total: 8450		Peds Cross: ☒ South Peds: 31 South Entering: 2050 South Leg Total: 3876
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### Comments



**Accu-Traffic Inc.**  
Traffic Monitoring & Data Analysis

# Accu-Traffic Inc.

## Traffic Count Summary

Intersection: **Mapleview Dr & Essa Rd**      Count Date: **7-Jul-15**      Municipality: **Barrie**

<b>North Approach Totals</b>						North/South Total Approaches	<b>South Approach Totals</b>					
Hour Ending	Includes Cars, Trucks, & Cyclists				Total Peds		Hour Ending	Includes Cars, Trucks, & Cyclists				Total Peds
	Left	Thru	Right	Grand Total				Left	Thru	Right	Grand Total	
7:00:00	0	0	0	0	0	0	7:00:00	0	0	0	0	0
8:00:00	95	67	34	196	0	407	8:00:00	27	74	110	211	3
9:00:00	106	91	46	243	1	469	9:00:00	28	87	111	226	4
11:00:00	0	0	0	0	0	0	11:00:00	0	0	0	0	0
12:00:00	96	98	63	257	1	469	12:00:00	26	84	102	212	9
13:00:00	115	115	74	304	1	530	13:00:00	29	81	116	226	3
14:00:00	112	108	68	288	1	504	14:00:00	27	86	103	216	1
15:00:00	0	0	0	0	0	0	15:00:00	0	0	0	0	0
16:00:00	112	133	101	346	4	668	16:00:00	53	144	125	322	6
17:00:00	120	120	116	356	0	671	17:00:00	53	142	120	315	4
18:00:00	76	119	126	321	3	643	18:00:00	71	137	114	322	1
<b>Totals:</b>	<b>832</b>	<b>851</b>	<b>628</b>	<b>2311</b>	<b>11</b>	<b>4361</b>	<b>S Totals:</b>	<b>314</b>	<b>835</b>	<b>901</b>	<b>2050</b>	<b>31</b>
<b>East Approach Totals</b>						East/West Total Approaches	<b>West Approach Totals</b>					
Hour Ending	Includes Cars, Trucks, & Cyclists				Total Peds		Hour Ending	Includes Cars, Trucks, & Cyclists				Total Peds
	Left	Thru	Right	Grand Total				Left	Thru	Right	Grand Total	
7:00:00	0	0	0	0	0	0	7:00:00	0	0	0	0	0
8:00:00	37	163	26	226	2	800	8:00:00	45	482	47	574	2
9:00:00	56	239	43	338	0	970	9:00:00	69	528	35	632	3
11:00:00	0	0	0	0	0	0	11:00:00	0	0	0	0	0
12:00:00	80	333	70	483	2	933	12:00:00	48	386	16	450	1
13:00:00	100	404	93	597	1	1106	13:00:00	48	442	19	509	1
14:00:00	102	388	95	585	1	1079	14:00:00	69	404	21	494	0
15:00:00	0	0	0	0	0	0	15:00:00	0	0	0	0	0
16:00:00	126	517	128	771	0	1246	16:00:00	75	378	22	475	1
17:00:00	108	597	155	860	1	1403	17:00:00	62	454	27	543	1
18:00:00	153	675	160	988	2	1503	18:00:00	68	421	26	515	1
<b>Totals:</b>	<b>762</b>	<b>3316</b>	<b>770</b>	<b>4848</b>	<b>9</b>	<b>9040</b>	<b>W Totals:</b>	<b>484</b>	<b>3495</b>	<b>213</b>	<b>4192</b>	<b>10</b>
<b>Calculated Values for Traffic Crossing Major Street</b>												
Hours Ending:	8:00	9:00	12:00	13:00			14:00	16:00	17:00	18:00		
Crossing Values:	200	228	223	261			248	310	317	287		



# Accu-Traffic Inc.

Count Date: 7-Jul-15 Site #: 1500200003

Interval Time	Passenger Cars - North Approach						Trucks - North Approach						Cyclists - North Approach						Pedestrians	
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		North Cross	
	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr
7:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15:00	15	15	15	15	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30:00	39	24	34	19	15	5	2	2	0	0	0	0	0	0	0	0	1	1	0	0
7:45:00	67	28	48	14	21	6	3	1	0	0	0	0	0	0	0	0	1	0	0	0
8:00:00	91	24	66	18	33	12	4	1	1	1	0	0	0	0	0	0	1	0	0	0
8:15:00	108	17	83	17	40	7	4	0	1	0	0	0	0	0	0	0	1	0	0	0
8:30:00	134	26	100	17	50	10	4	0	2	1	0	0	0	0	0	0	1	0	1	1
8:45:00	167	33	126	26	61	11	5	1	4	2	0	0	0	0	0	0	1	0	1	0
9:00:00	194	27	153	27	78	17	7	2	5	1	1	1	0	0	0	0	1	0	1	0
9:15:00	194	0	153	0	78	0	7	0	5	0	1	0	0	0	0	0	1	0	1	0
11:00:00	194	0	153	0	78	0	7	0	5	0	1	0	0	0	0	0	1	0	1	0
11:15:00	220	26	178	25	97	19	8	1	6	1	1	0	0	0	0	0	1	0	1	0
11:30:00	242	22	201	23	104	7	9	1	6	0	1	0	0	0	0	0	2	1	2	1
11:45:00	257	15	219	18	122	18	10	1	7	1	2	1	0	0	0	0	2	0	2	0
12:00:00	286	29	249	30	138	16	11	1	7	0	3	1	0	0	0	0	2	0	2	0
12:15:00	315	29	271	22	160	22	12	1	8	1	4	1	0	0	0	0	2	0	2	0
12:30:00	348	33	299	28	176	16	14	2	9	1	4	0	0	0	1	1	2	0	3	1
12:45:00	372	24	330	31	192	16	15	1	10	1	4	0	0	0	1	0	2	0	3	0
13:00:00	396	24	359	29	210	18	16	1	11	1	5	1	0	0	1	0	2	0	3	0
13:15:00	427	31	395	36	222	12	17	1	13	2	5	0	0	0	1	0	2	0	3	0
13:30:00	455	28	421	26	237	15	17	0	13	0	6	1	0	0	1	0	2	0	3	0
13:45:00	484	29	439	18	257	20	18	1	13	0	8	2	0	0	3	2	2	0	4	1
14:00:00	506	22	463	24	275	18	18	0	13	0	8	0	0	0	3	0	2	0	4	0
14:15:00	506	0	463	0	275	0	18	0	13	0	8	0	0	0	3	0	2	0	4	0
15:00:00	506	0	463	0	275	0	18	0	13	0	8	0	0	0	3	0	2	0	4	0
15:15:00	536	30	493	30	302	27	18	0	15	2	9	1	0	0	3	0	2	0	4	0
15:30:00	557	21	532	39	328	26	19	1	16	1	9	0	0	0	3	0	2	0	7	3
15:45:00	581	24	562	30	351	23	22	3	16	0	9	0	0	0	3	0	2	0	7	0
16:00:00	614	33	593	31	375	24	22	0	16	0	9	0	0	0	3	0	2	0	8	1
16:15:00	640	26	623	30	406	31	23	1	16	0	9	0	0	0	3	0	2	0	8	0
16:30:00	668	28	643	20	428	22	24	1	16	0	9	0	0	0	3	0	2	0	8	0
16:45:00	702	34	676	33	460	32	24	0	16	0	10	1	0	0	3	0	2	0	8	0
17:00:00	732	30	713	37	490	30	24	0	16	0	10	0	0	0	3	0	2	0	8	0
17:15:00	749	17	743	30	532	42	24	0	16	0	10	0	0	0	3	0	2	0	8	0
17:30:00	774	25	780	37	564	32	24	0	16	0	10	0	0	0	3	0	2	0	8	0
17:45:00	793	19	804	24	590	26	24	0	16	0	10	0	0	0	3	0	2	0	11	3
18:00:00	808	15	832	28	616	26	24	0	16	0	10	0	0	0	3	0	2	0	11	0
18:15:00	808	0	832	0	616	0	24	0	16	0	10	0	0	0	3	0	2	0	11	0
18:15:15	808	0	832	0	616	0	24	0	16	0	10	0	0	0	3	0	2	0	11	0



# Accu-Traffic Inc.

Count Date: 7-Jul-15 Site #: 1500200003

Interval Time	Passenger Cars - East Approach						Trucks - East Approach						Cyclists - East Approach						Pedestrians	
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		East Cross	
	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr
7:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15:00	10	10	41	41	6	6	2	2	0	0	0	0	0	0	1	1	0	0	1	1
7:30:00	19	9	71	30	11	5	2	0	3	3	0	0	0	0	1	0	0	0	1	0
7:45:00	24	5	119	48	16	5	4	2	6	3	1	1	0	0	1	0	0	0	1	0
8:00:00	31	7	151	32	23	7	5	1	11	5	3	2	1	1	1	0	0	0	2	1
8:15:00	39	8	191	40	32	9	8	3	15	4	3	0	1	0	1	0	0	0	2	0
8:30:00	45	6	254	63	41	9	8	0	16	1	3	0	1	0	1	0	0	0	2	0
8:45:00	58	13	300	46	51	10	11	3	18	2	3	0	1	0	1	0	0	0	2	0
9:00:00	81	23	378	78	66	15	11	0	21	3	3	0	1	0	3	2	0	0	2	0
9:15:00	81	0	378	0	66	0	11	0	21	0	3	0	1	0	3	0	0	0	2	0
11:00:00	81	0	378	0	66	0	11	0	21	0	3	0	1	0	3	0	0	0	2	0
11:15:00	95	14	446	68	80	14	14	3	22	1	4	1	1	0	3	0	0	0	2	0
11:30:00	114	19	526	80	101	21	15	1	24	2	5	1	1	0	3	0	0	0	3	1
11:45:00	133	19	604	78	115	14	18	3	26	2	7	2	1	0	3	0	0	0	3	0
12:00:00	153	20	705	101	132	17	19	1	27	1	7	0	1	0	3	0	0	0	4	1
12:15:00	173	20	795	90	157	25	22	3	30	3	7	0	1	0	3	0	0	0	4	0
12:30:00	195	22	913	118	178	21	24	2	33	3	7	0	1	0	4	1	0	0	4	0
12:45:00	218	23	1006	93	201	23	27	3	34	1	9	2	1	0	4	0	0	0	4	0
13:00:00	242	24	1098	92	223	22	30	3	37	3	9	0	1	0	4	0	0	0	5	1
13:15:00	273	31	1197	99	248	25	35	5	39	2	9	0	1	0	4	0	0	0	5	0
13:30:00	293	20	1290	93	266	18	37	2	45	6	9	0	1	0	4	0	0	0	5	0
13:45:00	314	21	1376	86	297	31	38	1	50	5	9	0	1	0	5	1	0	0	6	1
14:00:00	335	21	1468	92	318	21	39	1	54	4	9	0	1	0	5	0	0	0	6	0
14:15:00	335	0	1468	0	318	0	39	0	54	0	9	0	1	0	5	0	0	0	6	0
15:00:00	335	0	1468	0	318	0	39	0	54	0	9	0	1	0	5	0	0	0	6	0
15:15:00	369	34	1595	127	351	33	41	2	56	2	11	2	1	0	5	0	0	0	6	0
15:30:00	391	22	1714	119	372	21	44	3	60	4	12	1	1	0	5	0	0	0	6	0
15:45:00	424	33	1848	134	407	35	47	3	61	1	12	0	1	0	5	0	0	0	6	0
16:00:00	452	28	1974	126	442	35	48	1	65	4	13	1	1	0	5	0	0	0	6	0
16:15:00	477	25	2103	129	477	35	49	1	65	0	13	0	1	0	5	0	0	0	6	0
16:30:00	500	23	2254	151	507	30	50	1	67	2	13	0	1	0	5	0	0	0	6	0
16:45:00	529	29	2419	165	551	44	51	1	72	5	13	0	1	0	5	0	0	0	7	1
17:00:00	557	28	2562	143	597	46	51	0	74	2	13	0	1	0	5	0	0	0	7	0
17:15:00	597	40	2718	156	646	49	52	1	74	0	13	0	1	0	8	3	0	0	7	0
17:30:00	625	28	2905	187	687	41	53	1	76	2	13	0	2	1	8	0	0	0	7	0
17:45:00	665	40	3079	174	728	41	54	1	78	2	14	1	2	0	8	0	0	0	8	1
18:00:00	706	41	3228	149	756	28	54	0	80	2	14	0	2	0	8	0	0	0	9	1
18:15:00	706	0	3228	0	756	0	54	0	80	0	14	0	2	0	8	0	0	0	9	0
18:15:15	706	0	3228	0	756	0	54	0	80	0	14	0	2	0	8	0	0	0	9	0



# Accu-Traffic Inc.

Count Date: 7-Jul-15 Site #: 1500200003

Interval Time	Passenger Cars - South Approach						Trucks - South Approach						Cyclists - South Approach						Pedestrians	
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		South Cross	
	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr
7:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15:00	4	4	6	6	18	18	0	0	0	0	1	1	0	0	0	0	0	0	1	1
7:30:00	10	6	30	24	40	22	0	0	0	0	2	1	0	0	0	0	0	0	3	2
7:45:00	20	10	47	17	80	40	0	0	0	0	2	0	0	0	0	0	0	0	3	0
8:00:00	27	7	72	25	106	26	0	0	2	2	4	2	0	0	0	0	0	0	3	0
8:15:00	33	6	99	27	129	23	0	0	2	0	6	2	0	0	0	0	0	0	3	0
8:30:00	36	3	116	17	154	25	1	1	2	0	9	3	0	0	0	0	0	0	7	4
8:45:00	45	9	135	19	179	25	1	0	2	0	13	4	0	0	0	0	0	0	7	0
9:00:00	54	9	156	21	205	26	1	0	5	3	16	3	0	0	0	0	0	0	7	0
9:15:00	54	0	156	0	205	0	1	0	5	0	16	0	0	0	0	0	0	0	7	0
11:00:00	54	0	156	0	205	0	1	0	5	0	16	0	0	0	0	0	0	0	7	0
11:15:00	60	6	172	16	225	20	1	0	6	1	16	0	0	0	0	0	0	0	9	2
11:30:00	66	6	196	24	255	30	1	0	7	1	19	3	0	0	0	0	0	0	9	0
11:45:00	70	4	213	17	276	21	2	1	8	1	20	1	0	0	0	0	0	0	12	3
12:00:00	79	9	236	23	300	24	2	0	9	1	23	3	0	0	0	0	0	0	16	4
12:15:00	88	9	255	19	321	21	4	2	10	1	23	0	0	0	0	0	0	0	16	0
12:30:00	94	6	275	20	356	35	4	0	10	0	24	1	0	0	0	0	0	0	16	0
12:45:00	98	4	298	23	378	22	4	0	10	0	25	1	0	0	0	0	0	0	16	0
13:00:00	106	8	316	18	408	30	4	0	10	0	31	6	0	0	0	0	0	0	19	3
13:15:00	112	6	335	19	431	23	4	0	11	1	33	2	0	0	0	0	0	0	19	0
13:30:00	114	2	356	21	462	31	5	1	11	0	35	2	0	0	0	0	0	0	20	1
13:45:00	122	8	378	22	478	16	5	0	13	2	38	3	0	0	0	0	0	0	20	0
14:00:00	132	10	399	21	501	23	5	0	13	0	41	3	0	0	0	0	0	0	20	0
14:15:00	132	0	399	0	501	0	5	0	13	0	41	0	0	0	0	0	0	0	20	0
15:00:00	132	0	399	0	501	0	5	0	13	0	41	0	0	0	0	0	0	0	20	0
15:15:00	145	13	424	25	527	26	6	1	16	3	43	2	0	0	0	0	0	0	20	0
15:30:00	153	8	449	25	549	22	6	0	17	1	47	4	0	0	0	0	0	0	22	2
15:45:00	170	17	500	51	583	34	6	0	18	1	49	2	0	0	0	0	0	0	23	1
16:00:00	184	14	537	37	615	32	6	0	19	1	52	3	0	0	0	0	0	0	26	3
16:15:00	198	14	580	43	643	28	6	0	20	1	53	1	0	0	0	0	0	0	26	0
16:30:00	210	12	611	31	669	26	6	0	20	0	56	3	0	0	1	1	0	0	27	1
16:45:00	218	8	644	33	704	35	6	0	21	1	56	0	0	0	1	0	0	0	28	1
17:00:00	237	19	675	31	728	24	6	0	22	1	58	2	0	0	1	0	1	1	30	2
17:15:00	261	24	707	32	758	30	6	0	22	0	60	2	0	0	2	1	1	0	30	0
17:30:00	282	21	755	48	782	24	6	0	22	0	60	0	0	0	3	1	2	1	30	0
17:45:00	291	9	783	28	809	27	6	0	22	0	60	0	0	0	3	0	2	0	31	1
18:00:00	308	17	810	27	838	29	6	0	22	0	61	1	0	0	3	0	2	0	31	0
18:15:00	308	0	810	0	838	0	6	0	22	0	61	0	0	0	3	0	2	0	31	0
18:15:15	308	0	810	0	838	0	6	0	22	0	61	0	0	0	3	0	2	0	31	0



# Accu-Traffic Inc.

Count Date: 7-Jul-15 Site #: 1500200003

Interval Time	Passenger Cars - West Approach						Trucks - West Approach						Cyclists - West Approach						Pedestrians	
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		West Cross	
	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr	Cum	Incr
7:00:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15:00	10	10	98	98	8	8	0	0	2	2	1	1	0	0	0	0	0	0	0	0
7:30:00	19	9	208	110	14	6	0	0	7	5	1	0	0	0	1	1	0	0	1	1
7:45:00	29	10	328	120	27	13	0	0	8	1	1	0	0	0	2	1	0	0	2	1
8:00:00	45	16	464	136	46	19	0	0	14	6	1	0	0	0	4	2	0	0	2	0
8:15:00	55	10	595	131	54	8	2	2	16	2	1	0	0	0	4	0	0	0	2	0
8:30:00	71	16	719	124	62	8	2	0	18	2	2	1	0	0	6	2	0	0	5	3
8:45:00	93	22	847	128	66	4	2	0	20	2	2	0	0	0	7	1	0	0	5	0
9:00:00	112	19	982	135	80	14	2	0	21	1	2	0	0	0	7	0	0	0	5	0
9:15:00	112	0	982	0	80	0	2	0	21	0	2	0	0	0	7	0	0	0	5	0
11:00:00	112	0	982	0	80	0	2	0	21	0	2	0	0	0	7	0	0	0	5	0
11:15:00	120	8	1077	95	82	2	2	0	25	4	3	1	0	0	7	0	0	0	5	0
11:30:00	133	13	1166	89	86	4	3	1	28	3	3	0	0	0	7	0	0	0	5	0
11:45:00	144	11	1265	99	92	6	3	0	29	1	3	0	0	0	7	0	0	0	6	1
12:00:00	159	15	1359	94	95	3	3	0	30	1	3	0	0	0	7	0	0	0	6	0
12:15:00	169	10	1478	119	103	8	3	0	31	1	3	0	0	0	8	1	0	0	6	0
12:30:00	176	7	1566	88	104	1	3	0	37	6	3	0	0	0	8	0	0	0	7	1
12:45:00	190	14	1677	111	109	5	3	0	37	0	4	1	0	0	8	0	0	0	7	0
13:00:00	206	16	1790	113	113	4	4	1	40	3	4	0	0	0	8	0	0	0	7	0
13:15:00	233	27	1888	98	118	5	4	0	41	1	4	0	0	0	8	0	0	0	7	0
13:30:00	242	9	1981	93	122	4	4	0	44	3	5	1	1	1	8	0	0	0	7	0
13:45:00	254	12	2095	114	126	4	6	2	46	2	5	0	1	0	8	0	0	0	7	0
14:00:00	272	18	2186	91	133	7	6	0	48	2	5	0	1	0	8	0	0	0	7	0
14:15:00	272	0	2186	0	133	0	6	0	48	0	5	0	1	0	8	0	0	0	7	0
15:00:00	272	0	2186	0	133	0	6	0	48	0	5	0	1	0	8	0	0	0	7	0
15:15:00	282	10	2268	82	138	5	6	0	49	1	5	0	1	0	8	0	0	0	7	0
15:30:00	304	22	2338	70	142	4	6	0	51	2	6	1	1	0	8	0	0	0	8	1
15:45:00	325	21	2468	130	148	6	7	1	52	1	6	0	1	0	8	0	0	0	8	0
16:00:00	346	21	2556	88	154	6	7	0	56	4	6	0	1	0	8	0	0	0	8	0
16:15:00	359	13	2651	95	159	5	7	0	60	4	6	0	1	0	10	2	0	0	8	0
16:30:00	380	21	2771	120	167	8	7	0	61	1	6	0	1	0	10	0	0	0	8	0
16:45:00	398	18	2885	114	175	8	7	0	65	4	6	0	1	0	10	0	0	0	8	0
17:00:00	408	10	2994	109	181	6	7	0	70	5	6	0	1	0	10	0	0	0	9	1
17:15:00	423	15	3085	91	188	7	7	0	71	1	6	0	1	0	10	0	0	0	9	0
17:30:00	435	12	3169	84	193	5	7	0	75	4	6	0	1	0	10	0	0	0	10	1
17:45:00	459	24	3280	111	200	7	7	0	76	1	6	0	1	0	10	0	0	0	10	0
18:00:00	476	17	3408	128	207	7	7	0	77	1	6	0	1	0	10	0	0	0	10	0
18:15:00	476	0	3408	0	207	0	7	0	77	0	6	0	1	0	10	0	0	0	10	0
18:15:15	476	0	3408	0	207	0	7	0	77	0	6	0	1	0	10	0	0	0	10	0

# Trans-Plan Transportation Inc.

Site ID Code:  
 Intersection Location: Coughlin Road and Essa Road  
 Municipality: Barrie, Ontario  
 Count Date: Thursday, February 9, 2017  
 Weather and Temperature: Clear, -10C Degrees  
 Surveyor: TP

AM	NORTH APPROACH										Total	EAST APPROACH										Total	SOUTH APPROACH										Total	WEST APPROACH										Total	Grand Total
	CAR			TRUCKS			CYCLISTS					Peds	CAR			TRUCKS			CYCLISTS				Peds	CAR			TRUCKS			CYCLISTS				Peds											
	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														
7:15	0	36	4	0	1	1	0	0	0	0	42	0	0	0	0	0	0	0	0	0	0	0	0	6	37	0	2	4	0	0	0	0	0	49	17	0	19	0	0	2	0	0	0	38	150
7:30	0	53	8	0	1	1	0	0	0	0	63	0	0	0	0	0	0	0	0	0	0	0	0	8	54	0	1	1	0	0	0	0	0	64	17	0	46	1	0	2	0	0	0	66	194
7:45	0	57	3	0	4	0	0	0	0	0	64	0	0	0	0	0	0	0	0	0	0	0	0	8	54	0	1	1	0	0	0	0	64	17	0	46	1	0	2	0	0	0	66	194	
8:00	0	67	15	0	4	0	0	0	0	0	86	0	0	0	0	0	0	0	0	0	0	0	14	55	0	1	0	0	0	0	0	70	29	0	25	2	0	1	0	0	0	57	213		
8:15	0	65	6	0	3	0	0	0	0	0	74	0	0	0	0	0	0	0	0	0	0	0	21	59	0	0	2	0	0	0	0	82	17	0	32	0	0	0	0	0	0	49	205		
8:30	0	53	4	0	1	0	0	0	0	0	58	0	0	0	0	0	0	0	0	0	0	0	10	50	0	0	2	0	0	0	0	62	22	0	24	1	0	1	0	0	0	48	168		
8:45	0	55	7	0	4	0	0	0	0	0	66	0	0	0	0	0	0	0	0	0	0	0	23	57	0	0	2	0	0	0	0	82	25	0	29	0	0	2	0	0	0	56	204		
9:00	0	58	9	0	4	0	0	0	0	0	71	0	0	0	0	0	0	0	0	0	0	0	19	48	0	0	4	0	0	0	0	71	16	0	30	0	0	1	0	0	0	47	189		
MD																																													
11:15	0	47	11	0	1	0	0	0	0	0	59	0	0	0	0	0	0	0	0	0	0	0	23	26	0	0	2	0	0	0	0	51	17	0	20	0	0	0	0	0	0	37	147		
11:30	0	45	17	0	1	1	0	0	0	0	64	0	0	0	0	0	0	0	0	0	0	0	25	56	0	0	2	0	0	0	0	83	17	0	25	2	0	0	0	0	0	44	191		
11:45	0	58	12	0	1	0	0	0	0	0	71	0	0	0	0	0	0	0	0	0	0	0	19	44	0	0	0	0	0	0	0	63	13	0	17	0	0	0	0	0	0	30	164		
12:00	0	52	14	0	0	0	0	0	0	0	66	0	0	0	0	0	0	0	0	0	0	0	21	42	0	0	1	0	0	0	0	64	8	0	30	0	0	0	0	0	0	38	168		
12:15	0	48	12	0	1	1	0	0	0	0	62	0	0	0	0	0	0	0	0	0	0	0	27	44	0	0	0	0	0	0	0	71	11	0	21	0	0	1	0	0	0	33	166		
12:30	0	52	22	0	1	0	0	0	0	0	75	0	0	0	0	0	0	0	0	0	0	0	20	30	0	0	1	0	0	0	0	51	10	0	21	0	0	1	0	0	0	32	158		
12:45	0	64	13	0	1	0	0	0	0	0	78	0	0	0	0	0	0	0	0	0	0	0	29	36	0	1	2	0	0	0	0	68	16	0	31	1	0	1	0	0	0	49	195		
13:00	0	53	10	0	6	1	0	0	0	0	70	0	0	0	0	0	0	0	0	0	0	0	29	47	0	3	1	0	0	0	0	80	16	0	24	3	0	0	0	0	1	43	193		
13:15	0	61	12	0	2	0	0	0	0	0	75	0	0	0	0	0	0	0	0	0	0	0	30	47	0	0	0	0	0	0	0	77	17	0	29	0	0	0	0	0	0	46	198		
13:30	0	69	17	0	2	0	0	0	0	0	88	0	0	0	0	0	0	0	0	0	0	0	30	36	0	0	0	0	0	0	0	66	10	0	23	1	0	0	0	0	0	34	188		
13:45	0	67	12	0	3	1	0	0	0	0	83	0	0	0	0	0	0	0	0	0	0	0	18	44	0	0	6	0	0	0	0	68	18	0	21	0	0	0	0	0	0	39	190		
14:00	0	60	15	0	2	1	0	0	0	0	78	0	0	0	0	0	0	0	0	0	0	0	22	46	0	1	0	0	0	0	0	69	17	0	22	0	0	0	0	0	0	39	186		
PM																																													
15:15	0	78	17	0	1	1	0	0	0	0	97	0	0	0	0	0	0	0	0	0	0	42	60	0	0	1	0	0	0	0	103	16	0	34	1	0	2	0	0	0	53	253			
15:30	0	70	17	0	6	1	0	0	0	0	94	0	0	0	0	0	0	0	0	0	0	0	36	42	0	0	2	0	0	0	0	80	18	0	35	2	0	0	0	0	0	53	227		
15:45	0	83	18	0	7	0	0	0	0	0	108	0	0	0	0	0	0	0	0	0	0	0	46	83	0	0	8	0	0	0	0	137	19	0	41	1	0	0	0	0	1	61	306		
16:00	0	62	30	0	2	0	0	0	0	0	94	0	0	0	0	0	0	0	0	0	0	0	43	92	0	0	3	0	0	0	0	138	25	0	32	0	0	1	0	0	0	58	290		
16:15	0	73	22	0	2	0	0	0	0	0	97	0	0	0	0	0	0	0	0	0	0	0	45	68	0	0	3	0	0	0	0	116	32	0	30	1	0	0	0	0	0	63	276		
16:30	0	76	39	0	0	0	0	0	0	0	115	0	0	0	0	0	0	0	0	0	0	0	40	76	0	1	1	0	0	0	0	118	26	0	30	1	0	1	0	0	0	58	291		
16:45	0	74	34	0	1	1	0	0	0	0	110	0	0	0	0	0	0	0	0	0	0	0	54	77	0	0	0	0	0	0	0	131	24	0	16	0	0	0	0	0	40	281			
17:00	0	88	22	0	0	0	0	0	0	0	110	0	0	0	0	0	0	0	0	0	0	0	55	95	0	0	1	0	0	0	0	151	31	0	24	0	0	0	0	0	0	55	316		
17:15	0	88	29	0	1	0	0	0	0	0	118	0	0	0	0	0	0	0	0	0	0	0	55	96	0	0	1	0	0	0	0	152	9	0	15	0	0	0	0	0	0	24	294		
17:30	0	90	41	0	1	0	0	0	0	0	132	0	0	0	0	0	0	0	0	0	0	0	53	81	0	0	0	0	0	0	0	134	26	0	29	0	0	0	0	0	0	55	321		
17:45	0	92	21	0	1	0	0	0	0	0	114	0	0	0	0	0	0	0	0	0	0	0	63	71	0	0	2	0	0	0	0	136	18	0	29	0	0	1	0	0	0	48	298		
18:00	0	81	21	0	1	0	0	0	0	0	103	0	0	0	0	0	0	0	0	0	0	0	36	65	0	0	2	0	0	0	0	103	18	0	34	1	0	0	0	0	0	53	259		





### Turning Movement Count Diagram

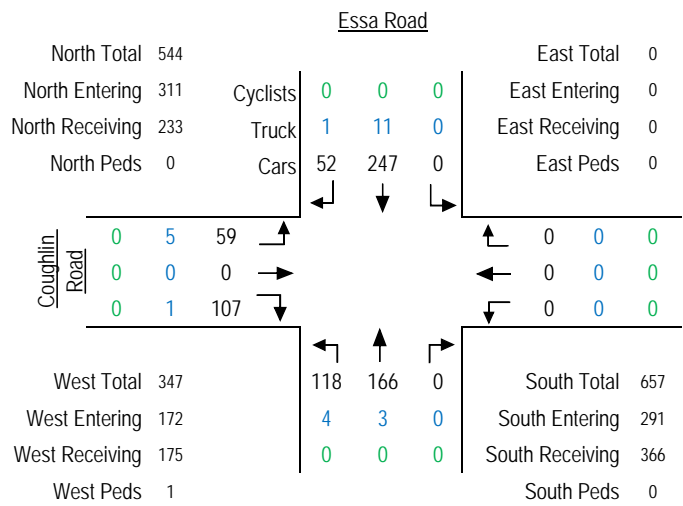
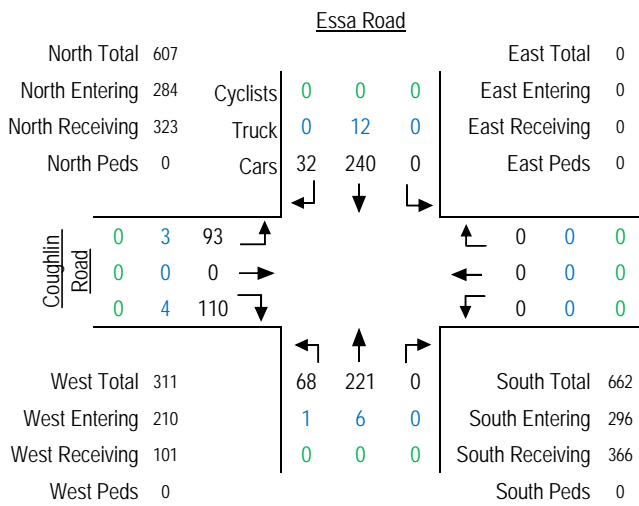
Intersection: Coughlin Road and Essa Road  
 Municipality: Barrie, Ontario

Intersection ID:

Date: Thursday, February 9, 2017

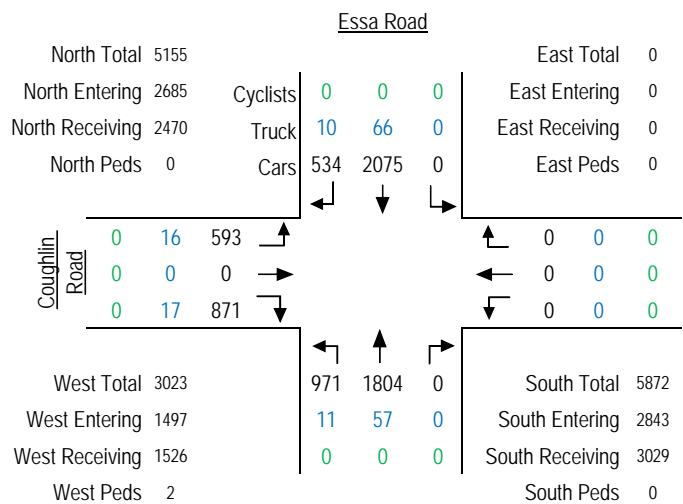
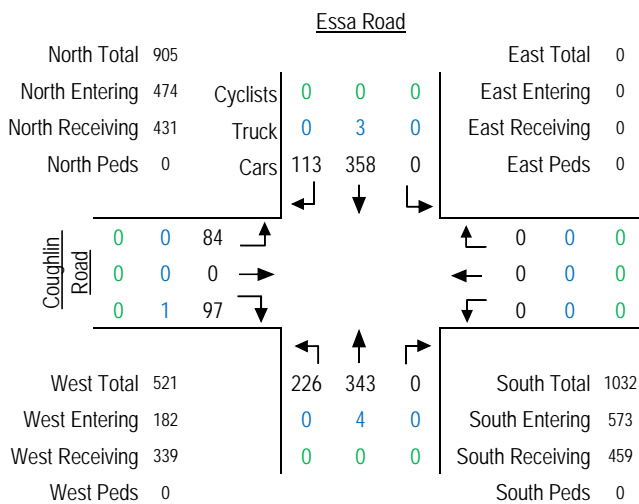
AM Peak Hour: 7:45 to 8:45

MD Peak Hour: 12:30 to 13:30



PM Peak Hour: 16:45 to 17:45

Total 8-Hour Count



**Appendix B**  
**Synchro Results – 2017 Analysis**

DRAFT

**Queues**

**Existing 2017 AM Peak Hour**

**1: Essa Road & Coughlin Road**

Essa Road EA



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	125	128	92	244	343
v/c Ratio	0.46	0.37	0.13	0.10	0.15
Control Delay	36.3	9.0	5.2	4.6	4.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	36.3	9.0	5.2	4.6	4.3
Queue Length 50th (m)	17.0	0.0	4.1	5.5	7.0
Queue Length 95th (m)	27.1	13.0	7.9	10.1	12.4
Internal Link Dist (m)	124.5			926.3	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	737	728	713	2433	2356
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.17	0.18	0.13	0.10	0.15

**Intersection Summary**

**HCM Signalized Intersection Capacity Analysis**

**Existing 2017 AM Peak Hour**

**1: Essa Road & Coughlin Road**

Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	96	114	69	227	252	32
Future Volume (vph)	96	114	69	227	252	32
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.97	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	1570	1807	3544	3414	
Flt Permitted	0.95	1.00	0.55	1.00	1.00	
Satd. Flow (perm)	1772	1570	1038	3544	3414	
Peak-hour factor, PHF	0.77	0.89	0.75	0.93	0.89	0.53
Adj. Flow (vph)	125	128	92	244	283	60
RTOR Reduction (vph)	0	108	0	0	12	0
Lane Group Flow (vph)	125	20	92	244	331	0
Heavy Vehicles (%)	3%	4%	1%	3%	5%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.6	12.6	56.3	56.3	56.3	
Effective Green, g (s)	12.6	12.6	56.3	56.3	56.3	
Actuated g/C Ratio	0.15	0.15	0.69	0.69	0.69	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	272	241	713	2436	2346	
v/s Ratio Prot	c0.07			0.07	c0.10	
v/s Ratio Perm		0.01	0.09			
v/c Ratio	0.46	0.08	0.13	0.10	0.14	
Uniform Delay, d1	31.5	29.7	4.4	4.3	4.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.2	0.1	0.4	0.1	0.1	
Delay (s)	32.8	29.8	4.8	4.4	4.6	
Level of Service	C	C	A	A	A	
Approach Delay (s)	31.3			4.5	4.6	
Approach LOS	C			A	A	

Intersection Summary			
HCM 2000 Control Delay	11.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	81.9	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

**Queues**

**Existing 2017 AM Peak Hour**

**2: Essa Road & Mapleview Drive**

Essa Road EA



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	131	623	95	346	89	37	160	120	204	169	109
v/c Ratio	0.33	0.67	0.35	0.43	0.19	0.09	0.25	0.21	0.32	0.19	0.13
Control Delay	19.8	34.2	20.7	31.5	2.7	24.7	25.4	6.0	15.1	15.7	3.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.8	34.2	20.7	31.5	2.7	24.7	25.4	6.0	15.1	15.7	3.8
Queue Length 50th (m)	14.6	52.4	10.4	27.6	0.0	4.5	20.4	0.0	18.6	16.2	0.0
Queue Length 95th (m)	22.0	71.1	13.0	30.8	0.1	11.1	36.0	12.4	32.0	29.8	3.0
Internal Link Dist (m)		184.4		226.9			89.0			926.3	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	413	1183	300	1160	626	406	631	577	637	895	832
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.53	0.32	0.30	0.14	0.09	0.25	0.21	0.32	0.19	0.13

**Intersection Summary**

HCM Signalized Intersection Capacity Analysis

Existing 2017 AM Peak Hour

2: Essa Road & Mapleview Drive

Essa Road EA



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	102	549	36	58	249	64	29	130	115	159	137	70
Future Volume (vph)	102	549	36	58	249	64	29	130	115	159	137	70
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fl <sub>t</sub> Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	3558		1644	3510	1633	1755	1865	1471	1772	1847	1601
Fl <sub>t</sub> Permitted	0.45	1.00		0.28	1.00	1.00	0.65	1.00	1.00	0.58	1.00	1.00
Satd. Flow (perm)	847	3558		480	3510	1633	1201	1865	1471	1083	1847	1601
Peak-hour factor, PHF	0.78	0.97	0.63	0.61	0.72	0.72	0.78	0.81	0.96	0.78	0.81	0.64
Adj. Flow (vph)	131	566	57	95	346	89	37	160	120	204	169	109
RTOR Reduction (vph)	0	8	0	0	0	68	0	0	80	0	0	57
Lane Group Flow (vph)	131	615	0	95	346	21	37	160	40	204	169	52
Heavy Vehicles (%)	3%	1%	3%	11%	4%	0%	4%	3%	11%	3%	4%	2%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	32.8	23.7		28.8	21.7	21.7	31.0	31.0	31.0	44.3	44.3	44.3
Effective Green, g (s)	32.8	23.7		28.8	21.7	21.7	31.0	31.0	31.0	44.3	44.3	44.3
Actuated g/C Ratio	0.36	0.26		0.31	0.24	0.24	0.34	0.34	0.34	0.48	0.48	0.48
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	393	915		239	827	384	404	627	495	590	888	770
v/s Ratio Prot	c0.03	c0.17		0.03	0.10			0.09		c0.03	0.09	
v/s Ratio Perm	0.09			0.09		0.01	0.03		0.03	c0.13		0.03
v/c Ratio	0.33	0.67		0.40	0.42	0.05	0.09	0.26	0.08	0.35	0.19	0.07
Uniform Delay, d <sub>1</sub>	20.7	30.7		23.4	29.8	27.3	20.9	22.2	20.8	14.1	13.7	12.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d <sub>2</sub>	0.5	2.0		1.1	0.3	0.1	0.4	1.0	0.3	0.4	0.5	0.2
Delay (s)	21.2	32.7		24.5	30.2	27.3	21.4	23.2	21.2	14.5	14.1	13.0
Level of Service	C	C		C	C	C	C	C	C	B	B	B
Approach Delay (s)		30.7			28.7			22.2			14.0	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	25.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	92.1	Sum of lost time (s)	21.0
Intersection Capacity Utilization	92.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

**Queues**

**Existing 2017 PM Peak Hour**

**1: Essa Road & Coughlin Road**

Essa Road EA



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	124	120	251	390	536
v/c Ratio	0.48	0.36	0.36	0.15	0.27
Control Delay	42.4	10.1	5.0	4.4	9.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.4	10.1	5.0	4.4	9.1
Queue Length 50th (m)	20.2	0.0	9.9	9.2	18.4
Queue Length 95th (m)	26.8	11.1	19.6	15.6	32.4
Internal Link Dist (m)	124.5			926.3	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	441	481	824	2582	2003
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.28	0.25	0.30	0.15	0.27

**Intersection Summary**

**HCM Signalized Intersection Capacity Analysis**

**Existing 2017 PM Peak Hour**

**1: Essa Road & Coughlin Road**

Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	84	98	226	347	361	113
Future Volume (vph)	84	98	226	347	361	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.95	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1617	1825	3614	3459	
Flt Permitted	0.95	1.00	0.42	1.00	1.00	
Satd. Flow (perm)	1825	1617	802	3614	3459	
Peak-hour factor, PHF	0.68	0.82	0.90	0.89	0.97	0.69
Adj. Flow (vph)	124	120	251	390	372	164
RTOR Reduction (vph)	0	103	0	0	37	0
Lane Group Flow (vph)	124	17	251	390	499	0
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	13.0	13.0	65.1	65.1	51.8	
Effective Green, g (s)	13.0	13.0	65.1	65.1	51.8	
Actuated g/C Ratio	0.14	0.14	0.71	0.71	0.57	
Clearance Time (s)	6.0	6.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	260	230	677	2582	1966	
v/s Ratio Prot	c0.07		c0.04	0.11	0.14	
v/s Ratio Perm		0.01	c0.23			
v/c Ratio	0.48	0.07	0.37	0.15	0.25	
Uniform Delay, d1	35.9	33.8	4.4	4.2	9.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.4	0.1	0.3	0.1	0.3	
Delay (s)	37.3	34.0	4.8	4.3	10.2	
Level of Service	D	C	A	A	B	
Approach Delay (s)	35.7			4.5	10.2	
Approach LOS	D			A	B	

Intersection Summary			
HCM 2000 Control Delay	12.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	91.1	Sum of lost time (s)	17.0
Intersection Capacity Utilization	61.7%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			



**Queues**

**Existing 2017 PM Peak Hour**

**2: Essa Road & Mapleview Drive**

Essa Road EA



Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	108	526	170	784	292	100	292	146	164	178	201
v/c Ratio	0.40	0.57	0.49	0.74	0.43	0.25	0.47	0.24	0.33	0.20	0.24
Control Delay	20.9	32.5	22.1	35.9	5.4	28.5	30.9	8.1	17.1	17.6	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.9	32.5	22.1	35.9	5.4	28.5	30.9	8.1	17.1	17.6	3.3
Queue Length 50th (m)	11.9	44.0	19.4	71.8	0.0	14.8	47.0	2.9	18.1	20.9	0.0
Queue Length 95th (m)	18.1	57.3	28.0	90.6	18.1	23.3	58.9	14.7	26.2	35.0	8.8
Internal Link Dist (m)		184.4		226.9			89.0			926.3	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	294	1111	358	1136	713	401	615	597	504	886	853
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.47	0.47	0.69	0.41	0.25	0.47	0.24	0.33	0.20	0.24

**Intersection Summary**

HCM Signalized Intersection Capacity Analysis

Existing 2017 PM Peak Hour

2: Essa Road & Mapleview Drive

Essa Road EA



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	82	429	27	134	690	269	75	222	124	128	166	165
Future Volume (vph)	82	429	27	134	690	269	75	222	124	128	166	165
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fr <sub>t</sub>	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fl <sub>t</sub> Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	3517		1789	3614	1633	1825	1902	1585	1825	1921	1617
Fl <sub>t</sub> Permitted	0.19	1.00		0.31	1.00	1.00	0.64	1.00	1.00	0.42	1.00	1.00
Satd. Flow (perm)	363	3517		585	3614	1633	1239	1902	1585	807	1921	1617
Peak-hour factor, PHF	0.76	0.87	0.81	0.79	0.88	0.92	0.75	0.76	0.85	0.78	0.93	0.82
Adj. Flow (vph)	108	493	33	170	784	292	100	292	146	164	178	201
RTOR Reduction (vph)	0	5	0	0	0	207	0	0	85	0	0	109
Lane Group Flow (vph)	108	521	0	170	784	85	100	292	61	164	178	92
Heavy Vehicles (%)	0%	3%	0%	2%	1%	0%	0%	1%	3%	0%	0%	1%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	33.4	26.1		37.8	28.3	28.3	31.1	31.1	31.1	44.3	44.3	44.3
Effective Green, g (s)	33.4	26.1		37.8	28.3	28.3	31.1	31.1	31.1	44.3	44.3	44.3
Actuated g/C Ratio	0.34	0.27		0.39	0.29	0.29	0.32	0.32	0.32	0.46	0.46	0.46
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	235	947		346	1055	476	397	610	508	465	878	739
v/s Ratio Prot	0.03	0.15		c0.05	c0.22			c0.15		c0.03	0.09	
v/s Ratio Perm	0.12			0.14		0.05	0.08		0.04	0.13		0.06
v/c Ratio	0.46	0.55		0.49	0.74	0.18	0.25	0.48	0.12	0.35	0.20	0.12
Uniform Delay, d <sub>1</sub>	23.0	30.4		20.4	31.0	25.6	24.3	26.4	23.2	16.3	15.7	15.1
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d <sub>2</sub>	1.4	0.7		1.1	2.9	0.2	1.5	2.7	0.5	0.5	0.5	0.3
Delay (s)	24.5	31.1		21.5	33.9	25.8	25.8	29.1	23.7	16.7	16.3	15.5
Level of Service	C	C		C	C	C	C	C	C	B	B	B
Approach Delay (s)		29.9			30.3			27.0			16.1	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	27.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	96.9	Sum of lost time (s)	21.0
Intersection Capacity Utilization	94.9%	ICU Level of Service	F
Analysis Period (min)	15		
c	Critical Lane Group		

**Appendix C**  
**Messa Village Development Traffic Forecast**

DRAFT

**Table 1 Weekday AM Total Trip Generation from Messa Village**

Parcel	Land Use	Variable		Weekday AM		
				IN	OUT	TOTAL
A	Specialty Retail	25,500	ft <sup>2</sup>	47	44	91
B	Specialty Retail	35,844	ft <sup>2</sup>	67	61	128
C	Specialty Retail (1st floor)	19,590	ft <sup>2</sup>	36	34	70
	Office Park (2nd and 3rd floors)	21,530	ft <sup>2</sup>	33	4	37
D	Specialty Retail (1st floor)	19,590	ft <sup>2</sup>	36	34	70
	Office Park (2nd and 3rd floors)	21,530	ft <sup>2</sup>	33	4	37
E	Supermarket	43,000	ft <sup>2</sup>	94	60	154
F	Office Park (1st floor)	9,924	ft <sup>2</sup>	15	2	17
	Mid-rise Apartment	76		7	16	23
G	Office Park (1st floor)	6,221	ft <sup>2</sup>	9	1	11
	Mid-rise Apartment	66		6	14	20
H	Mid-rise Apartment	72		7	15	22
I	Mid-rise Apartment	72		7	15	22
J	Low-rise residential condo/town	6		1	3	4
K	Low-rise residential condo/town	6		1	3	4
L	Low-rise residential condo/town	6		1	3	4
M	Low-rise residential condo/town	5		1	3	3
N	High-rise residential condo/town	90		6	25	31
O	High-rise residential condo/town	90		6	25	31
<b>TOTAL</b>				<b>413</b>	<b>364</b>	<b>777</b>

**Table 2 Weekday AM Trip Pass By Trips and Internal Trips Summary**

Land Use	AM Total	Pass By %	AM Pass By Trips	Internal %	AM Internal Trips	Sum of Reductions	TRIPS GENERATED
Specialty Retail	359	25%	90	10%	36	126	233
Supermarket	154	35%	54	10%	15	69	85
Office Park	101		-	10%	10	10	91
Residential	162		-		-	-	162
<b>TOTAL</b>	<b>777</b>		<b>144</b>		<b>61</b>	<b>205</b>	<b>572</b>

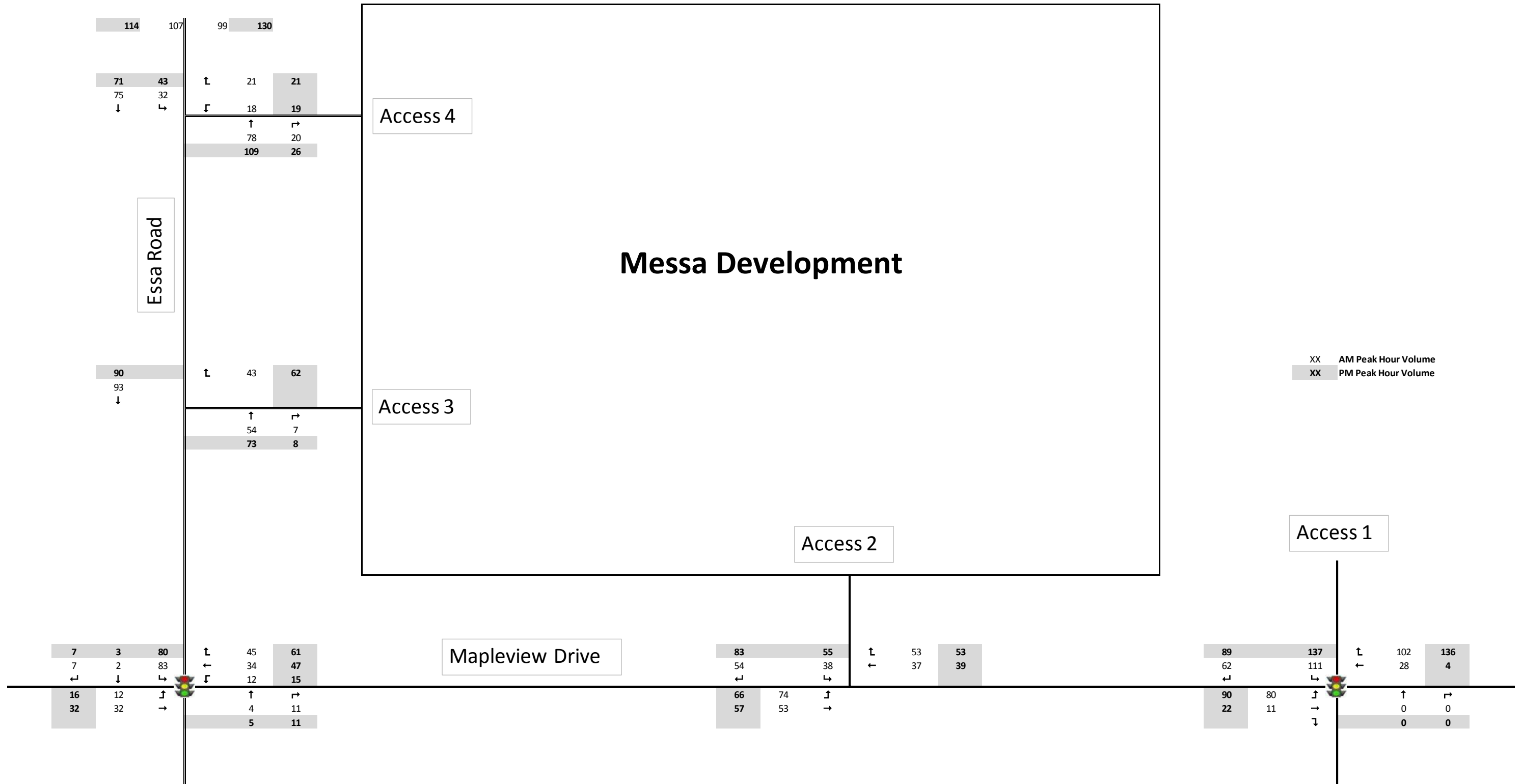


Figure 1 AM and PM Trip Assignment

**Appendix D**  
**Synchro Results - 2021 Analysis**

DRAFT

## Queues

2021 AM Peak Hour

## 1: Essa Road &amp; Coughlin Road

Essa Road EA



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	104	123	96	322	415
v/c Ratio	0.40	0.36	0.14	0.13	0.17
Control Delay	35.6	9.4	5.1	4.5	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	9.4	5.1	4.5	4.5
Queue Length 50th (m)	14.2	0.0	4.3	7.4	9.5
Queue Length 95th (m)	28.1	13.5	9.8	12.2	15.1
Internal Link Dist (m)	124.5			534.4	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	707	700	672	2460	2396
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.15	0.18	0.14	0.13	0.17

## Intersection Summary

HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2021 AM Peak Hour  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	104	123	96	322	380	35
Future Volume (vph)	104	123	96	322	380	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	1570	1807	3544	3446	
Flt Permitted	0.95	1.00	0.51	1.00	1.00	
Satd. Flow (perm)	1772	1570	968	3544	3446	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	104	123	96	322	380	35
RTOR Reduction (vph)	0	105	0	0	5	0
Lane Group Flow (vph)	104	18	96	322	410	0
Heavy Vehicles (%)	3%	4%	1%	3%	5%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.3	12.3	57.7	57.7	57.7	
Effective Green, g (s)	12.3	12.3	57.7	57.7	57.7	
Actuated g/C Ratio	0.15	0.15	0.70	0.70	0.70	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	262	232	672	2463	2395	
v/s Ratio Prot	c0.06			0.09	c0.12	
v/s Ratio Perm		0.01	0.10			
v/c Ratio	0.40	0.08	0.14	0.13	0.17	
Uniform Delay, d1	32.0	30.5	4.3	4.2	4.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.1	0.4	0.1	0.2	
Delay (s)	33.0	30.6	4.7	4.4	4.5	
Level of Service	C	C	A	A	A	
Approach Delay (s)	31.7			4.4	4.5	
Approach LOS	C			A	A	

Intersection Summary

HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.21		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Queues  
2: Essa Road & Mapleview Drive

2021 AM Peak Hour  
Essa Road EA




























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	122	665	75	304	114	31	145	135	255	150	83
v/c Ratio	0.29	0.69	0.29	0.37	0.24	0.08	0.23	0.23	0.40	0.17	0.10
Control Delay	19.1	34.6	19.7	30.4	5.1	24.7	25.5	5.8	16.3	15.7	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.1	34.6	19.7	30.4	5.1	24.7	25.5	5.8	16.3	15.7	4.2
Queue Length 50th (m)	13.6	56.6	8.1	23.8	0.0	3.8	18.9	0.0	25.0	14.8	0.0
Queue Length 95th (m)	24.2	76.9	16.3	35.2	9.6	11.3	37.3	13.0	47.5	30.1	8.1
Internal Link Dist (m)		184.4		226.9			89.0			367.9	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	438	1181	292	1155	624	408	622	581	640	891	816
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.56	0.26	0.26	0.18	0.08	0.23	0.23	0.40	0.17	0.10

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive










2021 AM Peak Hour  
Essa Road EA

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 			 							
Traffic Volume (vph)	122	626	39	75	304	114	31	145	135	255	150	83
Future Volume (vph)	122	626	39	75	304	114	31	145	135	255	150	83
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	3578		1644	3510	1633	1755	1865	1471	1772	1847	1601
Flt Permitted	0.49	1.00		0.25	1.00	1.00	0.66	1.00	1.00	0.59	1.00	1.00
Satd. Flow (perm)	921	3578		440	3510	1633	1222	1865	1471	1097	1847	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	122	626	39	75	304	114	31	145	135	255	150	83
RTOR Reduction (vph)	0	4	0	0	0	87	0	0	90	0	0	43
Lane Group Flow (vph)	122	661	0	75	304	27	31	145	45	255	150	40
Heavy Vehicles (%)	3%	1%	3%	11%	4%	0%	4%	3%	11%	3%	4%	2%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	33.5	24.6		28.9	22.3	22.3	30.7	30.7	30.7	44.3	44.3	44.3
Effective Green, g (s)	33.5	24.6		28.9	22.3	22.3	30.7	30.7	30.7	44.3	44.3	44.3
Actuated g/C Ratio	0.36	0.27		0.31	0.24	0.24	0.33	0.33	0.33	0.48	0.48	0.48
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	415	951		223	846	393	405	618	488	595	884	766
v/s Ratio Prot	c0.03	c0.18		0.02	0.09			0.08		c0.04	0.08	
v/s Ratio Perm	0.08			0.08		0.02	0.03		0.03	c0.16		0.02
v/c Ratio	0.29	0.69		0.34	0.36	0.07	0.08	0.23	0.09	0.43	0.17	0.05
Uniform Delay, d1	20.3	30.6		23.3	29.2	27.1	21.2	22.4	21.3	14.8	13.7	12.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	2.2		0.9	0.3	0.1	0.4	0.9	0.4	0.5	0.4	0.1
Delay (s)	20.7	32.8		24.2	29.4	27.2	21.6	23.3	21.7	15.3	14.1	13.0
Level of Service	C	C		C	C	C	C	C	C	B	B	B
Approach Delay (s)		30.9			28.1			22.4			14.5	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	25.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	92.5	Sum of lost time (s)	21.0
Intersection Capacity Utilization	94.4%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road & Messa Village Access

2021 AM Peak Hour  
Essa Road EA

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	18	21	397	20	32	471
Future Volume (Veh/h)	18	21	397	20	32	471
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	21	397	20	32	471
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (m)			392			
pX, platoon unblocked						
vC, conflicting volume	942	407			417	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	942	407			417	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	94	97			97	
cM capacity (veh/h)	284	644			1142	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	39	417	503			
Volume Left	18	0	32			
Volume Right	21	20	0			
cSH	406	1700	1142			
Volume to Capacity	0.10	0.25	0.03			
Queue Length 95th (m)	2.4	0.0	0.7			
Control Delay (s)	14.8	0.0	0.8			
Lane LOS	B		A			
Approach Delay (s)	14.8	0.0	0.8			
Approach LOS	B					
Intersection Summary						
Average Delay			1.0			
Intersection Capacity Utilization			61.1%	ICU Level of Service		B
Analysis Period (min)	15					

Queues

1: Essa Road & Coughlin Road

Essa Road EA

2021 PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	91	106	296	455	627
v/c Ratio	0.37	0.35	0.45	0.17	0.31
Control Delay	41.4	10.9	5.5	4.2	10.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	41.4	10.9	5.5	4.2	10.3
Queue Length 50th (m)	15.0	0.0	12.0	11.0	25.8
Queue Length 95th (m)	29.1	13.9	20.6	16.6	40.3
Internal Link Dist (m)	124.5			36.8	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	395	433	818	2622	2037
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.23	0.24	0.36	0.17	0.31

Intersection Summary

# HCM Signalized Intersection Capacity Analysis

## 1: Essa Road & Coughlin Road

Essa Road EA  
2021 PM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	91	106	296	455	505	122
Future Volume (vph)	91	106	296	455	505	122
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.97	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1617	1825	3614	3515	
Flt Permitted	0.95	1.00	0.37	1.00	1.00	
Satd. Flow (perm)	1825	1617	715	3614	3515	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	91	106	296	455	505	122
RTOR Reduction (vph)	0	92	0	0	15	0
Lane Group Flow (vph)	91	14	296	455	612	0
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.3	12.3	67.0	67.0	53.1	
Effective Green, g (s)	12.3	12.3	67.0	67.0	53.1	
Actuated g/C Ratio	0.13	0.13	0.73	0.73	0.58	
Clearance Time (s)	6.0	6.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	243	215	638	2623	2022	
v/s Ratio Prot	c0.05		c0.05	0.13	0.17	
v/s Ratio Perm		0.01	c0.29			
v/c Ratio	0.37	0.07	0.46	0.17	0.30	
Uniform Delay, d1	36.5	35.0	4.4	4.0	10.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.1	0.5	0.1	0.4	
Delay (s)	37.5	35.1	5.0	4.1	10.5	
Level of Service	D	D	A	A	B	
Approach Delay (s)	36.2			4.4	10.5	
Approach LOS	D			A	B	

### Intersection Summary

HCM 2000 Control Delay	10.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	92.3	Sum of lost time (s)	17.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

Essa Road EA  
2021 PM Peak Hour


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	105	525	160	794	352	81	245	145	219	183	186
v/c Ratio	0.39	0.57	0.46	0.75	0.48	0.21	0.40	0.24	0.40	0.21	0.22
Control Delay	20.8	32.4	21.5	36.2	5.5	28.1	29.7	5.7	17.9	17.6	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.8	32.4	21.5	36.2	5.5	28.1	29.7	5.7	17.9	17.6	3.3
Queue Length 50th (m)	11.5	44.0	18.2	72.8	0.0	11.8	38.3	0.0	24.9	21.6	0.0
Queue Length 95th (m)	21.3	59.7	30.9	94.9	19.4	23.8	60.8	13.4	40.6	35.9	11.7
Internal Link Dist (m)		184.4		226.9			89.0			361.6	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	291	1112	358	1137	755	395	609	606	547	886	846
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.47	0.45	0.70	0.47	0.21	0.40	0.24	0.40	0.21	0.22

Intersection Summary

# HCM Signalized Intersection Capacity Analysis

## 2: Essa Road & Mapleview Drive

Essa Road EA  
2021 PM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
Future Volume (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	3520		1789	3614	1633	1825	1902	1585	1825	1921	1617	
Flt Permitted	0.18	1.00		0.31	1.00	1.00	0.64	1.00	1.00	0.48	1.00	1.00	
Satd. Flow (perm)	351	3520		587	3614	1633	1233	1902	1585	918	1921	1617	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
RTOR Reduction (vph)	0	4	0	0	0	249	0	0	99	0	0	101	
Lane Group Flow (vph)	105	521	0	160	794	103	81	245	46	219	183	85	
Heavy Vehicles (%)	0%	3%	0%	2%	1%	0%	0%	1%	3%	0%	0%	1%	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	
Protected Phases	7	4		3	8			2		1	6		
Permitted Phases	4			8		8	2		2	6		6	
Actuated Green, G (s)	33.3	26.1		37.7	28.3	28.3	30.8	30.8	30.8	44.3	44.3	44.3	
Effective Green, g (s)	33.3	26.1		37.7	28.3	28.3	30.8	30.8	30.8	44.3	44.3	44.3	
Actuated g/C Ratio	0.34	0.27		0.39	0.29	0.29	0.32	0.32	0.32	0.46	0.46	0.46	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	230	949		345	1056	477	392	605	504	509	879	740	
v/s Ratio Prot	0.03	0.15		c0.04	c0.22			0.13		c0.04	0.10		
v/s Ratio Perm	0.12			0.14		0.06	0.07		0.03	c0.15		0.05	
v/c Ratio	0.46	0.55		0.46	0.75	0.22	0.21	0.40	0.09	0.43	0.21	0.12	
Uniform Delay, d1	23.1	30.3		20.3	31.1	25.9	24.1	25.8	23.2	16.5	15.7	15.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.4	0.7		1.0	3.1	0.2	1.2	2.0	0.4	0.6	0.5	0.3	
Delay (s)	24.5	31.0		21.3	34.1	26.1	25.3	27.8	23.5	17.1	16.3	15.3	
Level of Service	C	C		C	C	C	C	C	C	B	B	B	
Approach Delay (s)		29.9			30.4			26.1			16.3		
Approach LOS		C			C			C			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			26.8									HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.59										
Actuated Cycle Length (s)			96.8									Sum of lost time (s)	21.0
Intersection Capacity Utilization			97.8%									ICU Level of Service	F
Analysis Period (min)			15										
c	Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road

Essa Road EA  
2021 PM Peak Hour



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	19	21	730	26	43	568
Future Volume (Veh/h)	19	21	730	26	43	568
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	19	21	730	26	43	568
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None		None	
Median storage veh)						
Upstream signal (m)			386			
pX, platoon unblocked	0.93	0.93			0.93	
vC, conflicting volume	1397	743			756	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1390	690			704	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	86	95			95	
cM capacity (veh/h)	139	416			835	
<b>Direction, Lane #</b>						
	WB 1	NB 1	SB 1			
Volume Total	40	756	611			
Volume Left	19	0	43			
Volume Right	21	26	0			
cSH	214	1700	835			
Volume to Capacity	0.19	0.44	0.05			
Queue Length 95th (m)	5.1	0.0	1.2			
Control Delay (s)	25.7	0.0	1.4			
Lane LOS	D		A			
Approach Delay (s)	25.7	0.0	1.4			
Approach LOS	D					
<b>Intersection Summary</b>						
Average Delay			1.3			
Intersection Capacity Utilization			75.3%		ICU Level of Service	D
Analysis Period (min)			15			



Queues

1: Essa Road & Coughlin Road



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	104	123	96	322	415
v/c Ratio	0.40	0.36	0.14	0.13	0.17
Control Delay	35.6	9.4	5.1	4.5	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	9.4	5.1	4.5	4.5
Queue Length 50th (m)	14.2	0.0	4.3	7.4	9.5
Queue Length 95th (m)	28.1	13.5	9.8	12.2	15.1
Internal Link Dist (m)	124.5			31.5	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	707	700	672	2460	2396
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.15	0.18	0.14	0.13	0.17

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2021 AM Peak Hour - 3 Lane Widening  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	104	123	96	322	380	35
Future Volume (vph)	104	123	96	322	380	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	1570	1807	3544	3446	
Flt Permitted	0.95	1.00	0.51	1.00	1.00	
Satd. Flow (perm)	1772	1570	968	3544	3446	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	104	123	96	322	380	35
RTOR Reduction (vph)	0	105	0	0	5	0
Lane Group Flow (vph)	104	18	96	322	410	0
Heavy Vehicles (%)	3%	4%	1%	3%	5%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.3	12.3	57.7	57.7	57.7	
Effective Green, g (s)	12.3	12.3	57.7	57.7	57.7	
Actuated g/C Ratio	0.15	0.15	0.70	0.70	0.70	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	262	232	672	2463	2395	
v/s Ratio Prot	c0.06			0.09	c0.12	
v/s Ratio Perm		0.01	0.10			
v/c Ratio	0.40	0.08	0.14	0.13	0.17	
Uniform Delay, d1	32.0	30.5	4.3	4.2	4.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.1	0.4	0.1	0.2	
Delay (s)	33.0	30.6	4.7	4.4	4.5	
Level of Service	C	C	A	A	A	
Approach Delay (s)	31.7			4.4	4.5	
Approach LOS	C			A	A	

Intersection Summary

HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.21		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2021 AM Peak Hour - 3 Lane Widening  
Essa Road EA


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	122	665	75	304	114	31	145	135	255	150	83
v/c Ratio	0.29	0.69	0.29	0.37	0.24	0.08	0.23	0.23	0.40	0.17	0.10
Control Delay	19.1	34.6	19.7	30.4	5.1	24.7	25.5	5.8	16.3	15.7	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.1	34.6	19.7	30.4	5.1	24.7	25.5	5.8	16.3	15.7	4.2
Queue Length 50th (m)	13.6	56.6	8.1	23.8	0.0	3.8	18.9	0.0	25.0	14.8	0.0
Queue Length 95th (m)	24.2	76.9	16.3	35.2	9.6	11.3	37.3	13.0	47.5	30.1	8.1
Internal Link Dist (m)		184.4		226.9			89.0			367.9	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	438	1181	292	1155	624	408	622	581	640	891	816
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.56	0.26	0.26	0.18	0.08	0.23	0.23	0.40	0.17	0.10

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2021 AM Peak Hour - 3 Lane Widening  
Essa Road EA

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	122	626	39	75	304	114	31	145	135	255	150	83
Future Volume (vph)	122	626	39	75	304	114	31	145	135	255	150	83
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	3578		1644	3510	1633	1755	1865	1471	1772	1847	1601
Flt Permitted	0.49	1.00		0.25	1.00	1.00	0.66	1.00	1.00	0.59	1.00	1.00
Satd. Flow (perm)	921	3578		440	3510	1633	1222	1865	1471	1097	1847	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	122	626	39	75	304	114	31	145	135	255	150	83
RTOR Reduction (vph)	0	4	0	0	0	87	0	0	90	0	0	43
Lane Group Flow (vph)	122	661	0	75	304	27	31	145	45	255	150	40
Heavy Vehicles (%)	3%	1%	3%	11%	4%	0%	4%	3%	11%	3%	4%	2%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	33.5	24.6		28.9	22.3	22.3	30.7	30.7	30.7	44.3	44.3	44.3
Effective Green, g (s)	33.5	24.6		28.9	22.3	22.3	30.7	30.7	30.7	44.3	44.3	44.3
Actuated g/C Ratio	0.36	0.27		0.31	0.24	0.24	0.33	0.33	0.33	0.48	0.48	0.48
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	415	951		223	846	393	405	618	488	595	884	766
v/s Ratio Prot	c0.03	c0.18		0.02	0.09			0.08		c0.04	0.08	
v/s Ratio Perm	0.08			0.08		0.02	0.03		0.03	c0.16		0.02
v/c Ratio	0.29	0.69		0.34	0.36	0.07	0.08	0.23	0.09	0.43	0.17	0.05
Uniform Delay, d1	20.3	30.6		23.3	29.2	27.1	21.2	22.4	21.3	14.8	13.7	12.9
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	2.2		0.9	0.3	0.1	0.4	0.9	0.4	0.5	0.4	0.1
Delay (s)	20.7	32.8		24.2	29.4	27.2	21.6	23.3	21.7	15.3	14.1	13.0
Level of Service	C	C		C	C	C	C	C	C	B	B	B
Approach Delay (s)		30.9			28.1			22.4			14.5	
Approach LOS		C			C			C			B	

Intersection Summary		
HCM 2000 Control Delay	25.1	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.54	C
Actuated Cycle Length (s)	92.5	Sum of lost time (s)
Intersection Capacity Utilization	94.4%	21.0
Analysis Period (min)	15	ICU Level of Service
c Critical Lane Group		F

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road & Messa Village Access

2021 AM Peak Hour - 3 Lane Widening  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙		↑		↘	↑
Traffic Volume (veh/h)	18	21	397	20	32	471
Future Volume (Veh/h)	18	21	397	20	32	471
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	21	397	20	32	471
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage veh)			2		2	
Upstream signal (m)			392			
pX, platoon unblocked						
vC, conflicting volume	942	407			417	
vC1, stage 1 conf vol	407					
vC2, stage 2 conf vol	535					
vCu, unblocked vol	942	407			417	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	97			97	
cM capacity (veh/h)	490	644			1142	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	39	417	32	471		
Volume Left	18	0	32	0		
Volume Right	21	20	0	0		
cSH	563	1700	1142	1700		
Volume to Capacity	0.07	0.25	0.03	0.28		
Queue Length 95th (m)	1.7	0.0	0.7	0.0		
Control Delay (s)	11.9	0.0	8.2	0.0		
Lane LOS	B		A			
Approach Delay (s)	11.9	0.0	0.5			
Approach LOS	B					
Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization			36.6%		ICU Level of Service	A
Analysis Period (min)			15			

Queues

1: Essa Road & Coughlin Road



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	91	106	296	455	627
v/c Ratio	0.37	0.35	0.45	0.17	0.31
Control Delay	41.4	10.9	5.5	4.2	10.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	41.4	10.9	5.5	4.2	10.3
Queue Length 50th (m)	15.0	0.0	12.0	11.0	25.8
Queue Length 95th (m)	29.1	13.9	20.6	16.6	40.3
Internal Link Dist (m)	124.5			33.4	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	395	433	818	2622	2037
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.23	0.24	0.36	0.17	0.31

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2021 PM Peak Hour - 3 Lane Widening  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	91	106	296	455	505	122
Future Volume (vph)	91	106	296	455	505	122
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.97	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1617	1825	3614	3515	
Flt Permitted	0.95	1.00	0.37	1.00	1.00	
Satd. Flow (perm)	1825	1617	715	3614	3515	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	91	106	296	455	505	122
RTOR Reduction (vph)	0	92	0	0	15	0
Lane Group Flow (vph)	91	14	296	455	612	0
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.3	12.3	67.0	67.0	53.1	
Effective Green, g (s)	12.3	12.3	67.0	67.0	53.1	
Actuated g/C Ratio	0.13	0.13	0.73	0.73	0.58	
Clearance Time (s)	6.0	6.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	243	215	638	2623	2022	
v/s Ratio Prot	c0.05		c0.05	0.13	0.17	
v/s Ratio Perm		0.01	c0.29			
v/c Ratio	0.37	0.07	0.46	0.17	0.30	
Uniform Delay, d1	36.5	35.0	4.4	4.0	10.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.1	0.5	0.1	0.4	
Delay (s)	37.5	35.1	5.0	4.1	10.5	
Level of Service	D	D	A	A	B	
Approach Delay (s)	36.2			4.4	10.5	
Approach LOS	D			A	B	

Intersection Summary

HCM 2000 Control Delay	10.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	92.3	Sum of lost time (s)	17.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2021 PM Peak Hour - 3 Lane Widening  
Essa Road EA




























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	105	525	160	794	352	81	245	145	219	183	186
v/c Ratio	0.39	0.57	0.46	0.75	0.48	0.21	0.40	0.24	0.40	0.21	0.22
Control Delay	20.8	32.4	21.5	36.2	5.5	28.1	29.7	5.7	17.9	17.6	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.8	32.4	21.5	36.2	5.5	28.1	29.7	5.7	17.9	17.6	3.3
Queue Length 50th (m)	11.5	44.0	18.2	72.8	0.0	11.8	38.3	0.0	24.9	21.6	0.0
Queue Length 95th (m)	21.3	59.7	30.9	94.9	19.4	23.8	60.8	13.4	40.6	35.9	11.7
Internal Link Dist (m)		184.4		226.9			89.0			367.9	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	291	1112	358	1137	755	395	609	606	547	886	846
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.47	0.45	0.70	0.47	0.21	0.40	0.24	0.40	0.21	0.22

Intersection Summary



HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2021 PM Peak Hour - 3 Lane Widening  
Essa Road EA

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			 								
Traffic Volume (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
Future Volume (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	3520		1789	3614	1633	1825	1902	1585	1825	1921	1617	
Flt Permitted	0.18	1.00		0.31	1.00	1.00	0.64	1.00	1.00	0.48	1.00	1.00	
Satd. Flow (perm)	351	3520		587	3614	1633	1233	1902	1585	918	1921	1617	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
RTOR Reduction (vph)	0	4	0	0	0	249	0	0	99	0	0	101	
Lane Group Flow (vph)	105	521	0	160	794	103	81	245	46	219	183	85	
Heavy Vehicles (%)	0%	3%	0%	2%	1%	0%	0%	1%	3%	0%	0%	1%	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	
Protected Phases	7	4		3	8			2		1	6		
Permitted Phases	4			8		8	2		2	6		6	
Actuated Green, G (s)	33.3	26.1		37.7	28.3	28.3	30.8	30.8	30.8	44.3	44.3	44.3	
Effective Green, g (s)	33.3	26.1		37.7	28.3	28.3	30.8	30.8	30.8	44.3	44.3	44.3	
Actuated g/C Ratio	0.34	0.27		0.39	0.29	0.29	0.32	0.32	0.32	0.46	0.46	0.46	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	230	949		345	1056	477	392	605	504	509	879	740	
v/s Ratio Prot	0.03	0.15		c0.04	c0.22			0.13		c0.04	0.10		
v/s Ratio Perm	0.12			0.14		0.06	0.07		0.03	c0.15		0.05	
v/c Ratio	0.46	0.55		0.46	0.75	0.22	0.21	0.40	0.09	0.43	0.21	0.12	
Uniform Delay, d1	23.1	30.3		20.3	31.1	25.9	24.1	25.8	23.2	16.5	15.7	15.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.4	0.7		1.0	3.1	0.2	1.2	2.0	0.4	0.6	0.5	0.3	
Delay (s)	24.5	31.0		21.3	34.1	26.1	25.3	27.8	23.5	17.1	16.3	15.3	
Level of Service	C	C		C	C	C	C	C	C	B	B	B	
Approach Delay (s)		29.9			30.4			26.1			16.3		
Approach LOS		C			C			C			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			26.8									HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.59										
Actuated Cycle Length (s)			96.8									Sum of lost time (s)	21.0
Intersection Capacity Utilization			97.8%									ICU Level of Service	F
Analysis Period (min)			15										
c	Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
 8: Essa Road & Messa Village Access

2021 PM Peak Hour - 3 Lane Widening  
 Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↔		↑		↔	↑
Traffic Volume (veh/h)	19	21	730	26	43	568
Future Volume (Veh/h)	19	21	730	26	43	568
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	19	21	730	26	43	568
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage veh			2		2	
Upstream signal (m)			392			
pX, platoon unblocked	0.94	0.94			0.94	
vC, conflicting volume	1397	743			756	
vC1, stage 1 conf vol	743					
vC2, stage 2 conf vol	654					
vCu, unblocked vol	1390	695			708	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	95			95	
cM capacity (veh/h)	356	416			837	
<b>Direction, Lane #</b>						
	WB 1	NB 1	SB 1	SB 2		
Volume Total	40	756	43	568		
Volume Left	19	0	43	0		
Volume Right	21	26	0	0		
cSH	385	1700	837	1700		
Volume to Capacity	0.10	0.44	0.05	0.33		
Queue Length 95th (m)	2.6	0.0	1.2	0.0		
Control Delay (s)	15.4	0.0	9.5	0.0		
Lane LOS	C		A			
Approach Delay (s)	15.4	0.0	0.7			
Approach LOS	C					
<b>Intersection Summary</b>						
Average Delay			0.7			
Intersection Capacity Utilization			50.0%		ICU Level of Service	A
Analysis Period (min)			15			

## Queues

2021 AM Peak Hour - 5 Lane Widening

## 1: Essa Road &amp; Coughlin Road

Essa Road EA



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	104	123	96	322	415
v/c Ratio	0.40	0.36	0.14	0.13	0.17
Control Delay	35.6	9.4	5.1	4.5	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	35.6	9.4	5.1	4.5	4.5
Queue Length 50th (m)	14.2	0.0	4.3	7.4	9.5
Queue Length 95th (m)	28.1	13.5	9.8	12.2	15.1
Internal Link Dist (m)	124.5			534.4	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	707	700	672	2460	2396
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.15	0.18	0.14	0.13	0.17

## Intersection Summary

HCM Signalized Intersection Capacity Analysis  
 1: Essa Road & Coughlin Road

2021 AM Peak Hour - 5 Lane Widening  
 Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	104	123	96	322	380	35
Future Volume (vph)	104	123	96	322	380	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	1570	1807	3544	3446	
Flt Permitted	0.95	1.00	0.51	1.00	1.00	
Satd. Flow (perm)	1772	1570	968	3544	3446	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	104	123	96	322	380	35
RTOR Reduction (vph)	0	105	0	0	5	0
Lane Group Flow (vph)	104	18	96	322	410	0
Heavy Vehicles (%)	3%	4%	1%	3%	5%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.3	12.3	57.7	57.7	57.7	
Effective Green, g (s)	12.3	12.3	57.7	57.7	57.7	
Actuated g/C Ratio	0.15	0.15	0.70	0.70	0.70	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	262	232	672	2463	2395	
v/s Ratio Prot	c0.06			0.09	c0.12	
v/s Ratio Perm		0.01	0.10			
v/c Ratio	0.40	0.08	0.14	0.13	0.17	
Uniform Delay, d1	32.0	30.5	4.3	4.2	4.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.1	0.4	0.1	0.2	
Delay (s)	33.0	30.6	4.7	4.4	4.5	
Level of Service	C	C	A	A	A	
Approach Delay (s)	31.7			4.4	4.5	
Approach LOS	C			A	A	

Intersection Summary			
HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.21		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2021 AM Peak Hour - 5 Lane Widening  
Essa Road EA





























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	122	665	75	304	114	31	145	135	255	150	83
v/c Ratio	0.29	0.69	0.29	0.37	0.24	0.08	0.23	0.23	0.40	0.09	0.10
Control Delay	19.1	34.6	19.7	30.4	5.1	24.7	25.5	5.8	16.3	14.6	4.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.1	34.6	19.7	30.4	5.1	24.7	25.5	5.8	16.3	14.6	4.2
Queue Length 50th (m)	13.6	56.6	8.1	23.8	0.0	3.8	18.9	0.0	25.0	7.4	0.0
Queue Length 95th (m)	24.2	76.9	16.3	35.2	9.6	11.3	37.3	13.0	47.5	14.7	8.1
Internal Link Dist (m)		184.4		226.9			89.0			367.9	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	438	1181	292	1155	624	405	622	581	640	1695	816
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.56	0.26	0.26	0.18	0.08	0.23	0.23	0.40	0.09	0.10

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2021 AM Peak Hour - 5 Lane Widening  
Essa Road EA

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			 						 		
Traffic Volume (vph)	122	626	39	75	304	114	31	145	135	255	150	83	
Future Volume (vph)	122	626	39	75	304	114	31	145	135	255	150	83	
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	3578		1644	3510	1633	1755	1865	1471	1772	3510	1601	
Flt Permitted	0.49	1.00		0.25	1.00	1.00	0.66	1.00	1.00	0.59	1.00	1.00	
Satd. Flow (perm)	921	3578		440	3510	1633	1213	1865	1471	1097	3510	1601	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	122	626	39	75	304	114	31	145	135	255	150	83	
RTOR Reduction (vph)	0	4	0	0	0	87	0	0	90	0	0	43	
Lane Group Flow (vph)	122	661	0	75	304	27	31	145	45	255	150	40	
Heavy Vehicles (%)	3%	1%	3%	11%	4%	0%	4%	3%	11%	3%	4%	2%	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	
Protected Phases	7	4		3	8			2		1	6		
Permitted Phases	4			8		8	2		2	6		6	
Actuated Green, G (s)	33.5	24.6		28.9	22.3	22.3	30.7	30.7	30.7	44.3	44.3	44.3	
Effective Green, g (s)	33.5	24.6		28.9	22.3	22.3	30.7	30.7	30.7	44.3	44.3	44.3	
Actuated g/C Ratio	0.36	0.27		0.31	0.24	0.24	0.33	0.33	0.33	0.48	0.48	0.48	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	415	951		223	846	393	402	618	488	595	1681	766	
v/s Ratio Prot	c0.03	c0.18		0.02	0.09			0.08		c0.04	0.04		
v/s Ratio Perm	0.08			0.08		0.02	0.03		0.03	c0.16		0.02	
v/c Ratio	0.29	0.69		0.34	0.36	0.07	0.08	0.23	0.09	0.43	0.09	0.05	
Uniform Delay, d1	20.3	30.6		23.3	29.2	27.1	21.2	22.4	21.3	14.8	13.1	12.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	2.2		0.9	0.3	0.1	0.4	0.9	0.4	0.5	0.1	0.1	
Delay (s)	20.7	32.8		24.2	29.4	27.2	21.6	23.3	21.7	15.3	13.2	13.0	
Level of Service	C	C		C	C	C	C	C	C	B	B	B	
Approach Delay (s)		30.9			28.1			22.4			14.3		
Approach LOS		C			C			C			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			25.1									HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.54										
Actuated Cycle Length (s)			92.5									Sum of lost time (s)	21.0
Intersection Capacity Utilization			94.4%									ICU Level of Service	F
Analysis Period (min)			15										
c	Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road & Messa Village Access

2021 AM Peak Hour - 5 Lane Widening  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	18	21	397	20	32	471
Future Volume (Veh/h)	18	21	397	20	32	471
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	21	397	20	32	471
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage veh)			2		2	
Upstream signal (m)			392			
pX, platoon unblocked						
vC, conflicting volume	706	208			417	
vC1, stage 1 conf vol	407					
vC2, stage 2 conf vol	300					
vCu, unblocked vol	706	208			417	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	97			97	
cM capacity (veh/h)	552	797			1138	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	39	265	152	32	236	236
Volume Left	18	0	0	32	0	0
Volume Right	21	0	20	0	0	0
cSH	662	1700	1700	1138	1700	1700
Volume to Capacity	0.06	0.16	0.09	0.03	0.14	0.14
Queue Length 95th (m)	1.4	0.0	0.0	0.7	0.0	0.0
Control Delay (s)	10.8	0.0	0.0	8.3	0.0	0.0
Lane LOS	B			A		
Approach Delay (s)	10.8	0.0		0.5		
Approach LOS	B					
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			28.3%		ICU Level of Service	A
Analysis Period (min)			15			

Queues

1: Essa Road & Coughlin Road



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	91	106	296	455	627
v/c Ratio	0.38	0.35	0.51	0.17	0.24
Control Delay	40.9	10.7	9.4	4.2	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	40.9	10.7	9.4	4.2	4.1
Queue Length 50th (m)	14.6	0.0	19.0	11.0	14.3
Queue Length 95th (m)	28.3	13.6	39.8	16.5	21.1
Internal Link Dist (m)	124.5			540.7	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	448	477	580	2638	2582
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.20	0.22	0.51	0.17	0.24

Intersection Summary



HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2021 PM Peak Hour - 5 Lane Widening  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	91	106	296	455	505	122
Future Volume (vph)	91	106	296	455	505	122
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.97	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1617	1825	3614	3515	
Flt Permitted	0.95	1.00	0.41	1.00	1.00	
Satd. Flow (perm)	1825	1617	795	3614	3515	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	91	106	296	455	505	122
RTOR Reduction (vph)	0	92	0	0	16	0
Lane Group Flow (vph)	91	14	296	455	611	0
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.3	12.3	68.5	68.5	68.5	
Effective Green, g (s)	12.3	12.3	68.5	68.5	68.5	
Actuated g/C Ratio	0.13	0.13	0.73	0.73	0.73	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	239	212	580	2639	2566	
v/s Ratio Prot	c0.05			0.13	0.17	
v/s Ratio Perm		0.01	c0.37			
v/c Ratio	0.38	0.07	0.51	0.17	0.24	
Uniform Delay, d1	37.3	35.7	5.4	3.9	4.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.0	0.1	3.2	0.1	0.2	
Delay (s)	38.3	35.8	8.6	4.0	4.3	
Level of Service	D	D	A	A	A	
Approach Delay (s)	37.0			5.9	4.3	
Approach LOS	D			A	A	

Intersection Summary

HCM 2000 Control Delay	9.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	93.8	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2021 PM Peak Hour - 5 Lane Widening  
Essa Road EA





























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	105	525	160	794	352	81	245	145	219	183	186
v/c Ratio	0.39	0.57	0.46	0.75	0.48	0.21	0.40	0.24	0.40	0.11	0.22
Control Delay	20.8	32.4	21.5	36.2	5.5	28.1	29.7	5.7	17.9	16.2	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	20.8	32.4	21.5	36.2	5.5	28.1	29.7	5.7	17.9	16.2	3.3
Queue Length 50th (m)	11.5	44.0	18.2	72.8	0.0	11.8	38.3	0.0	24.9	10.7	0.0
Queue Length 95th (m)	21.3	59.7	30.9	94.9	19.4	23.8	60.8	13.4	40.6	17.4	11.7
Internal Link Dist (m)		184.4		226.9			89.0			361.6	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	291	1112	358	1137	755	391	609	606	547	1684	846
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.47	0.45	0.70	0.47	0.21	0.40	0.24	0.40	0.11	0.22

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2021 PM Peak Hour - 5 Lane Widening  
Essa Road EA

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			 					 			
Traffic Volume (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
Future Volume (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	3520		1789	3614	1633	1825	1902	1585	1825	3650	1617	
Flt Permitted	0.18	1.00		0.31	1.00	1.00	0.64	1.00	1.00	0.48	1.00	1.00	
Satd. Flow (perm)	351	3520		587	3614	1633	1223	1902	1585	918	3650	1617	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	105	496	29	160	794	352	81	245	145	219	183	186	
RTOR Reduction (vph)	0	4	0	0	0	249	0	0	99	0	0	101	
Lane Group Flow (vph)	105	521	0	160	794	103	81	245	46	219	183	85	
Heavy Vehicles (%)	0%	3%	0%	2%	1%	0%	0%	1%	3%	0%	0%	1%	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	
Protected Phases	7	4		3	8			2		1	6		
Permitted Phases	4			8		8	2		2	6		6	
Actuated Green, G (s)	33.3	26.1		37.7	28.3	28.3	30.8	30.8	30.8	44.3	44.3	44.3	
Effective Green, g (s)	33.3	26.1		37.7	28.3	28.3	30.8	30.8	30.8	44.3	44.3	44.3	
Actuated g/C Ratio	0.34	0.27		0.39	0.29	0.29	0.32	0.32	0.32	0.46	0.46	0.46	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	230	949		345	1056	477	389	605	504	509	1670	740	
v/s Ratio Prot	0.03	0.15		c0.04	c0.22			0.13		c0.04	0.05		
v/s Ratio Perm	0.12			0.14		0.06	0.07		0.03	c0.15		0.05	
v/c Ratio	0.46	0.55		0.46	0.75	0.22	0.21	0.40	0.09	0.43	0.11	0.12	
Uniform Delay, d1	23.1	30.3		20.3	31.1	25.9	24.1	25.8	23.2	16.5	15.0	15.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.4	0.7		1.0	3.1	0.2	1.2	2.0	0.4	0.6	0.1	0.3	
Delay (s)	24.5	31.0		21.3	34.1	26.1	25.3	27.8	23.5	17.1	15.1	15.3	
Level of Service	C	C		C	C	C	C	C	C	B	B	B	
Approach Delay (s)		29.9			30.4			26.1			15.9		
Approach LOS		C			C			C			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			26.8									HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.59										
Actuated Cycle Length (s)			96.8									Sum of lost time (s)	21.0
Intersection Capacity Utilization			97.8%									ICU Level of Service	F
Analysis Period (min)			15										
c	Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road

2021 PM Peak Hour - 5 Lane Widening  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	19	21	730	26	43	568
Future Volume (Veh/h)	19	21	730	26	43	568
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	19	21	730	26	43	568
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage veh)			2		2	
Upstream signal (m)			386			
pX, platoon unblocked						
vC, conflicting volume	1113	378			756	
vC1, stage 1 conf vol	743					
vC2, stage 2 conf vol	370					
vCu, unblocked vol	1113	378			756	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	97			95	
cM capacity (veh/h)	384	620			851	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	40	487	269	43	284	284
Volume Left	19	0	0	43	0	0
Volume Right	21	0	26	0	0	0
cSH	480	1700	1700	851	1700	1700
Volume to Capacity	0.08	0.29	0.16	0.05	0.17	0.17
Queue Length 95th (m)	2.1	0.0	0.0	1.2	0.0	0.0
Control Delay (s)	13.2	0.0	0.0	9.5	0.0	0.0
Lane LOS	B			A		
Approach Delay (s)	13.2	0.0		0.7		
Approach LOS	B					
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			37.7%		ICU Level of Service	A
Analysis Period (min)			15			

**Appendix E**  
**Synchro Results - 2031 Analysis**

DRAFT

Queues

2031 AM Peak Hour

1: Essa Road & Coughlin Road

Essa Road EA



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	127	150	114	376	482
v/c Ratio	0.47	0.41	0.18	0.15	0.20
Control Delay	37.6	9.1	5.7	4.8	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	37.6	9.1	5.7	4.8	4.8
Queue Length 50th (m)	17.9	0.0	5.3	8.8	11.3
Queue Length 95th (m)	33.6	14.8	12.5	15.2	19.0
Internal Link Dist (m)	124.5			46.0	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	679	694	627	2450	2387
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.19	0.22	0.18	0.15	0.20

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2031 AM Peak Hour  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	127	150	114	376	440	42
Future Volume (vph)	127	150	114	376	440	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	1570	1807	3544	3445	
Flt Permitted	0.95	1.00	0.48	1.00	1.00	
Satd. Flow (perm)	1772	1570	907	3544	3445	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	127	150	114	376	440	42
RTOR Reduction (vph)	0	127	0	0	5	0
Lane Group Flow (vph)	127	23	114	376	477	0
Heavy Vehicles (%)	3%	4%	1%	3%	5%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.8	12.8	57.9	57.9	57.9	
Effective Green, g (s)	12.8	12.8	57.9	57.9	57.9	
Actuated g/C Ratio	0.15	0.15	0.69	0.69	0.69	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	270	240	627	2451	2383	
v/s Ratio Prot	c0.07			0.11	c0.14	
v/s Ratio Perm		0.01	0.13			
v/c Ratio	0.47	0.10	0.18	0.15	0.20	
Uniform Delay, d1	32.4	30.5	4.5	4.4	4.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.3	0.2	0.6	0.1	0.2	
Delay (s)	33.7	30.6	5.2	4.6	4.8	
Level of Service	C	C	A	A	A	
Approach Delay (s)	32.0			4.7	4.8	
Approach LOS	C			A	A	

Intersection Summary

HCM 2000 Control Delay	10.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	83.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2031 AM Peak Hour  
Essa Road EA


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	147	804	89	363	129	38	176	163	293	183	99
v/c Ratio	0.36	0.77	0.39	0.41	0.25	0.10	0.29	0.28	0.49	0.21	0.12
Control Delay	19.6	37.0	21.5	30.3	6.2	26.3	27.7	5.8	19.1	17.4	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.6	37.0	21.5	30.3	6.2	26.3	27.7	5.8	19.1	17.4	4.0
Queue Length 50th (m)	16.6	72.7	9.8	29.2	0.0	5.2	25.8	0.0	34.0	21.0	0.0
Queue Length 95th (m)	28.6	96.1	18.9	41.6	12.6	13.2	44.3	14.1	55.0	36.1	8.9
Internal Link Dist (m)		184.4		226.9			89.0			358.3	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	423	1143	257	1118	608	381	599	583	605	863	800
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.70	0.35	0.32	0.21	0.10	0.29	0.28	0.48	0.21	0.12

Intersection Summary



HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2031 AM Peak Hour  
Essa Road EA

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	147	756	48	89	363	129	38	176	163	293	183	99
Future Volume (vph)	147	756	48	89	363	129	38	176	163	293	183	99
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1772	3577		1644	3510	1633	1755	1865	1471	1772	1847	1601
Flt Permitted	0.44	1.00		0.17	1.00	1.00	0.64	1.00	1.00	0.57	1.00	1.00
Satd. Flow (perm)	825	3577		301	3510	1633	1186	1865	1471	1063	1847	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	147	756	48	89	363	129	38	176	163	293	183	99
RTOR Reduction (vph)	0	4	0	0	0	95	0	0	111	0	0	53
Lane Group Flow (vph)	147	800	0	89	363	34	38	176	52	293	183	46
Heavy Vehicles (%)	3%	1%	3%	11%	4%	0%	4%	3%	11%	3%	4%	2%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	36.8	27.5		32.0	25.1	25.1	30.5	30.5	30.5	44.3	44.3	44.3
Effective Green, g (s)	36.8	27.5		32.0	25.1	25.1	30.5	30.5	30.5	44.3	44.3	44.3
Actuated g/C Ratio	0.38	0.29		0.33	0.26	0.26	0.32	0.32	0.32	0.46	0.46	0.46
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	409	1027		197	920	428	377	594	468	564	854	741
v/s Ratio Prot	c0.03	c0.22		c0.03	0.10			0.09		c0.05	0.10	
v/s Ratio Perm	0.10			0.12		0.02	0.03		0.04	c0.19		0.03
v/c Ratio	0.36	0.78		0.45	0.39	0.08	0.10	0.30	0.11	0.52	0.21	0.06
Uniform Delay, d1	19.9	31.3		23.4	29.0	26.6	22.9	24.5	23.0	16.8	15.3	14.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	3.8		1.6	0.3	0.1	0.5	1.3	0.5	0.8	0.6	0.2
Delay (s)	20.4	35.1		25.0	29.3	26.7	23.5	25.8	23.5	17.6	15.9	14.4
Level of Service	C	D		C	C	C	C	C	C	B	B	B
Approach Delay (s)		32.8			28.1			24.6			16.5	
Approach LOS		C			C			C			B	

Intersection Summary		
HCM 2000 Control Delay	26.7	HCM 2000 Level of Service C
HCM 2000 Volume to Capacity ratio	0.64	
Actuated Cycle Length (s)	95.7	Sum of lost time (s) 21.0
Intersection Capacity Utilization	98.3%	ICU Level of Service F
Analysis Period (min)	15	
c Critical Lane Group		

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road

2031 AM Peak Hour  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	18	21	468	20	32	558
Future Volume (Veh/h)	18	21	468	20	32	558
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	21	468	20	32	558
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (m)			382			
pX, platoon unblocked	1.00	1.00			1.00	
vC, conflicting volume	1100	478			488	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1099	475			486	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	92	96			97	
cM capacity (veh/h)	228	588			1075	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>			
Volume Total	39	488	590			
Volume Left	18	0	32			
Volume Right	21	20	0			
cSH	340	1700	1075			
Volume to Capacity	0.11	0.29	0.03			
Queue Length 95th (m)	2.9	0.0	0.7			
Control Delay (s)	17.0	0.0	0.8			
Lane LOS	C		A			
Approach Delay (s)	17.0	0.0	0.8			
Approach LOS	C					
<b>Intersection Summary</b>						
Average Delay			1.0			
Intersection Capacity Utilization			65.5%		ICU Level of Service C	
Analysis Period (min)			15			

## Queues

2031 PM Peak Hour

## 1: Essa Road &amp; Coughlin Road

Essa Road EA



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	111	129	349	538	739
v/c Ratio	0.45	0.39	0.58	0.21	0.37
Control Delay	43.4	10.5	7.6	4.5	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	43.4	10.5	7.6	4.5	11.8
Queue Length 50th (m)	18.7	0.0	14.6	13.3	33.0
Queue Length 95th (m)	34.6	15.1	26.9	21.3	54.0
Internal Link Dist (m)	124.5			43.6	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	369	430	785	2620	1997
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.30	0.30	0.44	0.21	0.37

## Intersection Summary

HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2031 PM Peak Hour  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	111	129	349	538	590	149
Future Volume (vph)	111	129	349	538	590	149
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.97	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1617	1825	3614	3512	
Flt Permitted	0.95	1.00	0.32	1.00	1.00	
Satd. Flow (perm)	1825	1617	609	3614	3512	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	111	129	349	538	590	149
RTOR Reduction (vph)	0	111	0	0	16	0
Lane Group Flow (vph)	111	18	349	538	723	0
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.8	12.8	68.0	68.0	52.9	
Effective Green, g (s)	12.8	12.8	68.0	68.0	52.9	
Actuated g/C Ratio	0.14	0.14	0.72	0.72	0.56	
Clearance Time (s)	6.0	6.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	249	220	585	2619	1980	
v/s Ratio Prot	c0.06		c0.07	0.15	0.21	
v/s Ratio Perm		0.01	c0.36			
v/c Ratio	0.45	0.08	0.60	0.21	0.37	
Uniform Delay, d1	37.2	35.4	5.1	4.2	11.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.3	0.2	1.6	0.2	0.5	
Delay (s)	38.5	35.5	6.7	4.3	11.8	
Level of Service	D	D	A	A	B	
Approach Delay (s)	36.9			5.3	11.8	
Approach LOS	D			A	B	

Intersection Summary

HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	93.8	Sum of lost time (s)	17.0
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2031 PM Peak Hour  
Essa Road EA


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	124	634	192	957	416	99	298	175	249	222	225
v/c Ratio	0.50	0.61	0.58	0.89	0.54	0.28	0.52	0.30	0.54	0.26	0.27
Control Delay	23.6	33.2	24.9	45.5	5.6	29.6	33.1	8.3	21.4	19.0	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.6	33.2	24.9	45.5	5.6	29.6	33.1	8.3	21.4	19.0	3.3
Queue Length 50th (m)	13.8	55.3	22.3	94.0	0.0	14.8	48.5	3.9	29.3	27.0	0.0
Queue Length 95th (m)	24.6	73.4	36.6	#129.0	20.8	28.5	74.2	19.1	46.1	43.1	12.7
Internal Link Dist (m)		184.4		226.9			89.0			359.2	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	265	1062	336	1087	782	360	574	582	465	847	839
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.60	0.57	0.88	0.53	0.28	0.52	0.30	0.54	0.26	0.27

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2031 PM Peak Hour  
Essa Road EA

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	124	598	36	192	957	416	99	298	175	249	222	225
Future Volume (vph)	124	598	36	192	957	416	99	298	175	249	222	225
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	3519		1789	3614	1633	1825	1902	1585	1825	1921	1617
Flt Permitted	0.14	1.00		0.26	1.00	1.00	0.62	1.00	1.00	0.40	1.00	1.00
Satd. Flow (perm)	264	3519		498	3614	1633	1190	1902	1585	760	1921	1617
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	124	598	36	192	957	416	99	298	175	249	222	225
RTOR Reduction (vph)	0	4	0	0	0	292	0	0	102	0	0	126
Lane Group Flow (vph)	124	630	0	192	957	124	99	298	73	249	222	99
Heavy Vehicles (%)	0%	3%	0%	2%	1%	0%	0%	1%	3%	0%	0%	1%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	38.2	29.1		39.2	29.6	29.6	30.2	30.2	30.2	44.0	44.0	44.0
Effective Green, g (s)	38.2	29.1		39.2	29.6	29.6	30.2	30.2	30.2	44.0	44.0	44.0
Actuated g/C Ratio	0.38	0.29		0.39	0.30	0.30	0.30	0.30	0.30	0.44	0.44	0.44
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	243	1027		320	1072	484	360	576	480	440	847	713
v/s Ratio Prot	0.05	0.18		c0.06	c0.26			0.16		c0.06	0.12	
v/s Ratio Perm	0.15			0.18		0.08	0.08		0.05	c0.19		0.06
v/c Ratio	0.51	0.61		0.60	0.89	0.26	0.28	0.52	0.15	0.57	0.26	0.14
Uniform Delay, d1	22.8	30.4		21.3	33.5	26.7	26.4	28.7	25.4	18.8	17.6	16.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.8	1.1		3.0	9.6	0.3	1.9	3.3	0.7	1.7	0.8	0.4
Delay (s)	24.7	31.5		24.3	43.1	26.9	28.3	32.0	26.1	20.4	18.3	17.0
Level of Service	C	C		C	D	C	C	C	C	C	B	B
Approach Delay (s)		30.4			36.5			29.6			18.7	
Approach LOS		C			D			C			B	

Intersection Summary		
HCM 2000 Control Delay	30.7	HCM 2000 Level of Service C
HCM 2000 Volume to Capacity ratio	0.72	
Actuated Cycle Length (s)	99.7	Sum of lost time (s) 21.0
Intersection Capacity Utilization	103.3%	ICU Level of Service G
Analysis Period (min)	15	
c Critical Lane Group		

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road

2031 PM Peak Hour  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	19	21	866	26	43	676
Future Volume (Veh/h)	19	21	866	26	43	676
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	19	21	866	26	43	676
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None		None	
Median storage veh						
Upstream signal (m)			383			
pX, platoon unblocked	0.89	0.89			0.89	
vC, conflicting volume	1641	879			892	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1659	801			816	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	79	94			94	
cM capacity (veh/h)	90	342			721	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	40	892	719			
Volume Left	19	0	43			
Volume Right	21	26	0			
cSH	146	1700	721			
Volume to Capacity	0.27	0.52	0.06			
Queue Length 95th (m)	8.0	0.0	1.4			
Control Delay (s)	38.6	0.0	1.6			
Lane LOS	E		A			
Approach Delay (s)	38.6	0.0	1.6			
Approach LOS	E					
Intersection Summary						
Average Delay			1.6			
Intersection Capacity Utilization			80.8%	ICU Level of Service		D
Analysis Period (min)			15			

Queues

1: Essa Road & Coughlin Road



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	127	150	114	376	482
v/c Ratio	0.47	0.41	0.18	0.15	0.20
Control Delay	37.6	9.1	5.7	4.8	4.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	37.6	9.1	5.7	4.8	4.8
Queue Length 50th (m)	17.9	0.0	5.3	8.8	11.3
Queue Length 95th (m)	33.6	14.8	12.5	15.2	19.0
Internal Link Dist (m)	124.5			34.7	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	679	694	627	2450	2387
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.19	0.22	0.18	0.15	0.20

Intersection Summary



HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2031 AM Peak Hour - 3 Lane Widening  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	127	150	114	376	440	42
Future Volume (vph)	127	150	114	376	440	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	1570	1807	3544	3445	
Flt Permitted	0.95	1.00	0.48	1.00	1.00	
Satd. Flow (perm)	1772	1570	907	3544	3445	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	127	150	114	376	440	42
RTOR Reduction (vph)	0	127	0	0	5	0
Lane Group Flow (vph)	127	23	114	376	477	0
Heavy Vehicles (%)	3%	4%	1%	3%	5%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.8	12.8	57.9	57.9	57.9	
Effective Green, g (s)	12.8	12.8	57.9	57.9	57.9	
Actuated g/C Ratio	0.15	0.15	0.69	0.69	0.69	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	270	240	627	2451	2383	
v/s Ratio Prot	c0.07			0.11	c0.14	
v/s Ratio Perm		0.01	0.13			
v/c Ratio	0.47	0.10	0.18	0.15	0.20	
Uniform Delay, d1	32.4	30.5	4.5	4.4	4.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.3	0.2	0.6	0.1	0.2	
Delay (s)	33.7	30.6	5.2	4.6	4.8	
Level of Service	C	C	A	A	A	
Approach Delay (s)	32.0			4.7	4.8	
Approach LOS	C			A	A	

**Intersection Summary**

HCM 2000 Control Delay	10.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	83.7	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2031 AM Peak Hour - 3 Lane Widening  
Essa Road EA


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	147	804	89	363	129	38	176	163	293	183	99
v/c Ratio	0.36	0.77	0.39	0.41	0.25	0.10	0.29	0.28	0.49	0.21	0.12
Control Delay	19.6	37.0	21.5	30.3	6.2	26.3	27.7	5.8	19.1	17.4	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.6	37.0	21.5	30.3	6.2	26.3	27.7	5.8	19.1	17.4	4.0
Queue Length 50th (m)	16.6	72.7	9.8	29.2	0.0	5.2	25.8	0.0	34.0	21.0	0.0
Queue Length 95th (m)	28.6	96.1	18.9	41.6	12.6	13.2	44.3	14.1	55.0	36.1	8.9
Internal Link Dist (m)		184.4		226.9			89.0			358.3	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	423	1143	257	1118	608	381	599	583	605	863	800
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.70	0.35	0.32	0.21	0.10	0.29	0.28	0.48	0.21	0.12

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2031 AM Peak Hour - 3 Lane Widening  
Essa Road EA

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	147	756	48	89	363	129	38	176	163	293	183	99	
Future Volume (vph)	147	756	48	89	363	129	38	176	163	293	183	99	
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	3577		1644	3510	1633	1755	1865	1471	1772	1847	1601	
Flt Permitted	0.44	1.00		0.17	1.00	1.00	0.64	1.00	1.00	0.57	1.00	1.00	
Satd. Flow (perm)	825	3577		301	3510	1633	1186	1865	1471	1063	1847	1601	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	147	756	48	89	363	129	38	176	163	293	183	99	
RTOR Reduction (vph)	0	4	0	0	0	95	0	0	111	0	0	53	
Lane Group Flow (vph)	147	800	0	89	363	34	38	176	52	293	183	46	
Heavy Vehicles (%)	3%	1%	3%	11%	4%	0%	4%	3%	11%	3%	4%	2%	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	
Protected Phases	7	4		3	8			2		1	6		
Permitted Phases	4			8		8	2		2	6		6	
Actuated Green, G (s)	36.8	27.5		32.0	25.1	25.1	30.5	30.5	30.5	44.3	44.3	44.3	
Effective Green, g (s)	36.8	27.5		32.0	25.1	25.1	30.5	30.5	30.5	44.3	44.3	44.3	
Actuated g/C Ratio	0.38	0.29		0.33	0.26	0.26	0.32	0.32	0.32	0.46	0.46	0.46	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	409	1027		197	920	428	377	594	468	564	854	741	
v/s Ratio Prot	c0.03	c0.22		c0.03	0.10			0.09		c0.05	0.10		
v/s Ratio Perm	0.10			0.12		0.02	0.03		0.04	c0.19		0.03	
v/c Ratio	0.36	0.78		0.45	0.39	0.08	0.10	0.30	0.11	0.52	0.21	0.06	
Uniform Delay, d1	19.9	31.3		23.4	29.0	26.6	22.9	24.5	23.0	16.8	15.3	14.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	3.8		1.6	0.3	0.1	0.5	1.3	0.5	0.8	0.6	0.2	
Delay (s)	20.4	35.1		25.0	29.3	26.7	23.5	25.8	23.5	17.6	15.9	14.4	
Level of Service	C	D		C	C	C	C	C	C	B	B	B	
Approach Delay (s)		32.8			28.1			24.6			16.5		
Approach LOS		C			C			C			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			26.7									HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.64										
Actuated Cycle Length (s)			95.7									Sum of lost time (s)	21.0
Intersection Capacity Utilization			98.3%									ICU Level of Service	F
Analysis Period (min)			15										
c	Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road

2031 AM Peak Hour - 3 Lane Widening  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	18	21	468	20	32	558
Future Volume (Veh/h)	18	21	468	20	32	558
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	21	468	20	32	558
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage veh)			2		2	
Upstream signal (m)			382			
pX, platoon unblocked	1.00	1.00			1.00	
vC, conflicting volume	1100	478			488	
vC1, stage 1 conf vol	478					
vC2, stage 2 conf vol	622					
vCu, unblocked vol	1099	475			486	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	96			97	
cM capacity (veh/h)	439	588			1075	
<b>Direction, Lane #</b>	<b>WB 1</b>	<b>NB 1</b>	<b>SB 1</b>	<b>SB 2</b>		
Volume Total	39	488	32	558		
Volume Left	18	0	32	0		
Volume Right	21	20	0	0		
cSH	508	1700	1075	1700		
Volume to Capacity	0.08	0.29	0.03	0.33		
Queue Length 95th (m)	1.9	0.0	0.7	0.0		
Control Delay (s)	12.7	0.0	8.5	0.0		
Lane LOS	B		A			
Approach Delay (s)	12.7	0.0	0.5			
Approach LOS	B					
<b>Intersection Summary</b>						
Average Delay			0.7			
Intersection Capacity Utilization			39.4%	ICU Level of Service	A	
Analysis Period (min)			15			

Queues

1: Essa Road & Coughlin Road



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	111	129	349	538	739
v/c Ratio	0.45	0.39	0.58	0.21	0.37
Control Delay	43.4	10.5	7.6	4.5	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	43.4	10.5	7.6	4.5	11.8
Queue Length 50th (m)	18.7	0.0	14.6	13.3	33.0
Queue Length 95th (m)	34.6	15.1	26.9	21.3	54.0
Internal Link Dist (m)	124.5			47.3	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	369	430	785	2620	1997
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.30	0.30	0.44	0.21	0.37

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2031 PM Peak Hour - 3 Lane Widening  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	111	129	349	538	590	149
Future Volume (vph)	111	129	349	538	590	149
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.97	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1617	1825	3614	3512	
Flt Permitted	0.95	1.00	0.32	1.00	1.00	
Satd. Flow (perm)	1825	1617	609	3614	3512	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	111	129	349	538	590	149
RTOR Reduction (vph)	0	111	0	0	16	0
Lane Group Flow (vph)	111	18	349	538	723	0
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%
Turn Type	Prot	Perm	pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.8	12.8	68.0	68.0	52.9	
Effective Green, g (s)	12.8	12.8	68.0	68.0	52.9	
Actuated g/C Ratio	0.14	0.14	0.72	0.72	0.56	
Clearance Time (s)	6.0	6.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	249	220	585	2619	1980	
v/s Ratio Prot	c0.06		c0.07	0.15	0.21	
v/s Ratio Perm		0.01	c0.36			
v/c Ratio	0.45	0.08	0.60	0.21	0.37	
Uniform Delay, d1	37.2	35.4	5.1	4.2	11.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.3	0.2	1.6	0.2	0.5	
Delay (s)	38.5	35.5	6.7	4.3	11.8	
Level of Service	D	D	A	A	B	
Approach Delay (s)	36.9			5.3	11.8	
Approach LOS	D			A	B	

Intersection Summary

HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	93.8	Sum of lost time (s)	17.0
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2031 PM Peak Hour - 3 Lane Widening  
Essa Road EA


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	124	634	192	957	416	99	298	175	249	222	225
v/c Ratio	0.50	0.61	0.58	0.89	0.54	0.28	0.52	0.30	0.54	0.26	0.27
Control Delay	23.6	33.2	24.9	45.5	5.6	29.6	33.1	8.3	21.4	19.0	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.6	33.2	24.9	45.5	5.6	29.6	33.1	8.3	21.4	19.0	3.3
Queue Length 50th (m)	13.8	55.3	22.3	94.0	0.0	14.8	48.5	3.9	29.3	27.0	0.0
Queue Length 95th (m)	24.6	73.4	36.6	#129.0	20.8	28.5	74.2	19.1	46.1	43.1	12.7
Internal Link Dist (m)		184.4		226.9			89.0			359.2	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	265	1062	336	1087	782	360	574	582	465	847	839
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.60	0.57	0.88	0.53	0.28	0.52	0.30	0.54	0.26	0.27

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2031 PM Peak Hour - 3 Lane Widening  
Essa Road EA

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	124	598	36	192	957	416	99	298	175	249	222	225	
Future Volume (vph)	124	598	36	192	957	416	99	298	175	249	222	225	
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	3519		1789	3614	1633	1825	1902	1585	1825	1921	1617	
Flt Permitted	0.14	1.00		0.26	1.00	1.00	0.62	1.00	1.00	0.40	1.00	1.00	
Satd. Flow (perm)	264	3519		498	3614	1633	1190	1902	1585	760	1921	1617	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	124	598	36	192	957	416	99	298	175	249	222	225	
RTOR Reduction (vph)	0	4	0	0	0	292	0	0	102	0	0	126	
Lane Group Flow (vph)	124	630	0	192	957	124	99	298	73	249	222	99	
Heavy Vehicles (%)	0%	3%	0%	2%	1%	0%	0%	1%	3%	0%	0%	1%	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	
Protected Phases	7	4		3	8			2		1	6		
Permitted Phases	4			8		8	2		2	6		6	
Actuated Green, G (s)	38.2	29.1		39.2	29.6	29.6	30.2	30.2	30.2	44.0	44.0	44.0	
Effective Green, g (s)	38.2	29.1		39.2	29.6	29.6	30.2	30.2	30.2	44.0	44.0	44.0	
Actuated g/C Ratio	0.38	0.29		0.39	0.30	0.30	0.30	0.30	0.30	0.44	0.44	0.44	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	243	1027		320	1072	484	360	576	480	440	847	713	
v/s Ratio Prot	0.05	0.18		c0.06	c0.26			0.16		c0.06	0.12		
v/s Ratio Perm	0.15			0.18		0.08	0.08		0.05	c0.19		0.06	
v/c Ratio	0.51	0.61		0.60	0.89	0.26	0.28	0.52	0.15	0.57	0.26	0.14	
Uniform Delay, d1	22.8	30.4		21.3	33.5	26.7	26.4	28.7	25.4	18.8	17.6	16.6	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.8	1.1		3.0	9.6	0.3	1.9	3.3	0.7	1.7	0.8	0.4	
Delay (s)	24.7	31.5		24.3	43.1	26.9	28.3	32.0	26.1	20.4	18.3	17.0	
Level of Service	C	C		C	D	C	C	C	C	C	B	B	
Approach Delay (s)		30.4			36.5			29.6			18.7		
Approach LOS		C			D			C			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			30.7									HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.72										
Actuated Cycle Length (s)			99.7									Sum of lost time (s)	21.0
Intersection Capacity Utilization			103.3%									ICU Level of Service	G
Analysis Period (min)			15										
c	Critical Lane Group												



HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road

2031 PM Peak Hour - 3 Lane Widening  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	19	21	866	26	43	676
Future Volume (Veh/h)	19	21	866	26	43	676
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	19	21	866	26	43	676
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL		TWLTL	
Median storage veh)			2		2	
Upstream signal (m)			383			
pX, platoon unblocked	0.89	0.89			0.89	
vC, conflicting volume	1641	879			892	
vC1, stage 1 conf vol	879					
vC2, stage 2 conf vol	762					
vCu, unblocked vol	1659	801			816	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3			2.2	
p0 queue free %	94	94			94	
cM capacity (veh/h)	297	342			721	
Direction, Lane #	WB 1	NB 1	SB 1	SB 2		
Volume Total	40	892	43	676		
Volume Left	19	0	43	0		
Volume Right	21	26	0	0		
cSH	319	1700	721	1700		
Volume to Capacity	0.13	0.52	0.06	0.40		
Queue Length 95th (m)	3.2	0.0	1.4	0.0		
Control Delay (s)	17.9	0.0	10.3	0.0		
Lane LOS	C		B			
Approach Delay (s)	17.9	0.0	0.6			
Approach LOS	C					
Intersection Summary						
Average Delay			0.7			
Intersection Capacity Utilization			57.2%		ICU Level of Service	B
Analysis Period (min)			15			

Queues

1: Essa Road & Coughlin Road



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	127	150	114	376	482
v/c Ratio	0.51	0.43	0.18	0.15	0.19
Control Delay	43.5	10.0	5.3	4.5	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	43.5	10.0	5.3	4.5	4.5
Queue Length 50th (m)	20.5	0.0	5.3	8.8	11.2
Queue Length 95th (m)	37.3	15.7	12.8	15.7	19.5
Internal Link Dist (m)	124.5			544.1	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	438	501	651	2545	2480
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.29	0.30	0.18	0.15	0.19

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
1: Essa Road & Coughlin Road

2031 AM Peak Hour - 5 Lane Widening  
Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	127	150	114	376	440	42
Future Volume (vph)	127	150	114	376	440	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	1570	1807	3544	3445	
Flt Permitted	0.95	1.00	0.48	1.00	1.00	
Satd. Flow (perm)	1772	1570	907	3544	3445	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	127	150	114	376	440	42
RTOR Reduction (vph)	0	129	0	0	6	0
Lane Group Flow (vph)	127	21	114	376	476	0
Heavy Vehicles (%)	3%	4%	1%	3%	5%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	13.2	13.2	66.9	66.9	66.9	
Effective Green, g (s)	13.2	13.2	66.9	66.9	66.9	
Actuated g/C Ratio	0.14	0.14	0.72	0.72	0.72	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	251	222	651	2546	2475	
v/s Ratio Prot	c0.07			0.11	c0.14	
v/s Ratio Perm		0.01	0.13			
v/c Ratio	0.51	0.10	0.18	0.15	0.19	
Uniform Delay, d1	36.9	34.8	4.2	4.1	4.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.6	0.2	0.6	0.1	0.2	
Delay (s)	38.5	34.9	4.8	4.2	4.5	
Level of Service	D	C	A	A	A	
Approach Delay (s)	36.6			4.4	4.5	
Approach LOS	D			A	A	

Intersection Summary

HCM 2000 Control Delay	11.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.24		
Actuated Cycle Length (s)	93.1	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Queues  
2: Essa Road & Mapleview Drive

2031 AM Peak Hour - 5 Lane Widening  
Essa Road EA


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	147	804	89	363	129	38	176	163	293	183	99
v/c Ratio	0.36	0.77	0.39	0.41	0.25	0.10	0.29	0.28	0.49	0.11	0.12
Control Delay	19.6	37.0	21.5	30.3	6.2	26.3	27.7	5.8	19.1	15.9	4.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	19.6	37.0	21.5	30.3	6.2	26.3	27.7	5.8	19.1	15.9	4.0
Queue Length 50th (m)	16.6	72.7	9.8	29.2	0.0	5.2	25.8	0.0	34.0	10.4	0.0
Queue Length 95th (m)	28.6	96.1	18.9	41.6	12.6	13.2	44.3	14.1	55.0	17.5	8.9
Internal Link Dist (m)		184.4		226.9			89.0			358.3	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	423	1143	257	1118	608	378	599	583	605	1640	800
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.70	0.35	0.32	0.21	0.10	0.29	0.28	0.48	0.11	0.12

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2031 AM Peak Hour - 5 Lane Widening  
Essa Road EA

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	147	756	48	89	363	129	38	176	163	293	183	99	
Future Volume (vph)	147	756	48	89	363	129	38	176	163	293	183	99	
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1772	3577		1644	3510	1633	1755	1865	1471	1772	3510	1601	
Flt Permitted	0.44	1.00		0.17	1.00	1.00	0.64	1.00	1.00	0.57	1.00	1.00	
Satd. Flow (perm)	825	3577		301	3510	1633	1176	1865	1471	1063	3510	1601	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	147	756	48	89	363	129	38	176	163	293	183	99	
RTOR Reduction (vph)	0	4	0	0	0	95	0	0	111	0	0	53	
Lane Group Flow (vph)	147	800	0	89	363	34	38	176	52	293	183	46	
Heavy Vehicles (%)	3%	1%	3%	11%	4%	0%	4%	3%	11%	3%	4%	2%	
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm	
Protected Phases	7	4		3	8			2		1	6		
Permitted Phases	4			8		8	2		2	6		6	
Actuated Green, G (s)	36.8	27.5		32.0	25.1	25.1	30.5	30.5	30.5	44.3	44.3	44.3	
Effective Green, g (s)	36.8	27.5		32.0	25.1	25.1	30.5	30.5	30.5	44.3	44.3	44.3	
Actuated g/C Ratio	0.38	0.29		0.33	0.26	0.26	0.32	0.32	0.32	0.46	0.46	0.46	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	409	1027		197	920	428	374	594	468	564	1624	741	
v/s Ratio Prot	c0.03	c0.22		c0.03	0.10			0.09		c0.05	0.05		
v/s Ratio Perm	0.10			0.12		0.02	0.03		0.04	c0.19		0.03	
v/c Ratio	0.36	0.78		0.45	0.39	0.08	0.10	0.30	0.11	0.52	0.11	0.06	
Uniform Delay, d1	19.9	31.3		23.4	29.0	26.6	23.0	24.5	23.0	16.8	14.6	14.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.5	3.8		1.6	0.3	0.1	0.5	1.3	0.5	0.8	0.1	0.2	
Delay (s)	20.4	35.1		25.0	29.3	26.7	23.5	25.8	23.5	17.6	14.7	14.4	
Level of Service	C	D		C	C	C	C	C	C	B	B	B	
Approach Delay (s)		32.8			28.1			24.6			16.1		
Approach LOS		C			C			C			B		
<b>Intersection Summary</b>													
HCM 2000 Control Delay			26.6									HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.64										
Actuated Cycle Length (s)			95.7									Sum of lost time (s)	21.0
Intersection Capacity Utilization			98.3%									ICU Level of Service	F
Analysis Period (min)			15										
c	Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road

2031 AM Peak Hour - 5 Lane Widening  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	18	21	468	20	32	558
Future Volume (Veh/h)	18	21	468	20	32	558
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	18	21	468	20	32	558
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	TWLTL			TWLTL		
Median storage veh	2			2		
Upstream signal (m)	382					
pX, platoon unblocked						
vC, conflicting volume	821	244			488	
vC1, stage 1 conf vol	478					
vC2, stage 2 conf vol	343					
vCu, unblocked vol	821	244			488	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	96	97			97	
cM capacity (veh/h)	504	757			1071	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	39	312	176	32	279	279
Volume Left	18	0	0	32	0	0
Volume Right	21	0	20	0	0	0
cSH	615	1700	1700	1071	1700	1700
Volume to Capacity	0.06	0.18	0.10	0.03	0.16	0.16
Queue Length 95th (m)	1.5	0.0	0.0	0.7	0.0	0.0
Control Delay (s)	11.3	0.0	0.0	8.5	0.0	0.0
Lane LOS	B			A		
Approach Delay (s)	11.3	0.0		0.5		
Approach LOS	B					
<b>Intersection Summary</b>						
Average Delay	0.6					
Intersection Capacity Utilization	30.2%			ICU Level of Service	A	
Analysis Period (min)	15					

Queues

1: Essa Road & Coughlin Road



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	111	129	349	538	739
v/c Ratio	0.45	0.39	0.68	0.21	0.29
Control Delay	42.1	10.2	15.8	4.5	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	42.1	10.2	15.8	4.5	4.5
Queue Length 50th (m)	17.7	0.0	27.5	13.3	17.7
Queue Length 95th (m)	33.3	14.6	70.9	21.0	27.4
Internal Link Dist (m)	124.5			543.1	94.9
Turn Bay Length (m)			50.0		
Base Capacity (vph)	451	497	516	2617	2561
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.25	0.26	0.68	0.21	0.29

Intersection Summary

HCM Signalized Intersection Capacity Analysis  
 1: Essa Road & Coughlin Road

2031 PM Peak Hour - 5 Lane Widening  
 Essa Road EA



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	111	129	349	538	590	149
Future Volume (vph)	111	129	349	538	590	149
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	7.0	7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frt	1.00	0.85	1.00	1.00	0.97	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1825	1617	1825	3614	3512	
Flt Permitted	0.95	1.00	0.37	1.00	1.00	
Satd. Flow (perm)	1825	1617	712	3614	3512	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	111	129	349	538	590	149
RTOR Reduction (vph)	0	111	0	0	17	0
Lane Group Flow (vph)	111	18	349	538	722	0
Heavy Vehicles (%)	0%	1%	0%	1%	1%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	12.7	12.7	67.5	67.5	67.5	
Effective Green, g (s)	12.7	12.7	67.5	67.5	67.5	
Actuated g/C Ratio	0.14	0.14	0.72	0.72	0.72	
Clearance Time (s)	6.0	6.0	7.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	248	220	515	2617	2543	
v/s Ratio Prot	c0.06			0.15	0.21	
v/s Ratio Perm		0.01	c0.49			
v/c Ratio	0.45	0.08	0.68	0.21	0.28	
Uniform Delay, d1	37.0	35.1	7.0	4.2	4.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	1.3	0.2	7.0	0.2	0.3	
Delay (s)	38.3	35.3	14.0	4.3	4.7	
Level of Service	D	D	B	A	A	
Approach Delay (s)	36.7			8.1	4.7	
Approach LOS	D			A	A	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	93.2	Sum of lost time (s)	13.0
Intersection Capacity Utilization	76.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			



Queues  
2: Essa Road & Mapleview Drive

2031 PM Peak Hour - 5 Lane Widening  
Essa Road EA


























Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	124	634	192	957	416	99	298	175	249	222	225
v/c Ratio	0.50	0.61	0.58	0.89	0.54	0.28	0.52	0.30	0.54	0.14	0.27
Control Delay	23.6	33.2	24.9	45.5	5.6	29.7	33.1	8.3	21.4	17.2	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.6	33.2	24.9	45.5	5.6	29.7	33.1	8.3	21.4	17.2	3.3
Queue Length 50th (m)	13.8	55.3	22.3	94.0	0.0	14.9	48.5	3.9	29.3	13.3	0.0
Queue Length 95th (m)	24.6	73.4	36.6	#129.0	20.8	28.6	74.2	19.1	46.1	20.6	12.7
Internal Link Dist (m)		184.4		226.9			89.0			359.2	
Turn Bay Length (m)						75.0		30.0	50.0		50.0
Base Capacity (vph)	265	1062	336	1087	782	356	574	582	465	1610	839
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.47	0.60	0.57	0.88	0.53	0.28	0.52	0.30	0.54	0.14	0.27

Intersection Summary

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

HCM Signalized Intersection Capacity Analysis  
2: Essa Road & Mapleview Drive

2031 PM Peak Hour - 5 Lane Widening  
Essa Road EA

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	124	598	36	192	957	416	99	298	175	249	222	225
Future Volume (vph)	124	598	36	192	957	416	99	298	175	249	222	225
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	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1825	3519		1789	3614	1633	1825	1902	1585	1825	3650	1617
Flt Permitted	0.14	1.00		0.26	1.00	1.00	0.61	1.00	1.00	0.40	1.00	1.00
Satd. Flow (perm)	264	3519		498	3614	1633	1178	1902	1585	760	3650	1617
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	124	598	36	192	957	416	99	298	175	249	222	225
RTOR Reduction (vph)	0	4	0	0	0	292	0	0	102	0	0	126
Lane Group Flow (vph)	124	630	0	192	957	124	99	298	73	249	222	99
Heavy Vehicles (%)	0%	3%	0%	2%	1%	0%	0%	1%	3%	0%	0%	1%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Perm	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Actuated Green, G (s)	38.2	29.1		39.2	29.6	29.6	30.2	30.2	30.2	44.0	44.0	44.0
Effective Green, g (s)	38.2	29.1		39.2	29.6	29.6	30.2	30.2	30.2	44.0	44.0	44.0
Actuated g/C Ratio	0.38	0.29		0.39	0.30	0.30	0.30	0.30	0.30	0.44	0.44	0.44
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	7.0	7.0	7.0	4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	243	1027		320	1072	484	356	576	480	440	1610	713
v/s Ratio Prot	0.05	0.18		c0.06	c0.26			0.16		c0.06	0.06	
v/s Ratio Perm	0.15			0.18		0.08	0.08		0.05	c0.19		0.06
v/c Ratio	0.51	0.61		0.60	0.89	0.26	0.28	0.52	0.15	0.57	0.14	0.14
Uniform Delay, d1	22.8	30.4		21.3	33.5	26.7	26.5	28.7	25.4	18.8	16.6	16.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.8	1.1		3.0	9.6	0.3	1.9	3.3	0.7	1.7	0.2	0.4
Delay (s)	24.7	31.5		24.3	43.1	26.9	28.4	32.0	26.1	20.4	16.7	17.0
Level of Service	C	C		C	D	C	C	C	C	C	B	B
Approach Delay (s)		30.4			36.5			29.6			18.1	
Approach LOS		C			D			C			B	

Intersection Summary		
HCM 2000 Control Delay	30.6	HCM 2000 Level of Service C
HCM 2000 Volume to Capacity ratio	0.72	
Actuated Cycle Length (s)	99.7	Sum of lost time (s) 21.0
Intersection Capacity Utilization	103.3%	ICU Level of Service G
Analysis Period (min)	15	
c Critical Lane Group		

HCM Unsignalized Intersection Capacity Analysis  
8: Essa Road

2031 PM Peak Hour - 5 Lane Widening  
Essa Road EA



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	19	21	866	26	43	676
Future Volume (Veh/h)	19	21	866	26	43	676
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	19	21	866	26	43	676
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
			TWLTL	TWLTL		
Median storage veh)			2	2		
Upstream signal (m)			383			
pX, platoon unblocked						
vC, conflicting volume	1303	446			892	
vC1, stage 1 conf vol	879					
vC2, stage 2 conf vol	424					
vCu, unblocked vol	1303	446			892	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.3			2.2	
p0 queue free %	94	96			94	
cM capacity (veh/h)	327	560			756	
Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	40	577	315	43	338	338
Volume Left	19	0	0	43	0	0
Volume Right	21	0	26	0	0	0
cSH	418	1700	1700	756	1700	1700
Volume to Capacity	0.10	0.34	0.19	0.06	0.20	0.20
Queue Length 95th (m)	2.4	0.0	0.0	1.4	0.0	0.0
Control Delay (s)	14.5	0.0	0.0	10.0	0.0	0.0
Lane LOS	B		B			
Approach Delay (s)	14.5	0.0	0.6			
Approach LOS	B					
Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization			41.4%	ICU Level of Service	A	
Analysis Period (min)			15			

**Appendix F**  
**SimTraffic Results - 2031 Analysis**

DRAFT

**Intersection: 1: Essa Road & Coughlin Road**

Movement	EB	EB	NB	NB	NB	SB	SB
Directions Served	L	R	L	T	T	T	TR
Maximum Queue (m)	46.7	33.4	39.0	22.0	32.2	39.8	21.8
Average Queue (m)	25.0	14.4	15.8	10.3	12.1	23.3	8.6
95th Queue (m)	41.9	23.2	30.7	21.4	24.8	38.4	17.5
Link Distance (m)	137.6	137.6		556.9	556.9	112.0	112.0
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)			50.0				
Storage Blk Time (%)							
Queuing Penalty (veh)							

**Intersection: 2: Essa Road & Mapleview Drive**

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	T	L	T	R	L	T	T
Maximum Queue (m)	43.1	107.1	91.3	32.2	62.6	49.4	14.4	42.9	27.7	120.3	12.1	19.0
Average Queue (m)	16.7	68.3	56.8	9.9	34.4	19.9	2.1	16.4	5.7	41.0	2.4	4.0
95th Queue (m)	32.2	101.1	88.4	23.6	52.4	43.0	7.7	37.1	18.7	81.4	7.9	13.4
Link Distance (m)	186.7	186.7	186.7	228.6	228.6	228.6		91.1			353.7	353.7
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)							75.0		30.0	50.0		
Storage Blk Time (%)								4	0	8		
Queuing Penalty (veh)								8	0	7		

**Intersection: 2: Essa Road & Mapleview Drive**

Movement	SB
Directions Served	R
Maximum Queue (m)	9.3
Average Queue (m)	0.5
95th Queue (m)	3.5
Link Distance (m)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	50.0
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 8: Essa Road & Messa Village Access

Movement	WB	SB
Directions Served	LR	L
Maximum Queue (m)	15.1	9.2
Average Queue (m)	6.3	2.7
95th Queue (m)	13.4	9.6
Link Distance (m)	117.0	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)	50.0	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 15

**Intersection: 1: Essa Road & Coughlin Road**

Movement	EB	EB	NB	NB	NB	SB	SB
Directions Served	L	R	L	T	T	T	TR
Maximum Queue (m)	47.4	23.0	75.0	174.1	125.3	53.2	55.9
Average Queue (m)	23.4	12.4	46.5	37.6	29.2	20.8	17.0
95th Queue (m)	39.3	19.4	79.4	118.0	80.0	38.6	34.7
Link Distance (m)	137.6	137.6		556.0	556.0	112.0	112.0
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (m)			50.0				
Storage Blk Time (%)			18				
Queuing Penalty (veh)			49				

**Intersection: 2: Essa Road & Mapleview Drive**

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	T	L	T	R	L	T	T
Maximum Queue (m)	42.6	127.8	115.5	50.9	112.3	102.0	29.5	69.4	26.3	48.1	14.2	18.0
Average Queue (m)	16.9	57.0	43.8	20.3	79.2	70.6	11.0	40.1	4.0	26.6	3.6	5.4
95th Queue (m)	33.7	95.1	85.9	40.8	101.3	95.6	25.9	60.4	13.4	42.4	11.4	14.1
Link Distance (m)	186.7	186.7	186.7	228.7	228.7	228.7		91.1			354.5	354.5
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (m)							75.0		30.0	50.0		
Storage Blk Time (%)								17	0	0		
Queuing Penalty (veh)								46	0	0		

**Intersection: 2: Essa Road & Mapleview Drive**

Movement	SB
Directions Served	R
Maximum Queue (m)	51.1
Average Queue (m)	11.7
95th Queue (m)	28.9
Link Distance (m)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (m)	50.0
Storage Blk Time (%)	0
Queuing Penalty (veh)	0

Intersection: 8: Essa Road

Movement	WB	SB
Directions Served	LR	L
Maximum Queue (m)	16.0	9.2
Average Queue (m)	6.7	5.0
95th Queue (m)	15.5	12.2
Link Distance (m)	106.3	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (m)		50.0
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 96