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Lakefield South Subdivision

TRAFFIC IMPACT STUDY ADDENDUM

Triple T Holdings Ltd.

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Issue	Date	Description
1	June 28, 2023	Final Report

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1 Introduction

Tatham Engineering Limited was retained by Triple T Holdings Ltd. to prepare an addendum to the *Lakefield South Subdivision - 3358 Lakefield Road - Traffic Study Report*¹ (TIS) completed by Tranplan Associates. This addendum has reviewed the proposed changes to the residential unit counts and commercial gross floor area, reassessed the network operations at the 2029 horizon (to assume partial build-out rather than full build-out as was assumed in the initial TIS) and further assessed network operations for the 2045 horizon. The addendum also addresses comments provided by the Township's peer reviewer with respect to the initial TIS. A response letter providing a brief summary of how the peer reviewer's comments have been addressed is included in Appendix A.

¹ *Lakefield South Subdivision - 3358 Lakefield Road - Traffic Study Report*. Tranplan Associates, March 2020.



2 Proposed Development

2.1 LAND USES

As per the current site plan (refer to Figure 1), the proposed development will consist of the following:

- 262 single-family detached units;
- 109 townhouse units;
- 523 apartment units; and
- 4,000 m² (43,100 ft²) of ground floor commercial space.

It is noted that the site plan indicates a total of 566 apartment units; however, the ground floor commercial space will displace a portion of these units. With an average apartment size of 93 m² (1,000 ft²), the proposed ground floor commercial space (4,000 m² or 43,100 ft²) will displace approximately 43 apartment units, reducing the total apartment unit count to 523 units.

It has been assumed that the ground floor commercial space will be located centrally within the subject site, within the apartment block located immediately east of Water Tower Road and bounded by the internal loop road illustrated in the site plan.

2.2 PHASING

Per communications with the client, construction of the development is expected to commence in 2025. In considering an average build rate of approximately 50 units per year (as is typical for the area), 200 units are expected to be built and occupied by the 2029 horizon. This reflects approximately 25% build-out of the residential component of the site by the 2029 horizon. For the purposes of this study, it is assumed that the commercial development will also be 25% built out by the 2029 horizon.

2.3 TRIP GENERATION

In accordance with the methodologies adopted in the initial TIS, the number of vehicle trips to be generated by the proposed development for the weekday AM and weekday PM peak hours has been determined based on the type of use, development size, and trip generation rates per the *ITE Trip Generation Manual, 10th Edition*². It is noted that the commercial space has been assumed to consist of 50% retail space and 50% office space, for which the *shopping centre* (ITE

² *Trip Generation Manual, 10th Edition*. Institute of Transportation Engineers. September 2017.



land-use code 820) and *general office* (ITE land-use code 710) land-uses have been applied, respectively. Furthermore, as resolved with the peer reviewer, the trip generation for the commercial uses has been established using the fitted curve equations as opposed to the average trip rates, resulting in a more conservative trip estimate (i.e. the fitted curve equations results in greater trip estimates as compared to the average trip rates). The trip rates/equations are summarized in Table 1.

Table 1: Trip Rates

LAND USE	VARIABLE	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
		In	Out	Total	In	Out	Total
single family detached (ITE 210)	unit	0.18	0.56	0.74	0.62	0.37	0.99
low-rise apartments (ITE 220)	unit	0.11	0.35	0.36	0.35	0.21	0.56
general office (ITE 710)	gross floor area	T = 0.94X + 26.49 ¹ 86% in / 14% out			LN(T) = 0.95LN(X) + 0.36 ¹ 16% in / 84% out		
shopping centre (ITE 820)	gross floor area	T = 0.50X + 150.78 ¹ 62% in / 38% out			LN(T) = 0.74LN(X) + 2.89 ¹ 48% in / 52% out		

¹ ITE fitted curve equation, where T = trips and X = 1,000 ft² GFA.

Rates for the *single family detached* (ITE land-use code 210) land-use have been considered for both the single-family units and townhouse units, in accordance with the methodologies adopted in the TIS. Trip estimates are summarized in Table 2. As indicated, the site is expected to generate a total of 727 trips during the weekday AM peak and 862 trips during the weekday PM peak.

As resolved between Tranplan and the peer reviewer, a 10% reduction has been applied to the commercial trips (i.e. office + retail) to represent internal trips generated by the proposed development. Internal trips are those trips made without accessing the external road network. For example, someone living in one of the townhouse units near the commercial space may visit a store without needing to use the surrounding external road network, thus generating an internal trip. The net trip estimates are summarized in Table 3.

As indicated, the site is expected to generate 706 new trips during the weekday AM peak and 842 trips during the weekday PM peak upon full build-out. For the 2029 horizon (i.e. 25% build-out), the site will be expected to generate 177 new trips during the AM peak hour and 211 new trips during the PM peak hour.



Table 2: Trip Estimates - Gross Trips

LAND USE (ITE CODE USED)	SIZE	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
		In	Out	Total	In	Out	Total
single family (210)	262 units	49	146	195	163	96	259
townhouses (210)	109 units	21	61	82	69	39	108
apartments (220)	523 units	55	186	241	185	108	293
residential total	894 units	125	393	518	417	243	660
office space (710)	21,550 ft ²	40	7	47	4	23	27
retail space (820)	21,550 ft ²	100	62	162	84	91	175
commercial total	43,100 ft²	140	69	209	88	114	202
Total Gross Trips		265	462	727	505	357	862

Table 3: Trip Estimates - Net Trips

TRIP TYPE	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
	In	Out	Total	In	Out	Total
residential trips	125	393	518	417	243	660
commercial trips (gross)	140	69	209	88	114	202
internal trips (10% of commercial)	14	7	21	9	11	20
Total Net Trips	251	455	706	496	346	842
Phase 1 Total Net Trips (25%)	63	114	177	124	87	211



3 Traffic Volumes

3.1 EXISTING VOLUMES

The 2018 design hour volumes (DHVs), as provided in the initial TIS, are illustrated in Figure 2.

3.2 BACKGROUND VOLUMES

The 2029 background volumes (as provided in the initial TIS) are illustrated in Figure 3 and are based on the 2018 DHVs with an assumed 2% growth per annum on each road.

To determine traffic volumes for the 2045 horizon year, a 1% growth per annum was applied to the 2029 background volumes on each road. While this is lower than the growth rate applied in the TIS for the period 2018 to 2029, it is in line with historical growth rates observed in census data for the County of Peterborough (approximately 1% per annum from 2011 to 2021) and projected annual growth needed to reach the population targets set out in the province's *A Place to Grow - Growth Plan for the Greater Golden Horseshoe*³ report (approximately 0.85% per annum from 2021 to 2051). The resulting 2045 background volumes are illustrated in Figure 4.

3.3 LAKEFIELD SOUTH VOLUMES

In considering the distribution of the site traffic volumes to the area road system, the residential trips were distributed based on the same distribution applied in the initial TIS, whereas the commercial trips were distributed based on a modified distribution resolved between Tranplan and the peer reviewer. The resulting trip distributions applied are summarized in Table 4.

Table 4: Trip Distribution

GATEWAY	TRAVEL DIRECTION	RESIDENTIAL	COMMERCIAL
Bridge Street	East	22%	30%
Clementi Street	North	2%	5%
County Road 18	West	18%	25%
7 th Line	West	8%	5%
County Road 29	South	50%	25%
Internal	-	-	10%

³ *A Place to Grow - Growth Plan for the Greater Golden Horseshoe*. Province of Ontario. August 2020



The site trips assigned to the network, assuming 100% build-out, are illustrated in:

- Figure 5 for the residential trips;
- Figure 6 for the commercial trips; and
- Figure 7 for the total site trips.

The site trips for the 2029 horizon, reflective of 25% build-out, are illustrated in Figure 8.

3.4 TOTAL VOLUMES

The resulting 2029 and 2045 total traffic volumes (i.e. background volumes + site traffic) are illustrated in Figure 9 and Figure 10.



4 Traffic Operations

The operations of the study area intersections were reviewed under 2029 total conditions (to determine the impact of the revised site trip generation), and for the 2045 horizon under both background and total conditions. The operational assessment has considered the intersection configuration and control as determined in the initial TIS, with intersection geometries reviewed and revised as needed based on subsequent field measurements undertaken by Tranplan (intersection geometries are provided in Appendix B). Procedures outlined in the *2000 Highway Capacity Manual*⁴ (using Synchro v.11 software) were used in the assessment. For signalized intersections, the analysis considers:

- the average delay (measured in seconds);
- level of service (LOS); and
- volume to capacity (v/c) for each signalized movements.

At unsignalized intersections, the analysis considers the same metrics, but with a focus on critical movements only, such as those operating under stop control.

With respect to the noted metrics:

- 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 (additional details provided in Appendix C); and
- a v/c ratio of less than 1.0 indicates the intersection movement/approach is operating at less than capacity while v/c of 1.0 indicates capacity has been reached.

Operational summaries at each horizon are provided below, with detailed operations worksheets provided in Appendix D.

4.1 2029 OPERATIONS

A summary of the intersection operations under 2029 total conditions (25% build-out) is provided in Table 5. As indicated, each intersection is expected to provide acceptable operations (LOS D or better) through the 2029 horizon under total conditions, assuming a build-out of approximately 25% of the subject site. Therefore, no network improvements are required to support this level of build-out.

⁴ *Highway Capacity Manual*. Transportation Research Board, Washington DC, 2000.



Table 5: Intersection Operations - 2029 Total

INTERSECTION, MOVEMENT & CONTROL			WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
			Delay	LOS	V/C	Delay	LOS	V/C
County Road 29 & Clementi Street	EB L	signal	7	A	0.12	11	B	0.33
	EB TR	signal	14	B	0.70	15	B	0.72
	WB L	signal	6	A	0.17	6	A	0.23
	WB TR	signal	8	A	0.58	15	B	0.82
	NB L	signal	32	C	0.48	31	C	0.38
	NB TR	signal	29	C	0.18	28	C	0.14
	SB L	signal	30	C	0.34	30	C	0.32
	SB TR	signal	28	C	0.06	28	C	0.10
	overall	signal	14	B	0.65	16	B	0.76
County Road 29 & Water Tower Road/ Commercial Access	EB L	free	9	A	0.01	11	B	0.00
	WB L	free	9	B	0.03	10	B	0.05
	NB LTR	stop	20	C	0.22	24	C	0.21
	SB LTR	stop	18	C	0.02	21	C	0.07
County Road 29 & County Road 18	EB L	signal	23	C	0.81	19	B	0.72
	EB R	signal	11	B	0.08	12	B	0.07
	NB L	signal	12	B	0.19	11	B	0.29
	NB T	signal	14	B	0.52	15	B	0.69
	SB T	signal	19	B	0.74	19	B	0.80
	SB R	signal	12	B	0.23	11	B	0.39
	overall	signal	17	B	0.78	16	B	0.76
County Road 29 & 7 th Line	EB LTR	stop	18	C	0.06	30	D	0.17
	WB LTR	stop	24	C	0.37	30	D	0.35
William Street & Clementi Street	EB LT	stop	8	A	0.10	8	A	0.09
	WB TR	stop	8	A	0.10	7	A	0.04
	SB LR	stop	8	A	0.14	8	A	0.13
Water Tower Road & North Collector	EB LTR	stop	9	A	0.01	9	A	0.01
	WB LTR	stop	9	A	0.01	9	A	0.01
7 th Line & South Collector	SB LR	stop	9	A	0.06	9	A	0.04



4.2 2045 OPERATIONS

4.2.1 Background Operations

Table 6 summarizes the intersection operations under 2045 background conditions.

Table 6: Intersection Operations – 2045 Background

INTERSECTION, MOVEMENT & CONTROL			WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
			Delay	LOS	V/C	Delay	LOS	V/C
County Road 29 & Clementi Street	EB L	signal	9	A	0.17	18	B	0.50
	EB TR	signal	22	C	0.84	19	B	0.82
	WB L	signal	8	A	0.23	7	A	0.29
	WB TR	signal	10	A	0.68	21	C	0.91
	NB L	signal	31	C	0.51	32	C	0.50
	NB TR	signal	28	C	0.20	29	C	0.17
	SB L	signal	30	C	0.37	31	C	0.43
	SB TR	signal	27	C	0.07	28	C	0.11
	overall	signal	18	B	0.75	21	C	0.87
County Road 29 & Water Tower Road/ Commercial Access	EB L	free	9	A	0.01	12	B	0.00
	WB L	free	11	B	0.00	11	B	0.00
	NB LTR	stop	19	C	0.01	23	C	0.01
	SB LTR	stop	19	C	0.02	24	C	0.10
County Road 29 & County Road 18	EB L	signal	32	C	0.90	25	C	0.79
	EB R	signal	11	B	0.09	13	B	0.08
	NB L	signal	13	B	0.24	13	B	0.42
	NB T	signal	15	B	0.58	18	B	0.75
	SB T	signal	24	C	0.82	26	C	0.88
	SB R	signal	12	B	0.25	12	B	0.45
	overall	signal	22	C	0.86	19	B	0.84
County Road 29 & 7 th Line	EB LTR	stop	18	C	0.05	34	D	0.16
	WB LTR	stop	22	C	0.20	20	C	0.16
William Street & Clementi Street	EB LT	stop	9	A	0.11	8	A	0.10
	WB TR	stop	8	A	0.12	7	A	0.04
	SB LR	stop	9	A	0.16	8	A	0.15



As indicated, and similar to the findings of the initial TIS under 2029 background conditions, the network will provide acceptable operations (LOS D or better) through the 2045 horizon under background conditions. Signal timing plans did not require modifications from those established under 2029 background conditions.

4.2.2 Total Conditions

A summary of the intersection operations under 2045 total conditions (i.e. 100% build-out) is provided in Table 7. Signal timing plans at each intersection were optimized as necessary to ensure optimal operations are achieved.

As indicated, most intersections are expected to provide acceptable operations (LOS E or better) through the 2045 horizon. It is noted that the intersections of County Road 29 with Water Tower Road and with 7th Line both experience poor operations (LOS F) with delays on some movements exceeding 150 seconds during peak times. Therefore, the recommendation to signalize these intersections to address poor operations, as per the initial TIS, is valid by the 2045 horizon.

A reassessment of the noted intersections under signalized control is presented in Table 8 and demonstrates that each intersection will provide acceptable operations (LOS E or better) under signalized control.

It is noted that some intersections along the County Road 29 corridor are operating at or near capacity (i.e. $v/c > 0.95$), which indicates that additional capacity may be needed to accommodate increasing volumes by the 2045 horizon. It is noted that such capacity concerns are also identified in the *Peterborough County 2022 Transportation Master Plan Update*⁵. The *Transportation Master Plan Update* recommends the construction of a new two-lane arterial road and bridge over the Otonabee River. The exact alignment of this new link is not yet determined, but would extend between County Road 29 in the west and County Road 33 in the east (i.e. through the Lakefield South Planning Area, possibly via 7th Line), thus providing an alternative high-capacity route around Lakefield and through the study area. The recommendations in the *Transportation Master Plan Update* are expected to address the note capacity concerns.

Notwithstanding the recommended traffic signals at the intersections of County Road 29 with Water Tower Road and 7th Line, no further improvements to the study area network are considered necessary to accommodate the 2045 future total conditions, recognizing that such will be addressed through the *Transportation Master Plan Update* improvements recommended for the wider road network.

⁵ *Peterborough County 2022 Transportation Master Plan Update*. Paradigm Transportation Solutions Inc. & Stantec. October 2022.



Table 7: Intersection Operations – 2045 Total

INTERSECTION, MOVEMENT & CONTROL			WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
			Delay	LOS	V/C	Delay	LOS	V/C
County Road 29 & Clementi Street	EB L	signal	9	A	0.24	51	D	0.79
	EB TR	signal	34	C	0.96	21	C	0.84
	WB L	signal	12	B	0.32	9	A	0.36
	WB TR	signal	12	B	0.74	34	C	0.98
	NB L	signal	31	C	0.51	40	D	0.48
	NB TR	signal	28	C	0.21	37	D	0.18
	SB L	signal	30	C	0.39	40	D	0.44
	SB TR	signal	27	C	0.08	36	D	0.14
	overall	signal	24	C	0.84	30	C	0.92
County Road 29 & Water Tower Road/ Commercial Access	EB L	free	9	A	0.01	12	B	0.00
	WB L	free	12	B	0.13	13	B	0.22
	NB LTR	stop	164	F	1.19	282	F	1.42
	SB LTR	stop	34	D	0.04	47	E	0.19
County Road 29 & County Road 18	EB L	signal	54	D	1.00	37	D	0.89
	EB R	signal	12	B	0.10	16	B	0.11
	NB L	signal	14	B	0.37	17	B	0.52
	NB T	signal	15	B	0.59	22	C	0.79
	SB T	signal	30	C	0.88	29	C	0.88
	SB R	signal	13	B	0.31	15	B	0.50
	overall	signal	30	C	0.94	25	C	0.88
County Road 29 & 7 th Line	EB LTR	stop	28	C	0.17	118	F	0.73
	WB LTR	stop	352	F	1.62	778	F	2.47
William Street & Clementi Street	EB LT	stop	9	A	0.11	8	A	0.10
	WB TR	stop	8	A	0.12	7	A	0.04
	SB LR	stop	9	A	0.16	8	A	0.15



Table 8: Intersection Operations – 2045 Total (with signalization)

INTERSECTION, MOVEMENT & CONTROL			WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
			Delay	LOS	V/C	Delay	LOS	V/C
County Road 29 & Water Tower Road/ Commercial Access	EB L	signal	6	A	0.03	5	A	0.02
	EB TR	signal	32	C	0.95	32	C	0.95
	WB L	signal	27	C	0.60	59	E	0.88
	WB TR	signal	17	B	0.79	43	D	1.00
	NB LTR	signal	67	E	0.92	73	E	0.89
	SB LTR	signal	25	C	0.01	34	C	0.04
	overall	signal	31	C	0.94	41	D	0.98
County Road 29 & 7 th Line	EB LTR	signal	21	C	0.07	25	C	0.20
	WB LTR	signal	54	D	0.89	40	D	0.76
	NB LTR	signal	14	B	0.57	22	C	0.86
	SB LTR	signal	17	B	0.70	17	B	0.75
	overall	signal	23	C	0.76	22	C	0.83

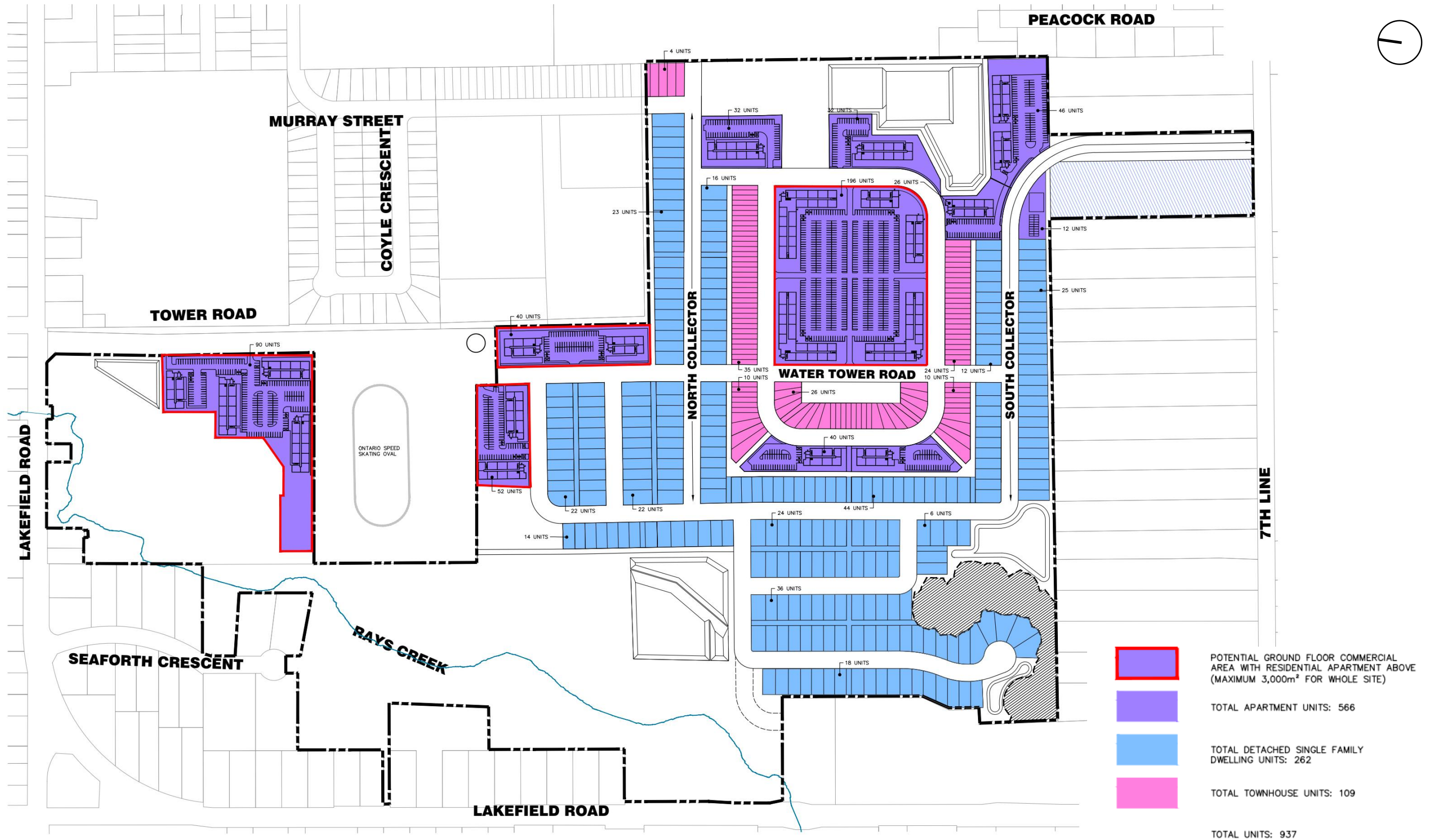


5 Summary

This addendum has been prepared to address comments provided by the peer reviewer and consider proposed changes to the Lakefield South Subdivision development plan. The trip generation for the site has been revisited and the road network operations reassessed for the future horizon years of 2029 and 2045. The following are the findings of the review for each horizon year:

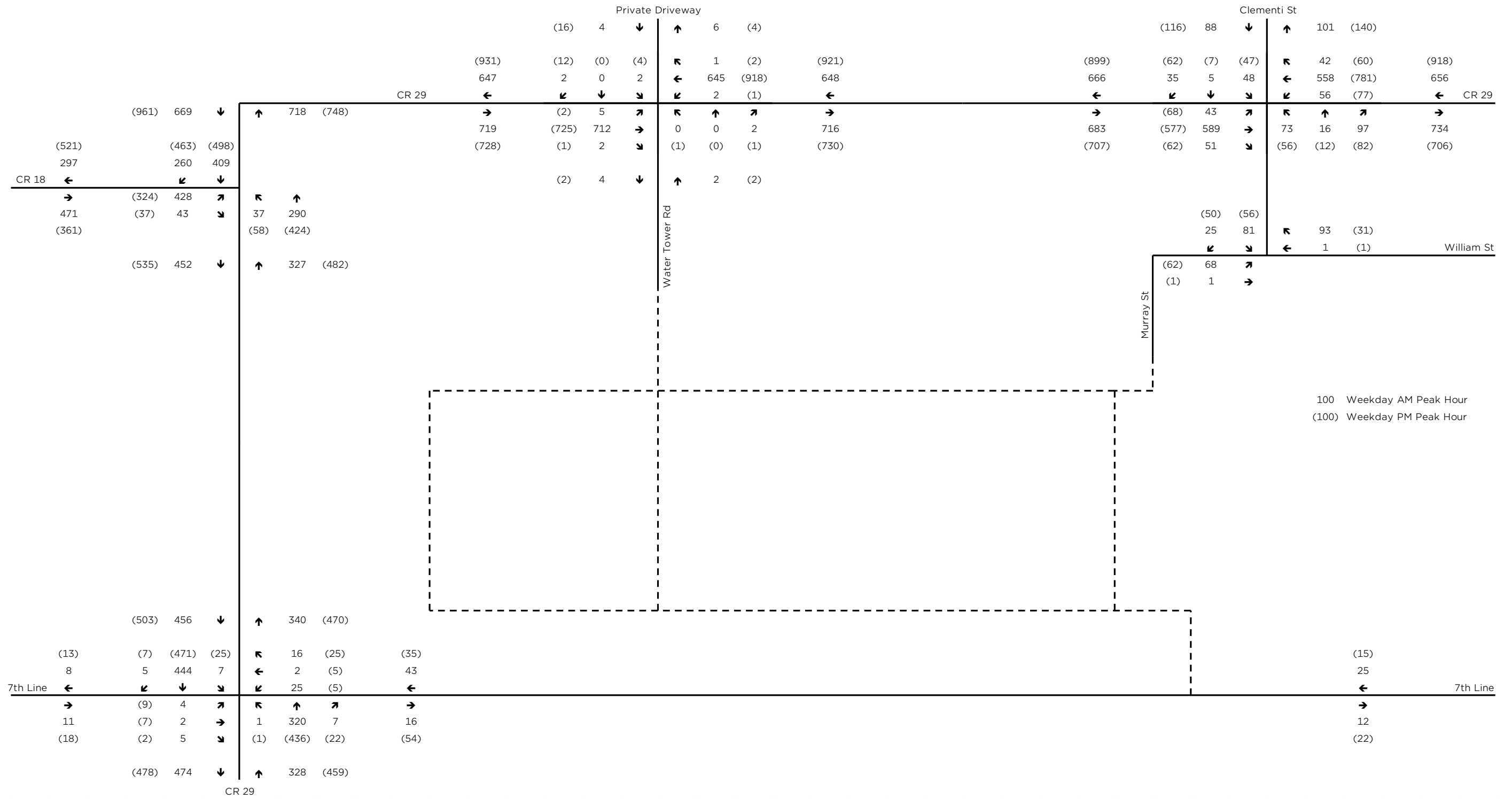
- 2029 horizon
 - Assuming 25% build-out of the site, no improvements are required to accommodate the 2029 conditions.
- 2045 Horizon
 - Traffic signals are recommended for the intersections of County Road 29 with Water Tower Road and 7th Line to support full build-out of the site.
 - While road capacity becomes somewhat limited at select intersections following build-out of the subject development, the capacity concerns are expected to be addressed through improvements to the wider road network as identified in the County's *Transportation Master Plan Update*.





LAKEFIELD SOUTH SUBDIVISION
Figure 1: Site Plan

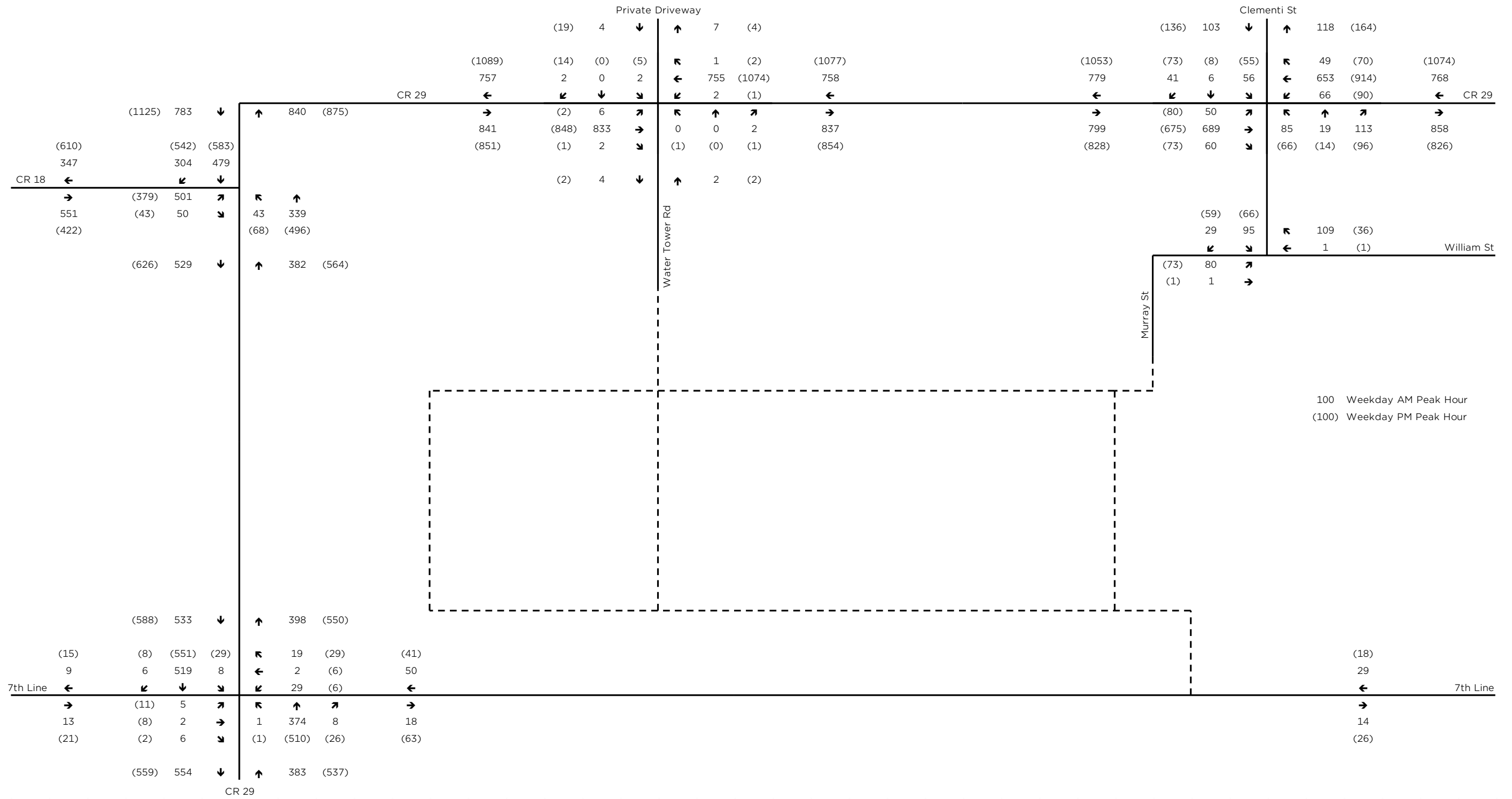




100 Weekday AM Peak Hour
 (100) Weekday PM Peak Hour

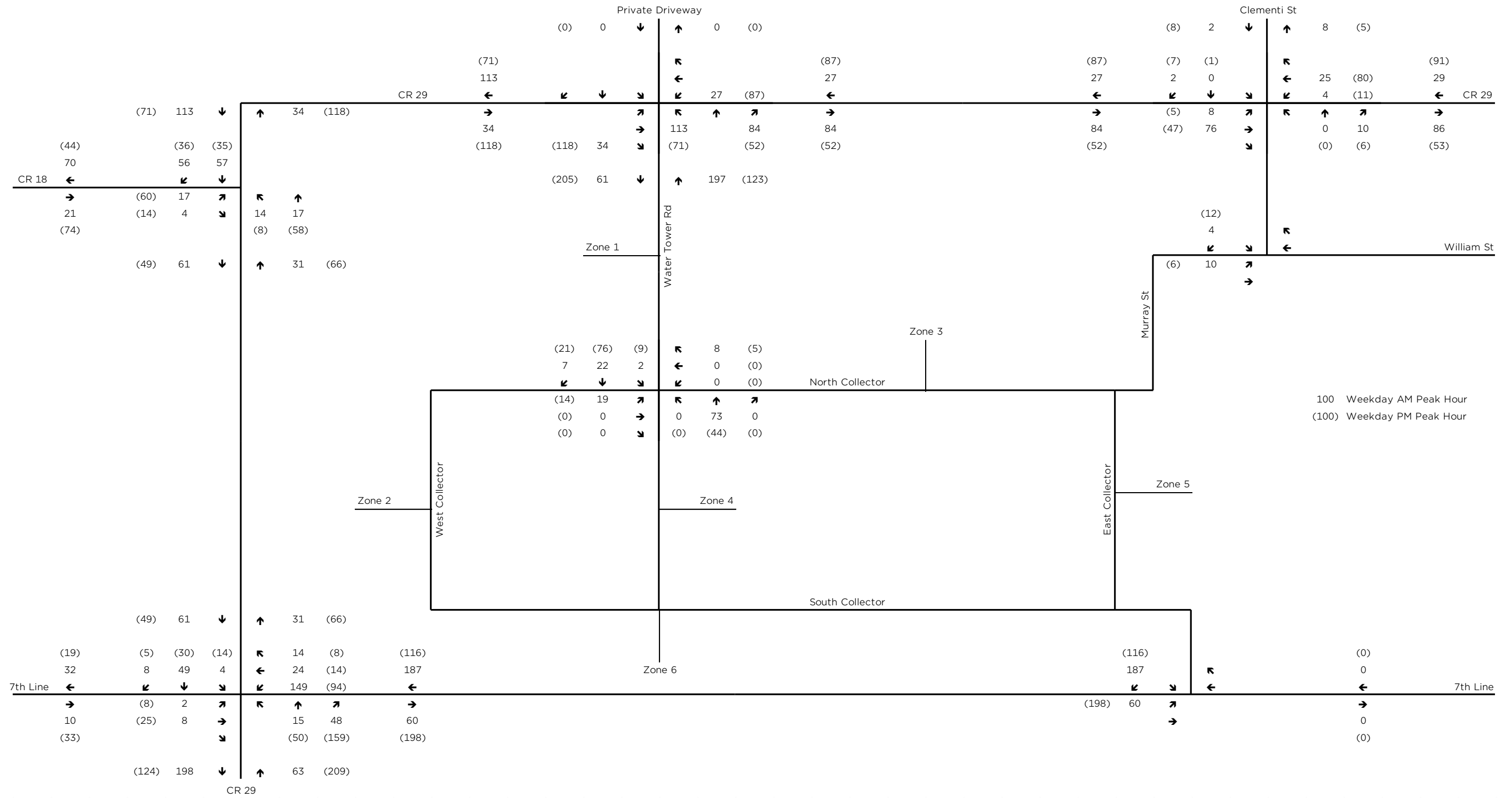
LAKEFIELD SOUTH SUBDIVISION
 Figure 3: Traffic Volumes - 2029 Background





LAKEFIELD SOUTH SUBDIVISION
Figure 4: Traffic Volumes - 2045 Background

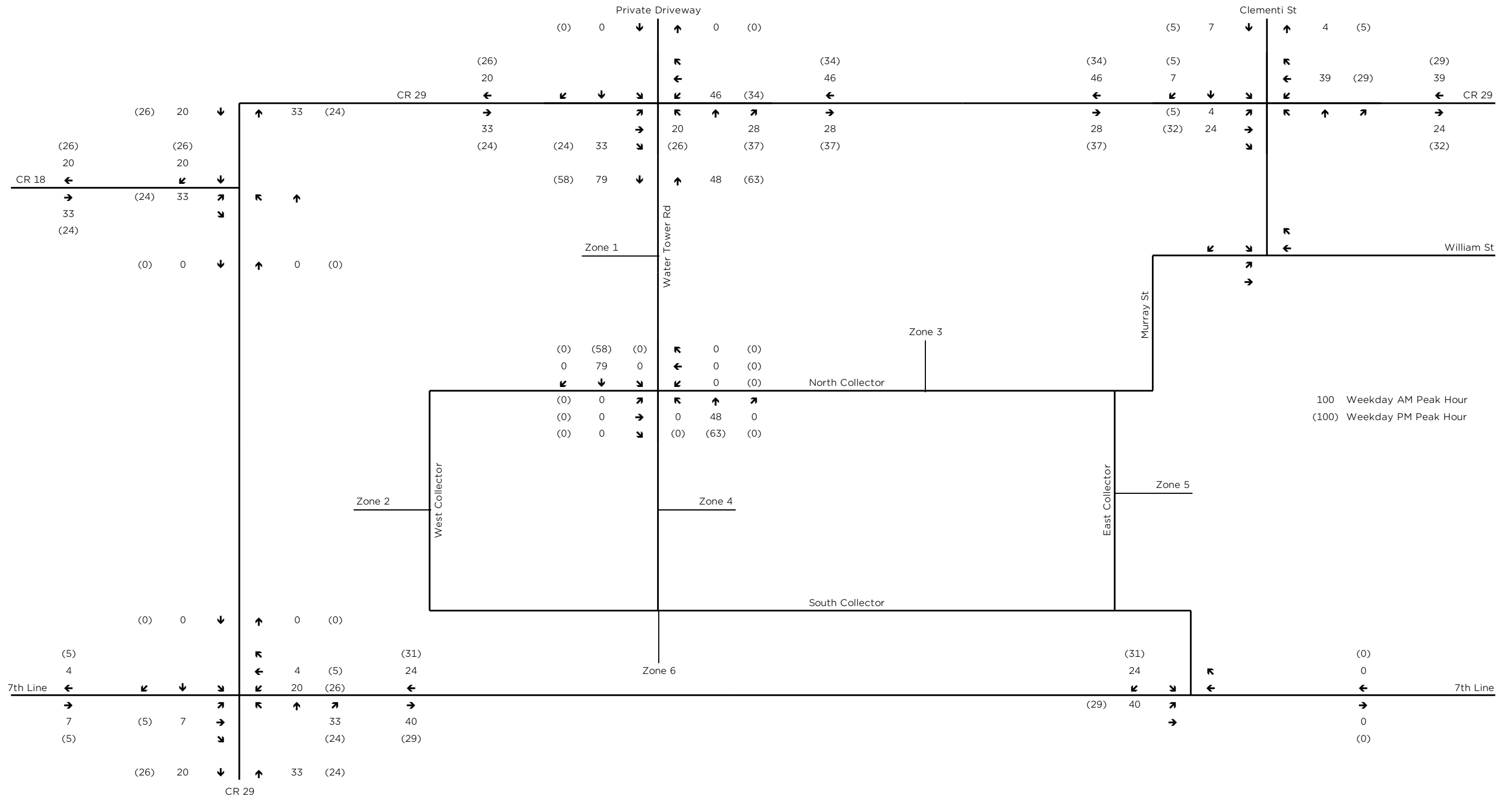




LAKEFIELD SOUTH SUBDIVISION

Figure 5: Site Traffic - Residential Trips

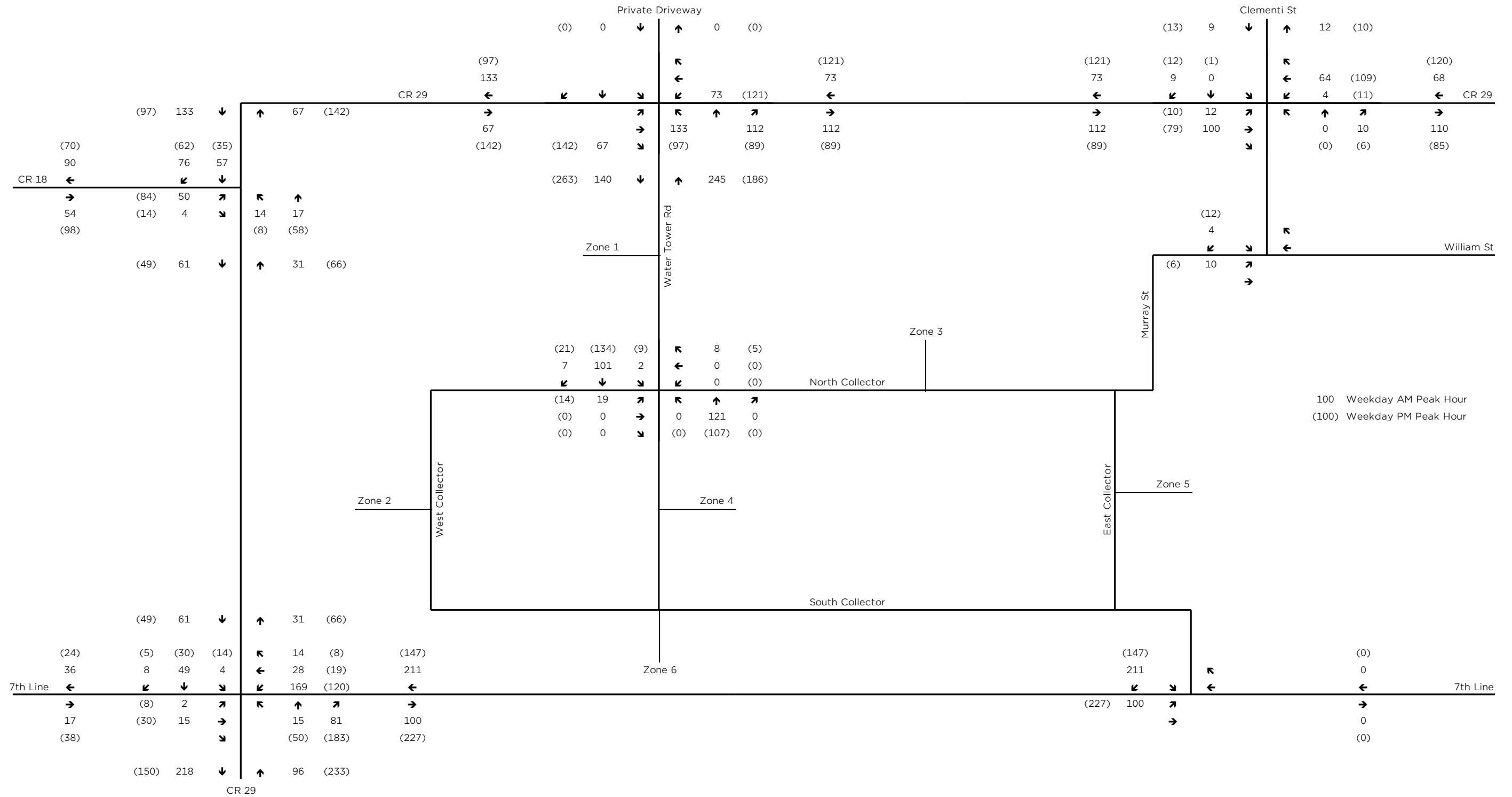




LAKEFIELD SOUTH SUBDIVISION

Figure 6: Site Traffic – Commercial Trips

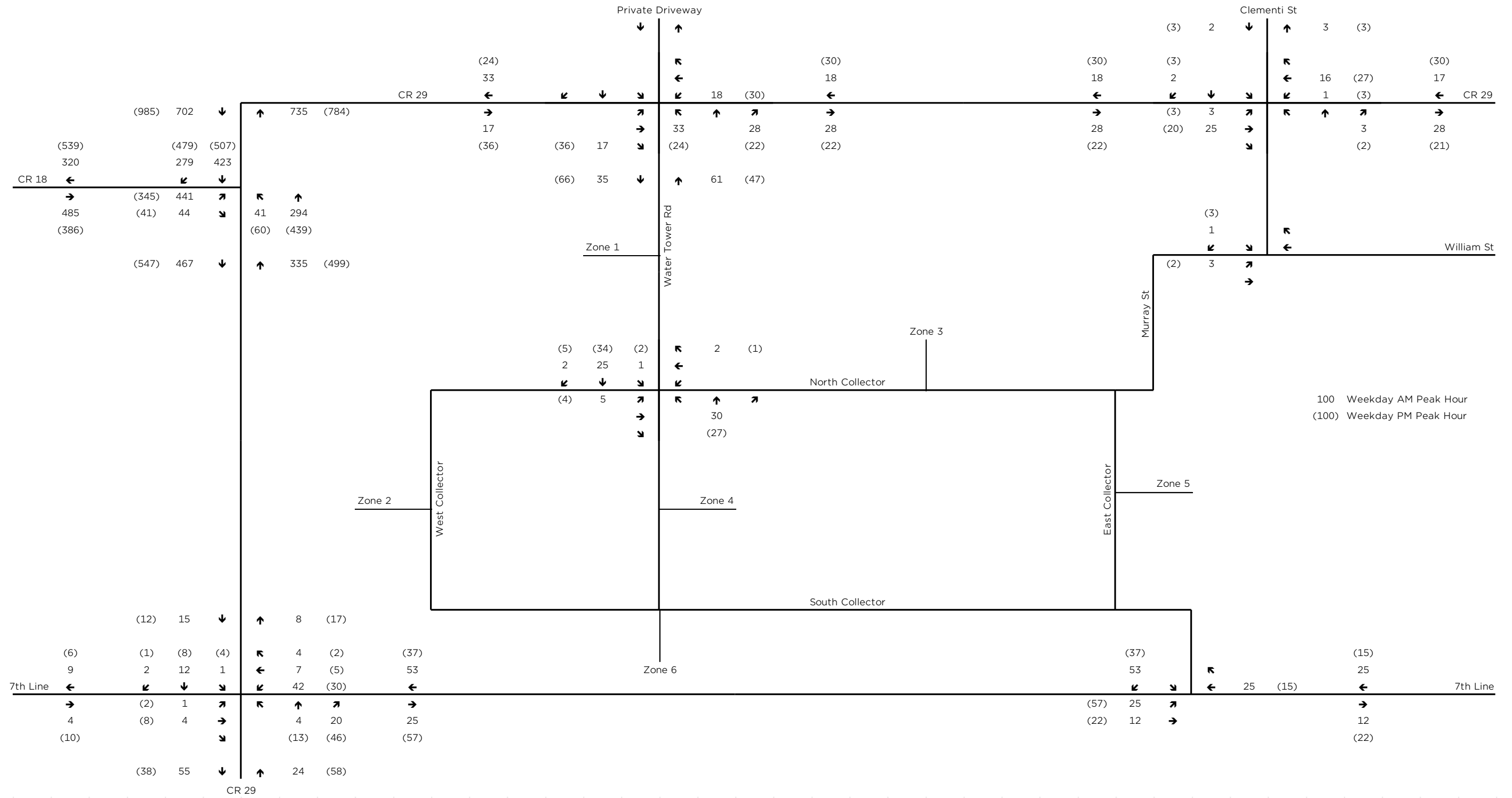




LAKEFIELD SOUTH SUBDIVISION

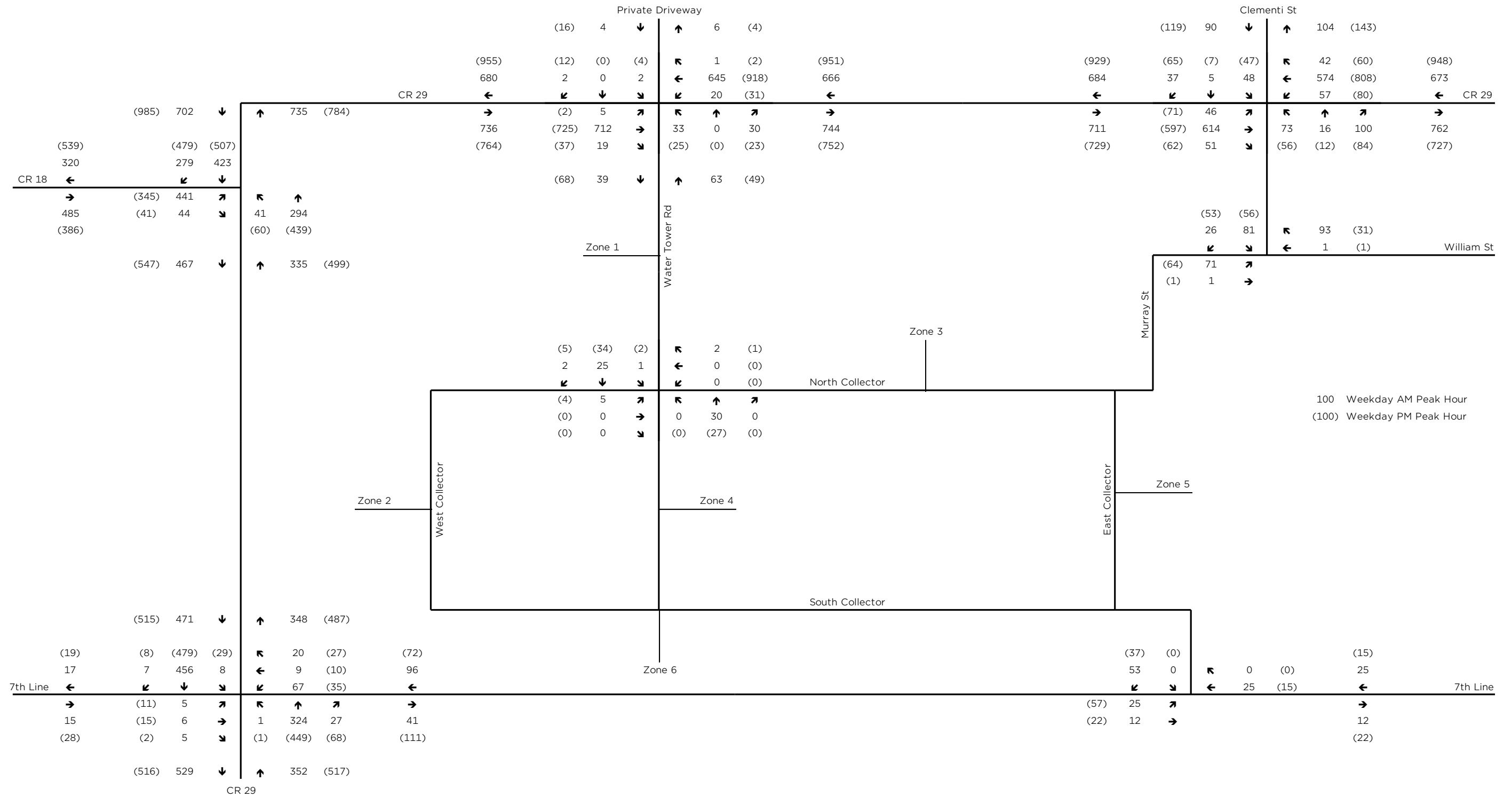
Figure 7: Site Traffic – Total Trips





LAKEFIELD SOUTH SUBDIVISION
Figure 8: Site Traffic – 25% Build-out (2029)

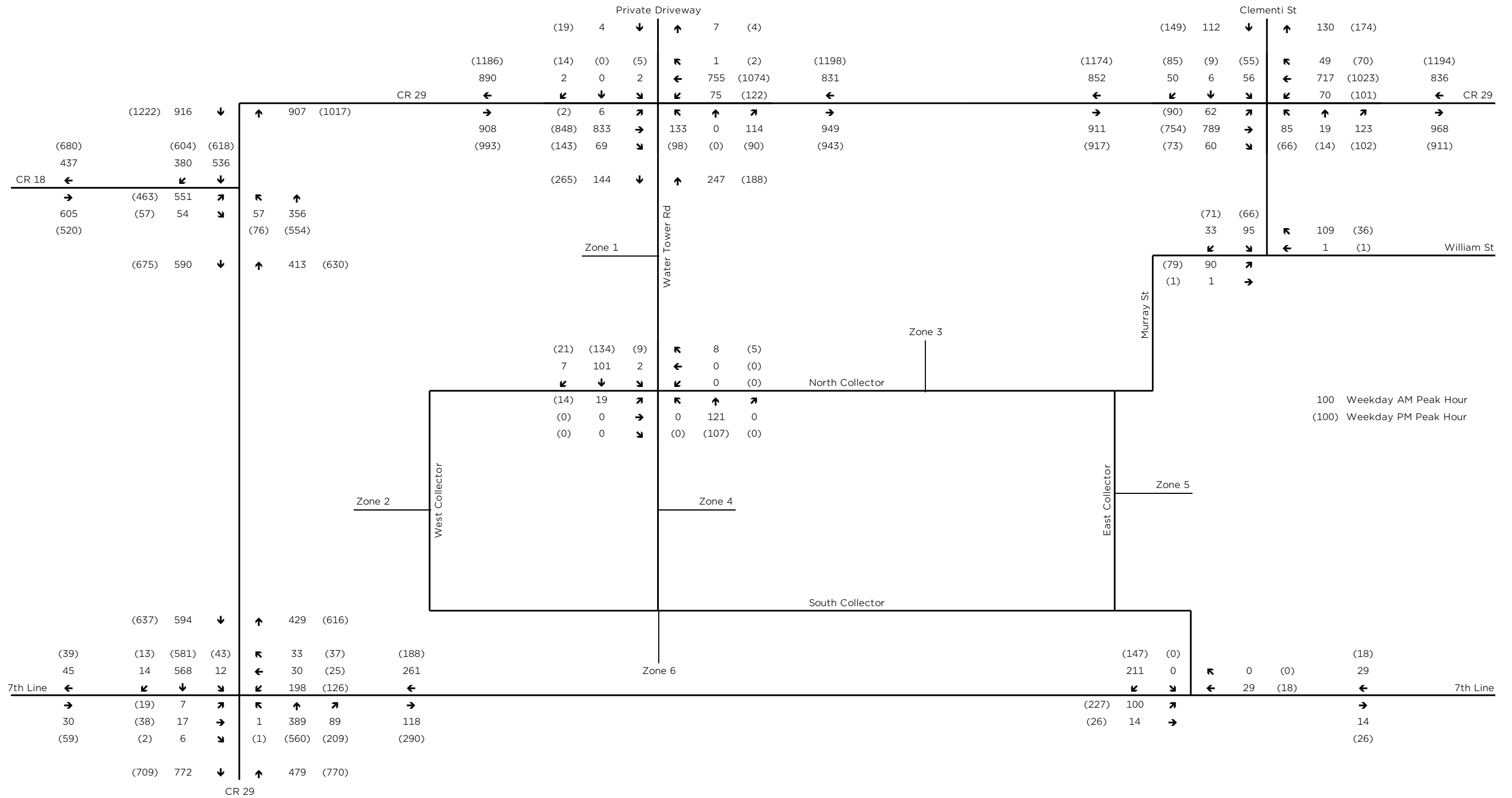




LAKEFIELD SOUTH SUBDIVISION

Figure 9: Traffic Volumes - 2029 Total





LAKEFIELD SOUTH SUBDIVISION
 Figure 10: Traffic Volumes - 2045 Total



**Appendix A:
Peer Review Comment Response
Letter**

File 517651

June 28, 2023

Bill Turner
Triple T Holdings Ltd.
PO Box 1079
Peterborough, Ontario K9J 7A9
bill@tttholdings.com

Re: Lakefield South Subdivision, Township of Selwyn
TIS Peer Review Comments -Response Summary

Dear Bill:

This letter provides a summary of our responses to the outstanding peer review comments received from the Township in relation to the *Lakefield South Subdivision – 3358 Lakefield Road – Traffic Study Report*¹, and is supplementary to the *Lakefield South Subdivision – Traffic Impact Study Addendum* (provided under separate cover). The addendum provides a fulsome technical response to the outstanding peer review comments and also considers revisions to the site plan, whereas this letter provides a brief summary of how each of the outstanding peer review comments have been addressed.

For ease of reference, the outstanding review comments are paraphrased in italics below (any comments described as “closed” have not been included). The complete peer review comments provided by the Township’s peer reviewer and additional follow-up correspondence are provided in Appendix A.

OUTSTANDING PEER REVIEW COMMENTS

Item 3 – Stantec’s differences with Report Intersection Geometrics

The peer review process identified several turn lanes at various intersections assessed in the study which were not correctly sized in the Synchro assessment. In response, Tranplan completed field measurements at the identified lanes to determine the existing dimensions of each. It is recommended that the revised geometrics be applied in subsequent analysis revisions.

The revised intersection geometries established by Tranplan through field measurements have been incorporated in the *Lakefield South Subdivision TIS Addendum*.

¹ *Lakefield South Subdivision – 3358 Lakefield Road – Traffic Study Report*. Tranplan Associates. March 2020.

Item 7 – Discrepancies in site-generated traffic volumes*7.2 – Apartment Trip Generation (LU 220)*

Tranplan identified that trip generation for apartments was completed using person trip rates rather than vehicle trip rates. In consideration of the anticipated revisions to the proposed commercial GFA entailing a reduction in apartment units and the envisioned construction timeframes, it is recommended to use the vehicular trip generation rates to update the trip generation calculations.

Vehicle trip rates were used to determine trip generation of all proposed land uses.

Item 8 – Commercial/Retail Trip Generation Forecasts

Stantec agreed with the methodology provided under separate cover, dated September 14, 2021.

The noted methodology is provided in Appendix A and has implemented in the *Lakefield South Subdivision TIS Addendum*.

Items 12 & 14 – Difference in AM & PM Commercial Trip Distribution

To be revised by consultant

Commercial trip distribution, as resolved through subsequent discussion between Tranplan and Stantec (see Appendix A), was implemented in the *Lakefield South Subdivision TIS Addendum*.

Item 18 – Options for Geometric Improvements at the CR 29/Water Tower Rd Intersection**Item 20 – Use of “All-or-Nothing” Assignment Does Not Account for Diverting Traffic**

Initial comments regarding Items 18 and 20 were intended to account for unexpected driver behaviours, such as drivers seeking alternate routes to bypass intersections experiencing high delays. It is acknowledged that “All-or-Nothing” assignment is acceptable for assignment of site-generated traffic. Request that the need for signalization of currently unsignalized intersections be confirmed.

The need for signalization at the intersections of County Road 29 with Water Tower Road and with 7th Line was reviewed in the *Lakefield South Subdivision TIS Addendum* for each horizon with recommendations identified as informed by the resulting traffic operations.

Item 21 – Signal Timing Plans Appended to the Technical Appendix

Request that signal timing plans used in Synchro assessment be included in technical appendix in order to perform spot checks during the review process.

Signal timing plans as coded in the Synchro assessments are provided in the technical appendices of the *Lakefield South Subdivision TIS Addendum*.



SUMMARY

We trust that the above, in conjunction with the detailed technical analysis provided in the *Lakefield South Subdivision TIS Addendum*, adequately addresses the outstanding peer review comments. Should you have any questions regarding the content provided herein, please do not hesitate to contact us.

Yours truly,

Tatham Engineering Limited



Matthew Buttrum B.Eng., EIT
Engineering Intern
MJB/DP: mjb



David Perks M.Sc., PTP
Transportation Planner – Group Leader

O:\Ottawa\2017 Projects\517651 - 3358 Lakefield Road\Documents\Reports\Traffic\Traffic Addendum (2023)\Peer Review Response\L - Turner - 3358 Lakefield Road - TIS Peer Review - Response Summary.docx



APPENDIX A: PEER REVIEW CORRESPONDENCE





Stantec Consulting Ltd.
300W-675 Cochrane Drive, Markham ON L3R 0B8

September 21, 2021
File: 160900933

Attention: Iain Mudd, B.A., MCIP, RPP
County of Peterborough
470 Water Street
Peterborough ON
N9H 3M3

Dear Iain Mudd,

Reference: DRAFT Response to the Peer Review of the Lakefield South Traffic Study

Stantec was retained by the Peterborough County ('the County') to perform a peer review of a Traffic Impact Study ('TIS') dated March 30, 2020 prepared for Triple T Holdings Ltd. in support of the proposed *Triple T Lakefield South Subdivision*. Stantec reviewed the TIS report and provided the County with a Peer Review document on July 5, 2021. In September 2021 a comment response document prepared by Tranplan Associates was received.

Tranplan Associates' responses to the peer review comments have been reviewed by Stantec and summarized herein in this memorandum. The evaluation of the comments and the responses are based on Stantec's understanding of the "**DRAFT Response to the Peer Review of the Lakefield South Traffic Study**" document and the revised resources in the Technical Appendix.

1 INITIAL COMMENTS

We agree that this traffic study requirements are not completely in line with a regular TIS. We did not consider TIS requirements in our Peer Review and did not include any TIS specific requirements such as a parking requirement review, internal circulation review, etc. Potential use of the term "TIS" in the Peer Review document could be related to the use of "Traffic Impact Study" term in the original report. The review conducted was to check the accuracy and validity of information and assumptions used in the report to ensure the outcomes can be used to assess the impact of the proposed subdivision to the transportation network in the study area.

As the study horizon year in the traffic study is 2029, the discussion of the subdivision being built over 20-25 years may not be in line with the study scope.

Reference: DRAFT Response to the Peer Review of the Lakefield South Traffic Study

2 BACKGROUND DATA

2.1 ITEM 1 – PROVIDE RAW VOLUME COUNT DATA

A comparison of the observed volume data and DHV volumes used as 2018 has been provided under Exhibits 1 and 2 for the AM and PM peak hours. While the comparison shows the acceptability of the annual growth used for the traffic volume projection, the comment requested the raw data received for the study area (TMC -ATR, or other sources) to be added to the report appendix.

2.2 ITEM 2 - METHODOLOGY FOR BALANCING VOLUMES BETWEEN INTERSECTIONS.

Peer review comment for the provision of a balancing methodology / explanation has been thoroughly addressed by the consultant. It is recommended to add a brief explanation of the considered methodology to the TIS report for reference. Item closed.

2.3 ITEM NO 3. – STANTEC'S DIFFERENCES WITH REPORT INTERSECTION GEOMETRICS

3 INTERSECTION CR 29/7TH LINE

Peer review comment for the consideration of the northbound right turn lane / taper at the intersection has been explained by the consultant and is based on field observations. Item closed

4 INTERSECTION CR 29/CR 18

Peer review comment pertaining to the “west approach” heading has been addressed. Item closed

Peer review comment pertaining to the northbound left storage lane component was explained by the consultant and it is noted that the parallel lane length was updated in the revised Synchro sheets in the technical appendix based on a re-measurement of the study area intersection geometrics. It is recommended to utilize the revised geometrics in the future analysis revisions reflecting the updated unit count / commercial space.

Peer review comment pertaining to the eastbound right storage lane component was explained by the consultant and it is noted that the parallel lane length was updated in the revised Synchro sheets in the technical appendix based on a re-measurement of the study area intersection geometrics. It is recommended to utilize the revised geometrics in the future analysis revisions reflecting the updated unit count / commercial space.

Peer review comment pertaining to the southbound right storage lane component was explained by the consultant and it is noted that the parallel lane length was updated in the revised Synchro sheets in the technical appendix based on a re-measurement of the study area intersection geometrics. It is recommended to utilize the revised geometrics in the future analysis revisions reflecting the updated unit count / commercial space.

Reference: DRAFT Response to the Peer Review of the Lakefield South Traffic Study

5 INTERSECTION – CR 29 AND WATER TOWER ROAD

Peer review comments pertaining to the eastbound right storage lane and the eastbound / westbound left storage lanes were explained by the consultant and it is noted that the parallel lane length was updated in the revised Synchro sheets in the technical appendix based on a re-measurement of the study area intersection geometrics. It is recommended to utilize the revised geometrics in the future analysis revisions reflecting the updated unit count / commercial space.

6 INTERSECTION – CR 29 AND CLEMENTI STREET

Peer review comments pertaining to the storage lane lengths at the intersection were explained by the consultant and it is noted that the parallel lane length was updated in the revised Synchro sheets in the technical appendix based on a re-measurement of the study area intersection geometrics. It is recommended to utilize the revised geometrics in the future analysis revisions reflecting the updated unit count / commercial space.

6.1 ITEM NO 4. – DATA SOURCE FOR THE WILLIAM/CLEMENTI INTERSECTION VOLUMES

Peer review comment pertaining to the source of the turning movement counts at the intersection has been addressed by the consultant. While in general using data collected in 2011 (aged over 10 years) will not be acceptable, considering the information provided and impact of the pandemic on a new traffic count, using the aged data is acceptable. Please include the source data in the TIS appendix report.

6.2 ITEM 5 – CLASSIFICATION OF WATER TOWER ROAD

Peer review comment regarding the classification of Water Tower Road has been addressed by the consultant and is recommended to be added to the TIS report for reference. Item closed.

6.3 ITEM 6 – JURISDICTION OF STUDY ROADS

Peer review comment regarding the jurisdiction of study roads has been addressed by the consultant and is recommended to be added to the TIS report for reference. Item closed.

7 TRIP GENERATION ANALYSIS:

7.1 ITEM 7 – DISCREPANCIES IN SITE-GENERATED TRAFFIC VOLUMES

7.1.1 7.1 - Single Family Homes & Townhouses Trip Generation (LU 210)

Peer review comment regarding the slight discrepancy of the trips generated by LUC 210 (Single Family Homes & Townhomes) has been explained by the consultant and was the result of rounding per traffic zone. Item closed.

Reference: DRAFT Response to the Peer Review of the Lakefield South Traffic Study

7.1.2 7.2 – Apartment Trip Generation (LU 220)

Peer review comment relating to the site generated trips for LU220 utilized for Apartments has been explained by the consultant and was the result of the utilization of person trip generation rates as opposed to vehicular rates. As indicated by the consultant, the total number of units has been revised between the March 2020 and February 2021 reports, and the overall difference between vehicular and person trip generation rates yields 41 trips during the AM peak hour as noted in Exhibit 3. In consideration of the anticipated revisions to the proposed commercial GFA entailing a reduction in apartment units and the envisioned construction timeframes, it is recommended to use the vehicular trip generation rate as the standard practice to update the trip generation calculations. This is also important to note that the in/out distribution ratios are different between the vehicular and person trip generation rates as commented in the initial Peer Review document which may impact the analysis results in a positive or negative way. Assumptions related to the potential trip reductions considering the potential residents of the development can be used separately and applied to the calculated trip generation.

7.2 ITEM 8 – COMMERCIAL/RETAIL TRIP GENERATION FORECASTS

We agree with the methodology provided in a separate document provided on September 14, 2021 and discussed in September 15, 2021 meeting.

7.3 ITEMS 9, 10, 11 & 13 – INCONSISTENCIES IN DISTRIBUTION OF SITE AND BACKGROUND TRAFFIC

Peer review comment pertaining to site generated traffic assignment has been thoroughly explained by the consultant and is based on local knowledge of the area. Item closed.

7.4 ITEMS 12 & 14 – DIFFERENCE IN AM & PM COMMERCIAL TRIP DISTRIBUTION

To be revised by the consultant.

8 SITE TRAFFIC ASSIGNMENT:

8.1 ITEM 15 – ASSIGNMENT FIGURE IN THE TECHNICAL APPENDIX

Peer review comment pertaining to the provision of a traffic assignment figure in the technical appendix has been explained by the consultant. It is noted that the approach of providing total traffic volumes and site generated traffic volumes in one figure is acceptable. Item closed.

8.2 ITEM 16 – DISCREPANCIES BETWEEN ZONE VOLUMES AND TOTAL SITE TRAFFIC

It is fully noted that the minor discrepancies were the result of inserting fixed numbers rather than formulas and will not alter the analysis findings. Item closed.

8.3 ITEM 17 – EXHIBIT FOR SITE TRAFFIC AND BACKGROUND TRAFFIC

Similar to *Item 15*. Item closed

Reference: DRAFT Response to the Peer Review of the Lakefield South Traffic Study

8.4 ITEM 18 – OPTIONS FOR GEOMETRIC IMPROVEMENTS AT THE CR 29/WATER TOWER RD. INTERSECTION & ITEM 20 - USE OF “ALL-OR-NOTHING” ASSIGNMENT DOES NOT ACCOUNT FOR DIVERTING TRAFFIC

Peer review comments pertaining to the intersection of CR 29 and Water Tower Road improvements as well as the application of demand rationalization or capacity restrained assignment have been explained by the consultant. Items 18 and 20 are closely interrelated and were merely suggested to attempt to account for expected driver behavior (selection of alternative travel routes to circumnavigate intersections operating above capacity or with high delays), which may be applicable for the intersection of CR 29 and Water Tower Road in conjunction with the intersection of CR29 with Clementi Street due to the relatively short distance between them (400m) and the presence of connecting roadways within the subdivision's internal road network (despite the all-or-nothing traffic assignment).

As the “All-or-Nothing” approach provides a more conservative estimate of the future traffic volumes and based on the information provided by the Consultant, using it for the traffic assignment is acceptable.

The results provided in the traffic study show that these intersections are expected to work with an acceptable level of service in 2029 under background traffic conditions and the additional traffic expected from the development will result in operational issues in both AM and PM peak hours. The study results also confirm that signalization can provide required mitigations as one of the future options. The exact timing for the provision of the required signals will need to be studied and confirmed as part of the development's different phases to be implemented as required.

8.5 ITEM 19 – SENSITIVITY ANALYSES TO DETERMINE THE NEED FOR AN EW COLLECTOR

Peer review comment regarding an east-west collector intersection with County Road 29 was explained by the consultant. Initially, the comment was to explore the feasibility of a new EW collector from a connectivity standpoint (given the distance between the north and south boundaries of the subdivision is approximately 1.4 km). The environmental issues associated with the provision of a new collector are noted. Item closed.

9 INTERSECTION CAPACITY ANALYSIS:

9.1 ITEM 21 – SIGNAL TIMING PLANS APPENDED TO THE TECHNICAL APPENDIX

Peer review comment to append the signal timing plans to the technical appendix was explained by the consultant. The intention of the peer review is to perform spot checks to review the phases coded in Synchro.

9.2 ITEM 22 – THE APPLICATION OF THE 0.92 PHF IN THE INTERSECTION ANALYSES

Consultant provided an explanation of the peak hour factor(s) utilized in the analysis and the approach is sound. It is recommended to add a brief explanation in the TIS report for reference. Item closed.

9.3 ITEM 23 – SOURCE FOR USE OF 15% HEAVY VEHICLE AND 10% ON THE 7TH LINE

Consultant provided an explanation of the heavy vehicle volumes utilized in the analysis and the approach is sound. Closing this comment is pending the provision of the raw traffic data to the report.

Reference: DRAFT Response to the Peer Review of the Lakefield South Traffic Study

9.4 ITEM 24 – RE-DO CR 29/7TH LINE TO INCLUDE A NB RIGHT TURN LANE

Covered under Item 3.

9.5 ITEM 25 – TAC VS OTM SIGNAL WARRANT ANALYSES

Consultant provided an explanation for the use of TAC Signal Warrant sheets vs. Ontario Traffic Manual Sheets. Considering that the “input summary and output warrant analysis are contained on a single worksheet” resulting in a “simple and straightforward methodology” for this planning study and the fact that both TAC signal warrant and operational analysis results confirm the requirement of signalization of the studies intersections using TAC Signal Warrant methodology is considered acceptable for this subdivision traffic study.

9.6 ITEM 26 – EXPLAIN THE DIFFERENCES IN FIELD GEOMETRICS AND GEOMETRICS USED IN THE SYNCHRO ANALYSES

Covered under Item 3.

9.7 ITEM 27 – CR 29/7TH LINE NB RIGHT TURN LANE WAS NOT CONSIDERED IN THE STUDY ANALYSES

Covered under Item 3.

9.8 ITEM 28 – REPORT SHOULD CLEARLY DESCRIBE IN DETAIL JUSTIFICATION FOR THE USE OF EACH PARAMETER IN THE INTERSECTION ANALYSES

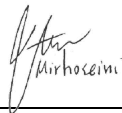
Covered under Items 3, 22, and 23

9.9 ITEM NO. 29 – A SPECIFIC EXHIBIT ILLUSTRATING THE ACTIVE TRANSPORTATION LINKS SHOULD BE INCLUDED IN THE STUDY REPORT.

Consultant explained that an exhibit illustrating the active transportation links is being prepared. Item closed.

Regards,

Stantec Consulting Ltd.



Arash Mirhoseini credentials
Associate, Transportation Planning and
Traffic Engineering
Phone: 416-722-8270
Arash.mirhoseini@stantec.com

Attachment: Attachment
c. C.C.

Good Morning Arash

Please find attached additional information on the commercial/retail trip distribution assumptions for Lakefield South as per your email below. I had considered reducing the CR 18 West component by 5% and increasing the CR 29 South by 5% but it's probably a better test of the CR 18/29 intersection the way it is. At the end of the day it probably won't make any real difference in study findings.

If you should require any additional information on the trip distribution just let me know. If it's acceptable I will apply it to the revised trip generation.

Regards

Bill

From: Mirhoseini, Arash [<mailto:Arash.Mirhoseini@stantec.com>]

Sent: November 17, 2021 3:44 PM

To: Bill Copeland <wjctranplan@trytel.net>

Cc: Mudd, Iain <IMudd@ptbocounty.ca>; Saccoccia, Doug <DSaccoccia@ptbocounty.ca>; Bill Turner <bill@tttholdings.com>; Freymond, Roger <roger.freymond@stantec.com>

Subject: RE: Lakefield South revised commercial/retail trip generation

Hi Bill,

Thank you for sending this methodology. Please find below my comments on the MethodRevComTGV1Sept14_21.docx (attached) and below revised commercial /retail trip generation as follows. The comments to the email are added in blue font to the same email.

The commercial trip generation forecasts will be based on the following assumptions:

- There will be a 50/50 mix of retail and non-retail uses. This will mean an area of 45,750 ft² of retail use and 45,750 ft² non-retail use. **Agreed**
- ITE LU 820 *Shopping Centre* will be applied to the retail area **Agreed but trip generation need to be calculated based on applying both average rate and fitted curve. As the shopping centre rates in ITE were calculated based on surveys on shopping centres with considerably higher GFAs just applying average rates will not result in reasonable trip generation. As an example using only average rates to calculate trip generation entering the site for 4,250 sqm of retail resulted in an estimate of only 10 vehicles entering the site in the AM peak that is considerably low.**
- ITE LU 710 *General Office Building* will be applied to the non-retail area **Agreed but calculate trips based on average rate and fitted curve.**
- The apartment unit trip reduction and the new commercial trip generation will be allocated to traffic zones 1, 4 and 6 in proportion to the number of apartment units in each of the 3 zones. **Agreed**

Best regards,

Arash Mirhoseini

Associate, Transportation

Mobile: 416-722-8270

arash.mirhoseini@stantec.com





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Please consider the environment before printing this email.

From: Bill Copeland <wjctranplan@trytel.net>

Sent: Monday, October 4, 2021 3:24 PM

To: Mirhoseini, Arash <Arash.Mirhoseini@stantec.com>

Cc: Mudd, Iain <IMudd@ptbocounty.ca>; Saccoccia, Doug <DSaccoccia@ptbocounty.ca>; Bill Turner <bill@tttholdings.com>

Subject: Lakefield South revised commercial/retail trip generation

Good afternoon Arash

Attached is a spreadsheet outlining my approach for computing the revised commercial/retail trip generation and trip distribution

I have reviewed the most recent trip generation rates from new just issued ITE Trip Generation Manual 11th ed and the current 10th ed

In reviewing the sheets I have computed the commercial/retail trip generation based on the following assumptions:

- A 50/50 split between each of the two land use types as discussed earlier **Agreed**
- Totalled the combined trip generation for commercial/retail and subtracted the displaced apartment units TG **Agreed but please review the comments in the email body and update the trip generation estimates.**
- A further reduction of 10% to account for internal capture since we are only looking at the traffic on the peripheral study intersections. **Agreed.**

A few comments:

- The 11th ed rates are producing higher traffic forecasts than the 10th ed. **As this study commenced before ITE 11th was issued it can still use ITE 10th rates. No need to update TG rates to ITE 11th.**
- The pre-amble to the 11th ed notes that in general trip generation rates seem to be dropping and post-Covid rates could well remain lower as people will tend to work more from home offices resulting in fewer peak hour trips **As this study commenced before ITE 11th was issued it can still use ITE 10th rates. No need to update TG rates to ITE 11th.**
- Residential peak hour trip generation rates are down in the 11th ed based on pre-Covid observations continuing a trend that was noted from the 9th to the 10th ed. **As this study commenced before ITE 11th was issued it can still use ITE 10th rates. No need to update TG rates to ITE 11th.**
- My preference is to use the TG based on the 10th ed given the nature of Lakefield's overall land use and its present trend towards retirees and empty-nesters. **Agreed**
- Full development of the 8,500 sq m of commercial/retail is an outer anticipated limit of this type of development and committing to potential construction of future road infrastructure for this level of development may overstate future road requirements.
- At the end of the day there will be update traffic studies for the phases as they come on-line. At that point the specific form of that phase of the development will be known and specific road improvements defined to support that phase. **Noted**

- Over time there will also be an accumulation of historic trip generation data specific to Lakefield South that will further help refine the on-going trip generation and distribution analyses [Noted](#)

Trip Distribution for the Commercial/Retail

The third sheet of the file contains my proposed trip distribution for the commercial/retail assignment. [I agree with the three assumptions listed in the Excel file/TrpDist tab but how TD percentages were calculated? Is this based on existing traffic volumes and population distribution or is this considering future growth as well? Please provide further information on how the rates were calculated. Also I assume it mean the same rates will be applied for inbound and outbound trips, please confirm.](#)

The nature of this development will likely draw from the local community and areas to the north and east of Lakefield. Areas to the south and west will have an attraction to Peterborough and to a lesser extent Bridgenorth. [Noted](#)

I would appreciate your review and comments on this trip generation approach and the trip distribution. I would like to have an agreement in principal on these 2 items before I get into assignment of trips to zones and then to the network followed up by the revise capacity analyses. If you would like to discuss any of this in more detail just let me know

Regards

Bill

Lakefield South Subdivision

DRAFT - Commercial/Retail Trip Distribution Assumptions Nov. 22/21

The proposed Commercial/Retail trip distribution is illustrated in the attached exhibit. Also included in the exhibit is the original 2003 trip distribution developed by the study consultant and confirmed by Township staff. This trip distribution was developed almost 20 years ago before the significant transition of Lakefield into a more “empty nester” community. The 2003 trip distribution has been used as a guide for the current (2021) study analyses. It has been modified to bring it in line with the current study road network and fabric of the currently planned Lakefield South community. It will be noted that it was assumed in 2003 that 40% of the commercial/retail travel would be internally generated by new Lakefield South community. **This study, as a worst case, is assuming only 10% internal commercial/retail trip generation.**

In reviewing the 2 tables attached, it will be noted that there are some similarities in the assumed trip distribution and some differences. Much of these differences are driven by the assumed 40% internal capture used in the 2003 analyses. When the full Lakefield South study area is built out, this may be the case, but in the context of this study it is unlikely that there will be this level of internal capture.

The proposed draft trip distribution is based on the 5 gateways assumed in the current study road network. The trip distribution assumptions by gateway are as follows:

1. CR 29 (Bridge St) East - 30%

This is the main gateway to the commercial core of Lakefield and much of the existing residential and retail development in the Lakefield community. It will be the largest source/destination of much of the external travel to/from the new Lakefield South subdivision.

2. Clementi Street – 5%

It is expected that there will be some travel to/from the residential areas in this part of Lakefield. During the summer there is an active RV campground and recreational facilities along the west side of the Otonabee River.

3. CR 18 West – 25%

This gateway will contain traffic from the west including Bridgenorth and the north end of Peterborough as well as the commercial areas along the Chemong Road corridor. In addition, it will be also carrying traffic from the CR 23 (Buckhorn Rd.) corridor that serves communities to the north and west of Lakefield including the First Nations community of Curve Lake. Lakefield is an important service centre for these communities.

4. 7th Line West - 5%

The 7th Line West presently carries mostly local traffic. It has good connectivity to the CR 23 corridor and Bridgenorth to the west. It could also be part of the new corridor leading to the future Otonabee Bridge Crossing. Since its role is not entirely clear at this time, only a minimum of traffic will be assigned to this gateway.

5. CR 29 (Lakefield Rd) South - 25%

Given Lakefield's proximity to the City of Peterborough there will be a continuing interaction with the overall Peterborough community for work trips, retail shopping, commercial activity and recreational travel.

6. Internal Capture – 10%

It is assumed that some of the commercial/retail travel will be internal capture within the Lakefield South community. In the future, with full development of Lakefield South, the internal capture will likely be larger, however, as a worst case, an internal capture of 10% was assumed for the study analyses.

Appendix B: Intersection Lane Geometries

Project: Lakefield South Subdivision

Date: 21-08-09

Major Street: P460 City Rd 29

Minor Street: 7th Line (Former Twp of Smith)

Control: TWSC - Stop 7th Line

GEOMETRICS

No. Of Approaches 4 X 3

East Approach

Urban Rural X Grade to Intersection -3 % Post Spd 40 kph

No. Of Through Lanes 2 Total Width of Platform 6.3 m

Auxiliary Lanes

Rt Turn Taper N Length m Rt Turn Lane N Length m

Lt Turn Taper N Length m Lt Turn Lane N Length m

West Approach

Urban Rural X Grade to Intersection +2 % Post Spd None kph

No. Of Through Lanes 2 Total Width of Platform 6.3 m

Auxiliary Lanes

Rt Turn Taper N Length m Rt Turn Lane N Length m

Lt Turn Taper N Length m Lt Turn Lane N Length m

North Approach

Urban Rural X Grade to Intersection 0 % Post Spd 70 kph

No. Of Through Lanes 2 Total Width of Platform 7.7 m Partial Paved Shoulders

Auxiliary Lanes

Rt Turn Taper N Length m Rt Turn Lane N Length m

Lt Turn Taper N Length m Lt Turn Lane N Length m

South Approach

Urban Rural X Grade to Intersection 0 % Post Spd 70 kph

No. Of Through Lanes 2 Total Width of Platform 7.5 m

Auxiliary Lanes

Rt Turn Taper 4 Length 5.0 m Parallel Rt Turn Lane 4 Length 12 m

Lt Turn Taper N Length m Lt Turn Lane N Length m

Project: Lakefield South Subdivision

Date: 21-08-09

Major Street: P460 City Rd 29

Minor Street: P460 City Rd 18

Control: Signal - No Ped Signals

GEOMETRICS

No. Of Approaches 4 3 X

East Approach

Urban Rural Grade to Intersection % Post Spd kph
No. Of Through Lanes Total Width of Platform m

Auxiliary Lanes

Rt Turn Taper Length m Rt Turn Lane Length m
Lt Turn Taper Length m Lt Turn Lane Length m

West Approach

Urban X Rural Grade to Intersection 4 % Post Spd 60 kph
No. Of Through Lanes 2 Total Width of Platform 7.6 m + Asphalt Shoulders

Auxiliary Lanes

Rt Turn Taper 4 Length 25 m Rt Turn Lane N Length / m
Lt Turn Taper N Length / m Lt Turn Lane N Length / m

North Approach

Urban X Rural Grade to Intersection +3 % Post Spd 60 kph
No. Of Through Lanes 2 Total Width of Platform 10.7 m

Auxiliary Lanes

Rt Turn Taper 4 Length 63 m Rt Turn Lane 4 Length 62 m As Striped
Lt Turn Taper N Length / m Lt Turn Lane N Length / m

South Approach

Urban X Rural Grade to Intersection -2 % Post Spd 60 kph
No. Of Through Lanes 2 Total Width of Platform 10.5 m

Auxiliary Lanes

Rt Turn Taper N Length / m Rt Turn Lane N Length / m
Lt Turn Taper 4 Length 135 m Lt Turn Lane 4 Length 60 m As Striped

Project: Lakefield South Subdivision

Date: 21-08-09

Major Street: P460 City Rd. 29 (Bridge St)

Minor Street: Water Tower Rd. (Top of Selwyn)

Control: TWSC - Stop on Water Tower Rd.

GEOMETRICS

No. Of Approaches 4 3 X plus North Commercial Entrance

East Approach

Urban X Rural Grade to Intersection -2 % Post Spd 60 kph

No. Of Through Lanes 2 Total Width of Platform 9.8 m

Auxiliary Lanes

Rt Turn Taper N Length m Rt Turn Lane N Length m

Lt Turn Taper NA Length m Lt Turn Lane Through Length m *Continuous*

West Approach

Urban X Rural Grade to Intersection 0 % Post Spd 60 kph

No. Of Through Lanes 2 Total Width of Platform 10 m

Auxiliary Lanes

Rt Turn Taper Y Length 60 m Rt Turn Lane N Length m

Lt Turn Taper NA Length m Lt Turn Lane Through Length m *Continuous*

North Approach - Commercial Entrance

Urban X Rural Grade to Intersection 0 % Post Spd NA kph

No. Of Through Lanes 2 Total Width of Platform 10 m

Auxiliary Lanes

Rt Turn Taper N Length m Rt Turn Lane N Length m

Lt Turn Taper N Length m Lt Turn Lane N Length m

South Approach

Urban X Rural Grade to Intersection -2 % Post Spd Assume 50 kph

No. Of Through Lanes 2 Total Width of Platform 9.3 m *Beyond Taper*

Auxiliary Lanes

* Rt Turn Taper Y Length ~60 m Rt Turn Lane N Length m

Lt Turn Taper N Length m Lt Turn Lane N Length m

* Stop Bar 5.6m

Curbing Continuous Taper - No Parallel Lane

Project: Lakefield South Subdivision

Date: 21-08-09

Major Street: Ptbo County Rd 29 (Bridge St)

Minor Street: Clementi St. (Top of Selwyn)

Control: Signal

GEOMETRICS

No. Of Approaches 4 X 3 _____

East Approach

Urban X Rural _____ Grade to Intersection +7 % Post Spd 50 kph

No. Of Through Lanes 2 Total Width of Platform 12.5 m

Auxiliary Lanes

Rt Turn Taper N Length / m Rt Turn Lane N Length / m

Lt Turn Taper 4 Length 37 m Lt Turn Lane 4 Length 30 m *As Striped*

West Approach

Urban X Rural _____ Grade to Intersection -2 % Post Spd 50 kph

No. Of Through Lanes 2 Total Width of Platform 13.2 m

Auxiliary Lanes

Rt Turn Taper 4 Length 50 m Rt Turn Lane 4 Length 50 m

Lt Turn Taper / Length / m Lt Turn Lane 4 Length 15 m

No Lt Taper Transitions to TOLTH

North Approach

Urban X Rural _____ Grade to Intersection +2 % Post Spd 40 kph

No. Of Through Lanes 2 Total Width of Platform 10.5 m

Auxiliary Lanes

Rt Turn Taper N Length / m Rt Turn Lane N Length / m

Lt Turn Taper 4 Length 15 m Lt Turn Lane 4 Length 25 m *Est. No Lane Markings*

South Approach

Urban X Rural _____ Grade to Intersection -3 % Post Spd 50 kph

No. Of Through Lanes 2 Total Width of Platform 11.5 m

Auxiliary Lanes

Rt Turn Taper N Length / m Rt Turn Lane N Length / m

Lt Turn Taper 4 Length 15 m Lt Turn Lane 4 Length 20 m *Est No Marking*

Project: Lakefield South Subdivision

Date: 21-08-09

Major Street: Clementi St. (Twp of Selwyn)

Minor Street: William St. (Twp of Selwyn)

Control: AWSC

GEOMETRICS

No. Of Approaches 4 3 X

East Approach

Urban Rural X Grade to Intersection +2 % Post Spd None kph

No. Of Through Lanes 2 Total Width of Platform 5.4 m

Auxiliary Lanes

Rt Turn Taper 4 Length 30 m Rt Turn Lane N Length m

Lt Turn Taper N Length m Lt Turn Lane N Length m

West Approach

Urban X Rural Grade to Intersection 0 % Post Spd None kph

No. Of Through Lanes 2 Total Width of Platform 6.9 m

Auxiliary Lanes

Rt Turn Taper N Length m Rt Turn Lane N Length m

Lt Turn Taper N Length m Lt Turn Lane N Length m

North Approach

Urban X Rural Grade to Intersection +2 % Post Spd None kph

No. Of Through Lanes 2 Total Width of Platform 8.1 m

Auxiliary Lanes

Rt Turn Taper N Length m Rt Turn Lane N Length m

Lt Turn Taper N Length m Lt Turn Lane N Length m

South Approach Entrance To Fairgrounds

Urban Rural X Grade to Intersection 0 % Post Spd NSA kph

No. Of Through Lanes 2 Total Width of Platform 10 m

Auxiliary Lanes

Rt Turn Taper Length m Rt Turn Lane Length m

Lt Turn Taper Length m Lt Turn Lane Length m

Appendix C: Level of Service Definitions

CAPACITY ANALYSIS AT SIGNALIZED INTERSECTIONS

Highway Capacity Manual Methodology

The capacity of signalized intersections has been determined in terms of delay taken from Chapter 9 of the Highway Capacity Manual, Special Report 209, by the Transportation Research Board, 2000.

To assist in clarifying the arithmetic analysis associated with traffic engineering, it is often useful to refer to "Level of Service". Level of Service (LOS) for signalized intersections is defined in terms of delay, which is made up of a number of factors that relate to control, geometrics, traffic, and incidents. Only the portion of total delay attributed to the control facility is quantified. This control delay includes initial deceleration, queue move-up time, stopped delay, and final acceleration delay. The following table describes in detail the characteristics of each level:

Level of Service	Expected Delay to Minor Street Traffic	Average Control Delay 'd' (sec/veh)
A	Describes operations with very low control delay, up to 10 seconds/vehicle. This level of service occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all at this LOS. Short cycle lengths may also contribute to low delay.	$d \leq 10$
B	Describes operations with control delay greater than 10 seconds and up to 20 seconds/vehicle. This level generally occurs with good progression, short cycle lengths, or both. More vehicles stop at this level than at LOS A, causing longer average delays.	$10 \leq d \leq 20$
C	Describes operations with control delay greater than 20 seconds and up to 35 seconds/vehicle. These higher delays may result from fair progression, longer cycle length, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, though many still pass through the intersection without stopping.	$20 \leq d \leq 35$
D	Describes operations with control delay greater than 35 seconds and up to 55 seconds/vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavourable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures become noticeable.	$35 \leq d \leq 55$
E	Describes operations with control delay greater than 55 seconds and up to 80 seconds/vehicle. This level is considered by many agencies to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.	$55 \leq d \leq 80$
F	LOS F describes operations with control delay in excess of 80 seconds/vehicle. This <i>oversaturation</i> , considered to be unacceptable to most drivers, occurs when arrival flow rates exceed the design capacity of the intersection. It may also occur at high v/c ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing factors to such high delay levels.	$d > 80$

CAPACITY ANALYSIS AT UNSIGNALIZED INTERSECTIONS

Highway Capacity Manual Methodology

The level of service at an unsignalized intersection is determined on the basis of control delay for each critical lane. This method of analysis is taken from the Highway Capacity Manual, Special Report 209, by the Transportation Research Board, 1997.




















The average control delay for any particular critical movement (control delay includes initial deceleration, queue move-up time, stopped delay, and final acceleration delay) is a function of the service rate or capacity of the approach and degree of saturation. The level of service criteria for unsignalized intersections is outlined below and is related to ranges in vehicle delay.

Level of Service	Expected Delay to Minor Street Traffic	Average Control Delay 'd' (sec/veh)
A	Little or no delays	$0 < d \leq 10$
B	Short traffic delays	$10 \leq d \leq 15$
C	Average traffic delays	$15 \leq d \leq 25$
D	Long traffic delays	$25 \leq d \leq 35$
E	Very long traffic delays	$35 \leq d \leq 50$
F	Extreme delays with queuing which may cause congestion affecting other traffic movements in the intersection	$d > 50$

**Appendix D:
Intersection Operations
Worksheets**

HCM Unsignalized Intersection Capacity Analysis
2: Water Tower Rd/Com. Access & CR 29

















2029 Total Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	712	19	20	645	1	33	1	30	2	1	2
Future Volume (Veh/h)	5	712	19	20	645	1	33	1	30	2	1	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	774	21	22	701	1	36	1	33	2	1	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh		2			2							
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	702			795			1542	1540	784	1563	1550	702
vC1, stage 1 conf vol							794	794		746	746	
vC2, stage 2 conf vol							748	746		818	805	
vCu, unblocked vol	702			795			1542	1540	784	1563	1550	702
tC, single (s)	4.2			4.2			7.2	6.6	6.3	7.2	6.6	6.3
tC, 2 stage (s)							6.2	5.6		6.2	5.6	
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	99			97			87	100	91	99	100	100
cM capacity (veh/h)	838			772			269	288	381	243	280	425
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	5	795	22	702	70	5						
Volume Left	5	0	22	0	36	2						
Volume Right	0	21	0	1	33	2						
cSH	838	1700	772	1700	313	303						
Volume to Capacity	0.01	0.47	0.03	0.41	0.22	0.02						
Queue Length 95th (m)	0.1	0.0	0.7	0.0	6.7	0.4						
Control Delay (s)	9.3	0.0	9.8	0.0	19.8	17.1						
Lane LOS	A		A		C	C						
Approach Delay (s)	0.1		0.3		19.8	17.1						
Approach LOS					C	C						
Intersection Summary												
Average Delay			1.1									
Intersection Capacity Utilization			50.9%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

4: CR 29 & 7th Line

2029 Total Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	6	5	67	9	20	1	324	27	8	456	7
Future Volume (Veh/h)	5	6	5	67	9	20	1	324	27	8	456	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	7	5	73	10	22	1	352	29	9	496	8
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	901	500	895	890	366	504			381		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	914	901	500	895	890	366	504			381		
tC, single (s)	7.2	6.6	6.3	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	98	97	99	70	96	97	100			99		
cM capacity (veh/h)	229	267	555	244	271	661	997			1110		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	17	105	382	513								
Volume Left	5	73	1	9								
Volume Right	5	22	29	8								
cSH	298	284	997	1110								
Volume to Capacity	0.06	0.37	0.00	0.01								
Queue Length 95th (m)	1.4	13.1	0.0	0.2								
Control Delay (s)	17.8	24.9	0.0	0.2								
Lane LOS	C	C	A	A								
Approach Delay (s)	17.8	24.9	0.0	0.2								
Approach LOS	C	C										
Intersection Summary												
Average Delay			3.0									
Intersection Capacity Utilization			49.3%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
 5: North Collector/William Street & Clementi St

















2029 Total Conditions
 AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	71	1	1	93	81	26
Future Volume (vph)	71	1	1	93	81	26
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	77	1	1	101	88	28
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total (vph)	78	102	116			
Volume Left (vph)	77	0	88			
Volume Right (vph)	0	101	28			
Hadj (s)	0.23	-0.56	0.04			
Departure Headway (s)	4.5	3.7	4.3			
Degree Utilization, x	0.10	0.10	0.14			
Capacity (veh/h)	775	940	797			
Control Delay (s)	8.0	7.1	8.0			
Approach Delay (s)	8.0	7.1	8.0			
Approach LOS	A	A	A			
Intersection Summary						
Delay			7.7			
Level of Service			A			
Intersection Capacity Utilization			24.6%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
6: South Collector/Water Tower Rd & North Collector

2029 Total Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	1	1	1	1	2	1	30	1	1	25	2
Future Volume (Veh/h)	5	1	1	1	1	2	1	30	1	1	25	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	1	1	1	1	2	1	33	1	1	27	2
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	68	66	28	67	66	34	29			34		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	68	66	28	67	66	34	29			34		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.3			2.3		
p0 queue free %	99	100	100	100	100	100	100			100		
cM capacity (veh/h)	914	818	1039	916	817	1031	1534			1527		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	7	4	35	30								
Volume Left	5	1	1	1								
Volume Right	1	2	1	2								
cSH	914	940	1534	1527								
Volume to Capacity	0.01	0.00	0.00	0.00								
Queue Length 95th (m)	0.2	0.1	0.0	0.0								
Control Delay (s)	9.0	8.8	0.2	0.3								
Lane LOS	A	A	A	A								
Approach Delay (s)	9.0	8.8	0.2	0.3								
Approach LOS	A	A										
Intersection Summary												
Average Delay			1.5									
Intersection Capacity Utilization			13.3%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
7: 7th Line & South Collector




















2029 Total Conditions
AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖	↗		↘	
Traffic Volume (veh/h)	25	12	25	1	1	53
Future Volume (Veh/h)	25	12	25	1	1	53
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	27	13	27	1	1	58
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	28				94	28
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	28				94	28
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	98				100	94
cM capacity (veh/h)	1535				870	1025
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	40	28	59			
Volume Left	27	0	1			
Volume Right	0	1	58			
cSH	1535	1700	1022			
Volume to Capacity	0.02	0.02	0.06			
Queue Length 95th (m)	0.4	0.0	1.5			
Control Delay (s)	5.0	0.0	8.7			
Lane LOS	A		A			
Approach Delay (s)	5.0	0.0	8.7			
Approach LOS			A			
Intersection Summary						
Average Delay			5.6			
Intersection Capacity Utilization		19.1%		ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
2: Water Tower Rd/Com. Access & CR 29

















2029 Total Conditions
PM Peak Hour

																								
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR												
Lane Configurations																								
Traffic Volume (veh/h)	2	725	37	31	918	2	25	1	23	4	1	12												
Future Volume (Veh/h)	2	725	37	31	918	2	25	1	23	4	1	12												
Sign Control		Free			Free			Stop			Stop													
Grade		0%			0%			0%			0%													
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92												
Hourly flow rate (vph)	2	788	40	34	998	2	27	1	25	4	1	13												
Pedestrians																								
Lane Width (m)																								
Walking Speed (m/s)																								
Percent Blockage																								
Right turn flare (veh)																								
Median type																								
	TWLTL					TWLTL																		
Median storage veh	2					2																		
Upstream signal (m)																								
pX, platoon unblocked																								
vC, conflicting volume	1000			828			1892			1880			808			1884			1899			999		
vC1, stage 1 conf vol							812			812						1067			1067					
vC2, stage 2 conf vol							1080			1068						818			832					
vCu, unblocked vol	1000			828			1892			1880			808			1884			1899			999		
tC, single (s)	4.2			4.2			7.2			6.6			6.3			7.2			6.6			6.3		
tC, 2 stage (s)							6.2			5.6						6.2			5.6					
tF (s)	2.3			2.3			3.6			4.1			3.4			3.6			4.1			3.4		
p0 queue free %	100			95			86			100			93			98			100			95		
cM capacity (veh/h)	644			750			193			224			369			190			217			285		
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1																		
Volume Total	2	828	34	1000	53	18																		
Volume Left	2	0	34	0	27	4																		
Volume Right	0	40	0	2	25	13																		
cSH	644	1700	750	1700	249	253																		
Volume to Capacity	0.00	0.49	0.05	0.59	0.21	0.07																		
Queue Length 95th (m)	0.1	0.0	1.1	0.0	6.3	1.8																		
Control Delay (s)	10.6	0.0	10.0	0.0	23.3	20.3																		
Lane LOS	B		B		C																			
Approach Delay (s)	0.0		0.3		23.3																			
Approach LOS					C																			
Intersection Summary																								
Average Delay	1.0																							
Intersection Capacity Utilization	61.0%					ICU Level of Service				B														
Analysis Period (min)	15																							

HCM Unsignalized Intersection Capacity Analysis

4: CR 29 & 7th Line

2029 Total Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	15	2	35	10	27	1	449	68	29	479	8
Future Volume (Veh/h)	11	15	2	35	10	27	1	449	68	29	479	8
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	16	2	38	11	29	1	488	74	32	521	9
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1151	1154	526	1126	1121	525	530			562		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1151	1154	526	1126	1121	525	530			562		
tC, single (s)	7.2	6.6	6.3	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	92	91	100	76	94	95	100			97		
cM capacity (veh/h)	149	184	537	159	192	537	975			948		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	30	78	563	562								
Volume Left	12	38	1	32								
Volume Right	2	29	74	9								
cSH	175	223	975	948								
Volume to Capacity	0.17	0.35	0.00	0.03								
Queue Length 95th (m)	4.8	12.0	0.0	0.8								
Control Delay (s)	29.8	29.6	0.0	0.9								
Lane LOS	D	D	A	A								
Approach Delay (s)	29.8	29.6	0.0	0.9								
Approach LOS	D	D										
Intersection Summary												
Average Delay			3.0									
Intersection Capacity Utilization			61.4%		ICU Level of Service				B			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
 5: North Collector/William Street & Clementi St

















2029 Total Conditions
 PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖	↗		↘	
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	64	1	1	31	56	53
Future Volume (vph)	64	1	1	31	56	53
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	70	1	1	34	61	58
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total (vph)	71	35	119			
Volume Left (vph)	70	0	61			
Volume Right (vph)	0	34	58			
Hadj (s)	0.23	-0.55	-0.16			
Departure Headway (s)	4.4	3.7	4.0			
Degree Utilization, x	0.09	0.04	0.13			
Capacity (veh/h)	789	940	875			
Control Delay (s)	7.8	6.8	7.6			
Approach Delay (s)	7.8	6.8	7.6			
Approach LOS	A	A	A			
Intersection Summary						
Delay			7.5			
Level of Service			A			
Intersection Capacity Utilization			24.5%	ICU Level of Service	A	
Analysis Period (min)			15			

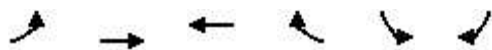
HCM Unsignalized Intersection Capacity Analysis
6: South Collector/Water Tower Rd & North Collector

2029 Total Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	4	1	1	1	1	1	1	27	1	2	34	5
Future Volume (Veh/h)	4	1	1	1	1	1	1	27	1	2	34	5
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	1	1	1	1	1	1	29	1	2	37	5
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	76	76	40	76	78	30	42			30		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	76	76	40	76	78	30	42			30		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.3			2.3		
p0 queue free %	100	100	100	100	100	100	100			100		
cM capacity (veh/h)	903	808	1023	903	805	1037	1517			1533		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	6	3	31	44								
Volume Left	4	1	1	2								
Volume Right	1	1	1	5								
cSH	903	905	1517	1533								
Volume to Capacity	0.01	0.00	0.00	0.00								
Queue Length 95th (m)	0.2	0.1	0.0	0.0								
Control Delay (s)	9.0	9.0	0.2	0.3								
Lane LOS	A	A	A	A								
Approach Delay (s)	9.0	9.0	0.2	0.3								
Approach LOS	A	A										
Intersection Summary												
Average Delay			1.2									
Intersection Capacity Utilization			13.3%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
7: 7th Line & South Collector

2029 Total Conditions
PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↖	↗		↘	
Traffic Volume (veh/h)	57	22	15	1	1	37
Future Volume (Veh/h)	57	22	15	1	1	37
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	62	24	16	1	1	40
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	17				164	16
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	17				164	16
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	96				100	96
cM capacity (veh/h)	1550				776	1040
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	86	17	41			
Volume Left	62	0	1			
Volume Right	0	1	40			
cSH	1550	1700	1031			
Volume to Capacity	0.04	0.01	0.04			
Queue Length 95th (m)	1.0	0.0	1.0			
Control Delay (s)	5.4	0.0	8.6			
Lane LOS	A		A			
Approach Delay (s)	5.4	0.0	8.6			
Approach LOS			A			
Intersection Summary						
Average Delay			5.7			
Intersection Capacity Utilization		21.5%		ICU Level of Service		A
Analysis Period (min)			15			

Timings
1: Clementi St & CR 29

2029 Total Conditions
AM Peak Hour

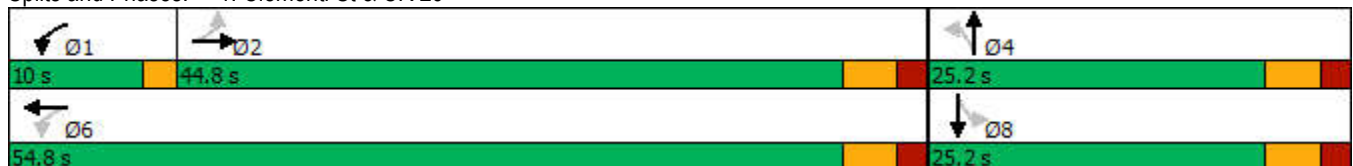


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	46	614	57	574	73	16	48	5
Future Volume (vph)	46	614	57	574	73	16	48	5
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		2	1	6		4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	4	4	8	8
Switch Phase								
Minimum Initial (s)	20.0	20.0	5.0	20.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.2	26.2	10.0	26.2	25.2	25.2	25.2	25.2
Total Split (s)	44.8	44.8	10.0	54.8	25.2	25.2	25.2	25.2
Total Split (%)	56.0%	56.0%	12.5%	68.5%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.3	3.3	2.0	3.3	3.3	3.3	3.3	3.3
All-Red Time (s)	1.9	1.9	0.0	1.9	1.9	1.9	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.2	5.2	2.0	5.2	5.2	5.2	5.2	5.2
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	None	Max	None	None	None	None
Act Effct Green (s)	48.9	48.9	56.2	54.1	13.8	13.8	13.8	13.8
Actuated g/C Ratio	0.66	0.66	0.76	0.73	0.19	0.19	0.19	0.19
v/c Ratio	0.12	0.67	0.14	0.56	0.40	0.39	0.28	0.17
Control Delay	10.5	17.5	4.9	9.6	32.0	11.1	29.1	11.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	10.5	17.5	4.9	9.6	32.0	11.1	29.1	11.1
LOS	B	B	A	A	C	B	C	B
Approach Delay		17.1		9.2		19.2		20.8
Approach LOS		B		A		B		C

Intersection Summary






















Cycle Length: 80
 Actuated Cycle Length: 74
 Natural Cycle: 80
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.67
 Intersection Signal Delay: 14.3
 Intersection LOS: B
 Intersection Capacity Utilization 70.6%
 ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 1: Clementi St & CR 29



HCM Signalized Intersection Capacity Analysis
1: Clementi St & CR 29

2029 Total Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	46	614	51	57	574	42	73	16	100	48	5	37
Future Volume (vph)	46	614	51	57	574	42	73	16	100	48	5	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.90		1.00	0.89	
Flpb, ped/bikes	0.98	1.00		1.00	1.00		0.95	1.00		0.95	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.87		1.00	0.87	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1538	1623		1565	1626		1407	1219		1416	1210	
Flt Permitted	0.39	1.00		0.27	1.00		0.73	1.00		0.68	1.00	
Satd. Flow (perm)	637	1623		442	1626		1078	1219		1008	1210	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	50	667	55	62	624	46	79	17	109	52	5	40
RTOR Reduction (vph)	0	3	0	0	3	0	0	92	0	0	34	0
Lane Group Flow (vph)	50	719	0	62	667	0	79	34	0	52	11	0
Confl. Peds. (#/hr)	30		30	30		30	30		30	30		30
Confl. Bikes (#/hr)			20			20			20			20
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	47.8	47.8		53.8	53.8		11.7	11.7		11.7	11.7	
Effective Green, g (s)	47.8	47.8		53.8	53.8		11.7	11.7		11.7	11.7	
Actuated g/C Ratio	0.63	0.63		0.71	0.71		0.15	0.15		0.15	0.15	
Clearance Time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	401	1022		372	1152		166	187		155	186	
v/s Ratio Prot		c0.44		0.01	c0.41			0.03			0.01	
v/s Ratio Perm	0.08			0.11			c0.07			0.05		
v/c Ratio	0.12	0.70		0.17	0.58		0.48	0.18		0.34	0.06	
Uniform Delay, d1	5.6	9.3		5.1	5.5		29.3	27.9		28.6	27.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	4.1		0.2	2.1		2.1	0.5		1.3	0.1	
Delay (s)	6.3	13.4		5.3	7.6		31.4	28.4		29.9	27.5	
Level of Service	A	B		A	A		C	C		C	C	
Approach Delay (s)		12.9			7.4			29.6			28.8	
Approach LOS		B			A			C			C	
Intersection Summary												
HCM 2000 Control Delay			13.4				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.65									
Actuated Cycle Length (s)			75.9				Sum of lost time (s)		12.4			
Intersection Capacity Utilization			70.6%				ICU Level of Service			C		
Analysis Period (min)			15									
c Critical Lane Group												

Timings
3: CR 29 & CR 18

2029 Total Conditions
AM Peak Hour

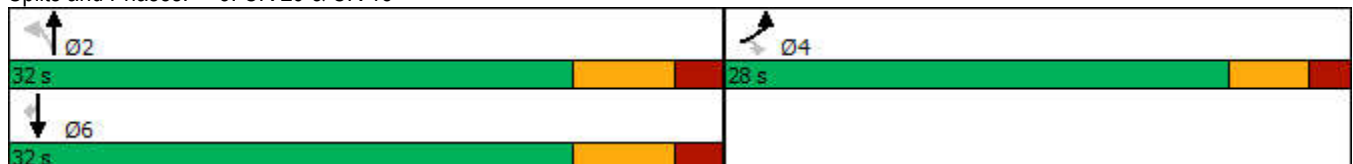


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↖	↖	↗	↗	↖
Traffic Volume (vph)	441	47	41	294	423	279
Future Volume (vph)	441	47	41	294	423	279
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	21.5	21.5	23.2	23.2	23.2	23.2
Total Split (s)	28.0	28.0	32.0	32.0	32.0	32.0
Total Split (%)	46.7%	46.7%	53.3%	53.3%	53.3%	53.3%
Yellow Time (s)	3.5	3.5	4.5	4.5	4.5	4.5
All-Red Time (s)	2.0	2.0	2.3	2.3	2.3	2.3
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Min	Min	Min	Min
Act Effct Green (s)	19.5	19.5	19.1	19.1	19.1	19.1
Actuated g/C Ratio	0.38	0.38	0.37	0.37	0.37	0.37
v/c Ratio	0.82	0.10	0.19	0.52	0.75	0.45
Control Delay	29.6	9.5	13.6	16.3	23.1	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.6	9.5	13.6	16.3	23.1	4.1
LOS	C	A	B	B	C	A
Approach Delay	27.7			16.0	15.5	
Approach LOS	C			B	B	

Intersection Summary













Cycle Length: 60
 Actuated Cycle Length: 51.4
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.82
 Intersection Signal Delay: 19.5
 Intersection LOS: B
 Intersection Capacity Utilization 68.8%
 ICU Level of Service C
 Analysis Period (min) 15

Splits and Phases: 3: CR 29 & CR 18



HCM Signalized Intersection Capacity Analysis
3: CR 29 & CR 18

2029 Total Conditions
AM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	441	47	41	294	423	279
Future Volume (vph)	441	47	41	294	423	279
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	3%			0%	0%	
Total Lost time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.94	1.00	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00
Fr _t	1.00	0.85	1.00	1.00	1.00	0.85
Fl _t Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1546	1300	1547	1652	1652	1319
Fl _t Permitted	0.95	1.00	0.39	1.00	1.00	1.00
Satd. Flow (perm)	1546	1300	636	1652	1652	1319
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	479	51	45	320	460	303
RTOR Reduction (vph)	0	10	0	0	0	189
Lane Group Flow (vph)	479	41	45	320	460	114
Confl. Peds. (#/hr)	20	20	20			20
Confl. Bikes (#/hr)		10				10
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	19.5	19.5	19.1	19.1	19.1	19.1
Effective Green, g (s)	19.5	19.5	19.1	19.1	19.1	19.1
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.38	0.38
Clearance Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	592	498	238	619	619	494
v/s Ratio Prot	c0.31			0.19	c0.28	
v/s Ratio Perm		0.03	0.07			0.09
v/c Ratio	0.81	0.08	0.19	0.52	0.74	0.23
Uniform Delay, d ₁	14.0	10.0	10.7	12.3	13.8	10.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d ₂	8.0	0.1	0.4	0.7	4.8	0.2
Delay (s)	22.1	10.1	11.1	13.1	18.6	11.1
Level of Service	C	B	B	B	B	B
Approach Delay (s)	20.9			12.8	15.6	
Approach LOS	C			B	B	
Intersection Summary						
HCM 2000 Control Delay			16.7		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.78			
Actuated Cycle Length (s)			50.9		Sum of lost time (s)	12.3
Intersection Capacity Utilization			68.8%		ICU Level of Service	C
Analysis Period (min)			15			
c Critical Lane Group						

Timings
1: Clementi St & CR 29

2029 Total Conditions
PM Peak Hour

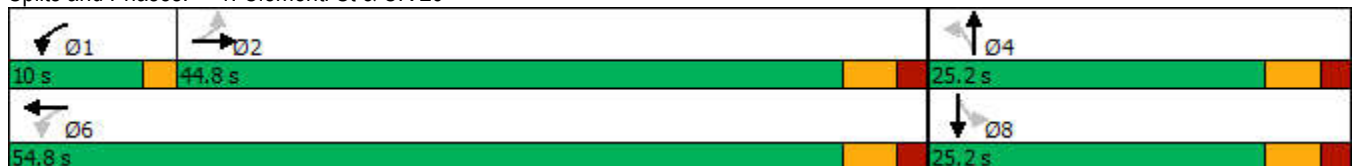


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	71	597	80	808	56	12	47	7
Future Volume (vph)	71	597	80	808	56	12	47	7
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		2	1	6		4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	4	4	8	8
Switch Phase								
Minimum Initial (s)	20.0	20.0	5.0	20.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.2	26.2	10.0	26.2	25.2	25.2	25.2	25.2
Total Split (s)	44.8	44.8	10.0	54.8	25.2	25.2	25.2	25.2
Total Split (%)	56.0%	56.0%	12.5%	68.5%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.3	3.3	2.0	3.3	3.3	3.3	3.3	3.3
All-Red Time (s)	1.9	1.9	0.0	1.9	1.9	1.9	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.2	5.2	2.0	5.2	5.2	5.2	5.2	5.2
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	None	Max	None	None	None	None
Act Effct Green (s)	47.1	47.1	56.2	54.1	13.7	13.7	13.7	13.7
Actuated g/C Ratio	0.64	0.64	0.76	0.73	0.19	0.19	0.19	0.19
v/c Ratio	0.31	0.69	0.20	0.79	0.31	0.34	0.27	0.28
Control Delay	16.0	18.8	5.2	17.4	29.9	10.9	28.9	10.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	18.8	5.2	17.4	29.9	10.9	28.9	10.5
LOS	B	B	A	B	C	B	C	B
Approach Delay		18.6		16.4		17.9		17.7
Approach LOS		B		B		B		B

Intersection Summary





















Cycle Length: 80
 Actuated Cycle Length: 74
 Natural Cycle: 80
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.79
 Intersection Signal Delay: 17.4
 Intersection Capacity Utilization 89.3%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 1: Clementi St & CR 29



HCM Signalized Intersection Capacity Analysis
1: Clementi St & CR 29

2029 Total Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	71	597	62	80	808	60	56	12	84	47	7	65
Future Volume (vph)	71	597	62	80	808	60	56	12	84	47	7	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.89		1.00	0.89	
Flpb, ped/bikes	0.99	1.00		1.00	1.00		0.95	1.00		0.95	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.87		1.00	0.87	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1553	1616		1565	1626		1412	1216		1414	1207	
Flt Permitted	0.24	1.00		0.26	1.00		0.71	1.00		0.69	1.00	
Satd. Flow (perm)	388	1616		429	1626		1049	1216		1027	1207	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	77	649	67	87	878	65	61	13	91	51	8	71
RTOR Reduction (vph)	0	4	0	0	3	0	0	77	0	0	60	0
Lane Group Flow (vph)	77	712	0	87	940	0	61	27	0	51	19	0
Confl. Peds. (#/hr)	30		30	30		30	30		30	30		30
Confl. Bikes (#/hr)			20			20			20			20
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	46.0	46.0		53.4	53.4		11.6	11.6		11.6	11.6	
Effective Green, g (s)	46.0	46.0		53.4	53.4		11.6	11.6		11.6	11.6	
Actuated g/C Ratio	0.61	0.61		0.71	0.71		0.15	0.15		0.15	0.15	
Clearance Time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	236	985		385	1151		161	187		158	185	
v/s Ratio Prot		0.44		0.02	c0.58			0.02			0.02	
v/s Ratio Perm	0.20			0.14			c0.06			0.05		
v/c Ratio	0.33	0.72		0.23	0.82		0.38	0.14		0.32	0.10	
Uniform Delay, d1	7.2	10.3		5.4	7.6		28.7	27.6		28.4	27.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.6	4.6		0.3	6.5		1.5	0.4		1.2	0.2	
Delay (s)	10.8	14.9		5.7	14.1		30.2	28.0		29.6	27.7	
Level of Service	B	B		A	B		C	C		C	C	
Approach Delay (s)		14.5			13.4			28.8			28.4	
Approach LOS		B			B			C			C	
Intersection Summary												
HCM 2000 Control Delay			15.9				HCM 2000 Level of Service				B	
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			75.4				Sum of lost time (s)			12.4		
Intersection Capacity Utilization			89.3%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

Timings
3: CR 29 & CR 18

2029 Total Conditions
PM Peak Hour



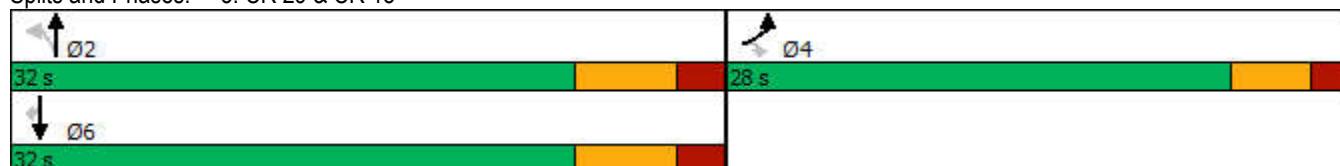
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↖	↖	↑	↑	↗
Traffic Volume (vph)	345	41	60	439	507	479
Future Volume (vph)	345	41	60	439	507	479
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	21.5	21.5	23.2	23.2	23.2	23.2
Total Split (s)	28.0	28.0	32.0	32.0	32.0	32.0
Total Split (%)	46.7%	46.7%	53.3%	53.3%	53.3%	53.3%
Yellow Time (s)	3.5	3.5	4.5	4.5	4.5	4.5
All-Red Time (s)	2.0	2.0	2.3	2.3	2.3	2.3
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Min	Min	Min	Min
Act Effect Green (s)	17.1	17.1	21.2	21.2	21.2	21.2
Actuated g/C Ratio	0.33	0.33	0.41	0.41	0.41	0.41
v/c Ratio	0.73	0.10	0.30	0.70	0.81	0.61
Control Delay	24.8	9.3	15.5	19.5	25.3	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.8	9.3	15.5	19.5	25.3	5.0
LOS	C	A	B	B	C	A
Approach Delay	23.1			19.0	15.4	
Approach LOS	C			B	B	

Intersection Summary

Cycle Length: 60
 Actuated Cycle Length: 51.1
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.81
 Intersection Signal Delay: 18.0
 Intersection Capacity Utilization 70.0%
 Analysis Period (min) 15

Intersection LOS: B
 ICU Level of Service C

Splits and Phases: 3: CR 29 & CR 18



HCM Signalized Intersection Capacity Analysis
3: CR 29 & CR 18

2029 Total Conditions
PM Peak Hour






















Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	345	41	60	439	507	479
Future Volume (vph)	345	41	60	439	507	479
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	3%			0%	0%	
Total Lost time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.94	1.00	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1546	1298	1551	1652	1652	1321
Flt Permitted	0.95	1.00	0.32	1.00	1.00	1.00
Satd. Flow (perm)	1546	1298	530	1652	1652	1321
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	375	45	65	477	551	521
RTOR Reduction (vph)	0	13	0	0	0	303
Lane Group Flow (vph)	375	32	65	477	551	218
Confl. Peds. (#/hr)	20	20	20			20
Confl. Bikes (#/hr)		10				10
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	17.1	17.1	21.2	21.2	21.2	21.2
Effective Green, g (s)	17.1	17.1	21.2	21.2	21.2	21.2
Actuated g/C Ratio	0.34	0.34	0.42	0.42	0.42	0.42
Clearance Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	522	438	222	692	692	553
v/s Ratio Prot	c0.24			0.29	c0.33	
v/s Ratio Perm		0.02	0.12			0.17
v/c Ratio	0.72	0.07	0.29	0.69	0.80	0.39
Uniform Delay, d1	14.6	11.4	9.7	12.0	12.8	10.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.7	0.1	0.7	2.9	6.3	0.5
Delay (s)	19.3	11.4	10.5	14.9	19.1	10.7
Level of Service	B	B	B	B	B	B
Approach Delay (s)	18.5			14.4	15.0	
Approach LOS	B			B	B	
Intersection Summary						
HCM 2000 Control Delay			15.6		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.76			
Actuated Cycle Length (s)			50.6		Sum of lost time (s)	12.3
Intersection Capacity Utilization			70.0%		ICU Level of Service	C
Analysis Period (min)			15			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis
2: Water Tower Rd/Com. Access & CR 29

















2045 Background Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	6	833	2	2	755	1	1	1	2	2	1	2
Future Volume (Veh/h)	6	833	2	2	755	1	1	1	2	2	1	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	905	2	2	821	1	1	1	2	2	1	2
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage (veh)		2			2							
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	822			907			1748	1746	906	1747	1746	822
vC1, stage 1 conf vol							920	920		826	826	
vC2, stage 2 conf vol							828	826		922	921	
vCu, unblocked vol	822			907			1748	1746	906	1747	1746	822
tC, single (s)	4.2			4.2			7.2	6.6	6.3	7.2	6.6	6.3
tC, 2 stage (s)							6.2	5.6		6.2	5.6	
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	99			100			100	100	99	99	100	99
cM capacity (veh/h)	754			699			233	255	323	233	256	362
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	7	907	2	822	4	5						
Volume Left	7	0	2	0	1	2						
Volume Right	0	2	0	1	2	2						
cSH	754	1700	699	1700	278	278						
Volume to Capacity	0.01	0.53	0.00	0.48	0.01	0.02						
Queue Length 95th (m)	0.2	0.0	0.1	0.0	0.4	0.4						
Control Delay (s)	9.8	0.0	10.2	0.0	18.2	18.2						
Lane LOS	A		B		C	C						
Approach Delay (s)	0.1		0.0		18.2	18.2						
Approach LOS					C	C						
Intersection Summary												
Average Delay			0.1									
Intersection Capacity Utilization			54.0%		ICU Level of Service				A			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

4: CR 29 & 7th Line

2045 Background Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	5	2	6	29	2	19	1	374	8	8	519	6
Future Volume (Veh/h)	5	2	6	29	2	19	1	374	8	8	519	6
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	2	7	32	2	21	1	407	9	9	564	7
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1021	1004	568	1007	1002	412	571			416		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1021	1004	568	1007	1002	412	571			416		
tC, single (s)	7.2	6.6	6.3	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	97	99	99	84	99	97	100			99		
cM capacity (veh/h)	198	232	508	206	232	623	940			1076		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	14	55	417	580								
Volume Left	5	32	1	9								
Volume Right	7	21	9	7								
cSH	294	279	940	1076								
Volume to Capacity	0.05	0.20	0.00	0.01								
Queue Length 95th (m)	1.2	5.8	0.0	0.2								
Control Delay (s)	17.9	21.1	0.0	0.2								
Lane LOS	C	C	A	A								
Approach Delay (s)	17.9	21.1	0.0	0.2								
Approach LOS	C	C										
Intersection Summary												
Average Delay			1.5									
Intersection Capacity Utilization			45.3%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
 5: North Collector/William Street & Clementi St




















2045 Background Conditions
 AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	80	1	1	109	93	29
Future Volume (vph)	80	1	1	109	93	29
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	87	1	1	118	101	32
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total (vph)	88	119	133			
Volume Left (vph)	87	0	101			
Volume Right (vph)	0	118	32			
Hadj (s)	0.23	-0.56	0.04			
Departure Headway (s)	4.6	3.8	4.4			
Degree Utilization, x	0.11	0.12	0.16			
Capacity (veh/h)	762	921	782			
Control Delay (s)	8.1	7.3	8.2			
Approach Delay (s)	8.1	7.3	8.2			
Approach LOS	A	A	A			
Intersection Summary						
Delay			7.9			
Level of Service			A			
Intersection Capacity Utilization			26.1%	ICU Level of Service	A	
Analysis Period (min)			15			

















HCM Unsignalized Intersection Capacity Analysis
2: Water Tower Rd/Com. Access & CR 29

2045 Background Conditions
PM Peak Hour

																				
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR								
Lane Configurations																				
Traffic Volume (veh/h)	2	848	1	1	1074	2	1	1	1	5	1	14								
Future Volume (Veh/h)	2	848	1	1	1074	2	1	1	1	5	1	14								
Sign Control		Free			Free			Stop			Stop									
Grade		0%			0%			0%			0%									
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92								
Hourly flow rate (vph)	2	922	1	1	1167	2	1	1	1	5	1	15								
Pedestrians																				
Lane Width (m)																				
Walking Speed (m/s)																				
Percent Blockage																				
Right turn flare (veh)																				
Median type																				
	TWLTL					TWLTL														
Median storage veh	2					2														
Upstream signal (m)																				
pX, platoon unblocked																				
vC, conflicting volume	1169				923				2111		2098		922		2098		2097		1168	
vC1, stage 1 conf vol									926		926				1170		1170			
vC2, stage 2 conf vol									1184		1171				928		927			
vCu, unblocked vol	1169				923				2111		2098		922		2098		2097		1168	
tC, single (s)	4.2				4.2				7.2		6.6		6.3		7.2		6.6		6.3	
tC, 2 stage (s)									6.2		5.6				6.2		5.6			
tF (s)	2.3				2.3				3.6		4.1		3.4		3.6		4.1		3.4	
p0 queue free %	100				100				99		100		100		97		100		93	
cM capacity (veh/h)	553				689				168		203		316		179		203		227	
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1														
Volume Total	2	923	1	1169	3	21														
Volume Left	2	0	1	0	1	5														
Volume Right	0	1	0	2	1	15														
cSH	553	1700	689	1700	213	212														
Volume to Capacity	0.00	0.54	0.00	0.69	0.01	0.10														
Queue Length 95th (m)	0.1	0.0	0.0	0.0	0.3	2.6														
Control Delay (s)	11.5	0.0	10.2	0.0	22.1	23.8														
Lane LOS	B		B		C								C							
Approach Delay (s)	0.0		0.0		22.1								23.8							
Approach LOS					C								C							
Intersection Summary																				
Average Delay			0.3																	
Intersection Capacity Utilization			66.6%		ICU Level of Service				C											
Analysis Period (min)			15																	

HCM Unsignalized Intersection Capacity Analysis
4: CR 29 & 7th Line

2045 Background Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	11	8	2	6	6	29	1	510	26	29	551	8
Future Volume (Veh/h)	11	8	2	6	6	29	1	510	26	29	551	8
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	9	2	7	7	32	1	554	28	32	599	9
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1273	1252	604	1244	1242	568	608			582		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1273	1252	604	1244	1242	568	608			582		
tC, single (s)	7.2	6.6	6.3	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	90	94	100	95	96	94	100			97		
cM capacity (veh/h)	122	160	484	135	163	507	910			931		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	23	46	583	640								
Volume Left	12	7	1	32								
Volume Right	2	32	28	9								
cSH	145	291	910	931								
Volume to Capacity	0.16	0.16	0.00	0.03								
Queue Length 95th (m)	4.4	4.4	0.0	0.9								
Control Delay (s)	34.4	19.7	0.0	0.9								
Lane LOS	D	C	A	A								
Approach Delay (s)	34.4	19.7	0.0	0.9								
Approach LOS	D	C										
Intersection Summary												
Average Delay			1.8									
Intersection Capacity Utilization			62.1%		ICU Level of Service					B		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
 5: North Collector/William Street & Clementi St

2045 Background Conditions
 PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	73	1	1	36	66	59
Future Volume (vph)	73	1	1	36	66	59
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	79	1	1	39	72	64
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total (vph)	80	40	136			
Volume Left (vph)	79	0	72			
Volume Right (vph)	0	39	64			
Hadj (s)	0.23	-0.55	-0.14			
Departure Headway (s)	4.5	3.7	4.0			
Degree Utilization, x	0.10	0.04	0.15			
Capacity (veh/h)	779	922	864			
Control Delay (s)	8.0	6.9	7.7			
Approach Delay (s)	8.0	6.9	7.7			
Approach LOS	A	A	A			
Intersection Summary						
Delay			7.7			
Level of Service			A			
Intersection Capacity Utilization			26.0%	ICU Level of Service	A	
Analysis Period (min)			15			

Timings
1: Clementi St & CR 29

2045 Background Conditions
AM Peak Hour

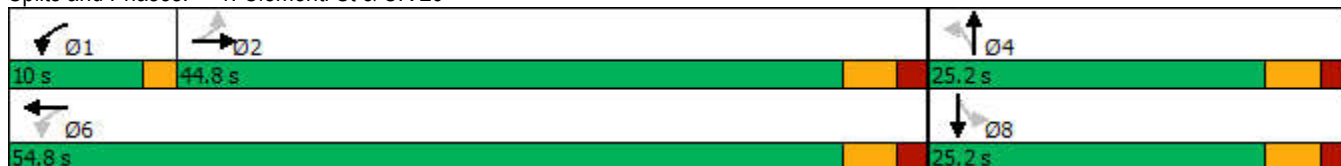


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	50	689	66	653	85	19	56	6
Future Volume (vph)	50	689	66	653	85	19	56	6
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		2	1	6		4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	4	4	8	8
Switch Phase								
Minimum Initial (s)	20.0	20.0	5.0	20.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.2	26.2	10.0	26.2	25.2	25.2	25.2	25.2
Total Split (s)	44.8	44.8	10.0	54.8	25.2	25.2	25.2	25.2
Total Split (%)	56.0%	56.0%	12.5%	68.5%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.3	3.3	2.0	3.3	3.3	3.3	3.3	3.3
All-Red Time (s)	1.9	1.9	0.0	1.9	1.9	1.9	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.2	5.2	2.0	5.2	5.2	5.2	5.2	5.2
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	None	Max	None	None	None	None
Act Effct Green (s)	45.3	45.3	55.8	52.5	13.0	13.0	13.0	13.0
Actuated g/C Ratio	0.60	0.60	0.73	0.69	0.17	0.17	0.17	0.17
v/c Ratio	0.16	0.84	0.21	0.68	0.51	0.46	0.37	0.21
Control Delay	11.0	25.0	5.1	11.6	37.0	12.2	32.7	11.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.0	25.0	5.1	11.6	37.0	12.2	32.7	11.8
LOS	B	C	A	B	D	B	C	B
Approach Delay		24.2		11.0		21.9		23.1
Approach LOS		C		B		C		C

Intersection Summary





















Cycle Length: 80
 Actuated Cycle Length: 76
 Natural Cycle: 90
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.84
 Intersection Signal Delay: 18.5
 Intersection Capacity Utilization 90.7%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service E

Splits and Phases: 1: Clementi St & CR 29



HCM Signalized Intersection Capacity Analysis
1: Clementi St & CR 29

2045 Background Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	50	689	60	66	653	49	85	19	113	56	6	41
Future Volume (vph)	50	689	60	66	653	49	85	19	113	56	6	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.90		1.00	0.90	
Flpb, ped/bikes	0.98	1.00		1.00	1.00		0.95	1.00		0.95	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.87		1.00	0.87	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1543	1621		1570	1625		1408	1228		1418	1224	
Flt Permitted	0.34	1.00		0.19	1.00		0.72	1.00		0.65	1.00	
Satd. Flow (perm)	551	1621		312	1625		1072	1228		970	1224	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	54	749	65	72	710	53	92	21	123	61	7	45
RTOR Reduction (vph)	0	3	0	0	3	0	0	102	0	0	37	0
Lane Group Flow (vph)	54	811	0	72	760	0	92	42	0	61	15	0
Confl. Peds. (#/hr)	30		30	30		30	30		30	30		30
Confl. Bikes (#/hr)			20			20			20			20
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	45.3	45.3		52.9	52.9		13.0	13.0		13.0	13.0	
Effective Green, g (s)	45.3	45.3		52.9	52.9		13.0	13.0		13.0	13.0	
Actuated g/C Ratio	0.59	0.59		0.69	0.69		0.17	0.17		0.17	0.17	
Clearance Time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	327	962		308	1126		182	209		165	208	
v/s Ratio Prot		c0.50		0.02	c0.47			0.03			0.01	
v/s Ratio Perm	0.10			0.14			c0.09			0.06		
v/c Ratio	0.17	0.84		0.23	0.68		0.51	0.20		0.37	0.07	
Uniform Delay, d1	7.0	12.6		7.5	6.7		28.7	27.2		28.0	26.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.1	8.9		0.4	3.3		2.2	0.5		1.4	0.1	
Delay (s)	8.1	21.5		7.9	10.0		30.9	27.7		29.4	26.7	
Level of Service	A	C		A	A		C	C		C	C	
Approach Delay (s)		20.7			9.8			28.9			28.2	
Approach LOS		C			A			C			C	
Intersection Summary												
HCM 2000 Control Delay			17.6				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.75									
Actuated Cycle Length (s)			76.3				Sum of lost time (s)		12.4			
Intersection Capacity Utilization			90.7%				ICU Level of Service		E			
Analysis Period (min)			15									
c	Critical Lane Group											

Timings
3: CR 29 & CR 18

2045 Background Conditions
AM Peak Hour

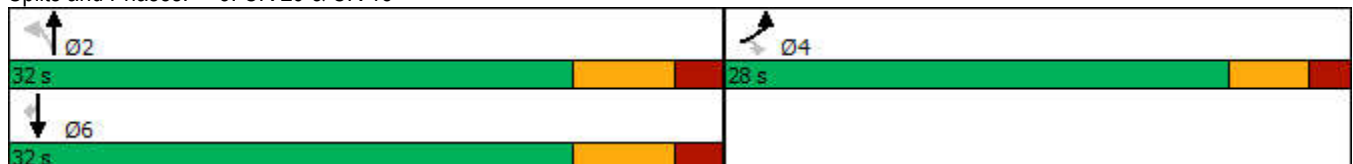


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↖	↖	↗	↗	↖
Traffic Volume (vph)	501	50	43	339	479	304
Future Volume (vph)	501	50	43	339	479	304
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	21.5	21.5	23.2	23.2	23.2	23.2
Total Split (s)	28.0	28.0	32.0	32.0	32.0	32.0
Total Split (%)	46.7%	46.7%	53.3%	53.3%	53.3%	53.3%
Yellow Time (s)	3.5	3.5	4.5	4.5	4.5	4.5
All-Red Time (s)	2.0	2.0	2.3	2.3	2.3	2.3
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Min	Min	Min	Min
Act Effct Green (s)	21.7	21.7	21.3	21.3	21.3	21.3
Actuated g/C Ratio	0.39	0.39	0.38	0.38	0.38	0.38
v/c Ratio	0.90	0.10	0.24	0.58	0.82	0.47
Control Delay	39.5	10.2	15.1	17.7	28.1	4.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.5	10.2	15.1	17.7	28.1	4.1
LOS	D	B	B	B	C	A
Approach Delay	36.8			17.4	18.8	
Approach LOS	D			B	B	

Intersection Summary

Cycle Length: 60
 Actuated Cycle Length: 55.5
 Natural Cycle: 65
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.90
 Intersection Signal Delay: 24.3
 Intersection LOS: C
 Intersection Capacity Utilization 73.7%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 3: CR 29 & CR 18



HCM Signalized Intersection Capacity Analysis

3: CR 29 & CR 18

2045 Background Conditions
AM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	501	50	43	339	479	304
Future Volume (vph)	501	50	43	339	479	304
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	3%			0%	0%	
Total Lost time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.94	1.00	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1546	1296	1549	1652	1652	1316
Flt Permitted	0.95	1.00	0.31	1.00	1.00	1.00
Satd. Flow (perm)	1546	1296	512	1652	1652	1316
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	545	54	47	368	521	330
RTOR Reduction (vph)	0	9	0	0	0	203
Lane Group Flow (vph)	545	45	47	368	521	127
Confl. Peds. (#/hr)	20	20	20			20
Confl. Bikes (#/hr)		10				10
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	21.8	21.8	21.3	21.3	21.3	21.3
Effective Green, g (s)	21.8	21.8	21.3	21.3	21.3	21.3
Actuated g/C Ratio	0.39	0.39	0.38	0.38	0.38	0.38
Clearance Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	608	509	196	635	635	505
v/s Ratio Prot	c0.35			0.22	c0.32	
v/s Ratio Perm		0.03	0.09			0.10
v/c Ratio	0.90	0.09	0.24	0.58	0.82	0.25
Uniform Delay, d1	15.7	10.6	11.6	13.5	15.3	11.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	15.8	0.1	0.6	1.3	8.4	0.3
Delay (s)	31.5	10.6	12.2	14.8	23.7	11.9
Level of Service	C	B	B	B	C	B
Approach Delay (s)	29.6			14.5	19.1	
Approach LOS	C			B	B	
Intersection Summary						
HCM 2000 Control Delay			21.5		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.86			
Actuated Cycle Length (s)			55.4		Sum of lost time (s)	12.3
Intersection Capacity Utilization			73.7%		ICU Level of Service	D
Analysis Period (min)			15			
c Critical Lane Group						

Timings
1: Clementi St & CR 29

2045 Background Conditions
PM Peak Hour

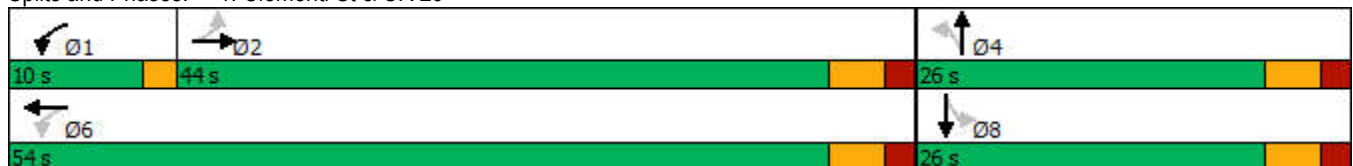


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	80	675	90	914	66	14	55	6
Future Volume (vph)	80	675	90	914	66	14	55	6
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		2	1	6		4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	4	4	8	8
Switch Phase								
Minimum Initial (s)	20.0	20.0	5.0	20.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.2	26.2	10.0	26.2	25.2	25.2	25.2	25.2
Total Split (s)	44.0	44.0	10.0	54.0	26.0	26.0	26.0	26.0
Total Split (%)	55.0%	55.0%	12.5%	67.5%	32.5%	32.5%	32.5%	32.5%
Yellow Time (s)	3.3	3.3	2.0	3.3	3.3	3.3	3.3	3.3
All-Red Time (s)	1.9	1.9	0.0	1.9	1.9	1.9	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.2	5.2	2.0	5.2	5.2	5.2	5.2	5.2
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	None	Max	None	None	None	None
Act Effct Green (s)	46.0	46.0	55.3	53.1	12.3	12.3	12.3	12.3
Actuated g/C Ratio	0.64	0.64	0.77	0.74	0.17	0.17	0.17	0.17
v/c Ratio	0.48	0.78	0.26	0.89	0.40	0.40	0.35	0.31
Control Delay	25.2	21.7	5.2	22.7	33.2	11.6	31.6	10.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	25.2	21.7	5.2	22.7	33.2	11.6	31.6	10.8
LOS	C	C	A	C	C	B	C	B
Approach Delay		22.1		21.2		19.8		19.4
Approach LOS		C		C		B		B

Intersection Summary

Cycle Length: 80
 Actuated Cycle Length: 71.6
 Natural Cycle: 90
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.89
 Intersection Signal Delay: 21.3
 Intersection Capacity Utilization 96.6%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service F

Splits and Phases: 1: Clementi St & CR 29

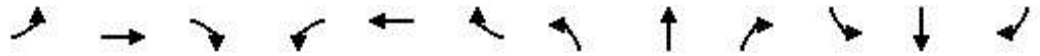


HCM Signalized Intersection Capacity Analysis

2045 Background Conditions

1: Clementi St & CR 29

PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	675	73	90	914	70	66	14	96	55	6	73
Future Volume (vph)	80	675	73	90	914	70	66	14	96	55	6	73
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.89		1.00	0.89	
Flpb, ped/bikes	0.99	1.00		1.00	1.00		0.95	1.00		0.95	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.87		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1559	1615		1567	1625		1415	1213		1418	1196	
Flt Permitted	0.17	1.00		0.21	1.00		0.70	1.00		0.68	1.00	
Satd. Flow (perm)	283	1615		340	1625		1044	1213		1016	1196	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	734	79	98	993	76	72	15	104	60	7	79
RTOR Reduction (vph)	0	3	0	0	3	0	0	89	0	0	68	0
Lane Group Flow (vph)	87	810	0	98	1066	0	72	30	0	60	18	0
Confl. Peds. (#/hr)	30		30	30		30	30		30	30		30
Confl. Bikes (#/hr)			20			20			20			20
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	44.9	44.9		52.4	52.4		10.2	10.2		10.2	10.2	
Effective Green, g (s)	44.9	44.9		52.4	52.4		10.2	10.2		10.2	10.2	
Actuated g/C Ratio	0.62	0.62		0.72	0.72		0.14	0.14		0.14	0.14	
Clearance Time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	174	993		336	1166		145	169		141	167	
v/s Ratio Prot		0.50		0.02	c0.66			0.02			0.02	
v/s Ratio Perm	0.31			0.19			c0.07			0.06		
v/c Ratio	0.50	0.82		0.29	0.91		0.50	0.17		0.43	0.11	
Uniform Delay, d1	7.8	10.8		6.4	8.5		29.0	27.7		28.7	27.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	9.9	7.3		0.5	12.5		2.7	0.5		2.1	0.3	
Delay (s)	17.7	18.2		6.9	20.9		31.7	28.2		30.8	27.7	
Level of Service	B	B		A	C		C	C		C	C	
Approach Delay (s)		18.2			19.8			29.5			29.0	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	20.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	73.0	Sum of lost time (s)	12.4
Intersection Capacity Utilization	96.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings
3: CR 29 & CR 18

2045 Background Conditions
PM Peak Hour

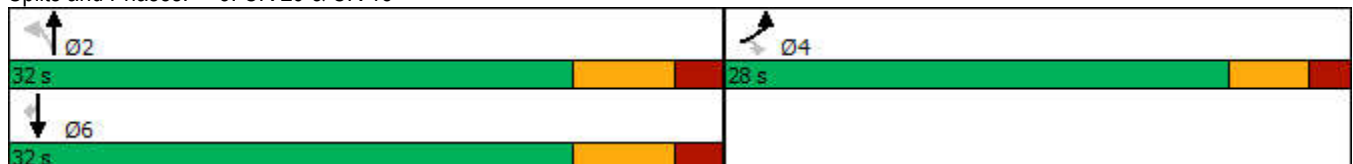


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↖	↑	↑	↗
Traffic Volume (vph)	379	43	68	496	583	542
Future Volume (vph)	379	43	68	496	583	542
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	21.5	21.5	23.2	23.2	23.2	23.2
Total Split (s)	28.0	28.0	32.0	32.0	32.0	32.0
Total Split (%)	46.7%	46.7%	53.3%	53.3%	53.3%	53.3%
Yellow Time (s)	3.5	3.5	4.5	4.5	4.5	4.5
All-Red Time (s)	2.0	2.0	2.3	2.3	2.3	2.3
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Min	Min	Min	Min
Act Effct Green (s)	18.5	18.5	23.9	23.9	23.9	23.9
Actuated g/C Ratio	0.34	0.34	0.44	0.44	0.44	0.44
v/c Ratio	0.79	0.11	0.42	0.75	0.88	0.65
Control Delay	29.5	9.4	21.1	22.6	32.7	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.5	9.4	21.1	22.6	32.7	5.3
LOS	C	A	C	C	C	A
Approach Delay	27.5			22.4	19.5	
Approach LOS	C			C	B	

Intersection Summary













Cycle Length: 60
 Actuated Cycle Length: 54.9
 Natural Cycle: 60
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.88
 Intersection Signal Delay: 21.9
 Intersection LOS: C
 Intersection Capacity Utilization 75.9%
 ICU Level of Service D
 Analysis Period (min) 15

Splits and Phases: 3: CR 29 & CR 18



HCM Signalized Intersection Capacity Analysis
3: CR 29 & CR 18

2045 Background Conditions
PM Peak Hour

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	379	43	68	496	583	542
Future Volume (vph)	379	43	68	496	583	542
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	3%			0%	0%	
Total Lost time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.94	1.00	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1546	1295	1554	1652	1652	1318
Flt Permitted	0.95	1.00	0.25	1.00	1.00	1.00
Satd. Flow (perm)	1546	1295	405	1652	1652	1318
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	412	47	74	539	634	589
RTOR Reduction (vph)	0	12	0	0	0	332
Lane Group Flow (vph)	412	35	74	539	634	257
Confl. Peds. (#/hr)	20	20	20			20
Confl. Bikes (#/hr)		10				10
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	18.5	18.5	23.9	23.9	23.9	23.9
Effective Green, g (s)	18.5	18.5	23.9	23.9	23.9	23.9
Actuated g/C Ratio	0.34	0.34	0.44	0.44	0.44	0.44
Clearance Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	522	437	176	721	721	575
v/s Ratio Prot	c0.27			0.33	c0.38	
v/s Ratio Perm		0.03	0.18			0.20
v/c Ratio	0.79	0.08	0.42	0.75	0.88	0.45
Uniform Delay, d1	16.3	12.3	10.6	12.9	14.1	10.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.8	0.1	1.6	4.2	11.8	0.6
Delay (s)	24.1	12.4	12.2	17.1	25.9	11.3
Level of Service	C	B	B	B	C	B
Approach Delay (s)	22.9			16.5	18.9	
Approach LOS	C			B	B	
Intersection Summary						
HCM 2000 Control Delay			19.1		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.84			
Actuated Cycle Length (s)			54.7		Sum of lost time (s)	12.3
Intersection Capacity Utilization			75.9%		ICU Level of Service	D
Analysis Period (min)			15			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis
2: Water Tower Rd/Com. Access & CR 29

















2045 Total Conditions
AM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR												
Lane Configurations																								
Traffic Volume (veh/h)	6	833	69	75	755	1	133	1	114	2	1	2												
Future Volume (Veh/h)	6	833	69	75	755	1	133	1	114	2	1	2												
Sign Control	Free			Free			Stop			Stop														
Grade	0%			0%			0%			0%														
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92												
Hourly flow rate (vph)	7	905	75	82	821	1	145	1	124	2	1	2												
Pedestrians																								
Lane Width (m)																								
Walking Speed (m/s)																								
Percent Blockage																								
Right turn flare (veh)																								
Median type																								
	TWLTL					TWLTL																		
Median storage veh	2					2																		
Upstream signal (m)																								
pX, platoon unblocked																								
vC, conflicting volume	822			980			1944			1942			942			2029			1980			822		
vC1, stage 1 conf vol							956			956						986			986					
vC2, stage 2 conf vol							988			986						1044			994					
vCu, unblocked vol	822			980			1944			1942			942			2029			1980			822		
tC, single (s)	4.2			4.2			7.2			6.6			6.3			7.2			6.6			6.3		
tC, 2 stage (s)							6.2			5.6						6.2			5.6					
tF (s)	2.3			2.3			3.6			4.1			3.4			3.6			4.1			3.4		
p0 queue free %	99			87			22			100			60			97			99			99		
cM capacity (veh/h)	754			655			186			208			308			72			178			362		
Direction, Lane #																								
	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1																		
Volume Total	7	980	82	822	270	5																		
Volume Left	7	0	82	0	145	2																		
Volume Right	0	75	0	1	124	2																		
cSH	754	1700	655	1700	228	128																		
Volume to Capacity	0.01	0.58	0.13	0.48	1.19	0.04																		
Queue Length 95th (m)	0.2	0.0	3.4	0.0	104.5	1.0																		
Control Delay (s)	9.8	0.0	11.3	0.0	163.8	34.2																		
Lane LOS	A		B		F		D																	
Approach Delay (s)	0.1		1.0		163.8		34.2																	
Approach LOS					F		D																	
Intersection Summary																								
Average Delay			21.0																					
Intersection Capacity Utilization			84.1%		ICU Level of Service				E															
Analysis Period (min)			15																					

HCM Unsignalized Intersection Capacity Analysis

4: CR 29 & 7th Line

2045 Total Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	7	17	6	198	30	33	1	389	89	12	568	14
Future Volume (Veh/h)	7	17	6	198	30	33	1	389	89	12	568	14
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	8	18	7	215	33	36	1	423	97	13	617	15
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	1176	1172	624	1140	1132	472	632			520		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1176	1172	624	1140	1132	472	632			520		
tC, single (s)	7.2	6.6	6.3	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	94	90	99	0	83	94	100			99		
cM capacity (veh/h)	131	183	471	155	194	576	891			983		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	33	284	521	645								
Volume Left	8	215	1	13								
Volume Right	7	36	97	15								
cSH	189	175	891	983								
Volume to Capacity	0.17	1.62	0.00	0.01								
Queue Length 95th (m)	4.9	153.4	0.0	0.3								
Control Delay (s)	28.0	351.7	0.0	0.4								
Lane LOS	D	F	A	A								
Approach Delay (s)	28.0	351.7	0.0	0.4								
Approach LOS	D	F										
Intersection Summary												
Average Delay			68.1									
Intersection Capacity Utilization			69.4%		ICU Level of Service					C		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
 5: North Collector/William Street & Clementi St

















2045 Total Conditions
 AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	90	1	1	109	95	33
Future Volume (vph)	90	1	1	109	95	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	98	1	1	118	103	36
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total (vph)	99	119	139			
Volume Left (vph)	98	0	103			
Volume Right (vph)	0	118	36			
Hadj (s)	0.23	-0.56	0.03			
Departure Headway (s)	4.6	3.8	4.4			
Degree Utilization, x	0.13	0.13	0.17			
Capacity (veh/h)	759	912	779			
Control Delay (s)	8.2	7.3	8.3			
Approach Delay (s)	8.2	7.3	8.3			
Approach LOS	A	A	A			
Intersection Summary						
Delay			8.0			
Level of Service			A			
Intersection Capacity Utilization			27.1%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
6: South Collector/Water Tower Rd & North Collector

2045 Total Conditions
AM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (veh/h)	19	1	1	1	1	8	1	121	1	2	101	7	
Future Volume (Veh/h)	19	1	1	1	1	8	1	121	1	2	101	7	
Sign Control		Stop			Stop			Free			Free		
Grade		0%			0%			0%			0%		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	21	1	1	1	1	9	1	132	1	2	110	8	
Pedestrians													
Lane Width (m)													
Walking Speed (m/s)													
Percent Blockage													
Right turn flare (veh)													
Median type							None						
Median storage veh													
Upstream signal (m)													
pX, platoon unblocked													
vC, conflicting volume	262	253	114	254	256	132	118					133	
vC1, stage 1 conf vol													
vC2, stage 2 conf vol													
vCu, unblocked vol	262	253	114	254	256	132	118					133	
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.2					4.2	
tC, 2 stage (s)													
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.3					2.3	
p0 queue free %	97	100	100	100	100	99	100					100	
cM capacity (veh/h)	676	644	931	690	641	909	1422					1404	
Direction, Lane #	EB 1	WB 1	NB 1	SB 1									
Volume Total	23	11	134	120									
Volume Left	21	1	1	2									
Volume Right	1	9	1	8									
cSH	683	852	1422	1404									
Volume to Capacity	0.03	0.01	0.00	0.00									
Queue Length 95th (m)	0.8	0.3	0.0	0.0									
Control Delay (s)	10.5	9.3	0.1	0.1									
Lane LOS	B	A	A	A									
Approach Delay (s)	10.5	9.3	0.1	0.1									
Approach LOS	B	A											
Intersection Summary													
Average Delay			1.3										
Intersection Capacity Utilization			20.9%	ICU Level of Service	A								
Analysis Period (min)			15										

HCM Unsignalized Intersection Capacity Analysis
7: 7th Line & South Collector




















2045 Total Conditions
AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Traffic Volume (veh/h)	100	14	29	1	1	211
Future Volume (Veh/h)	100	14	29	1	1	211
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	109	15	32	1	1	229
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	33				266	32
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	33				266	32
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	93				100	78
cM capacity (veh/h)	1529				656	1019
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	124	33	230			
Volume Left	109	0	1			
Volume Right	0	1	229			
cSH	1529	1700	1016			
Volume to Capacity	0.07	0.02	0.23			
Queue Length 95th (m)	1.8	0.0	7.0			
Control Delay (s)	6.7	0.0	9.6			
Lane LOS	A		A			
Approach Delay (s)	6.7	0.0	9.6			
Approach LOS			A			
Intersection Summary						
Average Delay			7.8			
Intersection Capacity Utilization			34.2%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
2: Water Tower Rd/Com. Access & CR 29

















2045 Total Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	2	848	143	122	1074	2	98	1	90	5	1	14
Future Volume (Veh/h)	2	848	143	122	1074	2	98	1	90	5	1	14
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	922	155	133	1167	2	107	1	98	5	1	15
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			TWLTL							
Median storage veh		2			2							
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1169			1077			2452	2438	1000	2458	2515	1168
vC1, stage 1 conf vol							1004	1004		1434	1434	
vC2, stage 2 conf vol							1448	1435		1024	1081	
vCu, unblocked vol	1169			1077			2452	2438	1000	2458	2515	1168
tC, single (s)	4.2			4.2			7.2	6.6	6.3	7.2	6.6	6.3
tC, 2 stage (s)							6.2	5.6		6.2	5.6	
tF (s)	2.3			2.3			3.6	4.1	3.4	3.6	4.1	3.4
p0 queue free %	100			78			0	99	66	88	99	93
cM capacity (veh/h)	553			601			100	130	285	42	104	227
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total	2	1077	133	1169	206	21						
Volume Left	2	0	133	0	107	5						
Volume Right	0	155	0	2	98	15						
cSH	553	1700	601	1700	145	108						
Volume to Capacity	0.00	0.63	0.22	0.69	1.42	0.19						
Queue Length 95th (m)	0.1	0.0	6.7	0.0	107.0	5.4						
Control Delay (s)	11.5	0.0	12.7	0.0	281.5	46.1						
Lane LOS	B		B		F	E						
Approach Delay (s)	0.0		1.3		281.5	46.1						
Approach LOS					F	E						
Intersection Summary												
Average Delay			23.3									
Intersection Capacity Utilization			88.3%		ICU Level of Service				E			
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis

4: CR 29 & 7th Line

2045 Total Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	19	38	2	126	25	37	1	560	209	43	581	13
Future Volume (Veh/h)	19	38	2	126	25	37	1	560	209	43	581	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	21	41	2	137	27	40	1	609	227	47	632	14
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type												
Median storage veh												
Upstream signal (m)												
pX, platoon unblocked												
vC, conflicting volume	1511	1571	639	1480	1464	722	646			836		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1511	1571	639	1480	1464	722	646			836		
tC, single (s)	7.2	6.6	6.3	7.2	6.6	6.3	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.6	4.1	3.4	2.3			2.3		
p0 queue free %	69	59	100	0	77	90	100			94		
cM capacity (veh/h)	67	99	462	64	115	413	880			744		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	64	204	837	693								
Volume Left	21	137	1	47								
Volume Right	2	40	227	14								
cSH	87	83	880	744								
Volume to Capacity	0.73	2.47	0.00	0.06								
Queue Length 95th (m)	29.2	153.4	0.0	1.6								
Control Delay (s)	117.2	777.3	0.0	1.7								
Lane LOS	F	F	A	A								
Approach Delay (s)	117.2	777.3	0.0	1.7								
Approach LOS	F	F										
Intersection Summary												
Average Delay			93.0									
Intersection Capacity Utilization			90.7%		ICU Level of Service					E		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
 5: North Collector/William Street & Clementi St

















2045 Total Conditions
 PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Sign Control		Stop	Stop		Stop	
Traffic Volume (vph)	79	1	1	36	66	71
Future Volume (vph)	79	1	1	36	66	71
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	86	1	1	39	72	77
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total (vph)	87	40	149			
Volume Left (vph)	86	0	72			
Volume Right (vph)	0	39	77			
Hadj (s)	0.23	-0.55	-0.18			
Departure Headway (s)	4.5	3.8	4.0			
Degree Utilization, x	0.11	0.04	0.17			
Capacity (veh/h)	773	910	867			
Control Delay (s)	8.0	6.9	7.8			
Approach Delay (s)	8.0	6.9	7.8			
Approach LOS	A	A	A			
Intersection Summary						
Delay			7.7			
Level of Service			A			
Intersection Capacity Utilization			27.2%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
6: South Collector/Water Tower Rd & North Collector

2045 Total Conditions
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	14	1	1	1	1	5	1	107	1	9	134	21
Future Volume (Veh/h)	14	1	1	1	1	5	1	107	1	9	134	21
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	15	1	1	1	1	5	1	116	1	10	146	23
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	302	296	158	298	308	116	169			117		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	302	296	158	298	308	116	169			117		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.2			4.2		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.3			2.3		
p0 queue free %	98	100	100	100	100	99	100			99		
cM capacity (veh/h)	637	605	880	643	597	928	1361			1423		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	17	7	118	179								
Volume Left	15	1	1	10								
Volume Right	1	5	1	23								
cSH	645	812	1361	1423								
Volume to Capacity	0.03	0.01	0.00	0.01								
Queue Length 95th (m)	0.6	0.2	0.0	0.2								
Control Delay (s)	10.7	9.5	0.1	0.5								
Lane LOS	B	A	A	A								
Approach Delay (s)	10.7	9.5	0.1	0.5								
Approach LOS	B	A										
Intersection Summary												
Average Delay			1.1									
Intersection Capacity Utilization			25.7%		ICU Level of Service					A		
Analysis Period (min)			15									

HCM Unsignalized Intersection Capacity Analysis
7: 7th Line & South Collector

2045 Total Conditions
PM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↔	↔		↔	
Traffic Volume (veh/h)	227	26	18	1	1	147
Future Volume (Veh/h)	227	26	18	1	1	147
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	247	28	20	1	1	160
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	21				542	20
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	21				542	20
tC, single (s)	4.2				6.5	6.3
tC, 2 stage (s)						
tF (s)	2.3				3.6	3.4
p0 queue free %	84				100	85
cM capacity (veh/h)	1544				410	1034
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	275	21	161			
Volume Left	247	0	1			
Volume Right	0	1	160			
cSH	1544	1700	1025			
Volume to Capacity	0.16	0.01	0.16			
Queue Length 95th (m)	4.6	0.0	4.5			
Control Delay (s)	7.1	0.0	9.2			
Lane LOS	A		A			
Approach Delay (s)	7.1	0.0	9.2			
Approach LOS			A			
Intersection Summary						
Average Delay			7.5			
Intersection Capacity Utilization			38.6%		ICU Level of Service	A
Analysis Period (min)			15			

Timings
1: Clementi St & CR 29

2045 Total Conditions
AM Peak Hour

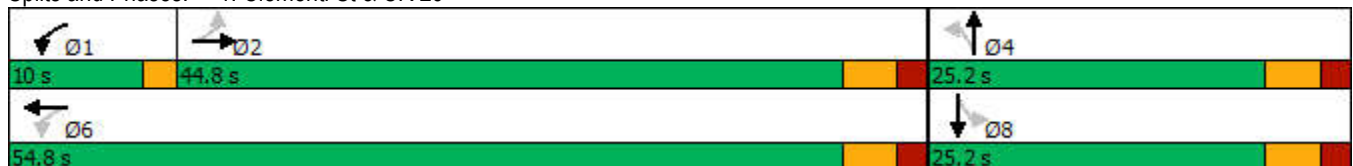


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↶	↷	↶	↷	↶	↷	↶	↷
Traffic Volume (vph)	62	789	70	717	85	19	56	6
Future Volume (vph)	62	789	70	717	85	19	56	6
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		2	1	6		4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	4	4	8	8
Switch Phase								
Minimum Initial (s)	20.0	20.0	5.0	20.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.2	26.2	10.0	26.2	25.2	25.2	25.2	25.2
Total Split (s)	44.8	44.8	10.0	54.8	25.2	25.2	25.2	25.2
Total Split (%)	56.0%	56.0%	12.5%	68.5%	31.5%	31.5%	31.5%	31.5%
Yellow Time (s)	3.3	3.3	2.0	3.3	3.3	3.3	3.3	3.3
All-Red Time (s)	1.9	1.9	0.0	1.9	1.9	1.9	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.2	5.2	2.0	5.2	5.2	5.2	5.2	5.2
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	None	Max	None	None	None	None
Act Effct Green (s)	45.3	45.3	55.8	52.6	13.1	13.1	13.1	13.1
Actuated g/C Ratio	0.60	0.60	0.73	0.69	0.17	0.17	0.17	0.17
v/c Ratio	0.23	0.95	0.28	0.74	0.51	0.48	0.39	0.24
Control Delay	12.5	38.4	6.4	13.9	37.2	12.2	33.5	11.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	12.5	38.4	6.4	13.9	37.2	12.2	33.5	11.4
LOS	B	D	A	B	D	B	C	B
Approach Delay		36.7		13.3		21.5		22.5
Approach LOS		D		B		C		C

Intersection Summary





















Cycle Length: 80
 Actuated Cycle Length: 76.1
 Natural Cycle: 90
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 24.9
 Intersection LOS: C
 Intersection Capacity Utilization 94.2%
 ICU Level of Service F
 Analysis Period (min) 15

Splits and Phases: 1: Clementi St & CR 29



HCM Signalized Intersection Capacity Analysis
1: Clementi St & CR 29

2045 Total Conditions
AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	62	789	60	70	717	49	85	19	123	56	6	50
Future Volume (vph)	62	789	60	70	717	49	85	19	123	56	6	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.90		1.00	0.90	
Flpb, ped/bikes	0.99	1.00		1.00	1.00		0.95	1.00		0.95	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.87		1.00	0.87	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1547	1625		1570	1628		1409	1225		1420	1217	
Flt Permitted	0.30	1.00		0.12	1.00		0.72	1.00		0.62	1.00	
Satd. Flow (perm)	481	1625		201	1628		1064	1225		927	1217	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	67	858	65	76	779	53	92	21	134	61	7	54
RTOR Reduction (vph)	0	3	0	0	2	0	0	111	0	0	45	0
Lane Group Flow (vph)	67	920	0	76	830	0	92	44	0	61	16	0
Confl. Peds. (#/hr)	30		30	30		30	30		30	30		30
Confl. Bikes (#/hr)			20			20			20			20
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	45.3	45.3		52.9	52.9		13.1	13.1		13.1	13.1	
Effective Green, g (s)	45.3	45.3		52.9	52.9		13.1	13.1		13.1	13.1	
Actuated g/C Ratio	0.59	0.59		0.69	0.69		0.17	0.17		0.17	0.17	
Clearance Time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	285	963		239	1127		182	210		158	208	
v/s Ratio Prot		c0.57		0.02	c0.51			0.04			0.01	
v/s Ratio Perm	0.14			0.20			c0.09			0.07		
v/c Ratio	0.24	0.96		0.32	0.74		0.51	0.21		0.39	0.08	
Uniform Delay, d1	7.4	14.6		10.5	7.4		28.7	27.2		28.1	26.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.9	20.1		0.8	4.3		2.2	0.5		1.6	0.2	
Delay (s)	9.3	34.7		11.2	11.7		30.9	27.7		29.6	26.7	
Level of Service	A	C		B	B		C	C		C	C	
Approach Delay (s)		32.9			11.6			28.9			28.2	
Approach LOS		C			B			C			C	
Intersection Summary												
HCM 2000 Control Delay			23.7				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			76.4				Sum of lost time (s)		12.4			
Intersection Capacity Utilization			94.2%				ICU Level of Service		F			
Analysis Period (min)			15									
c	Critical Lane Group											

Timings
2: Water Tower Road/Com. Access & CR 29

2045 Total Conditions
AM Peak Hour

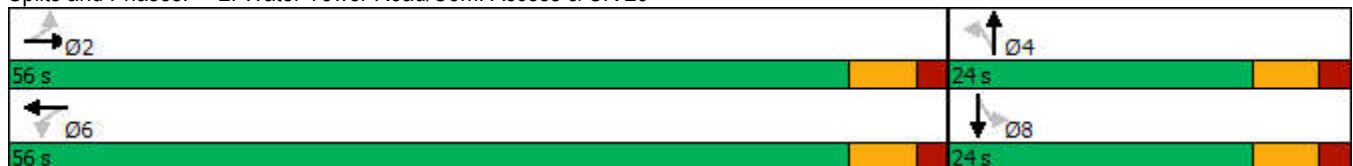


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↶	↷	↶	↷		↕		↕
Traffic Volume (vph)	6	833	75	755	133	1	2	1
Future Volume (vph)	6	833	75	755	133	1	2	1
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	6	6	4	4	8	8
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	56.0	56.0	56.0	56.0	24.0	24.0	24.0	24.0
Total Split (s)	56.0	56.0	56.0	56.0	24.0	24.0	24.0	24.0
Total Split (%)	70.0%	70.0%	70.0%	70.0%	30.0%	30.0%	30.0%	30.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0		6.0		6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
Act Effct Green (s)	51.1	51.1	51.1	51.1		17.4		17.4
Actuated g/C Ratio	0.63	0.63	0.63	0.63		0.22		0.22
v/c Ratio	0.03	0.95	0.60	0.79		0.93		0.02
Control Delay	6.2	34.2	32.5	18.0		65.7		21.0
Queue Delay	0.0	0.0	0.0	0.0		0.0		0.0
Total Delay	6.2	34.2	32.5	18.0		65.7		21.0
LOS	A	C	C	B		E		C
Approach Delay		34.0		19.3		65.7		21.0
Approach LOS		C		B		E		C

Intersection Summary

Cycle Length: 80	
Actuated Cycle Length: 80.5	
Natural Cycle: 90	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.95	
Intersection Signal Delay: 31.8	Intersection LOS: C
Intersection Capacity Utilization 94.7%	ICU Level of Service F
Analysis Period (min) 15	

Splits and Phases: 2: Water Tower Road/Com. Access & CR 29



HCM Signalized Intersection Capacity Analysis

2: Water Tower Road/Com. Access & CR 29

2045 Total Conditions
AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↕			↕	
Traffic Volume (vph)	6	833	69	75	755	1	133	1	114	2	1	2
Future Volume (vph)	6	833	69	75	755	1	133	1	114	2	1	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1800	1800	1800	1600	1600	1600
Total Lost time (s)	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	
Frbp, ped/bikes	1.00	0.99		1.00	1.00			0.95			0.96	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			0.96			0.99	
Frt	1.00	0.99		1.00	1.00			0.94			0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.98	
Satd. Flow (prot)	1570	1621		1570	1652			1363			1285	
Flt Permitted	0.23	1.00		0.13	1.00			0.83			0.89	
Satd. Flow (perm)	372	1621		217	1652			1161			1162	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	905	75	82	821	1	145	1	124	2	1	2
RTOR Reduction (vph)	0	4	0	0	0	0	0	38	0	0	2	0
Lane Group Flow (vph)	7	976	0	82	822	0	0	232	0	0	3	0
Confl. Peds. (#/hr)	30		30	30		30	30		30	20		20
Confl. Bikes (#/hr)			20			20			20			20
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%	10%	10%	10%	10%	10%	10%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	51.1	51.1		51.1	51.1			17.5			17.5	
Effective Green, g (s)	51.1	51.1		51.1	51.1			17.5			17.5	
Actuated g/C Ratio	0.63	0.63		0.63	0.63			0.22			0.22	
Clearance Time (s)	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	
Lane Grp Cap (vph)	235	1027		137	1047			252			252	
v/s Ratio Prot		c0.60			0.50							
v/s Ratio Perm	0.02			0.38				c0.20			0.00	
v/c Ratio	0.03	0.95		0.60	0.79			0.92			0.01	
Uniform Delay, d1	5.5	13.6		8.7	10.7			30.9			24.8	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.2	18.4		17.8	5.9			35.3			0.0	
Delay (s)	5.7	32.0		26.5	16.7			66.2			24.8	
Level of Service	A	C		C	B			E			C	
Approach Delay (s)		31.8			17.6			66.2			24.8	
Approach LOS		C			B			E			C	

Intersection Summary

HCM 2000 Control Delay	30.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	80.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	94.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings
3: CR 29 & CR 18

2045 Total Conditions
AM Peak Hour



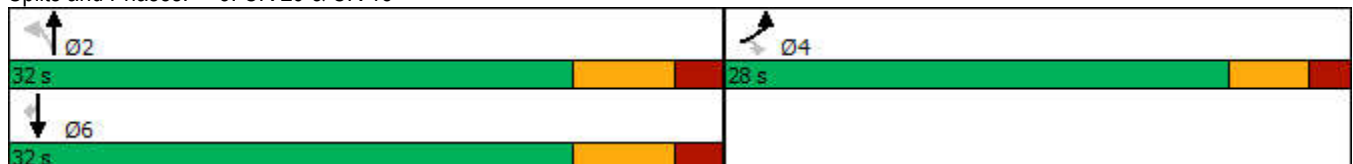
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↖	↖	↗	↗	↖
Traffic Volume (vph)	551	54	57	356	536	380
Future Volume (vph)	551	54	57	356	536	380
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	21.5	21.5	23.2	23.2	23.2	23.2
Total Split (s)	28.0	28.0	32.0	32.0	32.0	32.0
Total Split (%)	46.7%	46.7%	53.3%	53.3%	53.3%	53.3%
Yellow Time (s)	3.5	3.5	4.5	4.5	4.5	4.5
All-Red Time (s)	2.0	2.0	2.3	2.3	2.3	2.3
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Min	Min	Min	Min
Act Effct Green (s)	22.6	22.6	23.2	23.2	23.2	23.2
Actuated g/C Ratio	0.39	0.39	0.40	0.40	0.40	0.40
v/c Ratio	1.00	0.12	0.38	0.59	0.88	0.53
Control Delay	59.4	10.6	19.9	17.8	34.1	4.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.4	10.6	19.9	17.8	34.1	4.4
LOS	E	B	B	B	C	A
Approach Delay	55.1			18.1	21.8	
Approach LOS	E			B	C	

Intersection Summary

Cycle Length: 60
 Actuated Cycle Length: 58.1
 Natural Cycle: 80
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.00
 Intersection Signal Delay: 31.4
 Intersection Capacity Utilization 83.0%
 Analysis Period (min) 15

Intersection LOS: C
 ICU Level of Service E

Splits and Phases: 3: CR 29 & CR 18



HCM Signalized Intersection Capacity Analysis

3: CR 29 & CR 18

2045 Total Conditions
AM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	551	54	57	356	536	380
Future Volume (vph)	551	54	57	356	536	380
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	3%			0%	0%	
Total Lost time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.94	1.00	1.00	1.00	0.94
Flpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1546	1294	1552	1652	1652	1314
Flt Permitted	0.95	1.00	0.25	1.00	1.00	1.00
Satd. Flow (perm)	1546	1294	416	1652	1652	1314
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	599	59	62	387	583	413
RTOR Reduction (vph)	0	9	0	0	0	248
Lane Group Flow (vph)	599	50	62	387	583	165
Confl. Peds. (#/hr)	20	20	20			20
Confl. Bikes (#/hr)		10				10
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	22.6	22.6	23.2	23.2	23.2	23.2
Effective Green, g (s)	22.6	22.6	23.2	23.2	23.2	23.2
Actuated g/C Ratio	0.39	0.39	0.40	0.40	0.40	0.40
Clearance Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	601	503	166	659	659	524
v/s Ratio Prot	c0.39			0.23	c0.35	
v/s Ratio Perm		0.04	0.15			0.13
v/c Ratio	1.00	0.10	0.37	0.59	0.88	0.31
Uniform Delay, d1	17.7	11.3	12.3	13.7	16.2	12.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	35.6	0.1	1.4	1.3	13.4	0.3
Delay (s)	53.3	11.4	13.7	15.0	29.7	12.3
Level of Service	D	B	B	B	C	B
Approach Delay (s)	49.6			14.9	22.5	
Approach LOS	D			B	C	
Intersection Summary						
HCM 2000 Control Delay			29.3		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.94			
Actuated Cycle Length (s)			58.1		Sum of lost time (s)	12.3
Intersection Capacity Utilization			83.0%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						

Timings
4: CR 29 & 7th Line

2045 Total Conditions
AM Peak Hour

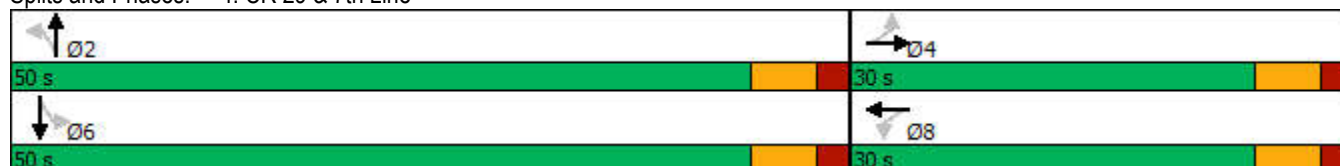


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↔		↔		↔		↔
Traffic Volume (vph)	7	17	198	30	1	389	12	568
Future Volume (vph)	7	17	198	30	1	389	12	568
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	24.0	24.0	24.0	24.0	50.0	50.0	50.0	50.0
Total Split (s)	30.0	30.0	30.0	30.0	50.0	50.0	50.0	50.0
Total Split (%)	37.5%	37.5%	37.5%	37.5%	62.5%	62.5%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0		6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
Act Effect Green (s)		22.1		22.1		44.9		44.9
Actuated g/C Ratio		0.28		0.28		0.57		0.57
v/c Ratio		0.09		0.89		0.57		0.70
Control Delay		17.8		57.8		14.0		17.9
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		17.8		57.8		14.0		17.9
LOS		B		E		B		B
Approach Delay		17.8		57.8		14.0		17.9
Approach LOS		B		E		B		B

Intersection Summary

Cycle Length: 80	
Actuated Cycle Length: 79	
Natural Cycle: 75	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.89	
Intersection Signal Delay: 24.2	Intersection LOS: C
Intersection Capacity Utilization 73.1%	ICU Level of Service D
Analysis Period (min) 15	

Splits and Phases: 4: CR 29 & 7th Line



HCM Signalized Intersection Capacity Analysis

4: CR 29 & 7th Line

2045 Total Conditions
AM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	7	17	6	198	30	33	1	389	89	12	568	14
Future Volume (vph)	7	17	6	198	30	33	1	389	89	12	568	14
Ideal Flow (vphpl)	1700	1700	1700	1700	1700	1700	1900	1900	1900	1900	1900	1900
Grade (%)		0%			-2%			0%			0%	
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frbp, ped/bikes		0.98			0.99			0.99			1.00	
Flpb, ped/bikes		0.99			0.97			1.00			1.00	
Frt		0.97			0.98			0.97			1.00	
Flt Protected		0.99			0.96			1.00			1.00	
Satd. Flow (prot)		1451			1418			1590			1642	
Flt Permitted		0.91			0.76			1.00			0.99	
Satd. Flow (perm)		1338			1113			1589			1624	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	8	18	7	215	33	36	1	423	97	13	617	15
RTOR Reduction (vph)	0	5	0	0	6	0	0	10	0	0	1	0
Lane Group Flow (vph)	0	28	0	0	278	0	0	511	0	0	644	0
Confl. Peds. (#/hr)	20		20	20		20	20		20	20		20
Confl. Bikes (#/hr)			10			10			10			10
Heavy Vehicles (%)	10%	10%	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		22.1			22.1			44.9			44.9	
Effective Green, g (s)		22.1			22.1			44.9			44.9	
Actuated g/C Ratio		0.28			0.28			0.57			0.57	
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)		374			311			903			923	
v/s Ratio Prot												
v/s Ratio Perm		0.02			c0.25			0.32			c0.40	
v/c Ratio		0.07			0.89			0.57			0.70	
Uniform Delay, d1		20.9			27.3			10.8			12.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.1			25.8			2.6			4.4	
Delay (s)		21.0			53.1			13.4			16.6	
Level of Service		C			D			B			B	
Approach Delay (s)		21.0			53.1			13.4			16.6	
Approach LOS		C			D			B			B	
Intersection Summary												
HCM 2000 Control Delay			22.6									C
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			79.0							12.0		
Intersection Capacity Utilization			73.1%									D
Analysis Period (min)			15									

c Critical Lane Group

Timings
1: Clementi St & CR 29

2045 Total Conditions
PM Peak Hour

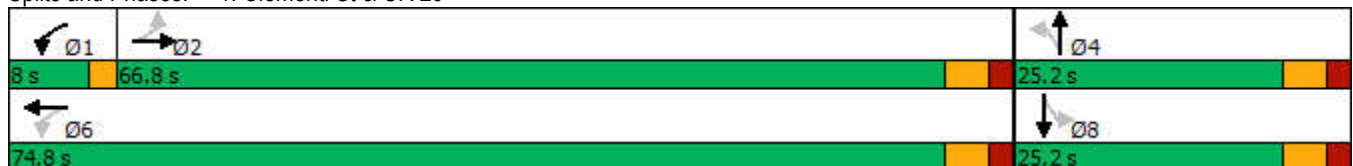


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↖	↗	↖	↗	↖	↗	↖	↗
Traffic Volume (vph)	90	754	101	1023	66	14	55	9
Future Volume (vph)	90	754	101	1023	66	14	55	9
Turn Type	Perm	NA	pm+pt	NA	Perm	NA	Perm	NA
Protected Phases		2	1	6		4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	1	6	4	4	8	8
Switch Phase								
Minimum Initial (s)	20.0	20.0	5.0	20.0	10.0	10.0	10.0	10.0
Minimum Split (s)	26.2	26.2	8.0	26.2	25.2	25.2	25.2	25.2
Total Split (s)	66.8	66.8	8.0	74.8	25.2	25.2	25.2	25.2
Total Split (%)	66.8%	66.8%	8.0%	74.8%	25.2%	25.2%	25.2%	25.2%
Yellow Time (s)	3.3	3.3	2.0	3.3	3.3	3.3	3.3	3.3
All-Red Time (s)	1.9	1.9	0.0	1.9	1.9	1.9	1.9	1.9
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.2	5.2	2.0	5.2	5.2	5.2	5.2	5.2
Lead/Lag	Lag	Lag	Lead					
Lead-Lag Optimize?	Yes	Yes	Yes					
Recall Mode	Max	Max	None	Max	None	None	None	None
Act Effct Green (s)	63.3	63.3	74.4	71.2	14.2	14.2	14.2	14.2
Actuated g/C Ratio	0.66	0.66	0.78	0.74	0.15	0.15	0.15	0.15
v/c Ratio	0.80	0.84	0.35	0.98	0.48	0.46	0.44	0.40
Control Delay	60.6	23.0	6.4	36.7	47.4	14.7	46.2	14.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.6	23.0	6.4	36.7	47.4	14.7	46.2	14.1
LOS	E	C	A	D	D	B	D	B
Approach Delay		26.7		34.1		26.6		26.0
Approach LOS		C		C		C		C

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 95.9
 Natural Cycle: 110
 Control Type: Semi Act-Uncoord
 Maximum v/c Ratio: 0.98
 Intersection Signal Delay: 30.3
 Intersection Capacity Utilization 102.3%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service G

Splits and Phases: 1: Clementi St & CR 29



HCM Signalized Intersection Capacity Analysis

2045 Total Conditions

1: Clementi St & CR 29

PM Peak Hour

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	90	754	73	101	1023	70	66	14	102	55	9	85
Future Volume (vph)	90	754	73	101	1023	70	66	14	102	55	9	85
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1800	1800	1800	1800	1800	1800
Total Lost time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	0.88		1.00	0.88	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.94	1.00		0.94	1.00	
Frt	1.00	0.99		1.00	0.99		1.00	0.87		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1570	1616		1570	1626		1394	1195		1399	1186	
Flt Permitted	0.11	1.00		0.18	1.00		0.69	1.00		0.63	1.00	
Satd. Flow (perm)	189	1616		301	1626		1014	1195		930	1186	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	820	79	110	1112	76	72	15	111	60	10	92
RTOR Reduction (vph)	0	3	0	0	2	0	0	95	0	0	78	0
Lane Group Flow (vph)	98	896	0	110	1186	0	72	31	0	60	24	0
Confl. Peds. (#/hr)	30		30	30		30	30		30	30		30
Confl. Bikes (#/hr)			20			20			20			20
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		2		1	6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	63.2	63.2		71.2	71.2		14.2	14.2		14.2	14.2	
Effective Green, g (s)	63.2	63.2		71.2	71.2		14.2	14.2		14.2	14.2	
Actuated g/C Ratio	0.66	0.66		0.74	0.74		0.15	0.15		0.15	0.15	
Clearance Time (s)	5.2	5.2		2.0	5.2		5.2	5.2		5.2	5.2	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	124	1066		303	1208		150	177		137	175	
v/s Ratio Prot		0.55		0.02	c0.73			0.03			0.02	
v/s Ratio Perm	0.52			0.25			c0.07			0.06		
v/c Ratio	0.79	0.84		0.36	0.98		0.48	0.18		0.44	0.14	
Uniform Delay, d1	11.6	12.4		9.0	11.7		37.4	35.7		37.2	35.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	38.8	8.0		0.7	21.9		2.4	0.5		2.2	0.4	
Delay (s)	50.4	20.5		9.8	33.6		39.8	36.2		39.4	35.8	
Level of Service	D	C		A	C		D	D		D	D	
Approach Delay (s)		23.4			31.5			37.5			37.1	
Approach LOS		C			C			D			D	
Intersection Summary												
HCM 2000 Control Delay			29.3				HCM 2000 Level of Service				C	
HCM 2000 Volume to Capacity ratio			0.92									
Actuated Cycle Length (s)			95.8				Sum of lost time (s)			12.4		
Intersection Capacity Utilization			102.3%				ICU Level of Service			G		
Analysis Period (min)			15									
c Critical Lane Group												

Timings
2: Water Tower Road/Com. Access & CR 29

2045 Total Conditions
PM Peak Hour

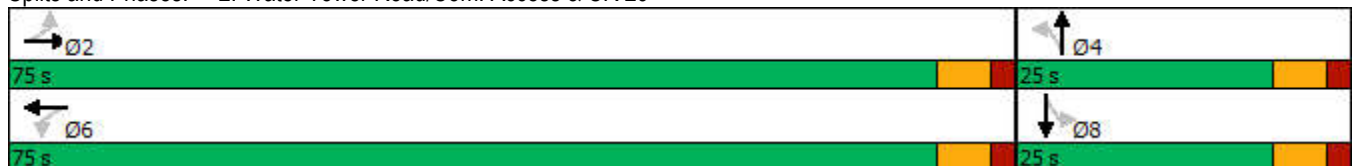


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations	↶	↷	↶	↷		↕		↕
Traffic Volume (vph)	2	848	122	1074	98	1	5	1
Future Volume (vph)	2	848	122	1074	98	1	5	1
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		2		6		4		8
Permitted Phases	2		6		4		8	
Detector Phase	2	2	6	6	4	4	8	8
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	56.0	56.0	56.0	56.0	24.0	24.0	24.0	24.0
Total Split (s)	75.0	75.0	75.0	75.0	25.0	25.0	25.0	25.0
Total Split (%)	75.0%	75.0%	75.0%	75.0%	25.0%	25.0%	25.0%	25.0%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0		0.0		0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0		6.0		6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	Max	Max	Max	Max	None	None	None	None
Act Effct Green (s)	71.5	71.5	71.5	71.5		17.8		17.8
Actuated g/C Ratio	0.71	0.71	0.71	0.71		0.18		0.18
v/c Ratio	0.02	0.95	0.88	1.00		0.89		0.10
Control Delay	5.5	33.3	65.8	44.1		70.2		19.9
Queue Delay	0.0	1.4	0.0	0.0		0.0		0.0
Total Delay	5.5	34.8	65.8	44.1		70.2		19.9
LOS	A	C	E	D		E		B
Approach Delay		34.7		46.3		70.2		19.9
Approach LOS		C		D		E		B

Intersection Summary

Cycle Length: 100	
Actuated Cycle Length: 101.3	
Natural Cycle: 90	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 1.00	
Intersection Signal Delay: 43.2	Intersection LOS: D
Intersection Capacity Utilization 99.5%	ICU Level of Service F
Analysis Period (min) 15	

Splits and Phases: 2: Water Tower Road/Com. Access & CR 29



HCM Signalized Intersection Capacity Analysis
2: Water Tower Road/Com. Access & CR 29

2045 Total Conditions
PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↕			↕	
Traffic Volume (vph)	2	848	143	122	1074	2	98	1	90	5	1	14
Future Volume (vph)	2	848	143	122	1074	2	98	1	90	5	1	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1800	1800	1800	1600	1600	1600
Total Lost time (s)	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	
Frbp, ped/bikes	1.00	0.98		1.00	1.00			0.93			0.92	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			0.96			0.99	
Frt	1.00	0.98		1.00	1.00			0.94			0.90	
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.99	
Satd. Flow (prot)	1570	1590		1570	1651			1333			1183	
Flt Permitted	0.08	1.00		0.13	1.00			0.83			0.94	
Satd. Flow (perm)	132	1590		214	1651			1129			1120	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	922	155	133	1167	2	107	1	98	5	1	15
RTOR Reduction (vph)	0	6	0	0	0	0	0	33	0	0	12	0
Lane Group Flow (vph)	2	1071	0	133	1169	0	0	173	0	0	9	0
Confl. Peds. (#/hr)	30		30	30		30	30		30	20		20
Confl. Bikes (#/hr)			20			20			20			20
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%	10%	10%	10%	10%	10%	10%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	71.5	71.5		71.5	71.5			17.8			17.8	
Effective Green, g (s)	71.5	71.5		71.5	71.5			17.8			17.8	
Actuated g/C Ratio	0.71	0.71		0.71	0.71			0.18			0.18	
Clearance Time (s)	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	
Lane Grp Cap (vph)	93	1122		151	1165			198			196	
v/s Ratio Prot		0.67			c0.71							
v/s Ratio Perm	0.02			0.62				c0.15			0.01	
v/c Ratio	0.02	0.95		0.88	1.00			0.87			0.04	
Uniform Delay, d1	4.5	13.4		11.6	14.9			40.7			34.7	
Progression Factor	1.00	1.00		1.00	1.00			1.00			1.00	
Incremental Delay, d2	0.4	18.0		47.0	27.2			31.9			0.1	
Delay (s)	4.9	31.4		58.5	42.1			72.6			34.8	
Level of Service	A	C		E	D			E			C	
Approach Delay (s)		31.4			43.8			72.6			34.8	
Approach LOS		C			D			E			C	

Intersection Summary

HCM 2000 Control Delay	40.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	101.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	99.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Timings
3: CR 29 & CR 18

2045 Total Conditions
PM Peak Hour

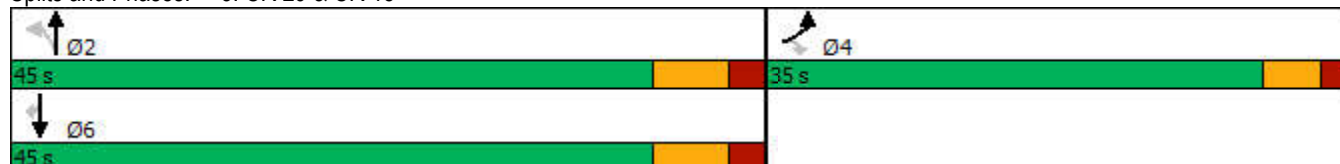


Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖	↗	↖	↑	↑	↗
Traffic Volume (vph)	463	57	76	554	618	604
Future Volume (vph)	463	57	76	554	618	604
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Detector Phase	4	4	2	2	6	6
Switch Phase						
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	21.5	21.5	23.2	23.2	23.2	23.2
Total Split (s)	35.0	35.0	45.0	45.0	45.0	45.0
Total Split (%)	43.8%	43.8%	56.3%	56.3%	56.3%	56.3%
Yellow Time (s)	3.5	3.5	4.5	4.5	4.5	4.5
All-Red Time (s)	2.0	2.0	2.3	2.3	2.3	2.3
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lead/Lag						
Lead-Lag Optimize?						
Recall Mode	None	None	Min	Min	Min	Min
Act Effct Green (s)	26.7	26.7	33.7	33.7	33.7	33.7
Actuated g/C Ratio	0.37	0.37	0.46	0.46	0.46	0.46
v/c Ratio	0.89	0.13	0.52	0.79	0.88	0.69
Control Delay	43.3	14.5	28.7	26.1	33.7	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	43.3	14.5	28.7	26.1	33.7	5.6
LOS	D	B	C	C	C	A
Approach Delay	40.1			26.4	19.8	
Approach LOS	D			C	B	

Intersection Summary

Cycle Length: 80
 Actuated Cycle Length: 73
 Natural Cycle: 80
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.89
 Intersection Signal Delay: 26.0
 Intersection LOS: C
 Intersection Capacity Utilization 82.4%
 ICU Level of Service E
 Analysis Period (min) 15

Splits and Phases: 3: CR 29 & CR 18



HCM Signalized Intersection Capacity Analysis
3: CR 29 & CR 18

2045 Total Conditions
PM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	463	57	76	554	618	604
Future Volume (vph)	463	57	76	554	618	604
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Grade (%)	3%			0%	0%	
Total Lost time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.93	1.00	1.00	1.00	0.93
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1546	1281	1570	1652	1652	1303
Flt Permitted	0.95	1.00	0.21	1.00	1.00	1.00
Satd. Flow (perm)	1546	1281	347	1652	1652	1303
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	503	62	83	602	672	657
RTOR Reduction (vph)	0	9	0	0	0	352
Lane Group Flow (vph)	503	53	83	602	672	305
Confl. Peds. (#/hr)	20	20	20			20
Confl. Bikes (#/hr)		10				10
Heavy Vehicles (%)	15%	15%	15%	15%	15%	15%
Turn Type	Prot	Perm	Perm	NA	NA	Perm
Protected Phases	4			2	6	
Permitted Phases		4	2			6
Actuated Green, G (s)	26.7	26.7	33.7	33.7	33.7	33.7
Effective Green, g (s)	26.7	26.7	33.7	33.7	33.7	33.7
Actuated g/C Ratio	0.37	0.37	0.46	0.46	0.46	0.46
Clearance Time (s)	5.5	5.5	6.8	6.8	6.8	6.8
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	567	470	160	765	765	604
v/s Ratio Prot	c0.33			0.36	c0.41	
v/s Ratio Perm		0.04	0.24			0.23
v/c Ratio	0.89	0.11	0.52	0.79	0.88	0.50
Uniform Delay, d1	21.6	15.2	13.8	16.5	17.6	13.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	15.5	0.1	2.8	5.4	11.2	0.7
Delay (s)	37.0	15.3	16.6	21.8	28.8	14.3
Level of Service	D	B	B	C	C	B
Approach Delay (s)	34.7			21.2	21.7	
Approach LOS	C			C	C	
Intersection Summary						
HCM 2000 Control Delay			24.4		HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio			0.88			
Actuated Cycle Length (s)			72.7		Sum of lost time (s)	12.3
Intersection Capacity Utilization			82.4%		ICU Level of Service	E
Analysis Period (min)			15			
c Critical Lane Group						

Timings
4: CR 29 & 7th Line

2045 Total Conditions
PM Peak Hour

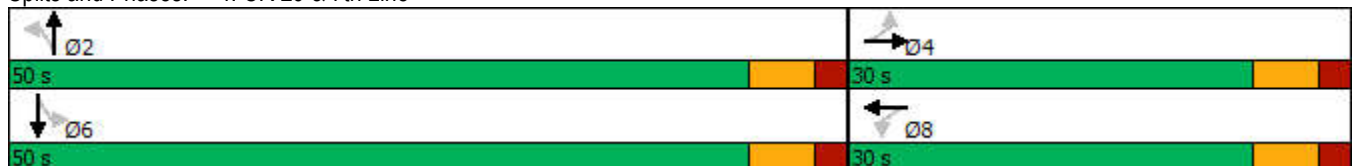


Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Configurations		↕		↕		↕		↕
Traffic Volume (vph)	19	38	126	25	1	560	43	581
Future Volume (vph)	19	38	126	25	1	560	43	581
Turn Type	Perm	NA	Perm	NA	Perm	NA	Perm	NA
Protected Phases		4		8		2		6
Permitted Phases	4		8		2		6	
Detector Phase	4	4	8	8	2	2	6	6
Switch Phase								
Minimum Initial (s)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Minimum Split (s)	24.0	24.0	24.0	24.0	50.0	50.0	50.0	50.0
Total Split (s)	30.0	30.0	30.0	30.0	50.0	50.0	50.0	50.0
Total Split (%)	37.5%	37.5%	37.5%	37.5%	62.5%	62.5%	62.5%	62.5%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)		0.0		0.0		0.0		0.0
Total Lost Time (s)		6.0		6.0		6.0		6.0
Lead/Lag								
Lead-Lag Optimize?								
Recall Mode	None	None	None	None	Max	Max	Max	Max
Act Effct Green (s)		17.5		17.5		47.0		47.0
Actuated g/C Ratio		0.23		0.23		0.61		0.61
v/c Ratio		0.21		0.77		0.86		0.75
Control Delay		22.9		44.0		25.1		19.4
Queue Delay		0.0		0.0		0.0		0.0
Total Delay		22.9		44.0		25.1		19.4
LOS		C		D		C		B
Approach Delay		22.9		44.0		25.1		19.4
Approach LOS		C		D		C		B

Intersection Summary

Cycle Length: 80	
Actuated Cycle Length: 76.5	
Natural Cycle: 75	
Control Type: Semi Act-Uncoord	
Maximum v/c Ratio: 0.86	
Intersection Signal Delay: 24.9	Intersection LOS: C
Intersection Capacity Utilization 94.5%	ICU Level of Service F
Analysis Period (min) 15	

Splits and Phases: 4: CR 29 & 7th Line



HCM Signalized Intersection Capacity Analysis

4: CR 29 & 7th Line

2045 Total Conditions
PM Peak Hour



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Volume (vph)	19	38	2	126	25	37	1	560	209	43	581	13
Future Volume (vph)	19	38	2	126	25	37	1	560	209	43	581	13
Ideal Flow (vphpl)	1700	1700	1700	1700	1700	1700	1900	1900	1900	1900	1900	1900
Grade (%)		0%			-2%			0%			0%	
Total Lost time (s)		6.0			6.0			6.0			6.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frbp, ped/bikes		1.00			0.98			0.98			1.00	
Flpb, ped/bikes		0.99			0.97			1.00			1.00	
Frt		1.00			0.97			0.96			1.00	
Flt Protected		0.98			0.97			1.00			1.00	
Satd. Flow (prot)		1497			1410			1562			1639	
Flt Permitted		0.88			0.76			1.00			0.91	
Satd. Flow (perm)		1337			1106			1562			1494	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	21	41	2	137	27	40	1	609	227	47	632	14
RTOR Reduction (vph)	0	2	0	0	12	0	0	14	0	0	1	0
Lane Group Flow (vph)	0	62	0	0	192	0	0	823	0	0	692	0
Confl. Peds. (#/hr)	20		20	20		20	20		20	20		20
Confl. Bikes (#/hr)			10			10			10			10
Heavy Vehicles (%)	10%	10%	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		17.5			17.5			47.0			47.0	
Effective Green, g (s)		17.5			17.5			47.0			47.0	
Actuated g/C Ratio		0.23			0.23			0.61			0.61	
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)		305			253			959			917	
v/s Ratio Prot												
v/s Ratio Perm		0.05			0.17			0.53			0.46	
v/c Ratio		0.20			0.76			0.86			0.75	
Uniform Delay, d1		23.9			27.5			12.0			10.6	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.3			12.2			9.8			5.7	
Delay (s)		24.2			39.7			21.9			16.4	
Level of Service		C			D			C			B	
Approach Delay (s)		24.2			39.7			21.9			16.4	
Approach LOS		C			D			C			B	
Intersection Summary												
HCM 2000 Control Delay			21.8									C
HCM 2000 Volume to Capacity ratio			0.83									
Actuated Cycle Length (s)			76.5						12.0			
Intersection Capacity Utilization			94.5%									F
Analysis Period (min)			15									

c Critical Lane Group