



9127 & 9515 Montrose Rose City of Niagara Falls Transportation Impact Assessment

Paradigm Transportation Solutions Limited

July 2022
210701



Project Number
210701

9127 & 9515 Montrose Road, City of Niagara Falls, Transportation Impact Assessment

July 2022

Client

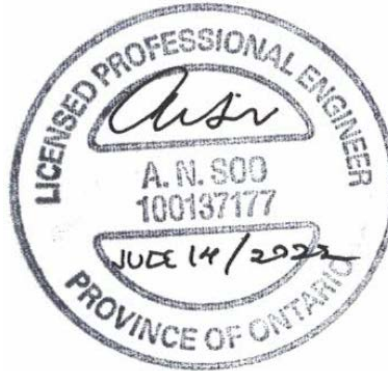
E.S. Fox Limited
Mark West
9127 Montrose Road
PO Box 1010
Niagara Falls, ON L2E 7J9

Client Contact

Mike Yousif

Consultant Project Team

Stew Elkins, BES
Scott Catton, C.E.T.
Stefan Hajgato, P.Eng.
Adrian Soo, P.Eng.



Adrian Soo, P.Eng.

Disclaimer

This document has been prepared for the titled project or named part thereof (the "project") and except for approval and commenting municipalities and agencies in their review and approval of this project, should not be relied upon or used for any other project without an independent check being carried out as to its suitability and prior written authorization of Paradigm Transportation Solutions Limited being obtained. Paradigm Transportation Solutions Limited accepts no responsibility or liability for the consequence of this document being used for a purpose other than the project for which it was commissioned. Any person using or relying on the document for such other purpose agrees and will by such use or reliance be taken to confirm their agreement to indemnify Paradigm Transportation Solutions Limited for all loss or damage resulting there from. Paradigm Transportation Solutions Limited accepts no responsibility or liability for this document to any party other than the person by whom it was commissioned and the approval and commenting municipalities and agencies for the project.

To the extent that this report is based on information supplied by other parties, Paradigm Transportation Solutions Limited accepts no liability for any loss or damage suffered by the client, whether through contract or tort, stemming from any conclusions based on data supplied by parties other than Paradigm Transportation Solutions Limited and used by Paradigm Transportation Solutions Limited in preparing this report.

Copyright Notice

This report is protected by Canadian and International copyright laws. Reproduction and/or distribution of the report without the written permission of Paradigm Transportation Solutions Limited is prohibited.

© 2021 Paradigm Transportation Solutions Limited. All rights reserved

Paradigm Transportation Solutions Limited

5A-150 Pinebush Road
Cambridge ON N1R 8J8
p: 519.896.3163
905.381.2229
416.479.9684

www.ptsl.com

Executive Summary

Content

E.S. Fox Limited retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Assessment for the proposed development at 9127 & 9515 Montrose Road in the City of Niagara Falls.

This study determines the impacts of the development traffic on the surrounding road network and identifies the improvements recommended to accommodate the site generated traffic.

Development Concept

The development proposal consists of three development blocks (Block A, B and C) within 9127 Montrose Road and one development block (Block D) at 9515 Montrose Road.

The land uses include office/light industrial employment and warehousing land uses. Build-out is estimated to occur by Year 2024.

Conclusion

The main findings and conclusions of this study are as follows:

- ▶ **Base Year Traffic Conditions:** A critical movement is noted at the Montrose Road intersection with Biggar Road/Lyons Creek Road. The southbound approach is forecast to operate at LOS F ($v/c > 1.00$) during the PM peak hour.
- ▶ **Site Description:** The site concept plan includes four blocks containing office/light industrial employment and warehousing land uses. Build-out is estimated to occur by Year 2024.
- ▶ **Site Driveways:** The proposed driveways to Block A, B and C all provide the minimum 30 metres of spacing between the driveway and the adjacent at-grade rail crossing. The proposed driveway locations exceed the minimum spacing requirement outlined in the Transport Canada Grade Crossing Standards.

The site plans as currently analyzed are highly conceptual and are subject to finalization. The site driveway geometrics will be designed to meet local standards or site-specific needs. The site driveway geometrics for each driveway will be reviewed at Site Plan Approval stage.

- ▶ **Sight Distance:** The sight distance at the proposed Driveway 'A' and Driveway 'B' locations do not currently meet



the minimum recommended sight distances recommended in the TAC Guide. The proposed driveway locations are expected to meet the minimum recommended sight distances once Montrose Road is reconstructed.

- ▶ **Site Trip Generation:** The subject site is forecast to generate approximately 301 and 307 new vehicle trips during the AM and PM peak hours, respectively.
- ▶ **Background Traffic Conditions (All Horizons):** Critical movements are noted at the Montrose Road intersections with Grassy Brook Road and Biggar Road/Lyons Creek Road. No critical movements are noted at the Private Driveway intersection with Montrose Road after implementation of the Montrose EA improvements.
- ▶ **Opening Date Total Traffic Conditions:** The capacity issues identified under background conditions are forecast to continue to occur. Additional critical movements are noted on Montrose Road at the Private Driveway/Driveway 'A', Grassy Brook Road, and Driveway 'B' intersections with the inclusion of site-generated traffic volumes.
- ▶ **Five-Year Total Traffic Conditions:** The capacity issues identified under background conditions are forecast to continue to occur. Additional critical movements are noted on Montrose Road at the Private Driveway/Driveway 'A', Grassy Brook Road, Biggar Road/Lyons Creek Road, and Driveway 'B' intersections with the inclusion of site-generated traffic volumes.
- ▶ **Ten-Year Total Traffic Conditions:** The capacity issues identified under background conditions are forecast to continue to occur. Additional critical movements are noted on Montrose Road at the Private Driveway/Driveway 'A', Grassy Brook Road, and Driveway 'B' intersections with the inclusion of site-generated traffic volumes.
- ▶ **Remedial Measures – Left-Turn Lanes:** A southbound left-turn lane is warranted on Montrose Road at Driveway 'A' with 25 metres of storage under Year 2024 total conditions. The Montrose EA includes a TWLTL at the proposed driveway locations and a sufficient left-turn storage length to accommodate the forecast northbound left-turn queues on Montrose Road at Grassy Brook Road.
- ▶ **Remedial Measures – Traffic Signals:** Traffic signals are not warranted at the currently unsignalized intersections on Montrose Road. However, implementing traffic signals at the Montrose Road and Grassy Brook Road intersection is forecast



to significantly improve the eastbound approach operations under background and total traffic conditions.

Recommendations

Based on the findings of this study, it is recommended that:

- ▶ The development of Block 'A' occurs following the implementation of the Montrose EA improvements.
- ▶ Driveway 'B' is not to be constructed until the Montrose EA improvements are implemented.
- ▶ The road authorities consider implementing an unwarranted traffic signal at the Montrose Road intersection with Grassy Brook Road to improve future operations.
- ▶ The eastbound left-turn lane on Grassy Brook Road at Montrose Road be designed to include 160 metres of storage. Should a traffic control signal be implemented, the storage lane length for the eastbound left-turn lane can be reduced to 65 metres and the southbound right-turn lane should be increased to 30 metres.
- ▶ The road authorities monitor traffic volumes and intersection operations at the Montrose Road intersection with Biggar Road/Lyons Creek Road and adjusts signal timing splits to best serve all traffic movements.



Contents

1	Introduction	1
2	Existing Conditions	3
2.1	Road Network	3
2.2	Cycling Network	5
2.3	Transit Service.....	5
2.4	Traffic Volumes	8
2.5	Traffic Operations	11
3	Development Concept	14
3.1	Development Description	14
3.2	Sight Distance Review	18
3.2.1	Block A Sight Distance	19
3.2.2	Block B Sight Distance	19
3.2.3	Block C Sight Distance	20
3.2.4	Block D Sight Distance	20
3.3	Trip Generation Estimate.....	21
3.4	Trip Distribution and Assignment.....	21
4	Future Traffic Conditions	25
4.1	Forecast Traffic	27
4.2	Opening Date Horizon – Operations	41
4.2.1	Background Traffic	41
4.2.2	Total Traffic	43
4.3	Five-Year Horizon – Operations	47
4.3.1	Background Traffic	47
4.3.2	Total Traffic	49
4.4	Ten-Year Horizon – Operations	53
4.4.1	Background Traffic	53
4.4.2	Total Traffic	55
5	Remedial Measures.....	59
5.1	Left-Turn Lane Warrants.....	59
5.2	Grassy Brook at Montrose Road Left-Turn Lane Storage ..	59
5.3	Traffic Signal Warrants	60
5.4	Sensitivity Analysis – Traffic Signal	60
6	Conclusions & Recommendations	62
6.1	Conclusions.....	62
6.2	Recommendations	63



Appendices

Appendix A	Pre-Study Consultation
Appendix B	Existing Data
Appendix C	Base Year Traffic Operations
Appendix D	TTS Survey Data
Appendix E	Site-Generated Traffic Forecast
Appendix F	Background Traffic Forecast
Appendix G	Opening Date Background Traffic Operations
Appendix H	Opening Date Total Traffic Operations
Appendix I	Five-Year Background Traffic Operations
Appendix J	Five-Year Total Traffic Operations
Appendix K	Ten-Year Background Traffic Operations
Appendix L	Ten-Year Total Traffic Operations
Appendix M	Left-Turn Lane Nomographs
Appendix N	Traffic Signal Warrants

Figures

Figure 1.1:	Site Location	2
Figure 2.1:	Existing Lane Configuration & Traffic Control	4
Figure 2.2:	Existing and Future Cycling Network	7
Figure 2.3:	Base Year Traffic – AM Peak Hour	9
Figure 2.4:	Base Year Traffic – PM Peak Hour	10
Figure 3.1:	Site Layout	16
Figure 3.2:	Conceptual Site Plans	17
Figure 3.3:	Forecast Site Traffic (All Blocks) – AM Peak Hour ...	23
Figure 3.4:	Forecast Site Traffic (All Blocks) – PM Peak Hour....	24
Figure 4.1:	Future Lane Configuration.....	26
Figure 4.2:	Opening Date Background Traffic – AM Peak Hour .	29
Figure 4.3:	Opening Date Background Traffic – PM Peak Hour..	30
Figure 4.4:	Five-Year Background Traffic – AM Peak Hour.....	31
Figure 4.5:	Five-Year Background Traffic – PM Peak Hour.....	32
Figure 4.6:	Ten-Year Background Traffic – AM Peak Hour	33
Figure 4.7:	Ten-Year Background Traffic – PM Peak Hour.....	34
Figure 4.8:	Opening Date Total Traffic – AM Peak Hour.....	35
Figure 4.9:	Opening Date Total Traffic – PM Peak Hour	36
Figure 4.10:	Five-Year Total Traffic – AM Peak Hour.....	37
Figure 4.11:	Five-Year Total Traffic – PM Peak Hour	38
Figure 4.12:	Ten-Year Total Traffic – AM Peak Hour.....	39
Figure 4.13:	Ten-Year Total Traffic – PM Peak Hour.....	40



Tables

Table 2.1:	Existing Transit Routes.....	5
Table 2.2:	Base Year Traffic Operations	13
Table 3.1:	TAC Guide Sight Distances	18
Table 3.2:	Sight Distance Measurements.....	19
Table 3.3:	Trip Generation Estimate	21
Table 3.4:	Estimated Trip Distribution.....	22
Table 3.5:	Estimated QEW Trip Assignment.....	22
Table 4.1:	Opening Date Background Traffic Operations.....	42
Table 4.2:	Opening Date Total Traffic Operations – AM Peak Hour	45
Table 4.3:	Opening Date Total Traffic Operations – PM Peak Hour	46
Table 4.4:	Five-Year Background Traffic Operations	48
Table 4.5:	Five-Year Total Traffic Operations – AM Peak Hour ..	51
Table 4.6:	Five-Year Total Traffic Operations – PM Peak Hour ..	52
Table 4.7:	Ten-Year Background Traffic Operations.....	54
Table 4.8:	Ten-Year Total Traffic Operations – AM Peak Hour ..	57
Table 4.9:	Ten-Year Total Traffic Operations – PM Peak Hour ..	58
Table 5.1:	Ten-year Traffic Operations – Sensitivity ANalysis ..	61



1 Introduction

E.S. Fox Limited retained Paradigm Transportation Solutions Limited (Paradigm) to conduct this Transportation Impact Assessment (TIA) for the proposed development at 9127 & 9515 Montrose Road in the City of Niagara Falls. **Figure 1.1** illustrates the site location.

The scope of the study includes:

- ▶ Determine and assess the current study area traffic conditions;
- ▶ Forecast the additional traffic generated by the proposed development;
- ▶ Analyze the impacts of the additional traffic on the study area road network; and
- ▶ Recommend necessary remedial measures required to mitigate the transportation impacts.

Appendix A contains the pre-study consultation correspondence with the City of Niagara Falls, Niagara Region, and the Ontario Ministry of Transportation (MTO). The study generally follows the City of Niagara Falls¹ and the Niagara Region Traffic Impact Study Guidelines².

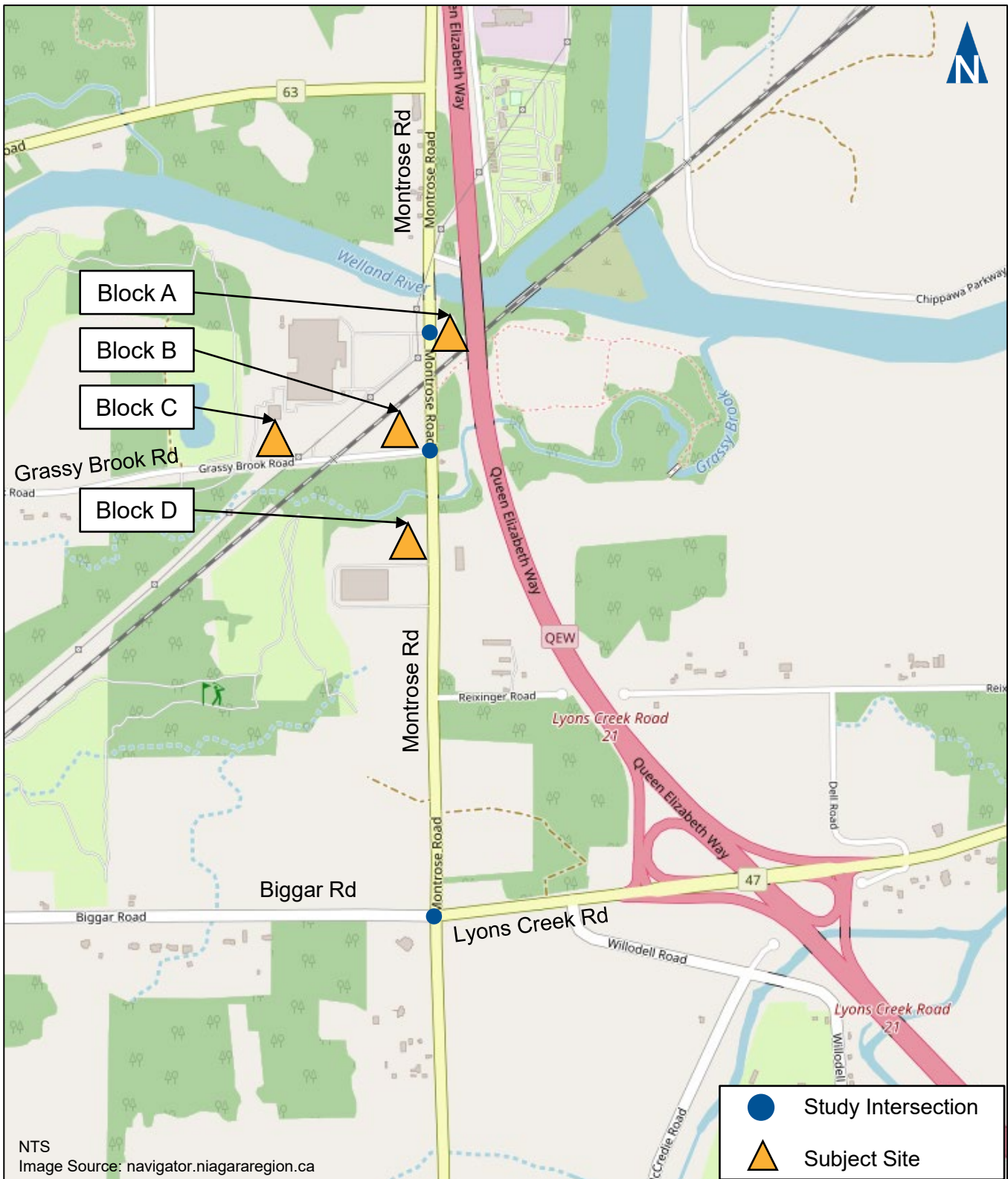
The study area intersections assessed include:

- ▶ Montrose Road at Grassy Brook Road (unsignalized);
- ▶ Montrose Road at Biggar Road/Lyons Creek Road (signalized);
- ▶ Montrose Road at Private Driveway (#9127) (unsignalized); and
- ▶ The proposed site driveways to Montrose Road and Grassy Brook Road.

¹ *Guidelines for the Preparation of Transportation Impact Studies and Site Plan Review*, City of Niagara Falls, November 2011.

² *Guidelines for Transportation Impact Studies*, Niagara Region, May 2012





Site Location

Figure 1.1

9127 & 9515 Montrose Rd
210701

2 Existing Conditions

2.1 Road Network

The characteristics of the roadways within the study area are described generally as follows³:

- ▶ **Montrose Road** (Regional Road 98) is a north/south Regional Road⁴ with a posted speed limit of 70 km/h. The intersection with Biggar Road/Lyons Creek Road is signalized. A railroad crosses Montrose Road approximately 185 metres north of the Grassy Brook Road intersection.
- ▶ **Lyons Creek Road** (Regional Road 47) is an east/west Regional Road with a posted speed limit of 80 km/h. West of Montrose Road, the roadway continues as Biggar Road.
- ▶ **Biggar Road** is an east/west local road with a posted speed limit of 80 km/h.
- ▶ **Grassy Brook Road** is an east/west local road with a posted speed limit of 40 km/h. The road ends as a cul-de-sac approximately one kilometre west of Montrose Road. A railroad crosses Grassy Brook Road approximately 245 metres west of the Montrose Road intersection.

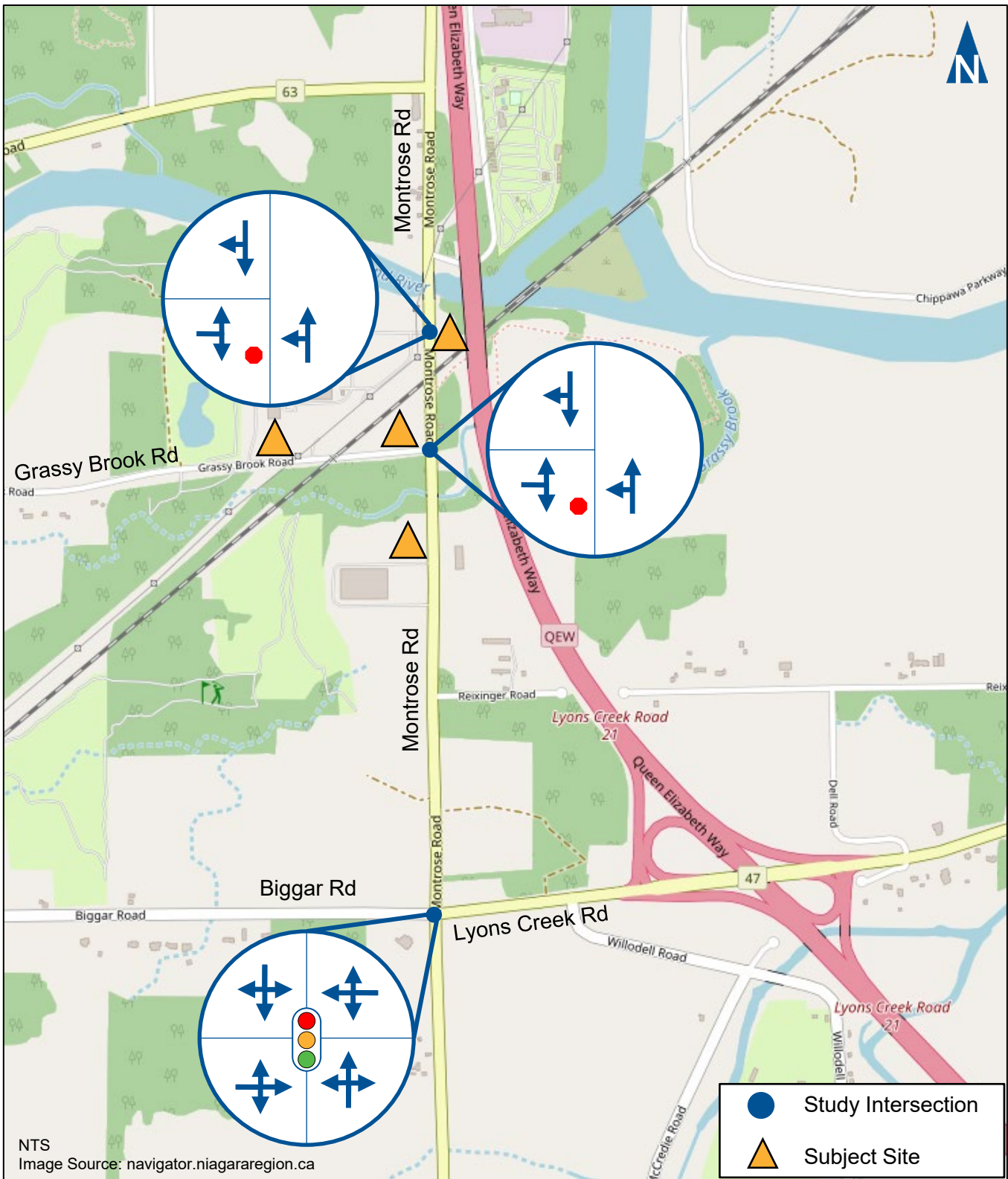
All study area roadways have two-lane rural cross-sections. No sidewalks are present within the study area.

Figure 2.1 illustrates the existing lane configuration and traffic control at the study area intersections.

³ *Classification of Transportation Facilities*, City of Burlington, May 2010.

⁴ <https://www.niagararegion.ca/exploring/pdf/regional-niagara.pdf>, Niagara Region, Printed 2020-03-17





Existing Lane Configuration & Traffic Control

9127 & 9515 Montrose Rd
210701

Figure 2.1

2.2 Cycling Network

Cycling infrastructure typically consists of on-street and off-street facilities. On-street facilities comprise of cycling lanes, signed cycling routes, and paved shoulders. Off-street facilities are in the form of multi-use or informal trails.

Figure 2.2 illustrates the existing and future cycling network⁵. The Port Robinson to Chippawa Route is a signed route that runs from Oakwood Drive, which is on the north side of the Welland River, to Grassy Brook Road. An infill link is provided on Montrose Road between Grassy Brook Road and Biggar Road/Lyons Creek Road; however, the facility type is not specified.

The Montrose and Lyons Creek Road/Biggar Road Environmental Assessment (Montrose EA)⁶ illustrates a multi-use path on the west side of Montrose Road from north of Biggar Road/Lyons Creek Road and on the north side of Biggar Road/Lyons Creek Road near the Montrose Road intersection.

2.3 Transit Service

Niagara Region Transit operates three bus routes near the subject lands. The three routes are available at the Concentrix bus stop which is located approximately 340 metres south of Grassy Brook Road on Montrose Road.

Table 2.1 summarizes service headways and schedules of the existing routes.

TABLE 2.1: EXISTING TRANSIT ROUTES

Route	Description
Route 22 (Fort Erie to Niagara Falls)	Provides service between Niagara Square and Leisureplex Fort Erie. Headways are in the order 60-180 minutes depending on the time of day.
Route 60/65 (Niagara Falls to/from Welland)	Offers service between Niagara Falls and Niagara College (Welland Campus). Headways are in the order of 60 minutes.

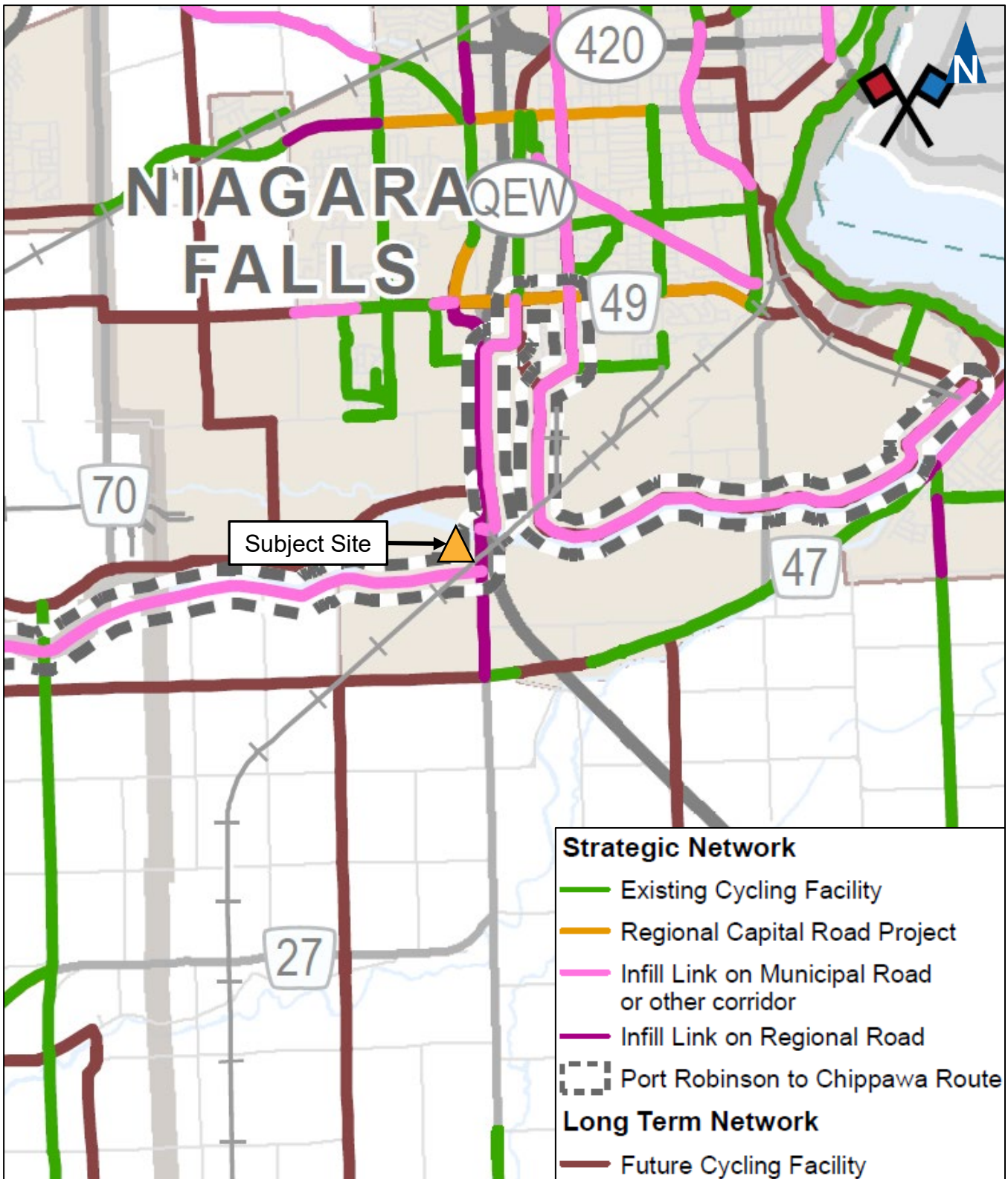
⁵ Appendix C - Strategic Cycling Network – Strategic Cycling Network Development Technical Paper, Niagara Region, June 2017.

⁶ Appendix G - Montrose Road and Lyons Creek Road/Biggar Road Municipal Class Environmental Assessment, Parsons, November 2021.



These transit routes operate from Monday to Saturday, except statutory holidays.



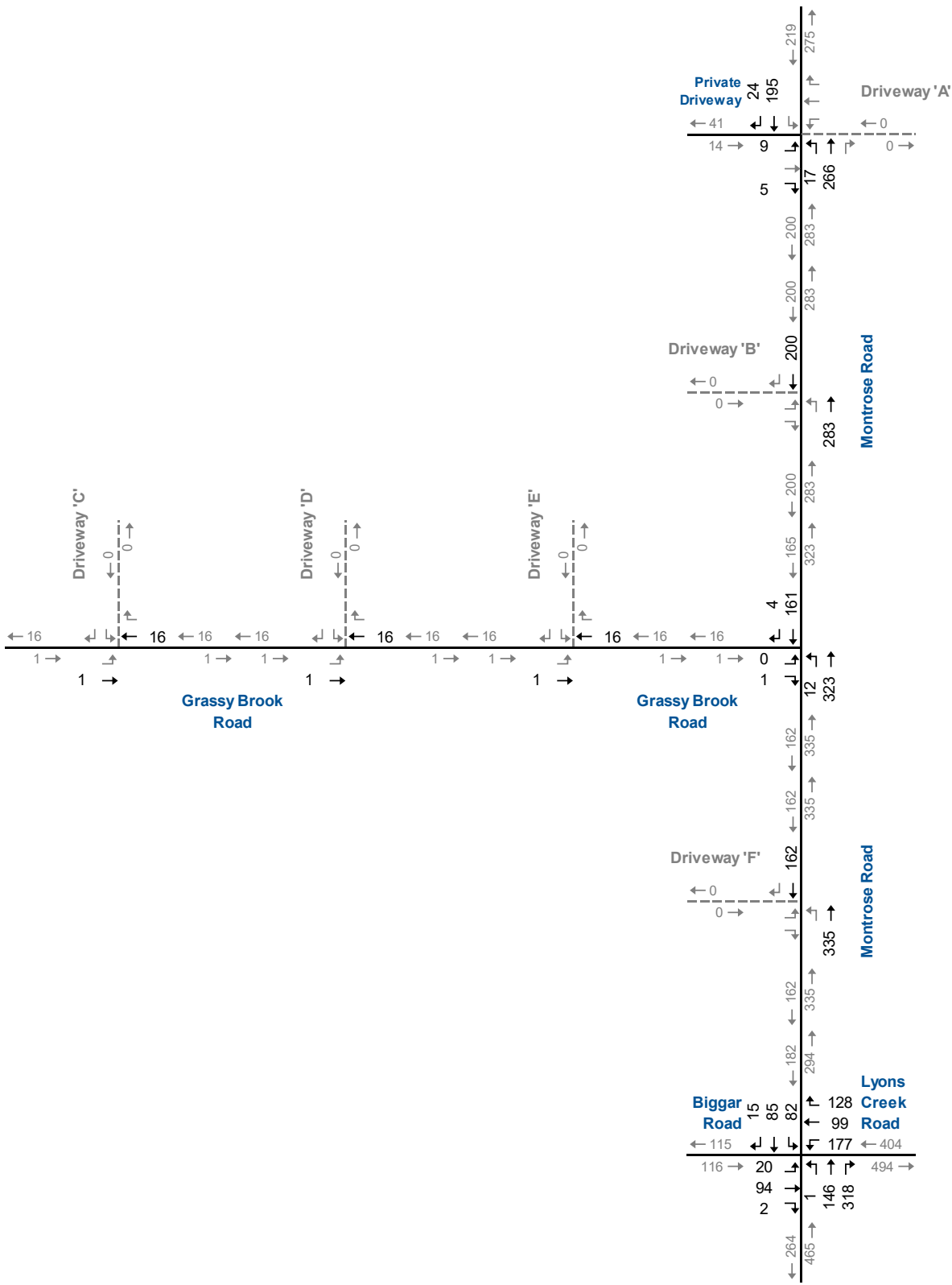


2.4 Traffic Volumes

Existing traffic volumes were collected at the study area intersections by Pyramid Traffic Inc. on Wednesday 01 June 2022.

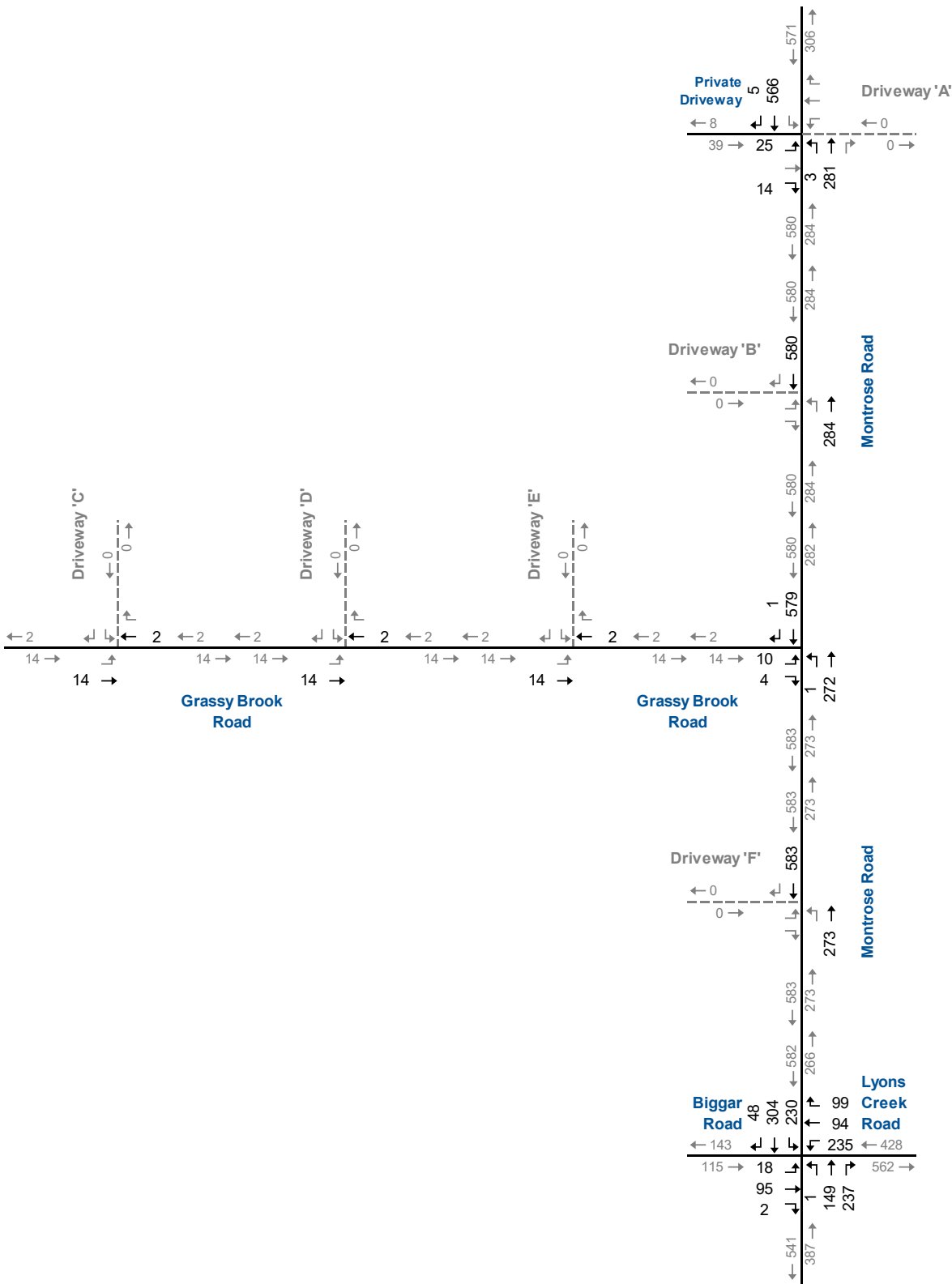
Figure 2.3 and **Figure 2.4** illustrate the base year traffic volumes for the AM and PM peak hours, respectively. **Appendix B** contains the existing count data and signal timings.





Base Year Traffic AM Peak Hour

Figure 2.3



Base Year Traffic PM Peak Hour

Figure 2.4

2.5 Traffic Operations

Intersection level of service (LOS) is a recognized method of quantifying the efficiency of traffic flow at intersections. It is based on the delay experienced by individual vehicles executing the various movements. The delay is related to the number of vehicles wanting to make a movement, compared to the estimated capacity for that movement. The capacity is based on several criteria related to the opposing traffic flows. The highest possible rating is LOS A, under which the average total delay is equal or less than 10.0 seconds per vehicle. When the average delay exceeds 80 seconds at signalized intersections (50 seconds at unsignalized), the movement is considered to have a LOS F and remedial measures are usually implemented if they are feasible.

The operations of the intersections in the study area were evaluated under base year conditions using Synchro 10 and HCM 2000 procedures. The intersection operational analysis considered three separate measures of performance:

- ▶ The LOS for each turning movement;
- ▶ The volume to capacity ratio (v/c) for each movement; and
- ▶ The 95th percentile queue lengths using Synchro 10.

The intersections on Montrose Road were evaluated using the Region's guidelines and the intersections on Grassy Brook Road were evaluated using the City's guidelines.

Under the Region's TIS guidelines, the operational analysis must include identification of signalized and unsignalized intersections where:

- ▶ v/c for through or shared through/turning movements that exceed 0.85 at a signalized intersection;
- ▶ v/c for exclusive turning movements that exceed 0.90 at a signalized intersection;
- ▶ The 95th percentile queues for an individual movement are projected to exceed available turning lane storage; and
- ▶ LOS, based on average delay per vehicle on individual movements, operate at LOS D or worse for unsignalized intersections.

Under the City's TIS guidelines, the operational analysis must include identification of signalized and unsignalized intersections where:



- ▶ v/c for exclusive turning movements that exceed 0.95 at a signalized intersection; and
- ▶ LOS, based on average delay per vehicle on individual movements, operate at LOS E or worse for unsignalized intersections.

Table 2.2 summarizes the level of service conditions. The operations of the study area intersections were evaluated with the base year turning movement volumes and signal timings. The following critical movements are noted:

- ▶ Montrose Road and Biggar Road/Lyons Creek Road:
 - Southbound approach: Estimated to operate at LOS F (v/c > 1.00) during the PM peak hour.

Appendix C contains the detailed Synchro 10 reports.



TABLE 2.2: BASE YEAR TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Montrose Road & Private Driveway	TWSC	LOS Delay V/C 95th	B 12 0.03 1	> > > >	B 12	<					<	A 1 0.01 0	A 1	<	A 0 0.14 0	> > > >	A 0	A 1	
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th	A 9 0.00 0	> > > >	A 9	<					<	A 0 0.01 0	A 0	<	A 0 0.11 0	> > > >	A 0	A 0	
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th	< < < <	B 12 0.18 26	> > > >	B 12	<	C 23 0.73 114	> > > >	C 23	<	C 20 0.66 81	C 20	<	B 17 0.45 39	> > > >	B 17	C 20 0.69	
PM Peak Hour	Montrose Road & Private Driveway	TWSC	LOS Delay V/C 95th	C 17 0.12 3	> > > >	C 17	<					<	A 0 0.00 0	A 0	<	A 0 0.36 0	> > > >	A 0	A 1	
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th	C 16 0.04 1	> > > >	C 16	<					<	A 0 0.00 0	A 0	<	A 0 0.37 0	> > > >	A 0	A 0	
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th	< < < <	B 18 0.19 25	> > > >	B 18	<	D 43 0.88 130	> > > >	D 43	<	B 17 0.48 63	B 17	<	F 139 1.22 214	> > > >	F 139	E 71 1.06	

TWSC - Two-Way Stop Control
 TCS - Traffic Control Signal
 MOE - Measure of Effectiveness
 LOS - Level of Service

V/C - Volume to Capacity Ratio
 95th - 95th Percentile Queue Length
 Storage - Existing Storage (m)
 Avail. - Available Storage (m)
 > - Shared Right-Turn Lane
 < - Shared Left-Turn Lane



3 Development Concept

3.1 Development Description

The development proposal consists of three development blocks (Block A, B and C) within 9127 Montrose Road and one development block (Block D) at 9515 Montrose Road. **Figure 3.1** illustrates the position of each block relative to the Montrose Road intersection with Grassy Brook Road. **Figure 3.2** illustrates the conceptual layout for each block.

The development concept for each block is described as follows:

- ▶ **Block A:** Approximately 18,250 sq.ft. (1,695 m²) of office/light industrial employment in a single building. Vehicle access is proposed by a private driveway to Montrose Road located directly opposite the driveway serving #9127 Montrose Road. Driveway 'A' is located approximately 200 metres south of Oakwood Drive;
- ▶ **Block B:** Approximately 72,450 sq.ft. (6,730 m²) of office/light industrial employment in three buildings. Vehicle access is proposed by one private driveway to Montrose Road and one driveway to Grassy Brook Road. Driveway 'B' is proposed to be located approximately 75 metres south of the existing railroad and Driveway 'E' is proposed to be located approximately 105 metres west of Montrose Road. The driveway parallel to the rail line as illustrated on the conceptual plan will be closed.
- ▶ **Block C:** Approximately 25,000 sq.ft. (2,323 m²) of warehousing in a single building. Vehicle access is proposed by two private driveways to Grassy Brook Road. Driveway 'C' and Driveway 'D' are proposed to be located approximately 120 metres and 180 metres west of the existing railroad, respectively; and
- ▶ **Block D:** Approximately 60,550 sq.ft. (5,625 m²) of office/light industrial employment in a single building. Vehicle access is proposed by a private driveway (Driveway 'F') located approximately 210 metres south of Grassy Brook Road. The site driveway to Montrose Road may be removed if/when a cross access agreement with the property to the south, 9515 Montrose Road, is achieved.

The site plans are highly conceptual at this time. The site driveway geometrics will be designed to meet local standards or site-specific needs. The site driveway geometrics for each driveway will be reviewed at the Site Plan Approval stage.

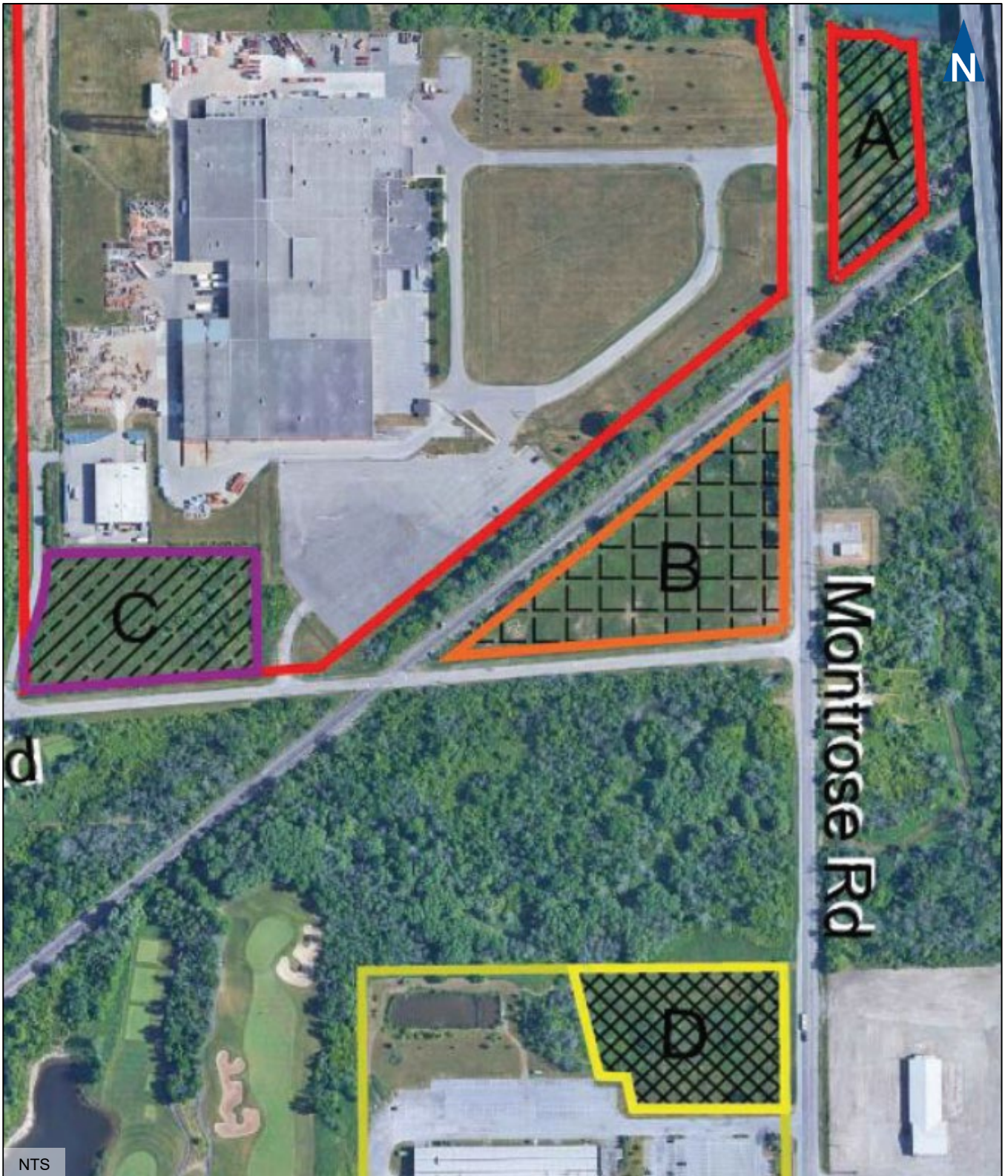


The proposed driveway locations exceed the minimum required distance of 30 metres from the nearest railroad as noted in the Transport Canada Grade Crossing Standards⁷.

As the site plan evolves, the site statistics are subject to change. Minor changes to the site plan may not materially impact the conclusions within this report. Build-out of the four blocks is estimated to occur by Year 2024.

⁷ Section 11.1 - Grade Crossing – Handbook, Transport Canada, 2019-10-30.





Site Layout

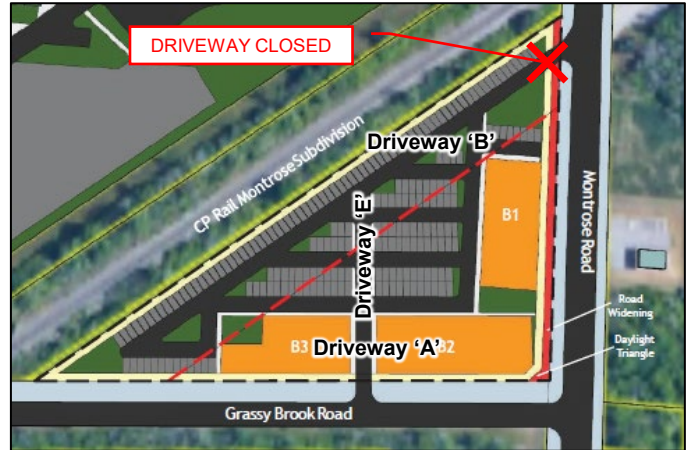
9127 & 9515 Montrose Rd
210701

Figure 3.1

Block A



Block B



Block C



Block D



3.2 Sight Distance Review

The available sight distance at the proposed site driveways were assessed based on the methodology outlined in the Transportation Association of Canada (TAC) *Geometric Design Guide for Canadian Roads*⁸ (“TAC Guide”). The following parameters have been referenced in the assessment:

- ▶ Object Height (vehicle tail or brake light) – 0.60 metres;
- ▶ Driver Eye Height – 1.08 metres; and
- ▶ Top of Car – 1.30 metres.

The sight distance requirements for the proposed driveway locations on Montrose Road were determined based on a design speed of 80 km/h, which is 10 km/h above the posted maximum speed limit of 70 km/h. The sight distance requirements for the proposed driveway locations on Grassy Brook Road were determined based on a design speed of 50 km/h, which is 10 km/h above the posted maximum speed limit of 40 km/h. A design speed was not identified for the study area roads in the Montrose EA. **Table 3.1** summarizes the sight distance measurements set out in the TAC Guide applicable to this analysis.

TABLE 3.1: TAC GUIDE SIGHT DISTANCES

Sight Distance	Design Speed	
	50 km/h	80 km/h
Minimum Stopping Sight Distance ⁹ <i>Driver approaching the site driveway.</i>	65 m	130 m
Intersection Sight Distance (Left-Turn from Stop) ¹⁰ <i>Driver looks to the right before turning left to exit the site.</i>	105 m	170 m
Intersection Sight Distance (Right-Turn from Stop) ¹¹ <i>Driver looks to the left before turning right to exit the site.</i>	95 m	145 m

⁸ Transportation Association of Canada. *Geometric Design Guide for Canadian Roads*. June 2017.

⁹ Ibid. *Table 2.5.2: Stopping Sight Distance on Level Roadways for Automobiles*.

¹⁰ Ibid. *Table 9.9.4: Design Intersection Sight Distance – Case B1, Left Turn from Stop*.

¹¹ Ibid. *Table 9.9.6: Design Intersection Sight Distance – Case B2, Right Turn from Stop*.



Paradigm conducted a sight distance review of the proposed site driveways during a June 2022 site visit. **Table 3.2** summarizes the measured sight distances.

TABLE 3.2: SIGHT DISTANCE MEASUREMENTS

Driveway	Stopping Sight Distance (m)		Intersection Sight Distance (m)	
	From North/West	From South/East	Left-Turn	Right-Turn
Block A Driveway 'A'	170	130	185	140
Block B Driveway 'B'	125	>200	>200	150
Block B Driveway 'E'	>130	105	>130	105
Block C Driveway 'C'	>130	>130	>130	>130
Block C Driveway 'D'	>130	>130	>130	>130
Block D Driveway 'F'	>200	>200	>200	>200

3.2.1 Block A Sight Distance

The right-turn from stop intersection sight distance at the proposed Driveway 'A' location is less than the minimum sight distance recommended in the TAC Guide under existing conditions. It is understood that Montrose Road will be reconstructed with a new road profile from south of Lyons Creek Road to Canadian Drive to the north by Year 2026 as detailed in the Montrose EA and confirmed by Region staff.

The minimum stopping and intersection sight distances were also evaluated with the future road profile using AutoCAD software. The proposed driveway location is expected to meet the minimum recommended sight distances once Montrose Road is reconstructed. It is recommended that Driveway 'A' be constructed following the completion/implementation of the Phase 3 Montrose EA improvements.

3.2.2 Block B Sight Distance

The stopping sight distance from the north at the proposed Driveway 'B' location is less than the minimum sight distance recommended in the TAC Guide under existing conditions.

The minimum stopping and intersection sight distances at Driveway 'B' were also evaluated with the future road profile identified in the Montrose EA using AutoCAD software. It is understood that Montrose



Road will be reconstructed from south of Lyons Creek Road to Grassy Brook Road in Year 2024 as noted by Region staff. The proposed driveway location is expected to meet the minimum recommended sight distances once Montrose Road is reconstructed. Like Driveway “A”, it is recommended that Driveway ‘B’ not to be constructed until Phase 3 of the Montrose EA improvements are completed. Prior to the EA improvements, site access can be provided by the proposed site driveways to Grassy Brook Road.

The sight distances at Driveway ‘E’ exceed the minimum sight distances recommended in the TAC Guide.

3.2.3 Block C Sight Distance

The sight distances at Driveway ‘C’ and at Driveway ‘D’ exceed the minimum sight distances recommended in the TAC Guide.

3.2.4 Block D Sight Distance

The sight distances at Driveway ‘F’ exceed the minimum sight distances recommended in the TAC Guide.



3.3 Trip Generation Estimate

The Institute of Transportation Engineers (ITE) Trip Generation Manual¹² methods were used to predict the site trip generation. The following Land Use Codes (LUC) were used to estimate the site's trip generation:

- ▶ Warehousing (150)¹³; and
- ▶ General Office Building (710)¹⁴.

The exact land uses of the blocks are unknown at this time so less specific LUC were applied. The regression equation was used to estimate the site generated trips at the request of Region staff.

Table 3.3 summarizes the estimated trip generation. The subject site is forecast to generate approximately 301 and 307 new vehicle trips during the AM and PM peak hours, respectively. A modal split was not applied to the site generated traffic volumes to remain conservative.

TABLE 3.3: TRIP GENERATION ESTIMATE

Land Use	AM Peak Hour			PM Peak Hour		
	In	Out	Sum	In	Out	Sum
Block A General Office Building (710) 18,250 sq.ft. GFA	34	5	39	7	34	41
Block B General Office Building (710) 72,450 sq.ft. GFA	112	15	127	22	105	127
Block C Warehousing (150) 25,000 sq.ft. GFA	20	6	26	8	21	29
Block D General Office Building (710) 60,550 sq.ft. GFA	96	13	109	19	91	110
Total Net Trips	262	39	301	56	251	307

3.4 Trip Distribution and Assignment

The Transportation Tomorrow Survey (TTS) 2016 origin and destination data was used to estimate the trip distribution of the trips generated by the subject site¹⁵. Trips to and from the subject zone were summed using the cardinal directions and the most logical path

¹² Trip Generation Manual 11th Edition Institute of Transportation Engineers

¹³ LUC 150 Regression Equations: AM $T = 0.12(X) + 23.62$ | PM $T = 0.12(X) + 26.48$

¹⁴ LUC 710 Regression Equations: AM $\ln(T) = 0.86 \ln(X) + 1.16$ |

PM $\ln(T) = 0.83 \ln(X) + 1.29$

¹⁵ Zone 6246



based on the existing road network. The final trip assignments were estimated using local context and engineering judgement with the TTS distribution used to provide general travel direction.

Table 3.4 summarizes the estimated trip distribution. **Appendix D** contains the TTS survey data.

TABLE 3.4: ESTIMATED TRIP DISTRIBUTION

Travel Direction	In	Out
East via Lyons Creek Road	15%	15%
West via Biggar Road	5%	5%
North via Montrose Road	55%	55%
South via Montrose Road	25%	25%
Total	100%	100%

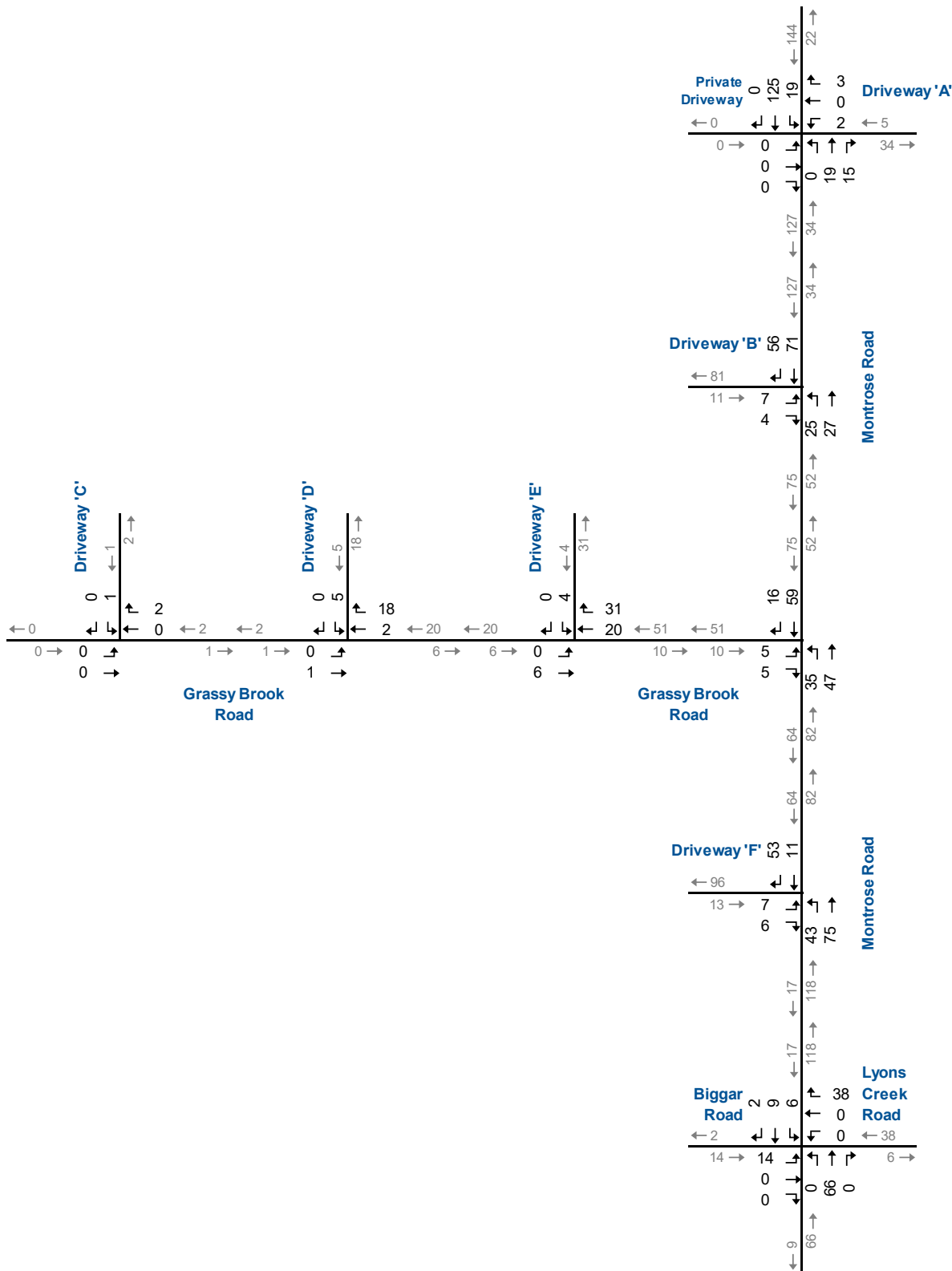
Figure 3.3 and **Figure 3.4** illustrate the site generated traffic volumes. **Appendix E** contains the site generated traffic volumes for each block.

Site generated traffic is anticipated to use the Queen Elizabeth Way (QEW). Highway interchanges are located both north and south of the subject site at McLeod Road and Lyons Creek Road. **Table 3.5** summarizes the estimated volume of site generated traffic using the QEW.

TABLE 3.5: ESTIMATED QEW TRIP ASSIGNMENT

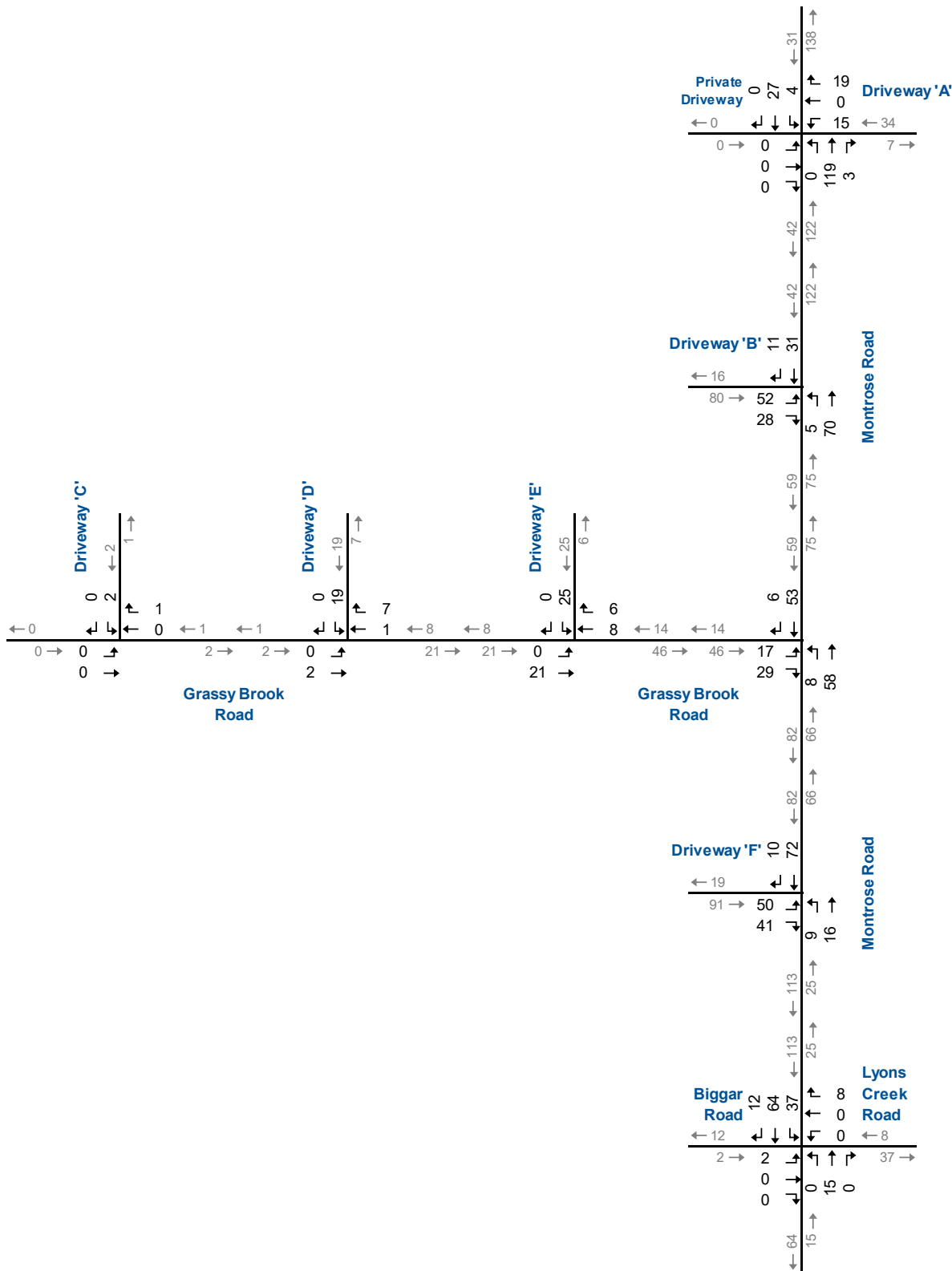
Travel Direction on QEW	AM Peak Hour		PM Peak Hour	
	In	Out	In	Out
Northbound	132	15	28	96
Southbound	13	2	3	12
Total	145	17	31	108





Forecast Site Traffic (All Blocks) AM Peak Hour

Figure 3.3



Forecast Site Traffic (All Blocks) PM Peak Hour

4 Future Traffic Conditions

Year 2024, Year 2029, and Year 2034 horizons have been assessed which represent the opening date, five-years, and ten-years post build-out.

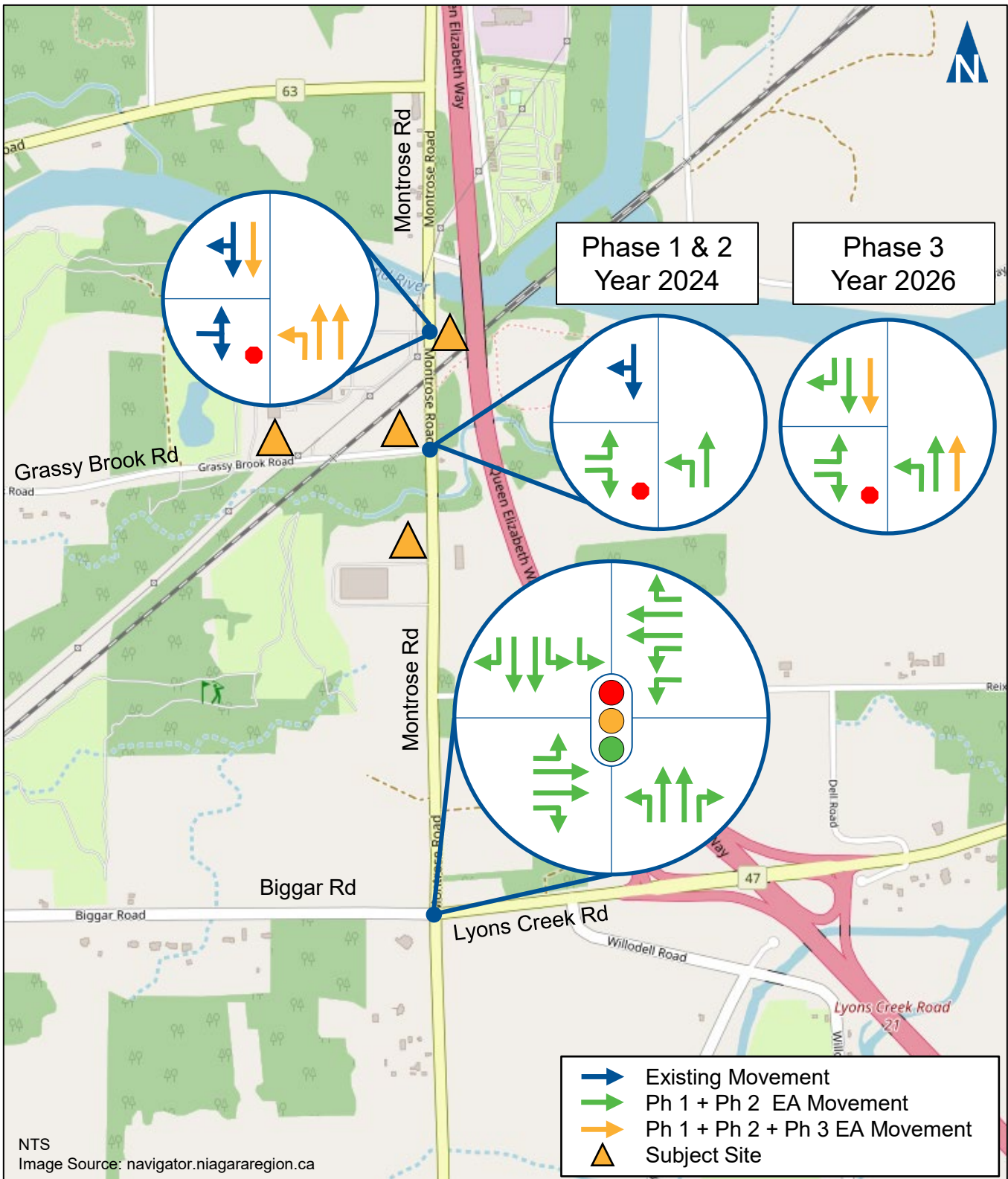
The assessment of future conditions in this section includes the following:

- ▶ Future background traffic estimates;
- ▶ Level of service analysis for background traffic (pre-development);
- ▶ Future total traffic estimates; and
- ▶ Level of service analysis for total traffic (post-development).

The Montrose EA improvements are expected to be implemented by Year 2026. The improvements generally includes two travel lanes in each direction, separate left and/or right-turn lanes on major intersections, and a Two-Way Left-Turn Lane (TWLTL) in between major intersections. Phase 1 and Phase 2 of the EA improvements extends from approximately 300 metres south of Lyons Creek Road to the Grassy Brook Road and is anticipated to be complete by Year 2024. Phase 3 of the EA improvements extends from Grassy Brook Road to Canadian Road and is anticipated to be complete by Year 2026.

Figure 4.1 illustrates the future lane configuration. Region staff indicated potential signalization of the Montrose Road and Grassy Brook Road intersection in the future.





NTS
Image Source: navigator.niagararegion.ca



Future Lane Configuration

9127 & 9515 Montrose Rd
210701

Figure 4.1

4.1 Forecast Traffic

The likely future traffic volumes near the subject site are estimated to consist of:

- ▶ Increased non-site traffic (generalized background traffic growth);
- ▶ Traffic generated by the build-out of nearby in-stream developments; and
- ▶ Traffic generated by the subject site.

The non-site traffic increase is the generalized traffic growth near the subject site. During pre-study consultations, Region staff confirmed an annual growth rate of 1% per annum which aligns with the growth rate used in the Montrose EA.

City staff requested the inclusion of the background developments noted in the Montrose EA. The following nearby in-stream developments were included:

- ▶ River Front Development;
- ▶ Warren Woods Development;
- ▶ Grand Niagara Development, which is referred to as the WSP Site Development in the Montrose EA; and
- ▶ South Niagara Hospital.

The background development traffic volumes were extracted from the Montrose EA¹⁶.

Appendix F contains the detailed traffic forecast for the adjacent development applications.

Figure 4.2 and **Figure 4.3** illustrate the forecast opening date background traffic volumes for the AM and PM peak hours, respectively.

Figure 4.4 and **Figure 4.5** illustrate the forecast five-year background traffic volumes for the AM and PM peak hours, respectively.

Figure 4.6 and **Figure 4.7** illustrate the forecast ten-year background traffic volumes for the AM and PM peak hours, respectively.

¹⁶ Ibid. Memorandum – South Niagara Background Traffic Layers – Appendix A, 18 December 2020.

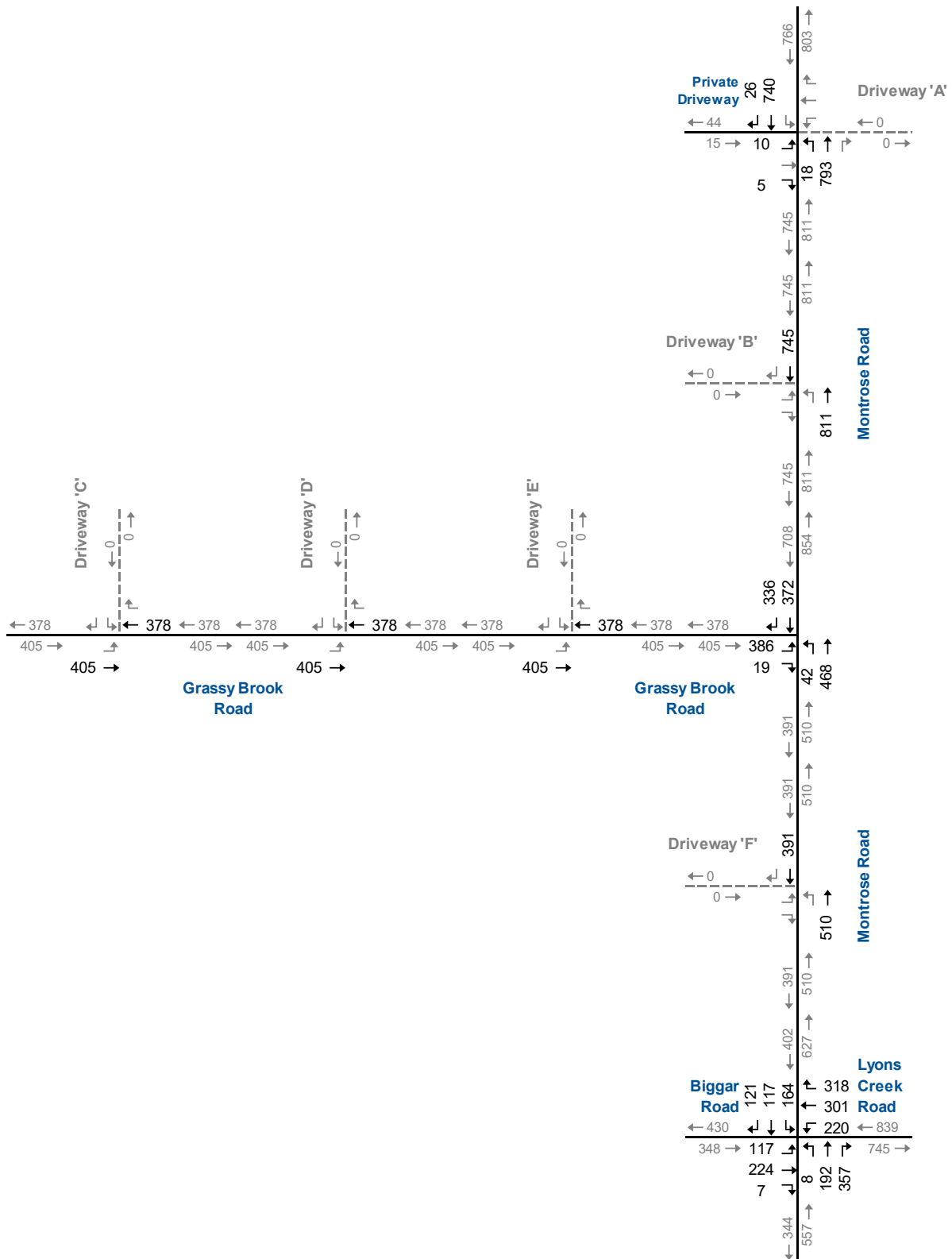


Figure 4.8 and **Figure 4.9** illustrate the forecast opening date total traffic volumes for the AM and PM peak hours, respectively.

Figure 4.10 and **Figure 4.11** illustrate the forecast five-year total traffic volumes for the AM and PM peak hours, respectively.

Figure 4.12 and **Figure 4.13** illustrate the forecast ten-year total traffic volumes for the AM and PM peak hours, respectively.

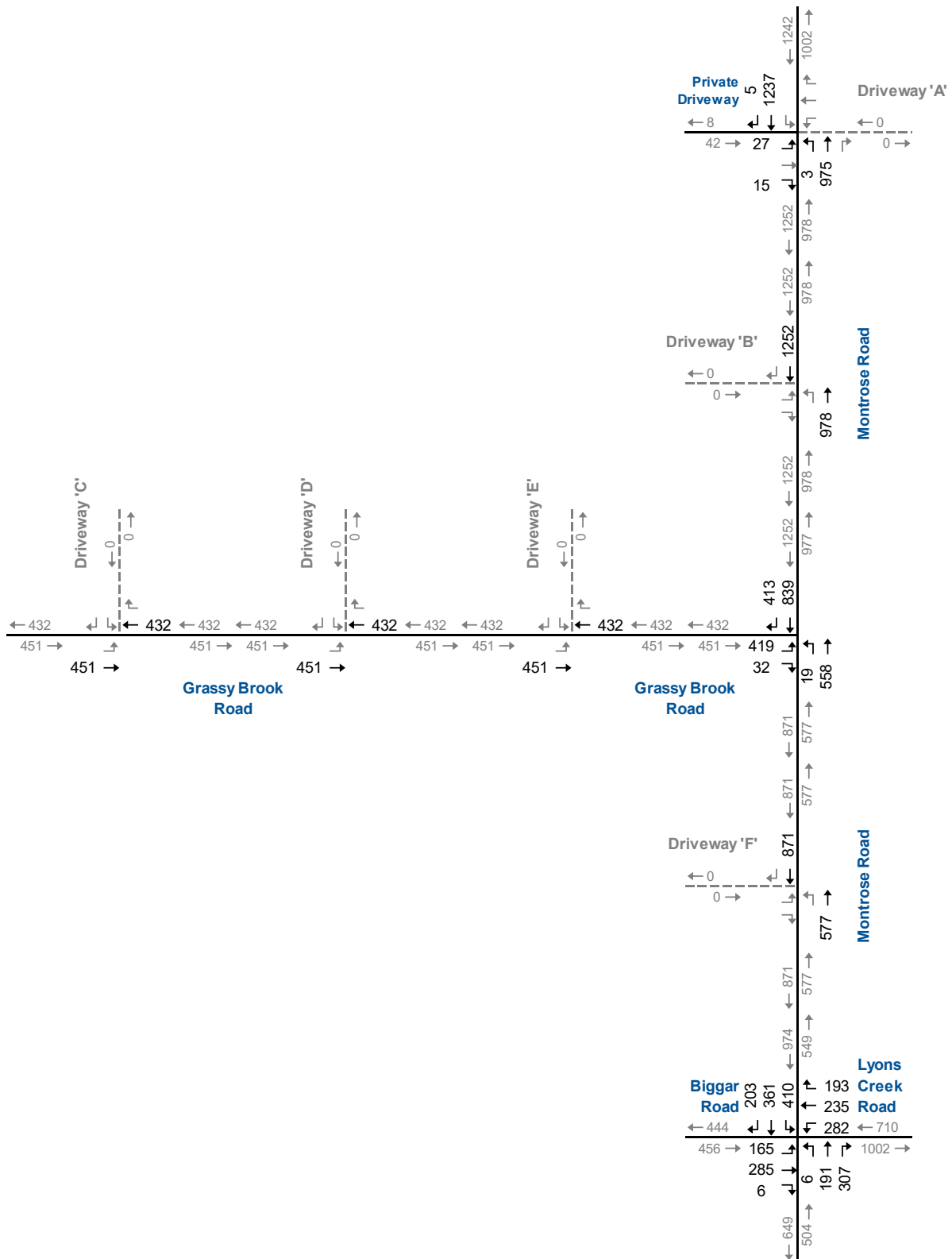




Five-Year Background Traffic AM Peak Hour

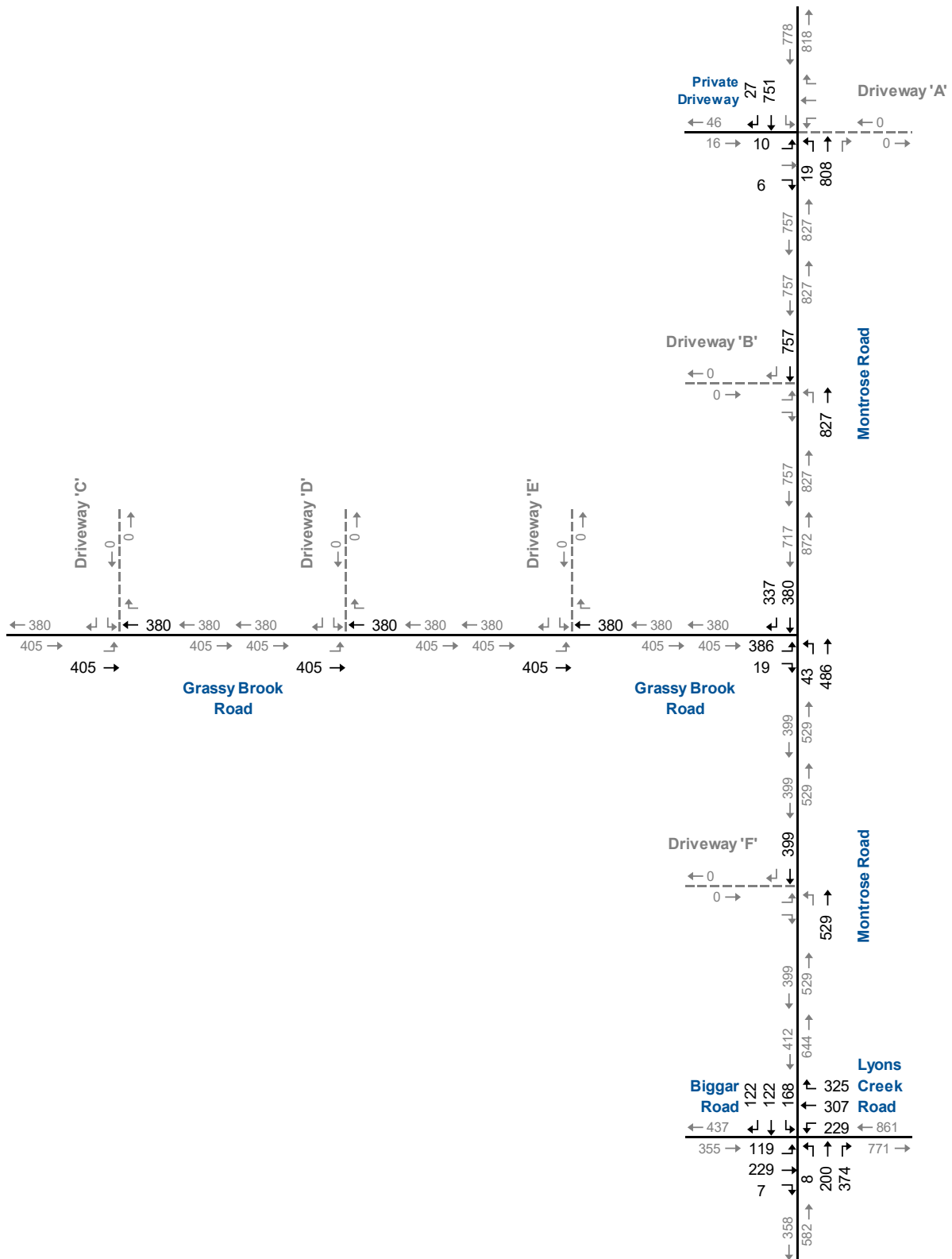
9127 & 9515 Montrose Rd
210701

Figure 4.4



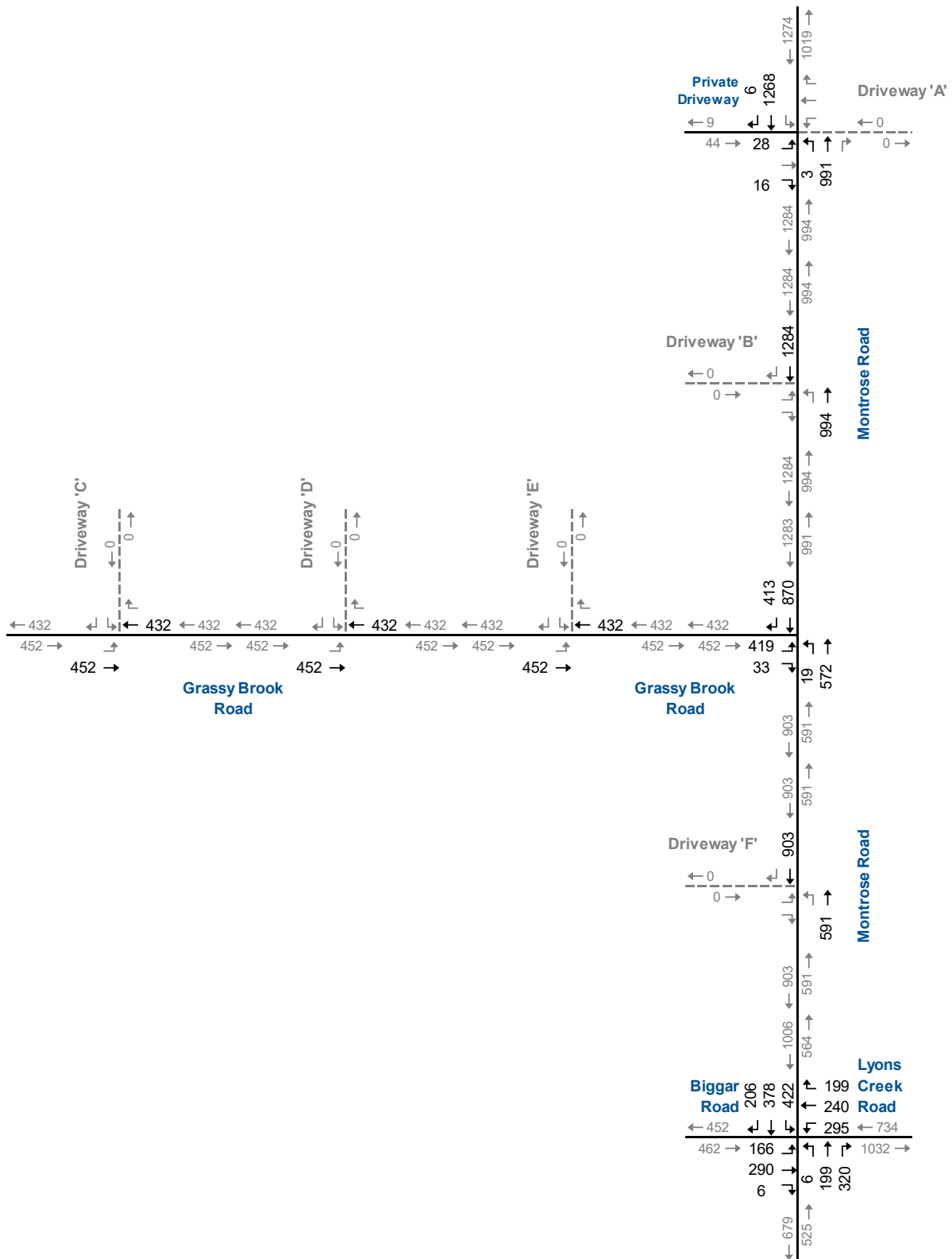
Five-Year Background Traffic PM Peak Hour

Figure 4.5

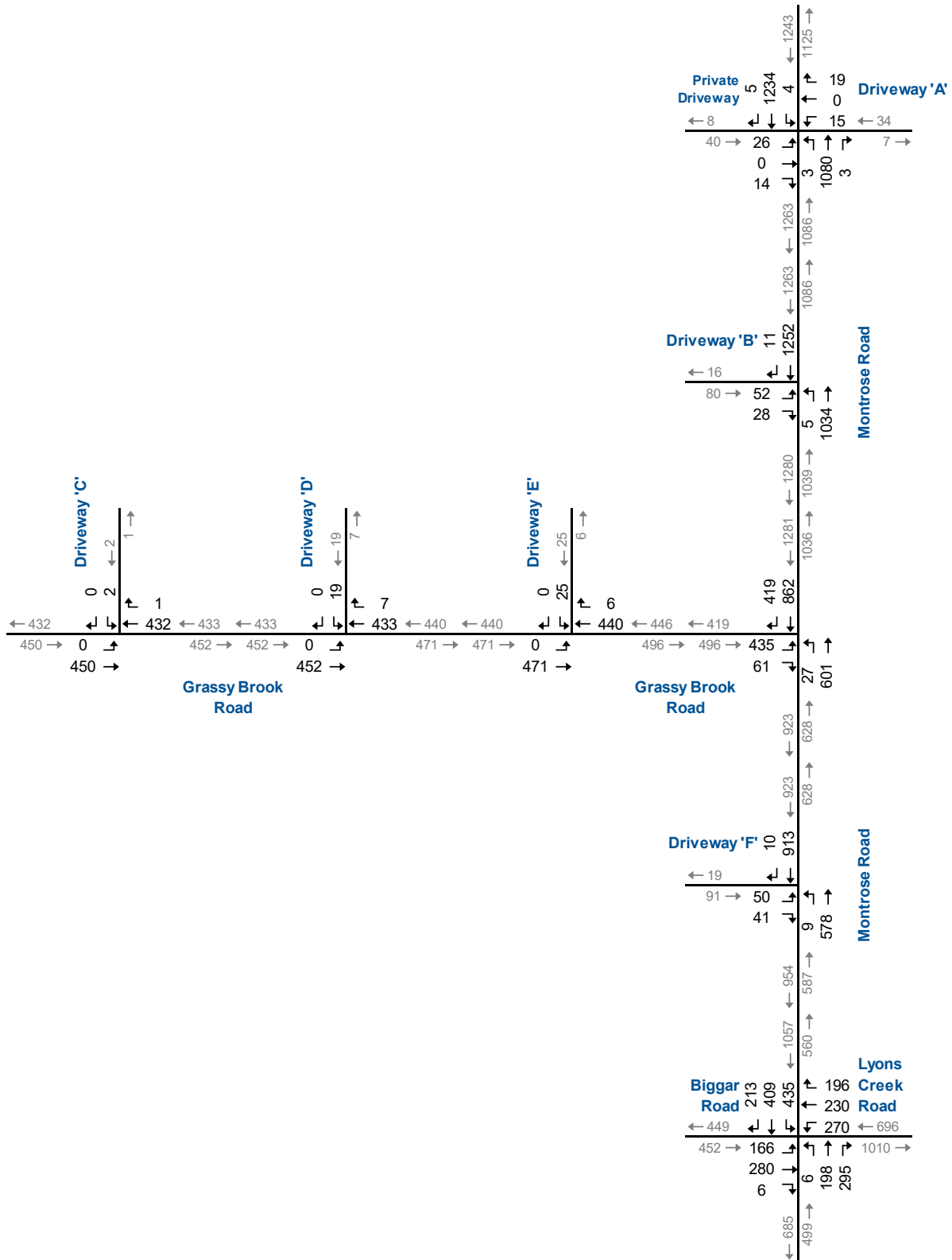


Ten-Year Background Traffic AM Peak Hour

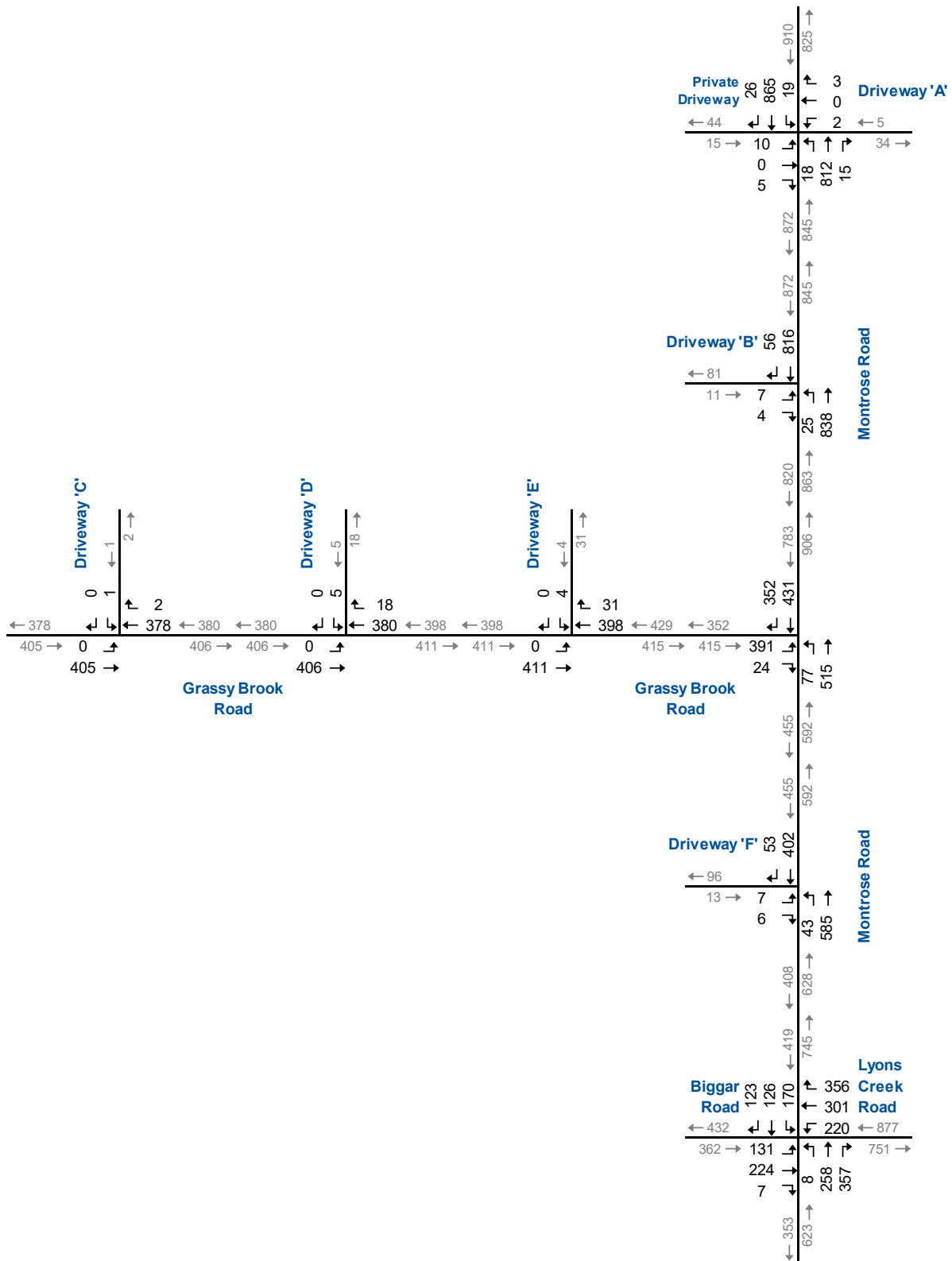
Figure 4.6



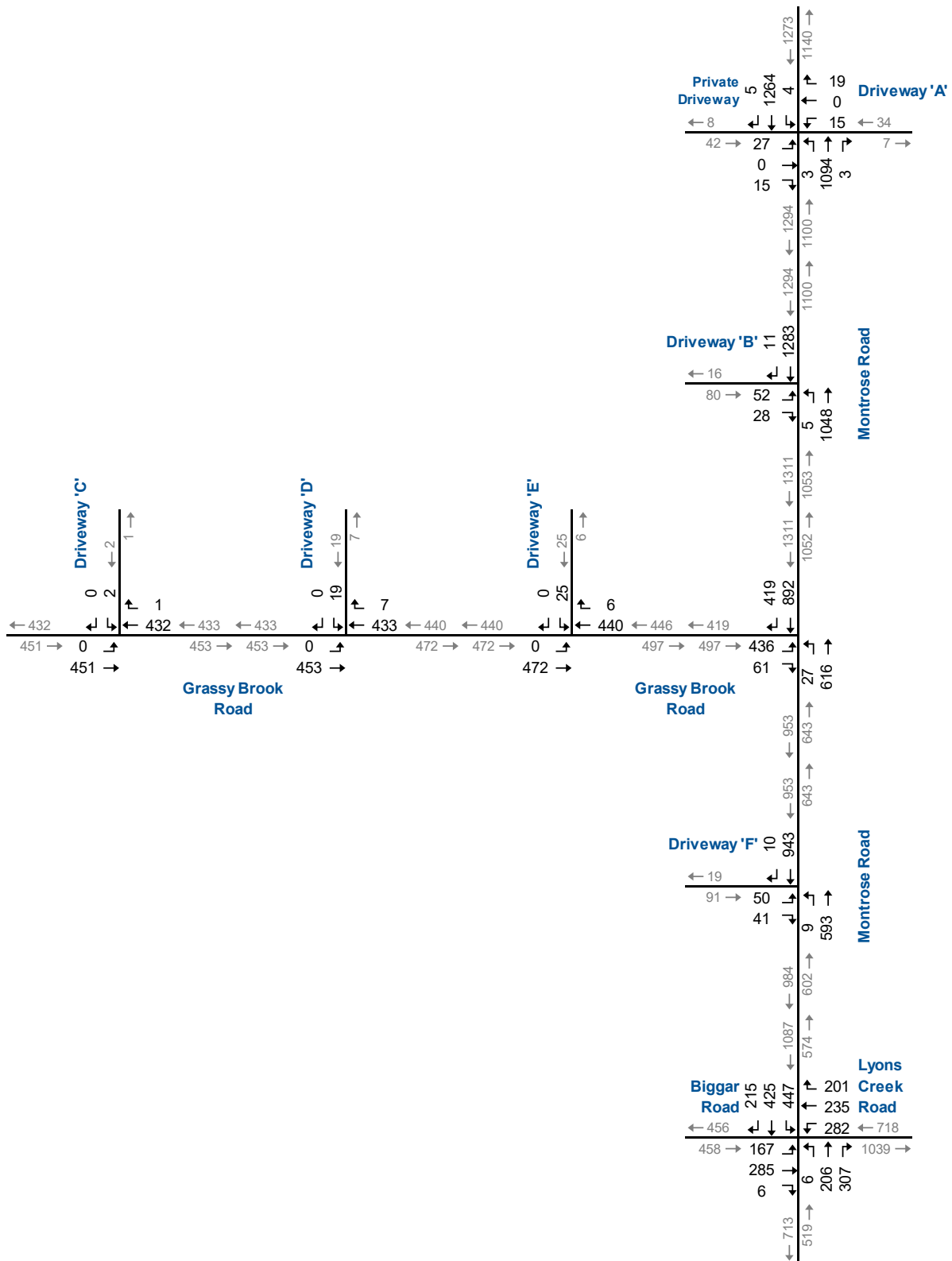
Ten-Year Background Traffic PM Peak Hour



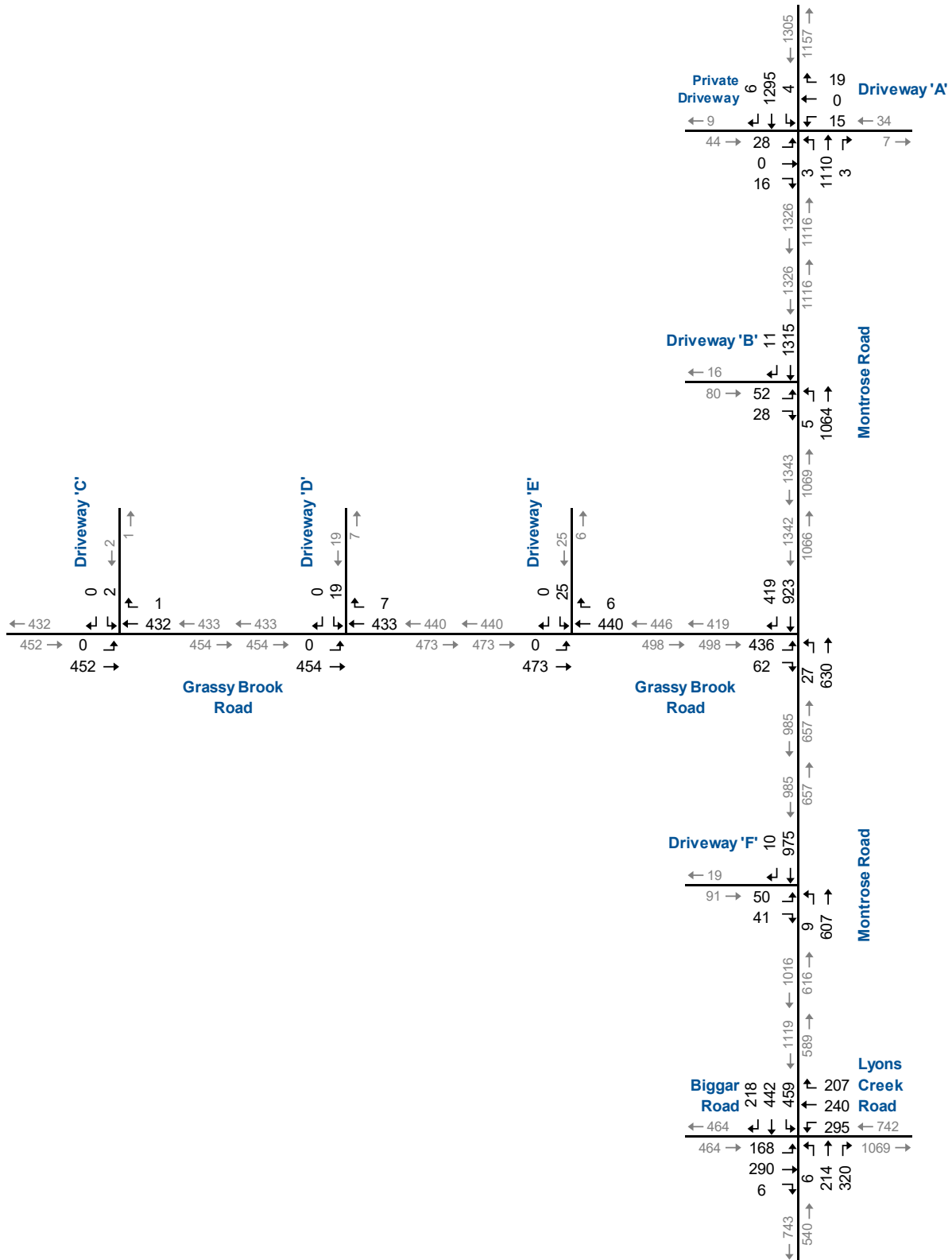
Opening Date Total Traffic PM Peak Hour



Five-Year Total Traffic AM Peak Hour



Five-Year Total Traffic PM Peak Hour



Ten-Year Total Traffic PM Peak Hour

4.2 Opening Date Horizon – Operations

4.2.1 Background Traffic

The study area intersection operational analysis followed the same methodology used for base year conditions. Signal timings were optimized, and the Phase 1 and Phase 2 of the Montrose EA improvements are assumed to be in place.

Table 4.1 summarizes the level of service conditions. The following critical movements are noted:

- ▶ Montrose Road and Private Driveway:
 - Eastbound approach (private driveway): Forecast to operate at LOS E ($v/c < 0.15$) during the AM peak hour and LOS F ($v/c < 0.80$) during the PM peak hour.
- ▶ Montrose Road and Grassy Brook Road:
 - Eastbound left-turn: Forecast to operate at LOS F ($v/c \geq 1.00$) during the AM peak hour and LOS F ($v/c < 0.80$) during the PM peak hour. The 95th percentile queue length is forecast to exceed the current available storage length by approximately 33 metres during the AM peak hour and 151 metres during the PM peak hour.
- ▶ Montrose Road and Biggar Road/Lyons Creek Road:
 - Westbound left-turn: Forecast to operate at LOS E ($v/c > 0.90$) during the PM peak hour; and
 - Southbound left-turn: Forecast to operate at LOS D ($v/c = 0.90$) during the PM peak hour.

Appendix G contains the detailed Synchro 10 reports.

The above noted capacity deficiencies are forecast to occur under background conditions. These deficiencies are not related nor are a result of the development of the subject site.



TABLE 4.1: OPENING DATE BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Montrose Road & Private Driveway	TWSC	LOS Delay V/C 95th	E 38 0.12 3	> > > >	E 38					< < < <	A 1 0.02 1		A 1		A 0 0 >	> > > >	A 0	A 1	
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 75 1.00 93 60 -33		F 72					A 9 1 60 59	A 0 0 -		A 1		A 0 0 -	> > > >	A 0	C 18	
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 22 0.45 30 120 90	B 18 0.26 23 -	B 19	D 49 0.82 43 160 117	B 11 0.22 24 -	B 12 0.25 14 120 107	C 21	B 17 0.03 4 100 96	B 18 0.23 19 -	B 19 0.27 17 80 63	B 18	D 47 0.76 34 160 126	B 11 0.09 10 -	B 11 0.09 9 20 11	C 26	C 21 0.46	
PM Peak Hour	Montrose Road & Private Driveway	TWSC	LOS Delay V/C 95th	F 179 0.77 25	> > > >	F 179					< < < <	A 0 0.01 0		A 0		A 0 0.77 0	> > > >	A 0	A 3	
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 334 1.64 211 60 -151		F 312					B 12 0.04 1 60 59	A 0 0.35 0 -		A 0		A 0 0.78 0 -	> > > >	A 0	F 63	
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 27 0.56 46 120 74	C 21 0.30 31 -	C 24	E 66 0.91 57 160 103	B 13 0.17 20 -	B 13 0.14 11 120 109	C 33	C 24 0.03 4 100 96	C 26 0.27 24 -	C 26 0.22 19 80 61	C 26	D 54 0.90 75 160 85	B 15 0.27 32 -	B 14 0.15 12 20 8	C 31	C 29 0.60	

TWSC - Two-Way Stop Control

V/C - Volume to Capacity Ratio

> - Shared Right-Turn Lane

TCS - Traffic Control Signal

95th - 95th Percentile Queue Length

< - Shared Left-Turn Lane

MOE - Measure of Effectiveness

Storage - Existing Storage (m)

LOS - Level of Service

Avail. - Available Storage (m)



4.2.2 Total Traffic

The study area intersection operational analysis followed the same methodology used for opening date background traffic conditions. Signal timings were optimized, and the Phase 1 and Phase 2 of the Montrose EA improvements are assumed to be in place.

Table 4.2 and **Table 4.3** summarize the level of service conditions.

The critical movements forecast to occur under background traffic are expected to continue to occur with the introduction of site generated traffic. Increases in delay and queueing are expected from the addition of site generated traffic. The following additional critical movements are a result of site generated traffic:

- ▶ Montrose Road and Private Driveway/Driveway 'A':
 - Westbound approach: Forecast to operate at LOS E ($v/c < 0.10$) during the AM peak hour and LOS F ($v/c > 1.00$) during the PM peak hour.
- ▶ Montrose Road and Grassy Brook Road:
 - Eastbound right-turn: Forecast to operate at LOS D ($v/c < 0.30$) during the PM peak hour.
- ▶ Montrose Road and Driveway 'B':
 - Eastbound approach: Forecast to operate at LOS E ($v/c < 0.15$) during the AM peak hour and LOS F ($v/c > 1.00$) during the PM peak hour.

The driveway approaches to Grassy Brook Road are forecast to operate with delays in the LOS C range with v/c ratios of less than 0.15 with queue lengths of less than 5 metres (less than one vehicle). The inbound left-turn movements into the site driveways are forecast to operate with delays in the LOS A range with no forecast queues.

The Driveway 'A' approach to Montrose Road is forecast to operate with delays in the LOS E range during the AM peak hour with a v/c ratio of 0.05 and a queue length of one metre (less than one vehicle). In the PM peak hour, the Driveway 'A' approach to Montrose Road is forecast to operate with delays in the LOS F range with a v/c ratio of greater than 1.00 and a queue length of 29 metres (+/- four vehicles).

The Driveway 'B' approach to Montrose Road is forecast to operate with delays in the LOS E range during the AM peak hour with a v/c ratio of less than 0.15 and a queue length of 3 metres (less than one vehicle). In the PM peak hour, the Driveway 'B' approach to Montrose Road is forecast to operate with delays in the LOS F range with a v/c



ratio of greater than 1.00 and a queue length of 68 metres (+/- nine vehicles).

The Driveway 'F' approach to Montrose Road is forecast to operate with delays in the LOS B to C range with v/c ratios of less than 0.30 and queue lengths of 8 metres or less (+/- one vehicle).

Appendix H contains the detailed Synchro 10 reports.



TABLE 4.2: OPENING DATE TOTAL TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL		
				Eastbound				Westbound				Northbound				Southbound						
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach			
AM Peak Hour	Montrose Road & Private Driveway / Driveway 'A'	TWSC	LOS Delay V/C 95th	< < < <	F 76 0.23 6	> > > >	F 76	< < < <	E 42 0.05 1	> > > >	E 42	< < < <	A 1 0.03 1	> > > >	A 1 0.03 1	< < < <	A 1 0.03 1	> > > >	A 1 0.03 1	A 2		
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 145 1.20 133 60 -73	> > > > > >	B 13 0.06 1 - -	F 138	> > > > > >	> > > > > >	> > > > > >	> > > > > >	> > > > > >	A 10 0.10 3 60 57	> > > > > >	A 0 0.32 0 - -	> > > > > >	A 0 0.50 0 - -	> > > > > >	A 0 0.50 0 - -	A 0 0.50 0 - -	D 33	
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 23 0.48 34 120 86	B 19 0.25 23 -	B 17 0.01 0 100 100	C 20	E 64 0.89 47 160 113	B 12 0.22 25 -	B 13 0.28 14 120 106	C 25	B 17 0.03 4 100 96	B 19 0.27 18 80 62	B 19	E 58 0.83 39 160 121	B 12 0.10 12 -	B 12 0.10 10 20 11	C 31	C 24 0.49	C 24 0.49	C 24	
	Montrose Road & Driveway 'B'	TWSC	LOS Delay V/C 95th	E 44 0.11 3	> > > >	> > > >	E 44	> > > >	> > > >	> > > >	> > > >	> > > >	> > > >	A 1 0.04 1	> > > >	A 1 0.04 1	> > > >	A 1 0.04 1	> > > >	A 1 0.04 1	A 1	
	Grassy Brook Road & Driveway 'C'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0	> > > >	A 0	> > > >	A 0 0.24 0	> > > >	A 0	> > > >	> > > >	> > > >	C 16 0.00 0	> > > >	C 16 0.00 0	> > > >	C 16 0.00 0	> > > >	C 16	A 0
	Grassy Brook Road & Driveway 'D'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0	> > > >	A 0	> > > >	A 0 0.25 0	> > > >	A 0	> > > >	> > > >	> > > >	C 16 0.02 0	> > > >	C 16 0.02 0	> > > >	C 16 0.02 0	> > > >	C 16	A 0
	Grassy Brook Road & Driveway 'E'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0	> > > >	A 0	> > > >	A 0 0.27 0	> > > >	A 0	> > > >	> > > >	> > > >	C 17 0.01 0	> > > >	C 17 0.01 0	> > > >	C 17 0.01 0	> > > >	C 17	A 0
	Montrose Road & Driveway 'F'	TWSC	LOS Delay V/C 95th	B 11 0.03 1	> > > >	> > > >	B 11	> > > >	> > > >	> > > >	> > > >	> > > >	> > > >	A 2 0.04 1	A 0 0.24 0	> > > >	A 0 0.17 0	A 0 0.12 0	A 0	A 1	A 1	

TWSC - Two-Way Stop Control
 TCS - Traffic Control Signal
 MOE - Measure of Effectiveness
 LOS - Level of Service

V/C - Volume to Capacity Ratio
 95th - 95th Percentile Queue Length
 Storage - Existing Storage (m)
 Avail. - Available Storage (m)

> - Shared Right-Turn Lane
 < - Shared Left-Turn Lane



TABLE 4.3: OPENING DATE TOTAL TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
PM Peak Hour	Montrose Road & Private Driveway / Driveway 'A'	TWSC	LOS Delay V/C 95th	< 698 < <	F > 1.74 39	> 698 >	F 698	< < <	F 348 1.07 29	> > >	F 348	< < <	A 0 0.01 0	> > >	A 0 0.01 0	> > >	A 0 > >	C 17		
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 435 1.86 246 60 -186	> > > >	D 26 0.28 8 - -	F 385					B 13 0.06 1 60 59	A 0 0.38 0 - -		A 0 > > >	> > >	A 0 > >	F 80		
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 28 0.57 46 120 74	C 22 0.30 31 -	B 19 0.00 0 100 100	C 24	E 68 0.92 57 160 103	B 13 0.17 20 -	B 13 0.15 11 120 109	C 34	C 24 0.03 4 100 96	C 26 0.29 25 -	C 26 0.22 19 80 61	C 26	E 73 0.99 84 160 76	B 15 0.31 38 -	B 14 0.16 12 20 8	D 39	C 33 0.63
	Montrose Road & Driveway 'B'	TWSC	LOS Delay V/C 95th	F 659 1.99 68	> > > >	> > >	F 659					< < < <	A 0 0.01 0		A 0 > >	0.81 > >	A 0 > >	C 22		
	Grassy Brook Road & Driveway 'C'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0	A 0 0.28 0	> > > >	A 0						C 18 0.01 0	> > >	C 18	A 0	
	Grassy Brook Road & Driveway 'D'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0	A 0 0.28 0	> > > >	A 0						C 19 0.07 2	> > >	C 19	A 0	
	Grassy Brook Road & Driveway 'E'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0	A 0 0.29 0	> > > >	A 0						C 20 0.10 3	> > >	C 20	A 1	
	Montrose Road & Driveway 'F'	TWSC	LOS Delay V/C 95th	C 18 0.27 8	> > > >	> > >	C 18					A 1 0.01 0	A 0 0.25 0		A 0	A 0 0.39 0	A 0 0.20 0	A 0	A 1	

TWSC - Two-Way Stop Control
 TCS - Traffic Control Signal
 MOE - Measure of Effectiveness
 LOS - Level of Service

V/C - Volume to Capacity Ratio
 95th - 95th Percentile Queue Length
 Storage - Existing Storage (m)
 Avail. - Available Storage (m)

> - Shared Right-Turn Lane
 < - Shared Left-Turn Lane



4.3 Five-Year Horizon – Operations

4.3.1 Background Traffic

The study area intersection operational analysis followed the same methodology used for opening date conditions. Signal timings were optimized, and the Phase 3 Montrose EA improvements are assumed to be in place.

Table 4.4 summarizes the level of service conditions. The following critical movements are noted:

- ▶ Montrose Road and Grassy Brook Road:
 - Eastbound left-turn: Forecast to operate at LOS D ($v/c < 0.80$) during the AM peak hour and LOS F ($v/c > 1.00$) during the PM peak hour. The 95th percentile queue length is forecast to exceed the current available storage length by approximately 112 metres during the PM peak hour.
- ▶ Montrose Road and Biggar Road/Lyons Creek Road:
 - Southbound left-turn: Forecast to operate at LOS F ($v/c = 0.90$) during the PM peak hour.

Appendix I contains the detailed Synchro 10 reports.

The above noted capacity deficiencies are forecast to occur under background conditions. These deficiencies are not related nor are a result of the development of the subject site.



TABLE 4.4: FIVE-YEAR BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL	
				Eastbound				Westbound				Northbound				Southbound					
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach		
AM Peak Hour	Montrose Road & Private Driveway	TWSC	LOS Delay V/C 95th	C 15 0.04 1		> > >	C 15							< < <	A 1 0.34 1		A 0		A 0 > >	A 0	A 0
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	D 33 0.79 56 60 4		A 10 0.03 1 -	D 32							A 9 0.05 1 60 59	A 0 0.15 0 -		A 1		A 0 0 0 15 15	A 0	A 8
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 22 0.44 31 120 90	B 18 0.26 23 -	B 16 0.01 0 100 100	B 19	E 60 0.88 47 160 113	B 11 0.22 24 -	B 12 0.25 14 120 107	C 24	B 17 0.03 4 100 96	B 19 0.24 21 -	B 20 0.28 19 80 62	B 19	D 50 0.79 37 160 123	B 12 0.10 11 -	B 12 0.10 9 20 11	C 27	C 23	C 0.47
PM Peak Hour	Montrose Road & Private Driveway	TWSC	LOS Delay V/C 95th	C 23 0.18 5		> > >	C 23							< < <	A 0 0.42 0		A 0		A 0 > >	A 0	A 0
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 219 1.38 172 60 -112		B 12 0.06 2 -	F 204							B 12 0.04 1 60 59	A 0 0.18 0 -		A 0		A 0 0 0 15 15	A 0	E 40
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 28 0.57 47 120 73	C 22 0.31 32 -	B 19 0.00 0 100 100	C 24	E 55 0.86 58 160 102	B 12 0.17 21 -	B 12 0.15 11 120 109	C 29	C 24 0.03 4 100 96	C 26 0.27 24 -	C 26 0.23 20 80 61	C 26	F 83 1.02 83 160 77	B 15 0.28 34 -	B 14 0.15 12 20 8	D 44	C 33	C 0.61

TWSC - Two-Way Stop Control

TCS - Traffic Control Signal

MOE - Measure of Effectiveness

LOS - Level of Service

V/C - Volume to Capacity Ratio

95th - 95th Percentile Queue Length

Storage - Existing Storage (m)

Avail. - Available Storage (m)

> - Shared Right-Turn Lane

< - Shared Left-Turn Lane



4.3.2 Total Traffic

The study area intersection operational analysis followed the same methodology used for the five-year background traffic conditions. Signal timings were optimized, and the Phase 3 Montrose EA improvements are assumed to be in place.

Table 4.5 and **Table 4.6** summarize the level of service conditions.

The critical movements forecast to occur under background traffic are expected to continue to occur with the introduction of site generated traffic. Increases in delay and queueing are expected from the addition of site generated traffic. The following critical movements are a result of site generated traffic:

- ▶ Montrose Road and Private Driveway/Driveway 'A':
 - Eastbound approach: Forecast to operate at LOS D ($v/c < 0.25$) during the PM peak hour.
- ▶ Montrose Road and Grassy Brook Road:
 - Eastbound left-turn: The 95th percentile queue length is forecast to exceed the current available storage length by approximately 23 metres during the AM peak hour.
- ▶ Montrose Road and Biggar Road/Lyons Creek Road:
 - Westbound left-turn: Forecast to operate at LOS F ($v/c > 1.00$) during the AM peak hour and LOS E ($v/c > 0.95$) during the PM peak hour.
- ▶ Montrose Road and Driveway 'B':
 - Eastbound approach: Forecast to operate at LOS D ($v/c = 0.40$) during the PM peak hour.

The driveway approaches to Grassy Brook Road are forecast to operate with delays in the LOS C range with v/c ratios of less than 0.15 with queue lengths of less than 4 metres (less than one vehicle). The inbound left-turn movements into the site driveways are forecast to operate with delays in the LOS A range with no forecast queues.

The Driveway 'A' approach to Montrose Road is forecast to operate with delays in the LOS B to C range with v/c ratios of less than 0.15 and queue lengths of 4 metres or less (less than one vehicle).

The Driveway 'B' approach to Montrose Road is forecast to operate with delays in the LOS C to D range with v/c ratios of 0.40 or less and queue lengths of 13 metres or less (+/- two vehicles).



The Driveway 'F' approach to Montrose Road is forecast to operate with delays in the LOS B to C range with v/c ratios of less than 0.30 and queue lengths of 8 metres or less (+/- one vehicle).

Appendix J contains the detailed Synchro 10 reports.



TABLE 4.5: FIVE-YEAR TOTAL TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL	
				Eastbound				Westbound				Northbound				Southbound					
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach		
AM Peak Hour	Montrose Road & Private Driveway / Driveway 'A'	TWSC	LOS Delay V/C 95th	< < < <	C 20 0.06 1	> > > >	C 20	< < < <	B 15 0.01 0	> > > >	B 15	< < < <	A 1 0.27 1	> > > >	A 1	< < < <	A 1 0.29 1	> > > >	A 0	A 1	
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 60 0.94 83		A 10 0.03 1	F 57					A 10 0.10 3	A 0 0.16 0		A 1		A 0 0.14 0	A 0 0.23 0	A 0 15 15	A 0	B 14
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 23 0.48 34	B 18 0.25 23	B 17 0.01 0	B 20	F 121 1.10 52	B 12 0.23 25	B 13 0.28 14	D 40	B 17 0.03 4	B 19 0.30 27	B 19 0.28 18	B 19	E 60 0.85 40	B 11 0.10 12	B 12 0.10 9	C 31	C 29	C 0.50
	Montrose Road & Driveway 'B'	TWSC	LOS Delay V/C 95th	C 15 0.03 1		> > > >	C 15					< < < <	A 1 0.36 1		A 0		A 0 0.35 0	> > > >	A 0	A 0	
	Grassy Brook Road & Driveway 'C'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0 0.24 0	> > > >	A 0					C 16 0.00 0		> > > >	C 16	A 0	
	Grassy Brook Road & Driveway 'D'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0 0.25 0	> > > >	A 0					C 16 0.02 0		> > > >	C 16	A 0	
	Grassy Brook Road & Driveway 'E'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0 0.27 0	> > > >	A 0					C 17 0.01 0		> > > >	C 17	A 0	
	Montrose Road & Driveway 'F'	TWSC	LOS Delay V/C 95th	B 11 0.03 1		> > > >	B 11					A 2 0.04 1	A 0 0.25 0		A 1		A 0 0.17 0	A 0 0.12 0	A 0	A 1	

TWSC - Two-Way Stop Control
 TCS - Traffic Control Signal
 MOE - Measure of Effectiveness
 LOS - Level of Service

V/C - Volume to Capacity Ratio
 95th - 95th Percentile Queue Length
 Storage - Existing Storage (m)
 Avail. - Available Storage (m)

> - Shared Right-Turn Lane
 < - Shared Left-Turn Lane



TABLE 4.6: FIVE-YEAR TOTAL TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL	
				Eastbound				Westbound				Northbound				Southbound					
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach		
PM Peak Hour	Montrose Road & Private Driveway / Driveway 'A'	TWSC	LOS Delay V/C 95th	< < < <	D 31 0.24 7	> > > >	D 31	< < < <	C 21 0.14 4	> > > >	C 21	< < < <	A 0 0.35 0	> > > >	A 0	< < < <	A 0 0.41 0	> > > >	A 0	A 1	
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 295 1.55 206 60 -146		B 13 0.12 3 - -	F 260					B 13 0.06 1 60 59	A 0 0.20 0 - -		A 1		A 0 0.28 0 - -	A 0 0.27 0 15 15		A 0 0 0 0 0	F 53
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 28 0.57 48 120 73	C 22 0.31 32 -	B 19 0.00 0 100 100	C 24	E 80 0.97 61 160 99	B 13 0.18 21 -	B 13 0.15 12 120 109	D 39	C 24 0.03 4 100 96	C 26 0.29 26 80 61	C 26	F 83 1.03 88 160 72	B 15 0.32 39 -	B 14 0.16 12 20 8	D 43	D 36	0.65	
	Montrose Road & Driveway 'B'	TWSC	LOS Delay V/C 95th	D 32 0.40 13		> > > >	D 32					< < < <	A 0 0.45 0		A 0		A 0 0.55 0	> > > >	A 0	A 1	
	Grassy Brook Road & Driveway 'C'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0	A 0 0.28 0	> > > >	A 0							C 18 0.01 0		> > > >	C 18	A 0
	Grassy Brook Road & Driveway 'D'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0	A 0 0.28 0	> > > >	A 0							C 19 0.07 2		> > > >	C 19	A 0
	Grassy Brook Road & Driveway 'E'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0	A 0 0.29 0	> > > >	A 0							C 20 0.10 3		> > > >	C 20	A 1
	Montrose Road & Driveway 'F'	TWSC	LOS Delay V/C 95th	C 19 0.28 8		> > > >	C 19					A 1 0.02 0	A 0 0.25 0		A 0		A 0 0.40 0	A 0 0.21 0	A 0	A 1	

TWSC - Two-Way Stop Control

TCS - Traffic Control Signal

MOE - Measure of Effectiveness

LOS - Level of Service

V/C - Volume to Capacity Ratio

95th - 95th Percentile Queue Length

Storage - Existing Storage (m)

Avail. - Available Storage (m)

> - Shared Right-Turn Lane

< - Shared Left-Turn Lane



4.4 Ten-Year Horizon – Operations

4.4.1 Background Traffic

The study area intersection operational analysis followed the same methodology used for the five-year background conditions. Signal timings were optimized, and the Phase 3 Montrose EA improvements are assumed to be in place.

Table 4.7 summarizes the level of service conditions. The following critical movements are noted:

- ▶ Montrose Road and Grassy Brook Road:
 - Eastbound left-turn: Forecast to operate at LOS D ($v/c < 0.85$) during the AM peak hour and LOS F ($v/c > 1.00$) during the PM peak hour. The 95th percentile queue length is forecast to exceed the current available storage length by approximately 122 metres during the PM peak hour.
- ▶ Montrose Road and Biggar Road/Lyons Creek Road:
 - Westbound left-turn: Forecast to operate at LOS F ($v/c > 1.00$) during the AM peak hour and at LOS E ($v/c > 0.90$) during the PM peak hour; and
 - Southbound left-turn: Forecast to operate at LOS F ($v/c > 1.00$) during the PM peak hour.

Appendix K contains the detailed Synchro 10 reports.

The above noted capacity deficiencies are forecast to occur under background conditions. These deficiencies are not related nor are a result of the development of the subject site.



TABLE 4.7: TEN-YEAR BACKGROUND TRAFFIC OPERATIONS

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL
				Eastbound				Westbound				Northbound				Southbound				
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	
AM Peak Hour	Montrose Road & Private Driveway	TWSC	LOS Delay V/C 95th	C 16 0.04 1	> > > >	C 16					< < < <	A 1 0.34 1		A 0		A > > > >	A 0 0 0	A 0		
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	D 35 0.81 58 60 2	A 10 0.03 1 - -	D 34					A 10 1 60 59	A 0 0 -		A 1		A 0 0 -	A 0 0 15 15	A 0		
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 22 0.44 31 120 89	B 18 0.26 24 -	B 16 0.01 0 100 100	B 19	F 121 1.10 53 160 107	B 12 0.23 26 -	B 12 0.26 14 120 106	D 41	B 17 0.03 4 100 96	B 18 0.24 21 -	B 19 0.29 18 80 62	B 19	D 52 0.81 39 160 121	B 11 0.10 11 9 20 11	B 11 0.10 9 20 11	C 28	C 29 0.49
PM Peak Hour	Montrose Road & Private Driveway	TWSC	LOS Delay V/C 95th	C 25 0.20 6	> > > >	C 25					< < < <	A 0 0.42 0		A 0		A 0 0.54 0	> > > >	A 0 0 0	A 1	
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 245 1.44 182 60 -122	B 12 0.06 2 -	F 229					B 13 0.04 1 60 59	A 0 0.18 0 -		A 0		A 0 0.28 0 -	A 0 0 15 15	A 0		
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 28 0.57 47 120 73	C 22 0.32 33 -	B 19 0.00 0 100 100	C 24	E 63 0.91 61 160 99	B 12 0.18 21 -	B 12 0.15 11 120 109	C 33	C 24 0.03 4 100 96	C 26 0.28 25 -	C 26 0.24 20 80 60	C 26	F 93 1.06 86 160 74	B 15 0.30 35 -	B 14 0.16 12 20 8	D 47	D 36 0.63

TWSC - Two-Way Stop Control

TCS - Traffic Control Signal

MOE - Measure of Effectiveness

LOS - Level of Service

V/C - Volume to Capacity Ratio

95th - 95th Percentile Queue Length

Storage - Existing Storage (m)

Avail. - Available Storage (m)

> - Shared Right-Turn Lane

< - Shared Left-Turn Lane



4.4.2 Total Traffic

The study area intersection operational analysis followed the same methodology used for background traffic conditions. Signal timings were optimized, and the Phase 3 Montrose EA improvements are assumed to be in place.

Table 4.8 and **Table 4.9** summarize the level of service conditions.

The critical movements forecast to occur under background traffic are expected to continue to occur with the introduction of site generated traffic. Increases in delay and queueing are expected from the addition of site generated traffic. The following critical movements are a result of site generated traffic:

- ▶ Montrose Road and Private Driveway/Driveway 'A':
 - Eastbound approach: Forecast to operate at LOS D ($v/c < 0.30$) during the PM peak hour.
- ▶ Montrose Road and Grassy Brook Road:
 - Eastbound left-turn: The 95th percentile queue length is forecast to exceed the current available storage length by approximately 27 metres during the AM peak hour. It is noted there is 2 metres of forecast storage available under background conditions.
- ▶ Montrose Road and Driveway 'B':
 - Eastbound approach: Forecast to operate at LOS D ($v/c < 0.45$) during the PM peak hour.

The driveway approaches to Grassy Brook Road are forecast to operate with delays in the LOS C range with v/c ratios of less than 0.15 with queue lengths of 3 metres or less (less than one vehicle). The inbound left-turn movements into the site driveways are forecast to operate with delays in the LOS A range with no forecast queues.

The Driveway 'A' approach to Montrose Road is forecast to operate with delays in the LOS C range with v/c ratios of less than 0.15 and queue lengths of 4 metres or less (less than one vehicle).

The Driveway 'B' approach to Montrose Road is forecast to operate with delays in the LOS C to D range with v/c ratios of less than 0.45 and queue lengths of 14 metres or less (+/- two vehicles).

The Driveway 'F' approach to Montrose Road is forecast to operate with delays in the LOS B to C range with v/c ratios of less than 0.30 and queue lengths of 9 metres or less (+/- one vehicle).



Appendix L contains the detailed Synchro 10 reports.



TABLE 4.8: TEN-YEAR TOTAL TRAFFIC OPERATIONS – AM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL		
				Eastbound				Westbound				Northbound				Southbound						
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach			
AM Peak Hour	Montrose Road & Private Driveway / Driveway 'A'	TWSC	LOS Delay V/C 95th	< < < <	C 20 0.06 2	> > > >	C 20	< < < <	C 15 0.01 0	> > > >	C 15	< < < <	A 1 0.27 1	> > > >	A 1	< < < <	A 1 0.30 1	> > > >	A 0	A 1		
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 64 0.96 87 60 -27	A 10 0.03 1 - -	F 61						B 10 0.11 3 60 57	A 0 0.17 0 - -		A 1		A 0 0.14 0 - -	A 0 0.23 0 15 15	A 0	B 14		
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	C 23 0.49 36 120 85	B 19 0.26 24 - -	B 17 0.01 0 100 100	C 20	F 145 1.16 56 160 104	B 13 0.23 27 - -	B 13 0.29 15 120 105	D 47	B 17 0.02 4 100 96	B 19 0.30 28 80 61	B 19	E 67 0.88 42 160 118	B 11 0.10 12 - -	B 11 0.10 9 20 11	C 34	C 33	0.51		
	Montrose Road & Driveway 'B'	TWSC	LOS Delay V/C 95th	C 16 0.03 1		> > > >	C 16							< < < <	A 1 0.36 1		A 0		A 0 0.35 0	> > > >	A 0	A 0
	Grassy Brook Road & Driveway 'C'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0	> > > >	A 0							C 16 0.00 0		> > > >	C 16	A 0
	Grassy Brook Road & Driveway 'D'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0	> > > >	A 0							C 16 0.02 0		> > > >	C 16	A 0
	Grassy Brook Road & Driveway 'E'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0	> > > >	A 0							C 17 0.01 0		> > > >	C 17	A 0
	Montrose Road & Driveway 'F'	TWSC	LOS Delay V/C 95th	B 12 0.03 1		> > > >	B 12							A 2 0.04 1	A 0 0.26 0		A 1		A 0 0.17 0	A 0 0.12 0	A 0	A 1

TWSC - Two-Way Stop Control

TCS - Traffic Control Signal

MOE - Measure of Effectiveness

LOS - Level of Service

V/C - Volume to Capacity Ratio

95th - 95th Percentile Queue Length

Storage - Existing Storage (m)

Avail. - Available Storage (m)

> - Shared Right-Turn Lane

< - Shared Left-Turn Lane



TABLE 4.9: TEN-YEAR TOTAL TRAFFIC OPERATIONS – PM PEAK HOUR

Analysis Period	Intersection	Control Type	MOE	Direction / Movement / Approach																OVERALL	
				Eastbound				Westbound				Northbound				Southbound					
				Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach	Left	Through	Right	Approach		
PM Peak Hour	Montrose Road & Private Driveway / Driveway 'A'	TWSC	LOS Delay V/C 95th	< < < <	D 33 0.27 8	> > > >	D 33 33	< < < <	C 21 0.14 4	> > > >	C 21 21	< < < <	A 0 0.36 0	> > > >	A 0 0	< < < <	A 0 0.42 0	> > > >	A 0 0	A 1	
	Montrose Road & Grassy Brook Road	TWSC	LOS Delay V/C 95th Storage Avail.	F 325 1.62 216 60 -156		B 13 0.13 3 - -	F 287						B 13 0.06 2 60 59	A 0 0.20 0 - -		A 1		A 0 0.29 0 - -	A 0 0.27 0 15 15	A 0 0	F 57
	Montrose Road & Biggar Road / Lyons Creek Road	TCS	LOS Delay V/C 95th Storage Avail.	D 38 0.64 57 120 63	C 28 0.35 39 -	C 25 0.00 0 100 100	C 32	D 55 0.81 62 160 98	B 16 0.18 26 -	B 16 0.16 13 120 107	C 31	C 29 0.04 5 100 95	C 32 0.33 31 -	C 32 0.29 26 80 54	C 32	D 44 0.79 85 160 75	B 16 0.32 43 -	B 15 0.18 15 20 5	C 28	C 30 0.63	
	Montrose Road & Driveway 'B'	TWSC	LOS Delay V/C 95th	D 33 0.41 14		> > > >	D 33						< < < <	A 0 0.45 0		A 0		A 0 0.56 0	> > > >	A 0 0	A 1
	Grassy Brook Road & Driveway 'C'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0 0.28 0	> > > >	A 0						C 18 0.01 0		> > > >	C 18	A 0
	Grassy Brook Road & Driveway 'D'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0 0.28 0	> > > >	A 0						C 19 0.07 2		> > > >	C 19	A 0
	Grassy Brook Road & Driveway 'E'	TWSC	LOS Delay V/C 95th	< < < <	A 0 0.00 0		A 0		A 0 0.29 0	> > > >	A 0						C 20 0.10 3		> > > >	C 20	A 1
	Montrose Road & Driveway 'F'	TWSC	LOS Delay V/C 95th	C 20 0.29 9		> > > >	C 20						A 1 0.02 0	A 0 0.26 0		A 0		A 0 0.42 0	A 0 0.21 0	A 0	A 1

TWSC - Two-Way Stop Control

TCS - Traffic Control Signal

MOE - Measure of Effectiveness

LOS - Level of Service

V/C - Volume to Capacity Ratio

95th - 95th Percentile Queue Length

Storage - Existing Storage (m)

Avail. - Available Storage (m)

> - Shared Right-Turn Lane

< - Shared Left-Turn Lane



5 Remedial Measures

5.1 Left-Turn Lane Warrants

The Ministry of Transportation's Design Supplement to the TAC Guide¹⁷ provides guidance on the assessment of and/or need for auxiliary left-turn lanes at intersections.

Appendix M contains the left-turn lane warrant nomographs. The following left-turn lanes are warranted:

- ▶ Montrose Road at Driveway 'A': Greater than 25 metres of southbound left-turn storage is warranted under Year 2024 total conditions. It is noted that a Two-Way Left Turn Lane (TWLTL) is proposed on Montrose Road north of Grassy Brook Road under Phase 3 of the Montrose EA improvements; and
- ▶ Montrose Road at Grassy Brook Road: 15 metres and 25 metres of northbound left-turn lane storage is warranted under future background and total conditions, respectively. As the Montrose EA proposes approximately 60 metres of northbound left-turn storage, no changes to the proposed storage length is recommended.

Driveway 'F' was not evaluated as a TWLTL is proposed from Grassy Brook Road to Biggar Road/Lyons Creek Road under Phase 1 of the Montrose EA improvements.

Left-turn lane warrants were not evaluated for the Grassy Brook Road driveway intersections as forecast inbound left-turning traffic is expected to be low and would not meet minimum threshold criteria for consideration.

5.2 Grassy Brook at Montrose Road Left-Turn Lane Storage

The queue length for the eastbound left-turn lane at the Grassy Brook Road intersection with Montrose Road is forecast to exceed the storage lane length. The Montrose EA improvements assumes approximately 60 metres of storage. To accommodate the forecast queue length, additional storage may be needed. The forecast queue length under the ten-year horizon is approximately 160 metres.

¹⁷ Transportation Association of Canada, *MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads – Appendix 9A*, Ministry of Transportation of Ontario, 2017.



5.3 Traffic Signal Warrants

The potential for implementing traffic signal control at the Private Driveway/Driveway 'A' and Grassy Brook Road intersections with Montrose Road were assessed using the Ontario Traffic Manual (OTM Book 12) signal warrant¹⁸ procedures. **Appendix N** contains the traffic signal warrants.

To warrant the installation of a traffic control signal at an existing intersection with forecast traffic volumes, the minimum vehicular warrant or the delay to cross traffic warrant must be 120% fulfilled.

The warrants indicate that traffic signals are not warranted under the forecast ten-year total traffic horizon. It is noted that Region staff indicated potential signalization of the Montrose Road and Grassy Brook Road in the future. If the intersection is not signalized, the future eastbound left-turn storage length should be increased to 160 metres.

5.4 Sensitivity Analysis – Traffic Signal

The Grassy Brook Road approach to Montrose Road is forecast to operate with high levels of delay for the horizon years assessed. The high level of delay is caused by the forecast traffic volumes using the mainline approaches of Montrose Road. It is noted that the Montrose EA forecast the eastbound left-turn movement, after the improvements are implemented, to operate at LOS C under Year 2026 conditions and LOS F under Year 2041 conditions¹⁹.

Sensitivity analysis was conducted to review the intersection operation with the introduction of an unwarranted traffic control signal at the Grassy Brook Road and Montrose Road intersection. **Table 5.1** summarizes the level of service conditions with a traffic signal in place.

With the introduction of traffic control signals, the operations on the Grassy Brook Road approach improve. It is recommended the road authority installs traffic signals at this location to improve future background and total traffic operations. If traffic signals are installed, it is recommended to implement the eastbound left-turn lane with 65 metres of storage and to implement the southbound right-turn lane with 30 metres of storage to accommodate the forecast queue lengths.

¹⁸ Ontario Traffic Manual Book 12, Ministry of Transportation of Ontario, July 2001.

¹⁹ Ibid. Table 3-8 – Transportation Assessment Report



TABLE 5.1: TEN-YEAR TRAFFIC OPERATIONS – SENSITIVITY ANALYSIS

Analysis Period	Intersection	MOE	Direction / Movement / Approach								
			Eastbound			Northbound			Southbound		
			Left	Right	Approach	Left	Through	Approach	Through	Right	Approach
Background AM	Montrose Road & Grassy Brook Road	LOS	B	A	B	A	B	B	B	A	A
		Delay	12	7	12	9	11	11	10	10	10
		V/C	0.60	0.01		0.14	0.45		0.36	0.25	
		95th	45	3		8	28		22	13	
		Storage Avail.	60	-		60	-		-	15	
Background PM	Montrose Road & Grassy Brook Road	LOS	B	A	B	A	B	B	B	B	B
		Delay	18	10	17	9	11	10	13	11	12
		V/C	0.70	0.02		0.13	0.44		0.66	0.43	
		95th	58	4		5	34		56	28	
		Storage Avail.	60	-		60	-		-	15	
Total AM	Montrose Road & Grassy Brook Road	LOS	B	A	B	B	B	B	B	A	B
		Delay	12	7	12	11	11	11	10	10	10
		V/C	0.61	0.02		0.27	0.48		0.41	0.26	
		95th	46	3		13	31		26	13	
		Storage Avail.	60	-		60	-		-	15	
Total PM	Montrose Road & Grassy Brook Road	LOS	B	A	B	B	B	B	B	B	B
		Delay	18	10	17	11	11	11	14	12	13
		V/C	0.71	0.07		0.21	0.50		0.70	0.45	
		95th	62	6		7	38		61	30	
		Storage Avail.	60	-		60	-		-	15	

TWSC - Two-Way Stop Control

TCS - Traffic Control Signal

MOE - Measure of Effectiveness

LOS - Level of Service

V/C - Volume to Capacity Ratio

95th - 95th Percentile Queue Length

Storage - Existing Storage (m)

Avail. - Available Storage (m)

> - Shared Right-Turn Lane

< - Shared Left-Turn Lane



6 Conclusions & Recommendations

6.1 Conclusions

The main findings and conclusions of this study are as follows:

- ▶ **Base Year Traffic Conditions:** A critical movement is noted at the Montrose Road intersection with Biggar Road/Lyons Creek Road. The southbound approach is forecast to operate at LOS F ($v/c > 1.00$) during the PM peak hour.
- ▶ **Site Description:** The site concept plan includes four blocks containing office/light industrial employment and warehousing land uses. Build-out is estimated to occur by Year 2024.
- ▶ **Site Driveways:** The proposed driveways to Block A, B and C all provide the minimum 30 metres of spacing between the driveway and the adjacent at-grade rail crossing. The proposed driveway locations exceed the minimum spacing requirement outlined in the Transport Canada Grade Crossing Standards.

The site plans as currently analyzed are highly conceptual and are subject to finalization. The site driveway geometrics will be designed to meet local standards or site-specific needs. The site driveway geometrics for each driveway will be reviewed at Site Plan Approval stage.

- ▶ **Sight Distance:** The sight distance at the proposed Driveway 'A' and Driveway 'B' locations do not currently meet the minimum recommended sight distances recommended in the TAC Guide. The proposed driveway locations are expected to meet the minimum recommended sight distances once Montrose Road is reconstructed.
- ▶ **Site Trip Generation:** The subject site is forecast to generate approximately 301 and 307 new vehicle trips during the AM and PM peak hours, respectively.
- ▶ **Background Traffic Conditions (All Horizons):** Critical movements are noted at the Montrose Road intersections with Grassy Brook Road and Biggar Road/Lyons Creek Road. No critical movements are noted at the Private Driveway intersection with Montrose Road after implementation of the Montrose EA improvements.
- ▶ **Opening Date Total Traffic Conditions:** The capacity issues identified under background conditions are forecast to continue to occur. Additional critical movements are noted on Montrose Road at the Private Driveway/Driveway 'A', Grassy Brook



Road, and Driveway 'B' intersections with the inclusion of site-generated traffic volumes.

- ▶ **Five-Year Total Traffic Conditions:** The capacity issues identified under background conditions are forecast to continue to occur. Additional critical movements are noted on Montrose Road at the Private Driveway/Driveway 'A', Grassy Brook Road, Biggar Road/Lyons Creek Road, and Driveway 'B' intersections with the inclusion of site-generated traffic volumes.
- ▶ **Ten-Year Total Traffic Conditions:** The capacity issues identified under background conditions are forecast to continue to occur. Additional critical movements are noted on Montrose Road at the Private Driveway/Driveway 'A', Grassy Brook Road, and Driveway 'B' intersections with the inclusion of site-generated traffic volumes.
- ▶ **Remedial Measures – Left-Turn Lanes:** A southbound left-turn lane is warranted on Montrose Road at Driveway 'A' with 25 metres of storage under Year 2024 total conditions. The Montrose EA includes a TWLTL at the proposed driveway locations and a sufficient left-turn storage length to accommodate the forecast northbound left-turn queues on Montrose Road at Grassy Brook Road.
- ▶ **Remedial Measures – Traffic Signals:** Traffic signals are not warranted at the currently unsignalized intersections on Montrose Road. However, implementing traffic signals at the Montrose Road and Grassy Brook Road intersection is forecast to significantly improve the eastbound approach operations under background and total traffic conditions.

6.2 Recommendations

Based on the findings of this study, it is recommended that:

- ▶ The development of Block 'A' occurs following the implementation of the Montrose EA improvements.
- ▶ Driveway 'B' is not to be constructed until the Montrose EA improvements are implemented.
- ▶ The road authorities consider implementing an unwarranted traffic signal at the Montrose Road intersection with Grassy Brook Road to improve future operations.
- ▶ The eastbound left-turn lane on Grassy Brook Road at Montrose Road be designed to include 160 metres of storage. Should a traffic control signal be implemented, the storage lane length for the eastbound left-turn lane can be reduced to



65 metres and the southbound right-turn lane should be increased to 30 metres.

- ▶ The road authorities monitor traffic volumes and intersection operations at the Montrose Road intersection with Biggar Road/Lyons Creek Road and adjusts signal timing splits to best serve all traffic movements.



Appendix A

Pre-Study Consultation



Stefan Hajgato

From: John Grubich <jgrubich@niagarafalls.ca>
Sent: Tuesday, May 24, 2022 9:27 AM
To: Stefan Hajgato; Nunes, Paul (MTO); Dunsmore, Susan
Cc: Scott Catton
Subject: RE: [EXTERNAL]-(210701: 9127 & 9515 Montrose Rd TIA) Scope of Work

Stefan;

Thank you for forwarding the terms of reference for the traffic study your firm is completing for this proposed development.

The City is only interested in the evaluation of the proposed Grassybrook Road driveways you noted. Please address the location of driveways and whether they comply with prevailing setbacks in the TAC guidelines and TC Grade Crossing Regulations.

Background developments are noted in the Montrose Road EA report - <https://niagararegion.ca/projects/montrose-lyons-creek-ea/>. Please note that the Niagara Square redevelopment is completed though some new retail units are still vacant while the last condominium block is under construction in the Warren Woods development.

John Grubich, C.E.T. | Traffic Planning Supervisor | Municipal Works - Transportation Services | City of Niagara Falls
8208 Heartland Forest Road | Niagara Falls, ON L2H 0L7 | (905) 356-7521 ext 5214 | Fax 905-356-5576 | jgrubich@niagarafalls.ca

From: Stefan Hajgato <shajgato@ptsl.com>
Sent: May 18, 2022 9:38 AM
To: John Grubich <jgrubich@niagarafalls.ca>; Nunes, Paul (MTO) <Paul.Nunes@ontario.ca>; Dunsmore, Susan <Susan.Dunsmore@niagararegion.ca>
Cc: Scott Catton <scatton@ptsl.com>
Subject: [EXTERNAL]-(210701: 9127 & 9515 Montrose Rd TIA) Scope of Work

Hi John, Paul, and Susan,

Paradigm has been retained to complete a Transportation Impact Assessment (TIA) for a proposed development consisting of 4 blocks at 9127 and 9515 Montrose Road in Niagara Falls. The development is expected to accommodate office/light employment land uses on Blocks A, B, and D, and a single industrial/warehouse building on Block C. The proposed parking supply for each block will meet the City's parking requirements.

It is noted an EA was completed for Montrose Road and Biggar Road / Lyons Creek Road in November 2021 (Montrose EA). The northern extents of the EA was McLeod Road.

We are proposing the following scope:

Study Intersections:

- Montrose Road and Grassy Brook Road.
- Montrose Road and 9127 Montrose Road Existing Driveway / Block A Driveway.
- Montrose Road and Block B Driveway.
- Grassy Brook Road and Block B Driveway.

- Grassy Brook Road and Block C Driveways (2).
- Montrose Road and Block D Driveway.

Development (site plan attached):

- Block A: Approximately 18,250 sq.ft. of office/light employment in a single building.
- Block B: Approximately 72,450 sq.ft. of office/light employment over 3 buildings.
- Block C: Approximately 49,750 sq.ft. of warehousing in a single building.
- Block D: Approximately 60,550 sq.ft. of office/light employment in a single building.
- Estimated occupancy of all blocks: Year 2024.

Horizon Year:

- Existing (Year 2022).
- Year of occupancy (Year 2024).
- 5-years post occupancy (Year 2029).
- 10-years post occupancy (Year 2034).

Growth Rate: 1% per annum (consistent with the Montrose EA).

Existing Traffic Volumes: New data will be collected in 2022.

Background Developments: Please identify.

Analysis Periods: Weekday AM & PM peak hours.

Trip Generation: ITE Trip Generation Manual 11e.

- LUC 150 (Warehousing).
- LUC 710 (General Office Building).
- Estimated to generate 284 AM and 287 PM peak hour Trips.

Trip Distribution:

- Local travel patterns.
- TTS.

Planned Roadway Improvements:

- 5-lane cross section on Montrose Road throughout study area. Please confirm if a median or a Two-Way Left-Turn Lane is proposed on Montrose Road north of Grassy Brook Road.
- Separate left and right-turn lanes on Grassy Brook Road at Montrose Road.
- Future signalization of Montrose Road at Grassy Brook Road.

Please reach out if you have any questions or comments.

Thanks,

Stefan Hajgato, P.Eng.

*Transportation Engineer
(He/Him)*



Paradigm Transportation Solutions Limited

150 Pinebush Road, Unit 5A, Cambridge ON N1R 8J8

p: 519.896.3163 x209

e: shajgato@ptsl.com

This e-mail and any files transmitted with it are confidential and intended solely for the use of the individual or entity to whom they are addressed. If you have received this e-mail in error please notify the sender immediately. Please note that any views or opinions presented in this e-mail are solely those of the author and do not necessarily represent those of Paradigm Transportation Solutions Limited. Finally, the recipient should check this e-mail and any attachments for the presence of viruses. Paradigm Transportation Solutions Limited accepts no liability for any damage caused by any virus transmitted by this e-mail.

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Stefan Hajgato

From: Dunsmore, Susan <Susan.Dunsmore@niagararegion.ca>
Sent: Wednesday, June 22, 2022 3:13 PM
To: Stefan Hajgato
Cc: Scott Catton; John Grubich; Alguire, Robert
Subject: RE: (210701: 9127 & 9515 Montrose Rd TIA) Scope of Work

Hello

Again apologize for the speeding incorrect response yesterday. For Montrose our timing is as follows, again pending budget approval in the upcoming years and assuming no projects are moved due to priority pressures or funding restrictions:

- Reconstruction of RR98 Montrose Rd from 300m south of Lyon's Creek Rd to Grassy Brooks intersection, including part of the Rexinger Rd extension, Biggar Rd and Lyon's Creek to 100m west of Willowdell as part of Phase 1. 2022. – tendering this fall
- Phase 2 will include reconstruction of the remainder of Lyon's Creek Rd with the MTO interchange work in 2024.
- Montrose Road from Grassy Brooks to Canadian is positioned in the 10 years forecast for 2026. This would include twinning of the Bridge over the Welland River.

If you require anything further please let me know.

Susan

From: Stefan Hajgato <shajgato@ptsl.com>
Sent: Tuesday, June 21, 2022 3:16 PM
To: Dunsmore, Susan <Susan.Dunsmore@niagararegion.ca>; John Grubich <jgrubich@niagarafalls.ca>
Cc: Scott Catton <scatton@ptsl.com>
Subject: RE: (210701: 9127 & 9515 Montrose Rd TIA) Scope of Work

CAUTION EXTERNAL EMAIL: This email originated from outside of the Niagara Region email system. Use caution when clicking links or opening attachments unless you recognize the sender and know the content is safe.

Hi Susan and John,

Just following up on the Montrose EA. What year do you expect the Montrose EA improvements to be implemented?

Thanks,

Stefan Hajgato, P.Eng.

Transportation Engineer
(He/Him)



Paradigm Transportation Solutions Limited

p: 519.896.3163 x209

From: Dunsmore, Susan <Susan.Dunsmore@niagararegion.ca>
Sent: Thursday, May 26, 2022 4:04 PM
To: Stefan Hajgato <shajgato@ptsl.com>; John Grubich <jgrubich@niagarafalls.ca>; Nunes, Paul (MTO) <Paul.Nunes@ontario.ca>
Cc: Scott Catton <scatton@ptsl.com>
Subject: RE: (210701: 9127 & 9515 Montrose Rd TIA) Scope of Work

Hello Stefan,

Regional transportation planning has reviewed the scope and provided the comments below in green. As for Regional traffic data requests are to be made through the Regional website using the following link. <https://www.niagararegion.ca/living/roads/permits/traffic-data-requests.aspx>.

If the TIS recommends any improvements a functional design is to be included in the TIA.

If you have any questions or concern please contact me at your convenience.

Susan M. Dunsmore, P. Eng.
Manager, Development Engineering
Planning and Development Services

Phone: (905) 980-6000 or 1-800-263-7215 ext 3661
Address: 1815 Sir Isaac Brock Way, Thorold ON, L2V4T7



From: Stefan Hajgato <shajgato@ptsl.com>
Sent: Wednesday, May 18, 2022 9:38 AM
To: John Grubich <jgrubich@niagarafalls.ca>; Nunes, Paul (MTO) <Paul.Nunes@ontario.ca>; Dunsmore, Susan <Susan.Dunsmore@niagararegion.ca>
Cc: Scott Catton <scatton@ptsl.com>
Subject: (210701: 9127 & 9515 Montrose Rd TIA) Scope of Work

CAUTION EXTERNAL EMAIL: This email originated from outside of the Niagara Region email system. Use caution when clicking links or opening attachments unless you recognize the sender and know the content is safe.

Hi John, Paul, and Susan,

Paradigm has been retained to complete a Transportation Impact Assessment (TIA) for a proposed development consisting of 4 blocks at 9127 and 9515 Montrose Road in Niagara Falls. The development is expected to accommodate office/light employment land uses on Blocks A, B, and D, and a single industrial/warehouse building on Block C. The proposed parking supply for each block will meet the City's parking requirements.

It is noted an EA was completed for Montrose Road and Biggar Road / Lyons Creek Road in November 2021 (Montrose EA). The northern extents of the EA was McLeod Road.

We are proposing the following scope:

Study Intersections:

- Montrose Road and Grassy Brook Road.
- Montrose Road and 9127 Montrose Road Existing Driveway / Block A Driveway.
- Montrose Road and Block B Driveway.
- Grassy Brook Road and Block B Driveway.
- Grassy Brook Road and Block C Driveways (2).
- Montrose Road and Block D Driveway.
- **Montrose Road and Biggar Road**

Development (site plan attached):

- Block A: Approximately 18,250 sq.ft. of office/light employment in a single building.
- Block B: Approximately 72,450 sq.ft. of office/light employment over 3 buildings.
- Block C: Approximately 49,750 sq.ft. of warehousing in a single building.
- Block D: Approximately 60,550 sq.ft. of office/light employment in a single building.
- Estimated occupancy of all blocks: Year 2024.

Horizon Year: **Accepted**

- Existing (Year 2022).
- Year of occupancy (Year 2024).
- 5-years post occupancy (Year 2029).
- 10-years post occupancy (Year 2034).

Growth Rate: 1% per annum (consistent with the Montrose EA). **Accepted**

Existing Traffic Volumes: New data will be collected in 2022.

Background Developments: Please identify.

Analysis Periods: Weekday AM & PM peak hours. **Accepted**

Trip Generation: ITE Trip Generation Manual 11e.

- LUC 150 (Warehousing).
- LUC 710 (General Office Building).
- Estimated to generate 284 AM and 287 PM peak hour Trips. **Please use the fitted curve method for trips estimation.**

Trip Distribution: **Accepted**

- Local travel patterns.
- TTS.

Planned Roadway Improvements:

- 5-lane cross section on Montrose Road throughout study area. Please confirm if a median or a Two-Way Left-Turn Lane is proposed on Montrose Road north of Grassy Brook Road. We have attached the preferred design for Montrose Road. Grassy Brook intersection is on Page 3 of 9. Although the drawings appear to show signalization, the EA indicated signalizing in the future. A 2 way left turn is proposed north of Grassy Brook as well as a southbound right turn lane. The cross section also provides 2 through lanes in each direction. Left turn lane only on Grassy Brook.
- Separate left and right-turn lanes on Grassy Brook Road at Montrose Road.
- Future signalization of Montrose Road at Grassy Brook Road.

As per Regional comments at precon:

- All required accesses are to meet TAC guidelines with respect to location, alignment, throat width and radius.
- Block B: The north entrance is not appropriate as it is too close to the rail line and not proposed at 90 degrees to the road. The submitted TIS should address whether two entrances are required. If a second entrance is required it should be located the required TAC distance from the rail line and intersection of Grassy Brook Road.
- Block D: The entrance should be shared with the existing entrance and easements granted through the Consent application. If a separate entrance is required, justification needs to be provided through the Traffic Impact Study.

Thanks,

Stefan Hajgato, P.Eng.

*Transportation Engineer
(He/Him)*



Paradigm Transportation Solutions Limited

150 Pinebush Road, Unit 5A, Cambridge ON N1R 8J8
 p: 519.896.3163 x209
 e: shajgato@ptsl.com
 w: www.ptsl.com

This e-mail and any files transmitted with it are confidential and intended solely for the use of the individual or entity to whom they are addressed. If you have received this e-mail in error please notify the sender immediately. Please note that any views or opinions presented in this e-mail are solely those of the author and do not necessarily represent those of Paradigm Transportation Solutions Limited. Finally, the recipient should check this e-mail and any attachments for the presence of viruses. Paradigm Transportation Solutions Limited accepts no liability for any damage caused by any virus transmitted by this e-mail.

The Regional Municipality of Niagara Confidentiality Notice The information contained in this communication including any attachments may be confidential, is intended only for the use of the recipient(s) named above, and may be legally privileged. If the reader of this message is not the intended recipient, you are hereby notified that any dissemination, distribution, disclosure, or copying of this communication, or any of its contents, is strictly prohibited. If you have received this communication in error, please re-send this communication to the sender and permanently delete the original and any copy of it from your computer system. Thank you.

This e-mail and any files transmitted with it are confidential and intended solely for the use of the individual or entity to whom they are addressed. If you have received this e-mail in error please notify the sender immediately. Please note that any views or opinions presented in this e-mail are solely those of the author and do not necessarily represent those of Paradigm Transportation Solutions Limited. Finally, the recipient should

check this e-mail and any attachments for the presence of viruses. Paradigm Transportation Solutions Limited accepts no liability for any damage caused by any virus transmitted by this e-mail.

Stefan Hajgato

From: Nunes, Paul (MTO) <Paul.Nunes@ontario.ca>
Sent: Wednesday, May 25, 2022 12:56 PM
To: Stefan Hajgato
Subject: RE: (210701: 9127 & 9515 Montrose Rd TIA) Scope of Work

Hi Stefan,

Re: Transportation Impact Assessment (Scope of Work) – Request for Comments
Proposed commercial/industrial development
9127 & 9515 Montrose Road, Niagara Falls, ON. (**QEW**)

After review of the scope of work for the TIA described above, the MTO Traffic Management Section provided the following comments:

1. Add Lyons Creek & Montrose to the list of study intersections, and
2. Indicate through the Trip Distribution the percentage of trucks and employee traffic that will use the QEW / Lyons Creek interchange.

Please do not hesitate to contact me if you have any questions.

Thanks,

Paul Nunes

Planner (Niagara/Hamilton)
Highway Corridor Management Section – Central Operations

Ministry of Transportation
159 Sir William Hearst Avenue, 7th Floor
Toronto, ON M3M 0B7

E-Mail: paul.nunes@ontario.ca

Web: www.mto.gov.on.ca/english/engineering/management/corridor



From: Stefan Hajgato <shajgato@ptsl.com>
Sent: May 18, 2022 9:38 AM
To: John Grubich <jgrubich@niagarafalls.ca>; Nunes, Paul (MTO) <Paul.Nunes@ontario.ca>; Dunsmore, Susan <Susan.Dunsmore@niagararegion.ca>
Cc: Scott Catton <scatton@ptsl.com>
Subject: (210701: 9127 & 9515 Montrose Rd TIA) Scope of Work

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Hi John, Paul, and Susan,

Paradigm has been retained to complete a Transportation Impact Assessment (TIA) for a proposed development consisting of 4 blocks at 9127 and 9515 Montrose Road in Niagara Falls. The development is expected to accommodate office/light employment land uses on Blocks A, B, and D, and a single industrial/warehouse building on Block C. The proposed parking supply for each block will meet the City's parking requirements.

It is noted an EA was completed for Montrose Road and Biggar Road / Lyons Creek Road in November 2021 (Montrose EA). The northern extents of the EA was McLeod Road.

We are proposing the following scope:

Study Intersections:

- Montrose Road and Grassy Brook Road.
- Montrose Road and 9127 Montrose Road Existing Driveway / Block A Driveway.
- Montrose Road and Block B Driveway.
- Grassy Brook Road and Block B Driveway.
- Grassy Brook Road and Block C Driveways (2).
- Montrose Road and Block D Driveway.

Development (site plan attached):

- Block A: Approximately 18,250 sq.ft. of office/light employment in a single building.
- Block B: Approximately 72,450 sq.ft. of office/light employment over 3 buildings.
- Block C: Approximately 49,750 sq.ft. of warehousing in a single building.
- Block D: Approximately 60,550 sq.ft. of office/light employment in a single building.
- Estimated occupancy of all blocks: Year 2024.

Horizon Year:

- Existing (Year 2022).
- Year of occupancy (Year 2024).
- 5-years post occupancy (Year 2029).
- 10-years post occupancy (Year 2034).

Growth Rate: 1% per annum (consistent with the Montrose EA).

Existing Traffic Volumes: New data will be collected in 2022.

Background Developments: Please identify.

Analysis Periods: Weekday AM & PM peak hours.

Trip Generation: ITE Trip Generation Manual 11e.

- LUC 150 (Warehousing).
- LUC 710 (General Office Building).
- Estimated to generate 284 AM and 287 PM peak hour Trips.

Trip Distribution:

- Local travel patterns.
- TTS.

Planned Roadway Improvements:

- 5-lane cross section on Montrose Road throughout study area. Please confirm if a median or a Two-Way Left-Turn Lane is proposed on Montrose Road north of Grassy Brook Road.
- Separate left and right-turn lanes on Grassy Brook Road at Montrose Road.
- Future signalization of Montrose Road at Grassy Brook Road.

Please reach out if you have any questions or comments.

Thanks,

Stefan Hajgato, P.Eng.

Transportation Engineer

(He/Him)



Paradigm Transportation Solutions Limited

150 Pinebush Road, Unit 5A, Cambridge ON N1R 8J8

p: 519.896.3163 x209

e: shajgato@ptsl.com

w: www.ptsl.com

This e-mail and any files transmitted with it are confidential and intended solely for the use of the individual or entity to whom they are addressed. If you have received this e-mail in error please notify the sender immediately. Please note that any views or opinions presented in this e-mail are solely those of the author and do not necessarily represent those of Paradigm Transportation Solutions Limited. Finally, the recipient should check this e-mail and any attachments for the presence of viruses. Paradigm Transportation Solutions Limited accepts no liability for any damage caused by any virus transmitted by this e-mail.

Appendix B

Existing Data



9127 Montrose Rd

Morning Peak Diagram

Specified Period

From: 7:00:00
To: 10:00:00

One Hour Peak

From: 7:45:00
To: 8:45:00

Municipality: Niagara Falls
Site #: 000000001
Intersection: Montrose Rd & Driveway
TFR File #: 1
Count date: 1-Jun-2022

Weather conditions:
Cloudy/Dry
Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 494
North Entering: 219
North Peds: 0
Peds Cross: \times

Heavys	0	7	7
Trucks	1	8	9
Cars	23	180	203
Totals	24	195	



Heavys	11
Trucks	6
Cars	258
Totals	275

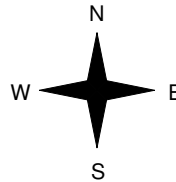
Heavys	Trucks	Cars	Totals
1	3	37	41



Montrose Rd



Driveway



Heavys	Trucks	Cars	Totals
1	0	8	9
1	1	3	5
2	1	11	



Montrose Rd



Peds Cross: \times
West Peds: 0
West Entering: 14
West Leg Total: 55

Cars	183
Trucks	9
Heavys	8
Totals	200



Cars	14	250	264
Trucks	2	6	8
Heavys	1	10	11
Totals	17	266	

Peds Cross: \times
South Peds: 0
South Entering: 283
South Leg Total: 483

Comments

9127 Montrose Rd

Mid-day Peak Diagram

Specified Period

From: 11:00:00

To: 13:00:00

One Hour Peak

From: 12:00:00

To: 13:00:00

Municipality: Niagara Falls
Site #: 000000001
Intersection: Montrose Rd & Driveway
TFR File #: 1
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Non-Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 645
 North Entering: 345
 North Peds: 0
 Peds Cross: ∇

Heavys	0	9	9
Trucks	1	5	6
Cars	36	294	330
Totals	37	308	



Heavys	8
Trucks	11
Cars	281
Totals	300

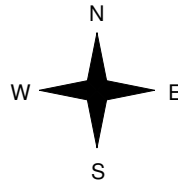
Heavys	0	Trucks	1	Cars	38	Totals	39
--------	---	--------	---	------	----	--------	----



Montrose Rd



Driveway



Heavys	0	Trucks	1	Cars	37	Totals	38
0	0	0	0	6	6		
0	1	43					



Montrose Rd



Peds Cross: ∇
 West Peds: 0
 West Entering: 44
 West Leg Total: 83

Cars	300
Trucks	5
Heavys	9
Totals	314



Cars	2	244	246
Trucks	0	10	10
Heavys	0	8	8
Totals	2	262	

Peds Cross: ∇
 South Peds: 0
 South Entering: 264
 South Leg Total: 578

Comments

9127 Montrose Rd

Afternoon Peak Diagram

Specified Period

From: 15:00:00

To: 18:00:00

One Hour Peak

From: 15:45:00

To: 16:45:00

Municipality: Niagara Falls
Site #: 000000001
Intersection: Montrose Rd & Driveway
TFR File #: 1
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Non-Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 877
 North Entering: 571
 North Peds: 0
 Peds Cross: ∇

Heavys	0	10	10
Trucks	0	3	3
Cars	5	553	558
Totals	5	566	



Heavys	8
Trucks	4
Cars	294
Totals	306

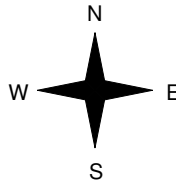
Heavys	Trucks	Cars	Totals
0	0	8	8



Montrose Rd



Driveway



Heavys	Trucks	Cars	Totals
0	0	25	25
1	0	13	14
1	0	38	



Montrose Rd



Peds Cross: ∇
 West Peds: 0
 West Entering: 39
 West Leg Total: 47

Cars	566
Trucks	3
Heavys	11
Totals	580



Cars	3	269	272
Trucks	0	4	4
Heavys	0	8	8
Totals	3	281	

Peds Cross: ∇
 South Peds: 0
 South Entering: 284
 South Leg Total: 864

Comments

9127 Montrose Rd

Total Count Diagram

Municipality: Niagara Falls
Site #: 000000001
Intersection: Montrose Rd & Driveway
TFR File #: 1
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Non-Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 4816
 North Entering: 2622
 North Peds: 0
 Peds Cross: ∇

Heavys	1	60	61
Trucks	3	34	37
Cars	92	2432	2524
Totals	96	2526	



Heavys	79
Trucks	44
Cars	2071
Totals	2194

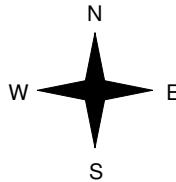
Heavys	Trucks	Cars	Totals
3	5	132	140



Montrose Rd



Driveway



Heavys	Trucks	Cars	Totals
1	2	128	131
4	3	79	86
5	5	207	



Montrose Rd



Peds Cross: ∇
 West Peds: 2
 West Entering: 217
 West Leg Total: 357

Cars	2511
Trucks	37
Heavys	64
Totals	2612



Cars	40	1943	1983
Trucks	2	42	44
Heavys	2	78	80
Totals	44	2063	

Peds Cross: ∇
 South Peds: 0
 South Entering: 2107
 South Leg Total: 4719

Comments

Montrose Rd @ Grassy Brook Rd

Morning Peak Diagram

Specified Period

From: 7:00:00
To: 10:00:00

One Hour Peak

From: 8:30:00
To: 9:30:00

Municipality: Niagara Falls
Site #: 000000002
Intersection: Montrose Rd & Grassy Brook Rd
TFR File #: 2
Count date: 1-Jun-2022

Weather conditions:
Cloudy/Dry
Person(s) who counted:
Cam

**** Non-Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 488
North Entering: 165
North Peds: 0
Peds Cross: \times

Heavys	0	3	3
Trucks	0	11	11
Cars	4	147	151
Totals	4	161	



Heavys	11
Trucks	8
Cars	304
Totals	323

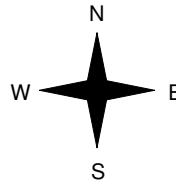
Heavys	Trucks	Cars	Totals
0	0	16	16



Montrose Rd



Grassy Brook Rd



Heavys	Trucks	Cars	Totals
0	0	0	0
0	0	1	1
0	0	1	



Montrose Rd

Peds Cross: \times
West Peds: 0
West Entering: 1
West Leg Total: 17

Cars	148
Trucks	11
Heavys	3
Totals	162



Cars	12	304	316
Trucks	0	8	8
Heavys	0	11	11
Totals	12	323	

Peds Cross: \times
South Peds: 0
South Entering: 335
South Leg Total: 497

Comments

Montrose Rd @ Grassy Brook Rd

Mid-day Peak Diagram

Specified Period

From: 11:00:00

To: 13:00:00

One Hour Peak

From: 12:00:00

To: 13:00:00

Municipality: Niagara Falls
Site #: 000000002
Intersection: Montrose Rd & Grassy Brook Rd
TFR File #: 2
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Non-Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 582

North Entering: 315

North Peds: 0

Peds Cross: \times

Heavys	0	9	9
Trucks	0	5	5
Cars	16	285	301
Totals	16	299	



Heavys	8
Trucks	10
Cars	249
Totals	267

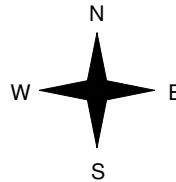
Heavys	0	Trucks	1	Cars	21	Totals	22
--------	---	--------	---	------	----	---------------	-----------



Montrose Rd



Grassy Brook Rd



Heavys	0	Trucks	0	Cars	2	Totals	2
0	1	3	4				
0	1	5					



Montrose Rd



Peds Cross: \times
 West Peds: 0
 West Entering: 6
 West Leg Total: 28

Cars	288
Trucks	6
Heavys	9
Totals	303



Cars	5	247	252
Trucks	1	10	11
Heavys	0	8	8
Totals	6	265	

Peds Cross: \times
 South Peds: 0
 South Entering: 271
 South Leg Total: 574

Comments

Montrose Rd @ Grassy Brook Rd

Afternoon Peak Diagram

Specified Period

From: 15:00:00

To: 18:00:00

One Hour Peak

From: 15:45:00

To: 16:45:00

Municipality: Niagara Falls
Site #: 000000002
Intersection: Montrose Rd & Grassy Brook Rd
TFR File #: 2
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Non-Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 862
 North Entering: 580
 North Peds: 0
 Peds Cross: ∇

Heavys	0	11	11
Trucks	0	2	2
Cars	1	566	567
Totals	1	579	



Heavys	8
Trucks	5
Cars	269
Totals	282

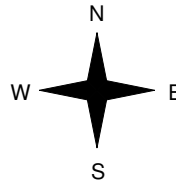
Heavys	Trucks	Cars	Totals
0	0	2	2



Montrose Rd



Grassy Brook Rd



Heavys	Trucks	Cars	Totals
0	0	10	10
0	0	4	4
0	0	14	



Montrose Rd



Peds Cross: ∇
 West Peds: 0
 West Entering: 14
 West Leg Total: 16

Cars	570
Trucks	2
Heavys	11
Totals	583



Cars	1	259	260
Trucks	0	5	5
Heavys	0	8	8
Totals	1	272	

Peds Cross: ∇
 South Peds: 0
 South Entering: 273
 South Leg Total: 856

Comments

Montrose Rd @ Grassy Brook Rd

Total Count Diagram

Municipality: Niagara Falls
Site #: 000000002
Intersection: Montrose Rd & Grassy Brook Rd
TFR File #: 2
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Non-Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 4720
 North Entering: 2615
 North Peds: 0
 Peds Cross: ∇

Heavys	0	62	62
Trucks	0	36	36
Cars	43	2474	2517
Totals	43	2572	



Heavys	77
Trucks	44
Cars	1984
Totals	2105

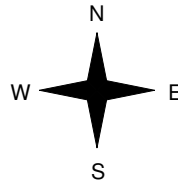
Heavys	Trucks	Cars	Totals
0	2	69	71



Montrose Rd



Grassy Brook Rd



Heavys	Trucks	Cars	Totals
0	1	28	29
0	1	20	21
0	2	48	



Montrose Rd



Peds Cross: ∇
 West Peds: 0
 West Entering: 50
 West Leg Total: 121

Cars	2494
Trucks	37
Heavys	62
Totals	2593



Cars	26	1956	1982
Trucks	2	43	45
Heavys	0	77	77
Totals	28	2076	

Peds Cross: ∇
 South Peds: 2
 South Entering: 2104
 South Leg Total: 4697

Comments

Montrose Rd @ Lyons Creek Rd

Morning Peak Diagram

Specified Period

From: 7:00:00
To: 10:00:00

One Hour Peak

From: 7:45:00
To: 8:45:00

Municipality: Niagara Falls
Site #: 000000003
Intersection: Montrose Rd & Lyons Creek Rd
TFR File #: 3
Count date: 1-Jun-2022

Weather conditions:
Cloudy/Dry
Person(s) who counted:
Cam

**** Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 476
North Entering: 182
North Peds: 0
Peds Cross: \times

Heavys	0	5	4	9
Trucks	1	3	4	8
Cars	14	77	74	165
Totals	15	85	82	



Heavys	7
Trucks	14
Cars	273
Totals	294

East Leg Total: 898
East Entering: 404
East Peds: 0
Peds Cross: \times

Heavys	Trucks	Cars	Totals
1	1	113	115

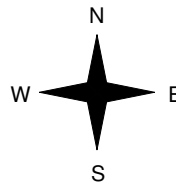


Montrose Rd

Cars	Trucks	Heavys	Totals
119	5	4	128
98	0	1	99
160	4	13	177
377	9	18	



Heavys	Trucks	Cars	Totals
0	0	20	20
4	1	89	94
1	0	1	2
5	1	110	



Lyons Creek Rd



Peds Cross: \times
West Peds: 0
West Entering: 116
West Leg Total: 231

Cars	238
Trucks	7
Heavys	19
Totals	264



Cars	1	134	300	435
Trucks	0	9	7	16
Heavys	0	3	11	14
Totals	1	146	318	

Peds Cross: \times
South Peds: 0
South Entering: 465
South Leg Total: 729

Comments

Montrose Rd @ Lyons Creek Rd

Mid-day Peak Diagram

Specified Period

From: 11:00:00

To: 13:00:00

One Hour Peak

From: 11:45:00

To: 12:45:00

Municipality: Niagara Falls
Site #: 000000003
Intersection: Montrose Rd & Lyons Creek Rd
TFR File #: 3
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Signalized Intersection ****

Major Road: Montrose Rd runs N/S

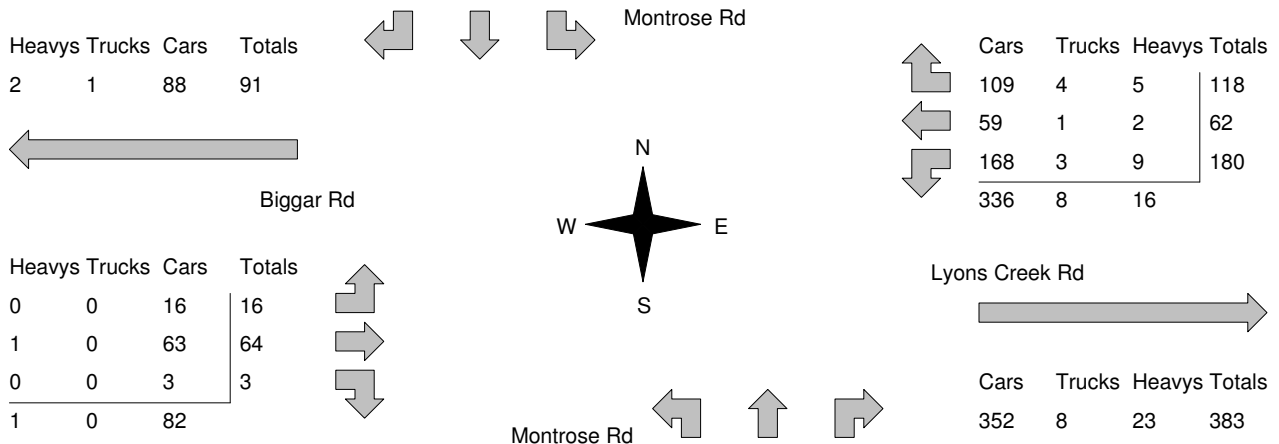
North Leg Total: 555
 North Entering: 283
 North Peds: 0
 Peds Cross: \times

Heavys	0	1	7	8
Trucks	0	3	2	5
Cars	25	132	113	270
Totals	25	136	122	



Heavys 10
 Trucks 9
 Cars 253
 Totals 272

East Leg Total: 743
 East Entering: 360
 East Peds: 0
 Peds Cross: \times



Peds Cross: \times
 West Peds: 0
 West Entering: 83
 West Leg Total: 174

Cars	303	Cars	4	128	176	308
Trucks	6	Trucks	0	5	6	11
Heavys	10	Heavys	0	5	15	20
Totals	319	Totals	4	138	197	

Peds Cross: \times
 South Peds: 0
 South Entering: 339
 South Leg Total: 658

Comments

Montrose Rd @ Lyons Creek Rd

Afternoon Peak Diagram

Specified Period

From: 15:00:00

To: 18:00:00

One Hour Peak

From: 16:15:00

To: 17:15:00

Municipality: Niagara Falls
Site #: 000000003
Intersection: Montrose Rd & Lyons Creek Rd
TFR File #: 3
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Signalized Intersection ****

Major Road: Montrose Rd runs N/S

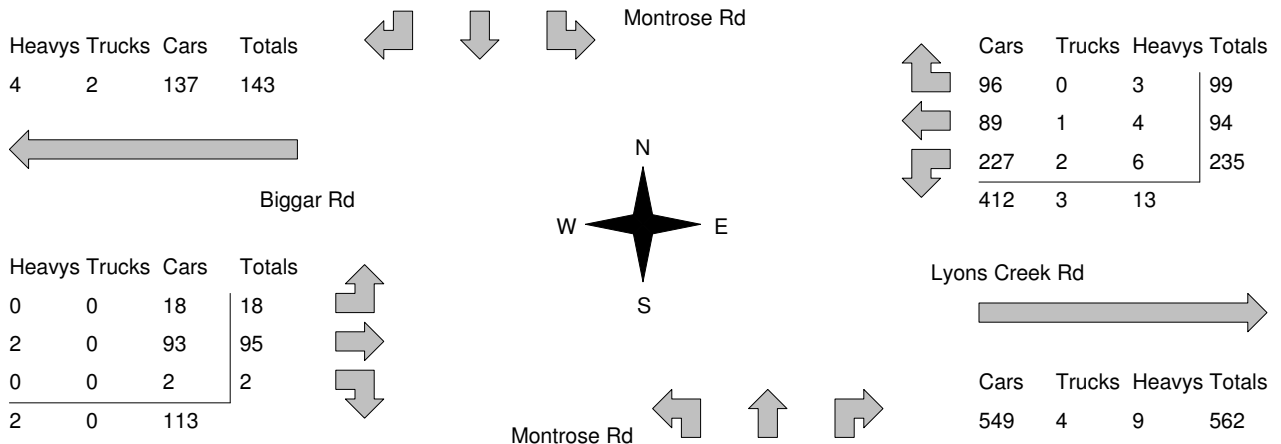
North Leg Total: 848
 North Entering: 582
 North Peds: 0
 Peds Cross: \times

Heavys	0	5	3	8
Trucks	1	1	1	3
Cars	47	298	226	571
Totals	48	304	230	



Heavys	6
Trucks	3
Cars	257
Totals	266

East Leg Total: 990
 East Entering: 428
 East Peds: 0
 Peds Cross: \times



Peds Cross: \times
 West Peds: 0
 West Entering: 115
 West Leg Total: 258

Cars	527
Trucks	3
Heavys	11
Totals	541

Peds Cross: \times
 South Peds: 0
 South Entering: 387
 South Leg Total: 928

Comments

Montrose Rd @ Lyons Creek Rd

Total Count Diagram

Municipality: Niagara Falls
Site #: 000000003
Intersection: Montrose Rd & Lyons Creek Rd
TFR File #: 3
Count date: 1-Jun-2022

Weather conditions:
 Cloudy/Dry
Person(s) who counted:
 Cam

**** Signalized Intersection ****

Major Road: Montrose Rd runs N/S

North Leg Total: 4606
 North Entering: 2565
 North Peds: 0
 Peds Cross: \times

Heavys	2	24	37	63
Trucks	5	15	13	33
Cars	203	1256	1010	2469
Totals	210	1295	1060	



Heavys	71
Trucks	57
Cars	1913
Totals	2041

East Leg Total: 6572
 East Entering: 3042
 East Peds: 0
 Peds Cross: \times

Heavys	Trucks	Cars	Totals
23	18	921	962

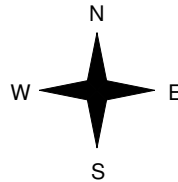


Montrose Rd

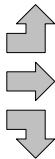
Cars	Trucks	Heavys	Totals
772	20	36	828
706	12	20	738
1372	25	79	1476
2850	57	135	



Biggar Rd



Heavys	Trucks	Cars	Totals
2	1	119	122
18	14	593	625
3	1	12	16
23	16	724	



Lyons Creek Rd



Cars	Trucks	Heavys	Totals
3331	74	125	3530

Peds Cross: \times
 West Peds: 1
 West Entering: 763
 West Leg Total: 1725

Cars	2640	Cars	12	1022	1728	2762
Trucks	41	Trucks	1	36	47	84
Heavys	106	Heavys	1	33	70	104
Totals	2787	Totals	14	1091	1845	



Montrose Rd

Peds Cross: \times
 South Peds: 0
 South Entering: 2950
 South Leg Total: 5737

Comments

Signal Code: 047098

Intersection: RR47 (LYON'S CREEK RD.) & RR98 (MONTROSE RD.)

Municipality: niagarafalls

Owner: Region

Last Modified: 2020-04-28 3:39:40 PM

Timing Parameters	EBD & WBD LYON'S CREEK RD.	NBD & SBD MONTROSE RD.	n/a	n/a	n/a	n/a
Min Green	10	10	0	0	0	0
Walk	8	10	0	0	0	0
Ped Clearance	12	15	0	0	0	0
Vehicle Ext.	6	6	0	0	0	0
Max Green	40	45	0	0	0	0
Yellow	4.1	4.1	0	0	0	0
All Red	2.2	2.2	0	0	0	0

Offset

Minimum Cycle	32.6	0
Pedestrian Cycle	57.6	
Maximum Cycle	97.6	0
Operation	FA	

Installed On: 2009-02-12

Count Date: 2015-08-26

FA = Fully Actuated

SA = Semi Actuated

FT = Fixed Time

Copyright 2001 © Regional Niagara

Appendix C

Base Year Traffic Operations



Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway

Base Year AM Peak Hour

	↖	↗	↙	↘	↕	↔
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖			↘	↔	↔
Traffic Volume (vph)	9	5	17	266	195	24
Future Volume (vph)	9	5	17	266	195	24
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.955				0.985	
Flt Protected	0.968			0.997		
Satd. Flow (prot)	1326	0	0	1617	1585	0
Flt Permitted	0.968			0.997		
Satd. Flow (perm)	1326	0	0	1617	1585	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	119.1			195.6	272.2	
Travel Time (s)	8.9			10.1	14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	11%	40%	18%	6%	8%	4%
Adj. Flow (vph)	10	5	18	289	212	26
Shared Lane Traffic (%)						
Lane Group Flow (vph)	15	0	0	307	238	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	40.3%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway

Base Year AM Peak Hour

	↖	↗	↙	↘	↕	↔
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖			↘	↔	↔
Traffic Volume (veh/h)	9	5	17	266	195	24
Future Volume (Veh/h)	9	5	17	266	195	24
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	5	18	289	212	26
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	550	225	238			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	550	225	238			
tC, single (s)	6.5	6.6	4.3			
tC, 2 stage (s)						
tF (s)	3.6	3.7	2.4			
p0 queue free %	98	99	99			
cM capacity (veh/h)	474	728	1241			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	15	307	238
Volume Left	10	18	0
Volume Right	5	0	26
cSH	536	1241	1700
Volume to Capacity	0.03	0.01	0.14
Queue Length 95th (m)	0.6	0.3	0.0
Control Delay (s)	11.9	0.6	0.0
Lane LOS	B	A	
Approach Delay (s)	11.9	0.6	0.0
Approach LOS	B		

Intersection Summary

Average Delay	0.6
Intersection Capacity Utilization	40.3%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
Base Year AM Peak Hour

	↖		↗		↘	
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖		↗		↘	
Traffic Volume (vph)	0	1	12	323	161	4
Future Volume (vph)	0	1	12	323	161	4
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.865		0.997			
Flt Protected			0.998			
Satd. Flow (prot)	1497	0	0	1633	1586	0
Flt Permitted			0.998			
Satd. Flow (perm)	1497	0	0	1633	1586	0
Link Speed (k/h)	40		70		70	
Link Distance (m)	110.1		214.2		105.8	
Travel Time (s)	9.9		11.0		5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	0%	0%	6%	9%	0%
Adj. Flow (vph)	0	1	13	351	175	4
Shared Lane Traffic (%)						
Lane Group Flow (vph)	1	0	0	364	179	0
Sign Control	Stop		Free		Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	39.0%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
2: Montrose Rd & Grassy Brooks Rd

210701
Base Year AM Peak Hour

	↖		↗		↘	
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖		↗		↘	
Traffic Volume (veh/h)	0	1	12	323	161	4
Future Volume (Veh/h)	0	1	12	323	161	4
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1	13	351	175	4
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	554	177	179			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	554	177	179			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	99			
cM capacity (veh/h)	489	871	1409			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	1	364	179
Volume Left	0	13	0
Volume Right	1	0	4
cSH	871	1409	1700
Volume to Capacity	0.00	0.01	0.11
Queue Length 95th (m)	0.0	0.2	0.0
Control Delay (s)	9.1	0.4	0.0
Lane LOS	A	A	
Approach Delay (s)	9.1	0.4	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	39.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

Base Year AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↙	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	20	94	2	177	99	128	1	146	318	82	85	15
Future Volume (vph)	20	94	2	177	99	128	1	146	318	82	85	15
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998			0.957			0.908			0.989	
Flt Protected		0.991			0.979						0.978	
Satd. Flow (prot)	0	1633	0	0	1518	0	0	1474	0	0	1532	0
Flt Permitted		0.905			0.815						0.635	
Satd. Flow (perm)	0	1491	0	0	1263	0	0	1474	0	0	994	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			30			155			6	
Link Speed (k/h)		80			80			70			70	
Link Distance (m)		446.7			423.1			424.8			983.5	
Travel Time (s)		20.1			19.0			21.8			50.6	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Adj. Flow (vph)	22	102	2	192	108	139	1	159	346	89	92	16
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	126	0	0	439	0	0	506	0	0	197	0
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)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	26.3	26.3		26.3	26.3		31.3	31.3		31.3	31.3	
Total Split (s)	46.3	46.3		46.3	46.3		51.3	51.3		51.3	51.3	
Total Split (%)	47.4%	47.4%		47.4%	47.4%		52.6%	52.6%		52.6%	52.6%	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.2	2.2		2.2	2.2		2.2	2.2		2.2	2.2	
Lost Time Adjust (s)		-2.3			-2.3			-2.3			-2.3	
Total Lost Time (s)		4.0			4.0			4.0			4.0	
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Act Effect Green (s)		33.9			33.9			31.9			31.9	
Actuated g/C Ratio		0.46			0.46			0.43			0.43	
v/c Ratio		0.19			0.74			0.70			0.46	
Control Delay		15.0			26.7			18.2			19.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		15.0			26.7			18.2			19.6	
LOS		B			C			B			B	
Approach Delay		15.0			26.7			18.2			19.6	
Approach LOS		B			C			B			B	
Queue Length 50th (m)		9.9			44.8			39.7			18.9	
Queue Length 95th (m)		25.6			#114.1			80.5			39.4	
Internal Link Dist (m)		422.7			399.1			400.8			959.5	
Turn Bay Length (m)												

Lanes, Volumes, Timings

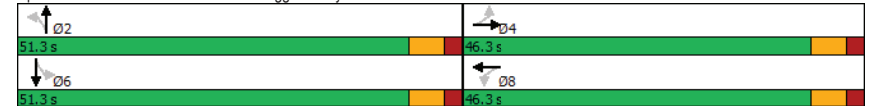
210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

Base Year AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↙	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)		912			783			1050			676	
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		0.14			0.56			0.48			0.29	
Intersection Summary												
Area Type:	Other											
Cycle Length:	97.6											
Actuated Cycle Length:	74.4											
Natural Cycle:	60											
Control Type:	Actuated-Uncoordinated											
Maximum v/c Ratio:	0.74											
Intersection Signal Delay:	21.1						Intersection LOS: C					
Intersection Capacity Utilization:	81.8%						ICU Level of Service D					
Analysis Period (min):	15											
#	95th percentile volume exceeds capacity, queue may be longer.											
	Queue shown is maximum after two cycles.											

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis
3: Montrose Rd & Biggar Rd/Lyons Creek Rd

210701
Base Year AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Volume (vph)	20	94	2	177	99	128	1	146	318	82	85	15
Future Volume (vph)	20	94	2	177	99	128	1	146	318	82	85	15
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0			4.0			4.0			4.0		
Lane Util. Factor	1.00			1.00			1.00			1.00		
Frt	1.00			0.96			0.91			0.99		
Fit Protected	0.99			0.98			1.00			0.98		
Satd. Flow (prot)	1633			1517			1473			1532		
Fit Permitted	0.90			0.81			1.00			0.63		
Satd. Flow (perm)	1490			1263			1473			994		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	22	102	2	192	108	139	1	159	346	89	92	16
RTOR Reduction (vph)	0	1	0	0	16	0	0	88	0	0	3	0
Lane Group Flow (vph)	0	125	0	0	423	0	0	418	0	0	194	0
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	4				8				2		6	
Permitted Phases	4		8				2		6			
Actuated Green, G (s)	31.4		31.4		31.4		29.5		29.5		29.5	
Effective Green, g (s)	33.7		33.7		33.7		31.8		31.8		31.8	
Actuated g/C Ratio	0.46		0.46		0.43		0.43		0.43		0.43	
Clearance Time (s)	6.3		6.3		6.3		6.3		6.3		6.3	
Vehicle Extension (s)	6.0		6.0		6.0		6.0		6.0		6.0	
Lane Grp Cap (vph)	683		579		637		430					
v/s Ratio Prot												
v/s Ratio Perm	0.08		c0.33		0.28		0.19					
v/c Ratio	0.18		0.73		0.66		0.45					
Uniform Delay, d1	11.8		16.2		16.5		14.7					
Progression Factor	1.00		1.00		1.00		1.00					
Incremental Delay, d2	0.4		6.4		3.9		2.1					
Delay (s)	12.1		22.6		20.4		16.8					
Level of Service	B		C		C		B					
Approach Delay (s)	12.1		22.6		20.4		16.8					
Approach LOS	B		C		C		B					

Intersection Summary			
HCM 2000 Control Delay	19.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	73.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings
1: Montrose Rd & Private Driveway

210701
Base Year PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔			↔	↔	
Traffic Volume (vph)	25	14	3	281	566	5
Future Volume (vph)	25	14	3	281	566	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.952				0.999	
Fit Protected	0.969					
Satd. Flow (prot)	1557		0		1665 1695 0	
Fit Permitted	0.969					
Satd. Flow (perm)	1557		0		1665 1695 0	
Link Speed (k/h)	48		70		70	
Link Distance (m)	119.1		195.6		272.2	
Travel Time (s)	8.9		10.1		14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	7%	0%	4%	2%	0%
Adj. Flow (vph)	27	15	3	305	615	5
Shared Lane Traffic (%)						
Lane Group Flow (vph)	42	0	0	308	620	0
Sign Control	Stop		Free		Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	42.7% ICU Level of Service A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
1: Montrose Rd & Private Driveway

210701
Base Year PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	25	14	3	281	566	5
Future Volume (Veh/h)	25	14	3	281	566	5
Sign Control	Stop		Free			
Grade	0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	15	3	305	615	5
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	928	618	620			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	928	618	620			
tC, single (s)	6.4	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.2			
p0 queue free %	91	97	100			
cM capacity (veh/h)	299	481	970			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	42	308	620			
Volume Left	27	3	0			
Volume Right	15	0	5			
cSH	345	970	1700			
Volume to Capacity	0.12	0.00	0.36			
Queue Length 95th (m)	3.1	0.1	0.0			
Control Delay (s)	16.9	0.1	0.0			
Lane LOS	C	A				
Approach Delay (s)	16.9	0.1	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			0.8			
Intersection Capacity Utilization			42.7%	ICU Level of Service	A	
Analysis Period (min)			15			

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
Base Year PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	10	4	1	272	579	1
Future Volume (vph)	10	4	1	272	579	1
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Fit	0.964					
Fit Protected	0.965					
Satd. Flow (prot)	1610	0	0	1648	1697	0
Fit Permitted	0.965					
Satd. Flow (perm)	1610	0	0	1648	1697	0
Link Speed (k/h)	40		70		70	
Link Distance (m)	110.1		214.2		105.8	
Travel Time (s)	9.9		11.0		5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	5%	2%	0%
Adj. Flow (vph)	11	4	1	296	629	1
Shared Lane Traffic (%)						
Lane Group Flow (vph)	15	0	0	297	630	0
Sign Control	Stop		Free		Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	43.2%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

210701

2: Montrose Rd & Grassy Brooks Rd

Base Year PM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↖ ↙ ↚					
Traffic Volume (veh/h)	10	4	1	272	579	1
Future Volume (Veh/h)	10	4	1	272	579	1
Sign Control	Stop		Free Free			
Grade	0%		0% 0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	4	1	296	629	1
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	928	630	630			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	928	630	630			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	99	100			
cM capacity (veh/h)	300	486	962			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	15	297	630			
Volume Left	11	1	0			
Volume Right	4	0	1			
cSH	334	962	1700			
Volume to Capacity	0.04	0.00	0.37			
Queue Length 95th (m)	1.1	0.0	0.0			
Control Delay (s)	16.3	0.0	0.0			
Lane LOS	C	A				
Approach Delay (s)	16.3	0.0	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay	0.3					
Intersection Capacity Utilization	43.2%		ICU Level of Service		A	
Analysis Period (min)	15					

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

Base Year PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔ ↕ ↗ ↘ ↖ ↙ ↚ ↛ ↜ ↝ ↞ ↠ ↡ ↢ ↣ ↤ ↥ ↦ ↧ ↨ ↩ ↪ ↫ ↬ ↭ ↮ ↯ ↰ ↱ ↲ ↳ ↴ ↵ ↶ ↷ ↸ ↹ ↺ ↻ ↼ ↽ ↾ ↿ ↺ ↻ ↼ ↽ ↾ ↿ ↺ ↻ ↼ ↽ ↾ ↿ ↺ ↻ ↼ ↽ ↾ ↿											
Traffic Volume (vph)	18	95	2	235	94	99	1	149	237	230	304	48
Future Volume (vph)	18	95	2	235	94	99	1	149	237	230	304	48
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fit	0.998		0.969		0.917		0.989		0.981			0.989
Fit Protected	0.992		0.973		0.917		0.981		0.981			0.981
Satd. Flow (prot)	0	1686	0	0	1577	0	0	1535	0	0	1646	0
Fit Permitted	0.907		0.766		0.999		0.617		0.617			0.617
Satd. Flow (perm)	0	1541	0	0	1242	0	0	1534	0	0	1035	0
Right Turn on Red			Yes		Yes		Yes		Yes			Yes
Satd. Flow (RTOR)	1		20		113		6		6			6
Link Speed (k/h)	80		80		70		70		70			70
Link Distance (m)	446.7		423.1		424.8		983.5		50.6			50.6
Travel Time (s)	20.1		19.0		21.8		50.6		50.6			50.6
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Adj. Flow (vph)	20	103	2	255	102	108	1	162	258	250	330	52
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	125	0	0	465	0	0	421	0	0	632	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	4		8		2		6		6			6
Permitted Phases	4		8		2		6		6			6
Detector Phase	4	4		8	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		10.0	10.0		10.0	10.0	
Minimum Split (s)	26.3	26.3		26.3	26.3		31.3	31.3		31.3	31.3	
Total Split (s)	46.3	46.3		46.3	46.3		51.3	51.3		51.3	51.3	
Total Split (%)	47.4%	47.4%		47.4%	47.4%		52.6%	52.6%		52.6%	52.6%	
Yellow Time (s)	4.1	4.1		4.1	4.1		4.1	4.1		4.1	4.1	
All-Red Time (s)	2.2	2.2		2.2	2.2		2.2	2.2		2.2	2.2	
Lost Time Adjust (s)	-2.3		-2.3		-2.3		-2.3		-2.3			-2.3
Total Lost Time (s)	4.0		4.0		4.0		4.0		4.0			4.0
Lead/Lag												
Lead-Lag Optimize?												
Recall Mode	None		None		Min		Min		Min			Min
Act Effect Green (s)	39.6		39.6		47.4		47.4		47.4			47.4
Actuated g/C Ratio	0.42		0.42		0.50		0.50		0.50			0.50
v/c Ratio	0.19		0.88		1.22		1.22		1.22			1.22
Control Delay	18.1		44.1		14.5		140.5		0.0			0.0
Queue Delay	0.0		0.0		0.0		0.0		0.0			0.0
Total Delay	18.1		44.1		14.5		140.5		0.0			140.5
LOS	B		D		B		F		F			F
Approach Delay	18.1		44.1		14.5		140.5		0.0			140.5
Approach LOS	B		D		B		F		F			F
Queue Length 50th (m)	13.9		72.7		37.3		~148.6		~148.6			~148.6
Queue Length 95th (m)	25.3		#129.8		63.4		#213.5		#213.5			#213.5
Internal Link Dist (m)	422.7		399.1		400.8		959.5		959.5			959.5
Turn Bay Length (m)												

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

Base Year PM Peak Hour

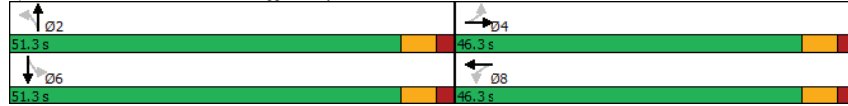


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Base Capacity (vph)		688			565			821			519	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.18			0.82			0.51			1.22	

Intersection Summary

Area Type:	Other
Cycle Length:	97.6
Actuated Cycle Length:	95
Natural Cycle:	65
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.22
Intersection Signal Delay:	71.6
Intersection LOS:	E
Intersection Capacity Utilization:	101.4%
ICU Level of Service:	G
Analysis Period (min):	15
~ Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

Base Year PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	18	95	2	235	94	99	1	149	237	230	304	48
Future Volume (vph)	18	95	2	235	94	99	1	149	237	230	304	48
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0			4.0			4.0			4.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Flt		1.00			0.97			0.92			0.99	
Flt Protected		0.99			0.97			1.00			0.98	
Satd. Flow (prot)		1685			1577			1535			1645	
Flt Permitted		0.91			0.77			1.00			0.62	
Satd. Flow (perm)		1540			1241			1534			1035	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	20	103	2	255	102	108	1	162	258	250	330	52
RTOR Reduction (vph)	0	1	0	0	12	0	0	57	0	0	3	0
Lane Group Flow (vph)	0	124	0	0	453	0	0	364	0	0	629	0
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		37.3			37.3			45.1			45.1	
Effective Green, g (s)		39.6			39.6			47.4			47.4	
Actuated g/C Ratio		0.42			0.42			0.50			0.50	
Clearance Time (s)		6.3			6.3			6.3			6.3	
Vehicle Extension (s)		6.0			6.0			6.0			6.0	
Lane Grp Cap (vph)		641			517			765			516	
v/s Ratio Prot												
v/s Ratio Perm		0.08			0.37			0.24			0.61	
v/c Ratio		0.19			0.88			0.48			1.22	
Uniform Delay, d1		17.6			25.5			15.6			23.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.4			17.1			1.3			115.2	
Delay (s)		18.0			42.6			17.0			139.0	
Level of Service		B			D			B			F	
Approach Delay (s)		18.0			42.6			17.0			139.0	
Approach LOS		B			D			B			F	

Intersection Summary

HCM 2000 Control Delay	71.2	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	95.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Appendix D

TTS Survey Data



Wed Jun 15 2022 16:21:44 GMT-0400 (Eastern Daylight Time) - Run Time: 2311ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: 2006 GTA zone of origin - gta06_orig

Column: 2006 GTA zone of destination - gta06_dest

Filters:

2006 GTA zone of destination - gta06_dest In 6246

Trip 2016

Table:

	6246
6027	17
6040	20
6071	28
6106	38
6117	14
6146	15
6170	36
6199	4
6219	15
6222	13
6225	32
6226	90
6248	8
6256	16
6259	16
6268	29
6296	13
6306	5
6315	26
6347	23
6362	7

Wed Jun 15 2022 16:25:35 GMT-0400 (Eastern Daylight Time) - Run Time: 2352ms

Cross Tabulation Query Form - Trip - 2016 v1.1

Row: 2006 GTA zone of destination - gta06_dest

Column: 2006 GTA zone of origin - gta06_orig

Filters:

2006 GTA zone of origin - gta06_orig In 6246

Trip 2016

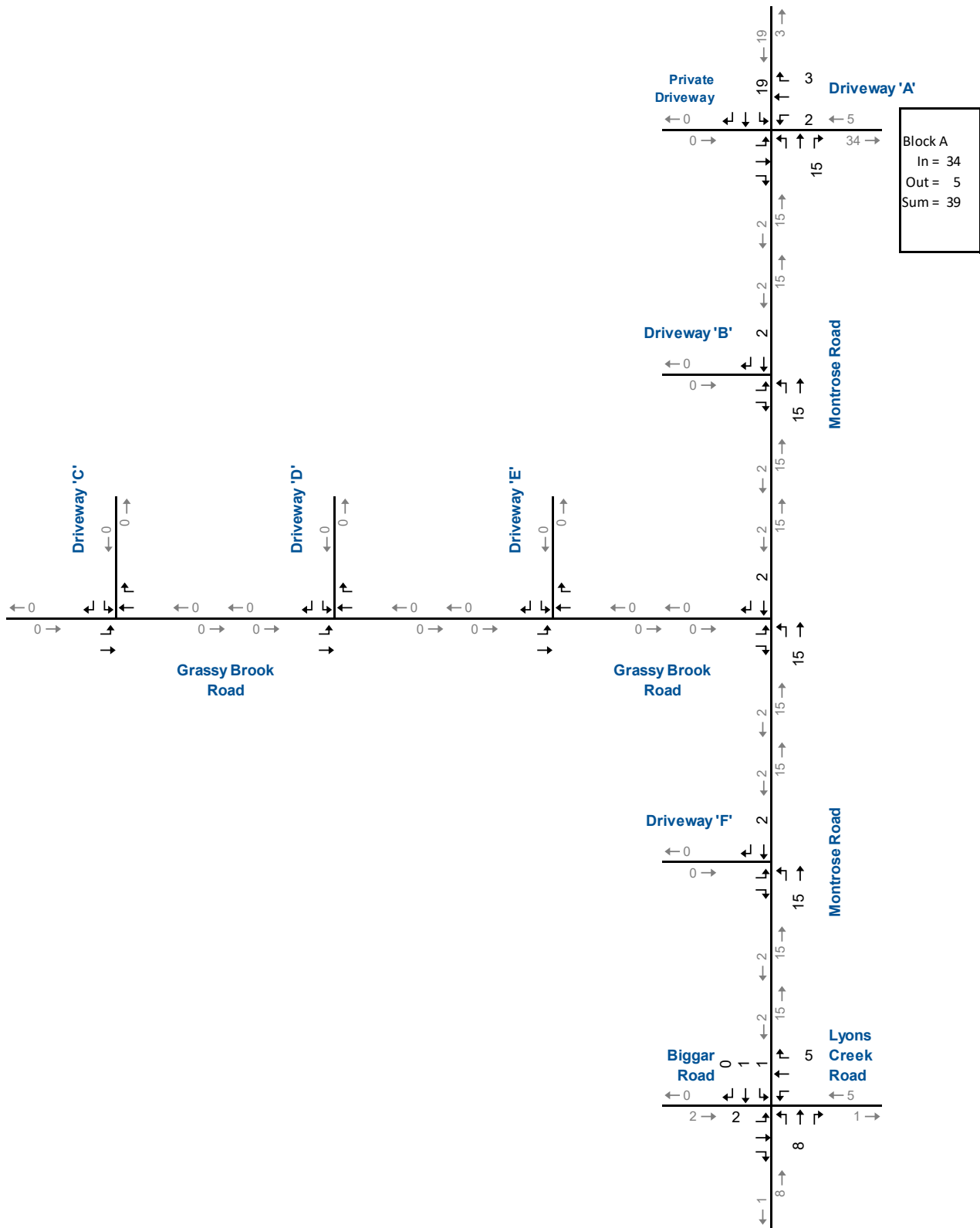
Table:

	6246
6027	17
6103	28
6106	38
6117	14
6146	15
6173	36
6199	4
6207	15
6225	88
6226	47
6248	8
6256	16
6259	16
6262	20
6268	29
6296	13
6306	5
6333	26
6347	23
6362	7

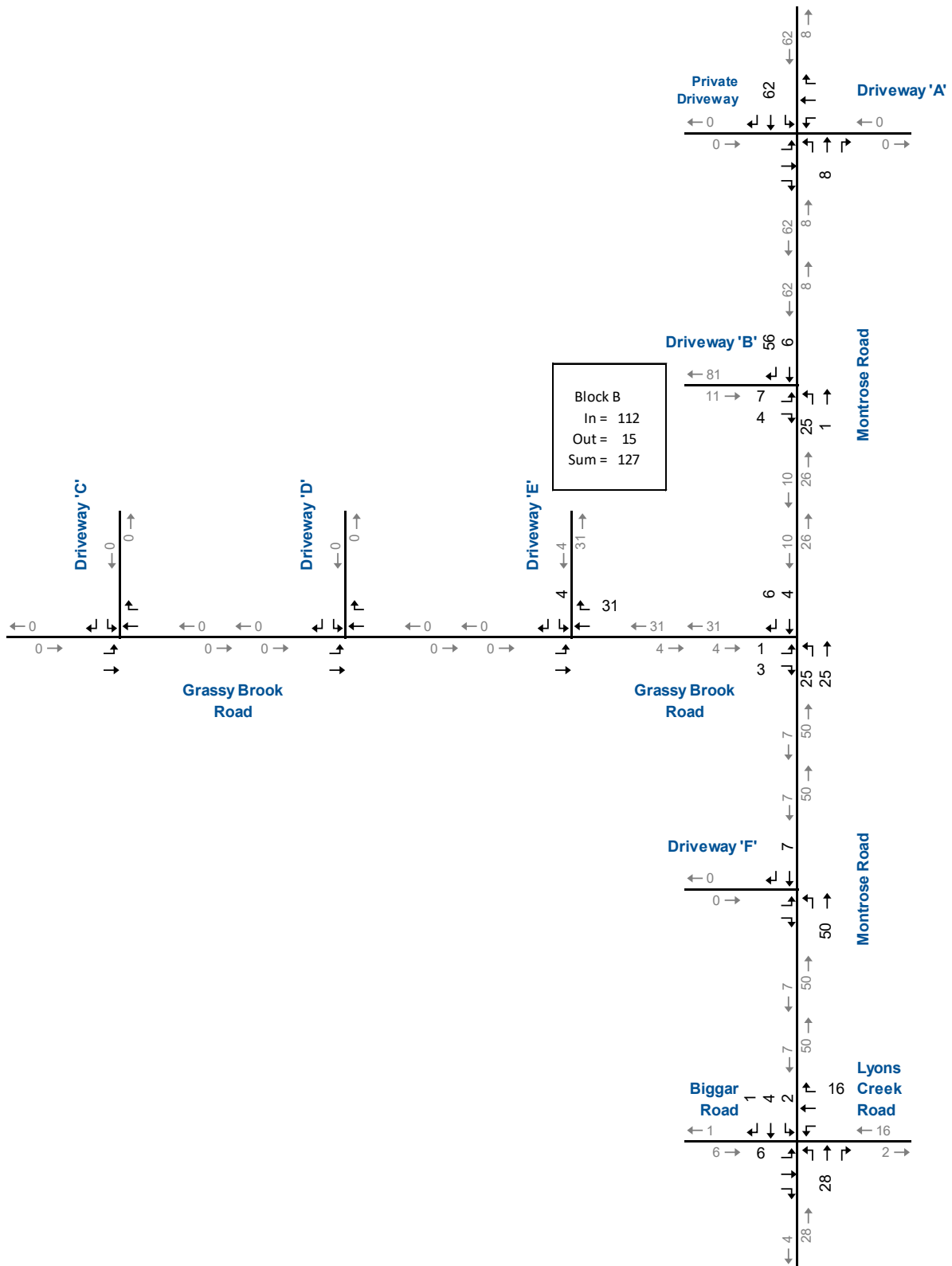
Appendix E

Site-Generated Traffic Forecast

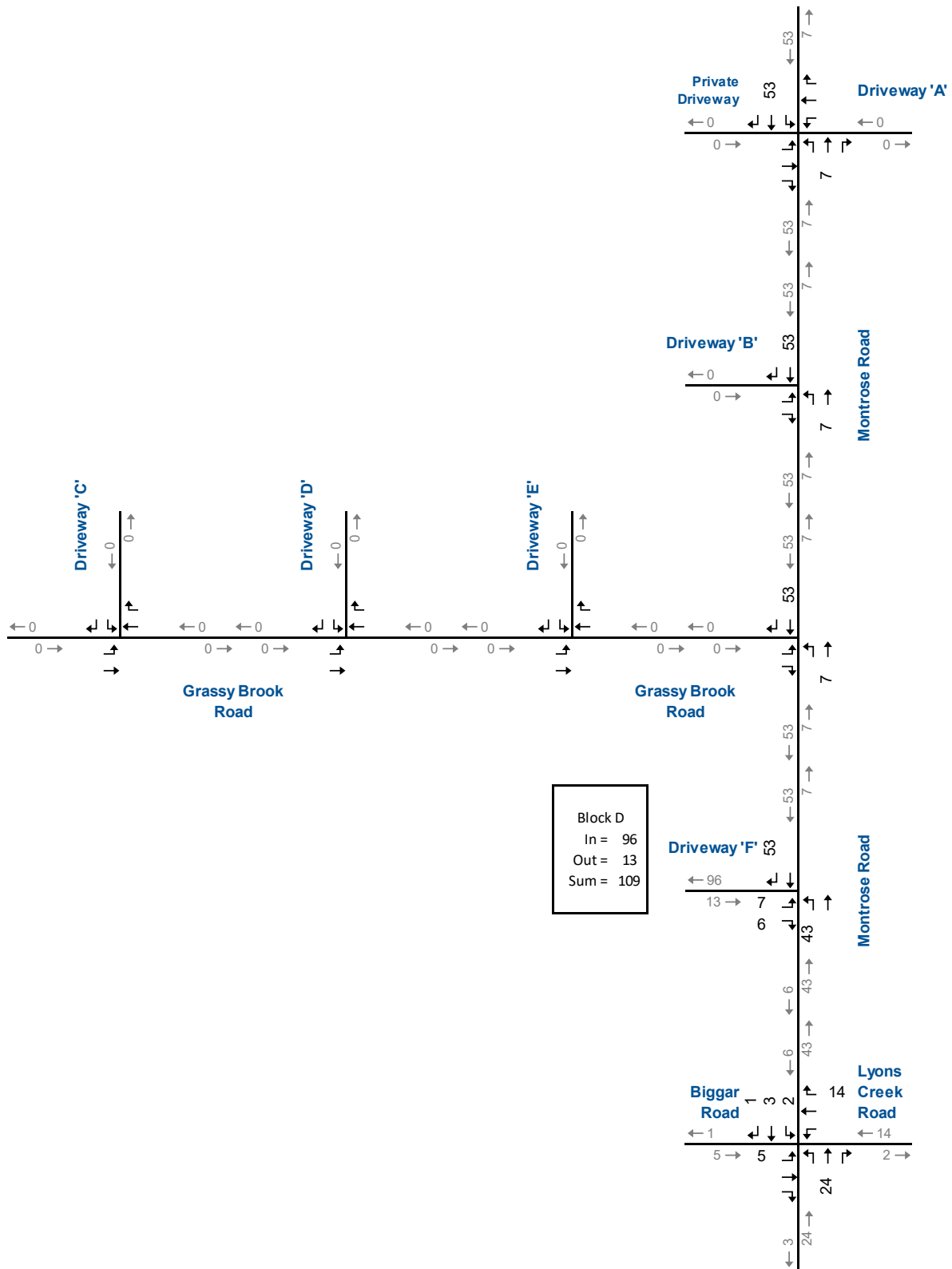




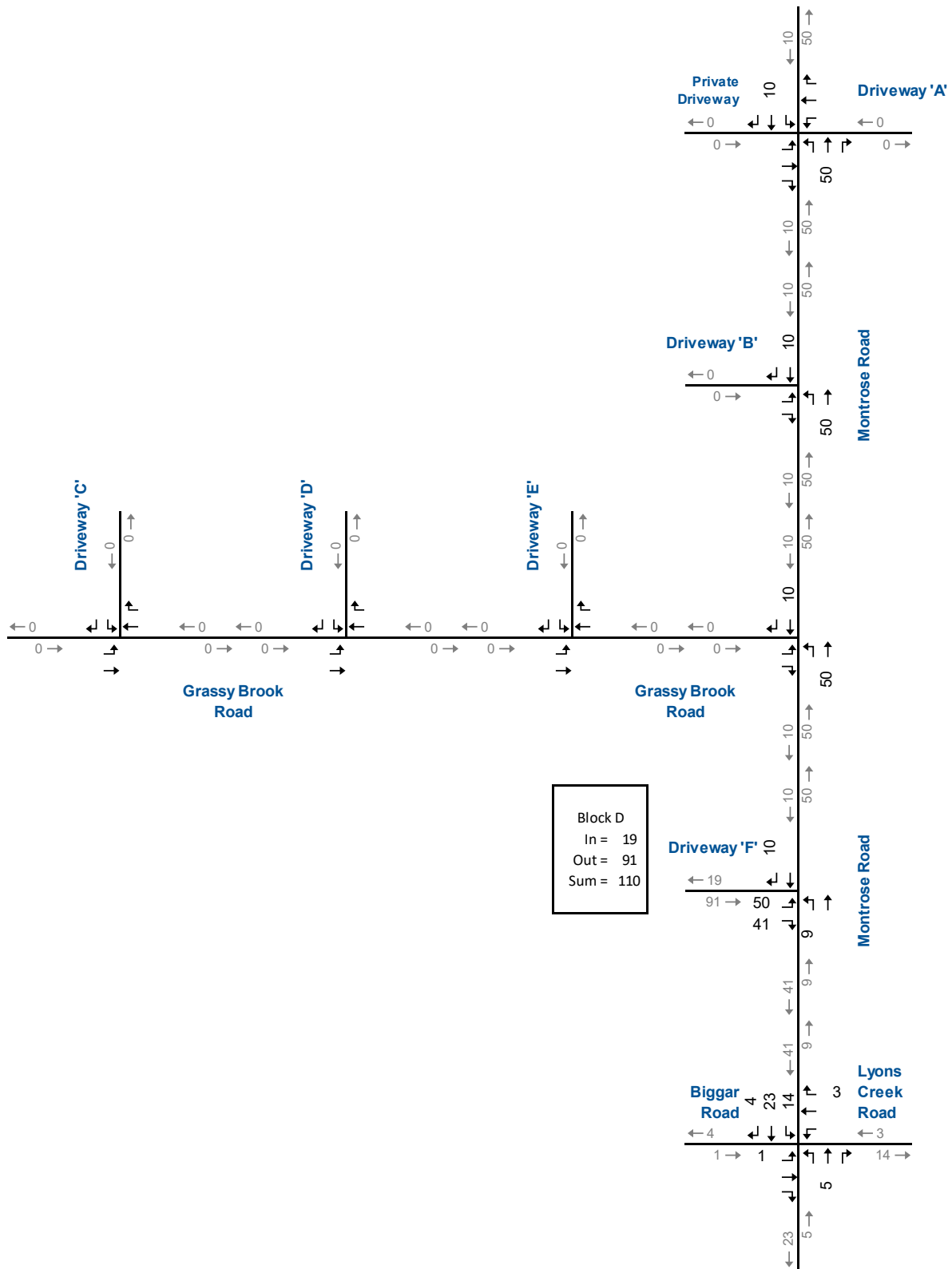
Site Generated Traffic Volumes Block A – AM Peak Hour



Site Generated Traffic Volumes Block B – AM Peak Hour



Site Generated Traffic Volumes Block D – AM Peak Hour

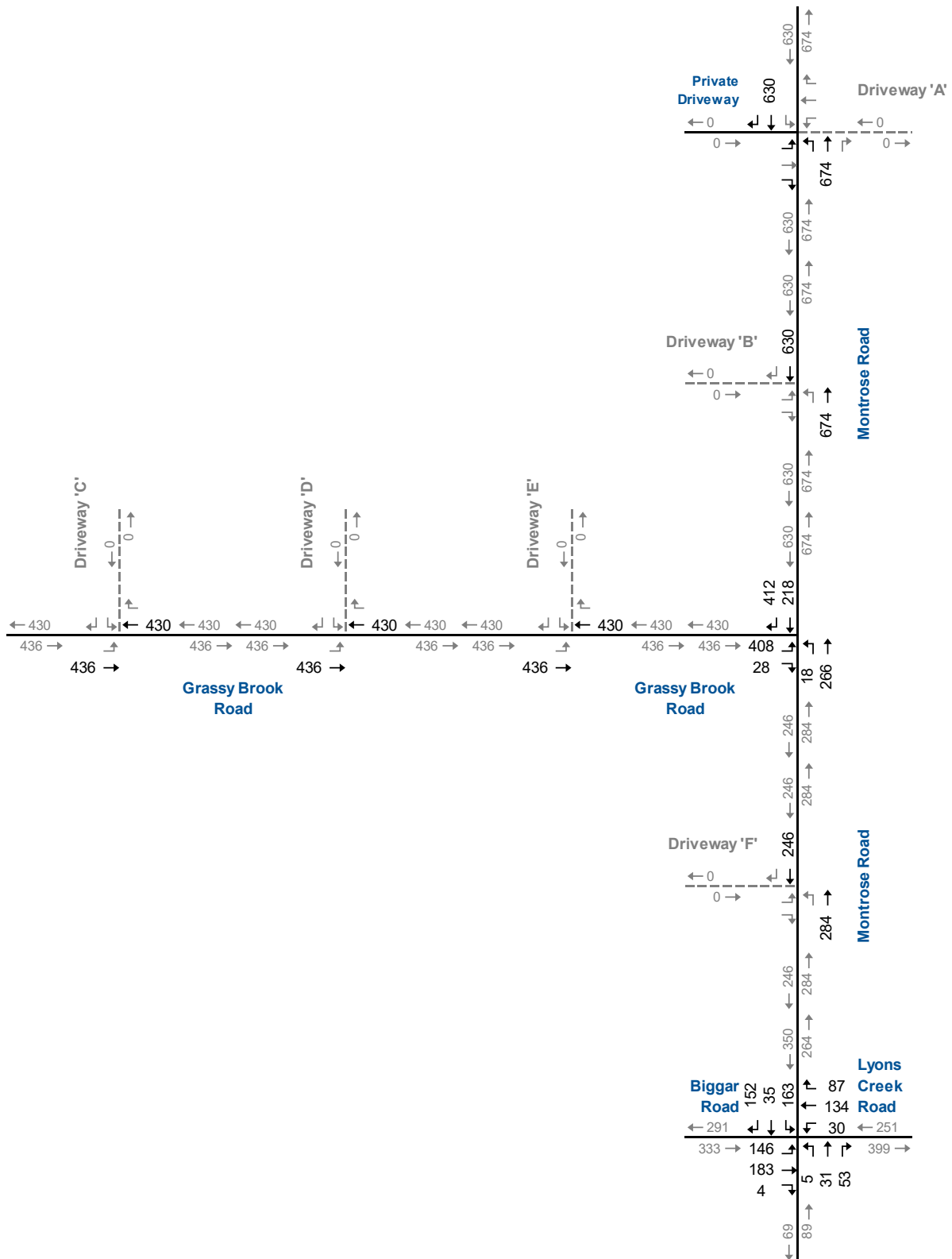


Site Generated Traffic Volumes Block D – PM Peak Hour

Appendix F

Background Traffic Forecast





Background Development Traffic Volumes PM Peak Hour

Appendix G

Opening Date Background Traffic Operations



Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway

2024 Background AM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	T			T	T	
Traffic Volume (vph)	9	5	17	779	729	24
Future Volume (vph)	9	5	17	779	729	24
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.955			0.996		
Flt Protected	0.968			0.999		
Satd. Flow (prot)	1326	0	0	1627	1598	0
Flt Permitted	0.968			0.999		
Satd. Flow (perm)	1326	0	0	1627	1598	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	119.1			195.6	272.2	
Travel Time (s)	8.9			10.1	14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	11%	40%	18%	6%	8%	4%
Adj. Flow (vph)	10	5	18	847	792	26
Shared Lane Traffic (%)						
Lane Group Flow (vph)	15	0	0	865	818	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 69.3%

ICU Level of Service C

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway

2024 Background AM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	T			T	T	
Traffic Volume (veh/h)	9	5	17	779	729	24
Future Volume (Veh/h)	9	5	17	779	729	24
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	5	18	847	792	26
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	1688	805	818			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1688	805	818			
tC, single (s)	6.5	6.6	4.3			
tC, 2 stage (s)						
tF (s)	3.6	3.7	2.4			
p0 queue free %	90	98	98			
cM capacity (veh/h)	95	329	745			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	15	865	818
Volume Left	10	18	0
Volume Right	5	0	26
cSH	125	745	1700
Volume to Capacity	0.12	0.02	0.48
Queue Length 95th (m)	3.0	0.6	0.0
Control Delay (s)	37.7	0.7	0.0
Lane LOS	E	A	
Approach Delay (s)	37.7	0.7	0.0
Approach LOS	E		

Intersection Summary

Average Delay

0.7

Intersection Capacity Utilization

69.3%

ICU Level of Service

C

Analysis Period (min)

15

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
2024 Background AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↑	↑	↔
Traffic Volume (vph)	386	19	41	451	363	336
Future Volume (vph)	386	19	41	451	363	336
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			0.0
Storage Lanes	1	1	1			0
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.935	
Fit Protected	0.950		0.950			
Satd. Flow (prot)	1612	1471	1644	1633	1546	0
Fit Permitted	0.950		0.950			
Satd. Flow (perm)	1612	1471	1644	1633	1546	0
Link Speed (k/h)	40			70	70	
Link Distance (m)	110.1			214.2	105.8	
Travel Time (s)	9.9			11.0	5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	0%	0%	6%	9%	0%
Adj. Flow (vph)	420	21	45	490	395	365
Shared Lane Traffic (%)						
Lane Group Flow (vph)	420	21	45	490	760	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	72.9%
ICU Level of Service	C
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
2: Montrose Rd & Grassy Brooks Rd

210701
2024 Background AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement	↔	↔	↔	↑	↑	↔
Lane Configurations	↔	↔	↔	↑	↑	↔
Traffic Volume (veh/h)	386	19	41	451	363	336
Future Volume (Veh/h)	386	19	41	451	363	336
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	420	21	45	490	395	365
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLT	None	
Median storage (veh)				2		
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1158	578	760			
vC1, stage 1 conf vol	578					
vC2, stage 2 conf vol	580					
vCu, unblocked vol	1158	578	760			
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 %	0	96	95			
cM capacity (veh/h)	422	520	861			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1
Volume Total	420	21	45	490	760
Volume Left	420	0	45	0	0
Volume Right	0	21	0	0	365
cSH	422	520	861	1700	1700
Volume to Capacity	1.00	0.04	0.05	0.29	0.45
Queue Length 95th (m)	93.4	0.9	1.2	0.0	0.0
Control Delay (s)	74.6	12.2	9.4	0.0	0.0
Lane LOS	F	B	A		
Approach Delay (s)	71.6		0.8		0.0
Approach LOS	F				

Intersection Summary

Average Delay	18.4
Intersection Capacity Utilization	72.9%
ICU Level of Service	C
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Background AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↗	↘	↙	↖
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖↖	↖	↖↖	↖↖	↖	↖	↖↖	↖	↖↖	↖↖	↖
Traffic Volume (vph)	116	218	7	210	295	311	8	183	340	159	112	120
Future Volume (vph)	116	218	7	210	295	311	8	183	340	159	112	120
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.557			0.950			0.675			0.950		
Satd. Flow (perm)	964	3131	981	2899	3256	1375	1168	3044	1388	2899	3017	1375
Right Turn on Red			Yes		Yes		Yes		Yes		Yes	
Satd. Flow (RTOR)			117		338		370		370		130	
Link Speed (k/h)	80			80			70			70		
Link Distance (m)	446.7			423.1			424.8			184.5		
Travel Time (s)	20.1			19.0			21.8			9.5		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Adj. Flow (vph)	126	237	8	228	321	338	9	199	370	173	122	130
Shared Lane Traffic (%)												
Lane Group Flow (vph)	126	237	8	228	321	338	9	199	370	173	122	130
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3		8		2		1		6
Permitted Phases	4		4			8	2		2			6
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	10.0	47.3	47.3	48.7	48.7	48.7	9.0	57.7	57.7
Total Split (%)	35.5%	35.5%	35.5%	9.5%	45.0%	45.0%	46.4%	46.4%	46.4%	8.6%	55.0%	55.0%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effct Green (s)	18.7	18.7	18.7	6.2	28.9	28.9	18.6	18.6	18.6	5.1	27.8	27.8
Actuated g/C Ratio	0.29	0.29	0.29	0.10	0.44	0.44	0.29	0.29	0.29	0.08	0.43	0.43
v/c Ratio	0.46	0.26	0.02	0.83	0.22	0.42	0.03	0.23	0.56	0.76	0.09	0.20
Control Delay	26.1	19.2	0.1	59.6	12.2	3.5	17.9	18.9	6.1	56.2	12.1	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.1	19.2	0.1	59.6	12.2	3.5	17.9	18.9	6.1	56.2	12.1	3.6
LOS	C	B	A	E	B	A	B	B	A	E	B	A
Approach Delay		21.1			21.1			10.7			27.4	
Approach LOS		C			C			B			C	
Queue Length 50th (m)	11.6	10.8	0.0	13.4	11.1	0.0	0.7	9.1	0.0	10.2	4.2	0.0

Lanes, Volumes, Timings

210701

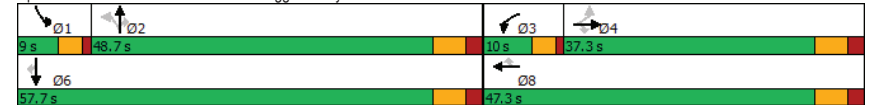
3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Background AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↗	↘	↙	↖
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	30.1	22.5	0.0	#42.6	23.7	13.5	3.9	18.8	17.0	#33.9	10.2	8.8
Internal Link Dist (m)		422.7			399.1			400.8			160.5	
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	507	1648	571	274	2229	1047	825	2151	1089	229	2539	1177
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.14	0.01	0.83	0.14	0.32	0.01	0.09	0.34	0.76	0.05	0.11

Intersection Summary	
Area Type:	Other
Cycle Length:	105
Actuated Cycle Length:	65
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.83
Intersection Signal Delay:	19.6
Intersection LOS:	B
Intersection Capacity Utilization:	47.6%
ICU Level of Service:	A
Analysis Period (min):	15
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Background AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	116	218	7	210	295	311	8	183	340	159	112	120
Future Volume (vph)	116	218	7	210	295	311	8	183	340	159	112	120
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Fit	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.56	1.00	1.00	0.95	1.00	1.00	0.67	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	965	3131	981	2899	3256	1375	1168	3044	1388	2899	3017	1375
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	126	237	8	228	321	338	9	199	370	173	122	130
RTOR Reduction (vph)	0	0	6	0	0	187	0	0	263	0	0	74
Lane Group Flow (vph)	126	237	2	228	321	151	9	199	107	173	122	56
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1		6
Permitted Phases	4		4			8	2		2			6
Actuated Green, G (s)	16.4	16.4	16.4	6.2	26.6	26.6	16.4	16.4	16.4	5.1	25.5	25.5
Effective Green, g (s)	18.7	18.7	18.7	6.2	28.9	28.9	18.7	18.7	18.7	5.1	27.8	27.8
Actuated g/C Ratio	0.29	0.29	0.29	0.10	0.45	0.45	0.29	0.29	0.29	0.08	0.43	0.43
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	278	904	283	277	1454	614	337	879	401	228	1296	590
v/s Ratio Prot		0.08		c0.08	0.10			0.07		c0.06		0.04
v/s Ratio Perm	c0.13		0.00			0.11	0.01		c0.08			0.04
v/c Ratio	0.45	0.26	0.01	0.82	0.22	0.25	0.03	0.23	0.27	0.76	0.09	0.09
Uniform Delay, d1	18.8	17.7	16.4	28.7	11.0	11.1	16.5	17.5	17.7	29.2	11.0	11.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.3	0.4	0.0	20.3	0.2	0.6	0.1	0.4	1.0	17.3	0.1	0.2
Delay (s)	22.1	18.1	16.4	49.0	11.2	11.7	16.6	17.9	18.7	46.5	11.1	11.2
Level of Service	C	B	B	D	B	B	B	B	B	D	B	B
Approach Delay (s)		19.4			21.1			18.4			25.5	
Approach LOS		B			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	21.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	64.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	47.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway

2024 Background PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	25	14	3	960	1207	5
Future Volume (vph)	25	14	3	960	1207	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Fit	0.952				0.999	
Fit Protected	0.969					
Satd. Flow (prot)	1557	0	0	1664	1695	0
Fit Permitted	0.969					
Satd. Flow (perm)	1557	0	0	1664	1695	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	119.1			195.6	272.2	
Travel Time (s)	8.9			10.1	14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	7%	0%	4%	2%	0%
Adj. Flow (vph)	27	15	3	1043	1312	5
Shared Lane Traffic (%)						
Lane Group Flow (vph)	42	0	0	1046	1317	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization 79.3%	ICU Level of Service D
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway

2024 Background PM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕	↕	↔
Traffic Volume (veh/h)	25	14	3	960	1207	5
Future Volume (Veh/h)	25	14	3	960	1207	5
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	15	3	1043	1312	5
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	2364	1314	1317			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2364	1314	1317			
tC, single (s)	6.4	6.3	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.4	2.2			
p0 queue free %	31	92	99			
cM capacity (veh/h)	39	188	532			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	42	1046	1317			
Volume Left	27	3	0			
Volume Right	15	0	5			
cSH	55	532	1700			
Volume to Capacity	0.77	0.01	0.77			
Queue Length 95th (m)	24.5	0.1	0.0			
Control Delay (s)	179.1	0.2	0.0			
Lane LOS	F	A				
Approach Delay (s)	179.1	0.2	0.0			
Approach LOS	F					
Intersection Summary						
Average Delay			3.2			
Intersection Capacity Utilization			79.3%	ICU Level of Service	D	
Analysis Period (min)			15			

Lanes, Volumes, Timings

210701

2: Montrose Rd & Grassy Brooks Rd

2024 Background PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕	↕	↔
Traffic Volume (vph)	418	32	19	543	808	413
Future Volume (vph)	418	32	19	543	808	413
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			0.0
Storage Lanes	1	1	1			0
Taper Length (m)	15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.850				0.954	
Fit Protected	0.950			0.950		
Satd. Flow (prot)	1644	1471	1644	1648	1629	0
Fit Permitted	0.950			0.950		
Satd. Flow (perm)	1644	1471	1644	1648	1629	0
Link Speed (k/h)	40			70	70	
Link Distance (m)	110.1			214.2	105.8	
Travel Time (s)	9.9			11.0	5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	5%	2%	0%
Adj. Flow (vph)	454	35	21	590	878	449
Shared Lane Traffic (%)						
Lane Group Flow (vph)	454	35	21	590	1327	0
Sign Control	Stop				Free	Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	105.3%				ICU Level of Service G	
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

210701

2: Montrose Rd & Grassy Brooks Rd

2024 Background PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕	↕	↔
Traffic Volume (veh/h)	418	32	19	543	808	413
Future Volume (Veh/h)	418	32	19	543	808	413
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	454	35	21	590	878	449
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLTL		None	
Median storage (veh)			2			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1734	1102	1327			
vC1, stage 1 conf vol	1102					
vC2, stage 2 conf vol	632					
vCu, unblocked vol	1734	1102	1327			
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 %	0	87	96			
cM capacity (veh/h)	278	260	527			
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	
Volume Total	454	35	21	590	1327	
Volume Left	454	0	21	0	0	
Volume Right	0	35	0	0	449	
cSH	278	260	527	1700	1700	
Volume to Capacity	1.64	0.13	0.04	0.35	0.78	
Queue Length 95th (m)	210.8	3.4	0.9	0.0	0.0	
Control Delay (s)	334.1	21.0	12.1	0.0	0.0	
Lane LOS	F	C	B			
Approach Delay (s)	311.7		0.4		0.0	
Approach LOS	F					
Intersection Summary						
Average Delay			62.9			
Intersection Capacity Utilization			105.3%		ICU Level of Service G	
Analysis Period (min)			15			

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Background PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	164	279	6	269	229	187	6	182	294	397	345	200
Future Volume (vph)	164	279	6	269	229	187	6	182	294	397	345	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Fit			0.850			0.850			0.850			0.850
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Fit Permitted	0.597			0.950			0.529			0.950		
Satd. Flow (perm)	1033	3224	1471	3097	3131	1428	915	3162	1428	3127	3224	1442
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			107			203			320			217
Link Speed (k/h)	80			80			70			70		
Link Distance (m)	446.7			423.1			424.8			184.5		
Travel Time (s)	20.1			19.0			21.8			9.5		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Adj. Flow (vph)	178	303	7	292	249	203	7	198	320	432	375	217
Shared Lane Traffic (%)												
Lane Group Flow (vph)	178	303	7	292	249	203	7	198	320	432	375	217
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4		4			8	2		2			6
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	12.0	49.3	49.3	49.7	49.7	49.7	16.0	65.7	65.7
Total Split (%)	32.4%	32.4%	32.4%	10.4%	42.9%	42.9%	43.2%	43.2%	43.2%	13.9%	57.1%	57.1%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effct Green (s)	24.4	24.4	24.4	8.2	36.6	36.6	18.2	18.2	18.2	12.2	34.5	34.5
Actuated g/C Ratio	0.31	0.31	0.31	0.10	0.46	0.46	0.23	0.23	0.23	0.15	0.44	0.44
v/c Ratio	0.56	0.31	0.01	0.92	0.17	0.26	0.03	0.27	0.56	0.90	0.27	0.29
Control Delay	31.1	22.0	0.0	73.2	13.2	3.1	25.8	26.9	7.5	58.9	15.7	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.1	22.0	0.0	73.2	13.2	3.1	25.8	26.9	7.5	58.9	15.7	3.5
LOS	C	C	A	E	B	A	C	C	A	E	B	A
Approach Delay	25.0			34.0			15.1			31.4		
Approach LOS	C			C			B			C		
Queue Length 50th (m)	21.3	17.4	0.0	22.3	10.5	0.0	0.8	12.7	0.0	32.4	18.1	0.0

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Background PM Peak Hour

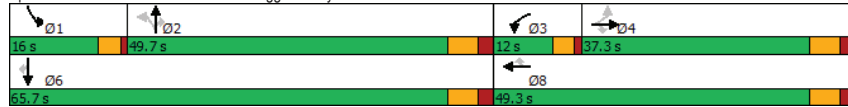


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	45.6	30.7	0.0	#56.8	20.2	10.9	4.2	23.5	19.3	#75.2	31.6	12.0
Internal Link Dist (m)	422.7			399.1			400.8			160.5		
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	442	1380	690	318	1823	916	537	1857	971	482	2557	1188
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.22	0.01	0.92	0.14	0.22	0.01	0.11	0.33	0.90	0.15	0.18

Intersection Summary

Area Type: Other
 Cycle Length: 115
 Actuated Cycle Length: 79.3
 Natural Cycle: 115
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.92
 Intersection Signal Delay: 27.9
 Intersection Capacity Utilization 52.2%
 Analysis Period (min) 15
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Background PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	164	279	6	269	229	187	6	182	294	397	345	200
Future Volume (vph)	164	279	6	269	229	187	6	182	294	397	345	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Fit	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Fit Permitted	0.60	1.00	1.00	0.95	1.00	1.00	0.53	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1034	3224	1471	3097	3131	1428	916	3162	1428	3127	3224	1442
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	178	303	7	292	249	203	7	198	320	432	375	217
RTOR Reduction (vph)	0	0	5	0	0	109	0	0	246	0	0	122
Lane Group Flow (vph)	178	303	2	292	249	94	7	198	74	432	375	95
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%

Turn Type	Perm	NA	Prot	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3		8		2		2		6
Permitted Phases	4		4		8		2		2		6	
Actuated Green, G (s)	22.1	22.1	22.1	8.2	34.3	34.3	16.0	16.0	16.0	12.2	32.2	32.2
Effective Green, g (s)	24.4	24.4	24.4	8.2	36.6	36.6	18.3	18.3	18.3	12.2	34.5	34.5
Actuated g/C Ratio	0.31	0.31	0.31	0.10	0.46	0.46	0.23	0.23	0.23	0.15	0.44	0.44
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	318	994	453	321	1448	660	211	731	330	482	1406	628
v/s Ratio Prot		0.09		c0.09		0.08		0.06		c0.14		c0.12
v/s Ratio Perm	c0.17		0.00		0.07		0.01		0.05		0.07	
v/c Ratio	0.56	0.30	0.00	0.91	0.17	0.14	0.03	0.27	0.22	0.90	0.27	0.15
Uniform Delay, d1	22.9	20.9	18.9	35.1	12.4	12.2	23.5	24.9	24.6	32.8	14.2	13.5
Progression Factor	1.00	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	4.6	0.5	0.0	30.4	0.2	0.3	0.2	0.6	1.0	20.7	0.3	0.3
Delay (s)	27.4	21.4	19.0	65.5	12.6	12.5	23.7	25.5	25.6	53.6	14.5	13.8
Level of Service	C	C	B	E	B	B	C	C	C	D	B	B
Approach Delay (s)		23.5			33.3			25.5			30.8	
Approach LOS		C			C			C			C	

Intersection Summary

HCM 2000 Control Delay: 29.2
 HCM 2000 Level of Service: C
 HCM 2000 Volume to Capacity ratio: 0.60
 Actuated Cycle Length (s): 79.1
 Sum of lost time (s): 16.0
 Intersection Capacity Utilization: 52.2%
 ICU Level of Service: A
 Analysis Period (min): 15
 c Critical Lane Group

Appendix H

Opening Date Total Traffic Operations



Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway/Driveway A

2024 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↙	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	9	0	5	2	0	3	17	798	15	19	854	24
Future Volume (vph)	9	0	5	2	0	3	17	798	15	19	854	24
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.955			0.919			0.998			0.996	
Flt Protected		0.968			0.980			0.999			0.999	
Satd. Flow (prot)	0	1326	0	0	1528	0	0	1625	0	0	1598	0
Flt Permitted		0.968			0.980			0.999			0.999	
Satd. Flow (perm)	0	1326	0	0	1528	0	0	1625	0	0	1598	0
Link Speed (k/h)		48			48			70			70	
Link Distance (m)		119.1			78.3			195.6			272.2	
Travel Time (s)		8.9			5.9			10.1			14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	11%	2%	40%	2%	2%	2%	18%	6%	2%	2%	8%	4%
Adj. Flow (vph)	10	0	5	2	0	3	18	867	16	21	928	26
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	15	0	0	5	0	0	901	0	0	975	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	70.8%
Analysis Period (min)	15
	ICU Level of Service C

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway/Driveway A

2024 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↙	↘	↙	↘
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (veh/h)	9	0	5	2	0	3	17	798	15	19	854	24
Future Volume (Veh/h)	9	0	5	2	0	3	17	798	15	19	854	24
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	0	5	2	0	3	18	867	16	21	928	26
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	1897	1902	941	1899	1907	875	954			883		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1897	1902	941	1899	1907	875	954			883		
tC, single (s)	7.2	6.5	6.6	7.1	6.5	6.2	4.3			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.0	3.7	3.5	4.0	3.3	2.4			2.2		
p0 queue free %	79	100	98	96	100	99	97			97		
cM capacity (veh/h)	47	65	272	50	65	349	660			766		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	15	5	901	975								
Volume Left	10	2	18	21								
Volume Right	5	3	16	26								
cSH	66	102	660	766								
Volume to Capacity	0.23	0.05	0.03	0.03								
Queue Length 95th (m)	5.9	1.1	0.6	0.6								
Control Delay (s)	75.5	42.1	0.8	0.8								
Lane LOS	F	E	A	A								
Approach Delay (s)	75.5	42.1	0.8	0.8								
Approach LOS	F	E										
Intersection Summary												
Average Delay							1.5					
Intersection Capacity Utilization							70.8%			ICU Level of Service		C
Analysis Period (min)							15					

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
2024 Total AM Peak Hour

	↖	↗	↙	↘	↕	↔
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↙	↘	↕	↔
Traffic Volume (vph)	391	24	76	498	422	352
Future Volume (vph)	391	24	76	498	422	352
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			0.0
Storage Lanes	1	1	1			0
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850			0.939	
Fit Protected	0.950		0.950			
Satd. Flow (prot)	1612	1471	1644	1633	1549	0
Fit Permitted	0.950		0.950			
Satd. Flow (perm)	1612	1471	1644	1633	1549	0
Link Speed (k/h)	40			70	70	
Link Distance (m)	110.1			214.2	105.8	
Travel Time (s)	9.9			11.0	5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	0%	0%	6%	9%	0%
Adj. Flow (vph)	425	26	83	541	459	383
Shared Lane Traffic (%)						
Lane Group Flow (vph)	425	26	83	541	842	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 85.6% ICU Level of Service E
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
2: Montrose Rd & Grassy Brooks Rd

210701
2024 Total AM Peak Hour

	↖	↗	↙	↘	↕	↔
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↙	↘	↕	↔
Traffic Volume (veh/h)	391	24	76	498	422	352
Future Volume (Veh/h)	391	24	76	498	422	352
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	425	26	83	541	459	383
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWTL	None	
Median storage (veh)				2		
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1358	650	842			
vC1, stage 1 conf vol	650					
vC2, stage 2 conf vol	707					
vCu, unblocked vol	1358	650	842			
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 %	0	94	90			
cM capacity (veh/h)	355	472	802			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1
Volume Total	425	26	83	541	842
Volume Left	425	0	83	0	0
Volume Right	0	26	0	0	383
cSH	355	472	802	1700	1700
Volume to Capacity	1.20	0.06	0.10	0.32	0.50
Queue Length 95th (m)	132.9	1.3	2.6	0.0	0.0
Control Delay (s)	145.4	13.1	10.0	0.0	0.0
Lane LOS	F	B	B		
Approach Delay (s)	137.8		1.3		0.0
Approach LOS	F				

Intersection Summary

Average Delay 32.8
Intersection Capacity Utilization 85.6% ICU Level of Service E
Analysis Period (min) 15

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↗	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖↖	↖	↖↖	↖↖	↖	↖	↖↖	↖	↖↖	↖↖	↖
Traffic Volume (vph)	130	218	7	210	295	349	8	249	340	165	121	122
Future Volume (vph)	130	218	7	210	295	349	8	249	340	165	121	122
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.557			0.950			0.668			0.950		
Satd. Flow (perm)	964	3131	981	2899	3256	1375	1156	3044	1388	2899	3017	1375
Right Turn on Red			Yes		Yes		Yes		Yes		Yes	
Satd. Flow (RTOR)			117		379				370			133
Link Speed (k/h)	80			80			70			70		
Link Distance (m)	446.7			423.1			424.8			184.5		
Travel Time (s)	20.1			19.0			21.8			9.5		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Adj. Flow (vph)	141	237	8	228	321	379	9	271	370	179	132	133
Shared Lane Traffic (%)												
Lane Group Flow (vph)	141	237	8	228	321	379	9	271	370	179	132	133
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3		8		2		1		6
Permitted Phases	4		4			8	2		2			6
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	10.0	47.3	47.3	48.7	48.7	48.7	9.0	57.7	57.7
Total Split (%)	35.5%	35.5%	35.5%	9.5%	45.0%	45.0%	46.4%	46.4%	46.4%	8.6%	55.0%	55.0%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effect Green (s)	21.4	21.4	21.4	6.2	31.8	31.8	21.2	21.2	21.2	5.2	30.5	30.5
Actuated g/C Ratio	0.30	0.30	0.30	0.09	0.45	0.45	0.30	0.30	0.30	0.07	0.43	0.43
v/c Ratio	0.48	0.25	0.02	0.90	0.22	0.46	0.03	0.30	0.55	0.85	0.10	0.20
Control Delay	27.0	19.5	0.1	73.4	12.7	3.6	19.4	20.5	5.9	71.2	13.3	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	0.0
Total Delay	27.0	19.5	0.1	73.4	12.7	3.6	19.4	20.5	5.9	71.2	13.3	3.8
LOS	C	B	A	E	B	A	B	C	A	E	B	A
Approach Delay		21.8			23.9			12.2			33.8	
Approach LOS		C			C			B			C	
Queue Length 50th (m)	14.3	11.6	0.0	14.9	12.2	0.0	0.8	13.6	0.0	11.7	4.9	0.0

Lanes, Volumes, Timings

210701

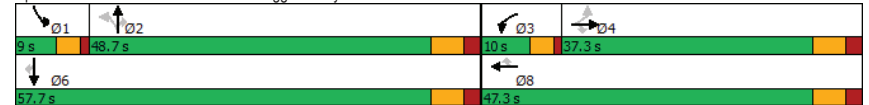
3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↗	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	34.4	23.1	0.0	#47.4	24.6	14.2	4.2	27.2	18.0	#38.8	12.0	9.5
Internal Link Dist (m)		422.7			399.1			400.8			160.5	
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	470	1526	538	254	2063	1010	756	1991	1036	211	2371	1109
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.16	0.01	0.90	0.16	0.38	0.01	0.14	0.36	0.85	0.06	0.12

Intersection Summary	
Area Type:	Other
Cycle Length:	105
Actuated Cycle Length:	70.5
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.90
Intersection Signal Delay:	22.2
Intersection LOS:	C
Intersection Capacity Utilization:	50.1%
ICU Level of Service:	A
Analysis Period (min):	15
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis
3: Montrose Rd & Biggar Rd/Lyons Creek Rd

210701
2024 Total AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	130	218	7	210	295	349	8	249	340	165	121	122
Future Volume (vph)	130	218	7	210	295	349	8	249	340	165	121	122
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.56	1.00	1.00	0.95	1.00	1.00	0.67	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	965	3131	981	2899	3256	1375	1157	3044	1388	2899	3017	1375
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	141	237	8	228	321	379	9	271	370	179	132	133
RTOR Reduction (vph)	0	0	6	0	0	208	0	0	258	0	0	75
Lane Group Flow (vph)	141	237	2	228	321	171	9	271	112	179	132	58
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1		6
Permitted Phases	4		4			8	2		2			6
Actuated Green, G (s)	19.2	19.2	19.2	6.2	29.4	29.4	18.9	18.9	18.9	5.2	28.1	28.1
Effective Green, g (s)	21.5	21.5	21.5	6.2	31.7	31.7	21.2	21.2	21.2	5.2	30.4	30.4
Actuated g/C Ratio	0.31	0.31	0.31	0.09	0.45	0.45	0.30	0.30	0.30	0.07	0.43	0.43
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	295	960	300	256	1472	621	349	920	419	215	1308	596
v/s Ratio Prot		0.08		c0.08	0.10			c0.09		c0.06		0.04
v/s Ratio Perm	c0.15		0.00			0.12	0.01		0.08			0.04
v/c Ratio	0.48	0.25	0.01	0.89	0.22	0.28	0.03	0.29	0.27	0.83	0.10	0.10
Uniform Delay, d1	19.7	18.2	16.9	31.6	11.7	12.0	17.2	18.7	18.6	32.0	11.8	11.7
Progression Factor	1.00	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	3.4	0.4	0.0	32.1	0.2	0.7	0.1	0.5	1.0	26.4	0.1	0.2
Delay (s)	23.2	18.6	16.9	63.8	11.9	12.7	17.3	19.2	19.5	58.4	11.9	11.9
Level of Service	C	B	B	E	B	B	B	B	B	E	B	B
Approach Delay (s)		20.2			25.0			19.4			30.6	
Approach LOS		C			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	23.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	70.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	50.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Montrose Rd & Driveway B

210701
2024 Total AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	7	4	25	823	806	56
Future Volume (vph)	7	4	25	823	806	56
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.955				0.991	
Fit Protected	0.968			0.999		
Satd. Flow (prot)	1568	0	0	1695	1681	0
Fit Permitted	0.968			0.999		
Satd. Flow (perm)	1568	0	0	1695	1681	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	69.9			105.8	195.6	
Travel Time (s)	5.2			5.4	10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	4	27	895	876	61
Shared Lane Traffic (%)						
Lane Group Flow (vph)	12	0	0	922	937	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization 78.9%	ICU Level of Service D
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
4: Montrose Rd & Driveway B

210701
2024 Total AM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			Y	Y	
Traffic Volume (veh/h)	7	4	25	823	806	56
Future Volume (Veh/h)	7	4	25	823	806	56
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	4	27	895	876	61
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None	None		
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1856	906	937			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1856	906	937			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	90	99	96			
cM capacity (veh/h)	78	334	731			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	12	922	937			
Volume Left	8	27	0			
Volume Right	4	0	61			
cSH	105	731	1700			
Volume to Capacity	0.11	0.04	0.55			
Queue Length 95th (m)	2.8	0.9	0.0			
Control Delay (s)	43.7	1.1	0.0			
Lane LOS	E	A				
Approach Delay (s)	43.7	1.1	0.0			
Approach LOS	E					
Intersection Summary						
Average Delay		0.8				
Intersection Capacity Utilization		78.9%		ICU Level of Service	D	
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Grassy Brooks Rd & Driveway C

210701
2024 Total AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		Y	Y		Y	
Traffic Volume (vph)	0	405	377	2	1	0
Future Volume (vph)	0	405	377	2	1	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999			
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1695	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1695	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		143.6	76.3		67.3	
Travel Time (s)		12.9	6.9		5.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	440	410	2	1	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	440	412	0	1	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	33.1%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
5: Grassy Brooks Rd & Driveway C

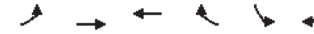
210701
2024 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	405	377	2	1	0
Future Volume (Veh/h)	0	405	377	2	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	440	410	2	1	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	412			851	411	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	412			851	411	
tC, single (s)	4.1			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	100			100	100	
cM capacity (veh/h)	1147			330	641	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	440	412	1			
Volume Left	0	0	1			
Volume Right	0	2	0			
cSH	1147	1700	330			
Volume to Capacity	0.00	0.24	0.00			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	15.9			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	15.9			
Approach LOS			C			
Intersection Summary						
Average Delay		0.0				
Intersection Capacity Utilization		33.1%	ICU Level of Service	A		
Analysis Period (min)		15				

Lanes, Volumes, Timings
6: Grassy Brooks Rd & Driveway D

210701
2024 Total AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	406	379	18	5	0
Future Volume (vph)	0	406	379	18	5	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994			
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1686	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1686	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		76.3	239.3		68.2	
Travel Time (s)		6.9	21.5		5.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	441	412	20	5	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	441	432	0	5	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	33.2%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Grassy Brooks Rd & Driveway D

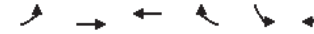
210701
2024 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	406	379	18	5	0
Future Volume (Veh/h)	0	406	379	18	5	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	441	412	20	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	432			863	422	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	432			863	422	
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			98	100	
cM capacity (veh/h)	1128			325	632	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	441	432	5			
Volume Left	0	0	5			
Volume Right	0	20	0			
cSH	1128	1700	325			
Volume to Capacity	0.00	0.25	0.02			
Queue Length 95th (m)	0.0	0.0	0.4			
Control Delay (s)	0.0	0.0	16.2			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	16.2			
Approach LOS			C			
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		33.2%	ICU Level of Service	A		
Analysis Period (min)		15				

Lanes, Volumes, Timings
7: Grassy Brooks Rd & Driveway E

210701
2024 Total AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	411	397	31	4	0
Future Volume (vph)	0	411	397	31	4	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.990			
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1680	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1680	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		239.3	110.1		77.3	
Travel Time (s)		21.5	9.9		5.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	447	432	34	4	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	447	466	0	4	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	34.7%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
7: Grassy Brooks Rd & Driveway E

210701
2024 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↑	
Traffic Volume (veh/h)	0	411	397	31	4	0
Future Volume (Veh/h)	0	411	397	31	4	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	447	432	34	4	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	466				896	449
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	466				896	449
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1095				311	610
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	447	466	4			
Volume Left	0	0	4			
Volume Right	0	34	0			
cSH	1095	1700	311			
Volume to Capacity	0.00	0.27	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	16.7			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	16.7			
Approach LOS			C			
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		34.7%		ICU Level of Service	A	
Analysis Period (min)		15				

Lanes, Volumes, Timings
8: Montrose Rd & Driveway F

210701
2024 Total AM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↑			↑	↑	
Traffic Volume (vph)	7	6	43	567	393	53
Future Volume (vph)	7	6	43	567	393	53
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.937				0.982	
Fit Protected	0.974			0.996		
Satd. Flow (prot)	1548	0	0	3211	3166	0
Fit Permitted	0.974			0.996		
Satd. Flow (perm)	1548	0	0	3211	3166	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	82.8			799.0	214.2	
Travel Time (s)	6.2			41.1	11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	7	47	616	427	58
Shared Lane Traffic (%)						
Lane Group Flow (vph)	15	0	0	663	485	0
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	45.3%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

210701

8: Montrose Rd & Driveway F

2024 Total AM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↖ ↙ ↚					
Traffic Volume (veh/h)	7	6	43	567	393	53
Future Volume (Veh/h)	7	6	43	567	393	53
Sign Control	Stop		Free			
Grade	0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	7	47	616	427	58
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLT	TWLT		
Median storage (veh)			2	2		
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	858	242	485			
vC1, stage 1 conf vol	456					
vC2, stage 2 conf vol	402					
vCu, unblocked vol	858	242	485			
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 %	98	99	96			
cM capacity (veh/h)	489	758	1074			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	15	252	411	285	200	
Volume Left	8	47	0	0	0	
Volume Right	7	0	0	0	58	
cSH	586	1074	1700	1700	1700	
Volume to Capacity	0.03	0.04	0.24	0.17	0.12	
Queue Length 95th (m)	0.6	1.0	0.0	0.0	0.0	
Control Delay (s)	11.3	1.9	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	11.3	0.7	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization			45.3%		ICU Level of Service A	
Analysis Period (min)	15					

Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway/Driveway A

2024 Total PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↖ ↙ ↚ ↛ ↜ ↝ ↞ ↠ ↡											
Traffic Volume (vph)	25	0	14	15	0	19	3	1079	3	4	1234	5
Future Volume (vph)	25	0	14	15	0	19	3	1079	3	4	1234	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fit	0.952		0.923									
Fit Protected	0.969		0.979									
Satd. Flow (prot)	0	1557	0	0	1533	0	0	1664	0	0	1695	0
Fit Permitted	0.969		0.979									
Satd. Flow (perm)	0	1557	0	0	1533	0	0	1664	0	0	1695	0
Link Speed (k/h)	48		48									
Link Distance (m)	119.1		77.4									
Travel Time (s)	8.9		5.8									
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	7%	2%	2%	2%	0%	4%	2%	2%	2%	0%
Adj. Flow (vph)	27	0	15	16	0	21	3	1173	3	4	1341	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	42	0	0	37	0	0	1179	0	0	1350	0
Sign Control	Stop		Stop				Free				Free	
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization 84.4%	ICU Level of Service E											
Analysis Period (min) 15												

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway/Driveway A

2024 Total PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↔			↔			↔			↔		
Traffic Volume (veh/h)	25	0	14	15	0	19	3	1079	3	4	1234	5	
Future Volume (Veh/h)	25	0	14	15	0	19	3	1079	3	4	1234	5	
Sign Control	Stop			Stop			Free			Free			
Grade	0%			0%			0%			0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	27	0	15	16	0	21	3	1173	3	4	1341	5	
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	2553	2534	1344	2547	2534	1174	1346						1176
vC1, stage 1 conf vol													
vC2, stage 2 conf vol													
vCu, unblocked vol	2553	2534	1344	2547	2534	1174	1346						1176
tC, single (s)	7.1	6.5	6.3	7.1	6.5	6.2	4.1						4.1
tC, 2 stage (s)													
tF (s)	3.5	4.0	3.4	3.5	4.0	3.3	2.2						2.2
p0 queue free %	0	100	92	2	100	91	99						99
cM capacity (veh/h)	16	27	181	16	27	233	518						594
Direction, Lane #	EB 1	WB 1	NB 1	SB 1									
Volume Total	42	37	1179	1350									
Volume Left	27	16	3	4									
Volume Right	15	21	3	5									
cSH	24	35	518	594									
Volume to Capacity	1.74	1.07	0.01	0.01									
Queue Length 95th (m)	39.3	29.0	0.1	0.2									
Control Delay (s)	698.2	347.6	0.3	0.4									
Lane LOS	F	F	A	A									
Approach Delay (s)	698.2	347.6	0.3	0.4									
Approach LOS	F	F											
Intersection Summary													
Average Delay	16.5												
Intersection Capacity Utilization	84.4%			ICU Level of Service			E						
Analysis Period (min)	15												

Lanes, Volumes, Timings

210701

2: Montrose Rd & Grassy Brooks Rd

2024 Total PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	
Lane Configurations	↔	↔	↔	↔	↔	↔	
Traffic Volume (vph)	435	61	27	601	861	419	
Future Volume (vph)	435	61	27	601	861	419	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	
Storage Length (m)	60.0	0.0	60.0	0.0			
Storage Lanes	1	1	1	0			
Taper Length (m)	15.0	15.0					
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	0.850		0.956				
Fit Protected	0.950	0.950					
Satd. Flow (prot)	1644	1471	1644	1648	1632	0	
Fit Permitted	0.950	0.950					
Satd. Flow (perm)	1644	1471	1644	1648	1632	0	
Link Speed (k/h)	40	70		70	70		
Link Distance (m)	110.1	214.2		105.8	105.8		
Travel Time (s)	9.9	11.0		5.4	5.4		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	0%	0%	0%	5%	2%	0%	
Adj. Flow (vph)	473	66	29	653	936	455	
Shared Lane Traffic (%)							
Lane Group Flow (vph)	473	66	29	653	1391	0	
Sign Control	Stop			Free		Free	
Intersection Summary							
Area Type:	Other						
Control Type:	Unsignalized						
Intersection Capacity Utilization	109.8%			ICU Level of Service H			
Analysis Period (min)	15						

HCM Unsignalized Intersection Capacity Analysis

210701

2: Montrose Rd & Grassy Brooks Rd

2024 Total PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕	↕	↔
Traffic Volume (veh/h)	435	61	27	601	861	419
Future Volume (Veh/h)	435	61	27	601	861	419
Sign Control	Stop		Free			
Grade	0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	473	66	29	653	936	455
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			TWLT	L	None	
Median storage (veh)			2			
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1874	1164	1391			
vC1, stage 1 conf vol	1164					
vC2, stage 2 conf vol	711					
vCu, unblocked vol	1874	1164	1391			
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 %	0	72	94			
cM capacity (veh/h)	254	239	498			
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1	
Volume Total	473	66	29	653	1391	
Volume Left	473	0	29	0	0	
Volume Right	0	66	0	0	455	
cSH	254	239	498	1700	1700	
Volume to Capacity	1.86	0.28	0.06	0.38	0.82	
Queue Length 95th (m)	245.8	8.2	1.4	0.0	0.0	
Control Delay (s)	435.1	25.7	12.7	0.0	0.0	
Lane LOS	F	D	B			
Approach Delay (s)	385.0		0.5	0.0		
Approach LOS	F					
Intersection Summary						
Average Delay			79.6			
Intersection Capacity Utilization			109.8%	ICU Level of Service	H	
Analysis Period (min)			15			

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Total PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↕	↔	↕	↕	↔	↕	↕	↔	↕	↕
Traffic Volume (vph)	166	279	6	269	229	195	6	197	294	434	409	212
Future Volume (vph)	166	279	6	269	229	195	6	197	294	434	409	212
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Fit Permitted	0.597			0.950			0.494			0.950		
Satd. Flow (perm)	1033	3224	1471	3097	3131	1428	855	3162	1428	3127	3224	1442
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			107			212			320			230
Link Speed (k/h)		80			80			70				70
Link Distance (m)		446.7			423.1			424.8				184.5
Travel Time (s)		20.1			19.0			21.8				9.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Adj. Flow (vph)	180	303	7	292	249	212	7	214	320	472	445	230
Shared Lane Traffic (%)												
Lane Group Flow (vph)	180	303	7	292	249	212	7	214	320	472	445	230
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1		6
Permitted Phases	4		4			8	2		2			6
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	12.0	49.3	49.3	49.7	49.7	49.7	16.0	65.7	65.7
Total Split (%)	32.4%	32.4%	32.4%	10.4%	42.9%	42.9%	43.2%	43.2%	43.2%	13.9%	57.1%	57.1%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effct Green (s)	24.7	24.7	24.7	8.1	36.9	36.9	18.9	18.9	18.9	12.2	35.2	35.2
Actuated g/C Ratio	0.31	0.31	0.31	0.10	0.46	0.46	0.24	0.24	0.24	0.15	0.44	0.44
v/c Ratio	0.57	0.31	0.01	0.93	0.17	0.28	0.03	0.29	0.55	0.99	0.31	0.30
Control Delay	31.6	22.3	0.0	76.3	13.4	3.1	25.8	27.0	7.3	77.7	16.2	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.6	22.3	0.0	76.3	13.4	3.1	25.8	27.0	7.3	77.7	16.2	3.5
LOS	C	C	A	E	B	A	C	C	A	E	B	A
Approach Delay		25.4			34.9			15.4				38.9
Approach LOS		C			C			B				D
Queue Length 50th (m)	22.3	18.0	0.0	22.9	11.0	0.0	0.8	13.9	0.0	-37.7	22.3	0.0

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Total PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	46.1	30.7	0.0	#56.8	20.2	11.1	4.2	25.2	19.3	#83.9	37.6	12.3
Internal Link Dist (m)	422.7			399.1			400.8			160.5		
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	436	1361	683	314	1799	910	495	1832	962	476	2523	1178
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.22	0.01	0.93	0.14	0.23	0.01	0.12	0.33	0.99	0.18	0.20

Intersection Summary

Area Type:	Other
Cycle Length:	115
Actuated Cycle Length:	80.3
Natural Cycle:	115
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.99
Intersection Signal Delay:	31.3
Intersection Capacity Utilization:	53.4%
Analysis Period (min):	15
Intersection LOS:	C
ICU Level of Service:	A
- Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd

Phase	Ø1	Ø2	Ø3	Ø4	Ø6	Ø8
15 s	49.7 s	12 s	37.3 s			
65.7 s	49.3 s					

HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2024 Total PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	166	279	6	269	229	195	6	197	294	434	409	212
Future Volume (vph)	166	279	6	269	229	195	6	197	294	434	409	212
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Fit	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Fit Permitted	0.60	1.00	1.00	0.95	1.00	1.00	0.49	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1034	3224	1471	3097	3131	1428	856	3162	1428	3127	3224	1442
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	180	303	7	292	249	212	7	214	320	472	445	230
RTOR Reduction (vph)	0	0	5	0	0	114	0	0	244	0	0	129
Lane Group Flow (vph)	180	303	2	292	249	98	7	214	76	472	445	101
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%

Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4		4			8	2		2			6
Actuated Green, G (s)	22.4	22.4	22.4	8.2	34.6	34.6	16.7	16.7	16.7	12.2	32.9	32.9
Effective Green, g (s)	24.7	24.7	24.7	8.2	36.9	36.9	19.0	19.0	19.0	12.2	35.2	35.2
Actuated g/C Ratio	0.31	0.31	0.31	0.10	0.46	0.46	0.24	0.24	0.24	0.15	0.44	0.44
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	318	994	453	317	1442	657	203	750	338	476	1416	633
v/s Ratio Prot		0.09		c0.09	0.08			0.07		c0.15	c0.14	
v/s Ratio Perm	c0.17		0.00			0.07	0.01		0.05			0.07
v/c Ratio	0.57	0.30	0.00	0.92	0.17	0.15	0.03	0.29	0.22	0.99	0.31	0.16
Uniform Delay, d1	23.2	21.1	19.2	35.6	12.7	12.5	23.5	25.0	24.6	33.9	14.6	13.5
Progression Factor	1.00	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	4.7	0.5	0.0	32.8	0.2	0.3	0.2	0.6	1.0	39.1	0.4	0.3
Delay (s)	27.9	21.6	19.2	68.4	12.8	12.8	23.7	25.6	25.6	73.0	15.0	13.9
Level of Service	C	C	B	E	B	B	C	C	C	E	B	B
Approach Delay (s)		23.9			34.4			25.6			38.6	
Approach LOS		C			C			C			D	

Intersection Summary

HCM 2000 Control Delay	32.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	80.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	53.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Montrose Rd & Driveway B

210701
2024 Total PM Peak Hour

	↖	↗	↙	↘	↕	↔
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖			↘	↖	↗
Traffic Volume (vph)	52	28	5	1034	1252	11
Future Volume (vph)	52	28	5	1034	1252	11
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	0.953				0.999	
Flt Protected	0.968					
Satd. Flow (prot)	1565	0	0	1697	1695	0
Flt Permitted	0.968					
Satd. Flow (perm)	1565	0	0	1697	1695	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	69.9			105.8	195.6	
Travel Time (s)	5.2			5.4	10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	57	30	5	1124	1361	12
Shared Lane Traffic (%)						
Lane Group Flow (vph)	87	0	0	1129	1373	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	83.9%
ICU Level of Service	E
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
4: Montrose Rd & Driveway B

210701
2024 Total PM Peak Hour

	↖	↗	↙	↘	↕	↔
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖			↘	↖	↗
Traffic Volume (veh/h)	52	28	5	1034	1252	11
Future Volume (Veh/h)	52	28	5	1034	1252	11
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	57	30	5	1124	1361	12
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	2501	1367	1373			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2501	1367	1373			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	83	99			
cM capacity (veh/h)	31	180	500			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	87	1129	1373
Volume Left	57	5	0
Volume Right	30	0	12
cSH	44	500	1700
Volume to Capacity	1.99	0.01	0.81
Queue Length 95th (m)	67.6	0.2	0.0
Control Delay (s)	658.9	0.4	0.0
Lane LOS	F	A	
Approach Delay (s)	658.9	0.4	0.0
Approach LOS	F		

Intersection Summary			
Average Delay		22.3	
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)		15	

Lanes, Volumes, Timings

210701

5: Grassy Brooks Rd & Driveway C

2024 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	450	432	1	2	0
Future Volume (vph)	0	450	432	1	2	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Fit						
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1697	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1697	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		143.6	76.3		67.3	
Travel Time (s)		12.9	6.9		5.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	489	470	1	2	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	489	471	0	2	0
Sign Control		Free	Free		Stop	

Intersection Summary

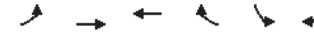
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	35.7%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

210701

5: Grassy Brooks Rd & Driveway C

2024 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	450	432	1	2	0
Future Volume (Veh/h)	0	450	432	1	2	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	489	470	1	2	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	471				960	470
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	471				960	470
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1091				285	593

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	489	471	2
Volume Left	0	0	2
Volume Right	0	1	0
cSH	1091	1700	285
Volume to Capacity	0.00	0.28	0.01
Queue Length 95th (m)	0.0	0.0	0.2
Control Delay (s)	0.0	0.0	17.7
Lane LOS			C
Approach Delay (s)	0.0	0.0	17.7
Approach LOS			C

Intersection Summary

Average Delay	0.0
Intersection Capacity Utilization	35.7%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

6: Grassy Brooks Rd & Driveway D

2024 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	452	433	7	19	0
Future Volume (vph)	0	452	433	7	19	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998				
Fit Protected				0.950		
Satd. Flow (prot)	0	1697	1693	0	1612	0
Fit Permitted				0.950		
Satd. Flow (perm)	0	1697	1693	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		76.3	239.3		68.2	
Travel Time (s)		6.9	21.5		5.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	491	471	8	21	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	491	479	0	21	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 35.8%

ICU Level of Service A

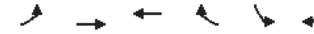
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

210701

6: Grassy Brooks Rd & Driveway D

2024 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	452	433	7	19	0
Future Volume (Veh/h)	0	452	433	7	19	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	491	471	8	21	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	479				966	475
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	479				966	475
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				93	100
cM capacity (veh/h)	1083				282	590

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	491	479	21
Volume Left	0	0	21
Volume Right	0	8	0
cSH	1083	1700	282
Volume to Capacity	0.00	0.28	0.07
Queue Length 95th (m)	0.0	0.0	1.8
Control Delay (s)	0.0	0.0	18.8
Lane LOS			C
Approach Delay (s)	0.0	0.0	18.8
Approach LOS			C

Intersection Summary

Average Delay 0.4

Intersection Capacity Utilization 35.8%

ICU Level of Service

A

Analysis Period (min) 15

Lanes, Volumes, Timings

210701

7: Grassy Brooks Rd & Driveway E

2024 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	471	440	6	25	0
Future Volume (vph)	0	471	440	6	25	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998				
Fit Protected				0.950		
Satd. Flow (prot)	0	1697	1693	0	1612	0
Fit Permitted				0.950		
Satd. Flow (perm)	0	1697	1693	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		239.3	110.1		77.3	
Travel Time (s)		21.5	9.9		5.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	512	478	7	27	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	512	485	0	27	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 36.9%

ICU Level of Service A

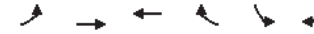
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

210701

7: Grassy Brooks Rd & Driveway E

2024 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	471	440	6	25	0
Future Volume (Veh/h)	0	471	440	6	25	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	512	478	7	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	485				994	482
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	485				994	482
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				90	100
cM capacity (veh/h)	1078				272	585

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	512	485	27
Volume Left	0	0	27
Volume Right	0	7	0
cSH	1078	1700	272
Volume to Capacity	0.00	0.29	0.10
Queue Length 95th (m)	0.0	0.0	2.5
Control Delay (s)	0.0	0.0	19.7
Lane LOS			C
Approach Delay (s)	0.0	0.0	19.7
Approach LOS			C

Intersection Summary

Average Delay 0.5

Intersection Capacity Utilization 36.9%

ICU Level of Service

A

Analysis Period (min) 15

Lanes, Volumes, Timings
8: Montrose Rd & Driveway F

210701
2024 Total PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	50	41	9	578	913	10
Future Volume (vph)	50	41	9	578	913	10
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.939			0.998		
Flt Protected	0.973			0.999		
Satd. Flow (prot)	1550	0	0	3220	3217	0
Flt Permitted	0.973			0.999		
Satd. Flow (perm)	1550	0	0	3220	3217	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	82.8			799.0	214.2	
Travel Time (s)	6.2			41.1	11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	45	10	628	992	11
Shared Lane Traffic (%)						
Lane Group Flow (vph)	99	0	0	638	1003	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	40.1%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
8: Montrose Rd & Driveway F

210701
2024 Total PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	41	9	578	913	10
Future Volume (Veh/h)	50	41	9	578	913	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	54	45	10	628	992	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLT	TWLT	
Median storage (veh)				2	2	
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1332	502	1003			
vC1, stage 1 conf vol	998					
vC2, stage 2 conf vol	334					
vCu, unblocked vol	1332	502	1003			
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 %	82	91	99			
cM capacity (veh/h)	298	515	686			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	99	219	419	661	342
Volume Left	54	10	0	0	0
Volume Right	45	0	0	0	11
cSH	368	686	1700	1700	1700
Volume to Capacity	0.27	0.01	0.25	0.39	0.20
Queue Length 95th (m)	8.0	0.3	0.0	0.0	0.0
Control Delay (s)	18.3	0.6	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	18.3	0.2		0.0	
Approach LOS	C				

Intersection Summary	
Average Delay	1.1
Intersection Capacity Utilization	40.1%
ICU Level of Service	A
Analysis Period (min)	15

Appendix I

Five-Year Background Traffic Operations



Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway

2029 Background AM Peak Hour

	↖	↗	↙	↘	↕	↗
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕			↕↕	↕↕	
Traffic Volume (vph)	9	5	18	793	740	25
Future Volume (vph)	9	5	18	793	740	25
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.955			0.995		
Flt Protected	0.968			0.999		
Satd. Flow (prot)	1326	0	0	3091	3033	0
Flt Permitted	0.968			0.999		
Satd. Flow (perm)	1326	0	0	3091	3033	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	119.1			195.6	272.2	
Travel Time (s)	8.9			10.1	14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	11%	40%	18%	6%	8%	4%
Adj. Flow (vph)	10	5	20	862	804	27
Shared Lane Traffic (%)						
Lane Group Flow (vph)	15	0	0	882	831	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	47.8%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway

2029 Background AM Peak Hour

	↖	↗	↙	↘	↕	↗
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕			↕↕	↕↕	
Traffic Volume (veh/h)	9	5	18	793	740	25
Future Volume (Veh/h)	9	5	18	793	740	25
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	5	20	862	804	27
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLT	TWLT	
Median storage (veh)				2	2	
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1288	416	831			
vC1, stage 1 conf vol	818					
vC2, stage 2 conf vol	471					
vCu, unblocked vol	1288	416	831			
tC, single (s)	7.0	7.7	4.5			
tC, 2 stage (s)	6.0					
tF (s)	3.6	3.7	2.4			
p0 queue free %	97	99	97			
cM capacity (veh/h)	325	492	702			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	15	307	575	536	295
Volume Left	10	20	0	0	0
Volume Right	5	0	0	0	27
cSH	367	702	1700	1700	1700
Volume to Capacity	0.04	0.03	0.34	0.32	0.17
Queue Length 95th (m)	1.0	0.7	0.0	0.0	0.0
Control Delay (s)	15.2	1.0	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	15.2	0.3		0.0	
Approach LOS	C				

Intersection Summary

Average Delay	0.3
Intersection Capacity Utilization	47.8%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
2029 Background AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (vph)	386	19	41	468	371	336
Future Volume (vph)	386	19	41	468	371	336
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			15.0
Storage Lanes	1	1	1			1
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Fit Protected	0.950		0.950			
Satd. Flow (prot)	1612	1471	1644	3102	3017	1471
Fit Permitted	0.950		0.950			
Satd. Flow (perm)	1612	1471	1644	3102	3017	1471
Link Speed (k/h)	40			70	70	
Link Distance (m)	110.1			214.2	105.8	
Travel Time (s)	9.9			11.0	5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	0%	0%	6%	9%	0%
Adj. Flow (vph)	420	21	45	509	403	365
Shared Lane Traffic (%)						
Lane Group Flow (vph)	420	21	45	509	403	365
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	47.7% ICU Level of Service A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
2: Montrose Rd & Grassy Brooks Rd

210701
2029 Background AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement	↔	↔	↔	↕↕	↕↕	↔
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (veh/h)	386	19	41	468	371	336
Future Volume (Veh/h)	386	19	41	468	371	336
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	420	21	45	509	403	365
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)						
pX, platoon unblocked						
vC, conflicting volume	748	202	768			
vC1, stage 1 conf vol	403					
vC2, stage 2 conf vol	344					
vCu, unblocked vol	748	202	768			
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 %	21	97	95			
cM capacity (veh/h)	529	812	855			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	420	21	45	254	254	202	202	365
Volume Left	420	0	45	0	0	0	0	0
Volume Right	0	21	0	0	0	0	0	365
cSH	529	812	855	1700	1700	1700	1700	1700
Volume to Capacity	0.79	0.03	0.05	0.15	0.15	0.12	0.12	0.21
Queue Length 95th (m)	56.0	0.6	1.2	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	33.1	9.6	9.4	0.0	0.0	0.0	0.0	0.0
Lane LOS	D	A	A					
Approach Delay (s)	32.0		0.8			0.0		
Approach LOS	D							

Intersection Summary	
Average Delay	8.2
Intersection Capacity Utilization	47.7% ICU Level of Service A
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Background AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↙	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖↖	↖	↖↖	↖↖	↖	↖	↖↖	↖	↖↖	↖↖	↖
Traffic Volume (vph)	117	223	7	219	301	318	8	191	356	163	117	121
Future Volume (vph)	117	223	7	219	301	318	8	191	356	163	117	121
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.554			0.950			0.671			0.950		
Satd. Flow (perm)	959	3131	981	2899	3256	1375	1161	3044	1388	2899	3017	1375
Right Turn on Red			Yes		Yes		Yes		Yes		Yes	
Satd. Flow (RTOR)			117		346				387			132
Link Speed (km/h)	80			80			70			70		
Link Distance (m)	446.7			423.1			424.8			184.5		
Travel Time (s)	20.1			19.0			21.8			9.5		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Adj. Flow (vph)	127	242	8	238	327	346	9	208	387	177	127	132
Shared Lane Traffic (%)												
Lane Group Flow (vph)	127	242	8	238	327	346	9	208	387	177	127	132
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3		8		2		1		6
Permitted Phases	4		4			8	2		2			6
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	10.0	47.3	47.3	48.7	48.7	48.7	9.0	57.7	57.7
Total Split (%)	35.5%	35.5%	35.5%	9.5%	45.0%	45.0%	46.4%	46.4%	46.4%	8.6%	55.0%	55.0%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effct Green (s)	20.1	20.1	20.1	6.2	30.5	30.5	19.2	19.2	19.2	5.2	28.5	28.5
Actuated g/C Ratio	0.30	0.30	0.30	0.09	0.45	0.45	0.29	0.29	0.29	0.08	0.42	0.42
v/c Ratio	0.44	0.26	0.02	0.89	0.22	0.43	0.03	0.24	0.58	0.80	0.10	0.20
Control Delay	25.3	18.9	0.1	70.1	12.1	3.4	19.0	19.8	6.3	62.2	13.0	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	0.0
Total Delay	25.3	18.9	0.1	70.1	12.1	3.4	19.0	19.8	6.3	62.2	13.0	3.8
LOS	C	B	A	E	B	A	B	B	A	E	B	A
Approach Delay		20.7			24.0				11.1			30.2
Approach LOS		C			C				B			C
Queue Length 50th (m)	11.9	11.1	0.0	14.5	11.4	0.0	0.8	9.8	0.0	10.7	4.5	0.0

Lanes, Volumes, Timings

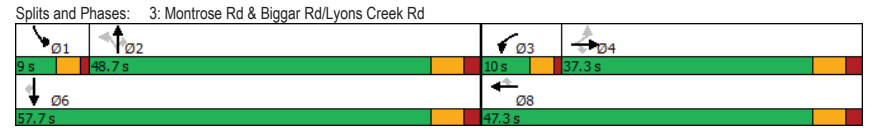
210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Background AM Peak Hour

	↖	→	↘	↙	←	↖	↙	↘	↙	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	30.5	23.1	0.0	#47.3	24.4	13.5	4.2	20.7	18.5	#36.7	11.3	9.3
Internal Link Dist (m)		422.7			399.1			400.8			160.5	
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	490	1600	558	266	2164	1030	796	2088	1073	222	2480	1153
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.15	0.01	0.89	0.15	0.34	0.01	0.10	0.36	0.80	0.05	0.11

Intersection Summary	
Area Type:	Other
Cycle Length:	105
Actuated Cycle Length:	67.2
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.89
Intersection Signal Delay:	21.3
Intersection Capacity Utilization:	48.0%
Analysis Period (min):	15
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	



HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Background AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	117	223	7	219	301	318	8	191	356	163	117	121
Future Volume (vph)	117	223	7	219	301	318	8	191	356	163	117	121
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.55	1.00	1.00	0.95	1.00	1.00	0.67	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	959	3131	981	2899	3256	1375	1162	3044	1388	2899	3017	1375
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	127	242	8	238	327	346	9	208	387	177	127	132
RTOR Reduction (vph)	0	0	6	0	0	189	0	0	276	0	0	76
Lane Group Flow (vph)	127	242	2	238	327	157	9	208	111	177	127	56
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1		6
Permitted Phases	4		4			8		2		2		6
Actuated Green, G (s)	17.9	17.9	17.9	6.2	28.1	28.1	16.9	16.9	16.9	5.2	26.1	26.1
Effective Green, g (s)	20.2	20.2	20.2	6.2	30.4	30.4	19.2	19.2	19.2	5.2	28.4	28.4
Actuated g/C Ratio	0.30	0.30	0.30	0.09	0.46	0.46	0.29	0.29	0.29	0.08	0.43	0.43
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	289	946	296	269	1481	625	333	874	398	225	1282	584
v/s Ratio Prot		0.08		c0.08	0.10			0.07		c0.06	0.04	
v/s Ratio Perm	c0.13		0.00			0.11	0.01		c0.08			0.04
v/c Ratio	0.44	0.26	0.01	0.88	0.22	0.25	0.03	0.24	0.28	0.79	0.10	0.10
Uniform Delay, d1	18.7	17.6	16.3	29.9	11.0	11.2	17.1	18.2	18.4	30.3	11.5	11.5
Progression Factor	1.00	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	3.0	0.4	0.0	29.9	0.2	0.6	0.1	0.4	1.1	19.9	0.1	0.2
Delay (s)	21.7	18.0	16.3	59.8	11.2	11.8	17.2	18.6	19.5	50.2	11.6	11.7
Level of Service	C	B	B	E	B	B	B	B	B	D	B	B
Approach Delay (s)		19.2			24.1			19.2			27.3	
Approach LOS		B			C			B			C	

Intersection Summary			
HCM 2000 Control Delay	22.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	66.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	48.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway

2029 Background PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	26	15	3	975	1236	5
Future Volume (vph)	26	15	3	975	1236	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.951				0.999	
Fit Protected	0.969					
Satd. Flow (prot)	1555	0	0	3162	3221	0
Fit Permitted	0.969					
Satd. Flow (perm)	1555	0	0	3162	3221	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	119.1			195.6	272.2	
Travel Time (s)	8.9			10.1	14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	7%	0%	4%	2%	0%
Adj. Flow (vph)	28	16	3	1060	1343	5
Shared Lane Traffic (%)						
Lane Group Flow (vph)	44	0	0	1063	1348	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization 47.3%	ICU Level of Service A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway

2029 Background PM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↕ ↙ ↚					
Traffic Volume (veh/h)	26	15	3	975	1236	5
Future Volume (Veh/h)	26	15	3	975	1236	5
Sign Control	Stop			Free		
Grade	0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	28	16	3	1060	1343	5
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)						
pX, platoon unblocked						
vC, conflicting volume	1882	674	1348			
vC1, stage 1 conf vol	1346					
vC2, stage 2 conf vol	536					
vCu, unblocked vol	1882	674	1348			
tC, single (s)	6.8	7.0	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.4	2.2			
p0 queue free %	86	96	99			
cM capacity (veh/h)	197	386	517			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	44	356	707	895	453	
Volume Left	28	3	0	0	0	
Volume Right	16	0	0	0	5	
cSH	239	517	1700	1700	1700	
Volume to Capacity	0.18	0.01	0.42	0.53	0.27	
Queue Length 95th (m)	4.9	0.1	0.0	0.0	0.0	
Control Delay (s)	23.4	0.2	0.0	0.0	0.0	
Lane LOS	C	A				
Approach Delay (s)	23.4	0.1		0.0		
Approach LOS	C					
Intersection Summary						
Average Delay			0.4			
Intersection Capacity Utilization			47.3%	ICU Level of Service	A	
Analysis Period (min)			15			

Lanes, Volumes, Timings

210701

2: Montrose Rd & Grassy Brooks Rd

2029 Background PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔ ↗ ↘ ↕ ↙ ↚					
Traffic Volume (vph)	418	32	19	557	838	413
Future Volume (vph)	418	32	19	557	838	413
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			15.0
Storage Lanes	1	1	1			1
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	0.850		0.850			
Fit Protected	0.950	0.950				
Satd. Flow (prot)	1644	1471	1644	3131	3224	1471
Fit Permitted	0.950	0.950				
Satd. Flow (perm)	1644	1471	1644	3131	3224	1471
Link Speed (k/h)	40	70		70	70	
Link Distance (m)	110.1	214.2		214.2	105.8	
Travel Time (s)	9.9	11.0		11.0	5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	5%	2%	0%
Adj. Flow (vph)	454	35	21	605	911	449
Shared Lane Traffic (%)						
Lane Group Flow (vph)	454	35	21	605	911	449
Sign Control	Stop			Free		Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	57.0%			ICU Level of Service B		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

210701

2: Montrose Rd & Grassy Brooks Rd

2029 Background PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR		
Lane Configurations	↔	↔	↔	↕	↕	↔		
Traffic Volume (veh/h)	418	32	19	557	838	413		
Future Volume (Veh/h)	418	32	19	557	838	413		
Sign Control	Stop		Free		Free			
Grade	0%		0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	454	35	21	605	911	449		
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)								
pX, platoon unblocked								
vC, conflicting volume	1256	456	1360					
vC1, stage 1 conf vol	911							
vC2, stage 2 conf vol	344							
vCu, unblocked vol	1256	456	1360					
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 %	0	94	96					
cM capacity (veh/h)	330	557	512					
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	454	35	21	302	302	456	456	449
Volume Left	454	0	21	0	0	0	0	0
Volume Right	0	35	0	0	0	0	0	449
cSH	330	557	512	1700	1700	1700	1700	1700
Volume to Capacity	1.38	0.06	0.04	0.18	0.18	0.27	0.27	0.26
Queue Length 95th (m)	172.1	1.5	1.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	218.9	11.9	12.3	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	B	B					
Approach Delay (s)	204.0		0.4		0.0			
Approach LOS	F							
Intersection Summary								
Average Delay			40.4					
Intersection Capacity Utilization			57.0%		ICU Level of Service		B	
Analysis Period (min)	15							

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Background PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↕	↔	↕	↕	↔	↕	↕	↔	↕	↕
Traffic Volume (vph)	165	284	6	281	234	193	6	190	307	409	360	203
Future Volume (vph)	165	284	6	281	234	193	6	190	307	409	360	203
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Fit			0.850			0.850			0.850			0.850
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Fit Permitted	0.595			0.950			0.521			0.950		
Satd. Flow (perm)	1030	3224	1471	3097	3131	1428	902	3162	1428	3127	3224	1442
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			107			210			334			221
Link Speed (k/h)	80			80			70			70		
Link Distance (m)	446.7			423.1			424.8			184.5		
Travel Time (s)	20.1			19.0			21.8			9.5		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Adj. Flow (vph)	179	309	7	305	254	210	7	207	334	445	391	221
Shared Lane Traffic (%)												
Lane Group Flow (vph)	179	309	7	305	254	210	7	207	334	445	391	221
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4		4			8	2		2			6
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	13.0	50.3	50.3	49.7	49.7	49.7	15.0	64.7	64.7
Total Split (%)	32.4%	32.4%	32.4%	11.3%	43.7%	43.7%	43.2%	43.2%	43.2%	13.0%	56.3%	56.3%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effct Green (s)	24.6	24.6	24.6	9.2	37.9	37.9	19.1	19.1	19.1	11.2	34.4	34.4
Actuated g/C Ratio	0.31	0.31	0.31	0.11	0.47	0.47	0.24	0.24	0.24	0.14	0.43	0.43
v/c Ratio	0.57	0.31	0.01	0.86	0.17	0.27	0.03	0.28	0.56	1.02	0.28	0.30
Control Delay	31.9	22.5	0.0	62.8	13.0	3.0	25.5	26.8	7.3	87.0	16.4	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.9	22.5	0.0	62.8	13.0	3.0	25.5	26.8	7.3	87.0	16.4	3.6
LOS	C	C	A	E	B	A	C	C	A	F	B	A
Approach Delay	25.6				30.0		14.9				43.4	
Approach LOS	C				C		B				D	
Queue Length 50th (m)	22.1	18.3	0.0	23.6	10.8	0.0	0.8	13.4	0.0	-37.6	19.6	0.0

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Background PM Peak Hour

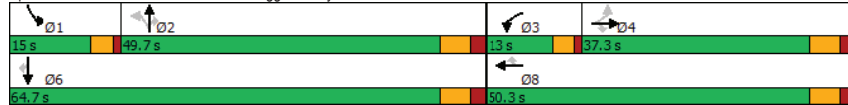


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	46.8	32.1	0.0	#57.7	20.7	11.1	4.2	24.3	19.5	#82.6	33.5	12.2
Internal Link Dist (m)		422.7			399.1			400.8			160.5	
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	435	1361	683	353	1838	925	523	1833	968	436	2482	1161
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.41	0.23	0.01	0.86	0.14	0.23	0.01	0.11	0.35	1.02	0.16	0.19

Intersection Summary

Area Type:	Other
Cycle Length:	115
Actuated Cycle Length:	80.4
Natural Cycle:	115
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.02
Intersection Signal Delay:	31.3
Intersection Capacity Utilization:	52.6%
Analysis Period (min):	15
Intersection LOS:	C
ICU Level of Service:	A
- Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Background PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↔	↔	↕	↔	↔	↕	↔	↔	↕	↔
Traffic Volume (vph)	165	284	6	281	234	193	6	190	307	409	360	203
Future Volume (vph)	165	284	6	281	234	193	6	190	307	409	360	203
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Flt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Flt Permitted	0.59	1.00	1.00	0.95	1.00	1.00	0.52	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1029	3224	1471	3097	3131	1428	901	3162	1428	3127	3224	1442
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	179	309	7	305	254	210	7	207	334	445	391	221
RTOR Reduction (vph)	0	0	5	0	0	111	0	0	254	0	0	126
Lane Group Flow (vph)	179	309	2	305	254	99	7	207	80	445	391	95
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%

Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3		8		2		1		6
Permitted Phases	4		4		8		2		2			6
Actuated Green, G (s)	22.4	22.4	22.4	9.2	35.6	35.6	16.8	16.8	16.8	11.2	32.0	32.0
Effective Green, g (s)	24.7	24.7	24.7	9.2	37.9	37.9	19.1	19.1	19.1	11.2	34.3	34.3
Actuated g/C Ratio	0.31	0.31	0.31	0.11	0.47	0.47	0.24	0.24	0.24	0.14	0.43	0.43
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	316	992	453	355	1479	674	214	753	340	436	1378	616
v/s Ratio Prot		0.10		c0.10	0.08			0.07		c0.14		c0.12
v/s Ratio Perm	c0.17		0.00			0.07	0.01		0.06			0.07
v/c Ratio	0.57	0.31	0.00	0.86	0.17	0.15	0.03	0.27	0.23	1.02	0.28	0.15
Uniform Delay, d1	23.3	21.2	19.2	34.9	12.1	12.0	23.5	24.9	24.6	34.5	14.9	14.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.8	0.5	0.0	20.6	0.2	0.3	0.2	0.6	1.0	48.4	0.3	0.3
Delay (s)	28.0	21.7	19.2	55.4	12.3	12.3	23.6	25.5	25.6	82.9	15.3	14.4
Level of Service	C	C	B	E	B	B	C	C	C	F	B	B
Approach Delay (s)		24.0			29.4			25.6			43.6	
Approach LOS		C			C			C			D	

Intersection Summary

HCM 2000 Control Delay	33.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	80.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	52.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Appendix J

Five-Year Total Traffic Operations



Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway/Driveway A

2029 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↖	↗	↘	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↕			↕			↕			↕		
Traffic Volume (vph)	9	0	5	2	0	3	18	812	15	19	865	25	
Future Volume (vph)	9	0	5	2	0	3	18	812	15	19	865	25	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95	
Frt		0.955			0.919			0.997			0.996		
Flt Protected		0.968			0.980			0.999			0.999		
Satd. Flow (prot)	0	1326	0	0	1528	0	0	3084	0	0	3036	0	
Flt Permitted		0.968			0.980			0.999			0.999		
Satd. Flow (perm)	0	1326	0	0	1528	0	0	3084	0	0	3036	0	
Link Speed (k/h)		48			48			70			70		
Link Distance (m)		119.1			75.1			195.6			272.2		
Travel Time (s)		8.9			5.6			10.1			14.0		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	11%	2%	40%	2%	2%	2%	18%	6%	2%	2%	8%	4%	
Adj. Flow (vph)	10	0	5	2	0	3	20	883	16	21	940	27	
Shared Lane Traffic (%)													
Lane Group Flow (vph)	0	15	0	0	5	0	0	919	0	0	988	0	
Sign Control		Stop			Stop			Free			Free		

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 51.6%

ICU Level of Service A

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway/Driveway A

2029 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↖	↗	↘	↙
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↕			↕			↕			↕		
Traffic Volume (veh/h)	9	0	5	2	0	3	18	812	15	19	865	25	
Future Volume (Veh/h)	9	0	5	2	0	3	18	812	15	19	865	25	
Sign Control		Stop			Stop			Free			Free		
Grade		0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	10	0	5	2	0	3	20	883	16	21	940	27	
Pedestrians													
Lane Width (m)													
Walking Speed (m/s)													
Percent Blockage													
Right turn flare (veh)													
Median type								TWLT			TWLT		
Median storage (veh)								2			2		
Upstream signal (m)													
pX, platoon unblocked													
vC, conflicting volume	1480	1934	484	1448	1940	450	967				899		
vC1, stage 1 conf vol	996	996		931	931								
vC2, stage 2 conf vol	484	939		517	1009								
vCu, unblocked vol	1480	1934	484	1448	1940	450	967				899		
tC, single (s)	7.7	6.5	7.7	7.5	6.5	6.9	4.5				4.1		
tC, 2 stage (s)	6.7	5.5		6.5	5.5								
tF (s)	3.6	4.0	3.7	3.5	4.0	3.3	2.4				2.2		
p0 queue free %	95	100	99	99	100	99	97				97		
cM capacity (veh/h)	216	222	439	245	220	557	618				751		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	15	5	462	458	491	497
Volume Left	10	2	20	0	21	0
Volume Right	5	3	0	16	0	27
cSH	260	369	618	1700	751	1700
Volume to Capacity	0.06	0.01	0.03	0.27	0.03	0.29
Queue Length 95th (m)	1.4	0.3	0.8	0.0	0.6	0.0
Control Delay (s)	19.7	14.9	0.9	0.0	0.8	0.0
Lane LOS	C	B	A	A	A	A
Approach Delay (s)	19.7	14.9	0.5	0.4		
Approach LOS	C	B				

Intersection Summary

Average Delay

0.6

Intersection Capacity Utilization

51.6%

ICU Level of Service

A

Analysis Period (min)

15

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
2029 Total AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (vph)	391	24	76	515	430	352
Future Volume (vph)	391	24	76	515	430	352
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			15.0
Storage Lanes	1	1	1			1
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Fit Protected	0.950		0.950			
Satd. Flow (prot)	1612	1471	1644	3102	3017	1471
Fit Permitted	0.950		0.950			
Satd. Flow (perm)	1612	1471	1644	3102	3017	1471
Link Speed (k/h)	40		70	70		
Link Distance (m)	110.1		214.2	105.8		
Travel Time (s)	9.9		11.0	5.4		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	0%	0%	6%	9%	0%
Adj. Flow (vph)	425	26	83	560	467	383
Shared Lane Traffic (%)						
Lane Group Flow (vph)	425	26	83	560	467	383
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 51.0% ICU Level of Service A
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis
2: Montrose Rd & Grassy Brooks Rd

210701
2029 Total AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement	↔	↔	↔	↕↕	↕↕	↔
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (veh/h)	391	24	76	515	430	352
Future Volume (Veh/h)	391	24	76	515	430	352
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	425	26	83	560	467	383
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)						
pX, platoon unblocked						
vC, conflicting volume	913	234	850			
vC1, stage 1 conf vol	467					
vC2, stage 2 conf vol	446					
vCu, unblocked vol	913	234	850			
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 %	6	97	90			
cM capacity (veh/h)	451	775	797			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	425	26	83	280	280	234	234	383
Volume Left	425	0	83	0	0	0	0	0
Volume Right	0	26	0	0	0	0	0	383
cSH	451	775	797	1700	1700	1700	1700	1700
Volume to Capacity	0.94	0.03	0.10	0.16	0.16	0.14	0.14	0.23
Queue Length 95th (m)	83.4	0.8	2.6	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	59.8	9.8	10.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	A	B					
Approach Delay (s)	56.9		1.3			0.0		
Approach LOS	F							

Intersection Summary

Average Delay 13.6
Intersection Capacity Utilization 51.0% ICU Level of Service A
Analysis Period (min) 15

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↖	↗	↘	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↖	↖↖	↖	↖↖	↖↖	↖	↖	↖↖	↖	↖↖	↖↖	↖	↖
Traffic Volume (vph)	131	223	7	219	301	356	8	257	356	169	126	123	
Future Volume (vph)	131	223	7	219	301	356	8	257	356	169	126	123	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0	
Storage Lanes	1		1	2		1	1		1	1		1	
Taper Length (m)	15.0			15.0			15.0			15.0			
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00	
Frt			0.850			0.850			0.850			0.850	
Fit Protected	0.950			0.950			0.950			0.950			
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375	
Fit Permitted	0.554			0.950			0.665			0.950			
Satd. Flow (perm)	959	3131	981	2899	3256	1375	1151	3044	1388	2899	3017	1375	
Right Turn on Red			Yes			Yes			Yes			Yes	
Satd. Flow (RTOR)			117			387			387			134	
Link Speed (k/h)	80			80			70			70			
Link Distance (m)	446.7			423.1			424.8			184.5			
Travel Time (s)	20.1			19.0			21.8			9.5			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%	
Adj. Flow (vph)	142	242	8	238	327	387	9	279	387	184	137	134	
Shared Lane Traffic (%)													
Lane Group Flow (vph)	142	242	8	238	327	387	9	279	387	184	137	134	
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	
Protected Phases													
Permitted Phases	4	4	4	3	8	8	2	2	2	1	6	6	
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6	
Switch Phase													
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0	
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3	
Total Split (s)	37.3	37.3	37.3	9.0	46.3	46.3	49.7	49.7	49.7	9.0	58.7	58.7	
Total Split (%)	35.5%	35.5%	35.5%	8.6%	44.1%	44.1%	47.3%	47.3%	47.3%	8.6%	55.9%	55.9%	
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1	
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2	
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead			
Lead-Lag Optimize?													
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min	
Act Effct Green (s)	21.4	21.4	21.4	5.2	30.8	30.8	21.4	21.4	21.4	5.2	30.7	30.7	
Actuated g/C Ratio	0.31	0.31	0.31	0.07	0.44	0.44	0.31	0.31	0.31	0.07	0.44	0.44	
v/c Ratio	0.48	0.25	0.02	1.11	0.23	0.47	0.03	0.30	0.56	0.86	0.10	0.20	
Control Delay	26.6	19.1	0.1	130.7	13.1	3.7	18.8	20.0	5.9	72.2	12.8	3.7	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	26.6	19.1	0.1	130.7	13.1	3.7	18.8	20.0	5.9	72.2	12.8	3.7	
LOS	C	B	A	F	B	A	B	C	A	E	B	A	
Approach Delay		21.4			38.7			11.9			34.1		
Approach LOS		C			D			B			C		
Queue Length 50th (m)	14.0	11.6	0.0	~17.6	12.5	0.0	0.8	13.7	0.0	11.8	5.0	0.0	

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↖	↗	↘	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Queue Length 95th (m)	34.4	23.3	0.0	#52.0	25.4	14.4	4.1	27.4	18.1	#39.8	12.2	9.4	
Internal Link Dist (m)		422.7			399.1			400.8			160.5		
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0	
Base Capacity (vph)	473	1546	543	214	2043	1006	780	2064	1065	214	2435	1136	
Starvation Cap Reductn	0	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	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.30	0.16	0.01	1.11	0.16	0.38	0.01	0.14	0.36	0.86	0.06	0.12	

Intersection Summary	
Area Type:	Other
Cycle Length:	105
Actuated Cycle Length:	69.7
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.11
Intersection Signal Delay:	27.8
Intersection Capacity Utilization:	50.6%
ICU Level of Service:	A
Analysis Period (min):	15
- Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis
3: Montrose Rd & Biggar Rd/Lyons Creek Rd

210701
2029 Total AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	131	223	7	219	301	356	8	257	356	169	126	123
Future Volume (vph)	131	223	7	219	301	356	8	257	356	169	126	123
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Fr't	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.55	1.00	1.00	0.95	1.00	1.00	0.67	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	959	3131	981	2899	3256	1375	1151	3044	1388	2899	3017	1375
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	142	242	8	238	327	387	9	279	387	184	137	134
RTOR Reduction (vph)	0	0	6	0	0	216	0	0	267	0	0	75
Lane Group Flow (vph)	142	242	2	238	327	171	9	279	120	184	137	59
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1		6
Permitted Phases	4		4			8	2		2			6
Actuated Green, G (s)	19.2	19.2	19.2	5.2	28.4	28.4	19.1	19.1	19.1	5.2	28.3	28.3
Effective Green, g (s)	21.5	21.5	21.5	5.2	30.7	30.7	21.4	21.4	21.4	5.2	30.6	30.6
Actuated g/C Ratio	0.31	0.31	0.31	0.08	0.44	0.44	0.31	0.31	0.31	0.08	0.44	0.44
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	297	971	304	217	1442	609	355	939	428	217	1332	607
v/s Ratio Prot		0.08		c0.08	0.10			c0.09		c0.06		0.05
v/s Ratio Perm	c0.15		0.00			0.12	0.01		0.09			0.04
v/c Ratio	0.48	0.25	0.01	1.10	0.23	0.28	0.03	0.30	0.28	0.85	0.10	0.10
Uniform Delay, d1	19.4	17.9	16.5	32.0	12.0	12.3	16.7	18.2	18.1	31.7	11.3	11.3
Progression Factor	1.00	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	3.4	0.4	0.0	89.4	0.2	0.7	0.1	0.5	1.0	28.4	0.1	0.2
Delay (s)	22.7	18.2	16.6	121.4	12.2	13.0	16.8	18.7	19.1	60.0	11.4	11.5
Level of Service	C	B	B	F	B	B	B	B	B	E	B	B
Approach Delay (s)		19.8			39.8			18.9			31.1	
Approach LOS		B			D			B			C	
Intersection Summary												
HCM 2000 Control Delay			29.4		HCM 2000 Level of Service				C			
HCM 2000 Volume to Capacity ratio	0.50											
Actuated Cycle Length (s)	69.3			Sum of lost time (s)				16.0				
Intersection Capacity Utilization	50.6%		ICU Level of Service				A					
Analysis Period (min)	15											
c Critical Lane Group												

Lanes, Volumes, Timings
4: Montrose Rd & Driveway B

210701
2029 Total AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	7	4	25	838	816	56
Future Volume (vph)	7	4	25	838	816	56
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Fr't	0.955				0.990	
Fit Protected	0.968			0.999		
Satd. Flow (prot)	1568	0	0	3220	3191	0
Fit Permitted	0.968			0.999		
Satd. Flow (perm)	1568	0	0	3220	3191	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	69.9			105.8	195.6	
Travel Time (s)	5.2			5.4	10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	4	27	911	887	61
Shared Lane Traffic (%)						
Lane Group Flow (vph)	12	0	0	938	948	0
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	54.7%		ICU Level of Service A			
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
4: Montrose Rd & Driveway B

210701
2029 Total AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	7	4	25	838	816	56
Future Volume (Veh/h)	7	4	25	838	816	56
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	4	27	911	887	61
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)						
pX, platoon unblocked						
vC, conflicting volume	1427	474	948			
vC1, stage 1 conf vol	918					
vC2, stage 2 conf vol	510					
vCu, unblocked vol	1427	474	948			
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	99	96			
cM capacity (veh/h)	306	537	720			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	12	331	607	591	357	
Volume Left	8	27	0	0	0	
Volume Right	4	0	0	0	61	
cSH	357	720	1700	1700	1700	
Volume to Capacity	0.03	0.04	0.36	0.35	0.21	
Queue Length 95th (m)	0.8	0.9	0.0	0.0	0.0	
Control Delay (s)	15.4	1.3	0.0	0.0	0.0	
Lane LOS	C	A				
Approach Delay (s)	15.4	0.4		0.0		
Approach LOS	C					
Intersection Summary						
Average Delay		0.3				
Intersection Capacity Utilization		54.7%		ICU Level of Service	A	
Analysis Period (min)		15				

Lanes, Volumes, Timings
5: Grassy Brooks Rd & Driveway C

210701
2029 Total AM Peak Hour

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	0	405	378	2	1	0
Future Volume (vph)	0	405	378	2	1	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.999			
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1695	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1695	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		143.6	76.3		67.3	
Travel Time (s)		12.9	6.9		5.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	440	411	2	1	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	440	413	0	1	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	33.1%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
5: Grassy Brooks Rd & Driveway C

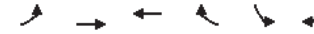
210701
2029 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↓	
Traffic Volume (veh/h)	0	405	378	2	1	0
Future Volume (Veh/h)	0	405	378	2	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	440	411	2	1	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	413				852	412
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	413				852	412
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1146				330	640
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	440	413	1			
Volume Left	0	0	1			
Volume Right	0	2	0			
cSH	1146	1700	330			
Volume to Capacity	0.00	0.24	0.00			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	15.9			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	15.9			
Approach LOS			C			
Intersection Summary						
Average Delay		0.0				
Intersection Capacity Utilization		33.1%	ICU Level of Service	A		
Analysis Period (min)		15				

Lanes, Volumes, Timings
6: Grassy Brooks Rd & Driveway D

210701
2029 Total AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↓	
Traffic Volume (vph)	0	406	380	18	5	0
Future Volume (vph)	0	406	380	18	5	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994			
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1686	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1686	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		76.3	239.3		68.2	
Travel Time (s)		6.9	21.5		5.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	441	413	20	5	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	441	433	0	5	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	33.2%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Grassy Brooks Rd & Driveway D

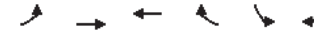
210701
2029 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↓	
Traffic Volume (veh/h)	0	406	380	18	5	0
Future Volume (Veh/h)	0	406	380	18	5	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	441	413	20	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	433			864	423	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	433			864	423	
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			98	100	
cM capacity (veh/h)	1127			325	631	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	441	433	5			
Volume Left	0	0	5			
Volume Right	0	20	0			
cSH	1127	1700	325			
Volume to Capacity	0.00	0.25	0.02			
Queue Length 95th (m)	0.0	0.0	0.4			
Control Delay (s)	0.0	0.0	16.3			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	16.3			
Approach LOS			C			
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		33.2%	ICU Level of Service	A		
Analysis Period (min)		15				

Lanes, Volumes, Timings
7: Grassy Brooks Rd & Driveway E

210701
2029 Total AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↓	
Traffic Volume (vph)	0	411	398	31	4	0
Future Volume (vph)	0	411	398	31	4	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.990			
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1680	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1680	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		239.3	110.1		77.3	
Travel Time (s)		21.5	9.9		5.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	447	433	34	4	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	447	467	0	4	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	34.8%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
7: Grassy Brooks Rd & Driveway E

210701
2029 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↑	
Traffic Volume (veh/h)	0	411	398	31	4	0
Future Volume (Veh/h)	0	411	398	31	4	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	447	433	34	4	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	467				897	450
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	467				897	450
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1094				310	609
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	447	467	4			
Volume Left	0	0	4			
Volume Right	0	34	0			
cSH	1094	1700	310			
Volume to Capacity	0.00	0.27	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	16.8			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	16.8			
Approach LOS			C			
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		34.8%		ICU Level of Service	A	
Analysis Period (min)		15				

Lanes, Volumes, Timings
8: Montrose Rd & Driveway F

210701
2029 Total AM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↑			↑↑	↑↑	
Traffic Volume (vph)	7	6	43	585	402	53
Future Volume (vph)	7	6	43	585	402	53
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.937				0.982	
Fit Protected	0.974			0.997		
Satd. Flow (prot)	1548	0	0	3214	3166	0
Fit Permitted	0.974			0.997		
Satd. Flow (perm)	1548	0	0	3214	3166	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	82.8			799.0	214.2	
Travel Time (s)	6.2			41.1	11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	7	47	636	437	58
Shared Lane Traffic (%)						
Lane Group Flow (vph)	15	0	0	683	495	0
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	46.1%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
8: Montrose Rd & Driveway F

210701
2029 Total AM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	7	6	43	585	402	53
Future Volume (Veh/h)	7	6	43	585	402	53
Sign Control	Stop		Free			
Grade	0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	7	47	636	437	58
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)						
pX, platoon unblocked						
vC, conflicting volume	878	248	495			
vC1, stage 1 conf vol	466					
vC2, stage 2 conf vol	412					
vCu, unblocked vol	878	248	495			
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 %	98	99	96			
cM capacity (veh/h)	482	753	1065			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	15	259	424	291	204	
Volume Left	8	47	0	0	0	
Volume Right	7	0	0	0	58	
cSH	579	1065	1700	1700	1700	
Volume to Capacity	0.03	0.04	0.25	0.17	0.12	
Queue Length 95th (m)	0.6	1.0	0.0	0.0	0.0	
Control Delay (s)	11.4	1.9	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	11.4	0.7	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			0.6			
Intersection Capacity Utilization			46.1%		ICU Level of Service A	
Analysis Period (min)	15					

Lanes, Volumes, Timings
1: Montrose Rd & Private Driveway/Driveway B

210701
2029 Total PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	26	0	15	15	0	19	3	1094	3	4	1263	5
Future Volume (vph)	26	0	15	15	0	19	3	1094	3	4	1263	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Fit	0.951		0.923		0.923		0.999					
Fit Protected	0.969		0.979		0.979							
Satd. Flow (prot)	0	1555	0	0	1533	0	0	3162	0	0	3221	0
Fit Permitted	0.969		0.979		0.979							
Satd. Flow (perm)	0	1555	0	0	1533	0	0	3162	0	0	3221	0
Link Speed (k/h)	48		48		70		70					
Link Distance (m)	119.1		75.5		195.6		272.2					
Travel Time (s)	8.9		5.7		10.1		14.0					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	7%	2%	2%	2%	0%	4%	2%	2%	2%	0%
Adj. Flow (vph)	28	0	16	16	0	21	3	1189	3	4	1373	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	44	0	0	37	0	0	1195	0	0	1382	0
Sign Control	Stop		Stop		Free		Free					
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization 51.6%							ICU Level of Service A					
Analysis Period (min) 15												

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway/Driveway B

2029 Total PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↔			↔			↕			↕			
Traffic Volume (veh/h)	26	0	15	15	0	19	3	1094	3	4	1263	5		
Future Volume (Veh/h)	26	0	15	15	0	19	3	1094	3	4	1263	5		
Sign Control	Stop			Stop			Free			Free				
Grade	0%			0%			0%			0%				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	28	0	16	16	0	21	3	1189	3	4	1373	5		
Pedestrians														
Lane Width (m)														
Walking Speed (m/s)														
Percent Blockage														
Right turn flare (veh)														
Median type							TWTL							TWTL
Median storage (veh)							2							2
Upstream signal (m)														
pX, platoon unblocked														
vC, conflicting volume	2005	2582	689	1907	2582	596	1378						1192	
vC1, stage 1 conf vol	1384	1384		1196	1196									
vC2, stage 2 conf vol	622	1198		710	1386									
vCu, unblocked vol	2005	2582	689	1907	2582	596	1378						1192	
tC, single (s)	7.5	6.5	7.0	7.5	6.5	6.9	4.1						4.1	
tC, 2 stage (s)	6.5	5.5		6.5	5.5									
tF (s)	3.5	4.0	3.4	3.5	4.0	3.3	2.2						2.2	
p0 queue free %	80	100	96	91	100	95	99						99	
cM capacity (veh/h)	141	156	377	171	155	447	504						581	
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2								
Volume Total	44	37	598	598	690	692								
Volume Left	28	16	3	0	4	0								
Volume Right	16	21	0	3	0	5								
cSH	183	263	504	1700	581	1700								
Volume to Capacity	0.24	0.14	0.01	0.35	0.01	0.41								
Queue Length 95th (m)	6.8	3.6	0.1	0.0	0.2	0.0								
Control Delay (s)	30.8	20.9	0.2	0.0	0.2	0.0								
Lane LOS	D	C	A	A	A									
Approach Delay (s)	30.8	20.9	0.1		0.1									
Approach LOS	D	C												
Intersection Summary														
Average Delay			0.9											
Intersection Capacity Utilization			51.6%		ICU Level of Service		A							
Analysis Period (min)			15											

Lanes, Volumes, Timings

210701

2: Montrose Rd & Grassy Brooks Rd

2029 Total PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕	↕	↕	↕	↕	↕
Traffic Volume (vph)	435	61	27	615	891	419
Future Volume (vph)	435	61	27	615	891	419
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			15.0
Storage Lanes	1	1	1			1
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	0.850		0.850			
Fit Protected	0.950	0.950				
Satd. Flow (prot)	1644	1471	1644	3131	3224	1471
Fit Permitted	0.950		0.950			
Satd. Flow (perm)	1644	1471	1644	3131	3224	1471
Link Speed (k/h)	40		70		70	
Link Distance (m)	110.1		214.2		105.8	
Travel Time (s)	9.9		11.0		5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	5%	2%	0%
Adj. Flow (vph)	473	66	29	668	968	455
Shared Lane Traffic (%)						
Lane Group Flow (vph)	473	66	29	668	968	455
Sign Control	Stop		Free		Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	59.6%		ICU Level of Service B			
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

2: Montrose Rd & Grassy Brooks Rd

210701

2029 Total PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR		
Lane Configurations	↔	↔	↔	↕	↕	↔		
Traffic Volume (veh/h)	435	61	27	615	891	419		
Future Volume (Veh/h)	435	61	27	615	891	419		
Sign Control	Stop		Free		Free			
Grade	0%		0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	473	66	29	668	968	455		
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)								
pX, platoon unblocked								
vC, conflicting volume	1360	484	1423					
vC1, stage 1 conf vol	968							
vC2, stage 2 conf vol	392							
vCu, unblocked vol	1360	484	1423					
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 %	0	88	94					
cM capacity (veh/h)	305	534	484					
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	473	66	29	334	334	484	484	455
Volume Left	473	0	29	0	0	0	0	0
Volume Right	0	66	0	0	0	0	0	455
cSH	305	534	484	1700	1700	1700	1700	1700
Volume to Capacity	1.55	0.12	0.06	0.20	0.20	0.28	0.28	0.27
Queue Length 95th (m)	206.1	3.1	1.4	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	294.9	12.7	12.9	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	B	B					
Approach Delay (s)	260.4		0.5		0.0			
Approach LOS	F							
Intersection Summary								
Average Delay	52.9							
Intersection Capacity Utilization	59.6%		ICU Level of Service		B			
Analysis Period (min)	15							

Lanes, Volumes, Timings

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

210701

2029 Total PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↕	↕	↔	↕	↕	↔	↕	↕	↔	↕	↕
Traffic Volume (vph)	167	284	6	281	234	201	6	205	307	446	424	215
Future Volume (vph)	167	284	6	281	234	201	6	205	307	446	424	215
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Fit Permitted	0.595			0.950			0.487			0.950		
Satd. Flow (perm)	1030	3224	1471	3097	3131	1428	843	3162	1428	3127	3224	1442
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			107			218			334			234
Link Speed (k/h)	80			80			70			70		
Link Distance (m)	446.7			423.1			424.8			184.5		
Travel Time (s)	20.1			19.0			21.8			9.5		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Adj. Flow (vph)	182	309	7	305	254	218	7	223	334	485	461	234
Shared Lane Traffic (%)												
Lane Group Flow (vph)	182	309	7	305	254	218	7	223	334	485	461	234
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases												
Permitted Phases	4	4	4	3	8	8	2	2	2	1	6	6
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	12.0	49.3	49.3	49.7	49.7	49.7	16.0	65.7	65.7
Total Split (%)	32.4%	32.4%	32.4%	10.4%	42.9%	42.9%	43.2%	43.2%	43.2%	13.9%	57.1%	57.1%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effct Green (s)	24.9	24.9	24.9	8.2	37.1	37.1	19.4	19.4	19.4	12.2	35.7	35.7
Actuated g/C Ratio	0.31	0.31	0.31	0.10	0.46	0.46	0.24	0.24	0.24	0.15	0.44	0.44
v/c Ratio	0.58	0.31	0.01	0.98	0.18	0.28	0.03	0.29	0.56	1.03	0.32	0.31
Control Delay	32.2	22.6	0.0	86.8	13.7	3.1	25.7	27.0	7.3	86.3	16.2	3.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.2	22.6	0.0	86.8	13.7	3.1	25.7	27.0	7.3	86.3	16.2	3.4
LOS	C	C	A	F	B	A	C	C	A	F	B	A
Approach Delay	25.8				39.4		15.3				42.5	
Approach LOS	C				D		B				D	
Queue Length 50th (m)	22.7	18.4	0.0	24.3	11.3	0.0	0.8	14.6	0.0	-41.8	23.4	0.0

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Total PM Peak Hour

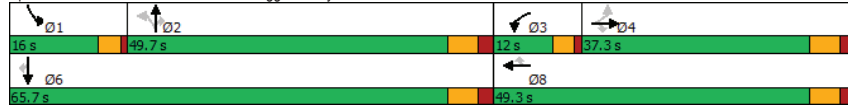


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	47.5	32.1	0.0	#60.9	21.3	11.5	4.2	26.1	19.5	#88.4	38.8	12.2
Internal Link Dist (m)		422.7			399.1			400.8			160.5	
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	432	1352	679	312	1787	908	485	1820	963	472	2506	1173
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.23	0.01	0.98	0.14	0.24	0.01	0.12	0.35	1.03	0.18	0.20

Intersection Summary

Area Type:	Other
Cycle Length:	115
Actuated Cycle Length:	81
Natural Cycle:	115
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.03
Intersection Signal Delay:	33.9
Intersection LOS:	C
Intersection Capacity Utilization:	53.9%
ICU Level of Service:	A
Analysis Period (min):	15
- Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2029 Total PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	167	284	6	281	234	201	6	205	307	446	424	215
Future Volume (vph)	167	284	6	281	234	201	6	205	307	446	424	215
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Flt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Flt Permitted	0.59	1.00	1.00	0.95	1.00	1.00	0.49	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1029	3224	1471	3097	3131	1428	842	3162	1428	3127	3224	1442
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	182	309	7	305	254	218	7	223	334	485	461	234
RTOR Reduction (vph)	0	0	5	0	0	118	0	0	254	0	0	131
Lane Group Flow (vph)	182	309	2	305	254	100	7	223	80	485	461	103
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%

Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3		8		2		1		6
Permitted Phases	4		4		8		2		2			6
Actuated Green, G (s)	22.6	22.6	22.6	8.2	34.8	34.8	17.1	17.1	17.1	12.2	33.3	33.3
Effective Green, g (s)	24.9	24.9	24.9	8.2	37.1	37.1	19.4	19.4	19.4	12.2	35.6	35.6
Actuated g/C Ratio	0.31	0.31	0.31	0.10	0.46	0.46	0.24	0.24	0.24	0.15	0.44	0.44
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	317	994	453	314	1439	656	202	760	343	472	1422	636
v/s Ratio Prot		0.10		c0.10	0.08			0.07		c0.16		c0.14
v/s Ratio Perm	c0.18		0.00			0.07	0.01		0.06			0.07
v/c Ratio	0.57	0.31	0.00	0.97	0.18	0.15	0.03	0.29	0.23	1.03	0.32	0.16
Uniform Delay, d1	23.4	21.3	19.3	36.1	12.8	12.7	23.5	25.0	24.7	34.2	14.7	13.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.9	0.5	0.0	43.6	0.2	0.3	0.2	0.6	1.0	48.6	0.4	0.3
Delay (s)	28.4	21.8	19.3	79.7	13.0	13.0	23.7	25.7	25.7	82.9	15.1	13.9
Level of Service	C	C	B	E	B	B	C	C	C	F	B	B
Approach Delay (s)		24.2			39.2			25.6			42.7	
Approach LOS		C			D			C			D	

Intersection Summary

HCM 2000 Control Delay	35.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	80.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	53.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Montrose Rd & Driveway B

210701
2029 Total PM Peak Hour

	↖		↗		↘	
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕		↕↕		↕↕	
Traffic Volume (vph)	52	28	5	1048	1283	11
Future Volume (vph)	52	28	5	1048	1283	11
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.953		0.999			
Flt Protected	0.968					
Satd. Flow (prot)	1565	0	0	3224	3220	0
Flt Permitted	0.968					
Satd. Flow (perm)	1565	0	0	3224	3220	0
Link Speed (k/h)	48		70		70	
Link Distance (m)	69.9		105.8		195.6	
Travel Time (s)	5.2		5.4		10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	57	30	5	1139	1395	12
Shared Lane Traffic (%)						
Lane Group Flow (vph)	87	0	0	1144	1407	0
Sign Control	Stop		Free		Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	50.5% ICU Level of Service A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
4: Montrose Rd & Driveway B

210701
2029 Total PM Peak Hour

	↖		↗		↘	
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕		↕↕		↕↕	
Traffic Volume (veh/h)	52	28	5	1048	1283	11
Future Volume (Veh/h)	52	28	5	1048	1283	11
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	57	30	5	1139	1395	12
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)						
pX, platoon unblocked						
vC, conflicting volume	1980	704	1407			
vC1, stage 1 conf vol	1401					
vC2, stage 2 conf vol	580					
vCu, unblocked vol	1980	704	1407			
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 %	68	92	99			
cM capacity (veh/h)	180	380	481			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	87	385	759	930	477
Volume Left	57	5	0	0	0
Volume Right	30	0	0	0	12
cSH	220	481	1700	1700	1700
Volume to Capacity	0.40	0.01	0.45	0.55	0.28
Queue Length 95th (m)	13.3	0.2	0.0	0.0	0.0
Control Delay (s)	31.7	0.3	0.0	0.0	0.0
Lane LOS	D	A			
Approach Delay (s)	31.7	0.1	0.0		
Approach LOS	D				

Intersection Summary	
Average Delay	1.1
Intersection Capacity Utilization	50.5% ICU Level of Service A
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

5: Grassy Brooks Rd & Driveway C

2029 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	451	432	1	2	0
Future Volume (vph)	0	451	432	1	2	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Fit						
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1697	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1697	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		143.6	76.3		67.3	
Travel Time (s)		12.9	6.9		5.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	490	470	1	2	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	490	471	0	2	0
Sign Control		Free	Free		Stop	

Intersection Summary

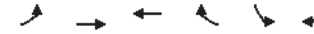
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	35.8%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

210701

5: Grassy Brooks Rd & Driveway C

2029 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	451	432	1	2	0
Future Volume (Veh/h)	0	451	432	1	2	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	490	470	1	2	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	471				960	470
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	471				960	470
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1091				285	593

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	490	471	2
Volume Left	0	0	2
Volume Right	0	1	0
cSH	1091	1700	285
Volume to Capacity	0.00	0.28	0.01
Queue Length 95th (m)	0.0	0.0	0.2
Control Delay (s)	0.0	0.0	17.7
Lane LOS			C
Approach Delay (s)	0.0	0.0	17.7
Approach LOS			C

Intersection Summary

Average Delay	0.0
Intersection Capacity Utilization	35.8%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

6: Grassy Brooks Rd & Driveway D

2029 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	453	433	7	19	0
Future Volume (vph)	0	453	433	7	19	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998				
Fit Protected				0.950		
Satd. Flow (prot)	0	1697	1693	0	1612	0
Fit Permitted				0.950		
Satd. Flow (perm)	0	1697	1693	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		76.3	239.3		68.2	
Travel Time (s)		6.9	21.5		5.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	492	471	8	21	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	492	479	0	21	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other
 Control Type: Unsignalized
 Intersection Capacity Utilization 35.9% ICU Level of Service A
 Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

210701

6: Grassy Brooks Rd & Driveway D

2029 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	453	433	7	19	0
Future Volume (Veh/h)	0	453	433	7	19	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	492	471	8	21	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	479				967	475
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	479				967	475
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				93	100
cM capacity (veh/h)	1083				282	590

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	492	479	21
Volume Left	0	0	21
Volume Right	0	8	0
cSH	1083	1700	282
Volume to Capacity	0.00	0.28	0.07
Queue Length 95th (m)	0.0	0.0	1.8
Control Delay (s)	0.0	0.0	18.8
Lane LOS			C
Approach Delay (s)	0.0	0.0	18.8
Approach LOS			C

Intersection Summary

Average Delay 0.4
 Intersection Capacity Utilization 35.9% ICU Level of Service A
 Analysis Period (min) 15

Lanes, Volumes, Timings

210701

7: Grassy Brooks Rd & Driveway E

2029 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	472	440	6	25	0
Future Volume (vph)	0	472	440	6	25	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998				
Flt Protected				0.950		
Satd. Flow (prot)	0	1697	1693	0	1612	0
Flt Permitted				0.950		
Satd. Flow (perm)	0	1697	1693	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		239.3	110.1		77.3	
Travel Time (s)		21.5	9.9		5.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	513	478	7	27	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	513	485	0	27	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 37.0%

ICU Level of Service A

Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

210701

7: Grassy Brooks Rd & Driveway E

2029 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	472	440	6	25	0
Future Volume (Veh/h)	0	472	440	6	25	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	513	478	7	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	485				994	482
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	485				994	482
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				90	100
cM capacity (veh/h)	1078				272	585

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	513	485	27
Volume Left	0	0	27
Volume Right	0	7	0
cSH	1078	1700	272
Volume to Capacity	0.00	0.29	0.10
Queue Length 95th (m)	0.0	0.0	2.5
Control Delay (s)	0.0	0.0	19.7
Lane LOS			C
Approach Delay (s)	0.0	0.0	19.7
Approach LOS			C

Intersection Summary

Average Delay		0.5	
Intersection Capacity Utilization	37.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
8: Montrose Rd & Driveway F

210701
2029 Total PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	50	41	9	593	943	10
Future Volume (vph)	50	41	9	593	943	10
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.939			0.998		
Flt Protected	0.973			0.999		
Satd. Flow (prot)	1550	0	0	3220	3217	0
Flt Permitted	0.973			0.999		
Satd. Flow (perm)	1550	0	0	3220	3217	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	82.8			799.0	214.2	
Travel Time (s)	6.2			41.1	11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	45	10	645	1025	11
Shared Lane Traffic (%)						
Lane Group Flow (vph)	99	0	0	655	1036	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	41.0%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
8: Montrose Rd & Driveway F

210701
2029 Total PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	41	9	593	943	10
Future Volume (Veh/h)	50	41	9	593	943	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	54	45	10	645	1025	11
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)						
pX, platoon unblocked						
vC, conflicting volume	1373	518	1036			
vC1, stage 1 conf vol	1030					
vC2, stage 2 conf vol	342					
vCu, unblocked vol	1373	518	1036			
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 %	81	91	98			
cM capacity (veh/h)	286	502	667			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	99	225	430	683	353
Volume Left	54	10	0	0	0
Volume Right	45	0	0	0	11
cSH	356	667	1700	1700	1700
Volume to Capacity	0.28	0.02	0.25	0.40	0.21
Queue Length 95th (m)	8.4	0.3	0.0	0.0	0.0
Control Delay (s)	19.0	0.6	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	19.0	0.2		0.0	
Approach LOS	C				

Intersection Summary

Average Delay	1.1
Intersection Capacity Utilization	41.0%
Analysis Period (min)	15
	ICU Level of Service A

Appendix K

Ten-Year Background Traffic Operations



Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway

2034 Background AM Peak Hour

	↖	↗	↙	↘	↕	↖
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕			↕↕	↕↕	
Traffic Volume (vph)	10	5	19	807	750	27
Future Volume (vph)	10	5	19	807	750	27
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.958			0.995		
Flt Protected	0.967			0.999		
Satd. Flow (prot)	1335	0	0	3091	3033	0
Flt Permitted	0.967			0.999		
Satd. Flow (perm)	1335	0	0	3091	3033	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	119.1			195.6	272.2	
Travel Time (s)	8.9			10.1	14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	11%	40%	18%	6%	8%	4%
Adj. Flow (vph)	11	5	21	877	815	29
Shared Lane Traffic (%)						
Lane Group Flow (vph)	16	0	0	898	844	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	49.0%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway

2034 Background AM Peak Hour

	↖	↗	↙	↘	↕	↖
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕			↕↕	↕↕	
Traffic Volume (veh/h)	10	5	19	807	750	27
Future Volume (Veh/h)	10	5	19	807	750	27
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	5	21	877	815	29
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)						
pX, platoon unblocked						
vC, conflicting volume	1310	422	844			
vC1, stage 1 conf vol	830					
vC2, stage 2 conf vol	480					
vCu, unblocked vol	1310	422	844			
tC, single (s)	7.0	7.7	4.5			
tC, 2 stage (s)	6.0					
tF (s)	3.6	3.7	2.4			
p0 queue free %	97	99	97			
cM capacity (veh/h)	320	486	694			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	16	313	585	543	301
Volume Left	11	21	0	0	0
Volume Right	5	0	0	0	29
cSH	358	694	1700	1700	1700
Volume to Capacity	0.04	0.03	0.34	0.32	0.18
Queue Length 95th (m)	1.0	0.7	0.0	0.0	0.0
Control Delay (s)	15.5	1.0	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	15.5	0.4		0.0	
Approach LOS	C				

Intersection Summary

Average Delay	0.3
Intersection Capacity Utilization	49.0%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
2034 Background AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (vph)	386	19	42	485	380	336
Future Volume (vph)	386	19	42	485	380	336
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			15.0
Storage Lanes	1	1	1			1
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Fit Protected	0.950		0.950			
Satd. Flow (prot)	1612	1471	1644	3102	3017	1471
Fit Permitted	0.950		0.950			
Satd. Flow (perm)	1612	1471	1644	3102	3017	1471
Link Speed (k/h)	40		70	70		
Link Distance (m)	110.1		214.2	105.8		
Travel Time (s)	9.9		11.0	5.4		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	0%	0%	6%	9%	0%
Adj. Flow (vph)	420	21	46	527	413	365
Shared Lane Traffic (%)						
Lane Group Flow (vph)	420	21	46	527	413	365
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	48.0% ICU Level of Service A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
2: Montrose Rd & Grassy Brooks Rd

210701
2034 Background AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement	↔	↔	↔	↕↕	↕↕	↔
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (veh/h)	386	19	42	485	380	336
Future Volume (Veh/h)	386	19	42	485	380	336
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	420	21	46	527	413	365
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)						
pX, platoon unblocked						
vC, conflicting volume	768	206	778			
vC1, stage 1 conf vol	413					
vC2, stage 2 conf vol	356					
vCu, unblocked vol	768	206	778			
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 %	19	97	95			
cM capacity (veh/h)	520	806	848			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	420	21	46	264	264	206	206	365
Volume Left	420	0	46	0	0	0	0	0
Volume Right	0	21	0	0	0	0	0	365
cSH	520	806	848	1700	1700	1700	1700	1700
Volume to Capacity	0.81	0.03	0.05	0.15	0.15	0.12	0.12	0.21
Queue Length 95th (m)	58.2	0.6	1.3	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	34.9	9.6	9.5	0.0	0.0	0.0	0.0	0.0
Lane LOS	D	A	A					
Approach Delay (s)	33.6		0.8			0.0		
Approach LOS	D							

Intersection Summary	
Average Delay	8.5
Intersection Capacity Utilization	48.0% ICU Level of Service A
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Background AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↖	↗	↘	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↖	↖↖	↖	↖↖	↖	↖	↖	↖↖	↖	↖↖	↖	↖	↖
Traffic Volume (vph)	118	228	7	229	306	325	8	199	374	168	121	121	
Future Volume (vph)	118	228	7	229	306	325	8	199	374	168	121	121	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0	
Storage Lanes	1		1	2		1	1		1	1		1	
Taper Length (m)	15.0			15.0			15.0			15.0			
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00	
Frt			0.850			0.850			0.850			0.850	
Fit Protected	0.950			0.950			0.950			0.950			
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375	
Fit Permitted	0.551			0.950			0.668			0.950			
Satd. Flow (perm)	954	3131	981	2899	3256	1375	1156	3044	1388	2899	3017	1375	
Right Turn on Red			Yes		Yes		Yes		Yes		Yes		
Satd. Flow (RTOR)			117		353		407		407		132		
Link Speed (k/h)	80			80			70			70			
Link Distance (m)	446.7			423.1			424.8			184.5			
Travel Time (s)	20.1			19.0			21.8			9.5			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%	
Adj. Flow (vph)	128	248	8	249	333	353	9	216	407	183	132	132	
Shared Lane Traffic (%)													
Lane Group Flow (vph)	128	248	8	249	333	353	9	216	407	183	132	132	
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	
Protected Phases													
Permitted Phases	4	4	4	3	8	8	2	2	2	1	6	6	
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6	
Switch Phase													
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0	
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3	
Total Split (s)	37.3	37.3	37.3	9.0	46.3	46.3	49.7	49.7	49.7	9.0	58.7	58.7	
Total Split (%)	35.5%	35.5%	35.5%	8.6%	44.1%	44.1%	47.3%	47.3%	47.3%	8.6%	55.9%	55.9%	
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1	
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2	
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead			
Lead-Lag Optimize?													
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min	
Act Effct Green (s)	20.3	20.3	20.3	5.2	29.6	29.6	19.9	19.9	19.9	5.2	29.2	29.2	
Actuated g/C Ratio	0.30	0.30	0.30	0.08	0.44	0.44	0.30	0.30	0.30	0.08	0.44	0.44	
v/c Ratio	0.44	0.26	0.02	1.12	0.23	0.44	0.03	0.24	0.58	0.82	0.10	0.20	
Control Delay	25.3	18.9	0.1	130.6	12.7	3.6	18.4	19.2	6.1	64.9	12.5	3.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	25.3	18.9	0.1	130.6	12.7	3.6	18.4	19.2	6.1	64.9	12.5	3.6	
LOS	C	B	A	F	B	A	B	B	A	E	B	A	
Approach Delay	20.7				40.7				10.7			31.3	
Approach LOS		C			D				B			C	
Queue Length 50th (m)	12.0	11.4	0.0	-17.7	12.1	0.0	0.8	10.1	0.0	11.2	4.6	0.0	

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Background AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↖	↗	↘	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Queue Length 95th (m)	30.8	23.7	0.0	#53.2	25.6	14.0	4.0	21.1	18.3	#38.6	11.4	9.1	
Internal Link Dist (m)		422.7			399.1			400.8				160.5	
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0	
Base Capacity (vph)	489	1607	560	223	2123	1019	814	2144	1098	223	2516	1169	
Starvation Cap Reductn	0	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	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.26	0.15	0.01	1.12	0.16	0.35	0.01	0.10	0.37	0.82	0.05	0.11	

Intersection Summary

Area Type:	Other
Cycle Length:	105
Actuated Cycle Length:	67.1
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.12
Intersection Signal Delay:	27.8
Intersection Capacity Utilization:	48.7%
ICU Level of Service:	A
Analysis Period (min):	15
- Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Background AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔↔	↔	↔↔	↔↔	↔	↔	↔↔	↔	↔↔	↔↔	↔
Traffic Volume (vph)	118	228	7	229	306	325	8	199	374	168	121	121
Future Volume (vph)	118	228	7	229	306	325	8	199	374	168	121	121
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.55	1.00	1.00	0.95	1.00	1.00	0.67	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	953	3131	981	2899	3256	1375	1157	3044	1388	2899	3017	1375
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	128	248	8	249	333	353	9	216	407	183	132	132
RTOR Reduction (vph)	0	0	6	0	0	197	0	0	285	0	0	74
Lane Group Flow (vph)	128	248	2	249	333	156	9	216	122	183	132	58
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1		6
Permitted Phases	4		4			8	2		2			6
Actuated Green, G (s)	18.0	18.0	18.0	5.2	27.2	27.2	17.6	17.6	17.6	5.2	26.8	26.8
Effective Green, g (s)	20.3	20.3	20.3	5.2	29.5	29.5	19.9	19.9	19.9	5.2	29.1	29.1
Actuated g/C Ratio	0.30	0.30	0.30	0.08	0.44	0.44	0.30	0.30	0.30	0.08	0.44	0.44
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	290	954	299	226	1442	609	345	909	414	226	1318	600
v/s Ratio Prot		0.08		c0.09	0.10			0.07		c0.06		0.04
v/s Ratio Perm	c0.13		0.00			0.11	0.01		c0.09			0.04
v/c Ratio	0.44	0.26	0.01	1.10	0.23	0.26	0.03	0.24	0.29	0.81	0.10	0.10
Uniform Delay, d1	18.6	17.5	16.1	30.7	11.5	11.7	16.5	17.6	17.9	30.2	11.0	11.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	3.0	0.4	0.0	89.8	0.2	0.6	0.1	0.4	1.1	22.1	0.1	0.2
Delay (s)	21.6	17.9	16.2	120.5	11.7	12.3	16.6	18.0	19.1	52.3	11.1	11.2
Level of Service	C	B	B	F	B	B	B	B	B	D	B	B
Approach Delay (s)		19.1			40.9			18.7			28.0	
Approach LOS		B			D			B			C	

Intersection Summary			
HCM 2000 Control Delay	29.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	66.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	48.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway

2034 Background PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↔↔	↔↔	↔
Traffic Volume (vph)	28	15	3	990	1267	5
Future Volume (vph)	28	15	3	990	1267	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.953				0.999	
Fit Protected	0.968					
Satd. Flow (prot)	1558	0	0	3162	3221	0
Fit Permitted	0.968					
Satd. Flow (perm)	1558	0	0	3162	3221	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	119.1			195.6	272.2	
Travel Time (s)	8.9			10.1	14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	7%	0%	4%	2%	0%
Adj. Flow (vph)	30	16	3	1076	1377	5
Shared Lane Traffic (%)						
Lane Group Flow (vph)	46	0	0	1079	1382	0
Sign Control	Stop			Free	Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	48.2%
	ICU Level of Service A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
1: Montrose Rd & Private Driveway

210701
2034 Background PM Peak Hour

	↖		↗		↘	
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖↗		↖↗		↖↗	
Traffic Volume (veh/h)	28	15	3	990	1267	5
Future Volume (Veh/h)	28	15	3	990	1267	5
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	30	16	3	1076	1377	5
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)						
pX, platoon unblocked						
vC, conflicting volume	1924	691	1382			
vC1, stage 1 conf vol	1380					
vC2, stage 2 conf vol	544					
vCu, unblocked vol	1924	691	1382			
tC, single (s)	6.8	7.0	4.1			
tC, 2 stage (s)	5.8					
tF (s)	3.5	3.4	2.2			
p0 queue free %	84	96	99			
cM capacity (veh/h)	189	376	502			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	46	362	717	918	464	
Volume Left	30	3	0	0	0	
Volume Right	16	0	0	0	5	
cSH	228	502	1700	1700	1700	
Volume to Capacity	0.20	0.01	0.42	0.54	0.27	
Queue Length 95th (m)	5.5	0.1	0.0	0.0	0.0	
Control Delay (s)	24.7	0.2	0.0	0.0	0.0	
Lane LOS	C	A				
Approach Delay (s)	24.7	0.1		0.0		
Approach LOS	C					
Intersection Summary						
Average Delay			0.5			
Intersection Capacity Utilization			48.2%	ICU Level of Service	A	
Analysis Period (min)			15			

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
2034 Background PM Peak Hour

	↖		↗		↘	
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖↗		↖↗		↖↗	
Traffic Volume (vph)	419	32	19	572	870	413
Future Volume (vph)	419	32	19	572	870	413
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			15.0
Storage Lanes	1	1	1			1
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	0.850					
Fit Protected	0.950	0.950				
Satd. Flow (prot)	1644	1471	1644	3131	3224	1471
Fit Permitted	0.950	0.950				
Satd. Flow (perm)	1644	1471	1644	3131	3224	1471
Link Speed (k/h)	40	70		70		
Link Distance (m)	110.1	214.2		105.8		
Travel Time (s)	9.9	11.0		5.4		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	5%	2%	0%
Adj. Flow (vph)	455	35	21	622	946	449
Shared Lane Traffic (%)						
Lane Group Flow (vph)	455	35	21	622	946	449
Sign Control	Stop		Free		Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	58.0%		ICU Level of Service B			
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

210701

2: Montrose Rd & Grassy Brooks Rd

2034 Background PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR		
Lane Configurations	↔	↔	↔	↕	↕	↔		
Traffic Volume (veh/h)	419	32	19	572	870	413		
Future Volume (Veh/h)	419	32	19	572	870	413		
Sign Control	Stop			Free	Free			
Grade	0%			0%	0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	455	35	21	622	946	449		
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)								
pX, platoon unblocked								
vC, conflicting volume	1299	473	1395					
vC1, stage 1 conf vol	946							
vC2, stage 2 conf vol	353							
vCu, unblocked vol	1299	473	1395					
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 %	0	94	96					
cM capacity (veh/h)	317	543	497					
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	455	35	21	311	311	473	473	449
Volume Left	455	0	21	0	0	0	0	0
Volume Right	0	35	0	0	0	0	0	449
cSH	317	543	497	1700	1700	1700	1700	1700
Volume to Capacity	1.44	0.06	0.04	0.18	0.18	0.28	0.28	0.26
Queue Length 95th (m)	182.3	1.5	1.0	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	245.1	12.1	12.6	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	B	B					
Approach Delay (s)	228.5		0.4			0.0		
Approach LOS	F							
Intersection Summary								
Average Delay	44.4							
Intersection Capacity Utilization	58.0%		ICU Level of Service		B			
Analysis Period (min)	15							

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Background PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	166	290	6	294	239	198	6	198	320	422	377	206
Future Volume (vph)	166	290	6	294	239	198	6	198	320	422	377	206
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Storage Lanes	1		1	2		1	1		1	1		1
Taper Length (m)	15.0			15.0			15.0			15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Fit Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Fit Permitted	0.591			0.950			0.511			0.950		
Satd. Flow (perm)	1023	3224	1471	3097	3131	1428	884	3162	1428	3127	3224	1442
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			107			215			348			224
Link Speed (k/h)		80			80			70				70
Link Distance (m)		446.7			423.1			424.8				184.5
Travel Time (s)		20.1			19.0			21.8				9.5
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Adj. Flow (vph)	180	315	7	320	260	215	7	215	348	459	410	224
Shared Lane Traffic (%)												
Lane Group Flow (vph)	180	315	7	320	260	215	7	215	348	459	410	224
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8		2		2	1	6	
Permitted Phases	4		4			8	2		2			6
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	13.0	50.3	50.3	49.7	49.7	49.7	15.0	64.7	64.7
Total Split (%)	32.4%	32.4%	32.4%	11.3%	43.7%	43.7%	43.2%	43.2%	43.2%	13.0%	56.3%	56.3%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead		
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effct Green (s)	24.8	24.8	24.8	9.2	38.0	38.0	19.3	19.3	19.3	11.2	34.6	34.6
Actuated g/C Ratio	0.31	0.31	0.31	0.11	0.47	0.47	0.24	0.24	0.24	0.14	0.43	0.43
v/c Ratio	0.58	0.32	0.01	0.91	0.18	0.27	0.03	0.28	0.58	1.06	0.30	0.30
Control Delay	32.3	22.6	0.0	69.6	13.1	3.0	25.5	26.8	7.4	96.8	16.5	3.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.3	22.6	0.0	69.6	13.1	3.0	25.5	26.8	7.4	96.8	16.5	3.6
LOS	C	C	A	E	B	A	C	C	A	F	B	A
Approach Delay		25.8			33.1		14.9			47.6		
Approach LOS		C			C		B			D		
Queue Length 50th (m)	22.3	18.7	0.0	25.1	11.2	0.0	0.8	14.0	0.0	-40.3	20.8	0.0

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Background PM Peak Hour

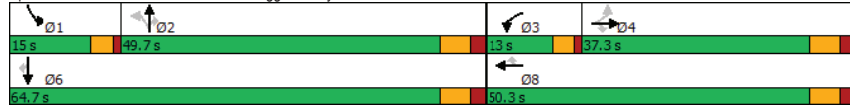


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	47.4	32.8	0.0	#61.4	21.3	11.3	4.1	25.2	20.0	#86.3	35.2	12.4
Internal Link Dist (m)		422.7			399.1			400.8			160.5	
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	430	1356	680	352	1831	924	510	1826	971	434	2472	1158
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.23	0.01	0.91	0.14	0.23	0.01	0.12	0.36	1.06	0.17	0.19

Intersection Summary

Area Type:	Other
Cycle Length:	115
Actuated Cycle Length:	80.8
Natural Cycle:	115
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.06
Intersection Signal Delay:	33.7
Intersection Capacity Utilization:	53.3%
Analysis Period (min):	15
Intersection LOS:	C
ICU Level of Service:	A
- Volume exceeds capacity, queue is theoretically infinite. Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Background PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔↔	↔	↔↔	↔↔	↔	↔	↔↔	↔	↔↔	↔↔	↔
Traffic Volume (vph)	166	290	6	294	239	198	6	198	320	422	377	206
Future Volume (vph)	166	290	6	294	239	198	6	198	320	422	377	206
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Flt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Flt Permitted	0.59	1.00	1.00	0.95	1.00	1.00	0.51	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1023	3224	1471	3097	3131	1428	885	3162	1428	3127	3224	1442
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	180	315	7	320	260	215	7	215	348	459	410	224
RTOR Reduction (vph)	0	0	5	0	0	114	0	0	265	0	0	128
Lane Group Flow (vph)	180	315	2	320	260	101	7	215	83	459	410	96
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%

Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3		8		2		1		6
Permitted Phases	4		4			8	2		2			6
Actuated Green, G (s)	22.5	22.5	22.5	9.2	35.7	35.7	17.0	17.0	17.0	11.2	32.2	32.2
Effective Green, g (s)	24.8	24.8	24.8	9.2	38.0	38.0	19.3	19.3	19.3	11.2	34.5	34.5
Actuated g/C Ratio	0.31	0.31	0.31	0.11	0.47	0.47	0.24	0.24	0.24	0.14	0.43	0.43
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	315	993	453	353	1477	674	212	758	342	435	1381	618
v/s Ratio Prot		0.10		c0.10	0.08			0.07		c0.15		c0.13
v/s Ratio Perm	c0.18		0.00			0.07	0.01		0.06			0.07
v/c Ratio	0.57	0.32	0.00	0.91	0.18	0.15	0.03	0.28	0.24	1.06	0.30	0.16
Uniform Delay, d1	23.4	21.4	19.3	35.2	12.2	12.1	23.4	25.0	24.7	34.6	15.1	14.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.9	0.5	0.0	27.9	0.2	0.3	0.2	0.6	1.0	58.4	0.3	0.3
Delay (s)	28.3	21.9	19.3	63.2	12.4	12.4	23.6	25.5	25.8	93.1	15.4	14.4
Level of Service	C	C	B	E	B	B	C	C	C	F	B	B
Approach Delay (s)		24.1			32.8			25.7		47.8		
Approach LOS		C			C			C		D		

Intersection Summary

HCM 2000 Control Delay	35.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	80.5	Sum of lost time (s)	16.0
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Appendix L

Ten-Year Total Traffic Operations



Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway/Driveway A

2034 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↘	↙	↘
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	10	0	5	2	0	3	19	826	15	19	875	27
Future Volume (vph)	10	0	5	2	0	3	19	826	15	19	875	27
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Frt		0.958			0.919			0.997			0.996	
Flt Protected		0.967			0.980			0.999			0.999	
Satd. Flow (prot)	0	1335	0	0	1528	0	0	3084	0	0	3036	0
Flt Permitted		0.967			0.980			0.999			0.999	
Satd. Flow (perm)	0	1335	0	0	1528	0	0	3084	0	0	3036	0
Link Speed (k/h)		48			48			70			70	
Link Distance (m)		119.1			75.1			195.6			272.2	
Travel Time (s)		8.9			5.6			10.1			14.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	11%	2%	40%	2%	2%	2%	18%	6%	2%	2%	8%	4%
Adj. Flow (vph)	11	0	5	2	0	3	21	898	16	21	951	29
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	16	0	0	5	0	0	935	0	0	1001	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	52.0%
Analysis Period (min)	15
ICU Level of Service	A

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway/Driveway A

2034 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↘	↙	↘
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (veh/h)	10	0	5	2	0	3	19	826	15	19	875	27
Future Volume (Veh/h)	10	0	5	2	0	3	19	826	15	19	875	27
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	11	0	5	2	0	3	21	898	16	21	951	29
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								TWLT			TWLT	
Median storage (veh)								2			2	
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1502	1964	490	1470	1970	457	980				914	
vC1, stage 1 conf vol	1008	1008		948	948							
vC2, stage 2 conf vol	494	956		522	1022							
vCu, unblocked vol	1502	1964	490	1470	1970	457	980				914	
tC, single (s)	7.7	6.5	7.7	7.5	6.5	6.9	4.5				4.1	
tC, 2 stage (s)	6.7	5.5		6.5	5.5							
tF (s)	3.6	4.0	3.7	3.5	4.0	3.3	2.4				2.2	
p0 queue free %	95	100	99	99	100	99	97				97	
cM capacity (veh/h)	212	217	434	239	215	551	610				742	
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2						
Volume Total	16	5	470	465	496	504						
Volume Left	11	2	21	0	21	0						
Volume Right	5	3	0	16	0	29						
cSH	252	362	610	1700	742	1700						
Volume to Capacity	0.06	0.01	0.03	0.27	0.03	0.30						
Queue Length 95th (m)	1.5	0.3	0.8	0.0	0.7	0.0						
Control Delay (s)	20.2	15.1	1.0	0.0	0.8	0.0						
Lane LOS	C	C	A	A	A	A						
Approach Delay (s)	20.2	15.1	0.5	0.4								
Approach LOS	C	C										
Intersection Summary												
Average Delay				0.6								
Intersection Capacity Utilization				52.0%			ICU Level of Service				A	
Analysis Period (min)				15								

Lanes, Volumes, Timings
2: Montrose Rd & Grassy Brooks Rd

210701
2034 Total AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (vph)	391	24	77	532	439	352
Future Volume (vph)	391	24	77	532	439	352
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			15.0
Storage Lanes	1	1	1			1
Taper Length (m)	15.0		15.0			
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt		0.850				0.850
Fit Protected	0.950		0.950			
Satd. Flow (prot)	1612	1471	1644	3102	3017	1471
Fit Permitted	0.950		0.950			
Satd. Flow (perm)	1612	1471	1644	3102	3017	1471
Link Speed (k/h)	40		70	70		
Link Distance (m)	110.1		214.2	105.8		
Travel Time (s)	9.9		11.0	5.4		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	2%	0%	0%	6%	9%	0%
Adj. Flow (vph)	425	26	84	578	477	383
Shared Lane Traffic (%)						
Lane Group Flow (vph)	425	26	84	578	477	383
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	51.3%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
2: Montrose Rd & Grassy Brooks Rd

210701
2034 Total AM Peak Hour

	EBL	EBR	NBL	NBT	SBT	SBR
Movement	↔	↔	↔	↕↕	↕↕	↔
Lane Configurations	↔	↔	↔	↕↕	↕↕	↔
Traffic Volume (veh/h)	391	24	77	532	439	352
Future Volume (Veh/h)	391	24	77	532	439	352
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	425	26	84	578	477	383
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)						
pX, platoon unblocked						
vC, conflicting volume	934	238	860			
vC1, stage 1 conf vol	477					
vC2, stage 2 conf vol	457					
vCu, unblocked vol	934	238	860			
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 %	4	97	89			
cM capacity (veh/h)	443	769	790			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	425	26	84	289	289	238	238	383
Volume Left	425	0	84	0	0	0	0	0
Volume Right	0	26	0	0	0	0	0	383
cSH	443	769	790	1700	1700	1700	1700	1700
Volume to Capacity	0.96	0.03	0.11	0.17	0.17	0.14	0.14	0.23
Queue Length 95th (m)	86.6	0.8	2.7	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	63.9	9.8	10.1	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	A	B					
Approach Delay (s)	60.8		1.3			0.0		
Approach LOS	F							

Intersection Summary

Average Delay	14.3
Intersection Capacity Utilization	51.3%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↖	↗	↘	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	↖	↖↖	↖	↖↖	↖↖	↖	↖	↖↖	↖	↖↖	↖↖	↖	↖
Traffic Volume (vph)	132	228	7	229	306	363	8	265	374	174	130	123	
Future Volume (vph)	132	228	7	229	306	363	8	265	374	174	130	123	
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	
Storage Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0	
Storage Lanes	1		1	2		1	1		1	1		1	
Taper Length (m)	15.0			15.0			15.0			15.0			
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00	
Frt			0.850			0.850			0.850			0.850	
Fit Protected	0.950			0.950			0.950			0.950			
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375	
Fit Permitted	0.551			0.950			0.663			0.950			
Satd. Flow (perm)	954	3131	981	2899	3256	1375	1147	3044	1388	2899	3017	1375	
Right Turn on Red			Yes			Yes			Yes			Yes	
Satd. Flow (RTOR)			117			395			407			134	
Link Speed (k/h)	80			80			70			70			
Link Distance (m)	446.7			423.1			424.8			184.5			
Travel Time (s)	20.1			19.0			21.8			9.5			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%	
Adj. Flow (vph)	143	248	8	249	333	395	9	288	407	189	141	134	
Shared Lane Traffic (%)													
Lane Group Flow (vph)	143	248	8	249	333	395	9	288	407	189	141	134	
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm	
Protected Phases													
Permitted Phases	4	4	4	3	8	8	2	2	2	1	6	6	
Detector Phase	4	4	4	3	8	8	2	2	2	1	6	6	
Switch Phase													
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0	
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3	
Total Split (s)	37.3	37.3	37.3	9.0	46.3	46.3	49.7	49.7	49.7	9.0	58.7	58.7	
Total Split (%)	35.5%	35.5%	35.5%	8.6%	44.1%	44.1%	47.3%	47.3%	47.3%	8.6%	55.9%	55.9%	
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1	
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2	
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lead/Lag	Lag	Lag	Lag	Lead			Lag	Lag	Lag	Lead			
Lead-Lag Optimize?													
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min	
Act Effct Green (s)	21.6	21.6	21.6	5.2	31.0	31.0	22.1	22.1	22.1	5.2	31.5	31.5	
Actuated g/C Ratio	0.31	0.31	0.31	0.07	0.44	0.44	0.31	0.31	0.31	0.07	0.45	0.45	
v/c Ratio	0.49	0.26	0.02	1.17	0.23	0.48	0.03	0.30	0.57	0.89	0.11	0.20	
Control Delay	27.4	19.6	0.1	152.7	13.5	3.8	18.6	19.9	5.8	78.6	12.7	3.6	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	27.4	19.6	0.1	152.7	13.5	3.8	18.6	19.9	5.8	78.6	12.7	3.6	
LOS	C	B	A	F	B	A	B	B	A	E	B	A	
Approach Delay		22.0			45.1			11.8			36.9		
Approach LOS		C			D			B			D		
Queue Length 50th (m)	14.6	12.2	0.0	-19.9	13.2	0.0	0.8	14.3	0.0	12.5	5.2	0.0	

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Total AM Peak Hour

	↖	→	↘	↙	←	↖	↗	↘	↙	↖	↗	↘	↙
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Queue Length 95th (m)	35.5	24.4	0.0	#55.6	26.6	14.9	4.1	28.1	18.6	#41.7	12.4	9.3	
Internal Link Dist (m)		422.7			399.1			400.8			160.5		
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0	
Base Capacity (vph)	465	1527	538	212	2017	1002	767	2037	1063	212	2407	1124	
Starvation Cap Reductn	0	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	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.31	0.16	0.01	1.17	0.17	0.39	0.01	0.14	0.38	0.89	0.06	0.12	

Intersection Summary	
Area Type:	Other
Cycle Length:	105
Actuated Cycle Length:	70.7
Natural Cycle:	105
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	1.17
Intersection Signal Delay:	30.8
Intersection Capacity Utilization:	51.1%
ICU Level of Service:	A
Analysis Period (min):	15
- Volume exceeds capacity, queue is theoretically infinite.	
Queue shown is maximum after two cycles.	
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd



HCM Signalized Intersection Capacity Analysis
3: Montrose Rd & Biggar Rd/Lyons Creek Rd

210701
2034 Total AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	132	228	7	229	306	363	8	265	374	174	130	123
Future Volume (vph)	132	228	7	229	306	363	8	265	374	174	130	123
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Fit	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Fit Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3131	981	2899	3256	1375	1644	3044	1388	2899	3017	1375
Fit Permitted	0.55	1.00	1.00	0.95	1.00	1.00	0.66	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	953	3131	981	2899	3256	1375	1147	3044	1388	2899	3017	1375
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	143	248	8	249	333	395	9	288	407	189	141	134
RTOR Reduction (vph)	0	0	6	0	0	221	0	0	278	0	0	74
Lane Group Flow (vph)	143	248	2	249	333	174	9	288	129	189	141	60
Heavy Vehicles (%)	0%	5%	50%	10%	1%	7%	0%	8%	6%	10%	9%	7%
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1		6
Permitted Phases	4		4			8		2		2		6
Actuated Green, G (s)	19.4	19.4	19.4	5.2	28.6	28.6	19.9	19.9	5.2	29.1	29.1	29.1
Effective Green, g (s)	21.7	21.7	21.7	5.2	30.9	30.9	22.2	22.2	22.2	5.2	31.4	31.4
Actuated g/C Ratio	0.31	0.31	0.31	0.07	0.44	0.44	0.32	0.32	0.32	0.07	0.45	0.45
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	294	966	302	214	1431	604	362	961	438	214	1347	614
v/s Ratio Prot		0.08		c0.09	0.10			c0.09		c0.07	0.05	
v/s Ratio Perm	c0.15		0.00			0.13	0.01		0.09			0.04
v/c Ratio	0.49	0.26	0.01	1.16	0.23	0.29	0.02	0.30	0.29	0.88	0.10	0.10
Uniform Delay, d1	19.8	18.2	16.8	32.5	12.3	12.6	16.6	18.2	18.1	32.2	11.3	11.3
Progression Factor	1.00	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	3.5	0.4	0.0	112.7	0.2	0.7	0.1	0.5	1.1	35.0	0.1	0.2
Delay (s)	23.3	18.6	16.9	145.2	12.5	13.4	16.7	18.7	19.2	67.2	11.4	11.4
Level of Service	C	B	B	F	B	B	B	B	B	E	B	B
Approach Delay (s)		20.3			46.7			18.9			34.1	
Approach LOS		C			D			B			C	
Intersection Summary												
HCM 2000 Control Delay			32.6		HCM 2000 Level of Service				C			
HCM 2000 Volume to Capacity ratio	0.51											
Actuated Cycle Length (s)	70.3			Sum of lost time (s)				16.0				
Intersection Capacity Utilization	51.1%		ICU Level of Service				A					
Analysis Period (min)	15											
c Critical Lane Group												

Lanes, Volumes, Timings
4: Montrose Rd & Driveway B

210701
2034 Total AM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↔			↔	↔	
Traffic Volume (vph)	7	4	25	854	828	56
Future Volume (vph)	7	4	25	854	828	56
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Fit	0.955				0.990	
Fit Protected	0.968			0.999		
Satd. Flow (prot)	1568	0	0	3220	3191	0
Fit Permitted	0.968			0.999		
Satd. Flow (perm)	1568	0	0	3220	3191	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	69.9			105.8	195.6	
Travel Time (s)	5.2			5.4	10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	4	27	928	900	61
Shared Lane Traffic (%)						
Lane Group Flow (vph)	12	0	0	955	961	0
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	55.2%		ICU Level of Service B			
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
4: Montrose Rd & Driveway B

210701
2034 Total AM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↑↑	↑↑	
Traffic Volume (veh/h)	7	4	25	854	828	56
Future Volume (Veh/h)	7	4	25	854	828	56
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	4	27	928	900	61
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)						
pX, platoon unblocked						
vC, conflicting volume	1448	480	961			
vC1, stage 1 conf vol	930					
vC2, stage 2 conf vol	518					
vCu, unblocked vol	1448	480	961			
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	99	96			
cM capacity (veh/h)	301	532	712			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	12	336	619	600	361	
Volume Left	8	27	0	0	0	
Volume Right	4	0	0	0	61	
cSH	352	712	1700	1700	1700	
Volume to Capacity	0.03	0.04	0.36	0.35	0.21	
Queue Length 95th (m)	0.8	0.9	0.0	0.0	0.0	
Control Delay (s)	15.6	1.3	0.0	0.0	0.0	
Lane LOS	C	A				
Approach Delay (s)	15.6	0.4		0.0		
Approach LOS	C					
Intersection Summary						
Average Delay			0.3			
Intersection Capacity Utilization			55.2%	ICU Level of Service	B	
Analysis Period (min)			15			

Lanes, Volumes, Timings
5: Grassy Brooks Rd & Driveway C

210701
2034 Total AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		Y	
Traffic Volume (vph)	0	405	380	2	1	0
Future Volume (vph)	0	405	380	2	1	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.999				
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1695	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1695	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		143.6	76.3		67.3	
Travel Time (s)		12.9	6.9		5.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	440	413	2	1	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	440	415	0	1	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	33.1%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
5: Grassy Brooks Rd & Driveway C

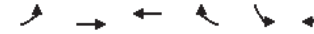
210701
2034 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↓	
Traffic Volume (veh/h)	0	405	380	2	1	0
Future Volume (Veh/h)	0	405	380	2	1	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	440	413	2	1	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	415				854	414
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	415				854	414
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	100
cM capacity (veh/h)	1144				329	638
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	440	415	1			
Volume Left	0	0	1			
Volume Right	0	2	0			
cSH	1144	1700	329			
Volume to Capacity	0.00	0.24	0.00			
Queue Length 95th (m)	0.0	0.0	0.1			
Control Delay (s)	0.0	0.0	16.0			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	16.0			
Approach LOS			C			
Intersection Summary						
Average Delay		0.0				
Intersection Capacity Utilization		33.1%	ICU Level of Service	A		
Analysis Period (min)		15				

Lanes, Volumes, Timings
6: Grassy Brooks Rd & Driveway D

210701
2034 Total AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↓	
Traffic Volume (vph)	0	406	382	18	5	0
Future Volume (vph)	0	406	382	18	5	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.994			
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1686	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1686	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		76.3	239.3		68.2	
Travel Time (s)		6.9	21.5		5.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	441	415	20	5	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	441	435	0	5	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	33.2%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
6: Grassy Brooks Rd & Driveway D

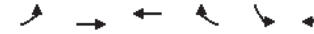
210701
2034 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	406	382	18	5	0
Future Volume (Veh/h)	0	406	382	18	5	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	441	415	20	5	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	435			866	425	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	435			866	425	
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			98	100	
cM capacity (veh/h)	1125			324	629	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	441	435	5			
Volume Left	0	0	5			
Volume Right	0	20	0			
cSH	1125	1700	324			
Volume to Capacity	0.00	0.26	0.02			
Queue Length 95th (m)	0.0	0.0	0.4			
Control Delay (s)	0.0	0.0	16.3			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	16.3			
Approach LOS			C			
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		33.2%	ICU Level of Service	A		
Analysis Period (min)		15				

Lanes, Volumes, Timings
7: Grassy Brooks Rd & Driveway E

210701
2034 Total AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	411	400	31	4	0
Future Volume (vph)	0	411	400	31	4	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.990			
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1680	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1680	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		239.3	110.1		77.3	
Travel Time (s)		21.5	9.9		5.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	447	435	34	4	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	447	469	0	4	0
Sign Control		Free	Free		Stop	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	34.9%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis
7: Grassy Brooks Rd & Driveway E

210701
2034 Total AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↑	
Traffic Volume (veh/h)	0	411	400	31	4	0
Future Volume (Veh/h)	0	411	400	31	4	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	447	435	34	4	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	469			899	452	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	469			899	452	
tC, single (s)	4.1			6.4	6.2	
tC, 2 stage (s)						
tF (s)	2.2			3.5	3.3	
p0 queue free %	100			99	100	
cM capacity (veh/h)	1093			309	608	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	447	469	4			
Volume Left	0	0	4			
Volume Right	0	34	0			
cSH	1093	1700	309			
Volume to Capacity	0.00	0.28	0.01			
Queue Length 95th (m)	0.0	0.0	0.3			
Control Delay (s)	0.0	0.0	16.8			
Lane LOS			C			
Approach Delay (s)	0.0	0.0	16.8			
Approach LOS			C			
Intersection Summary						
Average Delay		0.1				
Intersection Capacity Utilization		34.9%		ICU Level of Service	A	
Analysis Period (min)		15				

Lanes, Volumes, Timings
8: Montrose Rd & Driveway F

210701
2034 Total AM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↑			↑	↑	
Traffic Volume (vph)	7	6	43	604	410	53
Future Volume (vph)	7	6	43	604	410	53
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.937				0.983	
Fit Protected	0.974			0.997		
Satd. Flow (prot)	1548	0	0	3214	3169	0
Fit Permitted	0.974			0.997		
Satd. Flow (perm)	1548	0	0	3214	3169	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	82.8			799.0	214.2	
Travel Time (s)	6.2			41.1	11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	7	47	657	446	58
Shared Lane Traffic (%)						
Lane Group Flow (vph)	15	0	0	704	504	0
Sign Control	Stop			Free	Free	
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	47.0%			ICU Level of Service A		
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

210701

8: Montrose Rd & Driveway F

2034 Total AM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↘			↕	↕	
Traffic Volume (veh/h)	7	6	43	604	410	53
Future Volume (Veh/h)	7	6	43	604	410	53
Sign Control	Stop		Free			
Grade	0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	7	47	657	446	58
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)						
pX, platoon unblocked						
vC, conflicting volume	898	252	504			
vC1, stage 1 conf vol	475					
vC2, stage 2 conf vol	422					
vCu, unblocked vol	898	252	504			
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 %	98	99	96			
cM capacity (veh/h)	475	748	1057			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	15	266	438	297	207	
Volume Left	8	47	0	0	0	
Volume Right	7	0	0	0	58	
cSH	572	1057	1700	1700	1700	
Volume to Capacity	0.03	0.04	0.26	0.17	0.12	
Queue Length 95th (m)	0.6	1.0	0.0	0.0	0.0	
Control Delay (s)	11.5	1.9	0.0	0.0	0.0	
Lane LOS	B	A				
Approach Delay (s)	11.5	0.7		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay			0.5			
Intersection Capacity Utilization			47.0%	ICU Level of Service	A	
Analysis Period (min)			15			

Lanes, Volumes, Timings

210701

1: Montrose Rd & Private Driveway/Driveway B

2034 Total PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↕			↕	
Traffic Volume (vph)	28	0	15	15	0	19	3	1109	3	4	1294	5
Future Volume (vph)	28	0	15	15	0	19	3	1109	3	4	1294	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.95	0.95	0.95	0.95
Fit	0.953		0.923		0.999							
Fit Protected	0.968		0.979									
Satd. Flow (prot)	0	1558	0	0	1533	0	0	3162	0	0	3221	0
Fit Permitted	0.968		0.979									
Satd. Flow (perm)	0	1558	0	0	1533	0	0	3162	0	0	3221	0
Link Speed (k/h)	48		48		70							
Link Distance (m)	119.1		75.5		195.6							
Travel Time (s)	8.9		5.7		10.1							
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	7%	2%	2%	2%	0%	4%	2%	2%	2%	0%
Adj. Flow (vph)	30	0	16	16	0	21	3	1205	3	4	1407	5
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	46	0	0	37	0	0	1211	0	0	1416	0
Sign Control	Stop		Stop		Free		Free					
Intersection Summary												
Area Type:	Other											
Control Type:	Unsignalized											
Intersection Capacity Utilization	52.8%						ICU Level of Service A					
Analysis Period (min)	15											

HCM Unsignalized Intersection Capacity Analysis

210701

1: Montrose Rd & Private Driveway/Driveway B

2034 Total PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↔			↔			↕			↕			
Traffic Volume (veh/h)	28	0	15	15	0	19	3	1109	3	4	1294	5		
Future Volume (Veh/h)	28	0	15	15	0	19	3	1109	3	4	1294	5		
Sign Control	Stop			Stop			Free			Free				
Grade	0%			0%			0%			0%				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	30	0	16	16	0	21	3	1205	3	4	1407	5		
Pedestrians														
Lane Width (m)														
Walking Speed (m/s)														
Percent Blockage														
Right turn flare (veh)														
Median type							TWTL							TWTL
Median storage (veh)							2							2
Upstream signal (m)														
pX, platoon unblocked														
vC, conflicting volume	2047	2632	706	1940	2632	604	1412						1208	
vC1, stage 1 conf vol	1418	1418		1212	1212									
vC2, stage 2 conf vol	630	1214		728	1420									
vCu, unblocked vol	2047	2632	706	1940	2632	604	1412						1208	
tC, single (s)	7.5	6.5	7.0	7.5	6.5	6.9	4.1						4.1	
tC, 2 stage (s)	6.5	5.5		6.5	5.5									
tF (s)	3.5	4.0	3.4	3.5	4.0	3.3	2.2						2.2	
p0 queue free %	78	100	96	90	100	95	99						99	
cM capacity (veh/h)	135	151	367	167	150	441	489						573	
Direction, Lane #	EB 1	WB 1	NB 1	NB 2	SB 1	SB 2								
Volume Total	46	37	606	606	708	708								
Volume Left	30	16	3	0	4	0								
Volume Right	16	21	0	3	0	5								
cSH	173	258	489	1700	573	1700								
Volume to Capacity	0.27	0.14	0.01	0.36	0.01	0.42								
Queue Length 95th (m)	7.7	3.7	0.1	0.0	0.2	0.0								
Control Delay (s)	33.2	21.3	0.2	0.0	0.2	0.0								
Lane LOS	D	C	A	A	A									
Approach Delay (s)	33.2	21.3	0.1	0.1										
Approach LOS	D	C												
Intersection Summary														
Average Delay	0.9													
Intersection Capacity Utilization	52.8%		ICU Level of Service				A							
Analysis Period (min)	15													

Lanes, Volumes, Timings

210701

2: Montrose Rd & Grassy Brooks Rd

2034 Total PM Peak Hour



Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕	↕	↕	↕	↕	↕
Traffic Volume (vph)	436	61	27	630	923	419
Future Volume (vph)	436	61	27	630	923	419
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Storage Length (m)	60.0	0.0	60.0			15.0
Storage Lanes	1	1	1			1
Taper Length (m)	15.0			15.0		
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	1.00
Frt	0.850					
Fit Protected	0.950			0.950		
Satd. Flow (prot)	1644	1471	1644	3131	3224	1471
Fit Permitted	0.950			0.950		
Satd. Flow (perm)	1644	1471	1644	3131	3224	1471
Link Speed (k/h)	40			70	70	
Link Distance (m)	110.1			214.2	105.8	
Travel Time (s)	9.9			11.0	5.4	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	0%	0%	5%	2%	0%
Adj. Flow (vph)	474	66	29	685	1003	455
Shared Lane Traffic (%)						
Lane Group Flow (vph)	474	66	29	685	1003	455
Sign Control	Stop				Free	Free
Intersection Summary						
Area Type:	Other					
Control Type:	Unsignalized					
Intersection Capacity Utilization	60.6%		ICU Level of Service B			
Analysis Period (min)	15					

HCM Unsignalized Intersection Capacity Analysis

210701

2: Montrose Rd & Grassy Brooks Rd

2034 Total PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR		
Lane Configurations								
Traffic Volume (veh/h)	436	61	27	630	923	419		
Future Volume (Veh/h)	436	61	27	630	923	419		
Sign Control	Stop		Free		Free			
Grade	0%		0%		0%			
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Hourly flow rate (vph)	474	66	29	685	1003	455		
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)								
pX, platoon unblocked								
vC, conflicting volume	1404	502	1458					
vC1, stage 1 conf vol	1003							
vC2, stage 2 conf vol	400							
vCu, unblocked vol	1404	502	1458					
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 %	0	87	94					
cM capacity (veh/h)	293	520	470					
Direction, Lane #	EB 1	EB 2	NB 1	NB 2	NB 3	SB 1	SB 2	SB 3
Volume Total	474	66	29	342	342	502	502	455
Volume Left	474	0	29	0	0	0	0	0
Volume Right	0	66	0	0	0	0	0	455
cSH	293	520	470	1700	1700	1700	1700	1700
Volume to Capacity	1.62	0.13	0.06	0.20	0.20	0.29	0.29	0.27
Queue Length 95th (m)	216.2	3.2	1.5	0.0	0.0	0.0	0.0	0.0
Control Delay (s)	325.1	12.9	13.2	0.0	0.0	0.0	0.0	0.0
Lane LOS	F	B	B					
Approach Delay (s)	286.9	0.5		0.0				
Approach LOS	F							
Intersection Summary								
Average Delay	57.3							
Intersection Capacity Utilization	60.6%		ICU Level of Service		B			
Analysis Period (min)	15							

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Total PM Peak Hour

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	168	290	6	294	239	206	6	213	320	459	441	218
Future Volume (vph)	168	290	6	294	239	206	6	213	320	459	441	218
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Storage Length (m)	120.0	100.0		160.0	120.0		100.0	80.0		50.0	20.0	
Storage Lanes	1	1		2	1		1	1		1	1	
Taper Length (m)	15.0	15.0		15.0		15.0		15.0		15.0		
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	0.850		0.850		0.850		0.850		0.850			
Fit Protected	0.950	0.950		0.950		0.950		0.950		0.950		
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Fit Permitted	0.591	0.950		0.950		0.478		0.950		0.950		
Satd. Flow (perm)	1023	3224	1471	3097	3131	1428	827	3162	1428	3127	3224	1442
Right Turn on Red	Yes		Yes		Yes		Yes		Yes			
Satd. Flow (RTOR)	99		224		331		217					
Link Speed (k/h)	80		80		70		70		70			
Link Distance (m)	446.7		423.1		424.8		184.5					
Travel Time (s)	20.1		19.0		21.8		9.5					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Adj. Flow (vph)	183	315	7	320	260	224	7	232	348	499	479	237
Shared Lane Traffic (%)												
Lane Group Flow (vph)	183	315	7	320	260	224	7	232	348	499	479	237
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases	4		3		8		2		1		6	
Permitted Phases	4		4		8		2		2		6	
Detector Phase	4		4		8		2		2		6	
Switch Phase												
Minimum Initial (s)	10.0	10.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	37.3	37.3	37.3	9.0	37.3	37.3	48.3	48.3	48.3	9.0	37.3	37.3
Total Split (s)	37.3	37.3	37.3	16.0	53.3	53.3	48.7	48.7	48.7	23.0	71.7	71.7
Total Split (%)	29.8%	29.8%	29.8%	12.8%	42.6%	42.6%	39.0%	39.0%	39.0%	18.4%	57.4%	57.4%
Yellow Time (s)	4.1	4.1	4.1	3.0	4.1	4.1	4.1	4.1	4.1	3.0	4.1	4.1
All-Red Time (s)	2.2	2.2	2.2	1.0	2.2	2.2	2.2	2.2	2.2	1.0	2.2	2.2
Lost Time Adjust (s)	-2.3	-2.3	-2.3	0.0	-2.3	-2.3	-2.3	-2.3	-2.3	0.0	-2.3	-2.3
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag	Lag	Lead	Lag		Lag	Lag	Lag	Lead	Lag	
Lead-Lag Optimize?												
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Min	Min
Act Effect Green (s)	26.9	26.9	26.9	12.2	43.1	43.1	21.2	21.2	21.2	19.3	44.6	44.6
Actuated g/C Ratio	0.28	0.28	0.28	0.13	0.45	0.45	0.22	0.22	0.22	0.20	0.47	0.47
v/c Ratio	0.64	0.35	0.01	0.81	0.18	0.29	0.04	0.33	0.61	0.79	0.32	0.30
Control Delay	42.1	28.9	0.0	60.3	16.7	3.5	30.8	33.1	9.5	48.9	17.3	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	42.1	28.9	0.0	60.3	16.7	3.5	30.8	33.1	9.5	48.9	17.3	4.1
LOS	D	C	A	E	B	A	C	C	A	D	B	A
Approach Delay	33.3		30.4		19.1		27.7					
Approach LOS	C		C		B		C					
Queue Length 50th (m)	28.6	23.5	0.0	29.8	14.1	0.0	1.0	19.1	2.5	45.3	28.7	2.0

Lanes, Volumes, Timings

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Total PM Peak Hour

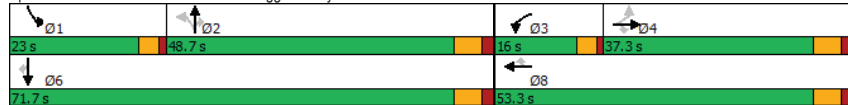


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Queue Length 95th (m)	57.3	39.3	0.0	#62.4	25.6	13.0	4.7	30.8	26.2	#84.9	42.8	14.8
Internal Link Dist (m)		422.7			399.1			400.8			160.5	
Turn Bay Length (m)	120.0		100.0	160.0		120.0	100.0		80.0	50.0		20.0
Base Capacity (vph)	360	1137	582	393	1635	852	391	1497	850	629	2311	1095
Starvation Cap Reductn	0	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	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.51	0.28	0.01	0.81	0.16	0.26	0.02	0.15	0.41	0.79	0.21	0.22

Intersection Summary

Area Type:	Other
Cycle Length:	125
Actuated Cycle Length:	95.8
Natural Cycle:	125
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.81
Intersection Signal Delay:	27.7
Intersection LOS:	C
Intersection Capacity Utilization:	54.4%
ICU Level of Service:	A
Analysis Period (min):	15
# 95th percentile volume exceeds capacity, queue may be longer.	
Queue shown is maximum after two cycles.	

Splits and Phases: 3: Montrose Rd & Biggar Rd/Lyons Creek Rd

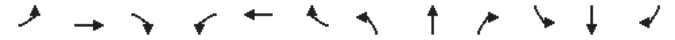


HCM Signalized Intersection Capacity Analysis

210701

3: Montrose Rd & Biggar Rd/Lyons Creek Rd

2034 Total PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔	↔
Traffic Volume (vph)	168	290	6	294	239	206	6	213	320	459	441	218
Future Volume (vph)	168	290	6	294	239	206	6	213	320	459	441	218
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Flt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1644	3224	1471	3097	3131	1428	1644	3162	1428	3127	3224	1442
Flt Permitted	0.59	1.00	1.00	0.95	1.00	1.00	0.48	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1023	3224	1471	3097	3131	1428	828	3162	1428	3127	3224	1442
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	183	315	7	320	260	224	7	232	348	499	479	237
RTOR Reduction (vph)	0	0	5	0	0	123	0	0	258	0	0	116
Lane Group Flow (vph)	183	315	2	320	260	101	7	232	90	499	479	121
Heavy Vehicles (%)	0%	2%	0%	3%	5%	3%	0%	4%	3%	2%	2%	2%
Turn Type	Perm	NA	Perm	Prot	NA	Perm	Perm	NA	Perm	Prot	NA	Perm
Protected Phases		4		3	8			2		1		6
Permitted Phases	4		4			8		2				6
Actuated Green, G (s)	24.6	24.6	24.6	12.2	40.8	40.8	18.9	18.9	18.9	19.3	42.2	42.2
Effective Green, g (s)	26.9	26.9	26.9	12.2	43.1	43.1	21.2	21.2	21.2	19.3	44.5	44.5
Actuated g/C Ratio	0.28	0.28	0.28	0.13	0.45	0.45	0.22	0.22	0.22	0.20	0.47	0.47
Clearance Time (s)	6.3	6.3	6.3	4.0	6.3	6.3	6.3	6.3	6.3	4.0	6.3	6.3
Vehicle Extension (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	287	907	413	395	1411	643	183	701	316	631	1500	671
v/s Ratio Prot		0.10		c0.10	0.08			0.07		c0.16		c0.15
v/s Ratio Perm	c0.18		0.00			0.07	0.01		0.06			0.08
v/c Ratio	0.64	0.35	0.00	0.81	0.18	0.16	0.04	0.33	0.29	0.79	0.32	0.18
Uniform Delay, d1	30.1	27.4	24.7	40.6	15.7	15.5	29.2	31.2	30.9	36.2	16.0	14.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.6	0.7	0.0	13.9	0.2	0.3	0.2	0.8	1.4	8.1	0.3	0.4
Delay (s)	37.6	28.0	24.7	54.5	15.9	15.8	29.4	32.0	32.3	44.4	16.4	15.3
Level of Service	D	C	C	D	B	B	C	C	C	D	B	B
Approach Delay (s)		31.5			31.2			32.2		27.7		
Approach LOS		C			C			C		C		

Intersection Summary

HCM 2000 Control Delay	30.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	95.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	54.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lanes, Volumes, Timings
4: Montrose Rd & Driveway B

210701
2034 Total PM Peak Hour

	↖		↗		↘	
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕		↕↕		↕↕	
Traffic Volume (vph)	52	28	5	1064	1315	11
Future Volume (vph)	52	28	5	1064	1315	11
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.953		0.999			
Flt Protected	0.968					
Satd. Flow (prot)	1565	0	0	3224	3220	0
Flt Permitted	0.968					
Satd. Flow (perm)	1565	0	0	3224	3220	0
Link Speed (k/h)	48		70		70	
Link Distance (m)	69.9		105.8		195.6	
Travel Time (s)	5.2		5.4		10.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	57	30	5	1157	1429	12
Shared Lane Traffic (%)						
Lane Group Flow (vph)	87	0	0	1162	1441	0
Sign Control	Stop		Free		Free	

Intersection Summary	
Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	51.5% ICU Level of Service A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis
4: Montrose Rd & Driveway B

210701
2034 Total PM Peak Hour

	↖		↗		↘	
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↕		↕↕		↕↕	
Traffic Volume (veh/h)	52	28	5	1064	1315	11
Future Volume (Veh/h)	52	28	5	1064	1315	11
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	57	30	5	1157	1429	12
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)						
pX, platoon unblocked						
vC, conflicting volume	2024	720	1441			
vC1, stage 1 conf vol	1435					
vC2, stage 2 conf vol	588					
vCu, unblocked vol	2024	720	1441			
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 %	67	92	99			
cM capacity (veh/h)	173	370	467			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	87	391	771	953	488
Volume Left	57	5	0	0	0
Volume Right	30	0	0	0	12
cSH	212	467	1700	1700	1700
Volume to Capacity	0.41	0.01	0.45	0.56	0.29
Queue Length 95th (m)	14.0	0.2	0.0	0.0	0.0
Control Delay (s)	33.4	0.3	0.0	0.0	0.0
Lane LOS	D	A			
Approach Delay (s)	33.4	0.1	0.0		
Approach LOS	D				

Intersection Summary	
Average Delay	1.1
Intersection Capacity Utilization	51.5% ICU Level of Service A
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

5: Grassy Brooks Rd & Driveway C

2034 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↓	
Traffic Volume (vph)	0	452	432	1	2	0
Future Volume (vph)	0	452	432	1	2	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Fit						
Fit Protected					0.950	
Satd. Flow (prot)	0	1697	1697	0	1612	0
Fit Permitted					0.950	
Satd. Flow (perm)	0	1697	1697	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		143.6	76.3		67.3	
Travel Time (s)		12.9	6.9		5.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	491	470	1	2	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	491	471	0	2	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	35.8%
ICU Level of Service	A
Analysis Period (min)	15

HCM Unsignalized Intersection Capacity Analysis

210701

5: Grassy Brooks Rd & Driveway C

2034 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑	↑		↓	
Traffic Volume (veh/h)	0	452	432	1	2	0
Future Volume (Veh/h)	0	452	432	1	2	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	491	470	1	2	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	471				962	470
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	471				962	470
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				99	100
cM capacity (veh/h)	1091				284	593

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	491	471	2
Volume Left	0	0	2
Volume Right	0	1	0
cSH	1091	1700	284
Volume to Capacity	0.00	0.28	0.01
Queue Length 95th (m)	0.0	0.0	0.2
Control Delay (s)	0.0	0.0	17.8
Lane LOS			C
Approach Delay (s)	0.0	0.0	17.8
Approach LOS			C

Intersection Summary

Average Delay	0.0
Intersection Capacity Utilization	35.8%
ICU Level of Service	A
Analysis Period (min)	15

Lanes, Volumes, Timings

210701

6: Grassy Brooks Rd & Driveway D

2034 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	454	433	7	19	0
Future Volume (vph)	0	454	433	7	19	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998				
Fit Protected				0.950		
Satd. Flow (prot)	0	1697	1693	0	1612	0
Fit Permitted				0.950		
Satd. Flow (perm)	0	1697	1693	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		76.3	239.3		68.2	
Travel Time (s)		6.9	21.5		5.1	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	493	471	8	21	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	493	479	0	21	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 35.9%

ICU Level of Service A

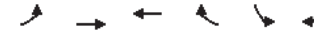
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

210701

6: Grassy Brooks Rd & Driveway D

2034 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	454	433	7	19	0
Future Volume (Veh/h)	0	454	433	7	19	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	493	471	8	21	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	479				968	475
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	479				968	475
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				93	100
cM capacity (veh/h)	1083				282	590

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	493	479	21
Volume Left	0	0	21
Volume Right	0	8	0
cSH	1083	1700	282
Volume to Capacity	0.00	0.28	0.07
Queue Length 95th (m)	0.0	0.0	1.8
Control Delay (s)	0.0	0.0	18.8
Lane LOS			C
Approach Delay (s)	0.0	0.0	18.8
Approach LOS			C

Intersection Summary

Average Delay 0.4

Intersection Capacity Utilization 35.9%

ICU Level of Service

A

Analysis Period (min) 15

Lanes, Volumes, Timings

210701

7: Grassy Brooks Rd & Driveway E

2034 Total PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (vph)	0	473	440	6	25	0
Future Volume (vph)	0	473	440	6	25	0
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.998				
Fit Protected				0.950		
Satd. Flow (prot)	0	1697	1693	0	1612	0
Fit Permitted				0.950		
Satd. Flow (perm)	0	1697	1693	0	1612	0
Link Speed (k/h)		40	40		48	
Link Distance (m)		239.3	110.1		77.3	
Travel Time (s)		21.5	9.9		5.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	514	478	7	27	0
Shared Lane Traffic (%)						
Lane Group Flow (vph)	0	514	485	0	27	0
Sign Control		Free	Free		Stop	

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 37.0%

ICU Level of Service A

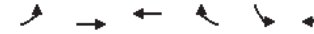
Analysis Period (min) 15

HCM Unsignalized Intersection Capacity Analysis

210701

7: Grassy Brooks Rd & Driveway E

2034 Total PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Volume (veh/h)	0	473	440	6	25	0
Future Volume (Veh/h)	0	473	440	6	25	0
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	514	478	7	27	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	485				996	482
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	485				996	482
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				90	100
cM capacity (veh/h)	1078				271	585

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	514	485	27
Volume Left	0	0	27
Volume Right	0	7	0
cSH	1078	1700	271
Volume to Capacity	0.00	0.29	0.10
Queue Length 95th (m)	0.0	0.0	2.5
Control Delay (s)	0.0	0.0	19.7
Lane LOS			C
Approach Delay (s)	0.0	0.0	19.7
Approach LOS			C

Intersection Summary

Average Delay		0.5	
Intersection Capacity Utilization	37.0%	ICU Level of Service	A
Analysis Period (min)	15		

Lanes, Volumes, Timings
8: Montrose Rd & Driveway F

210701
2034 Total PM Peak Hour

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	50	41	9	607	975	10
Future Volume (vph)	50	41	9	607	975	10
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Lane Util. Factor	1.00	1.00	0.95	0.95	0.95	0.95
Frt	0.939			0.998		
Flt Protected	0.973			0.999		
Satd. Flow (prot)	1550	0	0	3220	3217	0
Flt Permitted	0.973			0.999		
Satd. Flow (perm)	1550	0	0	3220	3217	0
Link Speed (k/h)	48			70	70	
Link Distance (m)	82.8			799.0	214.2	
Travel Time (s)	6.2			41.1	11.0	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	45	10	660	1060	11
Shared Lane Traffic (%)						
Lane Group Flow (vph)	99	0	0	670	1071	0
Sign Control	Stop			Free	Free	

Intersection Summary

Area Type:	Other
Control Type:	Unsignalized
Intersection Capacity Utilization	42.0%
Analysis Period (min)	15
	ICU Level of Service A

HCM Unsignalized Intersection Capacity Analysis
8: Montrose Rd & Driveway F

210701
2034 Total PM Peak Hour

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	41	9	607	975	10
Future Volume (Veh/h)	50	41	9	607	975	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	54	45	10	660	1060	11
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				TWLT	TWLT	
Median storage (veh)				2	2	
Upstream signal (m)						
pX, platoon unblocked						
vC, conflicting volume	1416	536	1071			
vC1, stage 1 conf vol	1066					
vC2, stage 2 conf vol	350					
vCu, unblocked vol	1416	536	1071			
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 %	80	91	98			
cM capacity (veh/h)	275	489	647			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	99	230	440	707	364
Volume Left	54	10	0	0	0
Volume Right	45	0	0	0	11
cSH	343	647	1700	1700	1700
Volume to Capacity	0.29	0.02	0.26	0.42	0.21
Queue Length 95th (m)	8.8	0.4	0.0	0.0	0.0
Control Delay (s)	19.7	0.6	0.0	0.0	0.0
Lane LOS	C	A			
Approach Delay (s)	19.7	0.2		0.0	
Approach LOS	C				

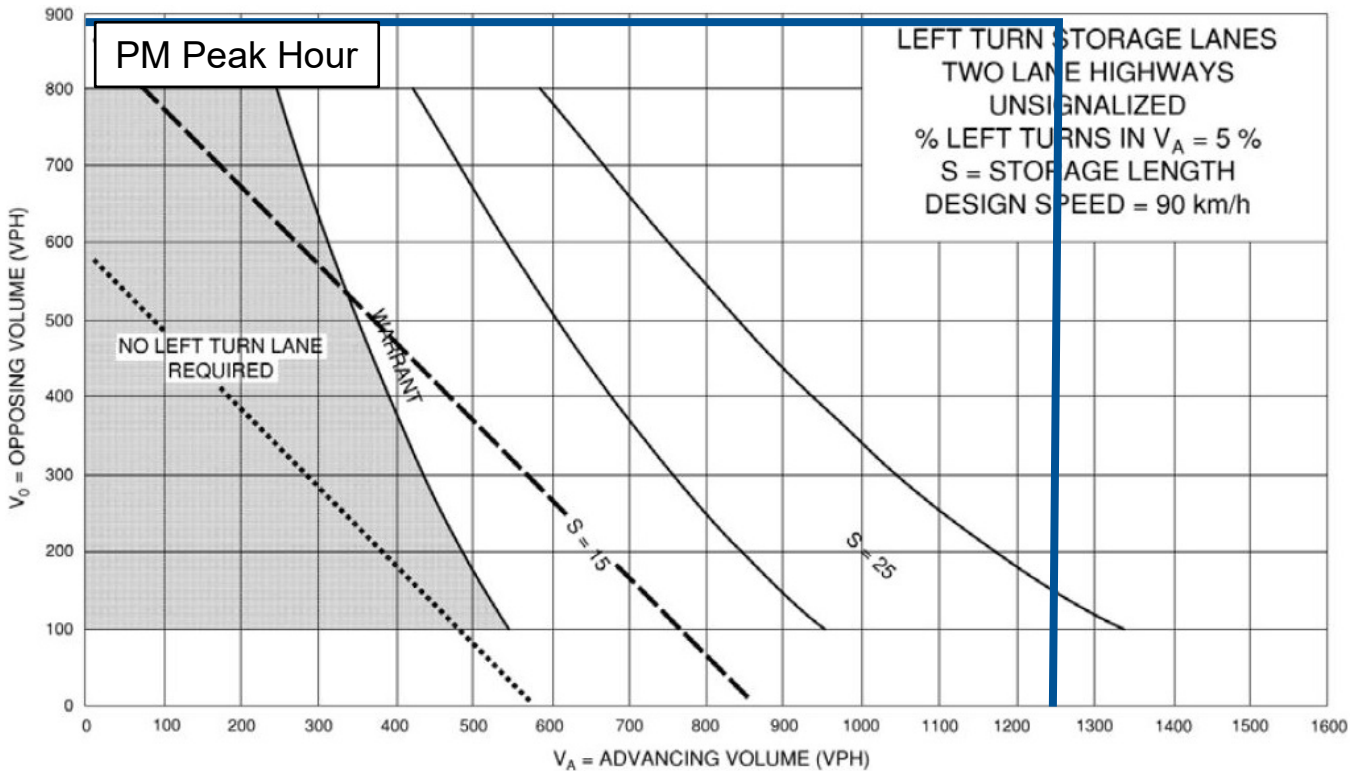
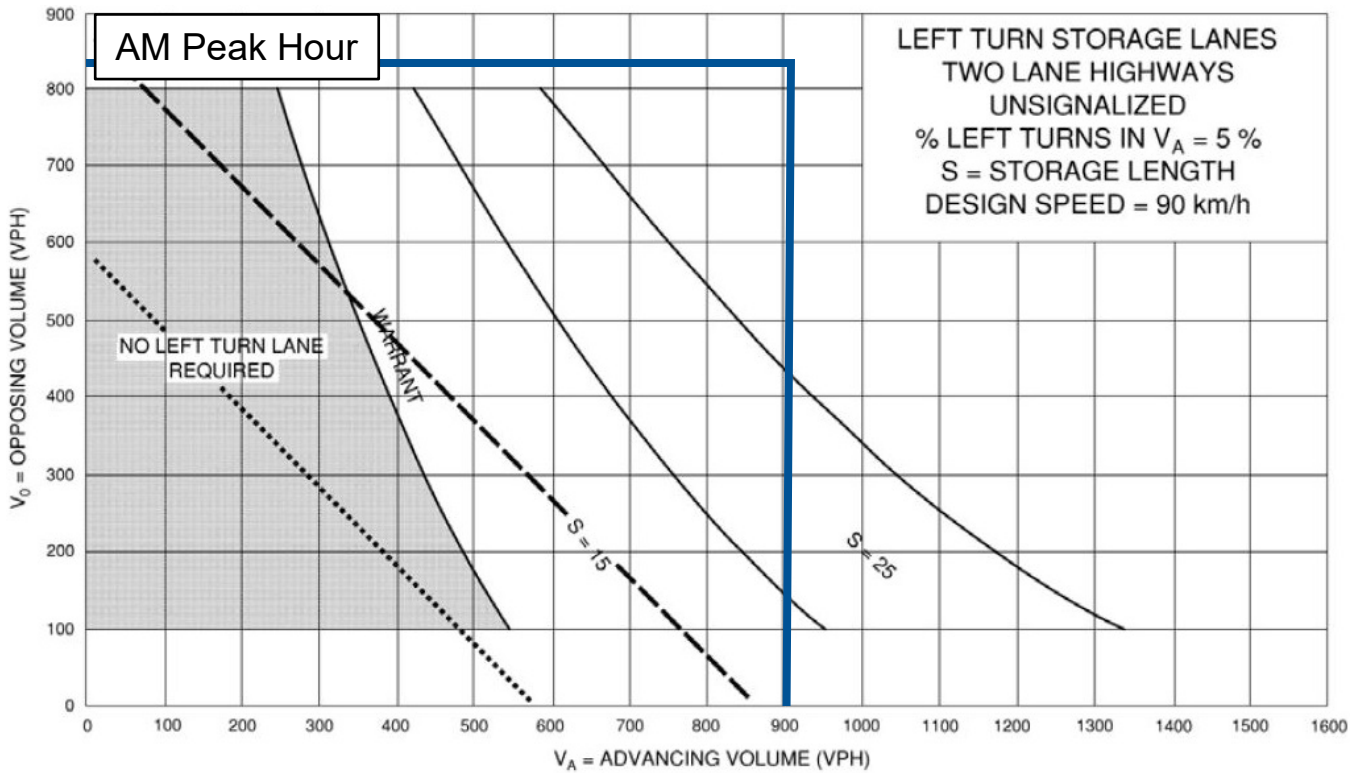
Intersection Summary

Average Delay	1.1
Intersection Capacity Utilization	42.0%
Analysis Period (min)	15
	ICU Level of Service A

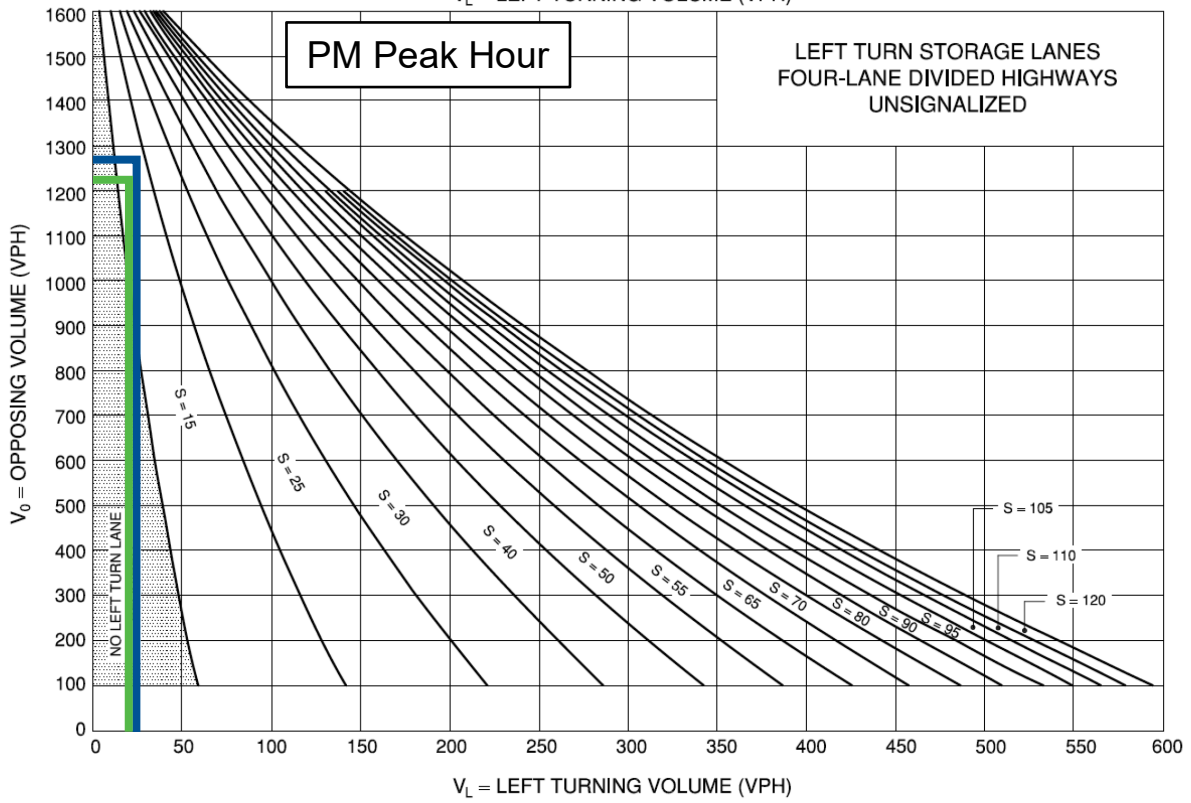
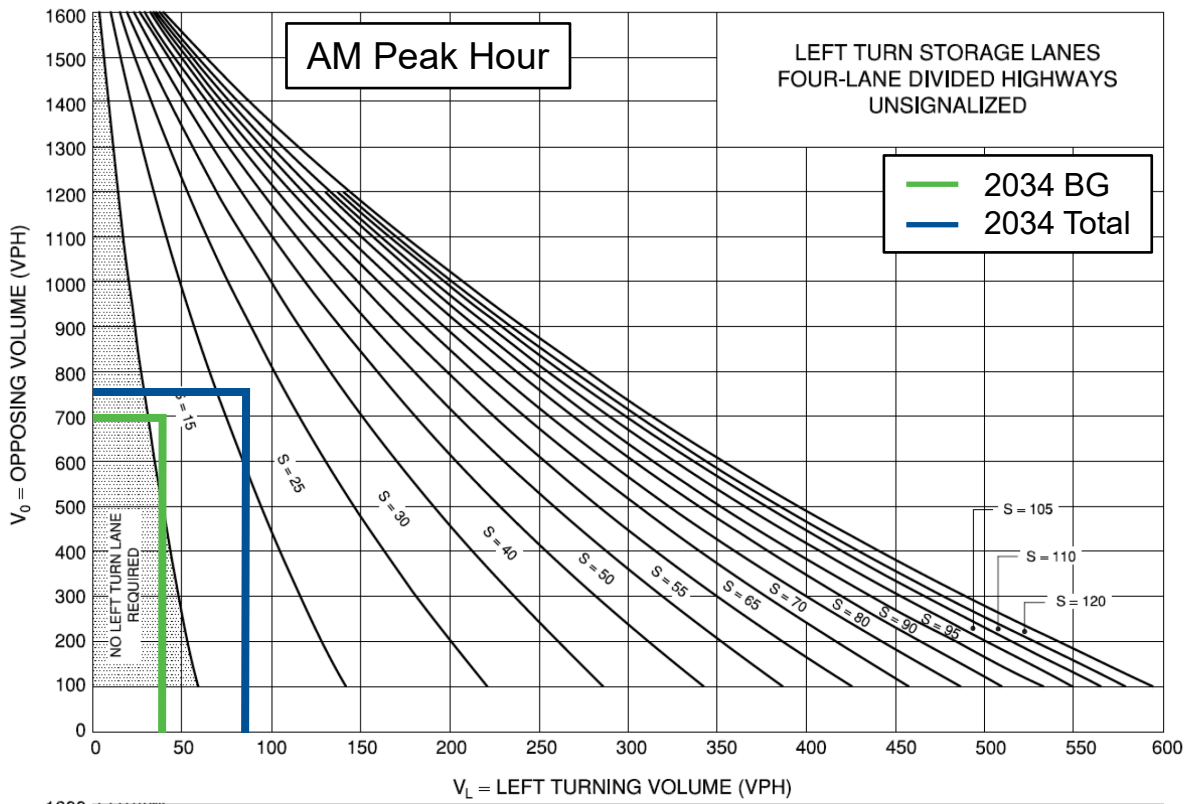
Appendix M

Left-Turn Lane Nomographs

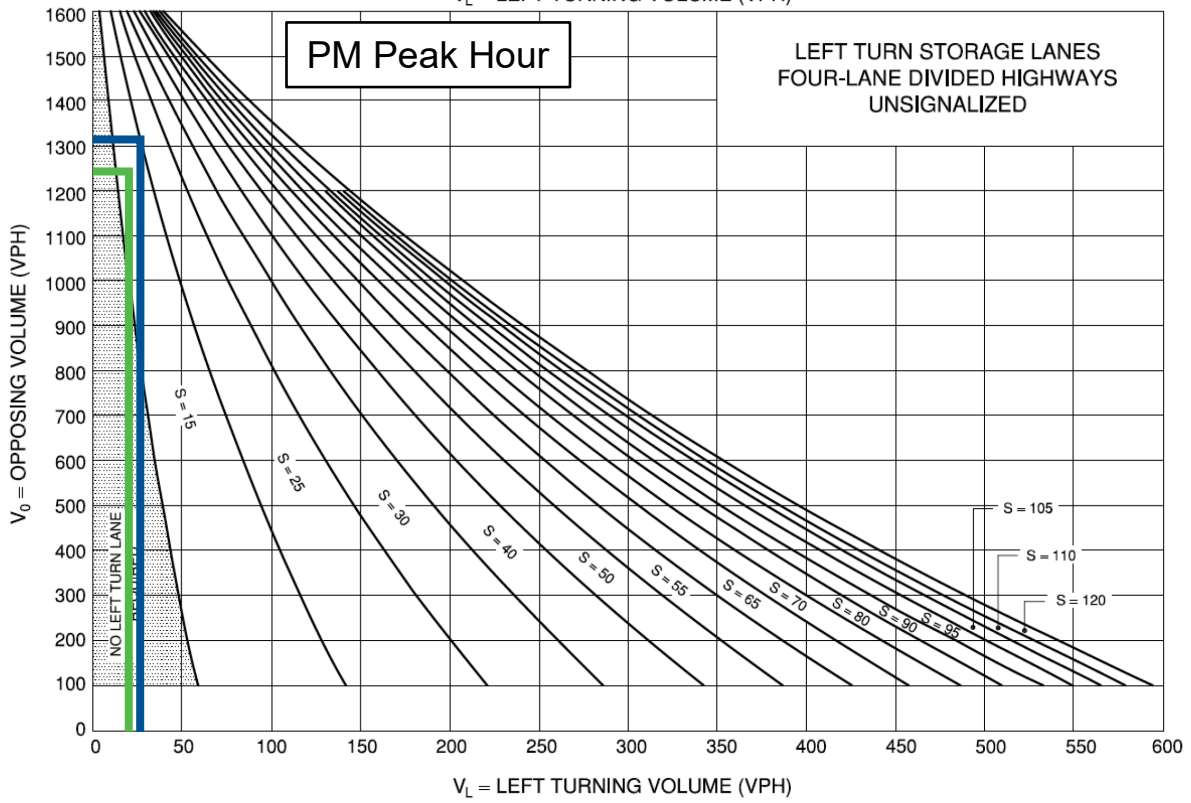
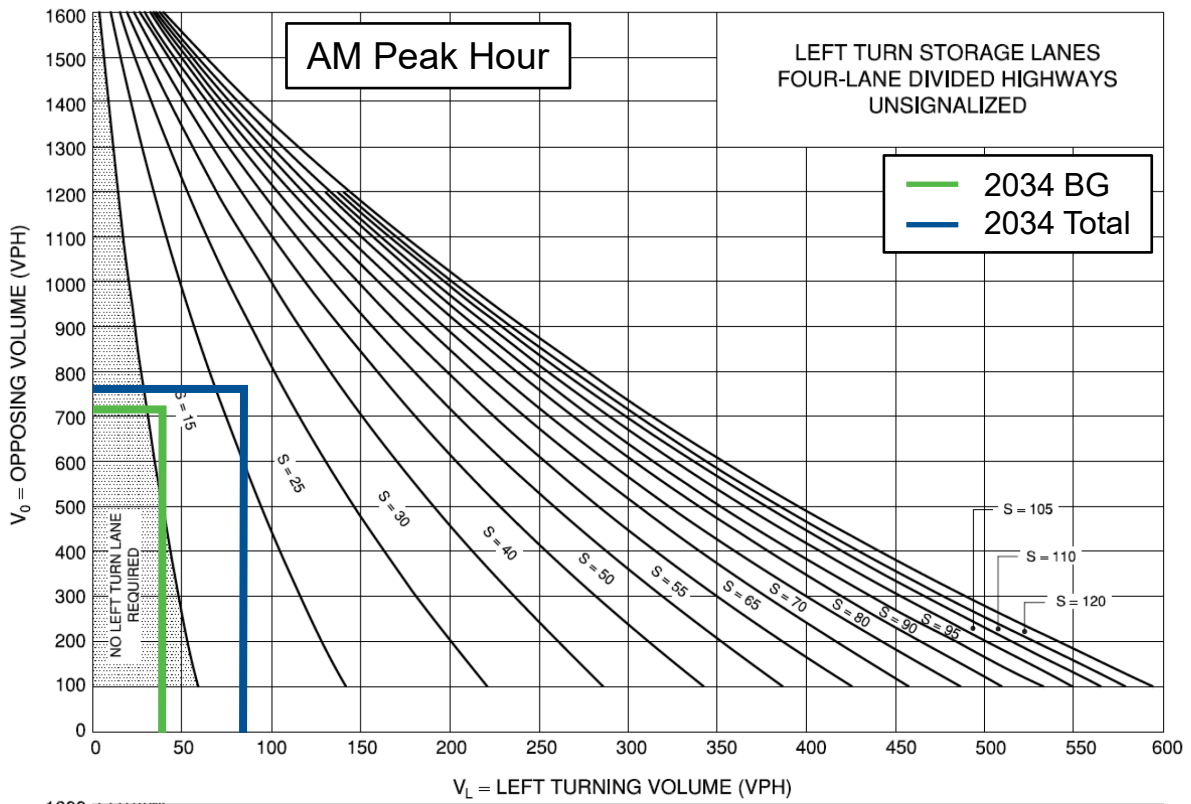




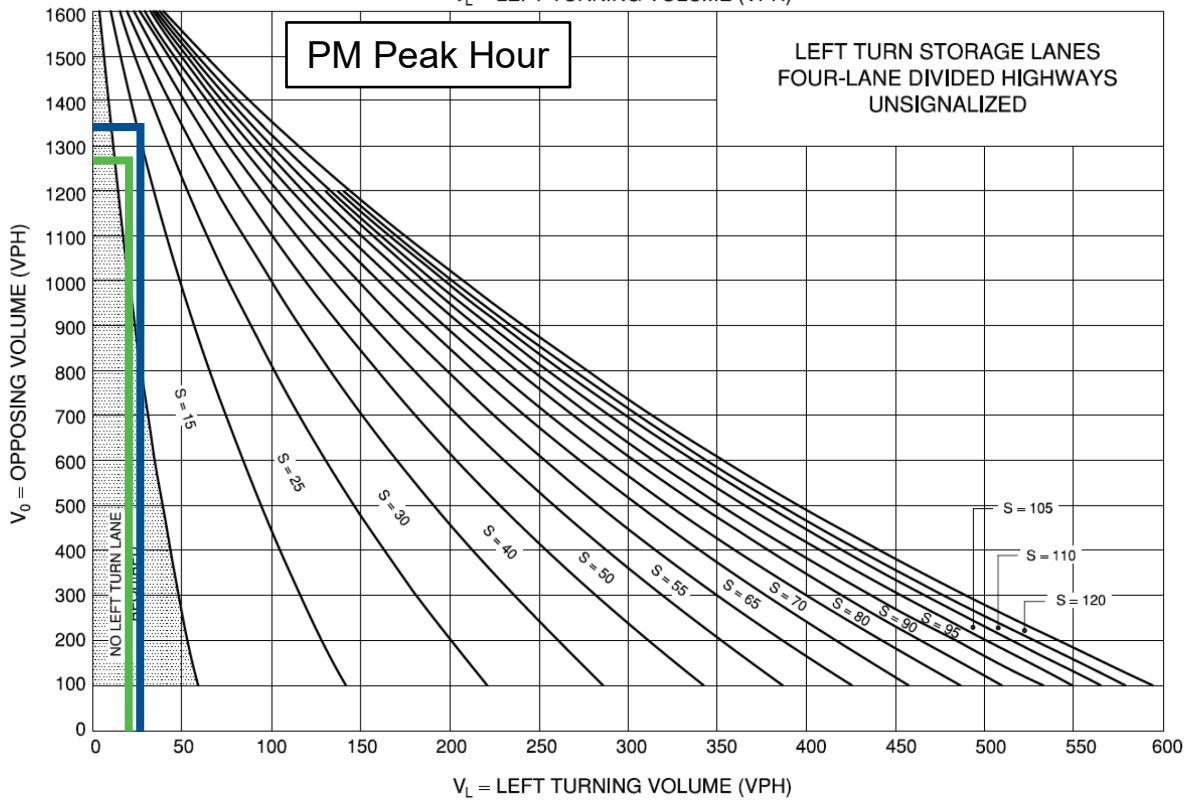
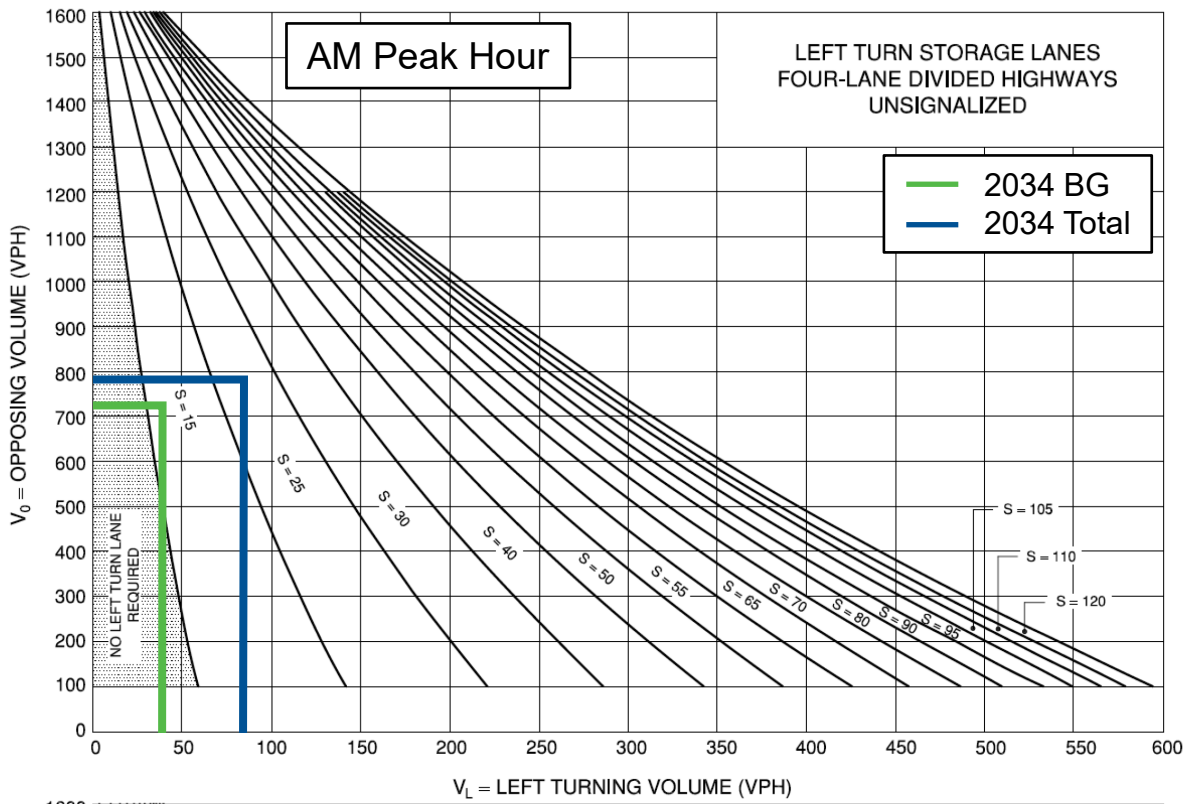
Left-Turn Lane Warrant 2024 Total Montrose Road at Driveway 'A'



Left-Turn Lane Warrant 2024 Horizon Montrose Road at Grassy Brook Road



Left-Turn Lane Warrant 2029 Horizon Montrose Road at Grassy Brook Road



Left-Turn Lane Warrant 2034 Horizon Montrose Road at Grassy Brook Road

Appendix N

Traffic Signal Warrants



Signal Justification Calculation for Forecasted Volumes (OTM Book 12 - Justification 7)



Horizon Year: 2034 Total
 Region/City/Township: Niagara Falls

Major Street: Montrose Road North/South?: Y
 Minor Street: Private Driveway/Driveway 'A'

Number of Approach Lanes: 2 or more
 Tee Intersection?: N
 Flow Conditions: Restricted

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

PM Forecast Only? N

Time Period	Major Street Montrose Road						Minor Street Private Driveway/Driveway 'A'						Peds Crossing
	Northbound			Southbound			Eastbound			Westbound			
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
	AM Peak Hour	19	827	15	19	876	27	10	0	6	2	0	
PM Peak Hour	3	1110	3	4	1295	6	28	0	16	15	0	19	0
Avg. Hourly Volume	6	484	5	6	543	8	10	0	5	4	0	6	0

Warrant	AHV
1A - All	1075
1B - Minor	25
2A - Major	1051
2B - Cross	14

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	All Approaches	480	720	600	900	
% Fulfilled						119%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Minor Street Approaches	120	170	120	170	
% Fulfilled						15%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Major Street Approaches	480	720	600	900	
% Fulfilled						117%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Traffic Crossing Major Street	50	75	50	75	
% Fulfilled						18%



Signal Warrant Montrose Road and Private Driveway / Driveway 'A'

Signal Justification Calculation for Forecasted Volumes (OTM Book 12 - Justification 7)



Horizon Year: 2034 Total
 Region/City/Township: Niagara Falls

Major Street: Montrose Road North/South?: Y
 Minor Street: Grassy Brook Road

Number of Approach Lanes: 2 or more
 Tee Intersection?: Y
 Flow Conditions: Restricted

Warrant Results		
150% Satisfied	No	Justification for new intersections with forecast traffic
120% Satisfied	No	Justification for existing intersections with forecast traffic

PM Forecast Only? N

Time Period	Major Street Montrose Road						Minor Street Grassy Brook Road						Peds Crossing
	Northbound			Southbound			Eastbound			Westbound			
	Left	Through	Right	Left	Through	Right	Left	Through	Right	Left	Through	Right	
AM Peak Hour	78	533			439	353	391	Through	24				0
PM Peak Hour	27	630			923	419	436		62				0
Avg. Hourly Volume	26	291	0	0	341	193	207	0	21	0	0	0	0

Warrant	AHV
1A - All	1079
1B - Minor	228
2A - Major	851
2B - Cross	207

Warrant 1 - Minimum Vehicular Volume

1A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	All Approaches	480	720	600	900	
					% Fulfilled	120%

1B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Minor Street Approaches	180	255	180	255	
					% Fulfilled	90%

Warrant 2 - Delay To Cross Traffic

2A	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Major Street Approaches	480	720	600	900	
					% Fulfilled	95%

2B	Approach Lanes	1		2 or more		Average Hourly Volume
	Flow Conditions	Free	Restricted	Free	Restricted	
	Traffic Crossing Major Street	50	75	50	75	
					% Fulfilled	276%



Signal Warrant Montrose Road and Grassy Brook Road