



C.C. Tatham & Associates Ltd.
Consulting Engineers

PANORAMA NORTH

Town of Collingwood

Traffic Impact Study

prepared by:

C.C. Tatham & Associates Ltd.
115 Sandford Fleming Drive, Suite 200
Collingwood, ON L9Y 5A6
Tel: (705) 444-2565 Fax: (705) 444-2327
info@cctatham.com

prepared for:

Ted North (295 Mountain Road) Ltd.

November 16, 2018

CCTA File 116167

Table of Contents

1	Introduction	1
2	Existing Conditions	3
2.1	Existing Road Network	3
2.2	Existing Traffic Volumes	3
2.3	Existing Traffic Operations	4
3	Future Background Conditions	8
3.1	Future Road Network	8
3.2	Future Background Traffic Volumes	9
3.3	Future Background Traffic Operations	15
4	Proposed Development	19
4.1	Land-Use & Phasing	19
4.2	Site Location & Access	20
4.3	Site Traffic	20
5	Transportation Impacts	31
5.1	Future Total Traffic Volumes	31
5.2	Future Total Traffic Operations	31
5.3	Active Transportation	42
5.4	Sight Line Analysis	42
6	Summary	43

Appendices

Appendix A: Traffic Operations - 2018

Appendix B: Background Development Traffic Volumes

Appendix C: Traffic Operations - 2028 Background

Appendix D: Traffic Operations - 2035 Background

Appendix E: Traffic Operations - 2040 Background

Appendix F: Traffic Operations - 2045 Background

Appendix G: Left Turn Warrants

Appendix H: Traffic Operations - 2028 Total

Appendix I: Traffic Operations - 2035 Total

Appendix J: Traffic Operations - 2040 Total

Appendix K: Traffic Operations - 2045 Total

Appendix L: Traffic Signal Warrants

List of Tables

Table 1: Intersection Operations - 2018 Existing Conditions	4
Table 2: Development Growth	10
Table 3: Intersection Operations - 2028 Background Conditions	15
Table 4: Intersection Operations - 2028 Background Conditions + Improvements	16
Table 5: Intersection Operations - 2035 Background Conditions	16
Table 6: Intersection Operations - 2040 Background Conditions	17
Table 7: Intersection Operations - 2045 Background Conditions	17
Table 8: Link Operations - Background Operations (PM Peak Hour)	18
Table 9: Panorama North - Phasing	19
Table 10: Trip Generation Rates	22
Table 11: Trip Generation Estimates	22
Table 12: Intersection Operations - 2028 Total Conditions	37
Table 14: Intersection Operations - 2035 Total Conditions	38
Table 15: Intersection Operations - 2035 Total Conditions + Improvements	39
Table 16: Intersection Operations - 2040 Total Conditions	39
Table 17: Intersection Operations - 2045 Total Conditions	40
Table 18: Roundabout Operations - 2045 Total Conditions	41
Table 19: Link Operations - Total Operations	41
Table 20: Sight Distances	42

List of Figures

Figure 1: Site Location	2
Figure 2: Area Road Network	5
Figure 3: 2018 Traffic Volumes	7
Figure 4: 2028 Background Traffic Volumes	11
Figure 5: 2035 Background Traffic Volumes	12
Figure 6: 2040 Background Traffic Volumes	13
Figure 7: 2045 Background Traffic Volumes	14
Figure 8: Site Plan	21
Figure 9: Panorama North - Phase 1 Traffic	24
Figure 10: Panorama North - Phase 2 Traffic	25
Figure 11: Panorama North - Phase 3 Traffic	26
Figure 12: Panorama North - Phase 4 Traffic	27
Figure 13: Panorama North - Phase 5 Traffic	28
Figure 14: Panorama North - 50% Build-out (Phases 1 to 3)	29
Figure 15: Panorama North - 100% Build-out (Phases 1 to 5)	30
Figure 16: 2028 Total Traffic Volumes	32
Figure 17: 2035 Total Traffic Volumes	33
Figure 18: 2040 Total Traffic Volumes	34
Figure 19: 2045 Total Traffic Volumes	35

1 Introduction

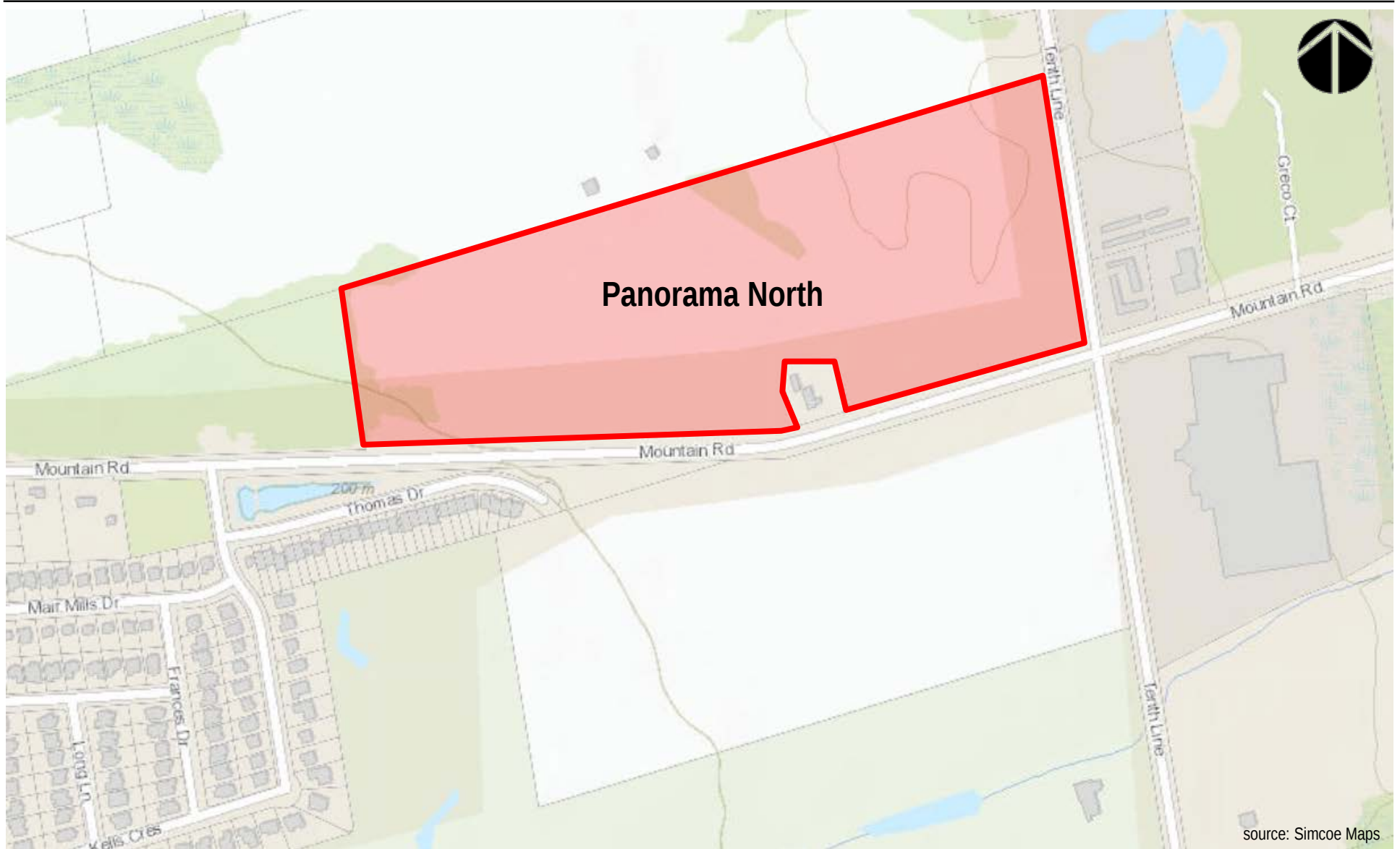
C.C. Tatham & Associates Ltd. was retained by Ted North (295 Mountain Road) Ltd. to address the traffic impacts associated with the proposed Panorama North residential development, located at 295 Mountain Road within the Town of Collingwood.

As per the *Town of Collingwood Official Plan*, the development site is located within the Mountain Road West Corridor, which is bounded by the Tenth Line to the east, Grey Road 19/Osler Bluff Road to the west, County Road 32/Sixth Street to the south and the Georgian Trail and Nottawasaga Bay shoreline to the north. For the purpose of this traffic impact assessment, the study area has been limited to the area bounded by Tenth Line to the east, Eleventh Line to the west, the Georgian Trail to the north and Mountain Road to the south. The location of the development site and the immediate area road network is illustrated in Figure 1.

The purpose of this study is to address the requirements of the Town of Collingwood with respect to the potential transportation impacts of the development on the local road network. In particular, the following will be discussed:

- the operations of the road system through the study area prior to the proposed development;
- an estimation of the growth in the traffic volumes not otherwise attributed to the development (i.e. from overall growth in the area and/or other developments);
- an estimation of the number of new trips the proposed development is likely to generate;
- the operations of the study area road system upon completion of the development; and
- the resulting impacts and need for mitigating measures (if required) to ensure acceptable overall road operations.

Chapter 2 of this report addresses the existing conditions, detailing the road system and corresponding traffic operations. Chapter 3 addresses future conditions, prior to the completion of the proposed development, and will address the expected growth in the traffic levels and the resulting operating conditions. Chapters 4 and 5 address the proposed development, the ensuing vehicle trips that it will generate, and the associated impacts on the road system. Lastly, Chapter 6 summarizes the report and the key findings.



2 Existing Conditions

This chapter will describe the road network, traffic volumes and operating characteristics as defined for the existing conditions.

2.1 Existing Road Network

The road network to be addressed by this study consists of Mountain Road and Tenth Line and their respective intersection.

Mountain Road is an east-west arterial road under the jurisdiction of the Town of Collingwood. The road has a two-lane rural cross-section, providing one lane of travel per direction bordered by 1.0 metre gravel shoulders and open ditches. The posted speed limit on Mountain Road is 60 km/h, thus a design speed of 70 km/h (posted + 10 km/h, typical for lower speed limits). As per the *Town of Collingwood Transportation Study*¹, Mountain Road has an assumed planning capacity of 900 vehicles per hour per lane (vphpl).

Tenth Line is a north-south collector road under the jurisdiction of the Town. The road has a rural cross-section and provides one lane of travel per direction. The posted speed limit is 50 km/h, and thus a design speed of 60 km/h has been assumed. As a collector road, Tenth Line has an assumed planning capacity of 700 vphpl. As per Schedule D in the *Town of Collingwood Official Plan*², Harbour Street West is to be extended to the west to connect with Tenth Line at its north limits. It is noted that there is no time line for the future connection, thus such has not been considered as part of the road network.

The intersection of Mountain Road and Tenth Line is a 4-leg intersection, operating under traffic signal control (with basic signal phases and timings). Each approach consists of a shared left/through/right turn lane.

The study area road network is illustrated in Figure 2.

2.2 Existing Traffic Volumes

Traffic volumes on Mountain Road and Tenth Line through the study area were determined from the *Town of Collingwood Tenth Line and Mountain Road Improvements Schedule C Municipal Class Environmental Assessment* Public Information Centre 1 (PIC 1) presentation boards. The PIC 1 boards presented 2017 traffic volumes, which are assumed as being representative of typical conditions. To reflect 2018 conditions, the 2017 volumes were adjusted by a background growth rate of 0.5% (additional discussion on background growth is provided in Section 3.2).

¹ *Town of Collingwood Transportation Study*. C.C. Tatham & Associates Ltd. (July 9, 2012)

² *Town of Collingwood Official Plan*. Town of Collingwood. (Office consolidated December 2015)

The corresponding 2018 peak hour traffic volumes are illustrated in Figure 3.

2.3 Existing Traffic Operations

The assessment of existing conditions provides the baseline from which the future traffic volumes and operations (both with and without the subject development) can be assessed. The capacity, and hence operations, of a road system is effectively dictated by its intersections. As such, the analysis focused on the operations of the intersection of Mountain Road with Tenth Line. The analysis is based on the 2018 traffic volumes, the existing configuration and control for each intersection and procedures outlined in the *2000 Highway Capacity Manual*³ (using Synchro v.10 software), a summary of which is provided in Table 1. For signalized intersections the analysis considers the conditions at each approach and the overall intersection. Level of service A corresponds to the best operating condition with minimal delays, whereas level of service F corresponds to poor operations resulting from high intersection delays. A volume to capacity (v/c) ratio of less than 1.0 indicates the intersection movement/approach is operating at less than capacity, while a v/c ratio of 1.0 indicates capacity has been reached. Detailed operations worksheets for the existing traffic conditions are included in Appendix A.

Table 1: Intersection Operations - 2018 Existing Conditions

Intersection and Movement	Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
		delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	7	A	0.38	6	A	0.47
	WB	6	A	0.44	7	A	0.62
	NB	16	B	0.33	23	C	0.41
	SB	15	B	0.25	23	C	0.46
	overall	8	A	0.42	10	A	0.59

Based on the 2018 volumes, the intersection of Mountain Road with Tenth Line provides excellent overall levels of service (LOS A) during both peak hours with minimal delays. As such, no improvements are necessary to address existing conditions.

³ *Highway Capacity Manual*. Transportation Research Board, Washington DC, 2000.



Looking north along Tenth Line from Mountain Road



Looking south along Tenth Line from Mountain Road



Looking east along Mountain Road from Tenth Line



Looking west along Mountain Road from Tenth Line



C.C. Tatham & Associates Ltd.
Consulting Engineers

Panorama North, Traffic Impact Study Area Road Network

Figure
2a



Looking north along Tenth Line from Site Access 1



Looking south along Tenth Line from Site Access 1



Looking east along Mountain Road from Site Access 2



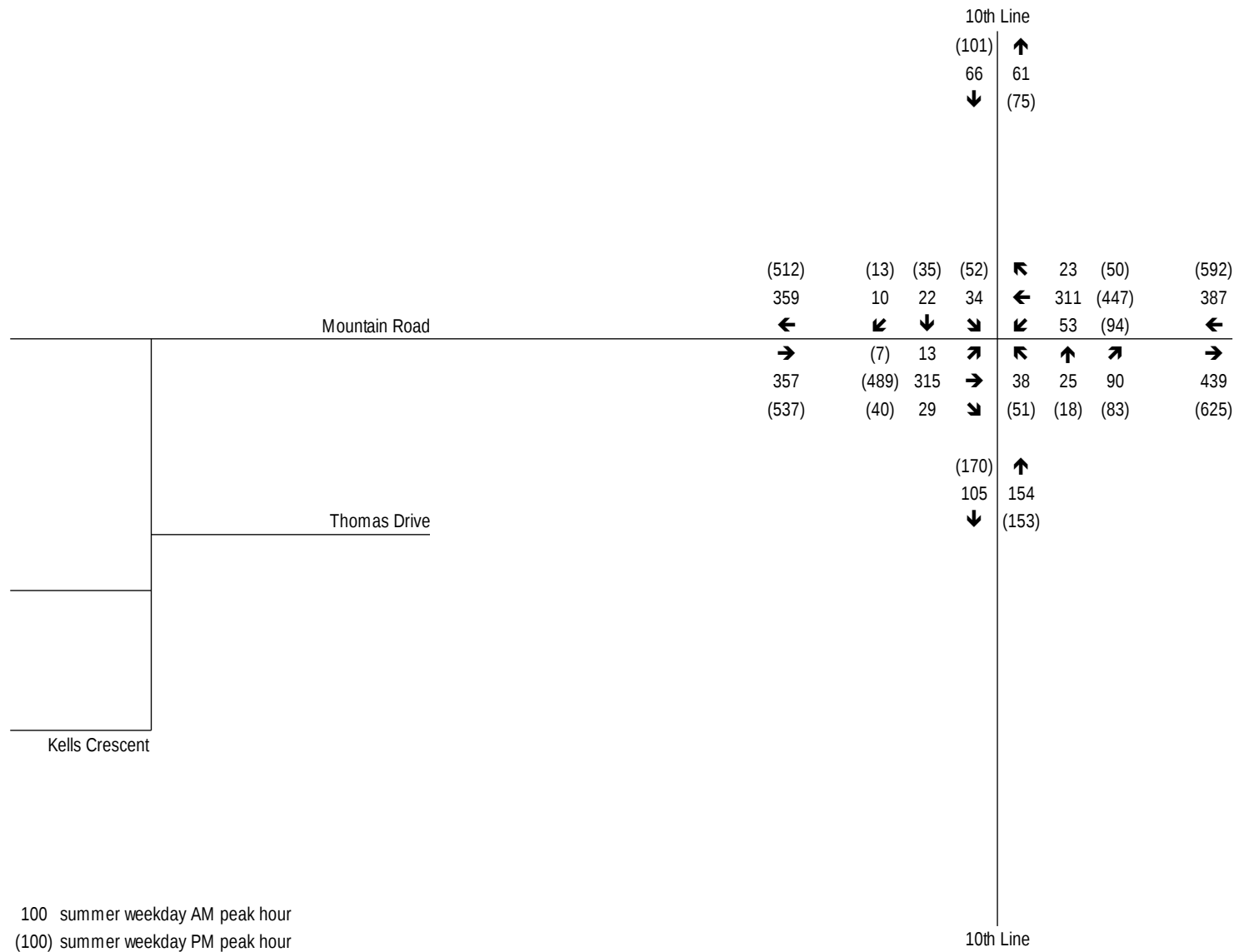
Looking west along Mountain Road from Site Access 2



C.C. Tatham & Associates Ltd.
Consulting Engineers

Panorama North, Traffic Impact Study Area Road Network

**Figure
2b**



3 Future Background Conditions

This chapter will describe the road network and background traffic volumes expected for the years 2028, 2035, 2040 and 2045. The 2028 and 2035 horizon years have been adopted to reflect 50% and 100% build-out and occupancy of the proposed Panorama North development (14-year build-out, with construction of Phase 1 beginning in 2021), whereas the 2040 and 2045 horizons will address the longer-term impacts (5 and 10 years beyond build-out).

3.1 Future Road Network

A number of road system improvements have been identified in the *Town of Collingwood Transportation Study*, including:

- eastbound and westbound left turn lanes on Mountain Road at Tenth Line;
- northbound right turn lane on Tenth Line at Mountain Road; and
- a widening of Mountain Road from 2 lanes to 4 lanes, from Tenth Line to Cambridge Street.

All of the above improvements were identified as being required between 2020 and 2030.

The Town of Collingwood is currently undertaking the *Tenth Line and Mountain Road Improvements Schedule C Municipal Class Environmental Assessment* to further investigate potential improvements to Mountain Road (from Cambridge Street to Tenth Line) and Tenth Line (from Mountain Road to Sixth Street), and the manner in which improvements can be implemented. The following needs and timings have been identified with respect to the study area:

2022 Horizon

- provide 3 lanes on Mountain Road from Tenth Line to Cambridge Street
- widen/replace the Black Ash Creek bridge
- urbanize Tenth Line

2030 Horizon

- add left turn lanes on each approach and install permanent traffic signals at Mountain Road/Tenth Line intersection (or construct two-lane roundabout)

2037 Horizon

- provide 5 lanes on Mountain Road from Tenth Line to Cambridge Street

The *Tenth Line and Mountain Road Improvements Schedule C Municipal Class Environmental Assessment* Public Information Centre 2 (PIC 2) was held on Thursday September 6, 2018. The preferred solution presented at PIC 2 included the following:

- a 5-lane urban cross-section on Mountain Road (from Tenth Line to Cambridge Street);
- a 2-lane urban cross-section on Tenth Line (from Mountain Road to Sixth Street); and
- improvements to the intersection of Mountain Road with Tenth Line (permanent signals with exclusive turn lanes or roundabout control).

Further to the above, the PIC 2 presentation boards also identified several options being considered with respect to implementing the preferred solution. The Class EA is still underway, with the preferred design option yet to be identified.

3.2 Future Background Traffic Volumes

Future background traffic volumes expected for the 2028, 2035, 2040 and 2045 horizon years have been determined in consideration of general growth in the area in addition to specific development growth.

General Growth

As per the *Town of Collingwood Transportation Study*, an annual growth rate of 0.5% has been considered to reflect general growth in the area.

Development Growth

A number of area developments have been identified for consideration in this study, given their location and potential to increase traffic volumes on the area road system. Development details and assumptions regarding completion levels for the noted horizon years were determined from the respective traffic impact studies (C.C. Tatham are involved in all but 2 of the noted developments) and/or the *Town of Collingwood Tenth Line and Mountain Road Improvements Schedule C Municipal Class Environmental Assessment*

Associated traffic volumes anticipated through the study area, following full build-out of each development, have been derived from the respective traffic impact studies and projected through the study area intersection as appropriate.

A summary of the development information is provided in Table 2, whereas the corresponding background development traffic volumes are provided in Appendix B.

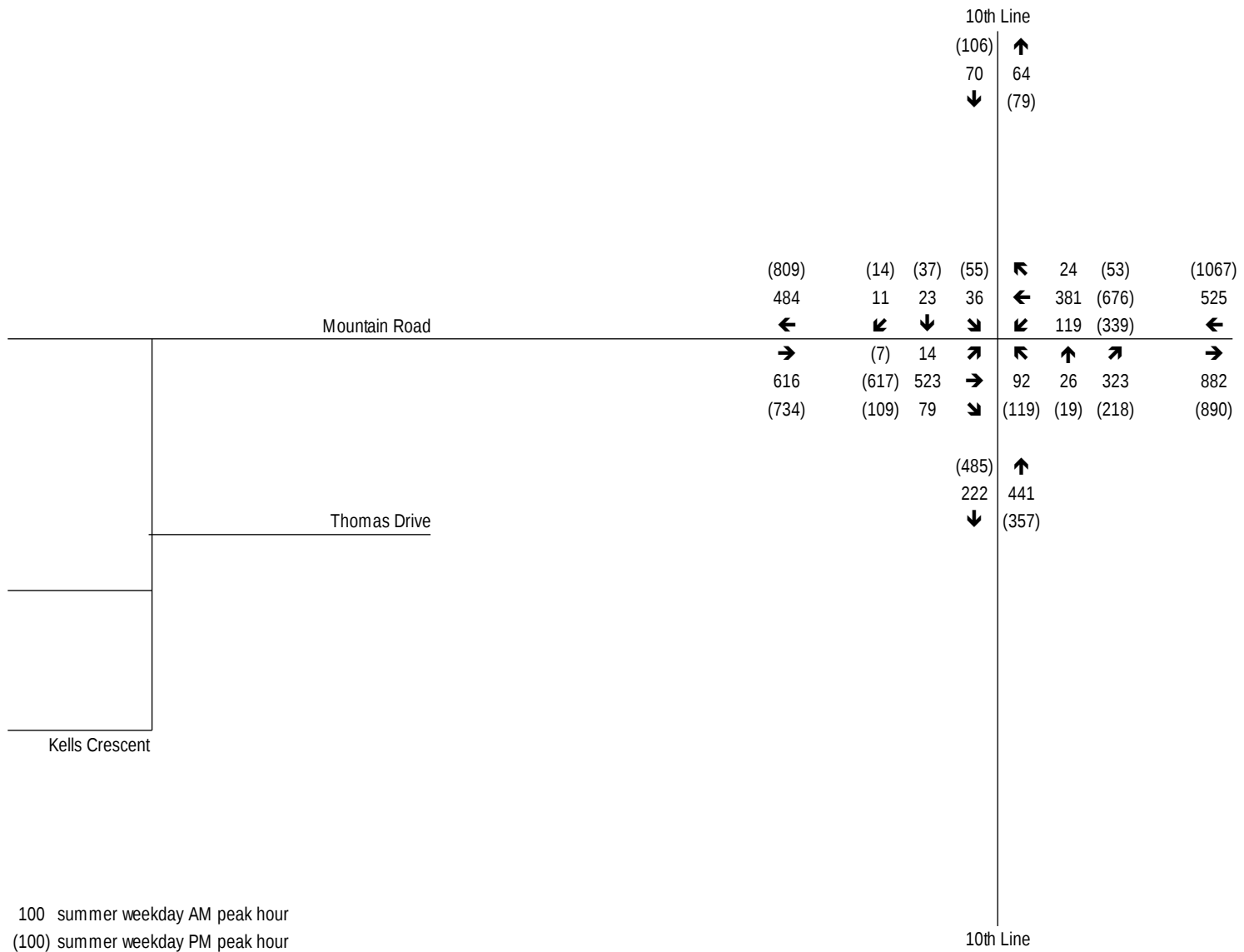
Table 2: Development Growth

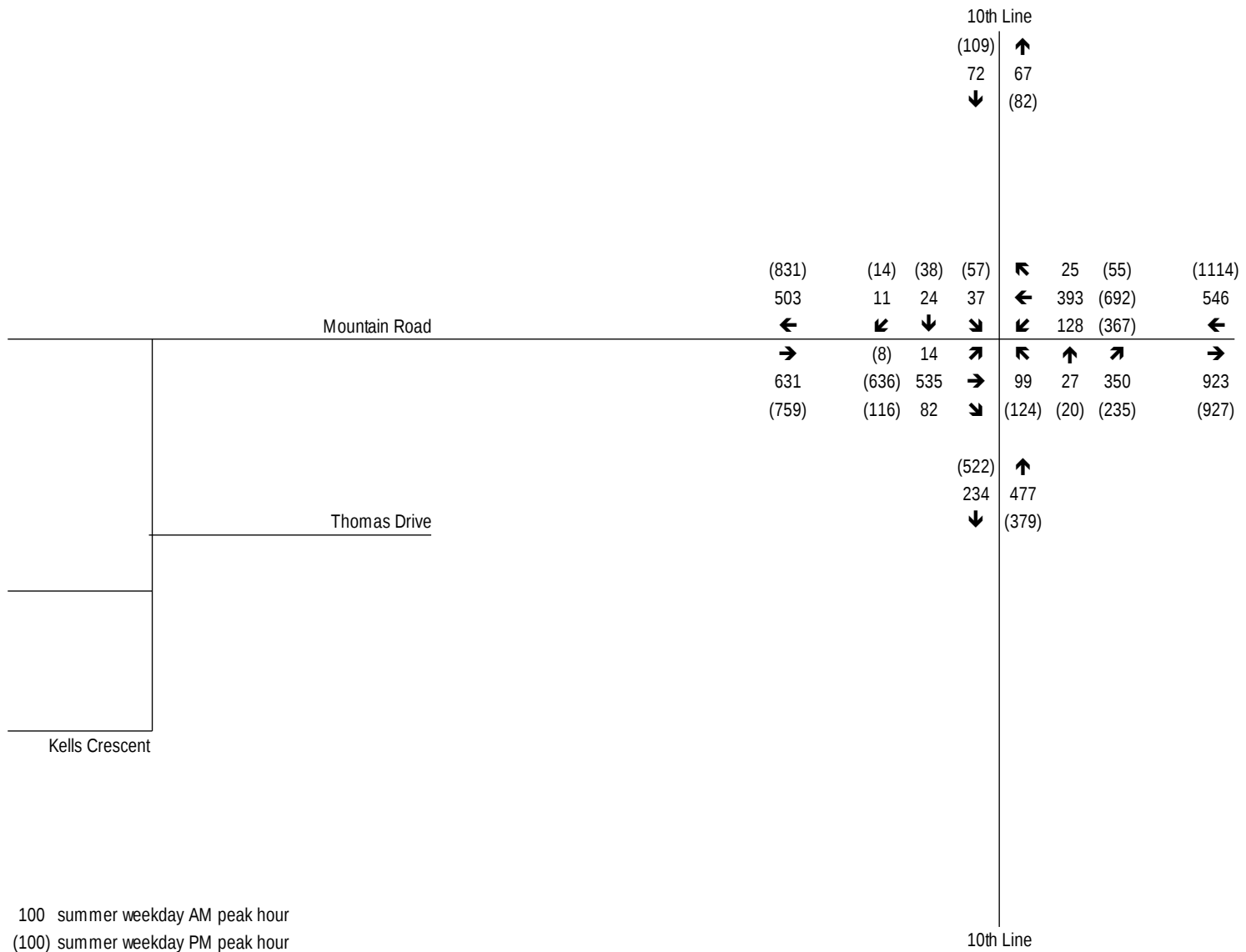
Development	Land Use & Size	% Complete By			
		2028	2035	2040	2045
100 Mountain Road	1,784 m ² commercial/industrial	100%	100%	100%	100%
120 Mountain Road	9,097 m ² commercial/industrial	100%	100%	100%	100%
180 Mountain Road	8,700 m ² marijuana grow-op	100%	100%	100%	100%
185 Mountain Road	12,806 m ² commercial/industrial	100%	100%	100%	100%
Linksvew Development	1,000 single, townhouse & apt units	73%	92%	100%	100%
Consar Development	237 single & townhouse units	100%	100%	100%	100%
Windfall Medium Density	242 condo units	100%	100%	100%	100%
Windfall	571 single & townhouse units	100%	100%	100%	100%
Second Nature	236 single & townhouse units	100%	100%	100%	100%
Nederand Development	121 single units	100%	100%	100%	100%
Panorama (formerly Mair Mills Village)	319 single & townhouse units 1,130 m ² commercial	100%	100%	100%	100%

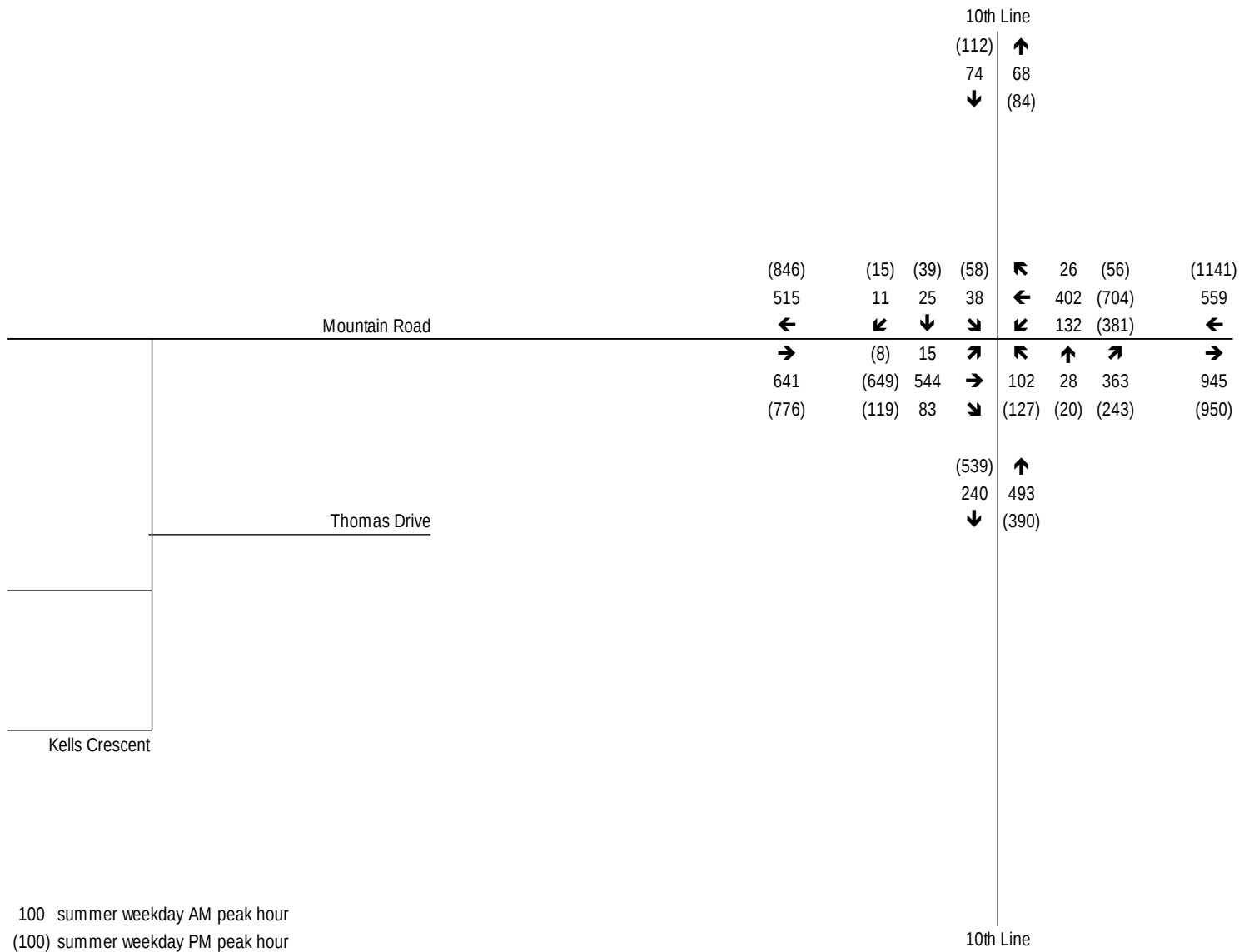
Future Background Traffic Volumes

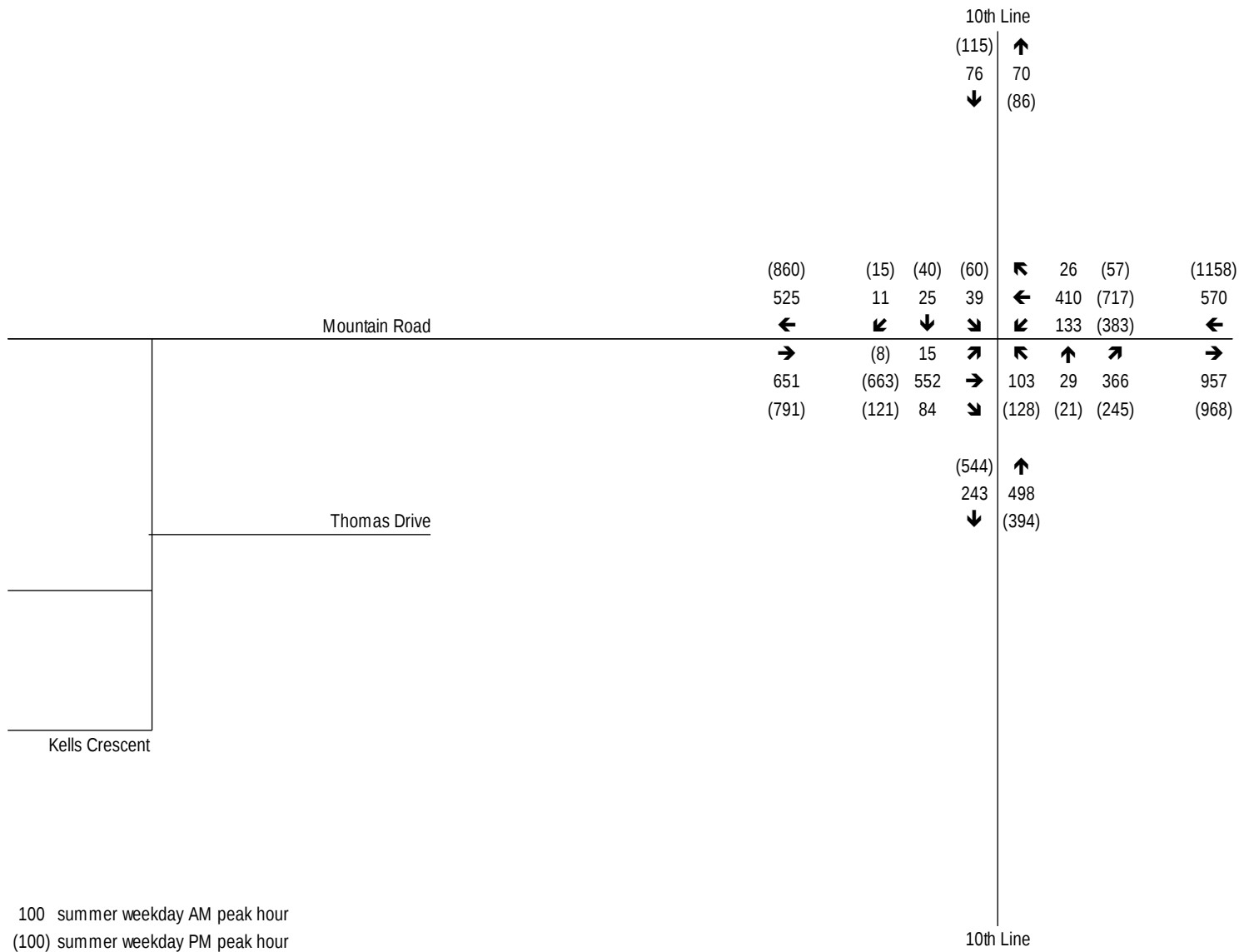
The resulting 2028, 2035, 2040 and 2045 traffic volumes are provided in Figure 4 through Figure 7.

In comparing the 2018 traffic volumes to the 2028 background traffic volumes, annual growth rates of 4.7% have been realized on Mountain Road and 9.1% on Tenth Line. In considering the 2045 projections, somewhat reduced growth rates are realized – 2.1% on Mountain Road and 4.9% on Tenth Line.









3.3 Future Background Traffic Operations

3.3.1 Intersection Operations

The subject intersection was again analyzed for each horizon year given the projected background volumes. While a number of future road system improvements have been previously identified, they have not been considered in the initial intersection review; rather, improvements will be considered as operations dictate (in accordance with the previously noted improvement strategies).

Background Traffic Operations - 2028

The results for the 2028 horizon year are presented in Table 3, whereas detailed worksheets are provided in Appendix C.

Table 3: Intersection Operations - 2028 Background Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	12	B	0.63	9	A	0.57
	WB		12	B	0.69	185	F	1.36
	NB		33	C	0.81	237	F	1.35
	SB		19	B	0.28	64	E	0.70
	overall	signal	18	B	0.73	131	F	1.35

As noted, the subject intersection will experience a poor overall level of service (LOS F) with long delays during the PM peak hour. To address the poor operating conditions, exclusive left turn lanes have been considered for all approaches. This is consistent with the intersection improvements identified in the *Tenth Line and Mountain Road Improvements Class EA* for the 2030 horizon (as noted in Section 3.1 above) and also the improvements noted in the *Panorama (formerly Mair Mills Village) Traffic Impact Study*⁴ - which suggests the northbound left turn lane at Mountain Road should be extended to serve the proposed access to the Panorama development (formerly Mair Mills Village) to the south. While it is acknowledged that the Class EA is also considering a roundabout configuration as a potential preferred design option, standard signalization has been considered in this assessment; however, a two-lane roundabout scenario has been considered under the 2045 total conditions (i.e. critical horizon) to provide a comparative review of a roundabout vs signalization.

In addition to the provision of exclusive left turn lanes, the signal timings have been revised to include an advanced green phase for the westbound left turn movement during the PM peak hour. The

⁴ *Mair Mills Village Traffic Impact Study*. C.C. Tatham & Associates, August 2017.

intersection was re-assessed to consider the noted improvements, the results of which are provided in Table 4.

Table 4: Intersection Operations - 2028 Background Conditions + Improvements

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	10	A	0.61	26	C	0.84
	WB		8	A	0.41	14	B	0.81
	NB		19	B	0.51	30	C	0.59
	SB		17	B	0.25	31	C	0.52
	overall	signal	12	B	0.58	21	C	0.78

As indicated, the intersection will provide good overall operations (LOS C or better) with average delays given the noted improvements.

Background Traffic Operations – 2035 through 2045

The operational assessment results for the 2035, 2040 and 2045 horizon years are presented in Table 5 through Table 7, whereas detailed worksheets are provided in Appendix D through Appendix F. The intersection improvements recommended to address background conditions in 2028, namely the provision of exclusive left turn lanes on all approaches and an advance green phase for the westbound left turn movement during the PM peak hour), have been maintained. The signal timings have been optimized as necessary.

Table 5: Intersection Operations - 2035 Background Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	10	A	0.60	27	C	0.84
	WB		8	A	0.41	16	B	0.84
	NB		21	C	0.57	36	D	0.66
	SB		19	B	0.28	45	D	0.70
	overall	signal	13	B	0.59	24	C	0.81

Table 6: Intersection Operations - 2040 Background Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	11	B	0.63	31	C	0.88
	WB		9	A	0.43	20	B	0.89
	NB		22	C	0.63	36	D	0.66
	SB		18	B	0.29	46	D	0.71
	overall	signal	14	B	0.63	27	C	0.84

Table 7: Intersection Operations - 2045 Background Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	11	B	0.64	33	C	0.89
	WB		9	A	0.44	23	C	0.93
	NB		22	C	0.64	36	D	0.65
	SB		18	B	0.29	48	D	0.73
	overall	signal	14	B	0.64	30	C	0.87

As noted, the intersection will continue to provide good overall operating conditions through the 2045 horizon given the projected background traffic volumes and the improvements recommended under the 2028 horizon. No further improvements are required to address the background conditions through 2045.

3.3.2 Link Operations

Further to the intersection operations, consideration has been given to the link volumes along Mountain Road (only the PM peak hour has been considered as it is more critical than the AM peak hour). As previously noted, a capacity of 900 vphpl has been assumed on Mountain Road. A review of the projected link volumes with respect to the assumed lane capacity is provided in Table 8. A widening Mountain Road is justified when the volume projections exceed the noted capacity, reflective of a v/c ratio greater than 1.0.

Based on the v/c ratio, widening of Mountain Road east of Tenth Line (i.e. from Tenth Line to Cambridge Street) should be considered by 2028. This is consistent with the *Town of Collingwood Transportation Study* in that the widening was identified in the 2020 to 2030 period. West of Tenth

Line, operations are acceptable through to 2045. As per the ongoing *Tenth Line and Mountain Road Improvements Schedule C Municipal Class Environmental Assessment*, widening of Mountain Road east of Tenth Line was noted for 2037.

Table 8: Link Operations - Background Operations (PM Peak Hour)

Road Section & Lanes per Direction			Capacity ¹		Traffic Volumes		Volume to Capacity	
			EB	WB	EB	WB	EB	WB
Mountain Road 2028	W of Tenth Line	1	900	900	734	809	0.82	0.90
	E of Tenth Line	1	900	900	890	1067	0.99	1.19
Mountain Road 2035	W of Tenth Line	1	900	900	759	831	0.84	0.92
	E of Tenth Line	1	900	900	927	1114	1.03	1.24
Mountain Road 2040	W of Tenth Line	1	900	900	776	846	0.86	0.94
	E of Tenth Line	1	900	900	950	1141	1.06	1.27
Mountain Road 2045	W of Tenth Line	1	900	900	791	860	0.88	0.96
	E of Tenth Line	1	900	900	968	1158	1.08	1.29

4 Proposed Development

This chapter will provide additional details with respect to the proposed development, including its location, the projected site generated traffic volumes and the assignment of such to the adjacent road network.

4.1 Land-Use & Phasing

The proposed Panorama North residential development will consist of 929 residential units (a concept plan is provided in Figure 8). The following is a breakdown of the proposed development by unit type:

- 122 single family detached units;
- 74 townhouse units;
- 458 stacked townhouse units;
- 56 back-to-back townhouse units; and
- 219 apartment units.

The development will be constructed in 5 phases. Commencement of Phase 1 is anticipated in 2021, with full build-out of the development assumed by 2035 (14-year build out). This translates to an average build rate of 67 units per year. It is noted that Phase 4 is expected to experience a slightly more conservative build rate (approximately 83 units/year) given that it includes the apartment blocks. It is noted that the 2028 horizon reflects 50% build-out. A summary of the phasing is provided in Table 9.

Table 9: Panorama North - Phasing

Phase	Year Complete	Unit Type					Total
		Singles	Towns	Stacked Towns	B2B Towns	Apts	
1	2024	38	10	114	0	0	162
2	2027	20	64	93	24	0	201
3	2028	64	0	0	0	0	64
4	2032	0	0	111	0	219	330
5	2035	0	0	140	32	0	172
Total		122	74	458	56	219	929

4.2 Site Location & Access

As previously illustrated in Figure 1, the proposed subdivision is located on the north side of Mountain Road just west of Tenth Line. The property is bounded by Tenth Line to the east, Mountain Road to the south and undeveloped land to the west and a residential parcel to the north.

Two access points to Panorama North will be provided as evident in Figure 8 and summarized below:

- the first access (Street A) will connect to Tenth Line approximately 185 metres north of the intersection of Mountain Road with Tenth Line; and
- the second access (Street E) will connect to Mountain Road approximately 205 metres east of Kells Crescent and 780 metres west of Mountain Road.

4.3 Site Traffic

4.3.1 Trip Generation

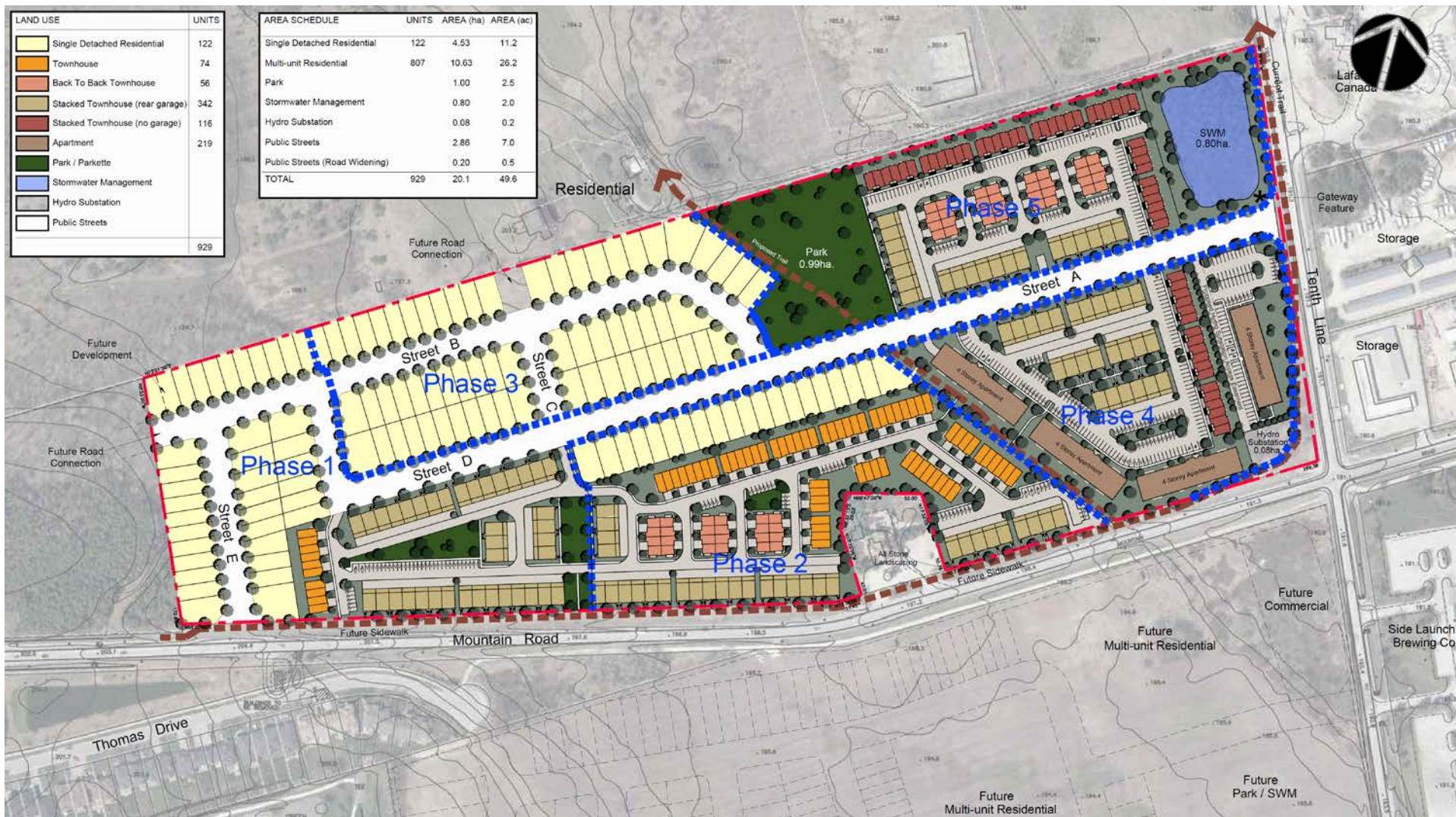
The number of vehicle trips to be generated by the proposed development during the weekday AM and PM peak hours has been determined based on the type of use, development size and trip generation rates as per the *ITE Trip Generation Manual 9th Edition*.

The following ITE land uses have been considered:

- *single family detached residential* (ITE code 210) - for single detached units;
- *low-rise residential condo/townhouse* (ITE code 231) - for townhouse units (all types); and
- *apartment* (ITE code 220) - for apartment units.

A summary of the corresponding trip rates is provided in Table 10, whereas the resulting trip rates for each phase of the Panorama North development are summarized in Table 11. For the sake of simplicity, it is noted that the various townhouse unit types (i.e. townhouse, stacked, back-to-back) have been consolidated as “townhouses” in Table 11, recognizing that the trip generation rates do not vary by type of unit.

Upon full build-out, the proposed development is expected to generate 597 trips during the weekday AM peak hour and 717 trips during the weekday PM peak hour.



C.C. Tatham & Associates Ltd.
Consulting Engineers

Panorama North, Traffic Impact Study

Site Plan

Figure

8

Table 10: Trip Generation Rates

Land Use	Variable	Weekday AM Peak Hour			Weekday PM Peak Hour		
		in	out	total	in	out	total
single family detached	units	0.19	0.56	0.75	0.63	0.37	1.00
low rise residential condo/town	units	0.17	0.50	0.67	0.45	0.33	0.78
apartment	units	0.10	0.41	0.51	0.40	0.22	0.62

Table 11: Trip Generation Estimates

Development		Units	Weekday AM Peak Hour			Weekday PM Peak Hour		
			in	out	total	in	out	total
Phase 1	singles	38	7	22	29	24	14	38
	towns	124	21	62	83	56	41	97
	apartments	-	-	-	-	-	-	-
Phase 2	singles	20	4	11	15	13	7	20
	towns	181	30	91	121	82	59	141
	apartments	-	-	-	-	-	-	-
Phase 3	singles	64	12	36	48	40	24	64
	towns	-	-	-	-	-	-	-
	apartments	-	-	-	-	-	-	-
Phase 4	singles	-	-	-	-	-	-	-
	towns	111	19	56	75	50	37	87
	apartments	219	22	89	111	88	48	136
Phase 5	singles	-	-	-	-	-	-	-
	towns	172	29	86	115	78	56	134
	apartments	-	-	-	-	-	-	-
Total – Phases 1 to 3 (50% build-out)			74	222	296	215	145	360
Total – Phases 1 to 5 (100% build-out)			144	453	597	431	286	717

4.3.2 Trip Distribution & Assignment

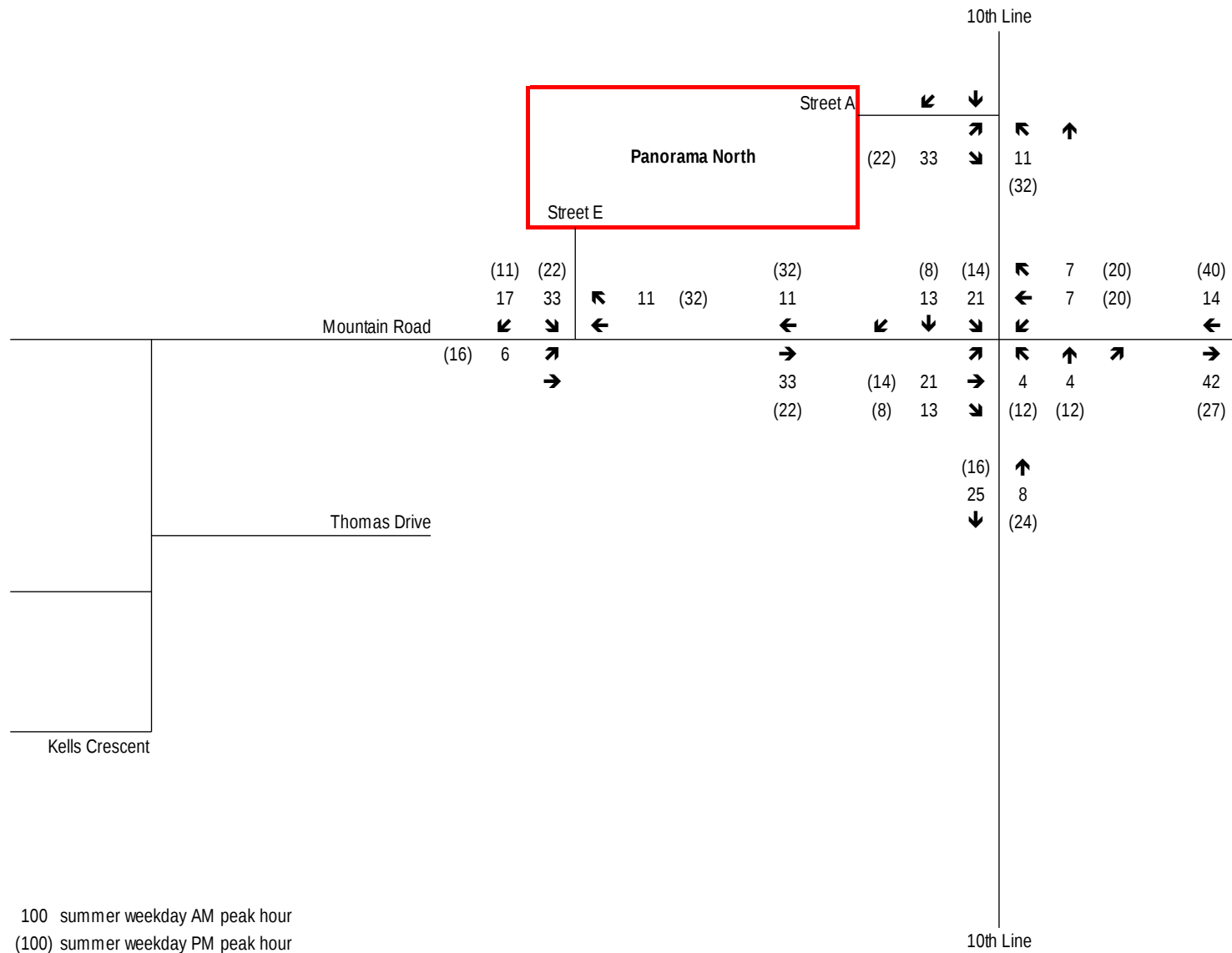
The distribution of the site-generated traffic to the area road system reflects the location of the site in context of the surrounding built-up areas (i.e. Collingwood and Blue Mountain). The resulting distribution assumed is as follows:

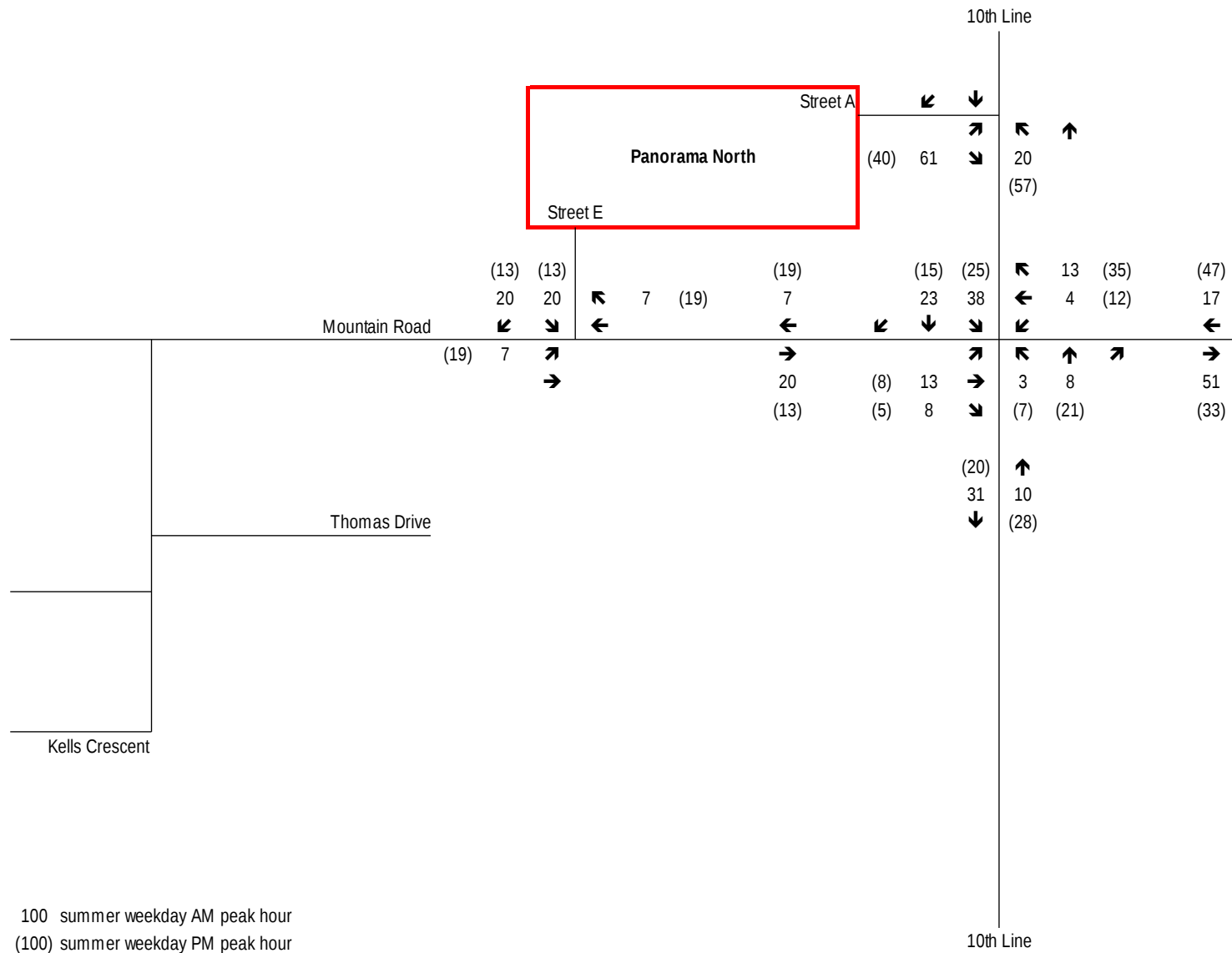
- 50% to/from the east on Mountain Road;
- 20% to/from the west on Mountain Road; and
- 30% to/from the south on Tenth Line.

It is noted that the above is comparable to the distributions assumed for the Panorama (formerly Mair Mills Village), Linksvew and Consar developments, following consideration for the respective development locations (e.g. south of Mountain Road on Tenth Line).

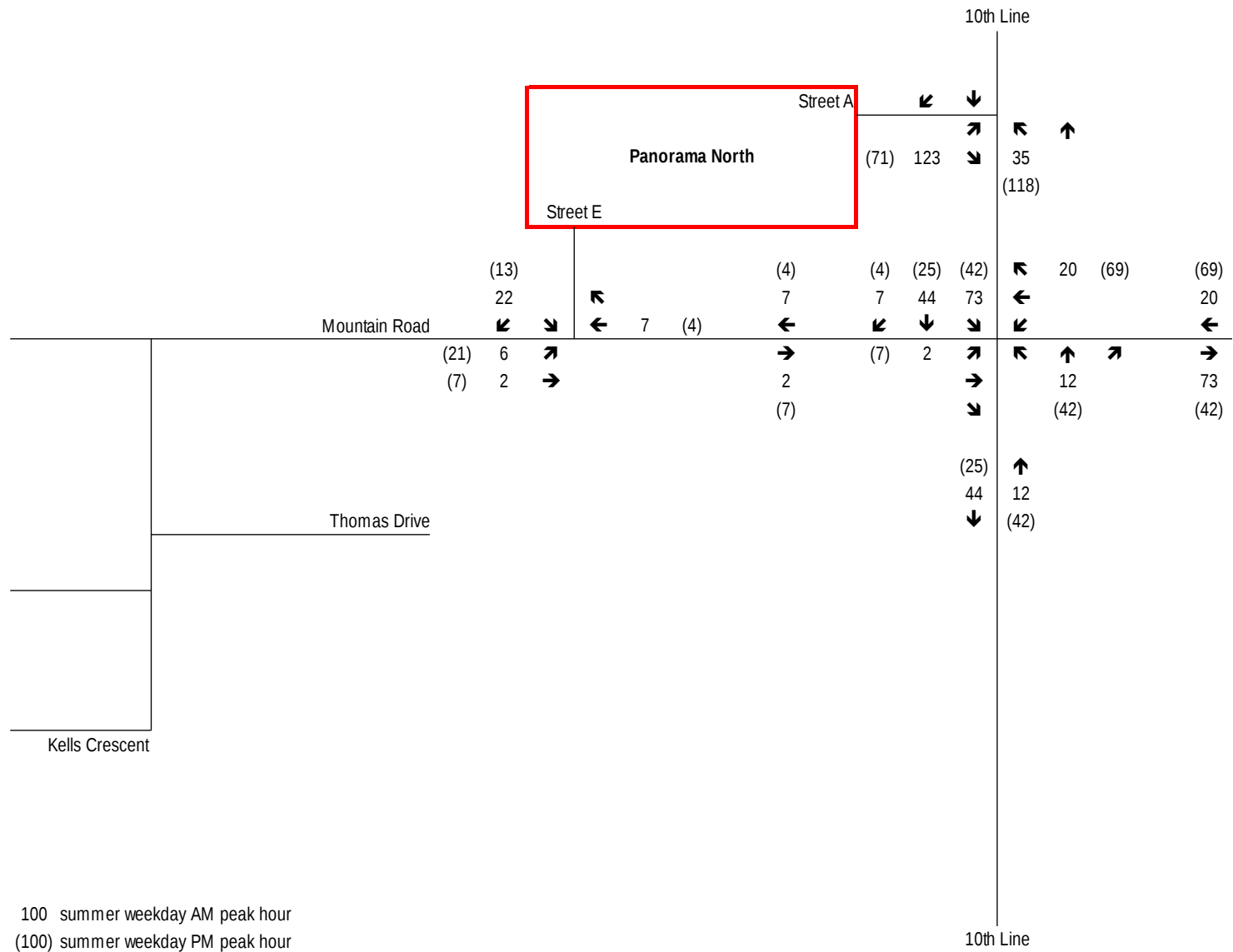
With respect to the assignment of the site generated trips to the access points, the site traffic was assigned to the proposed site access points based on the location of the residential units with respect to the access points and the directness of the internal road system. The resulting site generated traffic volumes are illustrated in indicated in Figure 9 through Figure 13 for Phases 1 through 5, respectively. Figure 14 illustrates the anticipated site traffic at 50% build-out (Phases 1 to 3), whereas Figure 15 illustrates full build-out (Phases 1 to 5).

As previously noted, Schedule D of the *Town of Collingwood Official Plan* indicates a future connection between Tenth Line and Harbour Street West to the north of the site. The connection has not been considered given the uncertainty of the timing (i.e. there is no timeline for construction of the extension of Harbour Street West to Tenth Line). It is noted that excluding the future connection from consideration requires that all site traffic exiting/entering via Tenth Line do so via the intersection of Tenth Line with Mountain Road – thus ensuring a conservative approach.

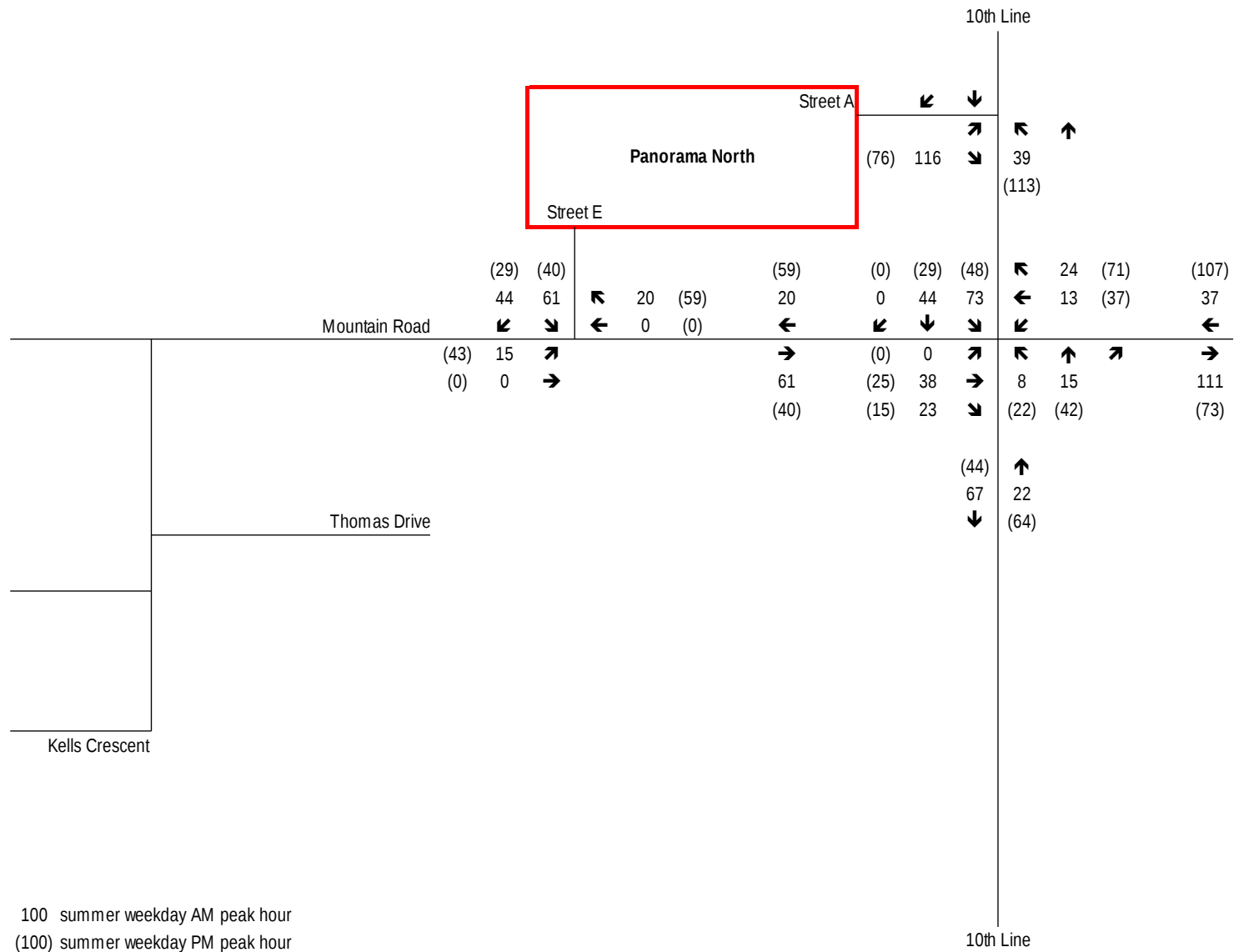


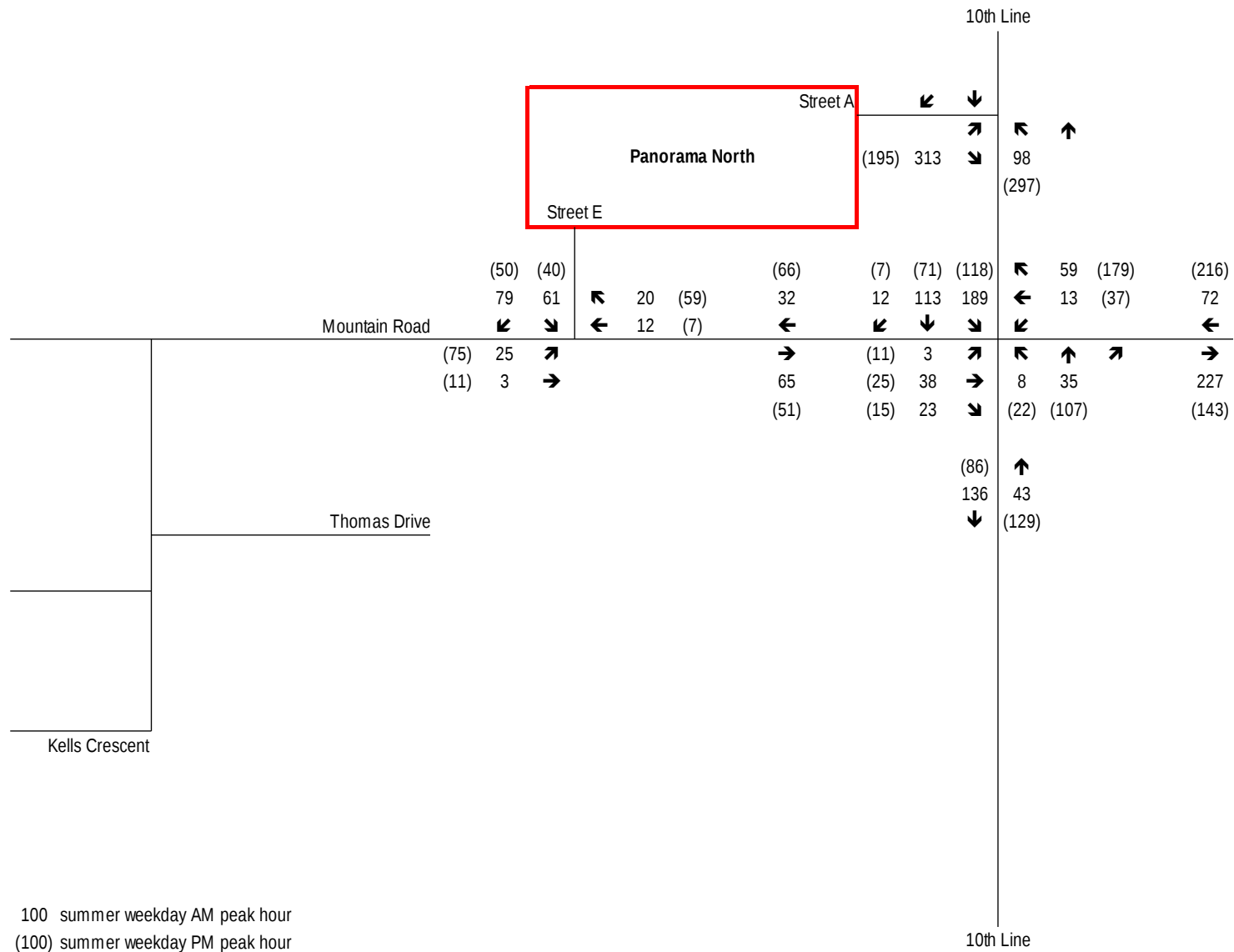












5 Transportation Impacts

This section will address the resulting impacts of the proposed residential development on the adjacent road system. Three areas are to be addressed:

- operations of the key intersections, including the site access points;
- available sight lines on Tenth Line and Mountain Road at the proposed site access; and
- potential improvements to the study area road network, if necessary.

5.1 Future Total Traffic Volumes

To assess the impacts of the increased traffic volumes resulting from the proposed Panorama North residential development, the site generated traffic was combined with the 2028, 2035, 2040 and 2045 background traffic volumes. The resulting future total traffic volumes are presented in Figure 16 through Figure 19.

5.2 Future Total Traffic Operations

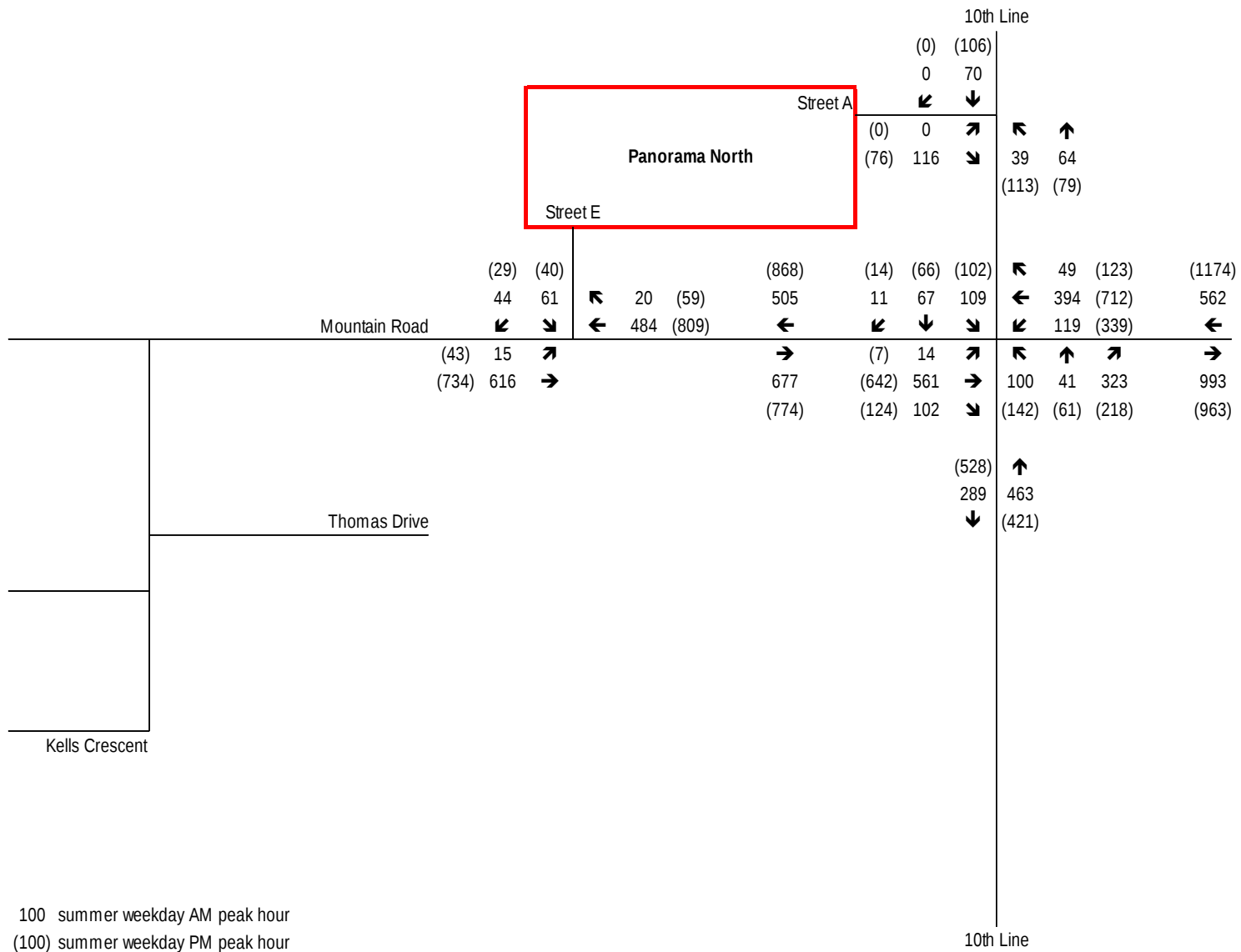
5.2.1 Turn Lane Requirements

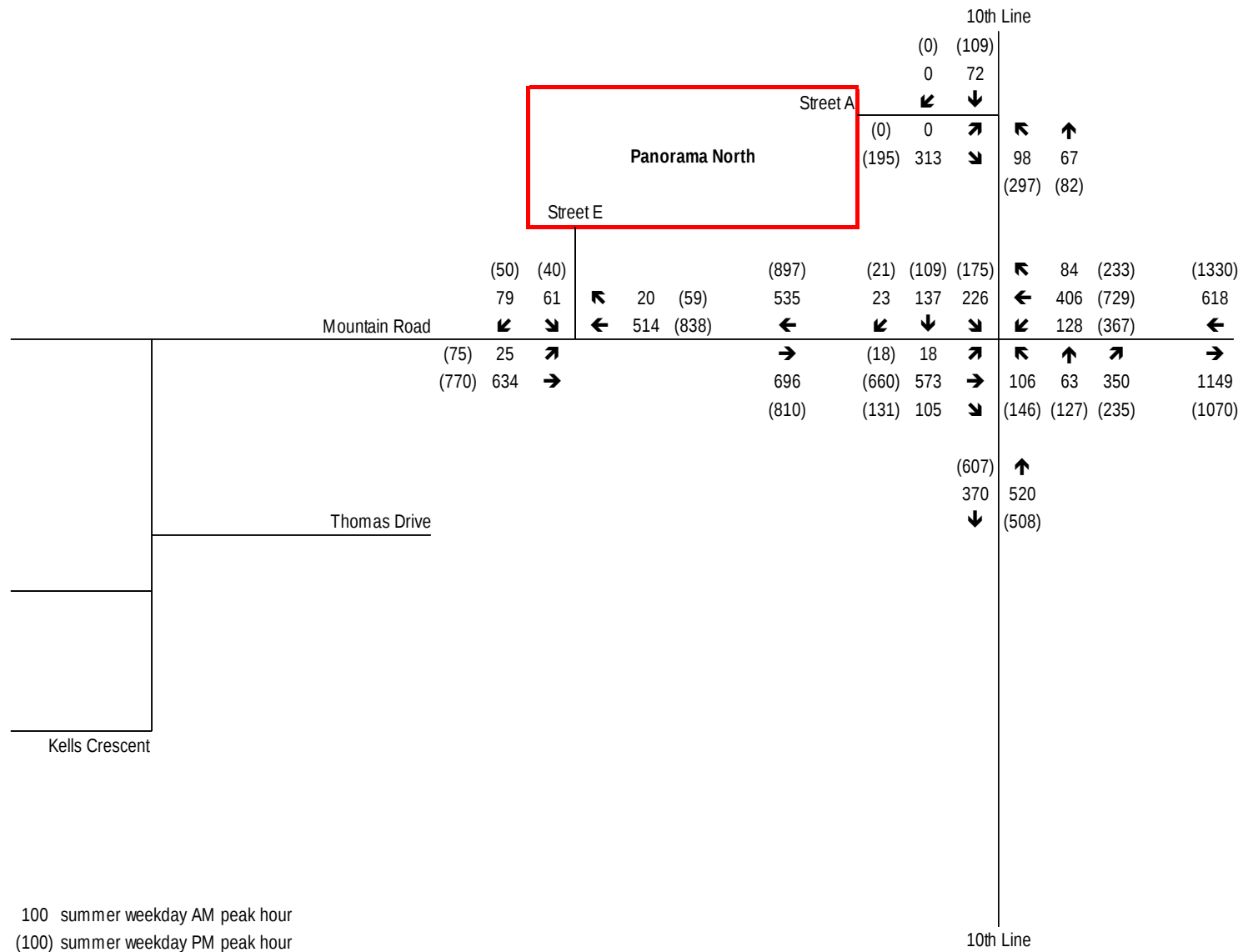
The need for exclusive left and right turn lanes on Mountain Road at Street E and on Tenth Line at Street A was reviewed based on the total projected volumes on the road network and MTO warrant criteria for exclusive turn lanes.

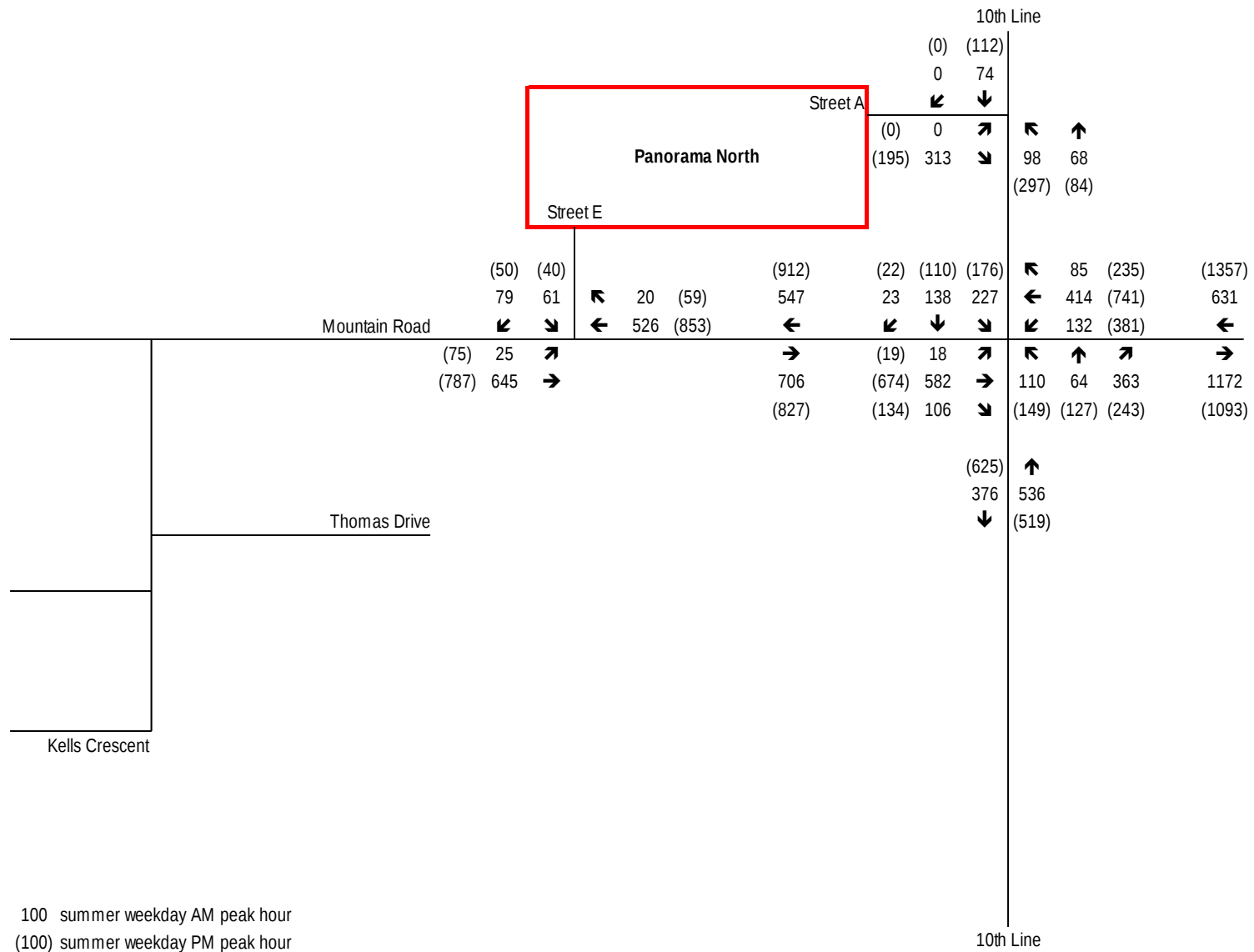
Right Turn Lane

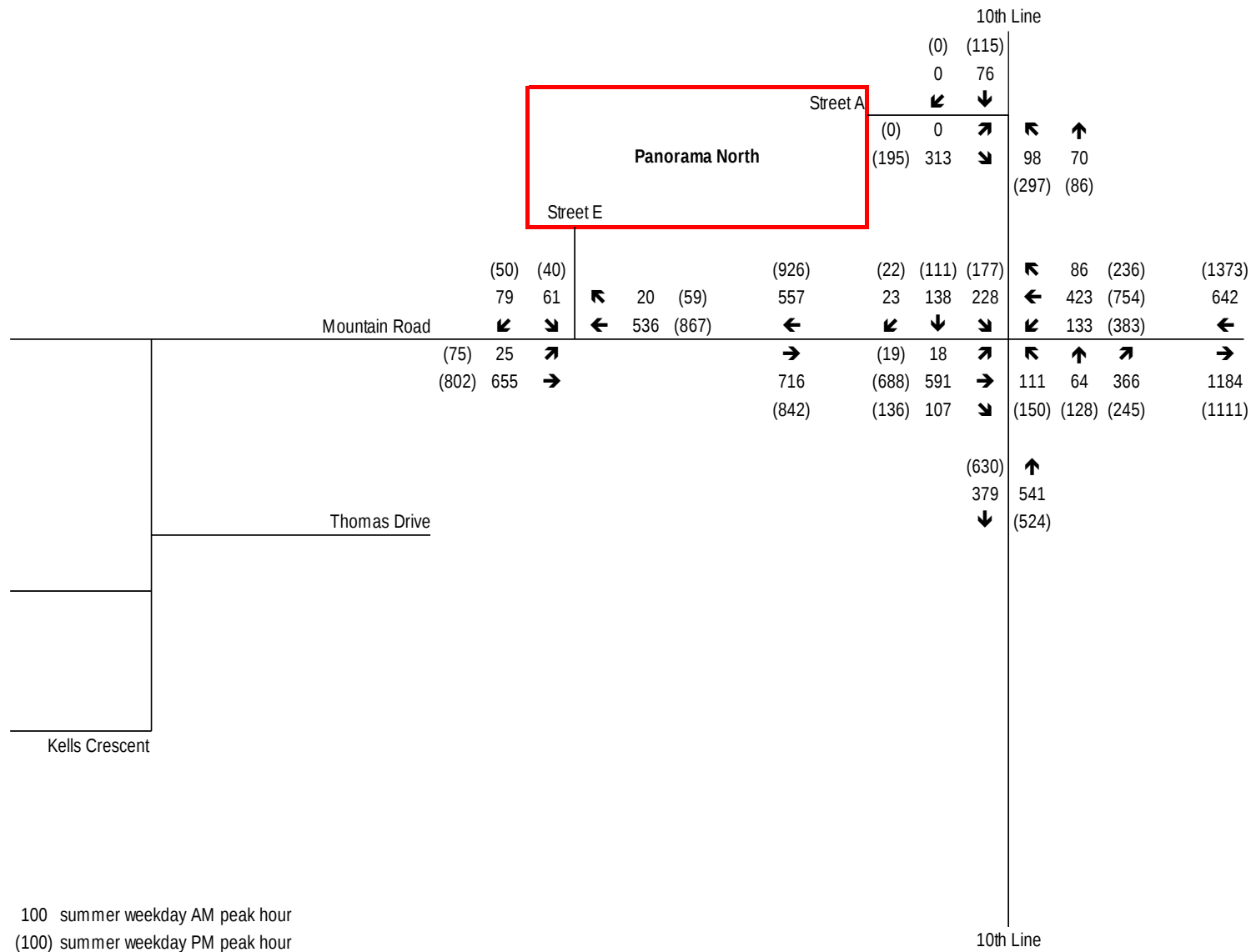
For a right turn lane, MTO criteria indicate that such should be considered when the turning volume exceeds 60 vehicles per hour and/or has the potential to impede through traffic. The westbound right turn volume on Mountain Road at Street E is projected to be in the order of 20 vehicles in the AM peak hour and 59 vehicles in the PM peak hour. In consideration of this, and given the significant through volumes on Mountain Road (approximately 840 vehicles at the time of full build-out in 2035), a right turn lane is recommended. However, given the reduced posted speed on Mountain Road, a 60 metre right turn taper is considered sufficient as opposed to a full turn lane (which is consistent with most other subdivision entrances in the Town). This turn lane should be constructed in conjunction with the site access which it serves.

The Street A access on Tenth Line is not expected to experience any significant southbound right turn traffic into the site (given the dead end nature of Tenth Line to the north, any right turning traffic will be nominal and infrequent). Thus, a right turn lane is not required on Tenth Line at Street A.









Left Turn Lane

As per the MTO left turn lane guidelines, the warrants are based on the design speed, advancing and opposing volumes (i.e. total volumes in each direction) and volume of left turns. In consideration of the 60 km/h posted speed limit on Mountain Road, a design speed of 70 km/h has been assumed, with the respective left turn warrants provided in Appendix G. Warrants were reviewed for the 2028 horizon (50% build-out) and the 2045 horizon (critical horizon where volumes are greatest). Based on the projected volumes, an eastbound left is warranted under both horizons (and thus would also be required for all the interim horizons) As per the completed warrants, a 35 metre storage length is required to serve all future horizons. Furthermore, as per MTO standards, the left turn lane would include a 40 metre parallel lane and a 115 metre taper (all in accordance with a 70 km/h design speed). A runout length of 145 metres (30 metre parallel + 115 metre taper) would also be required on the east side of the intersection to maintain lane balance. As previously noted, there is 205 metres between Kells Crescent and the proposed Street E intersection (measured centre to centre). Considering the respective left turn lane dimensions (the westbound left at Kells Crescent includes a 15 metre storage length, a 40 metre parallel lane and a 115 metre taper), the tapers will overlap and thus a continuous turn lane is recommended between Kells Crescent and Street E.

With respect to the Street A access on Tenth Line, a northbound left turn lane on Tenth Line is not considered necessary. While 100 to 300 northbound left turns are projected during the peak hours, the volumes on Tenth Line are not such that would require a left turn lane - 75 to 115 vehicles travelling south and 70 to 85 vehicles travelling north (which translates to 1 to 2 vehicles per minute per direction). While a northbound slip-by lane (to consist of 50 metre tapers on either side of the intersection and a 45 metre parallel lane through the intersection) could be constructed to alleviate delays to northbound travel, the existing Tenth Line right-of-way and cross-section does not readily permit such.

5.2.2 Intersection Operations

The operations of the key intersections, including the site access points (both of which are assumed as stop controlled with 1 entry lane and 1 exit lane), were investigated considering the 2028, 2035, 2040 and 2045 total traffic volumes.

As previously noted, an eastbound left turn lane and a westbound right turn taper on Mountain Road at Street E has been included in the assessment. The exclusive left turn lanes implemented on all approaches at the intersection of Mountain Road with Tenth Line, as recommended under 2028 future background conditions, have also been maintained.

Total Traffic Operations - 2028

The results of the operational review for the 2028 total operations scenario are provided in Table 12, whereas detailed worksheets are provided in Appendix H.

Table 12: Intersection Operations - 2028 Total Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	13	B	0.70	36	D	0.92
	WB		10	B	0.48	26	C	0.96
	NB		18	B	0.54	30	C	0.58
	SB		31	C	0.78	51	D	0.86
	overall	signal	15	B	0.73	32	C	0.90
Street A & Tenth Line	EB	stop	9	A	0.12	9	A	0.09
Street E & Mountain Road	SB	stop	26	D	0.39	59	F	0.54

As noted, the intersections of Mountain Road and Street A with Tenth Line will provide acceptable overall operations and levels of service with reasonable delays given the lane configurations employed. The intersection of Street E with Mountain Road will experience poor operating conditions (LOS F) with delays of 59 seconds during the PM peak hour. While traffic signals would address the operating conditions, such are not considered necessary given that the delays are only experienced during the PM peak hour and, despite the poor operating conditions, the intersection will continue to operate below capacity. It is noted that the intersection volumes do not warrant the implementation of traffic signals (completed traffic signal warrants are provided in Appendix L). Furthermore, motorists destined to the built-up area of Collingwood (via Mountain Road or Tenth Line) have the option to exit the development via the Street A intersection with Tenth Line to take advantage of the traffic signals at Mountain Road and Tenth Line. In this regard, and given that the delay at the Street E intersection is not unbearable, no improvements are considered necessary.

Total Traffic Operations - 2035

The 2035 operational results are provided in Table 14, whereas detailed worksheets are provided in Appendix I. The intersection and control applied under 2028 total conditions has been maintained.

Similar to the 2028 total conditions, the intersection of Street E with Mountain Road will experience poor operations (LOS F) with delays of 86 seconds. As previously discussed, no improvements are considered necessary to address the operations at Street E and Mountain Road (outbound motorists can use Street A to exit the development).

Table 13: Intersection Operations - 2035 Total Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	26	C	0.80	86	F	1.09
	WB		29	C	0.87	69	E	1.20
	NB		21	C	0.48	28	C	0.60
	SB		54	D	0.98	70	E	1.02
	overall	signal	31	C	0.92	67	E	1.08
Street A & Tenth Line	EB	stop	11	B	0.34	10	A	0.22
Street E & Mountain Road	SB	stop	30	D	0.51	86	F	0.73

The intersection of Mountain Road with Tenth Line will begin to experience capacity issues given the 2035 total volumes, with several movements and the overall intersection operating above capacity. The eastbound movement will experience poor operations (LOS F). In consideration of the future road network improvements/needs identified in the *Town of Collingwood Transportation Study* and *Tenth Line and Mountain Road Class EA* (namely the widening of Mountain Road to a 5-lane cross-section between Tenth Line and Cambridge Street), the following intersection improvements have been considered:

- re-configure the east approach to include an exclusive right turn lane, an exclusive through lane and an exclusive left turn lane; and
- re-configure the west approach to include a through/right turn lane, an exclusive through lane and an exclusive left turn lane.

The above improvements are consistent with the proposed 5-laning of Mountain Road to the east of Tenth Line, which would result in two receiving lanes on the east approach (thus accommodating the proposed eastbound through/right turn lane on the west approach). While it is acknowledged that these improvements would require the 5-laning of Mountain Road to the east of Tenth Line, it is also noted that should the 5-laning of Mountain Road not be required due to lower than projected volumes, it is likely that the proposed intersection improvements would also not be required. The recommended improvements are contingent on full build-out of several developments within the study area.

The intersection operations were again reviewed to consider the noted improvements. The results are summarized in Table 15, whereas detailed worksheets are provided in Appendix I. The traffic signals have been optimized.

Table 14: Intersection Operations - 2035 Total Conditions + Improvements

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	12	B	0.53	23	C	0.76
	WB		15	B	0.61	21	C	0.90
	NB		13	B	0.62	19	B	0.55
	SB		25	C	0.86	43	D	0.92
	overall	signal	16	B	0.74	23	C	0.90

As indicated, the intersection will provide good overall operations in 2035 under total conditions given the proposed improvements.

Total Traffic Operations - 2040 & 2045

The operational assessment results for the 2040 and 2045 horizon years are presented in Table 16 and Table 17, respectively. The corresponding worksheets provided in Appendix J and Appendix K.

Table 15: Intersection Operations - 2040 Total Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	13	B	0.53	27	C	0.81
	WB		16	B	0.61	21	C	0.89
	NB		13	B	0.62	19	B	0.55
	SB		28	C	0.88	46	D	0.94
	overall	signal	17	B	0.74	25	C	0.92
Street A & Tenth Line	EB	stop	11	B	0.34	10	A	0.22
Street E & Mountain Road	SB	stop	31	D	0.52	95	F	0.77

Table 16: Intersection Operations - 2045 Total Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	signal	13	B	0.54	28	C	0.83
	WB		17	B	0.63	22	C	0.90
	NB		14	B	0.62	19	B	0.55
	SB		29	C	0.89	46	D	0.94
	overall	signal	17	B	0.76	26	C	0.93
Street A & Tenth Line	EB	stop	11	B	0.34	10	A	0.22
Street E & Mountain Road	SB	stop	32	D	0.53	104	F	0.80

Notwithstanding the intersection of Street E with Mountain Road, the remaining study area intersections will provide good operating conditions (LOS C or better) with average delay through the 2045 horizon. No further improvements are considered necessary to accommodate the future total conditions.

With respect to the intersection of Street E with Mountain Road, the operating conditions, while poor, are not such that would require additional improvements. As previously noted, should conditions deteriorate during the PM peak hour, motorists have the option of accessing Tenth Line via Street A to avoid the delay exiting Street E at Mountain Road.

5.2.3 Mountain Road & Tenth Line - Roundabout

As previously noted, the *Tenth Line and Mountain Road Class EA* is considering roundabout control at the intersection of Mountain Road with Tenth Line. While the preferred design option has not been published, additional consideration has been given to the implementation of a two-lane roundabout at the subject intersection. The assessment has been conducted using Synchro software (v10) and considers a two-lane roundabout with two entry and receiving lanes on each approach. The assessment has been limited to the 2045 total conditions, considered the critical horizon. A summary of the assessment is provided in Table 18, whereas detailed worksheets are included in Appendix K.

As indicated, a two-lane roundabout will provide good overall operations through 2045 given the projected total volumes. Should the *Tenth Line and Mountain Road Class EA* identify a roundabout as the preferred option, it is anticipated that such would be implemented prior to 2045 (i.e. by 2028 to address the background conditions).

Table 17: Roundabout Operations - 2045 Total Conditions

Intersection and Movement		Control	Weekday AM Peak Hour			Weekday PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
Mountain Road & Tenth Line	EB	roundabout	12	B	0.53	20	C	0.70
	WB		8	A	0.37	25	C	0.87
	NB		17	C	0.65	15	C	0.51
	NB		10	A	0.37	17	C	0.48

5.2.4 Link Operations

The link operations were again reviewed for Mountain Road under each horizon, with the associated assessment provided in Table 19. The results are comparable to the future background assessment and suggest that a widening of Mountain Road east of Tenth Line should be considered by 2028 in response to the increased demands. It is noted that the widening is required to accommodate traffic demands associated with several developments both within the study area and beyond (i.e. ongoing development in the Town of the Blue Mountains). To the west of Tenth Line, Mountain Road will operate at or slightly above capacity in the westbound direction, suggesting additional capacity may be required beyond 2045 as continued development occurs.

Table 18: Link Operations - Total Operations

Road Section & Lanes per Direction			Capacity ¹		Traffic Volumes		Volume to Capacity	
			EB	WB	EB	WB	EB	WB
Mountain Road 2028	W of Tenth Line	1	900	900	774	868	0.86	0.96
	E of Tenth Line	1	900	900	963	1174	1.07	1.30
Mountain Road 2035	W of Tenth Line	1	900	900	810	897	0.90	1.00
	E of Tenth Line	1	900	900	1071	1331	1.19	1.48
Mountain Road 2040	W of Tenth Line	1	900	900	827	912	0.92	1.01
	E of Tenth Line	1	900	900	1094	1358	1.22	1.51
Mountain Road 2045	W of Tenth Line	1	900	900	842	926	0.94	1.03
	E of Tenth Line	1	900	900	1111	1374	1.23	1.53

5.3 Active Transportation

The site will include a comprehensive sidewalk network which will connect to external active transportation facilities. The site is in close proximity to the multi-use trails on Mountain Road and Tenth Line, both of which connect to the wider trail network serving the area – including the Tenth Line Trail and Georgian Trail to the north of the site, and the Georgian Meadows Trail to the east. As per the site plan, a future sidewalk/trail is planned along the north side of Mountain Road across the frontage of the site. An internal trail is also proposed with the potential for future trail links to the north of the site. Given the residential nature of the site, exclusive bicycle lanes are not considered necessary on the internal road network.

5.4 Sight Line Analysis

Based on MTO geometric design standards, the minimum stopping sight distance for a design speed of 70 km/h (posted 60 km/h + 10 km/h) is 110 metres, whereas for a design speed of 60 km/h (posted 50 km/h speed limit + 10 km/h) the minimum stopping sight distance is 85 metres. The minimum stopping sight distance provides sufficient distance for an approaching motorist to observe a stationary hazard in the road and bring their vehicle to a complete stop prior to the hazard.

The available sight lines along Tenth Line (at Street A) and Mountain Road (at Street E) are provided in Table 20.

Table 19: Sight Distances

Access	Design Speed	Minimum Stopping Sight Distance	Available Sight Lines to/from	
			N or E	S or W
Street A	60 km/h (Tenth Line)	85 m	>200 m	185 m (to Mountain Rd)
Street E	70 km/h (Mountain Road)	110 m	>200 m	>200 m

As indicated, the sight lines along Mountain Road and Tenth Line at the proposed access points satisfy MTO minimum stopping distance requirements for the respective design speeds. As such, no improvements are required to address the available sight lines.

6 Summary

This study has addressed the transportation impacts associated with the proposed Panorama North residential development located on the north side of Mountain Road, west of Tenth Line in the Town of Collingwood. Upon completion, the 929 residential unit development is expected to generate 597 trips during the AM peak hour and 717 trips during the PM peak hour.

In addressing the study area operations, the intersection of Mountain Road with Tenth Line, in addition to the new site access points (Street A on Tenth Line and Street E on Mountain Road) were reviewed. Under the future background conditions (without Panorama North), which considered area development including Linksvew, Consar, Windfall Medium Density, Windfall, Second Nature, Nederand, Panorama (formerly Mair Mills Village) and development at 100, 120, 180 and 185 Mountain Road, the following improvements are recommended:

- provide exclusive left turn lanes on all approaches at the intersection of Mountain Road with Tenth Line and revise the signal timing plans to include an advanced green phase during the PM peak hour for the westbound left turn movement to address 2028 background conditions; and
- widen Mountain Road to provide 2 lanes per direction from Tenth Line to Cambridge Street to address conditions in 2028 (dependant on rate of surrounding development).

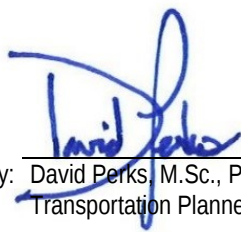
In considering the development of the Panorama North site, with full build-out assumed by 2035, the following recommendations are provided:

- provide a westbound right turn taper and an eastbound left turn lane on Mountain Road at Street E to serve the development;
- re-configure the intersection of Mountain Road with Tenth Line to include an exclusive right turn lane, exclusive through lane and exclusive left turn lane on the east approach, and a through/right turn lane, exclusive through lane and exclusive left turn lane on the west approach to accommodate 2035 total conditions; and
- widen Mountain Road to provide 2 lanes per direction from Tenth Line to Cambridge Street to address conditions after 2028 (as warranted by background conditions).

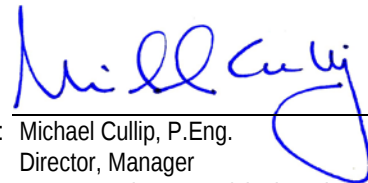
In considering the ongoing *Tenth Line and Mountain Road Class EA* and the potential implementation of a roundabout at the intersection of Mountain Road with Tenth Line as the preferred option (as opposed to traffic signals and turn lanes), the intersection operations were reviewed to consider a two-lane roundabout. Based on the projected volumes, a two-lane roundabout will provide good operating conditions through the 2045 horizon year. Should the *Tenth Line and Mountain Road Class EA* identify a roundabout as the preferred option, it is anticipated that such would be implemented prior to 2045 (i.e. by 2028 to address the intersection operations under background conditions).

While improvements have been identified to ensure acceptable operations of Mountain Road and Tenth Line over the next 20 years, these are required due to the cumulative growth in the area, including that of Panorama North, and are not directly attributed solely to the Panorama North development (other than the turn lanes required at Street E on Mountain Road, which directly serve the development). In this respect, the noted improvements should be implemented by the Town through their development charges program.

The available sight distances at the site access points on Tenth Line and Mountain Road were also reviewed and considered to be appropriate given the speed limit and design speed of the respective roads.



Authorized by: David Perks, M.Sc., PTP
Transportation Planner, Project Manager



Reviewed by: Michael Cullip, P.Eng.
Director, Manager
Transportation & Municipal Engineering

© C.C. Tatham & Associates Ltd

The information contained in this document is solely for the use of the Client identified on the cover sheet for the purpose for which it has been prepared and C.C. Tatham & Associates Ltd. undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

This document may not be used for any purpose other than that provided in the contract between the Owner/Client and the Engineer nor may any section or element of this document be removed, reproduced, electronically stored or transmitted in any form without the express written consent of C.C. Tatham & Associates Ltd.

Appendix A:
Traffic Operations - 2018

HCM Signalized Intersection Capacity Analysis

1: Tenth Line & Mountain Road

2018 Existing
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	13	315	29	53	311	23	38	25	90	34	22	10
Future Volume (vph)	13	315	29	53	311	23	38	25	90	34	22	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.99			0.92			0.98	
Flt Protected		1.00			0.99			0.99			0.97	
Satd. Flow (prot)		1859			1856			1712			1797	
Flt Permitted		0.98			0.91			0.89			0.81	
Satd. Flow (perm)		1825			1694			1548			1488	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	14	332	31	56	327	24	40	26	95	36	23	11
RTOR Reduction (vph)	0	6	0	0	4	0	0	80	0	0	9	0
Lane Group Flow (vph)	0	371	0	0	403	0	0	81	0	0	61	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		21.3			21.3			6.4			6.4	
Effective Green, g (s)		21.3			21.3			6.4			6.4	
Actuated g/C Ratio		0.54			0.54			0.16			0.16	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		979			908			249			239	
v/s Ratio Prot												
v/s Ratio Perm		0.20			0.24			0.05			0.04	
v/c Ratio		0.38			0.44			0.33			0.25	
Uniform Delay, d1		5.4			5.6			14.7			14.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.1			0.3			0.8			0.6	
Delay (s)		6.5			5.9			15.5			15.1	
Level of Service		A			A			B			B	
Approach Delay (s)		6.5			5.9			15.5			15.1	
Approach LOS		A			A			B			B	
Intersection Summary												
HCM 2000 Control Delay		8.3			HCM 2000 Level of Service			A				
HCM 2000 Volume to Capacity ratio		0.42										
Actuated Cycle Length (s)		39.7			Sum of lost time (s)			12.0				
Intersection Capacity Utilization		60.3%			ICU Level of Service			B				
Analysis Period (min)		15										

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

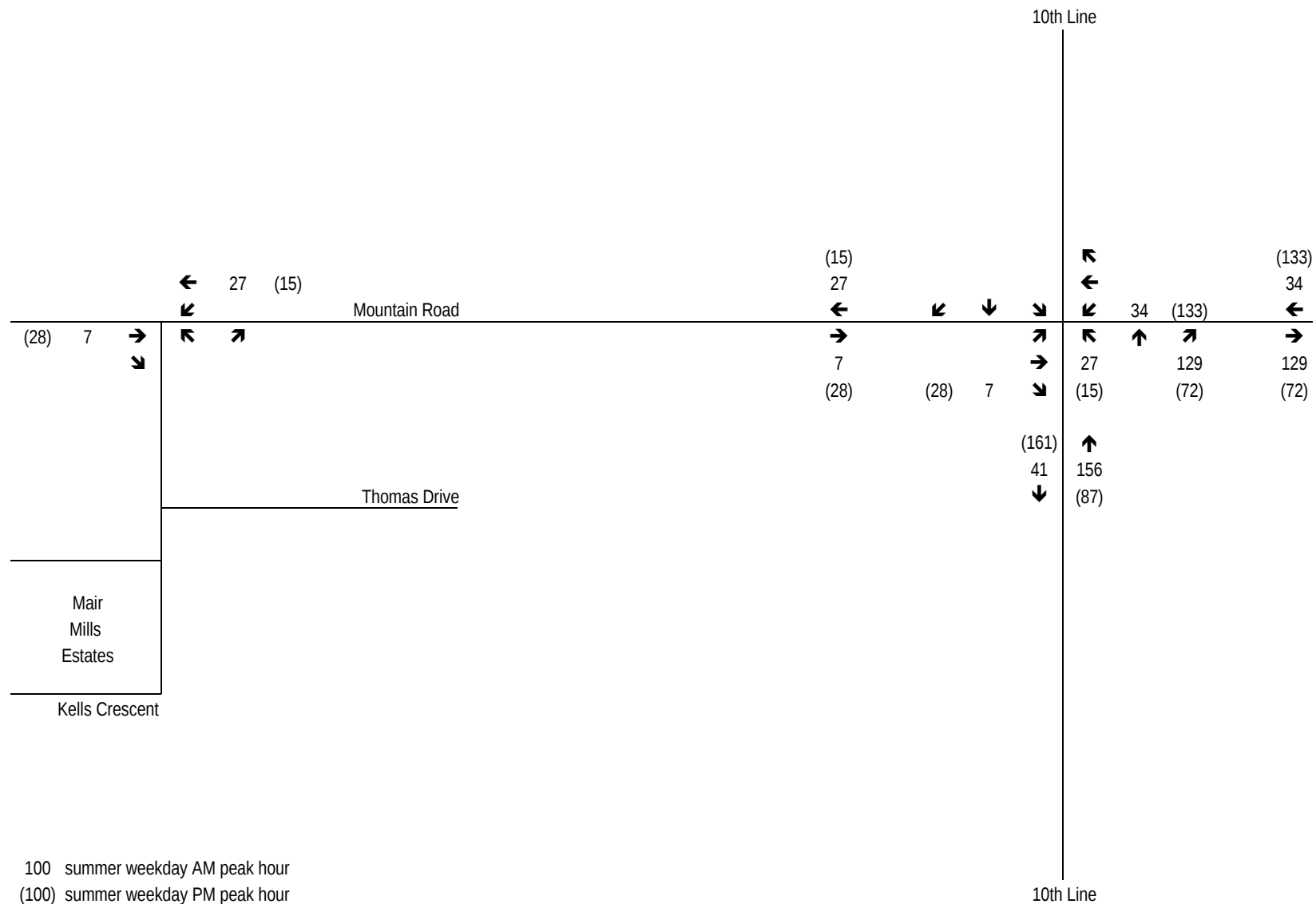
1: Tenth Line & Mountain Road

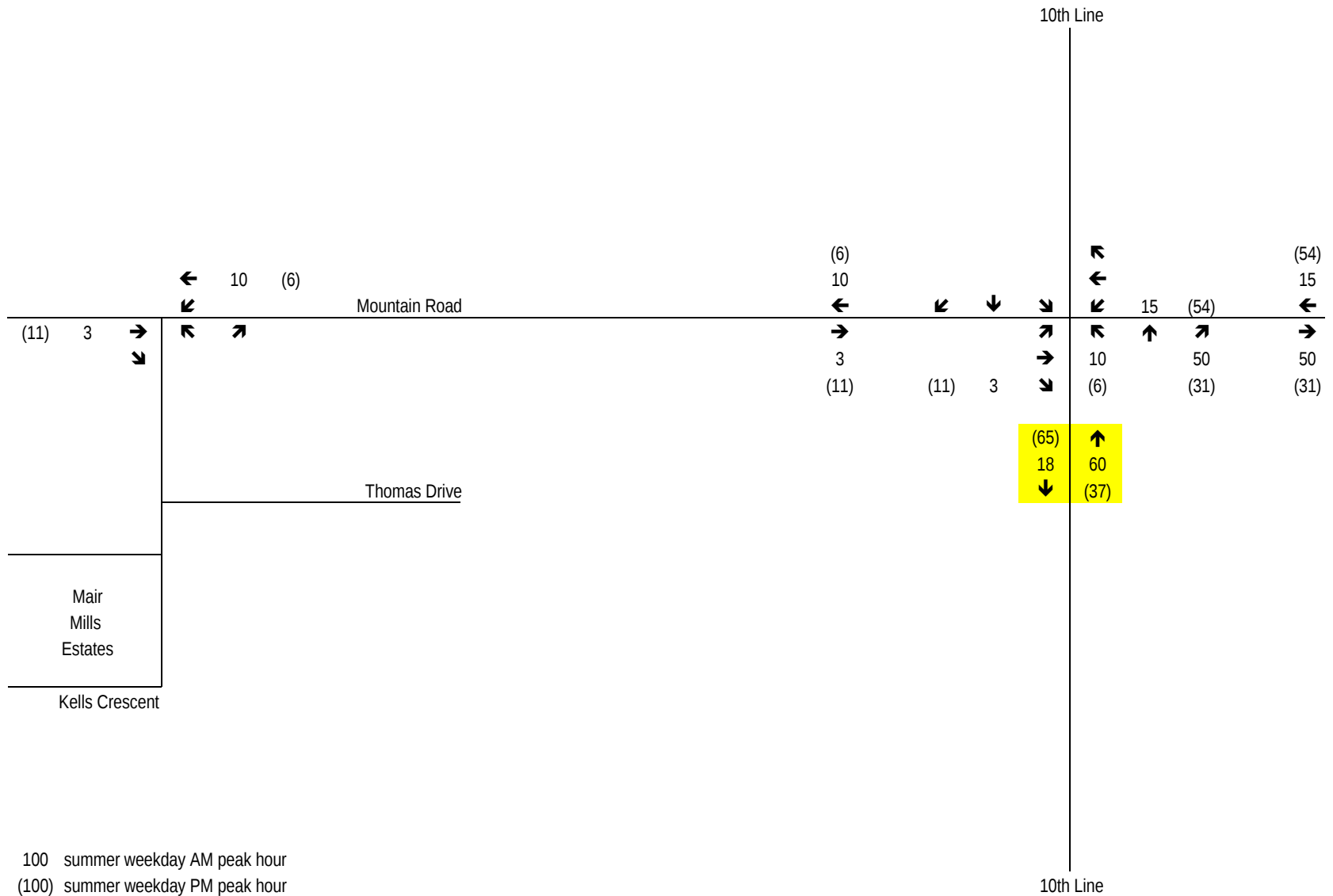
2018 Existing
PM Peak Hour

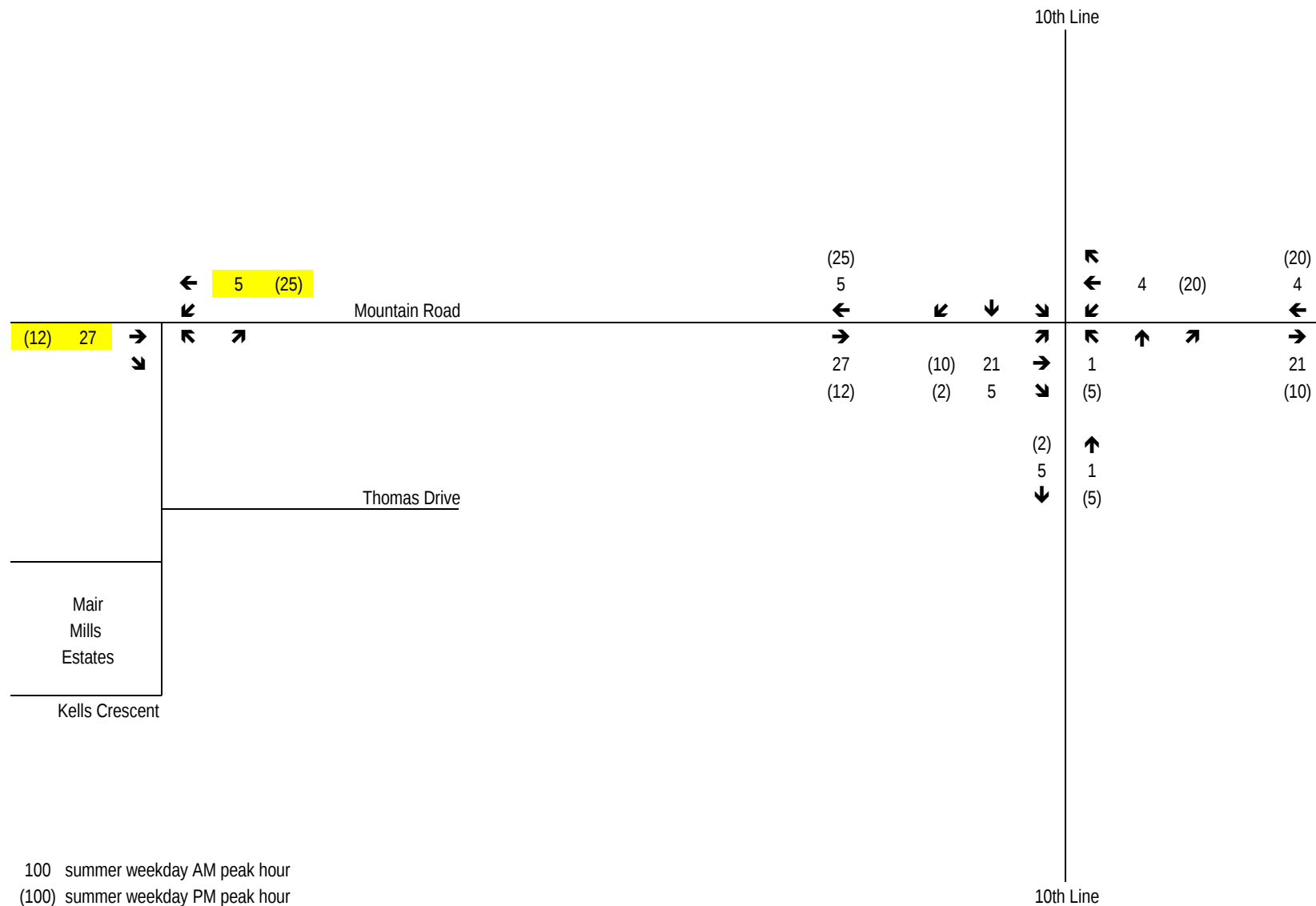
												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	7	489	40	94	447	50	51	18	83	52	35	13
Future Volume (vph)	7	489	40	94	447	50	51	18	83	52	35	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.99			0.99			0.93			0.98	
Flt Protected		1.00			0.99			0.98			0.97	
Satd. Flow (prot)		1863			1847			1716			1803	
Flt Permitted		0.99			0.84			0.85			0.81	
Satd. Flow (perm)		1851			1568			1490			1495	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	7	515	42	99	471	53	54	19	87	55	37	14
RTOR Reduction (vph)	0	4	0	0	4	0	0	75	0	0	10	0
Lane Group Flow (vph)	0	560	0	0	619	0	0	85	0	0	96	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		35.5			35.5			7.8			7.8	
Effective Green, g (s)		35.5			35.5			7.8			7.8	
Actuated g/C Ratio		0.64			0.64			0.14			0.14	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		1188			1006			210			210	
v/s Ratio Prot												
v/s Ratio Perm		0.30			c0.39			0.06			c0.06	
v/c Ratio		0.47			0.62			0.41			0.46	
Uniform Delay, d1		5.1			5.9			21.6			21.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.3			1.1			1.3			1.6	
Delay (s)		6.4			7.0			22.9			23.4	
Level of Service		A			A			C			C	
Approach Delay (s)		6.4			7.0			22.9			23.4	
Approach LOS		A			A			C			C	
Intersection Summary												
HCM 2000 Control Delay		9.7			HCM 2000 Level of Service			A				
HCM 2000 Volume to Capacity ratio		0.59										
Actuated Cycle Length (s)		55.3			Sum of lost time (s)			12.0				
Intersection Capacity Utilization		85.1%			ICU Level of Service			E				
Analysis Period (min)		15										

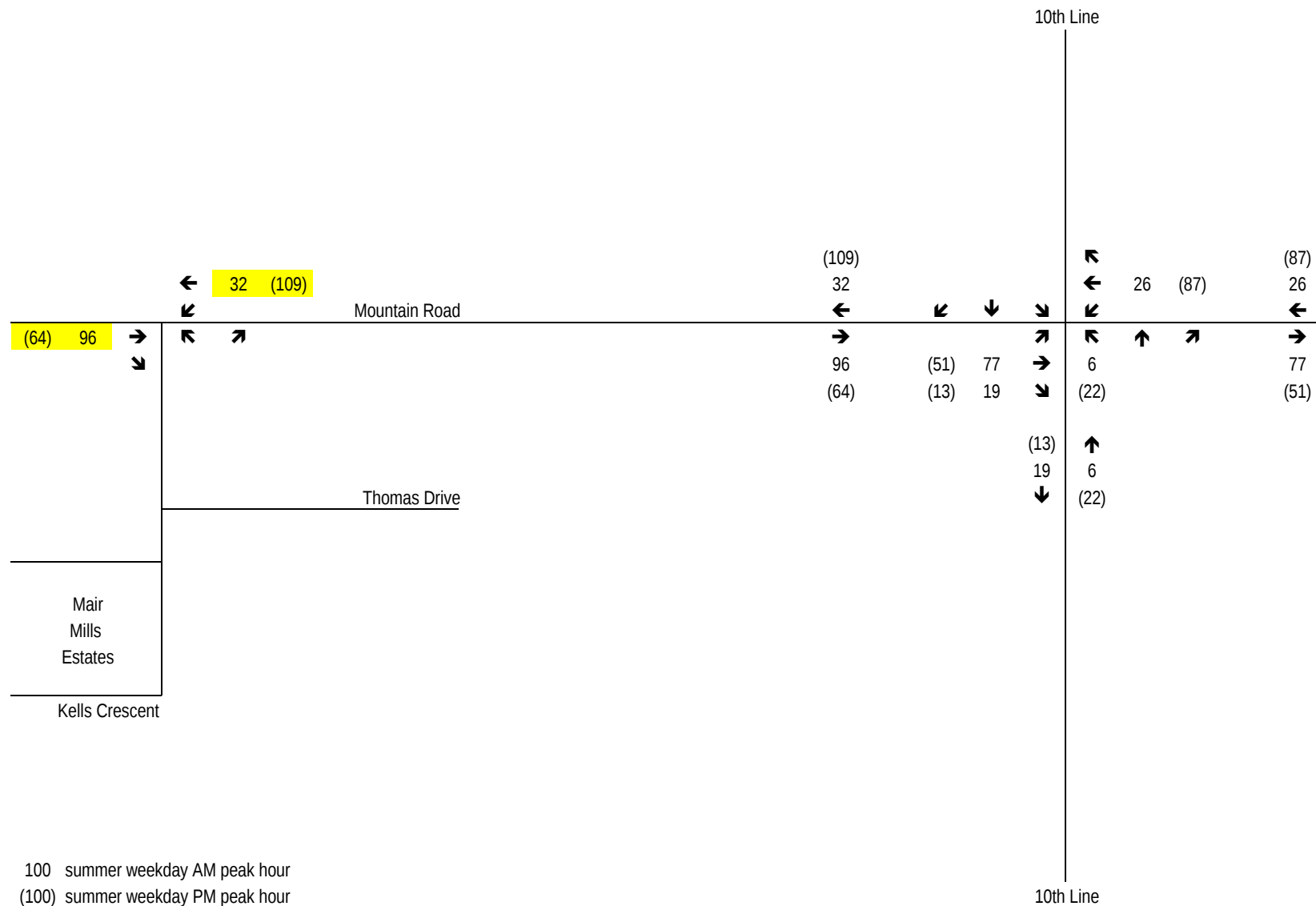
c Critical Lane Group

Appendix B:
Background Development Traffic Volumes

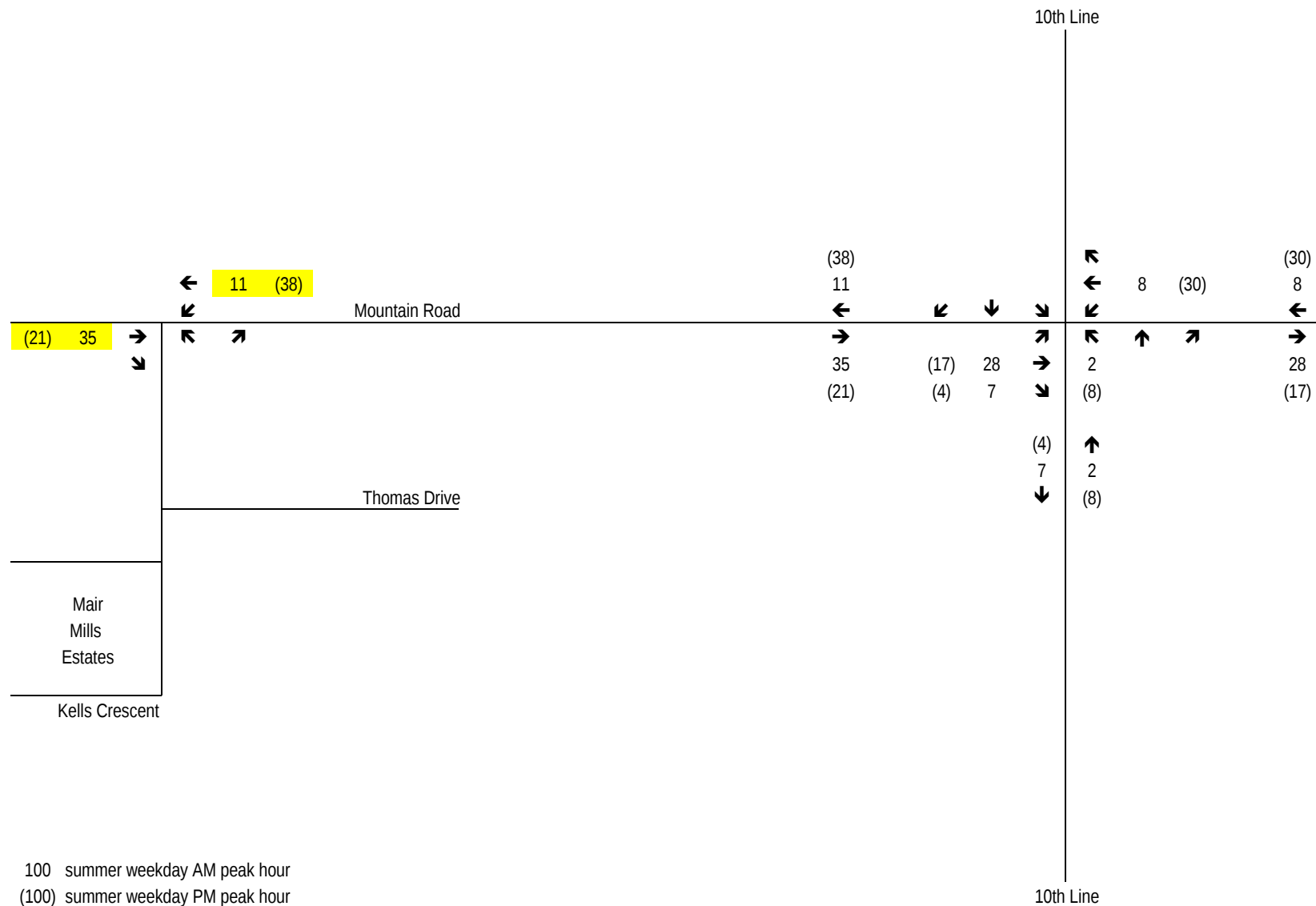


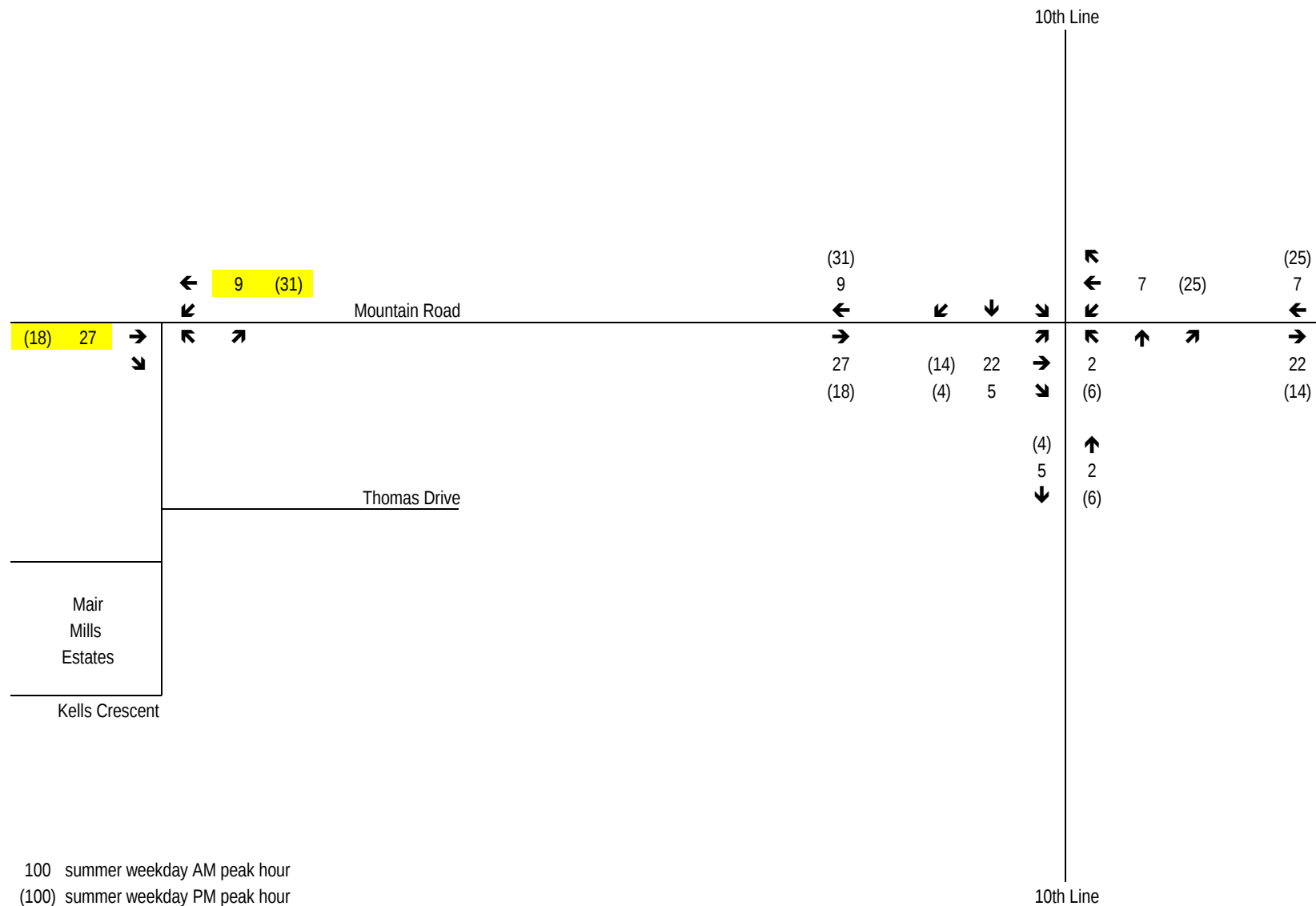


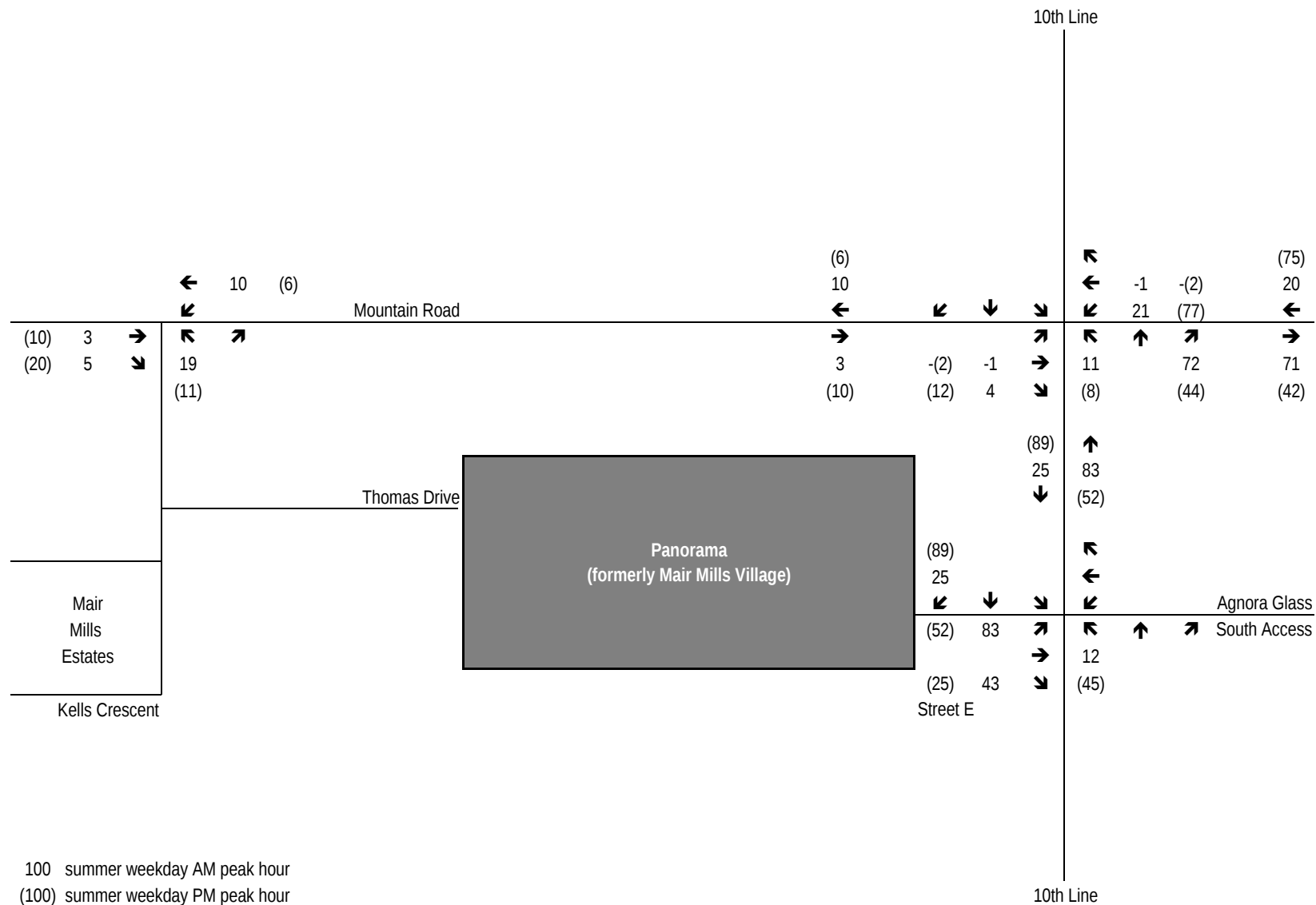




100 summer weekday AM peak hour
 (100) summer weekday PM peak hour







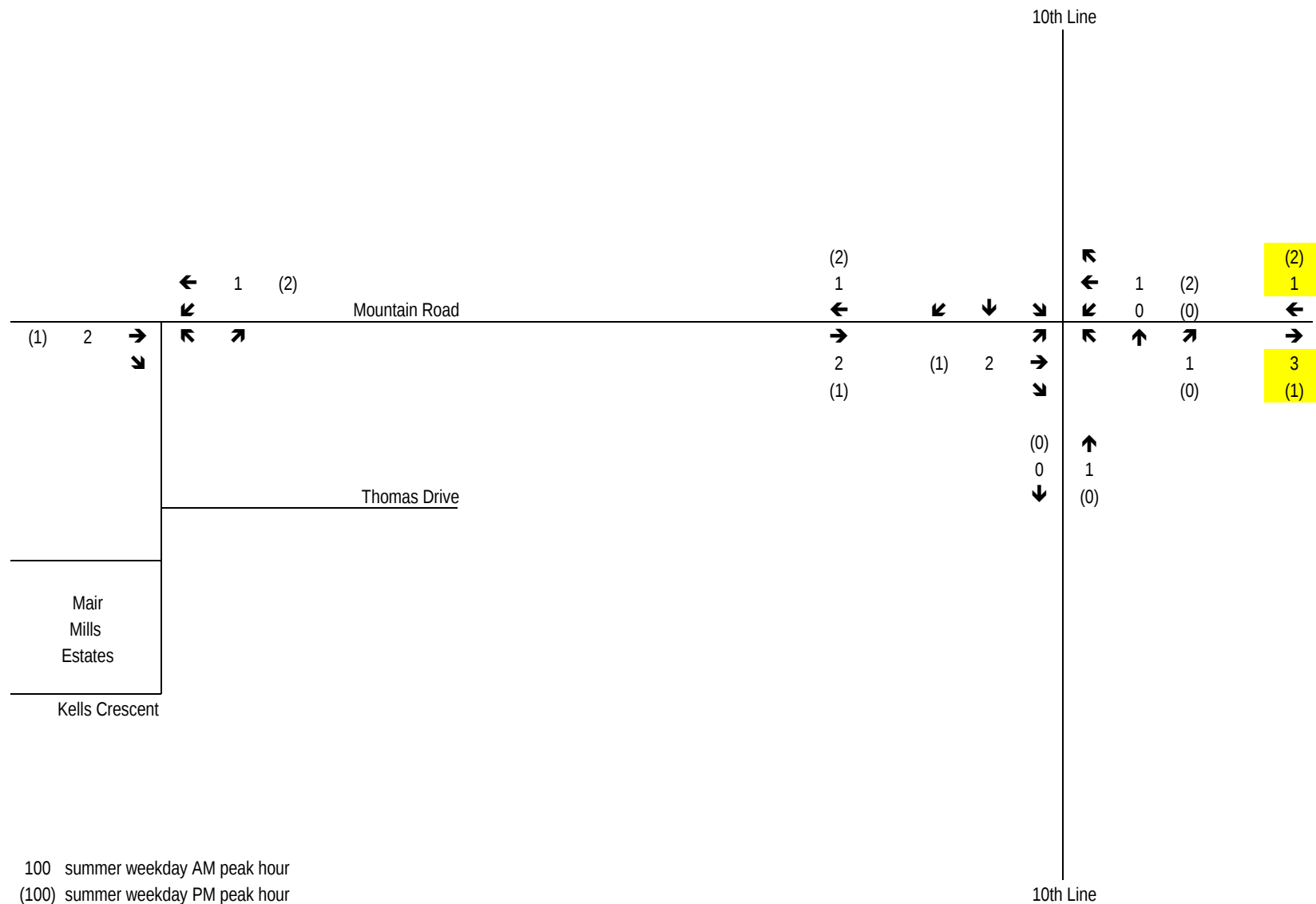
C.C. Tatham & Associates Ltd.
Consulting Engineers

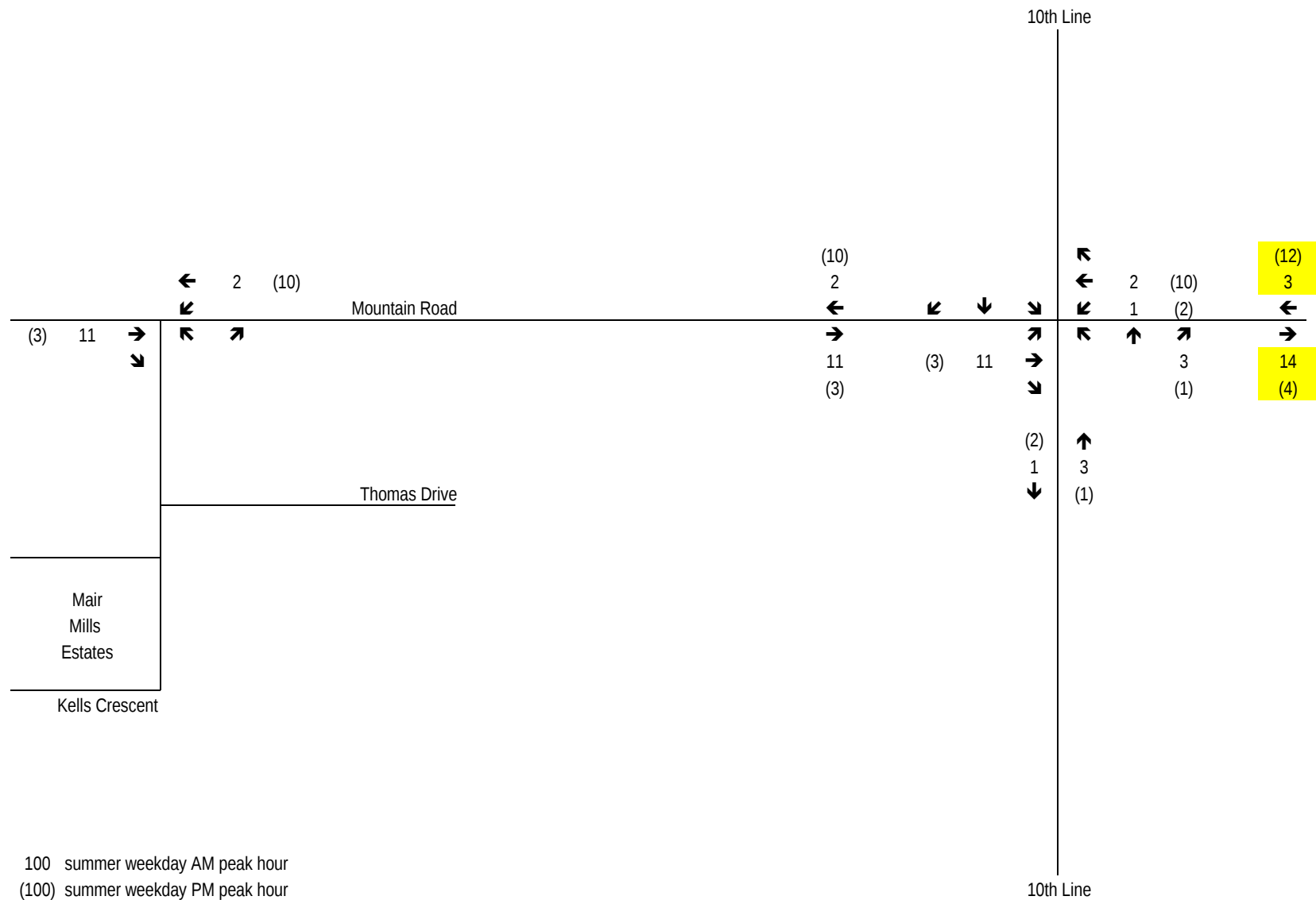
Panorama North

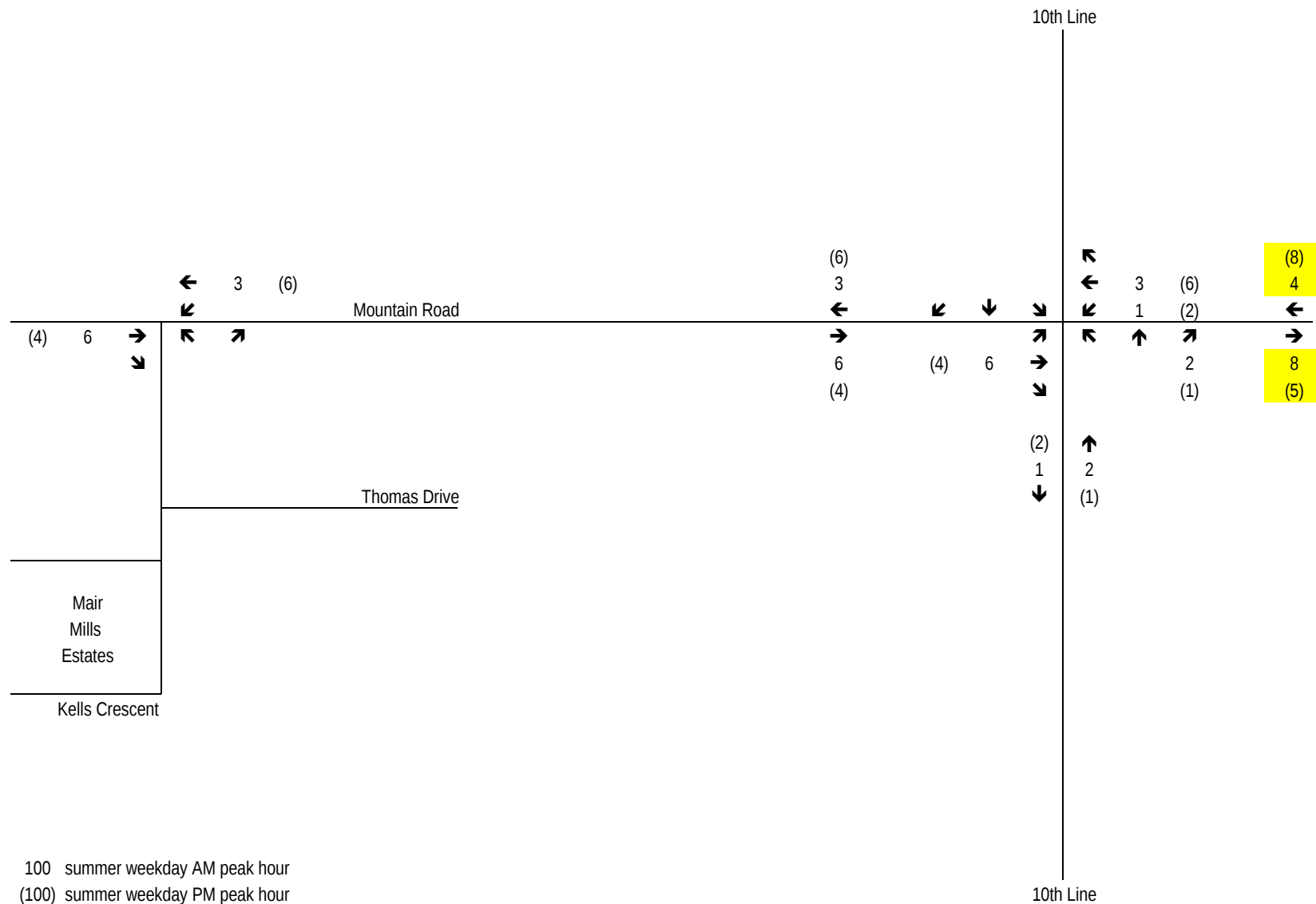
Panorama (formerly Mair Mills Village)

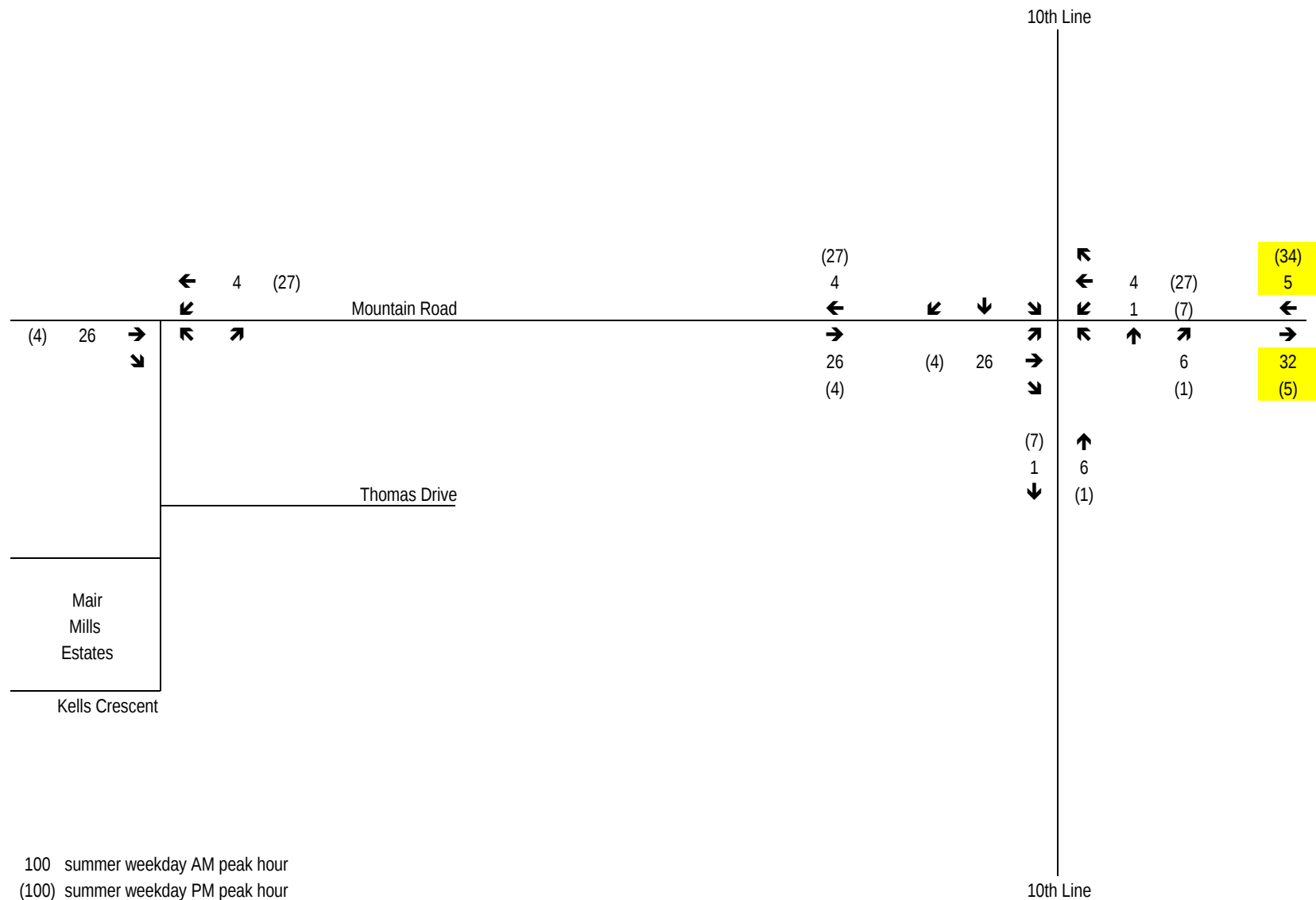
Appendix

B7









Appendix C:

Traffic Operations - 2028 Background

HCM Signalized Intersection Capacity Analysis

1: Tenth Line & Mountain Road

2028 Background

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	523	79	119	381	24	92	26	323	36	23	11
Future Volume (vph)	14	523	79	119	381	24	92	26	323	36	23	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.98			0.99			0.90			0.98	
Flt Protected		1.00			0.99			0.99			0.97	
Satd. Flow (prot)		1849			1851			1680			1796	
Flt Permitted		0.98			0.76			0.91			0.54	
Satd. Flow (perm)		1823			1421			1540			990	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	15	551	83	125	401	25	97	27	340	38	24	12
RTOR Reduction (vph)	0	8	0	0	3	0	0	171	0	0	9	0
Lane Group Flow (vph)	0	641	0	0	548	0	0	293	0	0	65	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		32.1			32.1			13.6			13.6	
Effective Green, g (s)		32.1			32.1			13.6			13.6	
Actuated g/C Ratio		0.56			0.56			0.24			0.24	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		1014			790			362			233	
v/s Ratio Prot												
v/s Ratio Perm		0.35			0.39			0.19			0.07	
v/c Ratio		0.63			0.69			0.81			0.28	
Uniform Delay, d1		8.8			9.3			20.8			18.0	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		3.0			2.7			12.5			0.7	
Delay (s)		11.7			11.9			33.3			18.7	
Level of Service		B			B			C			B	
Approach Delay (s)		11.7			11.9			33.3			18.7	
Approach LOS		B			B			C			B	
Intersection Summary												
HCM 2000 Control Delay			17.9				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			57.7				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			103.5%				ICU Level of Service			G		
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

1: Tenth Line & Mountain Road

2028 Background
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	7	617	109	339	676	53	119	19	218	55	37	14
Future Volume (vph)	7	617	109	339	676	53	119	19	218	55	37	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frt		0.98			0.99			0.92			0.98	
Flt Protected		1.00			0.98			0.98			0.97	
Satd. Flow (prot)		1845			1842			1699			1803	
Flt Permitted		0.99			0.60			0.84			0.50	
Satd. Flow (perm)		1826			1122			1445			918	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	7	649	115	357	712	56	125	20	229	58	39	15
RTOR Reduction (vph)	0	5	0	0	2	0	0	44	0	0	4	0
Lane Group Flow (vph)	0	766	0	0	1123	0	0	330	0	0	108	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)		96.0			96.0			22.0			22.0	
Effective Green, g (s)		96.0			96.0			22.0			22.0	
Actuated g/C Ratio		0.74			0.74			0.17			0.17	
Clearance Time (s)		6.0			6.0			6.0			6.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		1348			828			244			155	
v/s Ratio Prot												
v/s Ratio Perm		0.42			c1.00			c0.23			0.12	
v/c Ratio		0.57			1.36			1.35			0.70	
Uniform Delay, d1		7.7			17.0			54.0			50.8	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.7			168.4			183.1			12.7	
Delay (s)		9.4			185.4			237.1			63.6	
Level of Service		A			F			F			E	
Approach Delay (s)		9.4			185.4			237.1			63.6	
Approach LOS		A			F			F			E	
Intersection Summary												
HCM 2000 Control Delay		130.8										
HCM 2000 Volume to Capacity ratio		1.35										
Actuated Cycle Length (s)		130.0										
Intersection Capacity Utilization		135.1%										
Analysis Period (min)		15										

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2028 Background (w/improvements)

1: Tenth Line & Mountain Road

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	7	617	109	339	676	53	119	19	218	55	37	14
Future Volume (vph)	7	617	109	339	676	53	119	19	218	55	37	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.86		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1841		1789	1863		1789	1624		1789	1805	
Flt Permitted	0.37	1.00		0.14	1.00		0.72	1.00		0.38	1.00	
Satd. Flow (perm)	705	1841		265	1863		1359	1624		725	1805	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	7	649	115	357	712	56	125	20	229	58	39	15
RTOR Reduction (vph)	0	7	0	0	3	0	0	193	0	0	13	0
Lane Group Flow (vph)	7	757	0	357	765	0	125	56	0	58	41	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	37.2	37.2		52.1	52.1		11.8	11.8		11.8	11.8	
Effective Green, g (s)	37.2	37.2		52.1	52.1		11.8	11.8		11.8	11.8	
Actuated g/C Ratio	0.49	0.49		0.69	0.69		0.16	0.16		0.16	0.16	
Clearance Time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	345	902		440	1278		211	252		112	280	
v/s Ratio Prot		c0.41		c0.14	0.41			0.03			0.02	
v/s Ratio Perm	0.01			0.42			c0.09			0.08		
v/c Ratio	0.02	0.84		0.81	0.60		0.59	0.22		0.52	0.15	
Uniform Delay, d1	10.0	16.8		16.1	6.3		29.8	28.0		29.4	27.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	9.2		10.9	2.1		4.4	0.4		4.0	0.2	
Delay (s)	10.1	26.0		27.0	8.4		34.2	28.5		33.4	27.9	
Level of Service	B	C		C	A		C	C		C	C	
Approach Delay (s)		25.8			14.3			30.4			30.8	
Approach LOS		C			B			C			C	
Intersection Summary												
HCM 2000 Control Delay			21.3			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.78									
Actuated Cycle Length (s)			75.9			Sum of lost time (s)			14.0			
Intersection Capacity Utilization			94.0%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2028 Background (w/improvements)

1: Tenth Line & Mountain Road

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	523	79	119	381	24	92	26	323	36	23	11
Future Volume (vph)	14	523	79	119	381	24	92	26	323	36	23	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.86		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1846		1789	1867		1789	1622		1789	1789	
Flt Permitted	0.50	1.00		0.33	1.00		0.73	1.00		0.40	1.00	
Satd. Flow (perm)	941	1846		629	1867		1382	1622		761	1789	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	15	551	83	125	401	25	97	27	340	38	24	12
RTOR Reduction (vph)	0	8	0	0	4	0	0	203	0	0	10	0
Lane Group Flow (vph)	15	626	0	125	422	0	97	164	0	38	26	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	27.7	27.7		27.7	27.7		9.9	9.9		9.9	9.9	
Effective Green, g (s)	27.7	27.7		27.7	27.7		9.9	9.9		9.9	9.9	
Actuated g/C Ratio	0.56	0.56		0.56	0.56		0.20	0.20		0.20	0.20	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	525	1030		351	1042		275	323		151	357	
v/s Ratio Prot		c0.34			0.23			c0.10			0.01	
v/s Ratio Perm	0.02			0.20			0.07			0.05		
v/c Ratio	0.03	0.61		0.36	0.41		0.35	0.51		0.25	0.07	
Uniform Delay, d1	4.9	7.3		6.0	6.2		17.1	17.7		16.7	16.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	2.7		2.8	1.2		0.8	1.3		0.9	0.1	
Delay (s)	5.0	10.0		8.8	7.4		17.9	19.0		17.6	16.2	
Level of Service	A	A		A	A		B	B		B	B	
Approach Delay (s)		9.9			7.7			18.7			16.9	
Approach LOS		A			A			B			B	
Intersection Summary												
HCM 2000 Control Delay			11.9			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			49.6			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			83.6%			ICU Level of Service			E			
Analysis Period (min)			15									

c Critical Lane Group

Appendix D:
Traffic Operations - 2035 Background

HCM Signalized Intersection Capacity Analysis

1: Tenth Line & Mountain Road

2035 Background
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	535	82	128	393	25	99	27	350	37	24	11
Future Volume (vph)	14	535	82	128	393	25	99	27	350	37	24	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.86		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1846		1789	1867		1789	1621		1789	1792	
Flt Permitted	0.49	1.00		0.33	1.00		0.73	1.00		0.37	1.00	
Satd. Flow (perm)	914	1846		615	1867		1381	1621		698	1792	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	15	563	86	135	414	26	104	28	368	39	25	12
RTOR Reduction (vph)	0	8	0	0	3	0	0	211	0	0	10	0
Lane Group Flow (vph)	15	641	0	135	437	0	104	185	0	39	27	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	31.2	31.2		31.2	31.2		10.8	10.8		10.8	10.8	
Effective Green, g (s)	31.2	31.2		31.2	31.2		10.8	10.8		10.8	10.8	
Actuated g/C Ratio	0.58	0.58		0.58	0.58		0.20	0.20		0.20	0.20	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	528	1066		355	1078		276	324		139	358	
v/s Ratio Prot		c0.35			0.23			c0.11			0.02	
v/s Ratio Perm	0.02			0.22			0.08			0.06		
v/c Ratio	0.03	0.60		0.38	0.41		0.38	0.57		0.28	0.08	
Uniform Delay, d1	4.9	7.4		6.2	6.3		18.7	19.5		18.3	17.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	2.5		3.1	1.1		0.9	2.4		1.1	0.1	
Delay (s)	5.0	9.9		9.2	7.4		19.6	21.9		19.4	17.6	
Level of Service	A	A		A	A		B	C		B	B	
Approach Delay (s)		9.8			7.8			21.4			18.6	
Approach LOS		A			A			C			B	
Intersection Summary												
HCM 2000 Control Delay			12.7			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			54.0			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			86.0%			ICU Level of Service			E			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

1: Tenth Line & Mountain Road

2035 Background
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	636	116	367	692	55	124	20	235	57	38	14
Future Volume (vph)	8	636	116	367	692	55	124	20	235	57	38	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.86		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1840		1789	1863		1789	1623		1789	1806	
Flt Permitted	0.37	1.00		0.13	1.00		0.72	1.00		0.31	1.00	
Satd. Flow (perm)	693	1840		252	1863		1358	1623		589	1806	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	8	669	122	386	728	58	131	21	247	60	40	15
RTOR Reduction (vph)	0	7	0	0	3	0	0	211	0	0	13	0
Lane Group Flow (vph)	8	784	0	386	783	0	131	57	0	60	42	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	44.3	44.3		62.1	62.1		12.8	12.8		12.8	12.8	
Effective Green, g (s)	44.3	44.3		62.1	62.1		12.8	12.8		12.8	12.8	
Actuated g/C Ratio	0.51	0.51		0.71	0.71		0.15	0.15		0.15	0.15	
Clearance Time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	353	937		459	1331		200	239		86	266	
v/s Ratio Prot		c0.43		c0.15	0.42			0.04			0.02	
v/s Ratio Perm	0.01			0.45			0.10			c0.10		
v/c Ratio	0.02	0.84		0.84	0.59		0.66	0.24		0.70	0.16	
Uniform Delay, d1	10.6	18.2		20.2	6.1		35.0	32.8		35.2	32.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	8.8		13.0	1.9		7.5	0.5		21.8	0.3	
Delay (s)	10.7	27.0		33.2	8.0		42.5	33.3		57.0	32.6	
Level of Service	B	C		C	A		D	C		E	C	
Approach Delay (s)		26.8			16.3			36.3			45.4	
Approach LOS		C			B			D			D	
Intersection Summary												
HCM 2000 Control Delay			24.3			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.81									
Actuated Cycle Length (s)			86.9			Sum of lost time (s)			14.0			
Intersection Capacity Utilization			98.1%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group

Appendix E:
Traffic Operations - 2040 Background

HCM Signalized Intersection Capacity Analysis

2040 Background

1: Tenth Line & Mountain Road

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	544	83	132	402	26	102	28	363	38	25	11
Future Volume (vph)	15	544	83	132	402	26	102	28	363	38	25	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.86		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1846		1789	1866		1789	1621		1789	1794	
Flt Permitted	0.47	1.00		0.31	1.00		0.73	1.00		0.34	1.00	
Satd. Flow (perm)	888	1846		582	1866		1379	1621		649	1794	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	16	573	87	139	423	27	107	29	382	40	26	12
RTOR Reduction (vph)	0	8	0	0	4	0	0	192	0	0	9	0
Lane Group Flow (vph)	16	652	0	139	446	0	107	219	0	40	29	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	30.2	30.2		30.2	30.2		11.6	11.6		11.6	11.6	
Effective Green, g (s)	30.2	30.2		30.2	30.2		11.6	11.6		11.6	11.6	
Actuated g/C Ratio	0.56	0.56		0.56	0.56		0.22	0.22		0.22	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	498	1036		326	1047		297	349		139	386	
v/s Ratio Prot		c0.35			0.24			c0.14			0.02	
v/s Ratio Perm	0.02			0.24			0.08			0.06		
v/c Ratio	0.03	0.63		0.43	0.43		0.36	0.63		0.29	0.07	
Uniform Delay, d1	5.3	8.0		6.8	6.8		17.9	19.1		17.6	16.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	2.9		4.0	1.3		0.7	3.5		1.1	0.1	
Delay (s)	5.4	10.9		10.8	8.1		18.7	22.6		18.8	16.9	
Level of Service	A	B		B	A		B	C		B	B	
Approach Delay (s)		10.8			8.7			21.8			17.9	
Approach LOS		B			A			C			B	
Intersection Summary												
HCM 2000 Control Delay			13.5			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.63									
Actuated Cycle Length (s)			53.8			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			87.6%			ICU Level of Service			E			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2040 Background

1: Tenth Line & Mountain Road

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	649	119	381	704	56	127	20	243	58	39	15
Future Volume (vph)	8	649	119	381	704	56	127	20	243	58	39	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.86		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1840		1789	1863		1789	1622		1789	1804	
Flt Permitted	0.36	1.00		0.11	1.00		0.72	1.00		0.31	1.00	
Satd. Flow (perm)	684	1840		201	1863		1356	1622		575	1804	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	8	683	125	401	741	59	134	21	256	61	41	16
RTOR Reduction (vph)	0	7	0	0	3	0	0	218	0	0	14	0
Lane Group Flow (vph)	8	801	0	401	797	0	134	59	0	61	43	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	43.2	43.2		62.1	62.1		13.1	13.1		13.1	13.1	
Effective Green, g (s)	43.2	43.2		62.1	62.1		13.1	13.1		13.1	13.1	
Actuated g/C Ratio	0.50	0.50		0.71	0.71		0.15	0.15		0.15	0.15	
Clearance Time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	338	911		450	1326		203	243		86	271	
v/s Ratio Prot		c0.44		c0.17	0.43			0.04			0.02	
v/s Ratio Perm	0.01			0.46			0.10			c0.11		
v/c Ratio	0.02	0.88		0.89	0.60		0.66	0.24		0.71	0.16	
Uniform Delay, d1	11.2	19.7		23.9	6.3		34.9	32.7		35.2	32.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	11.8		19.3	2.0		7.8	0.5		23.4	0.3	
Delay (s)	11.4	31.5		43.2	8.3		42.7	33.2		58.6	32.5	
Level of Service	B	C		D	A		D	C		E	C	
Approach Delay (s)		31.3			20.0			36.3			46.0	
Approach LOS		C			B			D			D	
Intersection Summary												
HCM 2000 Control Delay			27.4			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			87.2			Sum of lost time (s)			14.0			
Intersection Capacity Utilization			100.2%			ICU Level of Service			G			
Analysis Period (min)			15									

c Critical Lane Group

Appendix F:

Traffic Operations - 2045 Background

HCM Signalized Intersection Capacity Analysis

2045 Background

1: Tenth Line & Mountain Road

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	15	552	84	133	410	26	103	29	366	39	25	11
Future Volume (vph)	15	552	84	133	410	26	103	29	366	39	25	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.86		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1846		1789	1867		1789	1622		1789	1794	
Flt Permitted	0.46	1.00		0.30	1.00		0.73	1.00		0.34	1.00	
Satd. Flow (perm)	871	1846		565	1867		1379	1622		633	1794	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	16	581	88	140	432	27	108	31	385	41	26	12
RTOR Reduction (vph)	0	8	0	0	4	0	0	187	0	0	9	0
Lane Group Flow (vph)	16	661	0	140	455	0	108	229	0	41	29	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	30.2	30.2		30.2	30.2		11.9	11.9		11.9	11.9	
Effective Green, g (s)	30.2	30.2		30.2	30.2		11.9	11.9		11.9	11.9	
Actuated g/C Ratio	0.56	0.56		0.56	0.56		0.22	0.22		0.22	0.22	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	486	1030		315	1042		303	356		139	394	
v/s Ratio Prot		c0.36			0.24			c0.14			0.02	
v/s Ratio Perm	0.02			0.25			0.08			0.06		
v/c Ratio	0.03	0.64		0.44	0.44		0.36	0.64		0.29	0.07	
Uniform Delay, d1	5.4	8.2		7.0	7.0		17.9	19.2		17.6	16.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	3.1		4.5	1.3		0.7	3.9		1.2	0.1	
Delay (s)	5.5	11.3		11.5	8.3		18.6	23.1		18.8	16.8	
Level of Service	A	B		B	A		B	C		B	B	
Approach Delay (s)		11.2			9.1			22.2			17.8	
Approach LOS		B			A			C			B	
Intersection Summary												
HCM 2000 Control Delay			13.8			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.64									
Actuated Cycle Length (s)			54.1			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			88.9%			ICU Level of Service			E			
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

1: Tenth Line & Mountain Road

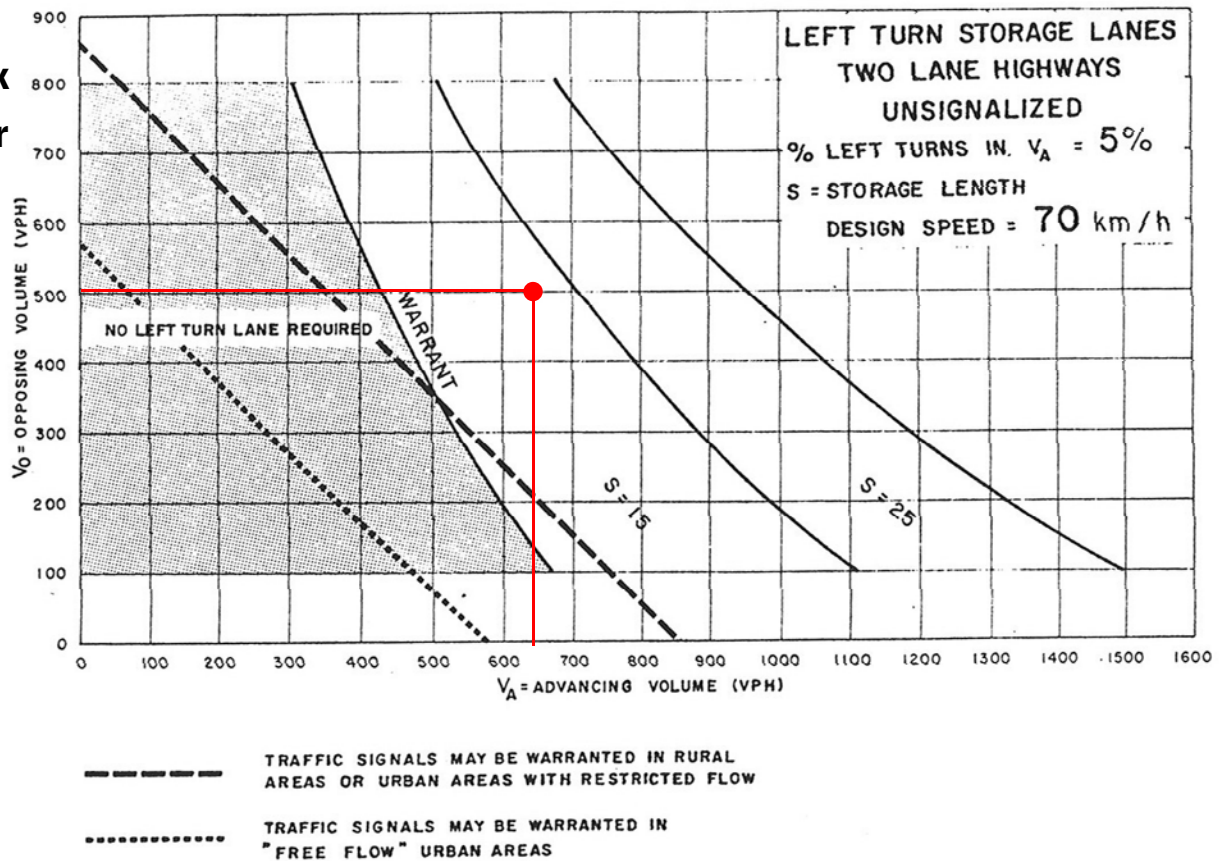
2045 Background
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	8	663	121	383	717	57	128	21	245	60	40	15
Future Volume (vph)	8	663	121	383	717	57	128	21	245	60	40	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.86		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1840		1789	1863		1789	1623		1789	1806	
Flt Permitted	0.36	1.00		0.10	1.00		0.72	1.00		0.30	1.00	
Satd. Flow (perm)	675	1840		180	1863		1355	1623		562	1806	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	8	698	127	403	755	60	135	22	258	63	42	16
RTOR Reduction (vph)	0	7	0	0	3	0	0	218	0	0	14	0
Lane Group Flow (vph)	8	818	0	403	812	0	135	62	0	63	44	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	43.5	43.5		62.1	62.1		13.4	13.4		13.4	13.4	
Effective Green, g (s)	43.5	43.5		62.1	62.1		13.4	13.4		13.4	13.4	
Actuated g/C Ratio	0.50	0.50		0.71	0.71		0.15	0.15		0.15	0.15	
Clearance Time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	335	914		432	1322		207	248		86	276	
v/s Ratio Prot		c0.44		c0.18	0.44			0.04			0.02	
v/s Ratio Perm	0.01			0.48			0.10			c0.11		
v/c Ratio	0.02	0.89		0.93	0.61		0.65	0.25		0.73	0.16	
Uniform Delay, d1	11.2	19.9		25.6	6.5		34.9	32.6		35.3	32.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	13.1		27.1	2.1		7.2	0.5		27.2	0.3	
Delay (s)	11.3	33.1		52.7	8.7		42.0	33.1		62.6	32.4	
Level of Service	B	C		D	A		D	C		E	C	
Approach Delay (s)		32.8			23.3			36.0			48.1	
Approach LOS		C			C			D			D	
Intersection Summary												
HCM 2000 Control Delay			29.6			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.87									
Actuated Cycle Length (s)			87.5			Sum of lost time (s)			14.0			
Intersection Capacity Utilization			101.4%			ICU Level of Service			G			
Analysis Period (min)			15									

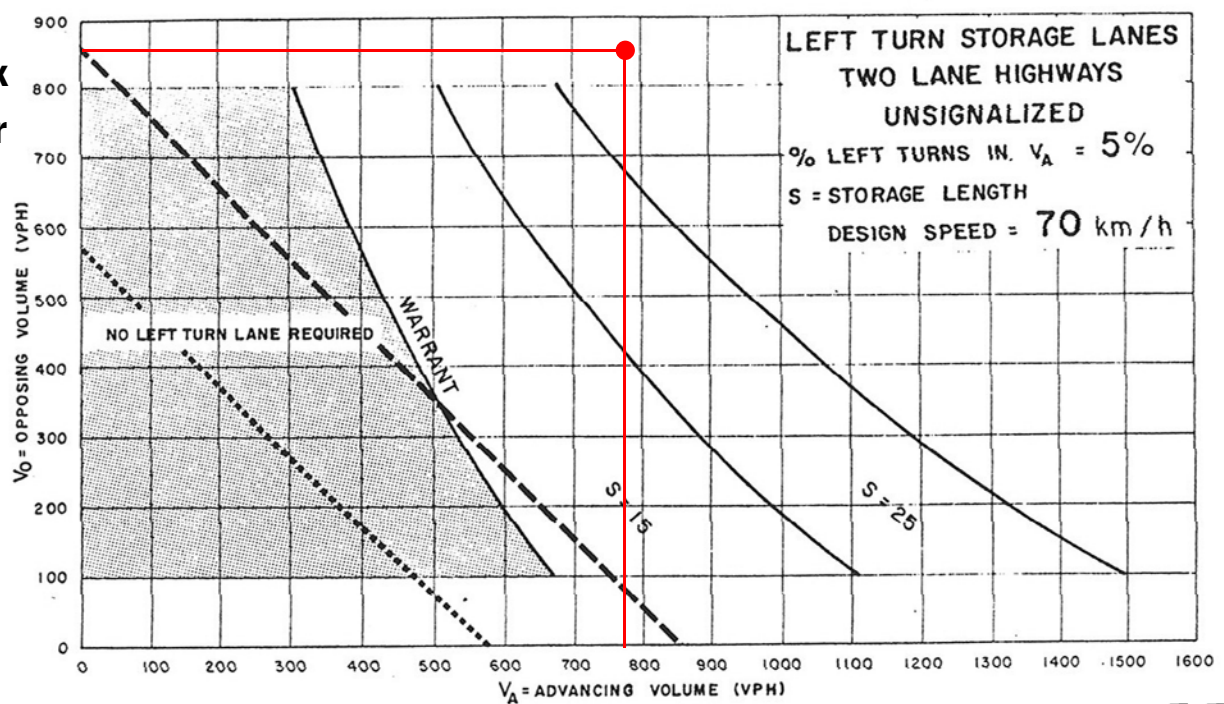
c Critical Lane Group

Appendix G: Left Turn Warrants

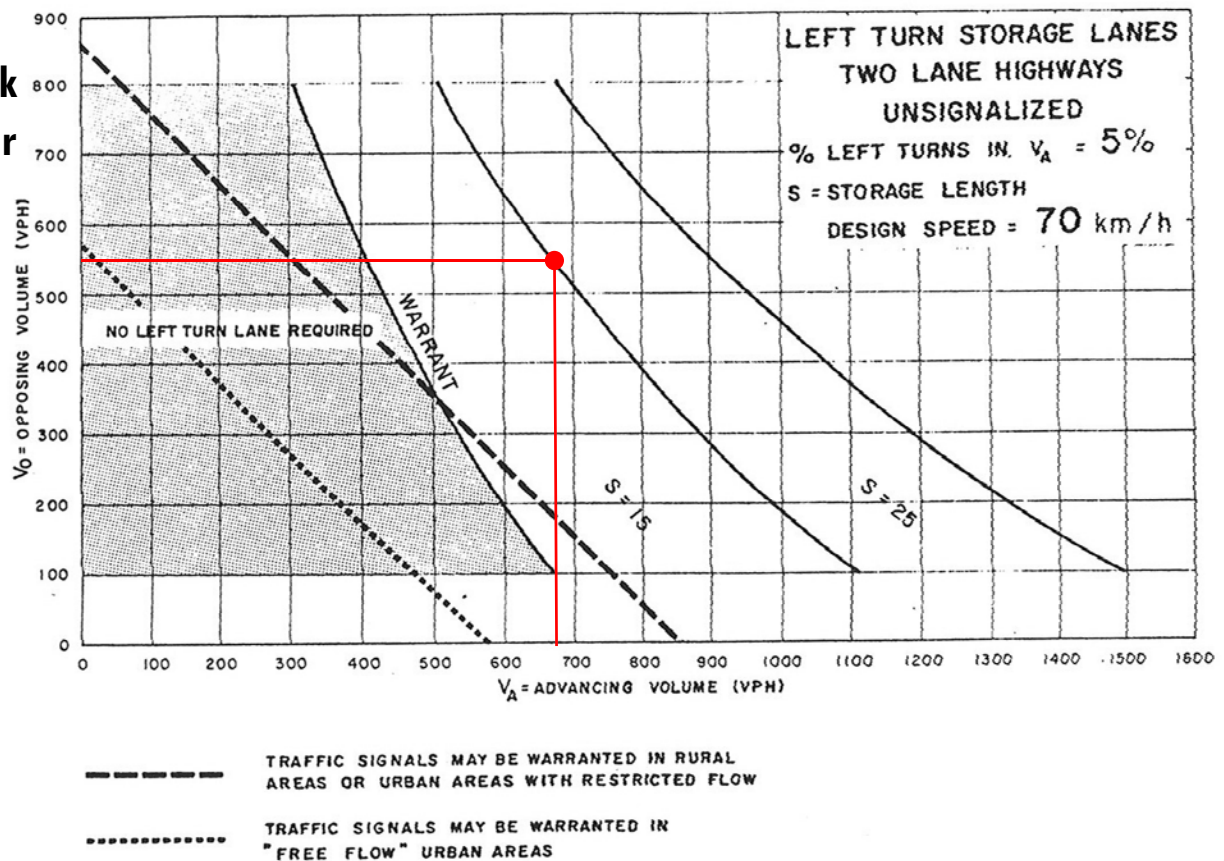
**AM
Peak
Hour**



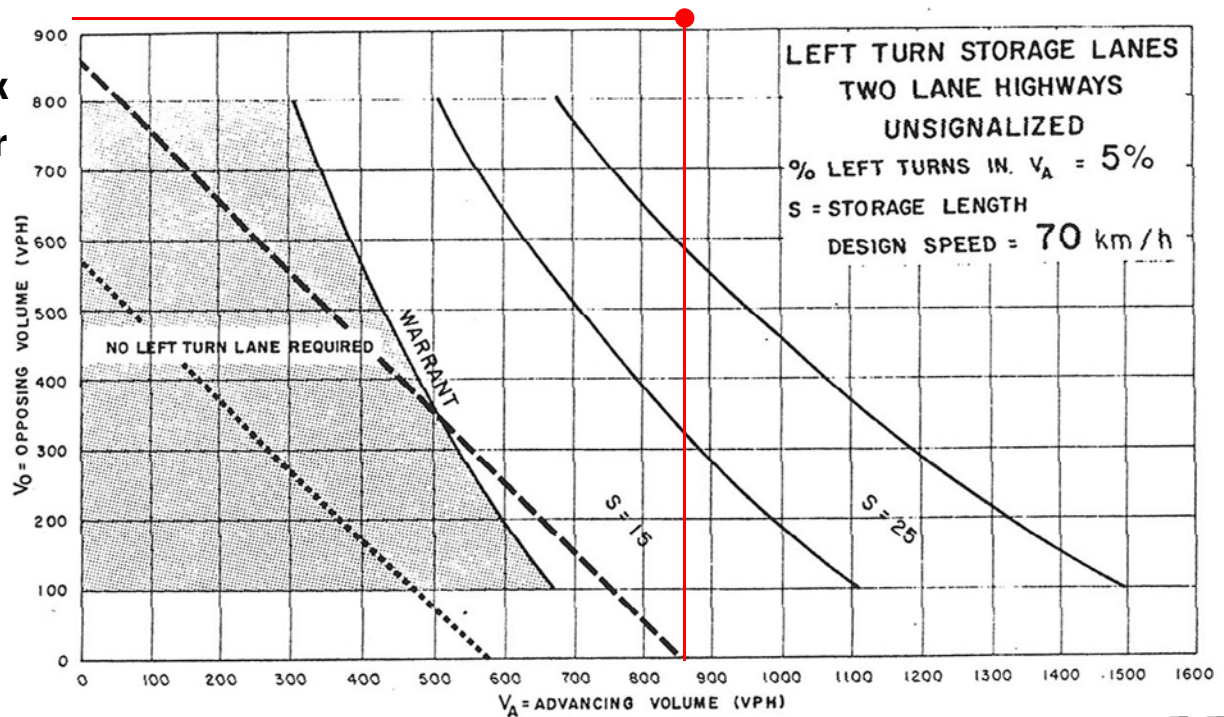
**PM
Peak
Hour**



**AM
Peak
Hour**



**PM
Peak
Hour**



Appendix H:
Traffic Operations - 2028 Total

HCM Signalized Intersection Capacity Analysis

2028 Total

1: Tenth Line & Mountain Road

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	14	561	102	119	394	49	100	41	323	109	67	11
Future Volume (vph)	14	561	102	119	394	49	100	41	323	109	67	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.87		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1840		1789	1852		1789	1633		1789	1843	
Flt Permitted	0.45	1.00		0.26	1.00		0.70	1.00		0.33	1.00	
Satd. Flow (perm)	848	1840		496	1852		1324	1633		623	1843	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	15	591	107	125	415	52	105	43	340	115	71	12
RTOR Reduction (vph)	0	11	0	0	8	0	0	173	0	0	9	0
Lane Group Flow (vph)	15	687	0	125	459	0	105	210	0	115	74	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	27.4	27.4		27.4	27.4		12.2	12.2		12.2	12.2	
Effective Green, g (s)	27.4	27.4		27.4	27.4		12.2	12.2		12.2	12.2	
Actuated g/C Ratio	0.53	0.53		0.53	0.53		0.24	0.24		0.24	0.24	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	450	977		263	983		313	386		147	435	
v/s Ratio Prot		c0.37			0.25			0.13			0.04	
v/s Ratio Perm	0.02			0.25			0.08			c0.18		
v/c Ratio	0.03	0.70		0.48	0.47		0.34	0.54		0.78	0.17	
Uniform Delay, d1	5.8	9.1		7.6	7.5		16.3	17.3		18.5	15.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	4.2		6.0	1.6		0.6	1.6		23.2	0.2	
Delay (s)	5.9	13.3		13.6	9.1		17.0	18.8		41.7	15.9	
Level of Service	A	B		B	A		B	B		D	B	
Approach Delay (s)		13.1			10.1			18.4			30.8	
Approach LOS		B			B			B			C	
Intersection Summary												
HCM 2000 Control Delay			15.3				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			51.6				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			90.5%				ICU Level of Service			E		
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

2028 Total

4: Tenth Line & Access 1

AM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	116	39	64	70	0
Future Volume (Veh/h)	0	116	39	64	70	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	122	41	67	74	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)				192		
pX, platoon unblocked						
vC, conflicting volume	223	74	74			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	223	74	74			
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	88	97			
cM capacity (veh/h)	745	988	1526			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	122	108	74			
Volume Left	0	41	0			
Volume Right	122	0	0			
cSH	988	1526	1700			
Volume to Capacity	0.12	0.03	0.04			
Queue Length 95th (m)	3.2	0.6	0.0			
Control Delay (s)	9.2	2.9	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.2	2.9	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			4.7			
Intersection Capacity Utilization			26.0%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

6: Mountain Road & Access 2

2028 Total
AM Peak Hour

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	15	616	484	20	61	44
Future Volume (Veh/h)	15	616	484	20	61	44
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	16	648	509	21	64	46
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	530				1189	509
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	530				1189	509
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				69	92
cM capacity (veh/h)	1037				204	564
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	16	648	509	21	110	
Volume Left	16	0	0	0	64	
Volume Right	0	0	0	21	46	
cSH	1037	1700	1700	1700	279	
Volume to Capacity	0.02	0.38	0.30	0.01	0.39	
Queue Length 95th (m)	0.4	0.0	0.0	0.0	13.7	
Control Delay (s)	8.5	0.0	0.0	0.0	26.1	
Lane LOS	A				D	
Approach Delay (s)	0.2		0.0		26.1	
Approach LOS					D	
Intersection Summary						
Average Delay			2.3			
Intersection Capacity Utilization			45.2%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

2028 Total

1: Tenth Line & Mountain Road

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	7	642	124	339	712	123	142	61	218	102	66	14
Future Volume (vph)	7	642	124	339	712	123	142	61	218	102	66	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.98		1.00	0.88		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1838		1789	1842		1789	1663		1789	1833	
Flt Permitted	0.28	1.00		0.10	1.00		0.70	1.00		0.34	1.00	
Satd. Flow (perm)	535	1838		192	1842		1323	1663		643	1833	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	7	676	131	357	749	129	149	64	229	107	69	15
RTOR Reduction (vph)	0	7	0	0	6	0	0	164	0	0	10	0
Lane Group Flow (vph)	7	800	0	357	872	0	149	129	0	107	74	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	37.2	37.2		51.3	51.3		15.3	15.3		15.3	15.3	
Effective Green, g (s)	37.2	37.2		51.3	51.3		15.3	15.3		15.3	15.3	
Actuated g/C Ratio	0.47	0.47		0.65	0.65		0.19	0.19		0.19	0.19	
Clearance Time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	253	869		371	1202		257	323		125	356	
v/s Ratio Prot		c0.44		c0.15	0.47			0.08			0.04	
v/s Ratio Perm	0.01			0.48			0.11			c0.17		
v/c Ratio	0.03	0.92		0.96	0.73		0.58	0.40		0.86	0.21	
Uniform Delay, d1	11.0	19.3		22.8	9.0		28.7	27.6		30.6	26.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	16.5		36.7	3.8		3.2	0.8		40.2	0.3	
Delay (s)	11.3	35.8		59.4	12.9		31.9	28.4		70.7	26.9	
Level of Service	B	D		E	B		C	C		E	C	
Approach Delay (s)		35.6			26.3			29.6			51.4	
Approach LOS		D			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			31.5				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.90									
Actuated Cycle Length (s)			78.6				Sum of lost time (s)			14.0		
Intersection Capacity Utilization			100.7%				ICU Level of Service			G		
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

2028 Total

4: Tenth Line & Access 1

PM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	76	113	79	106	0
Future Volume (Veh/h)	0	76	113	79	106	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	80	119	83	112	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)				192		
pX, platoon unblocked						
vC, conflicting volume	433	112	112			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	433	112	112			
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	91	92			
cM capacity (veh/h)	533	941	1478			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	80	202	112			
Volume Left	0	119	0			
Volume Right	80	0	0			
cSH	941	1478	1700			
Volume to Capacity	0.09	0.08	0.07			
Queue Length 95th (m)	2.1	2.0	0.0			
Control Delay (s)	9.2	4.8	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.2	4.8	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			4.3			
Intersection Capacity Utilization		28.5%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 6: Mountain Road & Access 2

2028 Total
PM Peak Hour

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	43	734	809	59	40	29
Future Volume (Veh/h)	43	734	809	59	40	29
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	45	773	852	62	42	31
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	914				1715	852
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	914				1715	852
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	94				55	91
cM capacity (veh/h)	746				93	359
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	45	773	852	62	73	
Volume Left	45	0	0	0	42	
Volume Right	0	0	0	62	31	
cSH	746	1700	1700	1700	136	
Volume to Capacity	0.06	0.45	0.50	0.04	0.54	
Queue Length 95th (m)	1.5	0.0	0.0	0.0	19.9	
Control Delay (s)	10.1	0.0	0.0	0.0	58.7	
Lane LOS	B				F	
Approach Delay (s)	0.6		0.0		58.7	
Approach LOS					F	
Intersection Summary						
Average Delay			2.6			
Intersection Capacity Utilization			53.2%		ICU Level of Service	A
Analysis Period (min)			15			

Appendix I:
Traffic Operations - 2035 Total

HCM Signalized Intersection Capacity Analysis

2035 Total

1: Tenth Line & Mountain Road

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	573	105	128	406	85	106	63	350	227	138	23
Future Volume (vph)	18	573	105	128	406	85	106	63	350	227	138	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.97		1.00	0.87		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1840		1789	1835		1789	1644		1789	1843	
Flt Permitted	0.34	1.00		0.17	1.00		0.65	1.00		0.34	1.00	
Satd. Flow (perm)	632	1840		322	1835		1225	1644		638	1843	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	19	603	111	135	427	89	112	66	368	239	145	24
RTOR Reduction (vph)	0	7	0	0	8	0	0	129	0	0	7	0
Lane Group Flow (vph)	19	707	0	135	508	0	112	305	0	239	162	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	43.0	43.0		43.0	43.0		34.1	34.1		34.1	34.1	
Effective Green, g (s)	43.0	43.0		43.0	43.0		34.1	34.1		34.1	34.1	
Actuated g/C Ratio	0.48	0.48		0.48	0.48		0.38	0.38		0.38	0.38	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	305	887		155	885		468	629		244	705	
v/s Ratio Prot		0.38			0.28			0.19			0.09	
v/s Ratio Perm	0.03			c0.42			0.09			c0.37		
v/c Ratio	0.06	0.80		0.87	0.57		0.24	0.48		0.98	0.23	
Uniform Delay, d1	12.3	19.4		20.6	16.5		18.7	20.8		27.2	18.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	7.4		44.4	2.7		0.3	0.6		51.2	0.2	
Delay (s)	12.7	26.7		65.0	19.2		19.0	21.4		78.4	18.8	
Level of Service	B	C		E	B		B	C		E	B	
Approach Delay (s)		26.4			28.7			20.9			53.7	
Approach LOS		C			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			30.5			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			89.1			Sum of lost time (s)			12.0			
Intersection Capacity Utilization			101.1%			ICU Level of Service			G			
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

2035 Total

4: Tenth Line & Access 1

AM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	315	99	67	72	0
Future Volume (Veh/h)	0	315	99	67	72	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	332	104	71	76	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)				192		
pX, platoon unblocked						
vC, conflicting volume	355	76	76			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	355	76	76			
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	66	93			
cM capacity (veh/h)	599	985	1523			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	332	175	76			
Volume Left	0	104	0			
Volume Right	332	0	0			
cSH	985	1523	1700			
Volume to Capacity	0.34	0.07	0.04			
Queue Length 95th (m)	11.4	1.7	0.0			
Control Delay (s)	10.5	4.7	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.5	4.7	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			7.4			
Intersection Capacity Utilization		41.8%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

6: Mountain Road & Access 2

2035 Total
AM Peak Hour

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	25	634	514	20	61	79
Future Volume (Veh/h)	25	634	514	20	61	79
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	26	667	541	21	64	83
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	562				1270	552
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	562				1270	552
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				65	84
cM capacity (veh/h)	1009				181	534
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	693	562	147			
Volume Left	26	0	64			
Volume Right	0	21	83			
cSH	1009	1700	288			
Volume to Capacity	0.03	0.33	0.51			
Queue Length 95th (m)	0.6	0.0	20.6			
Control Delay (s)	0.7	0.0	29.8			
Lane LOS	A		D			
Approach Delay (s)	0.7	0.0	29.8			
Approach LOS			D			
Intersection Summary						
Average Delay			3.5			
Intersection Capacity Utilization		68.5%		ICU Level of Service		C
Analysis Period (min)		15				

HCM Signalized Intersection Capacity Analysis

2035 Total

1: Tenth Line & Mountain Road

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	660	131	367	729	234	146	127	235	175	109	21
Future Volume (vph)	19	660	131	367	729	234	146	127	235	175	109	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.96		1.00	0.90		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1837		1789	1815		1789	1700		1789	1838	
Flt Permitted	0.11	1.00		0.10	1.00		0.67	1.00		0.32	1.00	
Satd. Flow (perm)	204	1837		193	1815		1261	1700		601	1838	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	20	695	138	386	767	246	154	134	247	184	115	22
RTOR Reduction (vph)	0	8	0	0	13	0	0	74	0	0	8	0
Lane Group Flow (vph)	20	825	0	386	1000	0	154	308	0	184	129	0
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6			8			4		
Actuated Green, G (s)	37.0	37.0		51.0	51.0		27.0	27.0		27.0	27.0	
Effective Green, g (s)	37.0	37.0		51.0	51.0		27.0	27.0		27.0	27.0	
Actuated g/C Ratio	0.41	0.41		0.57	0.57		0.30	0.30		0.30	0.30	
Clearance Time (s)	6.0	6.0		2.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	83	755		322	1028		378	510		180	551	
v/s Ratio Prot		c0.45		c0.16	0.55			0.18			0.07	
v/s Ratio Perm	0.10			0.52			0.12			c0.31		
v/c Ratio	0.24	1.09		1.20	0.97		0.41	0.60		1.02	0.23	
Uniform Delay, d1	17.3	26.5		26.8	18.8		25.1	26.9		31.5	23.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.8	61.1		115.5	22.2		0.7	2.0		73.0	0.2	
Delay (s)	24.1	87.6		142.3	41.1		25.8	28.9		104.5	23.9	
Level of Service	C	F		F	D		C	C		F	C	
Approach Delay (s)		86.1			69.0			28.0			70.1	
Approach LOS		F			E			C			E	
Intersection Summary												
HCM 2000 Control Delay			66.8			HCM 2000 Level of Service			E			
HCM 2000 Volume to Capacity ratio			1.08									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			14.0			
Intersection Capacity Utilization			112.2%			ICU Level of Service			H			
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

2035 Total

4: Tenth Line & Access 1

PM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	196	298	82	109	0
Future Volume (Veh/h)	0	196	298	82	109	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	206	314	86	115	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)				192		
pX, platoon unblocked						
vC, conflicting volume	829	115	115			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	829	115	115			
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	78	79			
cM capacity (veh/h)	268	937	1474			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	206	400	115			
Volume Left	0	314	0			
Volume Right	206	0	0			
cSH	937	1474	1700			
Volume to Capacity	0.22	0.21	0.07			
Queue Length 95th (m)	6.4	6.1	0.0			
Control Delay (s)	9.9	6.8	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.9	6.8	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			6.6			
Intersection Capacity Utilization			46.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

6: Mountain Road & Access 2

2035 Total
PM Peak Hour

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	76	770	838	59	40	50
Future Volume (Veh/h)	76	770	838	59	40	50
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	80	811	882	62	42	53
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	944				1853	882
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	944				1853	882
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				42	85
cM capacity (veh/h)	727				72	345
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	80	811	882	62	95	
Volume Left	80	0	0	0	42	
Volume Right	0	0	0	62	53	
cSH	727	1700	1700	1700	129	
Volume to Capacity	0.11	0.48	0.52	0.04	0.73	
Queue Length 95th (m)	2.8	0.0	0.0	0.0	31.9	
Control Delay (s)	10.6	0.0	0.0	0.0	85.9	
Lane LOS	B				F	
Approach Delay (s)	0.9		0.0		85.9	
Approach LOS					F	
Intersection Summary						
Average Delay			4.7			
Intersection Capacity Utilization			63.6%		ICU Level of Service	B
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

2035 Total (w/improvements)

1: Tenth Line & Mountain Road

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	573	105	128	406	85	106	63	350	227	138	23
Future Volume (vph)	18	573	105	128	406	85	106	63	350	227	138	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.87		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3495		1789	1883	1601	1789	1644		1789	1843	
Flt Permitted	0.43	1.00		0.35	1.00	1.00	0.65	1.00		0.41	1.00	
Satd. Flow (perm)	814	3495		660	1883	1601	1225	1644		780	1843	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	19	603	111	135	427	89	112	66	368	239	145	24
RTOR Reduction (vph)	0	33	0	0	0	56	0	75	0	0	14	0
Lane Group Flow (vph)	19	681	0	135	427	33	112	359	0	239	155	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	16.1	16.1		16.1	16.1	16.1	15.5	15.5		15.5	15.5	
Effective Green, g (s)	16.1	16.1		16.1	16.1	16.1	15.5	15.5		15.5	15.5	
Actuated g/C Ratio	0.37	0.37		0.37	0.37	0.37	0.36	0.36		0.36	0.36	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	300	1290		243	695	591	435	584		277	655	
v/s Ratio Prot		0.19			c0.23			0.22			0.08	
v/s Ratio Perm	0.02			0.20		0.02	0.09			c0.31		
v/c Ratio	0.06	0.53		0.56	0.61	0.06	0.26	0.62		0.86	0.24	
Uniform Delay, d1	8.9	10.8		10.9	11.2	8.9	10.0	11.6		13.1	9.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	1.5		8.9	4.0	0.2	0.3	1.9		23.1	0.2	
Delay (s)	9.3	12.3		19.8	15.3	9.0	10.3	13.5		36.1	10.1	
Level of Service	A	B		B	B	A	B	B		D	B	
Approach Delay (s)		12.2			15.3			12.9			25.3	
Approach LOS		B			B			B			C	
Intersection Summary												
HCM 2000 Control Delay			15.5									
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			43.6									
Intersection Capacity Utilization			83.8%									
Analysis Period (min)			15									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2035 Total (w/improvements)

1: Tenth Line & Mountain Road

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	660	131	367	729	234	146	127	235	175	109	21
Future Volume (vph)	19	660	131	367	729	234	146	127	235	175	109	21
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.90		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3490		1789	1883	1601	1789	1700		1789	1838	
Flt Permitted	0.30	1.00		0.20	1.00	1.00	0.67	1.00		0.37	1.00	
Satd. Flow (perm)	567	3490		377	1883	1601	1261	1700		696	1838	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	20	695	138	386	767	246	154	134	247	184	115	22
RTOR Reduction (vph)	0	27	0	0	0	121	0	112	0	0	11	0
Lane Group Flow (vph)	20	806	0	386	767	125	154	269	0	184	126	0
Turn Type	Perm	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	18.0	18.0		30.0	30.0	30.0	17.0	17.0		17.0	17.0	
Effective Green, g (s)	18.0	18.0		30.0	30.0	30.0	17.0	17.0		17.0	17.0	
Actuated g/C Ratio	0.31	0.31		0.51	0.51	0.51	0.29	0.29		0.29	0.29	
Clearance Time (s)	6.0	6.0		2.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	172	1064		431	957	814	363	489		200	529	
v/s Ratio Prot		0.23		c0.15	c0.41			0.16			0.07	
v/s Ratio Perm	0.04			0.30		0.08	0.12			c0.26		
v/c Ratio	0.12	0.76		0.90	0.80	0.15	0.42	0.55		0.92	0.24	
Uniform Delay, d1	14.8	18.5		11.0	12.0	7.7	17.0	17.8		20.3	16.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.4	5.0		20.5	7.0	0.4	0.8	1.3		41.8	0.2	
Delay (s)	16.1	23.6		31.5	19.1	8.1	17.8	19.0		62.1	16.3	
Level of Service	B	C		C	B	A	B	B		E	B	
Approach Delay (s)		23.4			20.6			18.7			42.6	
Approach LOS		C			C			B			D	
Intersection Summary												
HCM 2000 Control Delay			23.3			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.90									
Actuated Cycle Length (s)			59.0			Sum of lost time (s)			14.0			
Intersection Capacity Utilization			92.5%			ICU Level of Service			F			
Analysis Period (min)			15									

c Critical Lane Group

Appendix J:
Traffic Operations - 2040 Total

HCM Signalized Intersection Capacity Analysis

2040 Total

1: Tenth Line & Mountain Road

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	582	106	132	414	85	110	64	363	228	138	23
Future Volume (vph)	18	582	106	132	414	85	110	64	363	228	138	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.87		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3496		1789	1883	1601	1789	1643		1789	1843	
Flt Permitted	0.41	1.00		0.33	1.00	1.00	0.65	1.00		0.39	1.00	
Satd. Flow (perm)	772	3496		629	1883	1601	1225	1643		735	1843	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	19	613	112	139	436	89	116	67	382	240	145	24
RTOR Reduction (vph)	0	29	0	0	0	55	0	72	0	0	13	0
Lane Group Flow (vph)	19	696	0	139	436	34	116	377	0	240	156	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	18.1	18.1		18.1	18.1	18.1	17.8	17.8		17.8	17.8	
Effective Green, g (s)	18.1	18.1		18.1	18.1	18.1	17.8	17.8		17.8	17.8	
Actuated g/C Ratio	0.38	0.38		0.38	0.38	0.38	0.37	0.37		0.37	0.37	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	291	1321		237	711	604	455	610		273	684	
v/s Ratio Prot		0.20			c0.23			0.23			0.08	
v/s Ratio Perm	0.02			0.22		0.02	0.09			c0.33		
v/c Ratio	0.07	0.53		0.59	0.61	0.06	0.25	0.62		0.88	0.23	
Uniform Delay, d1	9.5	11.6		11.9	12.1	9.5	10.4	12.3		14.0	10.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	1.5		10.2	3.9	0.2	0.3	1.9		25.8	0.2	
Delay (s)	9.9	13.1		22.1	16.0	9.6	10.7	14.1		39.8	10.5	
Level of Service	A	B		C	B	A	B	B		D	B	
Approach Delay (s)		13.0			16.4			13.4			27.7	
Approach LOS		B			B			B			C	
Intersection Summary												
HCM 2000 Control Delay			16.6									
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			47.9									
Intersection Capacity Utilization			85.2%									
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

2040 Total

4: Tenth Line & Access 1

AM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	315	99	68	74	0
Future Volume (Veh/h)	0	315	99	68	74	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	332	104	72	78	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)				192		
pX, platoon unblocked						
vC, conflicting volume	358	78	78			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	358	78	78			
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	66	93			
cM capacity (veh/h)	597	983	1520			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	332	176	78			
Volume Left	0	104	0			
Volume Right	332	0	0			
cSH	983	1520	1700			
Volume to Capacity	0.34	0.07	0.05			
Queue Length 95th (m)	11.4	1.7	0.0			
Control Delay (s)	10.5	4.7	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.5	4.7	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			7.4			
Intersection Capacity Utilization		41.9%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 6: Mountain Road & Access 2

2040 Total
AM Peak Hour

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	25	645	526	20	61	79
Future Volume (Veh/h)	25	645	526	20	61	79
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	26	679	554	21	64	83
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	575				1285	554
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	575				1285	554
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				64	84
cM capacity (veh/h)	998				177	532
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	26	679	554	21	147	
Volume Left	26	0	0	0	64	
Volume Right	0	0	0	21	83	
cSH	998	1700	1700	1700	284	
Volume to Capacity	0.03	0.40	0.33	0.01	0.52	
Queue Length 95th (m)	0.6	0.0	0.0	0.0	21.1	
Control Delay (s)	8.7	0.0	0.0	0.0	30.5	
Lane LOS	A				D	
Approach Delay (s)	0.3		0.0		30.5	
Approach LOS					D	
Intersection Summary						
Average Delay			3.3			
Intersection Capacity Utilization			48.8%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

2040 Total

1: Tenth Line & Mountain Road

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	674	134	381	741	236	149	128	243	177	110	22
Future Volume (vph)	19	674	134	381	741	236	149	128	243	177	110	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.90		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3489		1789	1883	1601	1789	1698		1789	1837	
Flt Permitted	0.29	1.00		0.21	1.00	1.00	0.67	1.00		0.36	1.00	
Satd. Flow (perm)	548	3489		392	1883	1601	1259	1698		675	1837	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	20	709	141	401	780	248	157	135	256	186	116	23
RTOR Reduction (vph)	0	28	0	0	0	123	0	115	0	0	12	0
Lane Group Flow (vph)	20	822	0	401	780	125	157	276	0	186	127	0
Turn Type	Perm	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	17.2	17.2		30.0	30.0	30.0	17.4	17.4		17.4	17.4	
Effective Green, g (s)	17.2	17.2		30.0	30.0	30.0	17.4	17.4		17.4	17.4	
Actuated g/C Ratio	0.29	0.29		0.51	0.51	0.51	0.29	0.29		0.29	0.29	
Clearance Time (s)	6.0	6.0		2.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	158	1010		451	951	808	368	497		197	538	
v/s Ratio Prot		0.24		c0.16	c0.41			0.16			0.07	
v/s Ratio Perm	0.04			0.29		0.08	0.12			c0.28		
v/c Ratio	0.13	0.81		0.89	0.82	0.16	0.43	0.55		0.94	0.24	
Uniform Delay, d1	15.6	19.6		11.3	12.4	7.9	17.0	17.7		20.5	16.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.6	7.2		18.8	7.9	0.4	0.8	1.3		48.0	0.2	
Delay (s)	17.2	26.8		30.1	20.3	8.3	17.8	19.1		68.5	16.2	
Level of Service	B	C		C	C	A	B	B		E	B	
Approach Delay (s)		26.6			21.0			18.7			46.1	
Approach LOS		C			C			B			D	
Intersection Summary												
HCM 2000 Control Delay			24.7				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			59.4				Sum of lost time (s)			14.0		
Intersection Capacity Utilization			93.8%				ICU Level of Service			F		
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

2040 Total

4: Tenth Line & Access 1

PM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	196	298	84	112	0
Future Volume (Veh/h)	0	196	298	84	112	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	206	314	88	118	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)				192		
pX, platoon unblocked						
vC, conflicting volume	834	118	118			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	834	118	118			
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	78	79			
cM capacity (veh/h)	266	934	1470			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	206	402	118			
Volume Left	0	314	0			
Volume Right	206	0	0			
cSH	934	1470	1700			
Volume to Capacity	0.22	0.21	0.07			
Queue Length 95th (m)	6.4	6.2	0.0			
Control Delay (s)	9.9	6.7	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.9	6.7	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			6.6			
Intersection Capacity Utilization			46.4%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 6: Mountain Road & Access 2

2040 Total
PM Peak Hour

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	76	787	853	59	40	50
Future Volume (Veh/h)	76	787	853	59	40	50
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	80	828	898	62	42	53
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	960				1886	898
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	960				1886	898
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				39	84
cM capacity (veh/h)	717				69	338
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	80	828	898	62	95	
Volume Left	80	0	0	0	42	
Volume Right	0	0	0	62	53	
cSH	717	1700	1700	1700	124	
Volume to Capacity	0.11	0.49	0.53	0.04	0.77	
Queue Length 95th (m)	2.9	0.0	0.0	0.0	33.6	
Control Delay (s)	10.7	0.0	0.0	0.0	94.5	
Lane LOS	B				F	
Approach Delay (s)	0.9		0.0		94.5	
Approach LOS					F	
Intersection Summary						
Average Delay			5.0			
Intersection Capacity Utilization			64.4%		ICU Level of Service	C
Analysis Period (min)			15			

Appendix K:
Traffic Operations - 2045 Total

HCM Signalized Intersection Capacity Analysis

2045 Total

1: Tenth Line & Mountain Road

AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	18	591	107	133	423	86	111	64	366	229	139	23
Future Volume (vph)	18	591	107	133	423	86	111	64	366	229	139	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.87		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3496		1789	1883	1601	1789	1643		1789	1844	
Flt Permitted	0.40	1.00		0.33	1.00	1.00	0.65	1.00		0.39	1.00	
Satd. Flow (perm)	751	3496		617	1883	1601	1224	1643		729	1844	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	19	622	113	140	445	91	117	67	385	241	146	24
RTOR Reduction (vph)	0	29	0	0	0	57	0	70	0	0	13	0
Lane Group Flow (vph)	19	706	0	140	445	34	117	382	0	241	157	0
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	18.1	18.1		18.1	18.1	18.1	17.9	17.9		17.9	17.9	
Effective Green, g (s)	18.1	18.1		18.1	18.1	18.1	17.9	17.9		17.9	17.9	
Actuated g/C Ratio	0.38	0.38		0.38	0.38	0.38	0.37	0.37		0.37	0.37	
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	283	1318		232	710	603	456	612		271	687	
v/s Ratio Prot		0.20			c0.24			0.23			0.09	
v/s Ratio Perm	0.03			0.23		0.02	0.10			c0.33		
v/c Ratio	0.07	0.54		0.60	0.63	0.06	0.26	0.62		0.89	0.23	
Uniform Delay, d1	9.6	11.7		12.1	12.2	9.5	10.4	12.3		14.1	10.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.6		11.1	4.2	0.2	0.3	2.0		27.7	0.2	
Delay (s)	10.0	13.2		23.2	16.3	9.7	10.7	14.3		41.8	10.5	
Level of Service	B	B		C	B	A	B	B		D	B	
Approach Delay (s)		13.2			16.9			13.6			28.9	
Approach LOS		B			B			B			C	
Intersection Summary												
HCM 2000 Control Delay			17.0									B
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			48.0							12.0		
Intersection Capacity Utilization			85.7%								E	
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

2045 Total

4: Tenth Line & Access 1

AM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	315	99	70	76	0
Future Volume (Veh/h)	0	315	99	70	76	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	332	104	74	80	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)				192		
pX, platoon unblocked						
vC, conflicting volume	362	80	80			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	362	80	80			
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	66	93			
cM capacity (veh/h)	593	980	1518			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	332	178	80			
Volume Left	0	104	0			
Volume Right	332	0	0			
cSH	980	1518	1700			
Volume to Capacity	0.34	0.07	0.05			
Queue Length 95th (m)	11.5	1.7	0.0			
Control Delay (s)	10.5	4.6	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.5	4.6	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			7.3			
Intersection Capacity Utilization		42.0%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis 6: Mountain Road & Access 2

2045 Total
AM Peak Hour

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	25	655	537	20	61	79
Future Volume (Veh/h)	25	655	537	20	61	79
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	26	689	565	21	64	83
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	586				1306	565
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	586				1306	565
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	97				63	84
cM capacity (veh/h)	989				172	524
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	26	689	565	21	147	
Volume Left	26	0	0	0	64	
Volume Right	0	0	0	21	83	
cSH	989	1700	1700	1700	277	
Volume to Capacity	0.03	0.41	0.33	0.01	0.53	
Queue Length 95th (m)	0.6	0.0	0.0	0.0	21.9	
Control Delay (s)	8.7	0.0	0.0	0.0	31.8	
Lane LOS	A				D	
Approach Delay (s)	0.3		0.0		31.8	
Approach LOS					D	
Intersection Summary						
Average Delay			3.4			
Intersection Capacity Utilization			49.4%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis

2045 Total

1: Tenth Line & Mountain Road

PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	19	688	136	383	754	237	150	128	245	178	111	22
Future Volume (vph)	19	688	136	383	754	237	150	128	245	178	111	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		2.0	6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.90		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	3490		1789	1883	1601	1789	1698		1789	1837	
Flt Permitted	0.27	1.00		0.21	1.00	1.00	0.67	1.00		0.36	1.00	
Satd. Flow (perm)	506	3490		392	1883	1601	1257	1698		673	1837	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	20	724	143	403	794	249	158	135	258	187	117	23
RTOR Reduction (vph)	0	27	0	0	0	124	0	116	0	0	12	0
Lane Group Flow (vph)	20	840	0	403	794	125	158	277	0	187	128	0
Turn Type	Perm	NA		pm+pt	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		2		1	6			8			4	
Permitted Phases	2			6		6	8			4		
Actuated Green, G (s)	17.2	17.2		30.0	30.0	30.0	17.6	17.6		17.6	17.6	
Effective Green, g (s)	17.2	17.2		30.0	30.0	30.0	17.6	17.6		17.6	17.6	
Actuated g/C Ratio	0.29	0.29		0.50	0.50	0.50	0.30	0.30		0.30	0.30	
Clearance Time (s)	6.0	6.0		2.0	6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	146	1007		450	947	805	371	501		198	542	
v/s Ratio Prot		0.24		c0.16	c0.42			0.16			0.07	
v/s Ratio Perm	0.04			0.29		0.08	0.13			c0.28		
v/c Ratio	0.14	0.83		0.90	0.84	0.16	0.43	0.55		0.94	0.24	
Uniform Delay, d1	15.7	19.9		11.5	12.7	8.0	16.9	17.7		20.5	15.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.9	8.1		19.9	8.8	0.4	0.8	1.3		47.9	0.2	
Delay (s)	17.6	28.0		31.4	21.5	8.4	17.7	19.0		68.4	16.1	
Level of Service	B	C		C	C	A	B	B		E	B	
Approach Delay (s)		27.7			22.0			18.6			46.0	
Approach LOS		C			C			B			D	
Intersection Summary												
HCM 2000 Control Delay			25.5									
HCM 2000 Volume to Capacity ratio			0.93									
Actuated Cycle Length (s)			59.6									
Intersection Capacity Utilization			94.7%									
Analysis Period (min)			15									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

2045 Total

4: Tenth Line & Access 1

PM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	0	196	298	86	115	0
Future Volume (Veh/h)	0	196	298	86	115	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	0	206	314	91	121	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)				192		
pX, platoon unblocked						
vC, conflicting volume	840	121	121			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	840	121	121			
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	78	79			
cM capacity (veh/h)	264	930	1467			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	206	405	121			
Volume Left	0	314	0			
Volume Right	206	0	0			
cSH	930	1467	1700			
Volume to Capacity	0.22	0.21	0.07			
Queue Length 95th (m)	6.4	6.2	0.0			
Control Delay (s)	10.0	6.7	0.0			
Lane LOS	A	A				
Approach Delay (s)	10.0	6.7	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay		6.5				
Intersection Capacity Utilization		46.5%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis

6: Mountain Road & Access 2

2045 Total
PM Peak Hour

						
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	76	802	867	59	40	50
Future Volume (Veh/h)	76	802	867	59	40	50
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	80	844	913	62	42	53
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	975				1917	913
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	975				1917	913
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	89				36	84
cM capacity (veh/h)	707				66	331
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	80	844	913	62	95	
Volume Left	80	0	0	0	42	
Volume Right	0	0	0	62	53	
cSH	707	1700	1700	1700	119	
Volume to Capacity	0.11	0.50	0.54	0.04	0.80	
Queue Length 95th (m)	2.9	0.0	0.0	0.0	35.4	
Control Delay (s)	10.7	0.0	0.0	0.0	103.5	
Lane LOS	B				F	
Approach Delay (s)	0.9		0.0		103.5	
Approach LOS					F	
Intersection Summary						
Average Delay			5.4			
Intersection Capacity Utilization			65.1%		ICU Level of Service	C
Analysis Period (min)			15			

HCM 2010 Roundabout
1: Tenth Line & Mountain Road

2045 Total - Roundabout
AM Peak Hour

Intersection									
Intersection Delay, s/veh	11.6								
Intersection LOS	B								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	754		676		569		411		
Demand Flow Rate, veh/h	768		690		580		419		
Vehicles Circulating, veh/h	538		206		899		716		
Vehicles Exiting, veh/h	597		1273		407		180		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	12.1		7.6		17.2		9.7		
Approach LOS	B		A		C		A		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	R	L	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.322	0.678	0.587	0.413	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	361	407	324	366	187	393	246	173	
Cap Entry Lane, veh/h	755	775	968	978	576	602	660	685	
Entry HV Adj Factor	0.981	0.981	0.981	0.979	0.982	0.980	0.980	0.983	
Flow Entry, veh/h	354	399	318	358	184	385	241	170	
Cap Entry, veh/h	741	761	950	958	565	590	647	673	
V/C Ratio	0.478	0.525	0.335	0.374	0.325	0.653	0.372	0.253	
Control Delay, s/veh	11.6	12.5	7.4	7.9	11.0	20.1	10.7	8.4	
LOS	B	B	A	A	B	C	B	A	
95th %tile Queue, veh	3	3	1	2	1	5	2	1	

HCM 2010 Roundabout
1: Tenth Line & Mountain Road

2045 Total - Roundabout
PM Peak Hour

Intersection									
Intersection Delay, s/veh	20.9								
Intersection LOS	C								
Approach	EB		WB		NB		SB		
Entry Lanes	2		2		2		2		
Conflicting Circle Lanes	2		2		2		2		
Adj Approach Flow, veh/h	887		1446		551		327		
Demand Flow Rate, veh/h	904		1475		562		333		
Vehicles Circulating, veh/h	721		319		949		1382		
Vehicles Exiting, veh/h	994		1192		676		412		
Follow-Up Headway, s	3.186		3.186		3.186		3.186		
Ped Vol Crossing Leg, #/h	0		0		0		0		
Ped Cap Adj	1.000		1.000		1.000		1.000		
Approach Delay, s/veh	19.6		24.7		15.1		17.4		
Approach LOS	C		C		C		C		
Lane	Left	Right	Left	Right	Left	Right	Left	Right	
Designated Moves	LT	TR	LT	TR	LT	TR	LT	TR	
Assumed Moves	LT	TR	LT	TR	LT	TR	L	TR	
RT Channelized									
Lane Util	0.470	0.530	0.470	0.530	0.470	0.530	0.574	0.426	
Critical Headway, s	4.293	4.113	4.293	4.113	4.293	4.113	4.293	4.113	
Entry Flow, veh/h	425	479	693	782	264	298	191	142	
Cap Entry Lane, veh/h	658	682	890	904	555	582	401	429	
Entry HV Adj Factor	0.980	0.981	0.981	0.980	0.981	0.980	0.979	0.984	
Flow Entry, veh/h	417	470	680	766	259	292	187	140	
Cap Entry, veh/h	645	669	872	886	544	570	392	422	
V/C Ratio	0.646	0.702	0.779	0.865	0.476	0.512	0.477	0.331	
Control Delay, s/veh	18.4	20.6	20.9	28.1	14.9	15.3	19.6	14.3	
LOS	C	C	C	D	B	C	C	B	
95th %tile Queue, veh	5	6	8	11	3	3	2	1	

Appendix L: Traffic Signal Warrants



8-HOUR TRAFFIC SIGNAL WARRANT

Project & No.: Panorama North

116167

GENERAL INFORMATION

Analyst	David Perks	Jurisdiction/Area	Collingwood	Date	30 Oct 2018
Agency or Company	CCTA	East-West Street	Mountain Road		
Analysis Period	2028 Total	North-South Street	Street E		
Flow Conditions	Restricted flow (urban)	Major Street	East-West		
T Intersection	Yes	Approach Lanes per Direction	1		
		Hours of Traffic Volume Data	AM & PM peaks only		
Additional Comments					

TRAFFIC & PEDESTRIAN VOLUMES

Hour of Data	AM Peak							PM Peak	AM + PM
Hour Ending	hr ending							hr ending	4
MAJOR STREET									
Eastbound	right								0
	thru	616						734	338
	left	15						43	14
Westbound	right	20						59	20
	thru	484						809	323
	left								0
MINOR STREET									
Northbound	right								0
	thru								0
	left								0
Southbound	right	44						29	18
	thru								0
	left	61						40	25
PEDESTRIANS									
crossing MAJOR street									0
crossing MINOR street									0
APPROACH VOLUMES									
major		1136						1645	695
minor		105						69	44
TOTAL		1241						1713	739
CROSSING VOLUMES									
TOTAL		61						40	25
note 1		61						40	
note 2		0						0	
note 3		0						0	
3a		no						no	
3b		no						yes	
note 4		0						0	

NOTES

Traffic crossing MAJOR street defined as:

note 1: Left turns from both minor street approaches

note 2: The heaviest through volume from the minor street

note 3: 50% of the heavier left turn movement from the major street when both of the following are met:

3a: the left turn volume > 120

3b: the left turn volume + opposing volume > 720

note 4: Pedestrians crossing the major street

ACCIDENT HISTORY

Reportable accidents over the past 36 months susceptible to correction by a traffic signal.	months 1 to 12	-
	months 13 to 24	-
	months 25 to 36	-



8-HOUR TRAFFIC SIGNAL WARRANT

Project & No.: Panorama North

116167

GENERAL INFORMATION													
Analyst	David Perks				Jurisdiction/Area		Collingwood		Date		30 Oct 2018		
Agency or Company	CCTA				East-West Street		Mountain Road						
Analysis Period	2028 Total				North-South Street		Street E						
Flow Conditions	Restricted flow (urban)				Major Street		Mountain Road						
T Intersection	Yes				Approach Lanes per Direction		1						
Additional Comments					Hours of Traffic Volume Data		AM & PM peaks only						
JUSTIFICATION 1 - MINIMUM VEHICLE VOLUME													
JUSTIFICATION	GUIDANCE	HOUR ENDING								No. of hours with compliance			
		AM Peak	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	PM Peak				
1A	TOTAL TRAFFIC VOLUME ENTERING INTERSECTION (vph) (2 way Total)	1241	739	739	739	739	739	739	739	1713	100%	80%+	Average Compliance
	COMPLIANCE % $\frac{VOL \times 100}{720}$ OR $\frac{VOL \times 100}{900}$ (1 lane approach on main road) (2 or more lane approach on main road)	100%	100%	100%	100%	100%	100%	100%	100%	100%	8	8	100%
1B	TRAFFIC VOLUME ON MINOR STREET (vph) (2 way Total)	105	44	44	44	44	44	44	44	69	100%	80%+	Average Compliance
	COMPLIANCE % $\frac{VOL \times 100}{170}$ OR $\frac{VOL \times 100}{255}$ (full intersection) (tee intersection)	41%	17%	17%	17%	17%	17%	17%	17%	27%	0	0	21%
(RESTRICTED FLOW)		BOTH 1A AND 1B 100% FULFILLED EACH OF 8 HOURS										NO	
SIGNAL JUSTIFICATION 1:		LESSER OF 1A OR 1B AT LEAST 80% FULFILLED EACH OF 8 HOURS										NO	
JUSTIFICATION 2 - DELAY TO CROSS TRAFFIC													
JUSTIFICATION	GUIDANCE	HOUR ENDING								No. of hours with compliance			
		Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	Hour 8				
2A	MAIN ROAD TRAFFIC VOLUME (vph) (2 way Total)	1136	695	695	695	695	695	695	695	1645	100%	80%+	Average Compliance
	COMPLIANCE % $\frac{VOL \times 100}{720}$ OR $\frac{VOL \times 100}{900}$ (1 lane approach on main road) (2 or more lane approach on main road)	100%	97%	97%	97%	97%	97%	97%	97%	100%	2	8	97%
2B	CROSSING TRAFFIC VOLUME (vph) (2 way Total)	61	25	25	25	25	25	25	25	40	100%	80%+	Average Compliance
	COMPLIANCE % $\frac{VOL \times 100}{75}$	81%	34%	34%	34%	34%	34%	34%	34%	53%	0	1	42%
(RESTRICTED FLOW)		BOTH 2A AND 2B 100% FULFILLED EACH OF 8 HOURS										NO	
SIGNAL JUSTIFICATION 2:		LESSER OF 2A OR 2B AT LEAST 80% FULFILLED EACH OF 8 HOURS										NO	
JUSTIFICATION 3 - COLLISION EXPERIENCE													
A. Number of reportable collisions susceptible to prevention by a traffic signal.								Preceding Months	Number of Collisions	% Fulfillment			
								1 - 12	-	-			
								13 - 24	-	-			
								25 - 36	-	-			
								annual average	-	-			
B. Adequate trial of less restrictive remedies has failed to reduce collision frequency.								☐	YES	☐	NO	n/a	
C. Either Justification 1 (Minimum Vehicular Volume) or Justification 2 (Delay to Cross Traffic) satisfied to 80% or more.								☐	YES	☐	NO	n/a	
SIGNAL JUSTIFICATION 3:								ALL OF 3A, 3B & 3C FULFILLED TO 100%?			NO		
JUSTIFICATION 4 - COMBINATION JUSTIFICATION													
JUSTIFICATION SATISFIED 80% OR MORE								Two Justifications Satisfied 80% or more					
Justification 1	-	Minimum Vehicle Volume	NO					NO					
Justification 2	-	Delay to Cross Traffic	NO										
Justification 3	-	Collision Experience	-										
JUSTIFICATION SUMMARY													
ARE TRAFFIC SIGNALS JUSTIFIED FOR THE INTERSECTION IN QUESTION?								NO					



8-HOUR TRAFFIC SIGNAL WARRANT

Project & No.: Panorama North

116167

GENERAL INFORMATION

Analyst	David Perks	Jurisdiction/Area	Collingwood	Date	30 Oct 2018
Agency or Company	CCTA	East-West Street	Mountain Road		
Analysis Period	2035 Total	North-South Street	Street E		
Flow Conditions	Restricted flow (urban)	Major Street	East-West		
T Intersection	Yes	Approach Lanes per Direction	1		
		Hours of Traffic Volume Data	AM & PM peaks only		
Additional Comments					

TRAFFIC & PEDESTRIAN VOLUMES

Hour of Data	Hour Ending	AM Peak hr ending						PM Peak hr ending	AM + PM 4
MAJOR STREET									
Eastbound	right	634						770	0
	thru	25						76	351
	left								25
Westbound	right	20						59	20
	thru	514						838	338
	left								0
MINOR STREET									
Northbound	right								0
	thru								0
	left								0
Southbound	right	79						50	32
	thru								0
	left	61						40	25
PEDESTRIANS									
crossing MAJOR street									0
crossing MINOR street									0
APPROACH VOLUMES									
major		1195						1743	734
minor		141						90	58
TOTAL		1335						1833	792
CROSSING VOLUMES									
TOTAL		61						40	25
note 1		61						40	
note 2		0						0	
note 3		0						0	
3a		no						no	
3b		no						yes	
note 4		0						0	

NOTES

Traffic crossing MAJOR street defined as:

note 1: Left turns from both minor street approaches

note 2: The heaviest through volume from the minor street

note 3: 50% of the heavier left turn movement from the major street when both of the following are met:

3a: the left turn volume > 120

3b: the left turn volume + opposing volume > 720

note 4: Pedestrians crossing the major street

ACCIDENT HISTORY

Reportable accidents over the past 36 months susceptible to correction by a traffic signal.	months 1 to 12	-
	months 13 to 24	-
	months 25 to 36	-



8-HOUR TRAFFIC SIGNAL WARRANT

Project & No.: Panorama North

116167

GENERAL INFORMATION														
Analyst	David Perks				Jurisdiction/Area		Collingwood		Date		30 Oct 2018			
Agency or Company	CCTA				East-West Street		Mountain Road							
Analysis Period	2035 Total				North-South Street		Street E							
Flow Conditions	Restricted flow (urban)				Major Street		Mountain Road							
T Intersection	Yes				Approach Lanes per Direction		1							
Additional Comments					Hours of Traffic Volume Data		AM & PM peaks only							
JUSTIFICATION 1 - MINIMUM VEHICLE VOLUME														
JUSTIFICATION	GUIDANCE	HOUR ENDING								No. of hours with compliance				
		AM Peak	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	PM Peak					
1A	TOTAL TRAFFIC VOLUME ENTERING INTERSECTION (vph) (2 way Total)	1335	792	792	792	792	792	792	792	1833	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{720}$ OR $\frac{VOL \times 100}{900}$ (1 lane approach on main road) (2 or more lane approach on main road)	100%	100%	100%	100%	100%	100%	100%	100%	100%	8	8	100%	
1B	TRAFFIC VOLUME ON MINOR STREET (vph) (2 way Total)	141	58	58	58	58	58	58	58	90	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{170}$ OR $\frac{VOL \times 100}{255}$ (full intersection) (tee intersection)	55%	23%	23%	23%	23%	23%	23%	23%	35%	0	0	28%	
(RESTRICTED FLOW)		BOTH 1A AND 1B 100% FULFILLED EACH OF 8 HOURS										NO		
SIGNAL JUSTIFICATION 1:		LESSER OF 1A OR 1B AT LEAST 80% FULFILLED EACH OF 8 HOURS										NO		
JUSTIFICATION 2 - DELAY TO CROSS TRAFFIC														
JUSTIFICATION	GUIDANCE	HOUR ENDING								No. of hours with compliance				
		Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	Hour 8					
2A	MAIN ROAD TRAFFIC VOLUME (vph) (2 way Total)	1195	734	734	734	734	734	734	734	1743	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{720}$ OR $\frac{VOL \times 100}{900}$ (1 lane approach on main road) (2 or more lane approach on main road)	100%	100%	100%	100%	100%	100%	100%	100%	100%	8	8	100%	
2B	CROSSING TRAFFIC VOLUME (vph) (2 way Total)	61	25	25	25	25	25	25	25	40	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{75}$	81%	34%	34%	34%	34%	34%	34%	34%	53%	0	1	42%	
(RESTRICTED FLOW)		BOTH 2A AND 2B 100% FULFILLED EACH OF 8 HOURS										NO		
SIGNAL JUSTIFICATION 2:		LESSER OF 2A OR 2B AT LEAST 80% FULFILLED EACH OF 8 HOURS										NO		
JUSTIFICATION 3 - COLLISION EXPERIENCE														
A. Number of reportable collisions susceptible to prevention by a traffic signal.									Preceding Months	Number of Collisions	% Fulfillment			
									1 - 12	-	-			
									13 - 24	-	-			
									25 - 36	-	-			
									annual average	-	-			
B. Adequate trial of less restrictive remedies has failed to reduce collision frequency.									☐	YES	☐	NO	n/a	
C. Either Justification 1 (Minimum Vehicular Volume) or Justification 2 (Delay to Cross Traffic) satisfied to 80% or more.									☐	YES	☐	NO	n/a	
SIGNAL JUSTIFICATION 3:									ALL OF 3A, 3B & 3C FULFILLED TO 100%?				NO	
JUSTIFICATION 4 - COMBINATION JUSTIFICATION														
JUSTIFICATION SATISFIED 80% OR MORE									Two Justifications Satisfied 80% or more					
Justification 1	-	Minimum Vehicle Volume	NO							NO				
Justification 2	-	Delay to Cross Traffic	NO											
Justification 3	-	Collision Experience	-											
JUSTIFICATION SUMMARY														
ARE TRAFFIC SIGNALS JUSTIFIED FOR THE INTERSECTION IN QUESTION?									NO					



8-HOUR TRAFFIC SIGNAL WARRANT

Project & No.: Panorama North

116167

GENERAL INFORMATION

Analyst	David Perks	Jurisdiction/Area	Collingwood	Date	30 Oct 2018
Agency or Company	CCTA	East-West Street	Mountain Road		
Analysis Period	2040 Total	North-South Street	Street E		
Flow Conditions	Restricted flow (urban)	Major Street	East-West		
T Intersection	Yes	Approach Lanes per Direction	1		
		Hours of Traffic Volume Data	AM & PM peaks only		
Additional Comments					

TRAFFIC & PEDESTRIAN VOLUMES

Hour of Data	AM Peak							PM Peak	AM + PM
Hour Ending	hr ending							hr ending	4
MAJOR STREET									
Eastbound	right								0
	thru	645						787	358
	left	25						76	25
Westbound	right	20						59	20
	thru	526						853	345
	left								0
MINOR STREET									
Northbound	right								0
	thru								0
	left								0
Southbound	right	79						50	32
	thru								0
	left	61						40	25
PEDESTRIANS									
crossing MAJOR street									0
crossing MINOR street									0
APPROACH VOLUMES									
major		1217						1775	748
minor		141						90	58
TOTAL		1357						1865	806
CROSSING VOLUMES									
TOTAL		61						40	25
note 1		61						40	
note 2		0						0	
note 3		0						0	
3a		no						no	
3b		no						yes	
note 4		0						0	

NOTES

Traffic crossing MAJOR street defined as:

note 1: Left turns from both minor street approaches

note 2: The heaviest through volume from the minor street

note 3: 50% of the heavier left turn movement from the major street when both of the following are met:

3a: the left turn volume > 120

3b: the left turn volume + opposing volume > 720

note 4: Pedestrians crossing the major street

ACCIDENT HISTORY

Reportable accidents over the past 36 months susceptible to correction by a traffic signal.	months 1 to 12	-
	months 13 to 24	-
	months 25 to 36	-



8-HOUR TRAFFIC SIGNAL WARRANT

Project & No.: Panorama North

116167

GENERAL INFORMATION														
Analyst	David Perks				Jurisdiction/Area		Collingwood		Date		30 Oct 2018			
Agency or Company	CCTA				East-West Street		Mountain Road							
Analysis Period	2040 Total				North-South Street		Street E							
Flow Conditions	Restricted flow (urban)				Major Street		Mountain Road							
T Intersection	Yes				Approach Lanes per Direction		1							
Additional Comments					Hours of Traffic Volume Data		AM & PM peaks only							
JUSTIFICATION 1 - MINIMUM VEHICLE VOLUME														
JUSTIFICATION	GUIDANCE	HOUR ENDING								No. of hours with compliance				
		AM Peak	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	PM Peak					
1A	TOTAL TRAFFIC VOLUME ENTERING INTERSECTION (vph) (2 way Total)	1357	806	806	806	806	806	806	806	1865	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{720}$ OR $\frac{VOL \times 100}{900}$ (1 lane approach on main road) (2 or more lane approach on main road)	100%	100%	100%	100%	100%	100%	100%	100%	100%	8	8	100%	
1B	TRAFFIC VOLUME ON MINOR STREET (vph) (2 way Total)	141	58	58	58	58	58	58	58	90	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{170}$ OR $\frac{VOL \times 100}{255}$ (full intersection) (tee intersection)	55%	23%	23%	23%	23%	23%	23%	23%	35%	0	0	28%	
(RESTRICTED FLOW)		BOTH 1A AND 1B 100% FULFILLED EACH OF 8 HOURS										NO		
SIGNAL JUSTIFICATION 1:		LESSER OF 1A OR 1B AT LEAST 80% FULFILLED EACH OF 8 HOURS										NO		
JUSTIFICATION 2 - DELAY TO CROSS TRAFFIC														
JUSTIFICATION	GUIDANCE	HOUR ENDING								No. of hours with compliance				
		Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	Hour 8					
2A	MAIN ROAD TRAFFIC VOLUME (vph) (2 way Total)	1217	748	748	748	748	748	748	748	1775	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{720}$ OR $\frac{VOL \times 100}{900}$ (1 lane approach on main road) (2 or more lane approach on main road)	100%	100%	100%	100%	100%	100%	100%	100%	100%	8	8	100%	
2B	CROSSING TRAFFIC VOLUME (vph) (2 way Total)	61	25	25	25	25	25	25	25	40	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{75}$	81%	34%	34%	34%	34%	34%	34%	34%	53%	0	1	42%	
(RESTRICTED FLOW)		BOTH 2A AND 2B 100% FULFILLED EACH OF 8 HOURS										NO		
SIGNAL JUSTIFICATION 2:		LESSER OF 2A OR 2B AT LEAST 80% FULFILLED EACH OF 8 HOURS										NO		
JUSTIFICATION 3 - COLLISION EXPERIENCE														
A. Number of reportable collisions susceptible to prevention by a traffic signal.									Preceding Months	Number of Collisions	% Fulfillment			
									1 - 12	-	-			
									13 - 24	-	-			
									25 - 36	-	-			
									annual average	-	-			
B. Adequate trial of less restrictive remedies has failed to reduce collision frequency.									☐	YES	☐	NO	n/a	
C. Either Justification 1 (Minimum Vehicular Volume) or Justification 2 (Delay to Cross Traffic) satisfied to 80% or more.									☐	YES	☐	NO	n/a	
SIGNAL JUSTIFICATION 3:									ALL OF 3A, 3B & 3C FULFILLED TO 100%?				NO	
JUSTIFICATION 4 - COMBINATION JUSTIFICATION														
JUSTIFICATION SATISFIED 80% OR MORE									Two Justifications Satisfied 80% or more					
Justification 1	-	Minimum Vehicle Volume	NO							NO				
Justification 2	-	Delay to Cross Traffic	NO											
Justification 3	-	Collision Experience	-											
JUSTIFICATION SUMMARY														
ARE TRAFFIC SIGNALS JUSTIFIED FOR THE INTERSECTION IN QUESTION?									NO					



8-HOUR TRAFFIC SIGNAL WARRANT

Project & No.: Panorama North

116167

GENERAL INFORMATION

Analyst	David Perks	Jurisdiction/Area	Collingwood	Date	30 Oct 2018
Agency or Company	CCTA	East-West Street	Mountain Road		
Analysis Period	2045 Total	North-South Street	Street E		
Flow Conditions	Restricted flow (urban)	Major Street	East-West		
T Intersection	Yes	Approach Lanes per Direction	1		
Additional Comments		Hours of Traffic Volume Data	AM & PM peaks only		

TRAFFIC & PEDESTRIAN VOLUMES

Hour of Data Hour Ending	AM Peak hr ending							PM Peak hr ending	AM + PM 4
MAJOR STREET									
Eastbound right	655							802	0
thru	25							76	364
left									25
Westbound right	20							59	20
thru	537							867	351
left									0
MINOR STREET									
Northbound right									0
thru									0
left									0
Southbound right	79							50	32
thru									0
left	61							40	25
PEDESTRIANS									
crossing MAJOR street									0
crossing MINOR street									0
APPROACH VOLUMES									
major	1237							1804	760
minor	141							90	58
TOTAL	1378							1894	818
CROSSING VOLUMES									
TOTAL	61							40	25
note 1	61							40	
note 2	0							0	
note 3	0							0	
3a	no							no	
3b	no							yes	
note 4	0							0	

NOTES

Traffic crossing MAJOR street defined as:

note 1: Left turns from both minor street approaches

note 2: The heaviest through volume from the minor street

note 3: 50% of the heavier left turn movement from the major street when both of the following are met:

3a: the left turn volume > 120

3b: the left turn volume + opposing volume > 720

note 4: Pedestrians crossing the major street

ACCIDENT HISTORY

Reportable accidents over the past 36 months susceptible to correction by a traffic signal.	months 1 to 12	-
	months 13 to 24	-
	months 25 to 36	-



8-HOUR TRAFFIC SIGNAL WARRANT

Project & No.: Panorama North

116167

GENERAL INFORMATION														
Analyst	David Perks				Jurisdiction/Area		Collingwood		Date		30 Oct 2018			
Agency or Company	CCTA				East-West Street		Mountain Road							
Analysis Period	2045 Total				North-South Street		Street E							
Flow Conditions	Restricted flow (urban)				Major Street		Mountain Road							
T Intersection	Yes				Approach Lanes per Direction		1							
Additional Comments					Hours of Traffic Volume Data		AM & PM peaks only							
JUSTIFICATION 1 - MINIMUM VEHICLE VOLUME														
JUSTIFICATION	GUIDANCE	HOUR ENDING								No. of hours with compliance				
		AM Peak	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	PM Peak					
1A	TOTAL TRAFFIC VOLUME ENTERING INTERSECTION (vph) (2 way Total)	1378	818	818	818	818	818	818	818	1894	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{720}$ OR $\frac{VOL \times 100}{900}$ (1 lane approach on main road) (2 or more lane approach on main road)	100%	100%	100%	100%	100%	100%	100%	100%	100%	8	8	100%	
1B	TRAFFIC VOLUME ON MINOR STREET (vph) (2 way Total)	141	58	58	58	58	58	58	58	90	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{170}$ OR $\frac{VOL \times 100}{255}$ (full intersection) (tee intersection)	55%	23%	23%	23%	23%	23%	23%	23%	35%	0	0	28%	
(RESTRICTED FLOW)		BOTH 1A AND 1B 100% FULFILLED EACH OF 8 HOURS										NO		
SIGNAL JUSTIFICATION 1:		LESSER OF 1A OR 1B AT LEAST 80% FULFILLED EACH OF 8 HOURS										NO		
JUSTIFICATION 2 - DELAY TO CROSS TRAFFIC														
JUSTIFICATION	GUIDANCE	HOUR ENDING								No. of hours with compliance				
		Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7	Hour 8					
2A	MAIN ROAD TRAFFIC VOLUME (vph) (2 way Total)	1237	760	760	760	760	760	760	760	1804	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{720}$ OR $\frac{VOL \times 100}{900}$ (1 lane approach on main road) (2 or more lane approach on main road)	100%	100%	100%	100%	100%	100%	100%	100%	100%	8	8	100%	
2B	CROSSING TRAFFIC VOLUME (vph) (2 way Total)	61	25	25	25	25	25	25	25	40	100%	80%+	Average Compliance	
	COMPLIANCE % $\frac{VOL \times 100}{75}$	81%	34%	34%	34%	34%	34%	34%	34%	53%	0	1	42%	
(RESTRICTED FLOW)		BOTH 2A AND 2B 100% FULFILLED EACH OF 8 HOURS										NO		
SIGNAL JUSTIFICATION 2:		LESSER OF 2A OR 2B AT LEAST 80% FULFILLED EACH OF 8 HOURS										NO		
JUSTIFICATION 3 - COLLISION EXPERIENCE														
A. Number of reportable collisions susceptible to prevention by a traffic signal.									Preceding Months	Number of Collisions	% Fulfillment			
									1 - 12	-	-			
									13 - 24	-	-			
									25 - 36	-	-			
									annual average	-	-			
B. Adequate trial of less restrictive remedies has failed to reduce collision frequency.									☐	YES	☐	NO	n/a	
C. Either Justification 1 (Minimum Vehicular Volume) or Justification 2 (Delay to Cross Traffic) satisfied to 80% or more.									☐	YES	☐	NO	n/a	
SIGNAL JUSTIFICATION 3:									ALL OF 3A, 3B & 3C FULFILLED TO 100%?				NO	
JUSTIFICATION 4 - COMBINATION JUSTIFICATION														
JUSTIFICATION SATISFIED 80% OR MORE									Two Justifications Satisfied 80% or more					
Justification 1	-	Minimum Vehicle Volume	NO							NO				
Justification 2	-	Delay to Cross Traffic	NO											
Justification 3	-	Collision Experience	-											
JUSTIFICATION SUMMARY														
ARE TRAFFIC SIGNALS JUSTIFIED FOR THE INTERSECTION IN QUESTION?									NO					