## Mansfield Residential

## Township of Mulmur

Traffic Impact Study for 2735528 Ontario Inc.

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## Executive Summary

This report summarizes the traffic impact study prepared for a proposed development located in the northeast quadrant of the Airport Road (County Road 18) / County Road 17 intersection in the Township of Mulmur [Township], County of Dufferin [County]. The report assesses the impact of traffic related to the proposed development on the adjacent roadway and provides recommendations to accommodate this traffic in a safe and efficient manner.

The proposed residential development is anticipated to consist of 43 single family detached units and 28 semi-detached units.

The proposed development is anticipated to include one full movement access onto County Road 18 [Street ' $A$ '] and one full movement access onto County Road 17 opposite of Thomson Trail [Street ' $C$ '].

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

- County Road 18 / County Road 17;
- County Road 18 / Street 'A'; and
- Street 'C' \& Thompson Trail / County Road 17.


## Conclusions

1. The proposed development is expected to generate a total of 56 AM and 73 PM peak hour trips.
2. Detailed turning movement traffic and pedestrian counts for the County Road 18 / County Road 17 intersection were commissioned by JD Engineering.
3. An intersection operation analysis was completed at the study area intersections, using the existing (2024) and background (2026 and 2031) traffic volumes, without the proposed development traffic. This enabled a review of existing and future traffic deficiencies that would be present without the influence of the proposed development. No geometric lane improvements or traffic signal improvements are recommended within the study area.
4. An estimate of the amount of traffic that would be generated by the proposed development was prepared and assigned to the study area streets and intersections.
5. An intersection operation analysis was completed under total (2026 and 2031) traffic volumes with the proposed development operational at the study area intersections. No geometric lane improvements or traffic signal improvements are recommended within the study area.
6. Street ' $A$ ' will operate efficiently as full-movement accesses, with one-way stop control for the westbound movements. A single eastbound and westbound lane at Street ' $A$ ' will provide the necessary capacity to service the proposed development.
7. Street ' $C$ ' will operate efficiently as full-movement access, with two-way stop control for the northbound and southbound movements. A single northbound and southbound lane at Street ' $C$ ' will provide the necessary capacity to service the proposed development.
8. County Road 18 will need to be reconstructed to improve the vertical curve and sight distance. Preliminary plan and profile drawings are provided in Appendix H .
9. With the above-noted road reconstruction, the sight distance available for Street ' $A$ ' and Street ' $C$ ' are suitable for their intended use.
10. In summary, the proposed development will not cause any operational issues and will not add a notable delay or congestion to the local roadway network.

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## 1 Introduction

### 1.1 Background

2735528 Ontario Inc. [The Developer] is proposing to develop a residential subdivision, located in the northeast quadrant of the Airport Road (County Road 18) / County Road 17 intersection in the Township of Mulmur [Township], County of Dufferin [County].

The proposed residential development is anticipated to consist of 43 single family detached units and 28 semi-detached units.

The proposed development is anticipated to include one full movement access onto County Road 18 [Street ' A '] and one full movement access onto County Road 17 opposite of Thomson Trail [Street ' $C$ '].

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

### 1.2 Study Area

Figure 1 shows the location of the proposed development and study area intersections, in relation to the surrounding area. The Site Plan by IPS Consulting Inc. is provided in Appendix A.

The proposed development is bound by County Road 18 to the west, residential lands and County Road 17 to the south and agricultural/rural lands to the north and east.

Based on our correspondence with the Township and County, the following intersections will be analysed as part of this study:

- County Road 18 / County Road 17;
- County Road 18 / Street 'A'; and
- Street 'C' \& Thompson Trail / County Road 17.

Figure 1 - Proposed Site Location and Study Area


### 1.3 Study Scope and Objectives

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

- Consult with the Township and County to address any traffic-related issues or concerns they have with the proposed development;
- Determine existing traffic volumes and circulation patterns;
- Estimate future traffic volumes if the proposed development was not constructed, including the impact of additional proposed developments in the area;
- Complete level-of-service [LOS] analysis of horizon year (without the proposed development) traffic conditions and identify operational deficiencies;
- Estimate the amount of traffic that would be generated by the proposed development and assign to the roadway network;
- Complete LOS analysis of horizon year (with the proposed development) traffic conditions and identify additional operational deficiencies;
- Identify improvement options to address operational deficiencies; and
- Document findings and recommendations in a final report.


### 1.4 Horizon Year and Analysis Periods

Traffic scenarios for the existing year (2024), build-out year (2026) and 5 -year post build-out year (2031) were selected for analysis of traffic operations in the study area. The weekday morning [AM] and weekday afternoon [PM] peak hours have been selected as the analysis periods for this study.

## 2 Information Gathering

### 2.1 Street and Intersection Characteristics

County Road 18 (Airport Road) is a two-lane arterial road with no sidewalks. County Road 18 generally has an urban cross-section and an asphalt 'killstrip' within 100 metres of County Road 17 and generally has a rural cross-section with asphalt shoulders elsewhere within the study area. County Road 18 has a posted speed of $50 \mathrm{~km} / \mathrm{h}$ south of the north end of the subject site and a posted speed limit of $70 \mathrm{~km} / \mathrm{h}$ north of the north end of the subject site within the study area. County Road 18 is under the jurisdiction of the County within the study area.
$10^{\text {th }}$ Sideroad is a two-lane collector road. $10^{\text {th }}$ Sideroad, west of County Road 18 within the study area has a rural cross-section, a gravel shoulder on both sides of the road, a speed limit of $50 \mathrm{~km} / \mathrm{h}$ and is under the jurisdiction of the Township. $10^{\text {th }}$ Sideroad, east of County Road 18, is also known as County Road 17 and is under the jurisdiction of the County. County Road 17 has an urban cross section, an asphalt 'killstrip' on both sides of the road and a posted speed limit of $50 \mathrm{~km} / \mathrm{h}$ between County Road 18 and Adrian Avenue. County Road 17 has a rural cross section, gravel shoulders on both sides of the road and a posted speed limit of $70 \mathrm{~km} / \mathrm{h}$ east of Adrian Avenue within the study area.

Thomson Trail is a two-lane local road with a rural cross-section. Thomson Trail has gravel shoulders on both sides of the road, an assumed (unposted) speed limit of $50 \mathrm{~km} / \mathrm{h}$ and is under jurisdiction of the Township.

The existing lane configuration within the study area is illustrated in Figure 2.

Figure 2 - Existing Lane Configuration within Study Area


### 2.2 Local Transportation Infrastructure Improvements

Based on a review of the County's 2024 Capital Budget Package, County Road 17 and County Road 18 are anticipated to be resurfaced in 2029. These improvements are not anticipated to significantly change traffic operations within the study area. There are no other infrastructure improvements anticipated within the study area.

### 2.3 Transit Access

There is no municipal transit service within the study area.

### 2.4 Other Developments within the Study Area

A gas station was recently constructed at the southwest corner of the County Road 18 / County Road 17 intersection [Mansfield Gas Station West].

The traffic counts used in this report were completed prior to the construction of the Mansfield Gas Station West development. Consequently, the traffic generated from the Mansfield Gas Station West development has been added to the existing (2024) traffic volumes (further discussed in Section 2.6.1.).

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

The Mansfield Gas Station West development includes 4 pumping stations that provide 8 fueling positions and a 280 sq.m. convenience store with drive-through. The Mansfield Gas Station West development is currently constructed and operating.

The traffic generation for the Mansfield Gas Station West development has been calculated based on the data provided in the Institute of Transportation Engineers [ITE] Trip Generation Manual ( $10^{\text {th }}$ Edition) [ITE Trip Generation Manual]. The following ITE land uses have been applied to estimate the traffic:

- ITE land use 945 (Gasoline/ service station with convenience market) - General Urban / Suburban Setting; and
- ITE land use 937 (Coffee/Donut shop with drive-through window) - General Urban / Suburban Setting.

The AM and PM peak hour of traffic generation for the Mansfield Gas Station West development does not exactly align with the AM and PM peak hour in the traffic counts; consequently, we have applied the peak hour of adjacent street traffic. The estimated trip generation of the Mansfield Gas Station West development is illustrated below in Table 1.

It has been assumed that the convenience store drive-through will be for a coffee shop. In order to be conservative with our analysis, we have completed traffic generation calculations for ITE land use 937 in addition to ITE land use 945 assuming a quarter of the GFA of the convenience store will be for the coffee shop.

Table 1 - Estimated Traffic Generation - Mansfield Gas Station West

| Land Use | Size | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | IN | OUT | TOTAL | IN | OUT | TOTAL |
| Gasoline/ service station with convenience market ITE Land Use:945 | 8 Vehicle fueling positions | 51 | 49 | 100 | 57 | 55 | 112 |
| Coffee/Donut shop with drivethrough window ITE Land Use:937 | 754 sq.ft.* | 34 | 33 | 67 | 17 | 16 | 33 |
| TOTAL TRIP GENERATION |  | 85 | 82 | 167 | 74 | 71 | 145 |
| INTERNAL CAPTURE |  | -10 | -10 | -20 | -12 | -12 | -24 |
| NET SITE GENERATION |  | 75 | 72 | 147 | 62 | 59 | 121 |
| PASS-BY TRIPS (ITE \#945)** |  | -28 | -28 | -56 | -28 | -28 | -56 |
| PASS-BY TRIPS (ITE \#937)*** |  | -14 | -14 | -28 | -6 | -5 | -11 |
| PRIMARY TRIPS |  | 33 | 30 | 73 | 28 | 26 | 54 |

*It has been assumed that a quarter of the convenience store GFA will be for a coffee shop
**ITE Land Use 945 pass-by trips for the AM and PM peak hour are $62 \%$ and $56 \%$ respectively, according to the ITE data
***ITE Land Use 937 pass-by trips for the AM and PM peak hour are $49 \%$ and $50 \%$ respectively, according to the ITE data
The distribution of traffic for the Mansfield Gas Station West development is based on the distribution of the existing traffic volumes within the study area. Table 2 illustrates the calculation of the distribution of ingress and egress traffic for the Mansfield Gas Station West development.

Table 2 - Mansfield Gas Station West Traffic Distribution

| Travel Direction (to / from) | AM Peak Hour |  | PM Peak Hour |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Ingress | Egress | Ingress | Egress |
| North via County Road 18 | $47 \%$ | $37 \%$ | $37 \%$ | $45 \%$ |
| East via County Road 17 | $12 \%$ | $12 \%$ | $9 \%$ | $11 \%$ |
| Outside of Study Area* | $41 \%$ | $51 \%$ | $54 \%$ | $44 \%$ |
| TOTAL | $\mathbf{1 0 0 \%}$ | $\mathbf{1 0 0 \%}$ | $\mathbf{1 0 0 \%}$ | $\mathbf{1 0 0 \%}$ |

*Trips to and from the west via $10^{\text {th }}$ Sideroad and to and from the south via County Road 18 are considered to the be outside the study area as these trips are not anticipated to utilize the study area intersections.

Using the traffic distribution pattern noted above, the traffic assignment for the Mansfield Gas Station West development was calculated for the AM and PM peak hour and is illustrated in Figure 3.

Figure 3 - Mansfield Gas Station West development Traffic Assignment


### 2.5 Background Growth Rate

A background traffic growth rate of 4.7\% per year has been selected for County Road 18 and $4.4 \%$ per year for County Road 17 and $10^{\text {th }}$ Sideroad within the study area, based on historical traffic data provided by the County and historical 24-hour traffic count data on the County's traffic counts webpage.

### 2.6 Traffic Counts

Detailed turning movement traffic and pedestrian counts for the County Road 18 / County Road 17 intersection intersections were commissioned by JD Engineering.

Table 3 summarizes the traffic count data collection information.
Table 3 - Traffic Count Data

| Intersection <br> (N-S Street/E-W Street) | Count Date | AM Peak Hour | PM Peak Hour | Source |
| :---: | :---: | :---: | :---: | :---: |
| County Road 18 / County Road 17 | Tuesday, July 13, 2021 | $08: 00-9: 00$ | $16: 00-17: 00$ | JD Eng.* |

*Traffic counts were completed by Accu-Traffic Inc. on behalf of JD Engineering.
Detailed traffic count data can be found in Appendix B. The peak hours of traffic generation for the study area intersections generally aligned with the anticipated peak hour of traffic generation by the proposed development.

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

### 2.6.1 Calculation of Existing (2024) Traffic Volumes

### 2.6.1.1 Covid-19 Restrictions Adjustment

Although the traffic data was obtained in 2021 for the study area intersections, COVID-19 restrictions were implemented in Ontario at this time; consequently, these traffic counts do not reflect typical traffic conditions. To verify the 2021 counts, a comparison was completed for the 2021 traffic counts commissioned and the 2017 counts obtained from the County for County Road 18 at the north end of Mansfield and the 2019 counts obtained for County Road 17, 250 metres east of County Road 18.

To determine the equivalent 2021 traffic volumes from the 2017 and 2019 counts, for accurate comparison to the 2021 counts, the background traffic growth rate noted in Section 2.5 was applied to the 2017 and 2019 counts. Based on a comparison of the 2021 counts and the equivalent 2021 counts, the 2021 traffic volumes at the study area intersections were increased by $58 \%$ for County Road 18 and $14 \%$ for County Road 17 and $10^{\text {th }}$ Sideroad to account for COVID-19 restrictions.

### 2.6.1.2 County Road 17 / Thomson Trail

The eastbound and westbound through traffic volumes on County Road 17 at this intersection were estimated based on the traffic volumes calculated in Section 2.6.1.1.

The traffic volumes entering and exiting Thomson Trail intersection have been calculated based on the ITE Trip Generation Manual. The following ITE land uses have been applied to estimate the traffic from the existing Thomson Trail residential area:

- ITE land use 210 (Single-Family Detached Housing) - General Urban / Suburban Setting.

The estimated trip generation of the existing Thomson Trail residential area is illustrated below in Table 4. The AM and PM peak traffic generation for the existing Thomson Trail residential area is not expected to exactly align with the AM and PM peak hour in the traffic counts; consequently, we have applied the peak hour of adjacent street traffic values provided in the ITE Trip Generation Manual.

Table 4 - Estimated Traffic Generation - Thomson Trail Residential Area

| Land Use | Size | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | IN | OUT | TOTAL | IN | OUT | TOTAL |
| Single-Family Detached Housing <br> ITE Land Use: 210 | 60 units* $^{*}$ | 12 | 35 | 47 | 39 | 23 | 62 |

*There are 60 residential units on Thomson Trail and Sommerville Crescent which only have access to the Township and County road network via Thomson Trail

The distribution of traffic for the existing Thomson Trail residential area has been calculated based on the 2016 Transportation Tomorrow Survey [TTS] data for traffic zone 8411 retrieved using the TTS Internet Data Retrieval System [IDRS] (output attached as Appendix F). TTS data provides historical origin and destination work trip percentages for specific areas within the County and the Greater Toronto and Hamilton Area [GTHA].

Traffic distribution for the trips generated by the Thompson Trail residential area during the AM and PM peak hour is expected to generally follow commuter travel patterns. Our analysis is based on egress traffic during the AM peak hour. Logically, the distribution of ingress traffic will follow the inverse of the exiting traffic distribution. For each of the individual areas identified in the TTS data, we have selected the probable route of travel, assuming that people will select their route primarily based on travel time.

The distribution of traffic for the existing Thomson Trail residential area is illustrated in Table 5 using the methodology outlined above.

Table 5 - Thomson Trail Residential Area Traffic Distribution

| Travel Direction (to/from) | Percentage of Total <br> Traffic Generation |
| :---: | :---: |
| West via 10 th Sideroad | $11 \%$ |
| East via County Road 17 | $23 \%$ |
| South via County Road 18 | $59 \%$ |
| North via County Road 18 | $\mathbf{7 \%}$ |
| Total | $\mathbf{1 0 0 \%}$ |

### 2.6.1.3 Existing (2024) Traffic Volumes

The 2024 existing AM and PM peak hour traffic volumes in the study area are established based on the conducted traffic counts, adjusted to reflect the annual background growth rate noted in Section 2.5, COVID-19 adjustment noted in Section 2.6.1.1., in addition to the adjacent development traffic noted in Section 2.4.

Figure 4 illustrates the existing (2024) AM and PM peak hour traffic volumes within the study area.

### 2.7 Horizon Year Traffic Volumes

The background traffic growth rate discussed in Section 2.5 has been applied to the existing traffic volumes to estimate the background (2026 and 2031) horizon year traffic volumes.

Figures 5 and 6 illustrate the background (2026 and 2031) horizon year AM and PM peak hour traffic volumes in the study area.

Figure 4 - Existing (2024) Traffic Volumes


Figure 5 - Background (2026) Traffic Volumes


Figure 6 - Background (2031) Traffic Volumes


## 3 Intersection Operation without Proposed Development

### 3.1 Introduction

Existing year operational conditions were established to determine how the street network within the study area is currently functioning without the proposed development. This provides a base case scenario to compare with future development scenarios. Traffic operations within the study area were evaluated using the 2024 traffic volumes with the existing road configuration and traffic control. The intersection performance was measured using the traffic analysis software, Synchro 11, a deterministic model that employs Highway Capacity Manual and Intersection Capacity Utilization methodologies for analyzing intersection operations. These procedures are accepted by provincial and municipal agencies throughout North America.

Synchro 11 enables the study area to be graphically defined in terms of streets and intersections, along with their geometric and traffic control characteristics. The user is able to evaluate both signalized and
unsignalized intersections in relation to each other, thus not only providing level of service for the individual intersections, but also enabling an assessment of the impact the various intersections in a network have on each other in terms of spacing, traffic congestion, delay, and queuing.

### 3.2 Intersection Capacity Analysis Criteria

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

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

The LOS criteria for signalized and stop sign controlled intersections are shown in Table 6. A description of traffic performance characteristics is included for each LOS.

Table 6 - Level of Service Criteria for Intersections

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

### 3.3 Existing (2024) Intersection Operation

The results of the LOS analysis under existing (2024) traffic volumes during the AM and PM peak hour can be found below in Table 7. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in Appendix C.

Table 7 - Existing (2024) LOS

| Location <br> (N-S Street / E-W Street) | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | V/C | Delay (s) | LOS | V/C | Delay (s) | LOS |
| County Road 18 / County Road 17 <br> (signalized) | 0.34 | 8.6 | A | 0.51 | 9.9 | A |
|  | EB | 0.43 | 23.5 | C | 0.38 | 21.2 |
| C |  |  |  |  |  |  |
| WB | 0.41 | 23.2 | C | 0.40 | 21.2 | C |
|  | NB | 0.24 | 4.3 | A | 0.54 | 7.8 |
| A |  |  |  |  |  |  |
| County Road 17 / Thomson Trail |  |  |  |  |  |  |
| (unsignalized) | SB | 0.33 | 4.8 | A | 0.48 | 7.2 |
| A |  |  |  |  |  |  |

The results of the LOS analysis indicate that all intersections are operating within the typical design limits noted in Section 3.2.

An analysis was completed for left turn movements at the unsignalized study area intersections, based on the criteria outlined in Appendix 9A of the Ontario Ministry of Transportation Design Supplement for TAC Geometric Design Guide for Canadian Roads June 2017 [MTO DS]. Based on the MTO criteria, auxiliary left turn lanes are not warranted (results are provided in Appendix D).

A review of the need for an auxiliary right turn lane at the unsignalized study area intersections was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, an auxiliary right turn lane is not recommended.

Based on the Ontario Traffic Manual Book 12 Signal Justification, traffic signals are not warranted at the unsignalized study area intersections (results are provided in Appendix E).

No infrastructure improvements are recommended within the study area.

### 3.4 Background (2026) Intersection Operation

The results of the LOS analysis under background (2026) traffic volumes during the AM and PM peak hour can be found below in Table 8. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in Appendix F.

Table 8 - Background (2026) LOS

| Location <br> (N-S Street / E-W Street) | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | V/C | Delay (s) | LOS | V/C | Delay (s) | LOS |
| County Road 18 / County Road 17 (signalized) | 0.38 | 8.7 | A | 0.57 | 10.6 | B |
| EB | 0.45 | 23.3 | C | 0.39 | 21.2 | C |
| WB | 0.43 | 23.2 | C | 0.43 | 21.4 | C |
| NB | 0.26 | 4.5 | A | 0.60 | 8.8 | A |
| SB | 0.37 | 5.2 | A | 0.53 | 8.0 | A |
| County Road 17 / Thomson Trail (unsignalized) | - | 1.9 | A | - | 1.2 | A |
| NB | 0.04 | 9.4 | A | 0.03 | 9.8 | A |

The results of the LOS analysis indicate that all intersections are operating within the typical design limits noted in Section 3.2.

An analysis was completed for left turn movements at the unsignalized study area intersections, based on the criteria outlined in Appendix 9A of the MTO DS. Based on the MTO criteria, auxiliary left turn lanes are not warranted (results are provided in Appendix D).

A review of the need for an auxiliary right turn lane at the unsignalized study area intersections was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, an auxiliary right turn lane is not recommended.

Based on the Ontario Traffic Manual Book 12 Signal Justification, traffic signals are not warranted at the unsignalized study area intersections (results are provided in Appendix E).

No infrastructure improvements are recommended within the study area.

### 3.5 Background (2031) Intersection Operation

The results of the LOS analysis under background (2031) traffic volumes during the AM and PM peak hour can be found below in Table 9. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in Appendix F.

Table 9 - Background (2031) LOS

| Location <br> (N-S Street / E-W Street) | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | V/C | Delay (s) | LOS | V/C | Delay (s) | LOS |
| County Road 18 / County Road 17 <br> (signalized) | 0.47 | 9.7 | A | 0.72 | 14.2 | B |
|  | EB | 0.39 | 21.1 | C | 0.44 | 21.4 |
| C |  |  |  |  |  |  |
| WB | 0.39 | 21.2 | C | 0.51 | 21.8 | C |
| NB | 0.35 | 6.0 | A | 0.77 | 13.4 | B |
| County Road 17 / Thomson Trail <br> (unsignalized) | SB | 0.49 | 7.2 | A | 0.70 | 11.8 |
| B |  |  |  |  |  |  |

The results of the LOS analysis indicate that all intersections are operating within the typical design limits noted in Section 3.2.

An analysis was completed for left turn movements at the unsignalized study area intersections, based on the criteria outlined in Appendix 9A of the MTO DS. Based on the MTO criteria, auxiliary left turn lanes are not warranted (results are provided in Appendix D).

A review of the need for an auxiliary right turn lane at the unsignalized study area intersections was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, an auxiliary right turn lane is not recommended.

Based on the Ontario Traffic Manual Book 12 Signal Justification, traffic signals are not warranted at the unsignalized study area intersections (results are provided in Appendix E).

No infrastructure improvements are recommended within the study area.

## 4 Proposed Development Traffic Generation and Assignment

### 4.1 Traffic Generation

The traffic generation for the proposed development has been based on the ITE Trip Generation Manual. The following ITE land uses have been applied to estimate the traffic from the proposed development:

- ITE land use 210 (Single-Family Detached Housing) - General Urban / Suburban Setting.

The estimated trip generation of the proposed development is illustrated below in Table 10. The AM and PM peak traffic generation for the proposed development is not expected to exactly align with the AM and PM peak hour in the traffic counts; consequently, we have applied the peak hour of adjacent street traffic values provided in the ITE Trip Generation Manual.

Table 10 - Estimated Traffic Generation of Proposed Development

| Land Use | Size | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | IN | OUT | TOTAL | IN | OUT | TOTAL |
| Single-Family Detached Housing <br> ITE Land Use: 210 |  | 14 | 42 | 56 | 46 | 27 | 73 |

*Includes the proposed 43 single family detached units and 28 semi-detached units.
No transportation modal split has been applied to the above-noted traffic generation calculation.

### 4.2 Traffic Assignment

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

The ITE data provides the anticipated percentage of new traffic entering and exiting during the peak hour.

The distribution of traffic for the proposed development has been calculated based on the 2016 TTS data for traffic zone 8411 retrieved using the TTS IDRS (output attached as Appendix F). TTS data provides historical origin and destination work trip percentages for specific areas within the County and the GTHA.

Traffic distribution for the trips generated by the subject site during the AM and PM peak hour is expected to generally follow commuter travel patterns. Our analysis is based on egress traffic during the AM peak hour. Logically, the distribution of ingress traffic will follow the inverse of the exiting traffic distribution. For each of the individual areas identified in the TTS data, we have selected the probable route of travel, assuming that people will select their route primarily based on travel time.

The distribution of traffic for the proposed development is illustrated in Table 11 using the methodology outlined above.

Table 11 - Proposed Development Traffic Distribution

| Travel Direction (to/from) | Percentage of Total <br> Traffic Generation |
| :---: | :---: |
| West via 10 $0^{\text {th }}$ Sideroad | $14 \%$ |
| East via County Road 17 | $16 \%$ |
| South via County Road 18 | $61 \%$ |
| North via County Road 18 | $9 \%$ |
| Total | $\mathbf{1 0 0 \%}$ |

Using the traffic distributions pattern noted above, the traffic assignment for the proposed development was calculated for the AM and PM peak hour and is illustrated in Figure 7.

### 4.3 Total Horizon Year Traffic Volumes with the Proposed Development

For the total (2026 and 2031) horizon year traffic volumes, the proposed development traffic was added to the background (2026 and 2031) traffic volumes. The resulting total (2026 and 2031) horizon year traffic volumes for the AM and PM peak hour are illustrated in Figures $\mathbf{8}$ and 9.

Figure 7 - Proposed Development Traffic Assignment


Figure 8 -Total (2026) Traffic Volumes


Figure 9 -Total (2031) Traffic Volumes


## 5 Intersection <br> Operation <br> with <br> Proposed Development

### 5.1 Total (2026) Intersection Operation

The results of the LOS analysis under total (2026) traffic volumes during the AM and PM peak hour can be found below in Table 12. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in Appendix G.

Table 12 - Total (2026) LOS

| Location <br> (N-S Street / E-W Street) | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | V/C | Delay (s) | LOS | V/C | Delay (s) | LOS |
| County Road 18 / County Road 17 (signalized) | 0.40 | 9.3 | A | 0.60 | 11.2 | B |
| EB | 0.33 | 20.7 | C | 0.40 | 21.2 | C |
| WB | 0.40 | 21.3 | C | 0.47 | 21.7 | C |
| NB | 0.29 | 5.5 | A | 0.63 | 9.5 | A |
| SB | 0.40 | 6.4 | A | 0.55 | 8.4 | A |
| County Road $17 /$ Thomson Trail \& Street ' $C$ ' (unsignalized) | - | 2.9 | A | - | 2.0 | A |
| NB | 0.05 | 9.8 | A | 0.04 | 10.5 | B |
| SB | 0.03 | 9.1 | A | 0.02 | 9.6 | A |
| County Road 18 / Street ' A ' (unsignalized) | - | 0.4 | A | - | 0.3 | A |
| WB | 0.05 | 13.6 | B | 0.06 | 21.0 | C |

The results of the LOS analysis indicate that all intersections are operating within the typical design limits noted in Section 3.2.

An analysis was completed for left turn movements at the unsignalized study area intersections, based on the criteria outlined in Appendix 9A of the MTO DS. Based on the MTO criteria, auxiliary left turn lanes are not warranted (results are provided in Appendix D).

A review of the need for an auxiliary right turn lane at the unsignalized study area intersections was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, an auxiliary right turn lane is not recommended.

Based on the Ontario Traffic Manual Book 12 Signal Justification, traffic signals are not warranted at the unsignalized study area intersections (results are provided in Appendix E).

No infrastructure improvements are recommended within the study area

### 5.2 Total (2031) Intersection Operation

The results of the LOS analysis under total (2031) traffic volumes during the AM and PM peak hour can be found below in Table 13. Existing intersection geometry and traffic control have been utilized for this scenario. Detailed output of the Synchro analysis can be found in Appendix G.

Table 13 - Total (2031) LOS

| Location <br> (N-S Street / E-W Street) | AM Peak Hour |  |  | PM Peak Hour |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | V/C | Delay (s) | LOS | V/C | Delay (s) | LOS |
| County Road 18 / County Road 17 (signalized) | 0.50 | 10.2 | B | 0.75 | 15.6 | B |
| EB | 0.38 | 20.9 | C | 0.46 | 21.4 | C |
| WB | 0.47 | 21.8 | C | 0.54 | 22.3 | C |
| NB | 0.36 | 6.3 | A | 0.81 | 15.4 | B |
| SB | 0.51 | 7.7 | A | 0.73 | 12.8 | B |
| County Road $17 /$ Thomson Trail \& Street ' C ' (unsignalized) | - | 2.6 | A | - | 1.8 | A |
| NB | 0.05 | 10.0 | B | 0.04 | 10.9 | B |
| SB | 0.03 | 9.2 | A | 0.02 | 9.8 | A |
| County Road 18 / Street ' $A$ ' (unsignalized) | - | 0.4 | A | - | 0.4 | A |
| WB | 0.06 | 15.9 | C | 0.10 | 34.8 | D |

The results of the LOS analysis indicate that all intersections are operating within the typical design limits noted in Section 3.2. The egress movement at the Street A connection operates at a satisfactory level of service (LOS D). It is noted that during the same peak period, the alternate access point (Street C), provides an excellent level of service (LOS A) with minor delays. Consequently, should the delays at Street A become an issue, motorists will have the opportunity to divert to a secondary access point.

An analysis was completed for left turn movements at the unsignalized study area intersections, based on the criteria outlined in Appendix 9A of the MTO DS. Based on the MTO criteria, auxiliary left turn lanes are not warranted (results are provided in Appendix D).

A review of the need for an auxiliary right turn lane at the unsignalized study area intersections was completed as part of our analysis. The results of the Synchro analysis indicate that there is excess capacity for all movements; consequently, an auxiliary right turn lane is not recommended.

Based on the Ontario Traffic Manual Book 12 Signal Justification, traffic signals are not warranted at the unsignalized study area intersections (results are provided in Appendix E).

No infrastructure improvements are recommended within the study area.

### 5.3 Sight Distance Review

A review of the available sight distance for the proposed municipal roads within the study area was completed as part of this analysis.

The sight distance south (greater than 200 metres) of Street ' $A$ ' at County Road 18 is greater than the minimum visibility requirements identified in the County's Entrance Policy 5-3-17 [County Entrance Policy] ( 160 metres for commercial entrance on a road with a posted speed limit of $50 \mathrm{~km} / \mathrm{h}$ ).

The sight stance north of Street 'A' at County Road 18 does not meet the minimum visibility requirements identified in the County Entrance Policy. Consequently, County Road 18 will need to be reconstructed to improve the vertical curve and sight distance. Preliminary plan and profile drawings are provided in Appendix H . The drawing illustrate the minimum visibility requirements identified in the County Entrance Policy can be met from Street ' A ' with the proposed road reconstruction. The decision point elevation on Street " A " and at the adjacent driveway was assumed to be 0.25 metres below the centerline of County Road 18 , which is a conservative approach.

A detailed design for the road reconstruction will be completed as part of the detailed engineering design, however, the vertical curve values used in the preliminary design meet the minimum TAC requirements for a posted speed of $50 \mathrm{~km} / \mathrm{h}$. Depending on the final design configuration, the existing $50 \mathrm{~km} / \mathrm{h}$ zone on County Road 18 may need to be extended slightly to the north.

The sight distance east (greater than 200 metres) and west (greater than 200 metres) of the Street ' $C$ ' at County Road 17 is greater than the minimum visibility requirements identified in the County Entrance Policy ( 160 metres for commercial entrance on a road with a posted speed limit of $50 \mathrm{~km} / \mathrm{h}$ ).

With the proposed road reconstruction of County Road 18, the sight distance for the proposed municipal roads within the study area are suitable for their intended use.

### 5.4 Site Access

Street ' $C$ ' at County Road 17 will operate efficiently as full-movement accesses, with two-way stop control for the northbound and southbound movements. No lane improvements are recommended on County Road 17 at Street ' $C$ '. A single northbound and southbound lane on Street ' $C$ ' will provide the necessary capacity to service the proposed development.

Street ' $A$ ' at the County Road 18 will operate efficiently as a full-movement access, with one-way stop control for westbound movements. No lane improvements are recommended on County Road 18 at Street ' $A$ '. A single westbound lane on Street ' $A$ ' will provide the necessary capacity to service the proposed development.

The proposed spacing (measured edge of driveway to edge of road) between the Street 'C' \& Thomson Trail / County Road 17 intersection and the existing driveways to the east and west are in excess of the suggested minimum corner clearance requirements for a intersections as identified in the TAC Guidelines - Figure 8.8.2 (Suggested Minimum Corner Clearances to Accesses or Public Lanes at Major Intersections) - 25 metres for unsignalized condition.

The proposed spacing (approximately 135 meters, measured edge to edge of road) between the Street 'A' / County Road 18 intersection and the County Road 17 / County Road 18 intersection is in excess of the suggested minimum corner clearance requirements for an intersection as identified in the TAC Guidelines - Figure 8.8.2 (Suggested Minimum Corner Clearances to Accesses or Public Lanes at Major Intersections) - 70 metres for signalized condition.

The proposed spacing (measured edge of driveway to edge of road) between the Street ' $A$ ' / County Road 18 intersection and the existing driveway to the south and between the Street 'A' / County Road 18 intersection and the existing driveway to the north are in excess of the suggested minimum corner clearance requirements for an intersection as identified in the TAC Guidelines - Figure 8.8.2 (Suggested Minimum Corner Clearances to Accesses or Public Lanes at Major Intersections) - 25 metres and 35 metres for unsignalized condition.

Furthermore, the anticipated $95^{\text {th }}$ percentile queue length for the southbound movements at the County Road 17 / County Road 18 intersection (56 and 112 meters during the AM and PM peak hours for the critical total (2031) scenario) is less than the proposed spacing (measured edge to edge of road) between the Street 'A' / County Road 18 intersection and the County Road 17 / County Road 18 intersection.

## 6 Summary

2735528 Ontario Inc. retained JD Engineering to prepare this traffic impact study in support of the proposed development, located in the northeast quadrant of the County Road 18 / County Road 17 intersection in the Township of Mulmur [Township], County of Dufferin [County]. The proposed Site Plan is shown in Appendix A. This chapter summarizes the conclusions and recommendations from the study.

The proposed residential development is anticipated to consist of 43 single family detached units, and 28 semi-detached units.

1. The proposed development is expected to generate a total of 56 AM and 73 PM peak hour trips.
2. Detailed turning movement traffic and pedestrian counts for the County Road 18 / County Road 17 intersection were commissioned by JD Engineering.
3. An intersection operation analysis was completed at the study area intersections, using the existing (2024) and background (2026 and 2031) traffic volumes, without the proposed development traffic. This enabled a review of existing and future traffic deficiencies that would be present without the influence of the proposed development. No geometric lane improvements or traffic signal improvements are recommended within the study area.
4. An estimate of the amount of traffic that would be generated by the proposed development was prepared and assigned to the study area streets and intersections.
5. An intersection operation analysis was completed under total (2026 and 2031) traffic volumes with the proposed development operational at the study area intersections. No geometric lane improvements or traffic signal improvements are recommended within the study area.
6. Street ' $A$ ' will operate efficiently as full-movement accesses, with one-way stop control for the westbound movements. A single eastbound and westbound lane at Street ' $A$ ' will provide the necessary capacity to service the proposed development.
7. Street ' $C$ ' will operate efficiently as full-movement access, with two-way stop control for the northbound and southbound movements. A single northbound and southbound lane at Street ' $C$ ' will provide the necessary capacity to service the proposed development.
8. County Road 18 will need to be reconstructed to improve the vertical curve and sight distance. Preliminary plan and profile drawings are provided in Appendix H .
9. With the above-noted road reconstruction, the sight distance available for Street ' $A$ ' and Street ' $C$ ' are suitable for their intended use.
10. In summary, the proposed development will not cause any operational issues and will not add a notable delay or congestion to the local roadway network.

## Appendix A Site Plan



## Appendix B Traffic Count Data

## Accu-Traffic Inc.



Comments

## Accu-Traffic Inc.



Comments

## Accu-Traffic Inc.

## Total Count Diagram



Comments

Accu-Traffic Inc
Traffic Monitoring \& Data Analysis






## Appendix C - <br> Synchro Analysis Output Existing Traffic Volumes

|  | 4 | $\rightarrow$ | 7 |  | 4 | $\dagger$ |  | $\frac{1}{\dagger}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
| Lane Configurations |  | $\uparrow$ |  | $\uparrow$ |  | * |  | * |
| Traffic Volume (vph) | 21 | 37 | 20 | 32 | 7 | 206 | 32 | 279 |
| Future Volume (vph) | 21 | 37 | 20 | 32 | 7 | 206 | 32 | 279 |
| Lane Group Flow (vph) | 0 | 76 | 0 | 96 | 0 | 258 | 0 | 376 |
| Turn Type | Perm | NA | Perm | NA | Perm | NA | Perm | NA |
| Protected Phases |  | 4 |  | 8 |  | 2 |  | 6 |
| Permitted Phases | 4 |  | 8 |  | 2 |  | 6 |  |
| Detector Phase | 4 | 4 | 8 | 8 | 2 | 2 | 6 | 6 |
| Switch Phase |  |  |  |  |  |  |  |  |
| Minimum Initial (s) | 7.0 | 7.0 | 7.0 | 7.0 | 25.0 | 25.0 | 25.0 | 25.0 |
| Minimum Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 32.0 | 32.0 | 32.0 | 32.0 |
| Total Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| Total Split (\%) | 37.5\% | 37.5\% | 37.5\% | 37.5\% | 62.5\% | 62.5\% | 62.5\% | 62.5\% |
| Yellow Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Lost Time (s) |  | 6.0 |  | 6.0 |  | 7.0 |  | 7.0 |
| Lead/Lag |  |  |  |  |  |  |  |  |
| Lead-Lag Optimize? |  |  |  |  |  |  |  |  |
| Recall Mode | None | None | None | None | Max | Max | Max | Max |
| v/c Ratio |  | 0.28 |  | 0.33 |  | 0.21 |  | 0.29 |
| Control Delay |  | 18.9 |  | 15.7 |  | 5.2 |  | 5.6 |
| Queue Delay |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Delay |  | 18.9 |  | 15.7 |  | 5.2 |  | 5.6 |
| Queue Length 50th (m) |  | 5.4 |  | 4.9 |  | 9.4 |  | 14.9 |
| Queue Length 95th (m) |  | 14.0 |  | 14.3 |  | 21.0 |  | 31.1 |
| Internal Link Dist (m) |  | 439.9 |  | 535.3 |  | 514.2 |  | 133.5 |
| Turn Bay Length (m) |  |  |  |  |  |  |  |  |
| Base Capacity (vph) |  | 506 |  | 520 |  | 1220 |  | 1297 |
| Starvation Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Spillback Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Storage Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Reduced v/c Ratio |  | 0.15 |  | 0.18 |  | 0.21 |  | 0.29 |
| Intersection Summary |  |  |  |  |  |  |  |  |
| Cycle Length: 56 |  |  |  |  |  |  |  |  |
| Actuated Cycle Length: 48.3 |  |  |  |  |  |  |  |  |
| Natural Cycle: 55 |  |  |  |  |  |  |  |  |
| Control Type: Semi Act-Uncoord |  |  |  |  |  |  |  |  |

Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17


c Critical Lane Group


|  | 4 | $\rightarrow$ | $\checkmark$ |  | 4 | $\dagger$ |  | $\dagger$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
| Lane Configurations |  | $\uparrow$ |  | * |  | \& |  | * |
| Traffic Volume (vph) | 31 | 33 | 19 | 57 | 31 | 433 | 48 | 346 |
| Future Volume (vph) | 31 | 33 | 19 | 57 | 31 | 433 | 48 | 346 |
| Lane Group Flow (vph) | 0 | 95 | 0 | 119 | 0 | 577 | 0 | 465 |
| Turn Type | Perm | NA | Perm | NA | Perm | NA | Perm | NA |
| Protected Phases |  | 4 |  | 8 |  | 2 |  | 6 |
| Permitted Phases | 4 |  | 8 |  | 2 |  | 6 |  |
| Detector Phase | 4 | 4 | 8 | 8 | 2 | 2 | 6 | 6 |
| Switch Phase |  |  |  |  |  |  |  |  |
| Minimum Initial (s) | 7.0 | 7.0 | 7.0 | 7.0 | 25.0 | 25.0 | 25.0 | 25.0 |
| Minimum Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 32.0 | 32.0 | 32.0 | 32.0 |
| Total Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| Total Split (\%) | 37.5\% | 37.5\% | 37.5\% | 37.5\% | 62.5\% | 62.5\% | 62.5\% | 62.5\% |
| Yellow Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Lost Time (s) |  | 6.0 |  | 6.0 |  | 7.0 |  | 7.0 |
| Lead/Lag |  |  |  |  |  |  |  |  |
| Lead-Lag Optimize? |  |  |  |  |  |  |  |  |
| Recall Mode | None | None | None | None | Max | Max | Max | Max |
| v/c Ratio |  | 0.36 |  | 0.39 |  | 0.51 |  | 0.45 |
| Control Delay |  | 18.5 |  | 17.9 |  | 8.7 |  | 8.2 |
| Queue Delay |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Delay |  | 18.5 |  | 17.9 |  | 8.7 |  | 8.2 |
| Queue Length 50th (m) |  | 6.0 |  | 7.1 |  | 27.6 |  | 21.3 |
| Queue Length 95th (m) |  | 15.9 |  | 18.1 |  | 58.5 |  | 46.3 |
| Internal Link Dist (m) |  | 439.9 |  | 535.3 |  | 514.2 |  | 133.5 |
| Turn Bay Length (m) |  |  |  |  |  |  |  |  |
| Base Capacity (vph) |  | 459 |  | 525 |  | 1138 |  | 1040 |
| Starvation Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Spillback Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Storage Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Reduced v/c Ratio |  | 0.21 |  | 0.23 |  | 0.51 |  | 0.45 |
| Intersection Summary |  |  |  |  |  |  |  |  |
| Cycle Length: 56 |  |  |  |  |  |  |  |  |
| Actuated Cycle Length: 49.9 |  |  |  |  |  |  |  |  |
| Natural Cycle: 55 |  |  |  |  |  |  |  |  |
| Control Type: Semi Act-Uncoord |  |  |  |  |  |  |  |  |

Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17




## Appendix D MTO Left Turn Warrant Analysis

Exhibit 9A-10



Exhibit 9A-10

————— TRAFFIC SIGNALS MAY BE WARRANTED IN RURAL
AREAS OR URBAN AREAS WITH RESTRICTED FLOW
RAFFIC SIGNALS MAY BE WARRANTED IN
"FREE FLOW" URBAN AREAS
Street 'C' \& Thomson Trail / County Road 17
Total (2031) - Westbound
PM Peak Hour (Critical Scenario)


Exhibit 9A-10



## Appendix E- <br> OTM Signal Justification Sheets

## Justification No. 7-2031 Total Traffic (Critical Case)

Street 'A' / County Road 18

| Justification | Description |  | Compliance |  |  | Signal Warrant | Underground Provisions Warrant |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Sectional |  | Entire \% |  |  |
|  |  | Rest. Flow | Numerical | \% |  |  |  |
| 1. Minimum Vehicluar Volume | A. Vehicle volume, all aproaches (average hour) | 720 | 525 | 73\% | 2\% | NO | NO |
|  | B. Vehicle volume, along minor streets (average hour) | 255 | 9 | 3\% |  | NO | NO |
| 2. Delay to cross traffic | A. Vehicle volume, major street (average hour) | 720 | 511 | 71\% | 6\% | NO | NO |
|  | B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour) | 75 | 7 | 9\% |  | NO | NO |

## Justification No. 7-2031 Total Traffic (Critical Case)

Street 'C' \& Thomson Trail / County Road 17

| Justification | Description |  | Compliance |  |  | Signal Warrant | Underground Provisions Warrant |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Sectional |  | Entire \% |  |  |
|  |  | Rest. Flow | Numerical | \% |  |  |  |
| 1. Minimum Vehicluar Volume | A. Vehicle volume, all aproaches (average hour) | 720 | 143 | 20\% | 11\% | NO | NO |
|  | B. Vehicle volume, along minor streets (average hour) | 170 | 23 | 14\% |  | NO | NO |
|  | A. Vehicle volume, major street (average hour) | 720 | 107 | 15\% | 12\% | NO | NO |
| 2. Delay to cross traffic | B. Combined vehicle and pedestrian volume crossing artery from minor streets (average hour) | 75 | 14 | 19\% |  | NO | NO |

## Appendix F Synchro Analysis Output Background Traffic Volumes



Cycle Length: 56
Actuated Cycle Length: 48
Natural Cycle: 55
Control Type: Semi Act-Uncoord

Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17



|  | $\rightarrow$ | $\geqslant$ | 7 | $\Perp$ | 4 | P |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBT | EBR | WBL | WBT | NBL | NBR |  |
| Lane Configurations | F |  |  | $\uparrow$ | * |  |  |
| Traffic Volume (veh/h) | 76 | 9 | 3 | 56 | 27 | 8 |  |
| Future Volume (Veh/h) | 76 | 9 | 3 | 56 | 27 | 8 |  |
| Sign Control | Free |  |  | Free | Stop |  |  |
| Grade | 0\% |  |  | 0\% | 0\% |  |  |
| Peak Hour Factor | 0.87 | 0.87 | 0.87 | 0.87 | 0.92 | 0.92 |  |
| Hourly flow rate (vph) | 87 | 10 | 3 | 64 | 29 | 9 |  |
| Pedestrians |  |  |  |  |  |  |  |
| Lane Width (m) |  |  |  |  |  |  |  |
| Walking Speed (m/s) |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |
| Median type | None |  |  | None |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |
| Upstream signal (m) |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |
| vC , conflicting volume |  |  | 97 |  | 162 | 92 |  |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |
| vCu , unblocked vol |  |  | 97 |  | 162 | 92 |  |
| tC , single (s) |  |  | 4.1 |  | 6.4 | 6.2 |  |
| tC, 2 stage (s) |  |  |  |  |  |  |  |
| tF (s) |  |  | 2.2 |  | 3.5 | 3.3 |  |
| p0 queue free \% |  |  | 100 |  | 96 | 99 |  |
| cM capacity (veh/h) |  |  | 1496 |  | 827 | 965 |  |
| Direction, Lane \# | EB 1 | WB 1 | NB 1 |  |  |  |  |
| Volume Total | 97 | 67 | 38 |  |  |  |  |
| Volume Left | 0 | 3 | 29 |  |  |  |  |
| Volume Right | 10 | 0 | 9 |  |  |  |  |
| cSH | 1700 | 1496 | 856 |  |  |  |  |
| Volume to Capacity | 0.06 | 0.00 | 0.04 |  |  |  |  |
| Queue Length 95th (m) | 0.0 | 0.0 | 1.1 |  |  |  |  |
| Control Delay (s) | 0.0 | 0.3 | 9.4 |  |  |  |  |
| Lane LOS |  | A | A |  |  |  |  |
| Approach Delay (s) | 0.0 | 0.3 | 9.4 |  |  |  |  |
| Approach LOS |  |  | A |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |
| Average Delay |  |  | 1.9 |  |  |  |  |
| Intersection Capacity Utilization |  |  | 15.4\% | ICU Level of Service |  |  | A |
| Analysis Period (min) |  |  | 15 |  |  |  |  |



Cycle Length: 56
Actuated Cycle Length: 50.1
Natural Cycle: 55
Control Type: Semi Act-Uncoord

Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17





Cycle Length: 56
Actuated Cycle Length: 50
Natural Cycle: 55
Control Type: Semi Act-Uncoord

Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17




|  |  |  |  |  |  |  |  |  |  |
| :--- | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |

Cycle Length: 56
Actuated Cycle Length: 50.9
Natural Cycle: 60
Control Type: Semi Act-Uncoord
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17




## Appendix G Synchro Analysis Output Total Traffic Volumes

|  | 4 | $\rightarrow$ | $\checkmark$ |  | 4 | $\dagger$ | ( | $\dagger$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
| Lane Configurations |  | $\uparrow$ |  | * |  | \& |  | * |
| Traffic Volume (vph) | 23 | 41 | 33 | 37 | 7 | 230 | 35 | 320 |
| Future Volume (vph) | 23 | 41 | 33 | 37 | 7 | 230 | 35 | 320 |
| Lane Group Flow (vph) | 0 | 83 | 0 | 119 | 0 | 290 | 0 | 431 |
| Turn Type | Perm | NA | Perm | NA | Perm | NA | Perm | NA |
| Protected Phases |  | 4 |  | 8 |  | 2 |  | 6 |
| Permitted Phases | 4 |  | 8 |  | 2 |  | 6 |  |
| Detector Phase | 4 | 4 | 8 | 8 | 2 | 2 | 6 | 6 |
| Switch Phase |  |  |  |  |  |  |  |  |
| Minimum Initial (s) | 7.0 | 7.0 | 7.0 | 7.0 | 25.0 | 25.0 | 25.0 | 25.0 |
| Minimum Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 32.0 | 32.0 | 32.0 | 32.0 |
| Total Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| Total Split (\%) | 37.5\% | 37.5\% | 37.5\% | 37.5\% | 62.5\% | 62.5\% | 62.5\% | 62.5\% |
| Yellow Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Lost Time (s) |  | 6.0 |  | 6.0 |  | 7.0 |  | 7.0 |
| Lead/Lag |  |  |  |  |  |  |  |  |
| Lead-Lag Optimize? |  |  |  |  |  |  |  |  |
| Recall Mode | None | None | None | None | Max | Max | Max | Max |
| v/c Ratio |  | 0.29 |  | 0.40 |  | 0.27 |  | 0.38 |
| Control Delay |  | 18.8 |  | 17.6 |  | 6.5 |  | 7.4 |
| Queue Delay |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Delay |  | 18.8 |  | 17.6 |  | 6.5 |  | 7.4 |
| Queue Length 50th (m) |  | 6.0 |  | 6.7 |  | 11.3 |  | 18.6 |
| Queue Length 95th (m) |  | 14.8 |  | 17.3 |  | 25.4 |  | 39.4 |
| Internal Link Dist (m) |  | 439.9 |  | 535.3 |  | 514.2 |  | 133.5 |
| Turn Bay Length (m) |  |  |  |  |  |  |  |  |
| Base Capacity (vph) |  | 496 |  | 491 |  | 1073 |  | 1136 |
| Starvation Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Spillback Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Storage Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Reduced v/c Ratio |  | 0.17 |  | 0.24 |  | 0.27 |  | 0.38 |
| Intersection Summary |  |  |  |  |  |  |  |  |
| Cycle Length: 56 |  |  |  |  |  |  |  |  |
| Actuated Cycle Length: 50 |  |  |  |  |  |  |  |  |
| Natural Cycle: 55 |  |  |  |  |  |  |  |  |
| Control Type: Semi Act-Uncoord |  |  |  |  |  |  |  |  |

Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17




|  | 4 | $\rightarrow$ | $\checkmark$ | 7 |  | 4 | 4 | $\dagger$ | \% |  | $\dagger$ | $\checkmark$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | \$ |  |  | $\$$ |  |  | \& |  |  | * |  |
| Traffic Volume (veh/h) | 5 | 76 | 9 | 3 | 56 | 2 | 27 | 0 | 8 | 7 | 0 | 14 |
| Future Volume (Veh/h) | 5 | 76 | 9 | 3 | 56 | 2 | 27 | 0 | 8 | 7 | 0 | 14 |
| Sign Control |  | Free |  |  | Free |  |  | Stop |  |  | Stop |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 |
| Hourly flow rate (vph) | 6 | 87 | 10 | 3 | 64 | 2 | 31 | 0 | 9 | 8 | 0 | 16 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (m/s) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  | None |  |  | None |  |  |  |  |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| vC , conflicting volume | 66 |  |  | 97 |  |  | 191 | 176 | 92 | 184 | 180 | 65 |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu , unblocked vol | 66 |  |  | 97 |  |  | 191 | 176 | 92 | 184 | 180 | 65 |
| tC, single (s) | 4.1 |  |  | 4.1 |  |  | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  | 2.2 |  |  | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free \% | 100 |  |  | 100 |  |  | 96 | 100 | 99 | 99 | 100 | 98 |
| cM capacity (veh/h) | 1536 |  |  | 1496 |  |  | 753 | 713 | 965 | 766 | 710 | 999 |
| Direction, Lane \# | EB 1 | WB 1 | NB 1 | SB 1 |  |  |  |  |  |  |  |  |
| Volume Total | 103 | 69 | 40 | 24 |  |  |  |  |  |  |  |  |
| Volume Left | 6 | 3 | 31 | 8 |  |  |  |  |  |  |  |  |
| Volume Right | 10 | 2 | 9 | 16 |  |  |  |  |  |  |  |  |
| cSH | 1536 | 1496 | 792 | 907 |  |  |  |  |  |  |  |  |
| Volume to Capacity | 0.00 | 0.00 | 0.05 | 0.03 |  |  |  |  |  |  |  |  |
| Queue Length 95th (m) | 0.1 | 0.0 | 1.3 | 0.7 |  |  |  |  |  |  |  |  |
| Control Delay (s) | 0.5 | 0.3 | 9.8 | 9.1 |  |  |  |  |  |  |  |  |
| Lane LOS | A | A | A | A |  |  |  |  |  |  |  |  |
| Approach Delay (s) | 0.5 | 0.3 | 9.8 | 9.1 |  |  |  |  |  |  |  |  |
| Approach LOS |  |  | A | A |  |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 2.9 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 17.1\% |  | CU Level | Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |


|  | 4 | $\rightarrow$ | $\checkmark$ |  | 4 | $\dagger$ |  | $\dagger$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
| Lane Configurations |  | $\uparrow$ |  | * |  | \& |  | * |
| Traffic Volume (vph) | 36 | 38 | 28 | 63 | 33 | 489 | 52 | 388 |
| Future Volume (vph) | 36 | 38 | 28 | 63 | 33 | 489 | 52 | 388 |
| Lane Group Flow (vph) | 0 | 108 | 0 | 139 | 0 | 664 | 0 | 520 |
| Turn Type | Perm | NA | Perm | NA | Perm | NA | Perm | NA |
| Protected Phases |  | 4 |  | 8 |  | 2 |  | 6 |
| Permitted Phases | 4 |  | 8 |  | 2 |  | 6 |  |
| Detector Phase | 4 | 4 | 8 | 8 | 2 | 2 | 6 | 6 |
| Switch Phase |  |  |  |  |  |  |  |  |
| Minimum Initial (s) | 7.0 | 7.0 | 7.0 | 7.0 | 25.0 | 25.0 | 25.0 | 25.0 |
| Minimum Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 32.0 | 32.0 | 32.0 | 32.0 |
| Total Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| Total Split (\%) | 37.5\% | 37.5\% | 37.5\% | 37.5\% | 62.5\% | 62.5\% | 62.5\% | 62.5\% |
| Yellow Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Lost Time (s) |  | 6.0 |  | 6.0 |  | 7.0 |  | 7.0 |
| Lead/Lag |  |  |  |  |  |  |  |  |
| Lead-Lag Optimize? |  |  |  |  |  |  |  |  |
| Recall Mode | None | None | None | None | Max | Max | Max | Max |
| v/c Ratio |  | 0.38 |  | 0.44 |  | 0.59 |  | 0.51 |
| Control Delay |  | 18.5 |  | 19.2 |  | 10.8 |  | 9.6 |
| Queue Delay |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Delay |  | 18.5 |  | 19.2 |  | 10.8 |  | 9.6 |
| Queue Length 50th (m) |  | 6.9 |  | 9.1 |  | 36.3 |  | 26.6 |
| Queue Length 95th (m) |  | 17.3 |  | 21.1 |  | 78.0 |  | 58.5 |
| Internal Link Dist (m) |  | 439.9 |  | 535.3 |  | 514.2 |  | 133.5 |
| Turn Bay Length (m) |  |  |  |  |  |  |  |  |
| Base Capacity (vph) |  | 464 |  | 506 |  | 1120 |  | 1015 |
| Starvation Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Spillback Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Storage Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Reduced v/c Ratio |  | 0.23 |  | 0.27 |  | 0.59 |  | 0.51 |
| Intersection Summary |  |  |  |  |  |  |  |  |
| Cycle Length: 56 |  |  |  |  |  |  |  |  |
| Actuated Cycle Length: 50.5 |  |  |  |  |  |  |  |  |
| Natural Cycle: 60 |  |  |  |  |  |  |  |  |
| Control Type: Semi Act-Uncoord |  |  |  |  |  |  |  |  |

Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17



|  | 4 | $\rightarrow$ | $\checkmark$ | 7 |  | 4 | 4 | 9 | 7 |  | $\frac{1}{\dagger}$ | $\downarrow$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | \& |  |  | \& |  |  | * |  |  | \& |  |
| Traffic Volume (veh/h) | 17 | 98 | 30 | 9 | 91 | 8 | 18 | 0 | 5 | 5 | 0 | 9 |
| Future Volume (Veh/h) | 17 | 98 | 30 | 9 | 91 | 8 | 18 | 0 | 5 | 5 | 0 | 9 |
| Sign Control |  | Free |  |  | Free |  |  | Stop |  |  | Stop |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Hourly flow rate (vph) | 19 | 111 | 34 | 10 | 103 | 9 | 20 | 0 | 6 | 6 | 0 | 10 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (m/s) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  | None |  |  | None |  |  |  |  |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| vC , conflicting volume | 112 |  |  | 145 |  |  | 304 | 298 | 128 | 300 | 310 | 108 |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu , unblocked vol | 112 |  |  | 145 |  |  | 304 | 298 | 128 | 300 | 310 | 108 |
| tC , single (s) | 4.1 |  |  | 4.1 |  |  | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  | 2.2 |  |  | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free \% | 99 |  |  | 99 |  |  | 97 | 100 | 99 | 99 | 100 | 99 |
| cM capacity (veh/h) | 1478 |  |  | 1437 |  |  | 632 | 602 | 922 | 639 | 592 | 946 |
| Direction, Lane \# | EB 1 | WB 1 | NB 1 | SB 1 |  |  |  |  |  |  |  |  |
| Volume Total | 164 | 122 | 26 | 16 |  |  |  |  |  |  |  |  |
| Volume Left | 19 | 10 | 20 | 6 |  |  |  |  |  |  |  |  |
| Volume Right | 34 | 9 | 6 | 10 |  |  |  |  |  |  |  |  |
| cSH | 1478 | 1437 | 682 | 802 |  |  |  |  |  |  |  |  |
| Volume to Capacity | 0.01 | 0.01 | 0.04 | 0.02 |  |  |  |  |  |  |  |  |
| Queue Length 95th (m) | 0.3 | 0.2 | 1.0 | 0.5 |  |  |  |  |  |  |  |  |
| Control Delay (s) | 1.0 | 0.7 | 10.5 | 9.6 |  |  |  |  |  |  |  |  |
| Lane LOS | A | A | B | A |  |  |  |  |  |  |  |  |
| Approach Delay (s) | 1.0 | 0.7 | 10.5 | 9.6 |  |  |  |  |  |  |  |  |
| Approach LOS |  |  | B | A |  |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 2.0 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 21.5\% |  | CU Level | Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |



|  | 4 | $\rightarrow$ | 7 |  | 4 | $\dagger$ |  | $\frac{1}{\dagger}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
| Lane Configurations |  | $\uparrow$ |  | $\uparrow$ |  | * |  | * |
| Traffic Volume (vph) | 27 | 51 | 38 | 45 | 9 | 288 | 43 | 397 |
| Future Volume (vph) | 27 | 51 | 38 | 45 | 9 | 288 | 43 | 397 |
| Lane Group Flow (vph) | 0 | 103 | 0 | 143 | 0 | 362 | 0 | 530 |
| Turn Type | Perm | NA | Perm | NA | Perm | NA | Perm | NA |
| Protected Phases |  | 4 |  | 8 |  | 2 |  | 6 |
| Permitted Phases | 4 |  | 8 |  | 2 |  | 6 |  |
| Detector Phase | 4 | 4 | 8 | 8 | 2 | 2 | 6 | 6 |
| Switch Phase |  |  |  |  |  |  |  |  |
| Minimum Initial (s) | 7.0 | 7.0 | 7.0 | 7.0 | 25.0 | 25.0 | 25.0 | 25.0 |
| Minimum Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 32.0 | 32.0 | 32.0 | 32.0 |
| Total Split (s) | 21.0 | 21.0 | 21.0 | 21.0 | 35.0 | 35.0 | 35.0 | 35.0 |
| Total Split (\%) | 37.5\% | 37.5\% | 37.5\% | 37.5\% | 62.5\% | 62.5\% | 62.5\% | 62.5\% |
| Yellow Time (s) | 4.0 | 4.0 | 4.0 | 4.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Lost Time Adjust (s) |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Lost Time (s) |  | 6.0 |  | 6.0 |  | 7.0 |  | 7.0 |
| Lead/Lag |  |  |  |  |  |  |  |  |
| Lead-Lag Optimize? |  |  |  |  |  |  |  |  |
| Recall Mode | None | None | None | None | Max | Max | Max | Max |
| v/c Ratio |  | 0.33 |  | 0.46 |  | 0.34 |  | 0.48 |
| Control Delay |  | 18.9 |  | 18.3 |  | 7.4 |  | 8.9 |
| Queue Delay |  | 0.0 |  | 0.0 |  | 0.0 |  | 0.0 |
| Total Delay |  | 18.9 |  | 18.3 |  | 7.4 |  | 8.9 |
| Queue Length 50th (m) |  | 7.4 |  | 8.3 |  | 15.5 |  | 25.9 |
| Queue Length 95th (m) |  | 17.2 |  | 20.1 |  | 34.8 |  | 55.6 |
| Internal Link Dist (m) |  | 439.9 |  | 535.3 |  | 514.2 |  | 133.5 |
| Turn Bay Length (m) |  |  |  |  |  |  |  |  |
| Base Capacity (vph) |  | 503 |  | 488 |  | 1060 |  | 1114 |
| Starvation Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Spillback Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Storage Cap Reductn |  | 0 |  | 0 |  | 0 |  | 0 |
| Reduced v/c Ratio |  | 0.20 |  | 0.29 |  | 0.34 |  | 0.48 |
| Intersection Summary |  |  |  |  |  |  |  |  |
| Cycle Length: 56 |  |  |  |  |  |  |  |  |
| Actuated Cycle Length: 50.5 |  |  |  |  |  |  |  |  |
| Natural Cycle: 55 |  |  |  |  |  |  |  |  |
| Control Type: Semi Act-Uncoord |  |  |  |  |  |  |  |  |

Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17



|  | 4 | $\rightarrow$ | $\checkmark$ | 7 |  | 4 | 4 | $\dagger$ | \% |  | $\dagger$ | $\checkmark$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | \$ |  |  | $\$$ |  |  | \& |  |  | * |  |
| Traffic Volume (veh/h) | 5 | 93 | 9 | 3 | 69 | 2 | 27 | 0 | 8 | 7 | 0 | 14 |
| Future Volume (Veh/h) | 5 | 93 | 9 | 3 | 69 | 2 | 27 | 0 | 8 | 7 | 0 | 14 |
| Sign Control |  | Free |  |  | Free |  |  | Stop |  |  | Stop |  |
| Grade |  | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |
| Peak Hour Factor | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 |
| Hourly flow rate (vph) | 6 | 107 | 10 | 3 | 79 | 2 | 31 | 0 | 9 | 8 | 0 | 16 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (m/s) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  | None |  |  | None |  |  |  |  |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| vC , conflicting volume | 81 |  |  | 117 |  |  | 226 | 211 | 112 | 219 | 215 | 80 |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu , unblocked vol | 81 |  |  | 117 |  |  | 226 | 211 | 112 | 219 | 215 | 80 |
| tC, single (s) | 4.1 |  |  | 4.1 |  |  | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  | 2.2 |  |  | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free \% | 100 |  |  | 100 |  |  | 96 | 100 | 99 | 99 | 100 | 98 |
| cM capacity (veh/h) | 1517 |  |  | 1471 |  |  | 714 | 682 | 941 | 727 | 679 | 980 |
| Direction, Lane \# | EB 1 | WB 1 | NB 1 | SB 1 |  |  |  |  |  |  |  |  |
| Volume Total | 123 | 84 | 40 | 24 |  |  |  |  |  |  |  |  |
| Volume Left | 6 | 3 | 31 | 8 |  |  |  |  |  |  |  |  |
| Volume Right | 10 | 2 | 9 | 16 |  |  |  |  |  |  |  |  |
| cSH | 1517 | 1471 | 755 | 878 |  |  |  |  |  |  |  |  |
| Volume to Capacity | 0.00 | 0.00 | 0.05 | 0.03 |  |  |  |  |  |  |  |  |
| Queue Length 95th (m) | 0.1 | 0.0 | 1.3 | 0.7 |  |  |  |  |  |  |  |  |
| Control Delay (s) | 0.4 | 0.3 | 10.0 | 9.2 |  |  |  |  |  |  |  |  |
| Lane LOS | A | A | B | A |  |  |  |  |  |  |  |  |
| Approach Delay (s) | 0.4 | 0.3 | 10.0 | 9.2 |  |  |  |  |  |  |  |  |
| Approach LOS |  |  | B | A |  |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 2.6 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 18.1\% |  | CU Level | Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |




Cycle Length: 56
Actuated Cycle Length: 51.4
Natural Cycle: 60
Control Type: Semi Act-Uncoord
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
Splits and Phases: 6: Airport Rd (County Rd 18) \& 10th Sideroad/County Rd 17



|  | 4 | $\rightarrow$ | $\cdots$ | 7 |  | 4 | 4 | $\dagger$ | $p$ |  | $\dagger$ | $\pm$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations |  | \& |  |  | $\uparrow$ |  |  | \& |  |  | \& |  |
| Traffic Volume (veh/h) | 17 | 121 | 30 | 9 | 112 | 8 | 18 | 0 | 5 | 5 | 0 | 9 |
| Future Volume (Veh/h) | 17 | 121 | 30 | 9 | 112 | 8 | 18 | 0 | 5 | 5 | 0 | 9 |
| Sign Control |  | Free |  | Free |  |  | Stop |  |  | Stop |  |  |
| Grade | 0\% |  |  | 0\% |  |  | 0\% |  |  | 0\% |  |  |
| Peak Hour Factor | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Hourly flow rate (vph) | 19 | 138 | 34 | 10 | 127 | 9 | 20 | 0 | 6 | 6 | 0 | 10 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed ( $\mathrm{m} / \mathrm{s}$ ) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  | None |  |  | None |  |  |  |  |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| vC , conflicting volume | 136 |  |  | 172 |  |  | 354 | 349 | 155 | 350 | 362 | 132 |
| $\mathrm{vC1}$, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| $\mathrm{vC2}$, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu , unblocked vol | 136 |  |  | 172 |  |  | 354 | 349 | 155 | 350 | 362 | 132 |
| tC , single (s) | 4.1 |  |  | 4.1 |  |  | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  | 2.2 |  |  | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free \% | 99 |  |  | 99 |  |  | 97 | 100 | 99 | 99 | 100 | 99 |
| cM capacity (veh/h) | 1448 |  |  | 1405 |  |  | 585 | 563 | 891 | 591 | 554 | 918 |
| Direction, Lane \# | EB 1 | WB 1 | NB 1 | SB 1 |  |  |  |  |  |  |  |  |
| Volume Total | 191 | 146 | 26 | 16 |  |  |  |  |  |  |  |  |
| Volume Left | 19 | 10 | 20 | 6 |  |  |  |  |  |  |  |  |
| Volume Right | 34 | 9 | 6 | 10 |  |  |  |  |  |  |  |  |
| cSH | 1448 | 1405 | 635 | 760 |  |  |  |  |  |  |  |  |
| Volume to Capacity | 0.01 | 0.01 | 0.04 | 0.02 |  |  |  |  |  |  |  |  |
| Queue Length 95th (m) | 0.3 | 0.2 | 1.0 | 0.5 |  |  |  |  |  |  |  |  |
| Control Delay (s) | 0.8 | 0.6 | 10.9 | 9.8 |  |  |  |  |  |  |  |  |
| Lane LOS | A | A | B | A |  |  |  |  |  |  |  |  |
| Approach Delay (s) | 0.8 | 0.6 | 10.9 | 9.8 |  |  |  |  |  |  |  |  |
| Approach LOS |  |  | B | A |  |  |  |  |  |  |  |  |
| Intersection Summary |  |  |  |  |  |  |  |  |  |  |  |  |
| Average Delay |  |  | 1.8 |  |  |  |  |  |  |  |  |  |
| Intersection Capacity Utilization |  |  | 23.2\% |  | CU Level | Service |  |  | A |  |  |  |
| Analysis Period (min) |  |  | 15 |  |  |  |  |  |  |  |  |  |



## Appendix H Sight Distance Drawings



