

File 421487

March 1, 2023

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Re: 15 Harvie Road, Barrie
Traffic Impact Study Addendum

Dear Mark:

We have prepared this addendum letter in response to changes to the draft plan which was originally considered in the *15 Harvie Road Traffic Impact Study*¹ report (TIS). It is our understanding that a school block will replace a portion of the residential development considered in the TIS. It is the intent of this letter to review these changes in context of the trip generation of the former and currently proposed uses and identify the net impact to the operations of the area road network, if any.

DEVELOPMENT

Original Draft Plan

As noted in the TIS, the residential portion of the original draft plan included 787 residential units consisting of the following:

- 66 semi-detached units;
- 182 townhouse units; and
- 539 mid-rise residential units.

Revised Draft Plan

A new school block is now being proposed, replacing a portion the residential units. To accommodate the proposed school block, the number of residential units has been reduced by a total of 93 units (8 fewer semi-detached units and 85 fewer townhouse units). While it is understood that the school will be an elementary school, specific details of the school (i.e. enrollment or gross floor area) are not yet available

¹ *15 Harvie Road Traffic Impact Study*. Tatham Engineering Limited. March 18, 2022.

from the local school board. As such, it has been assumed that the new school will be similar to the existing Trillium Woods Elementary School, located on Elmbrook Drive in the adjacent subdivision. Trillium Woods Elementary has an enrollment of approximately 500 students, thus it is assumed that the proposed elementary school will have a similar capacity.

It is noted that the introduction of the school block does not impact the employment blocks located on the east side of the Bryne Drive extension.

TRIP GENERATION

Original Draft Plan

The trip generation associated with the residential blocks, as presented in the TIS, are summarized in Table 1. As indicated, the residential units were expected to generate 326 and 404 trips during the AM and PM peak hours, respectively.

Table 1: Trip Generation – Original Draft Plan (Residential)

LAND USE	SIZE	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
		in	Out	Total	in	Out	Total
semi-detached units	66 units	12	37	49	41	24	65
townhouse units	182 units	19	64	83	64	38	102
mid-rise units	539 units	50	144	194	145	92	237
Total	787 units	81	245	326	250	154	404

Revised Draft Plan

As previously noted, the revised draft plan is to consist of the following:

- 58 semi-detached units;
- 97 townhouse units;
- 539 mid-rise residential units; and
- 500 student elementary school.

The number of vehicle trips to be generated by the revised draft plan for the weekday AM and PM peak hours has been determined based on type of use, development size, and trip generation rates as per the *ITE Trip Generation Manual, 10th Edition* (while it is recognized that ITE has released the 11th Edition



Manual, the 10th Edition rates have been applied to maintain consistency with the TIS, which considered the 10th Edition trip rates). Based on the proposed development, trip rates for the following ITE land use categories have been employed:

- single family detached (ITE code 210);
- multifamily housing - low-rise (ITE code 220);
- multifamily housing - mid-rise (ITE code 221); and
- elementary school (ITE code 520).

The associated trip rates are provided in Table 2, whereas the resulting trip estimates are summarized in Table 3

Table 2: Trip Generation Rates

LAND USE	VARIABLE	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
		in	Out	Total	in	Out	Total
single family detached (ITE 210)	units	0.19	0.56	0.74	0.62	0.37	0.99
multifamily low-rise (ITE 220)	units	0.11	0.35	0.46	0.35	0.21	0.56
multifamily mid-rise (ITE 221)	units	0.09	0.27	0.36	0.27	0.17	0.44
elementary school	students	0.36	0.31	0.67	0.08	0.09	0.17

Table 3: Trip Generation - Revised Draft Plan (Residential & School)

LAND USE	SIZE	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
		in	Out	Total	in	Out	Total
semi-detached units	58 units	11	32	43	36	21	57
townhouse units	97 units	10	34	44	34	20	54
mid-rise units	539 units	50	144	194	145	92	237
elementary school	500 students	181	154	335	41	44	85
Total		252	364	616	256	177	433



Comparative Analysis

To determine the net impact of the elementary school in terms of trip generation, a comparative assessment of the original and revised draft plans has been conducted. Table 4 summarizes the trip estimates for the original and revised draft plans. It is noted that the employment lands are unaffected by the introduction of the school block and thus have not been considered in the comparative analysis.

Table 4: Trip Generation

LAND USE	WEEKDAY AM PEAK HOUR			WEEKDAY PM PEAK HOUR		
	in	Out	Total	in	Out	Total
original draft plan	81	245	326	250	154	404
revised draft plan (with school block)	252	364	616	256	177	433
Net Impact	+171	+119	+290	+6	+23	+29

While the net impact to the PM peak hour is negligible (29 additional trips will not impact the intersection operations as reported in the TIS), the net impact to the AM peak hour in terms of trip generation is considerable. As such, the intersection operations for the AM peak hour have been revisited to consider the impact of the new school block.

INTERSECTION OPERATIONS

Trip Distribution and Assignment

To assess the impact of the revised draft plan, the school trip estimates were distributed through the road network based on the following:

- to/from the north – 30%;
- to/from the south – 20%; and
- to/from the west – 50%.

The distribution differs from that of the TIS, recognizing that the school trip distribution will be influenced by the location of the school in relation to the residential development it will serve. In this respect, most of the existing and future residential development in the area is located north, south and west of the proposed school location. No trips were distributed to/from the east recognizing the absence of residential lands near the school in that direction.



The assignment of the trips generated by the development to the area road network has been based on the trip distribution noted above with consideration given to the expected travel routes.

Trips generated by the school are illustrated in Figure 1, whereas the total trip generation for the 15 Harvie Road development (i.e. full build-out of school, residential and employment blocks) is illustrated in Figure 2.

Traffic Volumes

For the purpose of this assessment, the intersection operations for the 2043 horizon have been considered (the ultimate horizon considered in the TIS). The total traffic volumes for the 2043 horizon are illustrated in Figure 3, reflective of the 2043 total volumes provided in the TIS, adjusted to consider the trip estimates associated with the revised draft plan.

Intersection Operations

The operations of the study area intersections during the weekday AM peak hour were reassessed under 2043 total conditions (utilizing the same HCM methodology employed in the TIS). The signal timings employed under 2043 conditions in the ITS have been maintained, with the exception of the intersection of Harvie Road with Bryne Drive where minor optimizations to the signal timing were required to ensure acceptable operations. The resulting intersection operations are summarized in Table 5 with detailed worksheets appended. The operations associated with the original draft plan, as presented in the TIS, have been included for comparative purposes.

As indicated, operations of the network with the school are comparable to those identified in the TIS, with minimal changes to delays, levels of service, and utilized capacity at each intersection. As such, the findings and recommendations of the TIS remain valid and will accommodate the addition of the proposed school block.



Table 5: Intersection Operations – 2043 Total Conditions (AM Peak Hour)

INTERSECTION, APPROACH & CONTROL			ORIGINAL DRAFT PLAN			REVISED DRAFT PLAN		
			Delay	LOS	V/C	Delay	LOS	V/C
Bryne Drive & Essa Road	EB	signal	41	D	0.76	42	D	0.76
	WB	signal	47	D	0.64	48	D	0.68
	NB	signal	33	C	0.66	34	C	0.66
	SB	signal	31	C	0.76	32	C	0.78
	overall	signal	36	D	0.74	37	D	0.75
Harvie Road & Veterans Drive	EB	signal	29	C	0.55	29	C	0.55
	WB	signal	23	C	0.63	23	C	0.63
	NB	signal	37	D	0.57	37	D	0.57
	SB	signal	34	C	0.92	38	D	0.95
	overall	signal	31	C	0.82	32	C	0.84
Harvie Road & Thrushwood Drive	NB	stop	24	C	0.36	27	D	0.43
	SB	stop	17	C	0.20	17	C	0.20
Bryne Drive & Harvie Road	EB	signal	29	C	0.68	32	C	0.71
	WB	signal	29	C	0.93	30	C	0.92
	NB	signal	39	D	0.43	42	D	0.47
	SB	signal	51	D	0.93	50	E	0.91
	overall	signal	34	C	0.99	37	D	0.98
Harvie Road & Fairview Road	EB	signal	12	B	0.59	12	B	0.59
	WB	signal	19	B	0.61	19	B	0.62
	SB	signal	34	C	0.78	34	C	0.78
	overall	signal	19	B	0.68	19	B	0.68
	EB	stop	9	A	0.02	11	B	0.03



INTERSECTION, APPROACH & CONTROL			ORIGINAL DRAFT PLAN			REVISED DRAFT PLAN		
			Delay	LOS	V/C	Delay	LOS	V/C
Cranberry Lane & Thrushwood Drive	WB	stop	9	A	0.09	12	B	0.27
Bryne Drive & Cranberry Lane	EB	signal	23	C	0.47	23	C	0.54
	WB	signal	25	C	0.21	25	C	0.21
	NB	signal	15	B	0.44	16	B	0.44
	SB	signal	9	A	0.69	9	A	0.69
	overall	signal	14	B	0.75	14	B	0.77
Veterans Drive & Brookwood Drive	EB	signal	24	C	0.23	24	C	0.48
	WB	signal	31	C	0.56	41	D	0.80
	NB	signal	12	B	0.42	17	B	0.51
	SB	signal	19	B	0.68	28	C	0.77
	overall	signal	19	B	0.62	26	C	0.76
Bryne Drive & Bryne Court	WB	stop	12	B	0.02	12	B	0.02
Bryne Drive & Caplan Avenue	EB	signal	44	D	0.91	44	D	0.91
	WB	signal	27	C	0.59	27	C	0.59
	NB	signal	21	C	0.46	21	C	0.46
	SB	signal	27	C	0.55	26	C	0.54
	overall	signal	29	C	0.67	29	C	0.66
Bryne Drive & Mapleview Drive	EB	signal	43	D	0.92	43	D	0.92
	WB	signal	29	C	0.94	29	C	0.94
	NB	signal	42	D	0.28	42	D	0.28
	SB	signal	47	D	0.90	45	D	0.88
	overall	signal	37	D	0.99	37	D	0.98



SUMMARY

This letter has considered the traffic impacts associated with the revised draft plan for 15 Harvie Road, which considers a new school block and an reduction in the number of residential units (as required to accommodate the school block). Based on the assessment contained herein, the findings and recommendations of the initial traffic impact study remain valid. No further improvements are required to accommodate the noted changes to the draft plan (i.e. addition of a school block).

CLOSING

Should you have any further questions or comments, please do not hesitate to contact us.

Yours truly,

Tatham Engineering Limited



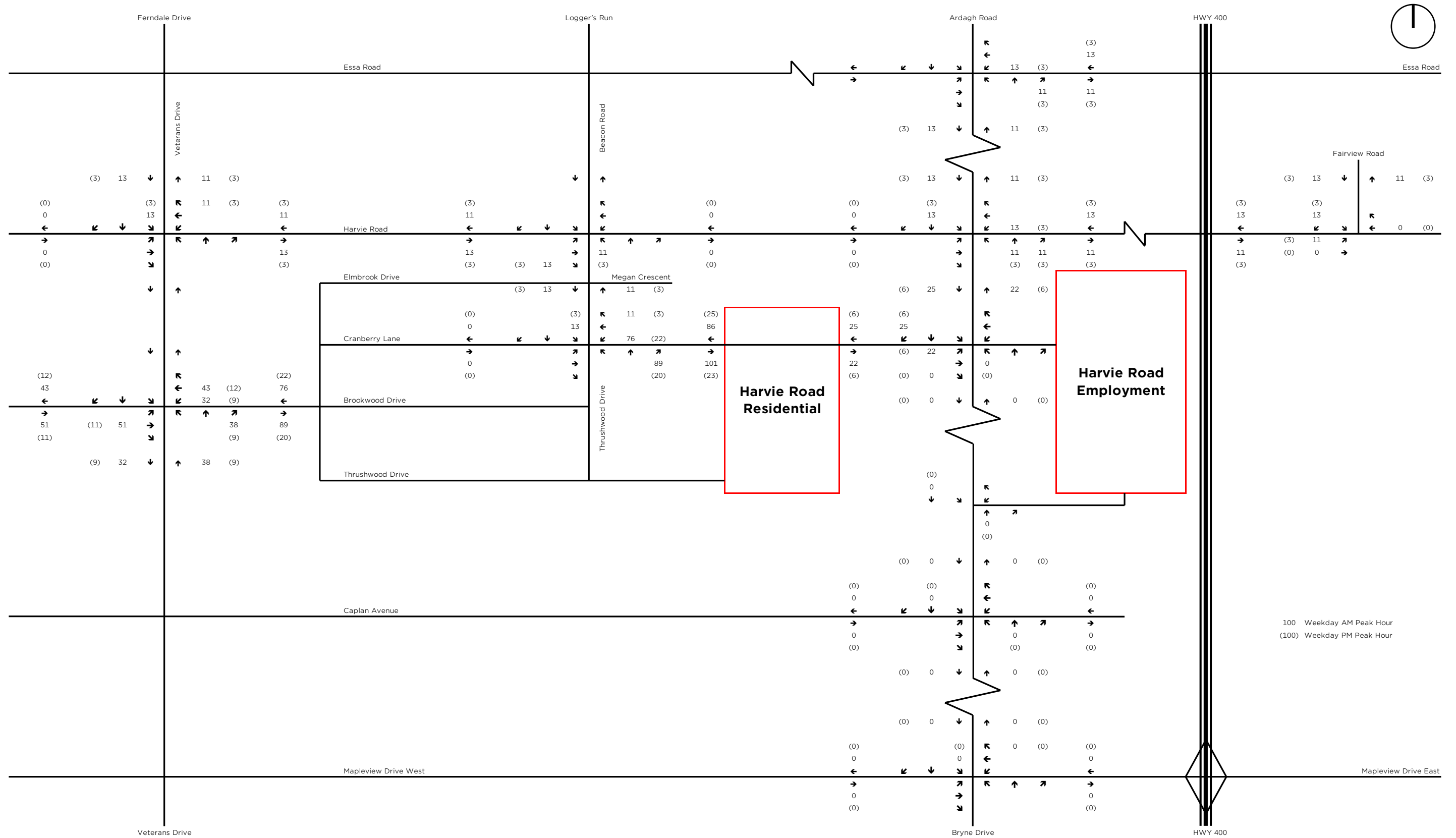
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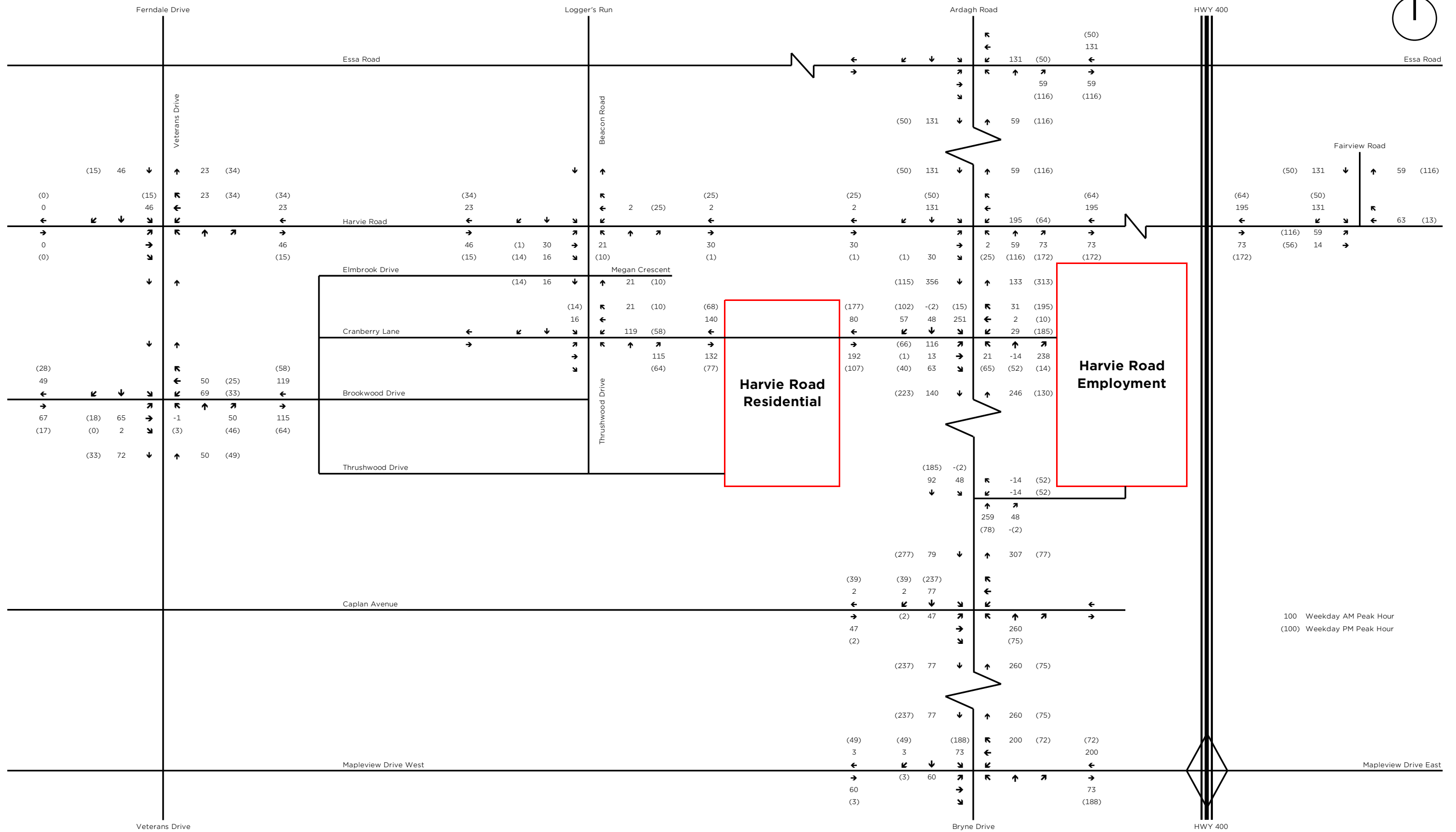
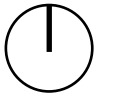
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(Feb 2023)\L - McCann - 15 Harvie Road Addendum - Draft.docx





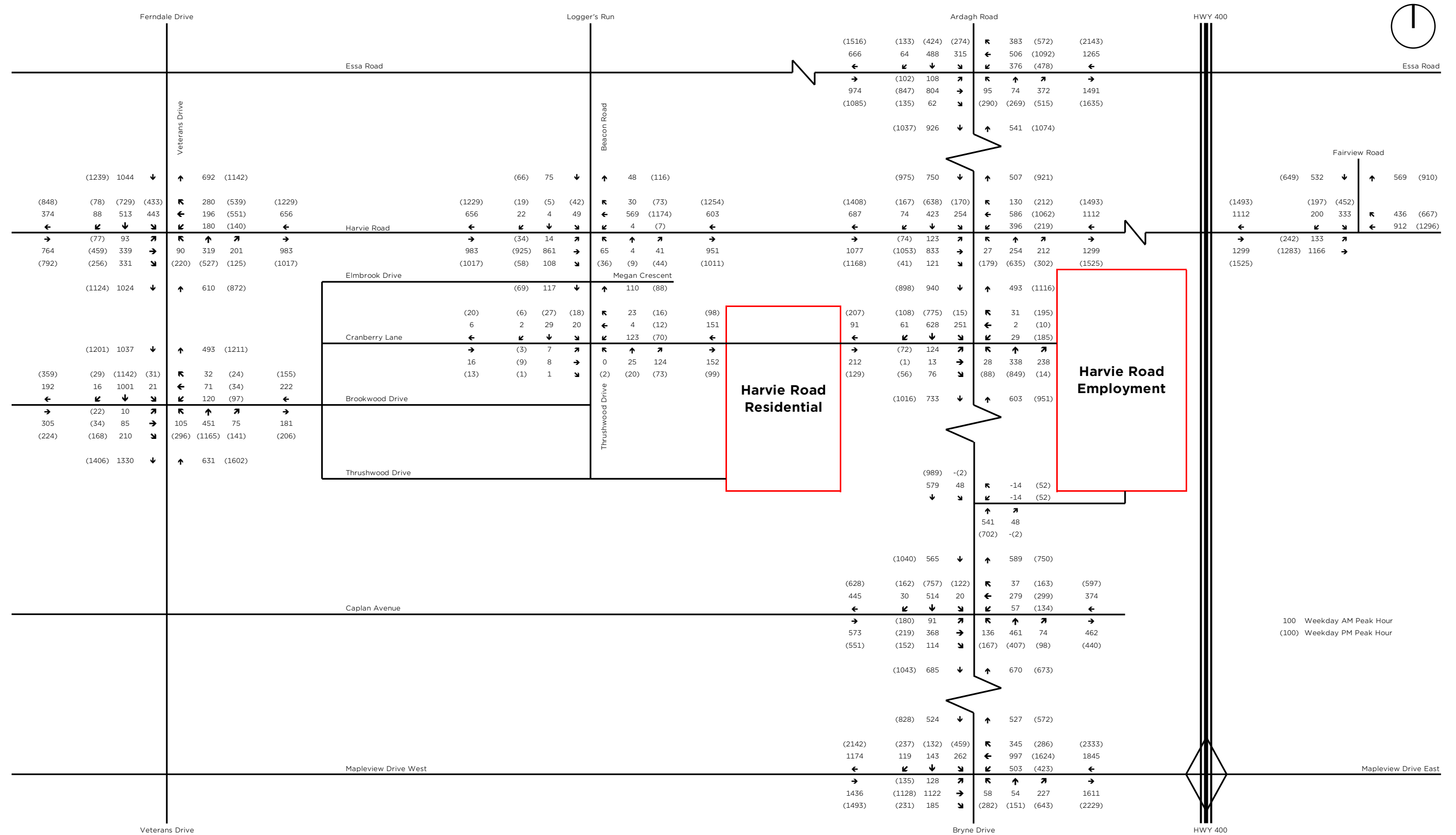
15 HARVIE ROAD
Figure 1: Site Generated Traffic – Elementary School





15 HARVIE ROAD
Figure 2: Site Generated Traffic – Full Build-out





15 HARVIE ROAD
Figure 3: Traffic Volumes – 2043 Total



HCM Signalized Intersection Capacity Analysis

1: Essa Road & Ardagh Road/Bryne Drive

2043 Total Conditions

Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	315	488	64	95	74	385	108	804	62	391	506	383
Future Volume (vph)	315	488	64	95	74	385	108	804	62	391	506	383
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3516		1789	3579	1601	1789	3579	1601	3471	3579	1601
Flt Permitted	0.56	1.00		0.34	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1058	3516		643	3579	1601	1789	3579	1601	3471	3579	1601
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)	342	530	70	103	80	418	117	874	67	425	550	416
RTOR Reduction (vph)	0	9	0	0	0	259	0	0	42	0	0	243
Lane Group Flow (vph)	342	591	0	103	80	159	117	874	25	425	550	173
Turn Type	pm+pt	NA		pm+pt	NA	Perm	Prot	NA	Perm	Prot	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Actuated Green, G (s)	35.8	24.8		23.0	16.0	16.0	11.9	40.2	40.2	17.2	45.5	45.5
Effective Green, g (s)	35.8	24.8		23.0	16.0	16.0	11.9	40.2	40.2	17.2	45.5	45.5
Actuated g/C Ratio	0.33	0.23		0.21	0.15	0.15	0.11	0.37	0.37	0.16	0.42	0.42
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	452	798		208	524	234	194	1317	589	546	1491	667
v/s Ratio Prot	c0.11	0.17		0.03	0.02		0.07	c0.24		c0.12	0.15	
v/s Ratio Perm	c0.14			0.07		0.10			0.02			0.11
v/c Ratio	0.76	0.74		0.50	0.15	0.68	0.60	0.66	0.04	0.78	0.37	0.26
Uniform Delay, d1	30.9	39.2		36.2	40.7	44.2	46.4	28.8	22.1	44.2	22.0	20.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	7.1	3.7		1.9	0.1	7.6	5.2	2.7	0.1	6.9	0.7	0.9
Delay (s)	38.0	42.9		38.0	40.8	51.7	51.6	31.5	22.3	51.1	22.7	21.8
Level of Service	D	D		D	D	D	D	C	C	D	C	C
Approach Delay (s)		41.1			47.9			33.1			31.1	
Approach LOS		D			D			C			C	
Intersection Summary												
HCM 2000 Control Delay	36.5			HCM 2000 Level of Service			D					
HCM 2000 Volume to Capacity ratio	0.75											
Actuated Cycle Length (s)	109.2			Sum of lost time (s)			20.0					
Intersection Capacity Utilization	76.8%			ICU Level of Service			D					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: Veterans Drive & Harvie Road

2043 Total Conditions
Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	93	339	331	180	196	287	90	319	201	451	513	88
Future Volume (vph)	93	339	331	180	196	287	90	319	201	451	513	88
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.95	
Frt	1.00	0.93		1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1789	3313		1789	1883	1601	1789	3579	1601	1789	3500	
Flt Permitted	0.62	1.00		0.20	1.00	1.00	0.40	1.00	1.00	0.36	1.00	
Satd. Flow (perm)	1177	3313		380	1883	1601	759	3579	1601	670	3500	
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)	101	368	360	196	213	312	98	347	218	490	558	96
RTOR Reduction (vph)	0	152	0	0	0	200	0	0	181	0	14	0
Lane Group Flow (vph)	101	576	0	196	213	112	98	347	37	490	640	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2		2	6		
Actuated Green, G (s)	36.3	30.8		44.5	35.0	35.0	22.2	16.7	16.7	41.2	31.7	
Effective Green, g (s)	36.3	30.8		44.5	35.0	35.0	22.2	16.7	16.7	41.2	31.7	
Actuated g/C Ratio	0.37	0.32		0.46	0.36	0.36	0.23	0.17	0.17	0.42	0.32	
Clearance Time (s)	4.0	6.0		4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	471	1044		312	674	573	230	611	273	517	1135	
v/s Ratio Prot	0.01	0.17		c0.06	0.11		0.02	0.10		c0.20	0.18	
v/s Ratio Perm	0.07			c0.22		0.07	0.07		0.02	c0.20		
v/c Ratio	0.21	0.55		0.63	0.32	0.20	0.43	0.57	0.14	0.95	0.56	
Uniform Delay, d1	20.4	27.7		18.1	22.7	21.6	30.9	37.2	34.4	23.3	27.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	2.1		3.9	1.2	0.8	1.3	1.2	0.2	26.7	0.6	
Delay (s)	20.7	29.8		22.0	23.9	22.4	32.1	38.4	34.6	50.0	27.9	
Level of Service	C	C		C	C	C	C	D	C	D	C	
Approach Delay (s)		28.7			22.7			36.2			37.4	
Approach LOS		C			C			D			D	
Intersection Summary												
HCM 2000 Control Delay	31.9			HCM 2000 Level of Service			C					
HCM 2000 Volume to Capacity ratio	0.84											
Actuated Cycle Length (s)	97.7			Sum of lost time (s)			20.0					
Intersection Capacity Utilization	89.1%			ICU Level of Service			E					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

3: Thrushwood Drive & Harvie Road

2043 Total Conditions
Weekday AM Peak Hour

															
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR			
Lane Configurations															
Traffic Volume (veh/h)	14	864	114	4	572	30	70	4	41	49	4	22			
Future Volume (Veh/h)	14	864	114	4	572	30	70	4	41	49	4	22			
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)	15	939	124	4	622	33	76	4	45	53	4	24			
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)	318			401											
pX, platoon unblocked	0.95						0.95	0.95			0.95	0.95	0.95		
vC, conflicting volume	655	1063					1376	1694	532	1193	1740	328			
vC1, stage 1 conf vol							1031	1031			646	646			
vC2, stage 2 conf vol							345	663			546	1093			
vCu, unblocked vol	525	1063					1286	1622	532	1093	1670	180			
tC, single (s)	4.1	4.1					7.5	6.5	6.9	7.5	6.5	6.9			
tC, 2 stage (s)							6.5	5.5			6.5	5.5			
tF (s)	2.2	2.2					3.5	4.0	3.3	3.5	4.0	3.3			
p0 queue free %	98	99					68	98	91	84	98	97			
cM capacity (veh/h)	983	651					234	264	492	340	249	789			
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1							
Volume Total	15	626	437	4	415	240	125	81							
Volume Left	15	0	0	4	0	0	76	53							
Volume Right	0	0	124	0	0	33	45	24							
cSH	983	1700	1700	651	1700	1700	290	400							
Volume to Capacity	0.02	0.37	0.26	0.01	0.24	0.14	0.43	0.20							
Queue Length 95th (m)	0.4	0.0	0.0	0.1	0.0	0.0	15.7	5.7							
Control Delay (s)	8.7	0.0	0.0	10.6	0.0	0.0	26.5	16.3							
Lane LOS	A				B			D	C						
Approach Delay (s)	0.1				0.1			26.5	16.3						
Approach LOS							D	C							
Intersection Summary															
Average Delay				2.5											
Intersection Capacity Utilization				41.7%	ICU Level of Service				A						
Analysis Period (min)				15											

HCM Signalized Intersection Capacity Analysis

4: Bryne Drive & Harvie Road

2043 Total Conditions

Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	123	833	124	416	586	130	30	267	229	254	438	74
Future Volume (vph)	123	833	124	416	586	130	30	267	229	254	438	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.91	0.91
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	3579	1601	1789	3419	1457
Flt Permitted	0.41	1.00	1.00	0.14	1.00	1.00	0.36	1.00	1.00	0.41	1.00	1.00
Satd. Flow (perm)	772	3579	1601	270	3579	1601	683	3579	1601	774	3419	1457
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)	134	905	135	452	637	141	33	290	249	276	476	80
RTOR Reduction (vph)	0	0	84	0	0	69	0	0	206	0	1	56
Lane Group Flow (vph)	134	905	51	452	637	72	33	290	43	276	483	16
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		6
Actuated Green, G (s)	47.1	40.1	40.1	68.2	57.2	57.2	23.3	19.3	19.3	32.3	24.3	24.3
Effective Green, g (s)	47.1	40.1	40.1	68.2	57.2	57.2	23.3	19.3	19.3	32.3	24.3	24.3
Actuated g/C Ratio	0.42	0.36	0.36	0.61	0.51	0.51	0.21	0.17	0.17	0.29	0.22	0.22
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	386	1275	570	489	1819	814	180	613	274	303	738	314
v/s Ratio Prot	0.02	0.25		c0.20	0.18		0.01	0.08		c0.07	0.14	
v/s Ratio Perm	0.12		0.03	c0.36		0.04	0.03		0.03	c0.19		0.01
v/c Ratio	0.35	0.71	0.09	0.92	0.35	0.09	0.18	0.47	0.16	0.91	0.65	0.05
Uniform Delay, d1	20.5	31.2	24.1	27.8	16.5	14.2	36.1	42.0	39.7	37.2	40.3	34.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	3.4	0.3	23.3	0.5	0.2	0.5	0.6	0.3	29.8	2.1	0.1
Delay (s)	21.1	34.6	24.4	51.1	17.1	14.4	36.6	42.6	39.9	67.0	42.4	35.0
Level of Service	C	C	C	D	B	B	D	D	D	E	D	D
Approach Delay (s)		31.8			29.3			41.1			49.9	
Approach LOS		C			C			D			D	
Intersection Summary												
HCM 2000 Control Delay			36.3									
HCM 2000 Level of Service											D	
HCM 2000 Volume to Capacity ratio			0.98									
Actuated Cycle Length (s)			112.5								20.0	
Intersection Capacity Utilization			95.5%								F	
ICU Level of Service												
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

5: Harvie Road & Fairview Road

2043 Total Conditions
Weekday AM Peak Hour



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	146	1170	918	436	333	215
Future Volume (vph)	146	1170	918	436	333	215
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	0.95	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1789	3579	3579	1601	1789	1601
Flt Permitted	0.17	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	319	3579	3579	1601	1789	1601
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	159	1272	998	474	362	234
RTOR Reduction (vph)	0	0	0	233	0	173
Lane Group Flow (vph)	159	1272	998	241	362	61
Turn Type	pm+pt	NA	NA	Perm	Perm	Perm
Protected Phases	7	4	8			
Permitted Phases	4			8	6	6
Actuated Green, G (s)	54.2	54.2	40.4	40.4	23.3	23.3
Effective Green, g (s)	54.2	54.2	40.4	40.4	23.3	23.3
Actuated g/C Ratio	0.61	0.61	0.45	0.45	0.26	0.26
Clearance Time (s)	4.0	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)	354	2167	1615	722	465	416
v/s Ratio Prot	0.05	c0.36	0.28			
v/s Ratio Perm	0.22			0.15	c0.20	0.04
v/c Ratio	0.45	0.59	0.62	0.33	0.78	0.15
Uniform Delay, d1	10.3	10.8	18.7	15.9	30.7	25.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	1.2	1.8	1.2	8.0	0.2
Delay (s)	11.2	12.0	20.5	17.1	38.7	25.6
Level of Service	B	B	C	B	D	C
Approach Delay (s)		11.9	19.4		33.6	
Approach LOS		B	B		C	

Intersection Summary

HCM 2000 Control Delay	18.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	89.5	Sum of lost time (s)	16.0
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

6: Thrushwood Drive & Cranberry Lane

2043 Total Conditions
Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	7	8	1	156	4	28	0	25	162	26	29	2
Future Volume (Veh/h)	7	8	1	156	4	28	0	25	162	26	29	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)	8	9	1	170	4	30	0	27	176	28	32	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	236	292	33	210	205	115	34			203		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	236	292	33	210	205	115	34			203		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	99	100	77	99	97	100			98		
cM capacity (veh/h)	682	606	1041	727	677	937	1578			1369		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	18	204	203	62								
Volume Left	8	170	0	28								
Volume Right	1	30	176	2								
cSH	653	751	1578	1369								
Volume to Capacity	0.03	0.27	0.00	0.02								
Queue Length 95th (m)	0.6	8.4	0.0	0.5								
Control Delay (s)	10.7	11.6	0.0	3.6								
Lane LOS	B	B		A								
Approach Delay (s)	10.7	11.6	0.0	3.6								
Approach LOS	B	B										
Intersection Summary												
Average Delay			5.7									
Intersection Capacity Utilization			41.9%	ICU Level of Service						A		
Analysis Period (min)			15									

HCM Signalized Intersection Capacity Analysis

7: Bryne Drive & Cranberry Lane

2043 Total Conditions
Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	133	13	76	29	2	31	28	361	238	251	655	72
Future Volume (vph)	133	13	76	29	2	31	28	361	238	251	655	72
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.87		1.00	0.86		1.00	0.94		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1642		1789	1617		1789	3365		1789	3526	
Flt Permitted	0.77	1.00		1.00	1.00		0.35	1.00		0.27	1.00	
Satd. Flow (perm)	1449	1642		1883	1617		665	3365		503	3526	
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)	145	14	83	32	2	34	30	392	259	273	712	78
RTOR Reduction (vph)	0	75	0	0	32	0	0	140	0	0	9	0
Lane Group Flow (vph)	145	22	0	32	4	0	30	511	0	273	781	0
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		pm+pt	NA	
Protected Phases	7	4		3	8			2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	9.3	5.2		4.5	2.8		19.0	19.0		30.2	30.2	
Effective Green, g (s)	9.3	5.2		4.5	2.8		19.0	19.0		30.2	30.2	
Actuated g/C Ratio	0.17	0.09		0.08	0.05		0.34	0.34		0.55	0.55	
Clearance Time (s)	6.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	269	154		150	82		229	1160		397	1932	
v/s Ratio Prot	c0.04	0.01		0.01	0.00			0.15		c0.06	0.22	
v/s Ratio Perm	c0.05			0.01			0.05			c0.31		
v/c Ratio	0.54	0.14		0.21	0.05		0.13	0.44		0.69	0.40	
Uniform Delay, d1	20.7	22.9		23.7	24.9		12.4	13.9		7.7	7.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.1	0.4		0.7	0.2		1.2	1.2		4.9	0.6	
Delay (s)	22.8	23.3		24.4	25.1		13.6	15.2		12.6	7.9	
Level of Service	C	C		C	C		B	B		B	A	
Approach Delay (s)		23.0			24.8			15.1			9.1	
Approach LOS		C			C			B			A	
Intersection Summary												
HCM 2000 Control Delay	13.2			HCM 2000 Level of Service			B					
HCM 2000 Volume to Capacity ratio	0.77											
Actuated Cycle Length (s)	55.1			Sum of lost time (s)			24.0					
Intersection Capacity Utilization	60.5%			ICU Level of Service			B					
Analysis Period (min)	15											
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: Veterans Drive & Mapleton Drive/Brookwood Drive

2043 Total Conditions
Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	107	212	133	89	32	106	451	92	21	1001	16
Future Volume (vph)	10	107	212	133	89	32	106	451	92	21	1001	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0			6.0	6.0	4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	0.95		1.00	0.95	
Frt	1.00	0.90			1.00	0.85	1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00			0.97	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1696			1829	1601	1789	3488		1789	3570	
Flt Permitted	0.45	1.00			0.56	1.00	0.11	1.00		0.43	1.00	
Satd. Flow (perm)	840	1696			1061	1601	199	3488		806	3570	
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)	11	116	230	145	97	35	115	490	100	23	1088	17
RTOR Reduction (vph)	0	66	0	0	0	25	0	15	0	0	1	0
Lane Group Flow (vph)	11	280	0	0	242	10	115	575	0	23	1104	0
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)	30.9	30.9			25.7	25.7	46.8	40.2		38.6	36.0	
Effective Green, g (s)	30.9	30.9			25.7	25.7	46.8	40.2		38.6	36.0	
Actuated g/C Ratio	0.34	0.34			0.29	0.29	0.52	0.45		0.43	0.40	
Clearance Time (s)	4.0	6.0			6.0	6.0	4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	302	584			303	458	224	1563		375	1432	
v/s Ratio Prot	0.00	c0.17					c0.04	0.16		0.00	c0.31	
v/s Ratio Perm	0.01				c0.23	0.01	0.23			0.02		
v/c Ratio	0.04	0.48			0.80	0.02	0.51	0.37		0.06	0.77	
Uniform Delay, d1	19.7	23.1			29.6	23.0	15.0	16.4		14.7	23.3	
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.0	0.6			13.6	0.0	2.0	0.7		0.1	4.1	
Delay (s)	19.8	23.7			43.2	23.0	17.0	17.0		14.8	27.3	
Level of Service	B	C			D	C	B	B		B	C	
Approach Delay (s)		23.6			40.7			17.0			27.1	
Approach LOS		C			D			B			C	
Intersection Summary												
HCM 2000 Control Delay			25.2				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			89.7				Sum of lost time (s)			20.0		
Intersection Capacity Utilization			83.2%				ICU Level of Service			E		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

9: Bryne Drive & Bryne Court

2043 Total Conditions
Weekday AM Peak Hour

							
Movement	WBL	WBR	NBT	NBR	SBL	SBT	
Lane Configurations							
Traffic Volume (veh/h)	9	9	541	75	75	579	
Future Volume (Veh/h)	9	9	541	75	75	579	
Sign Control	Stop		Free			Free	
Grade	0%		0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	
Hourly flow rate (vph)	10	10	588	82	82	629	
Pedestrians							
Lane Width (m)							
Walking Speed (m/s)							
Percent Blockage							
Right turn flare (veh)							
Median type			TWLT		TWLT		
Median storage veh			2		2		
Upstream signal (m)			251				
pX, platoon unblocked	0.91	0.91			0.91		
vC, conflicting volume	1108	335			670		
vC1, stage 1 conf vol	629						
vC2, stage 2 conf vol	478						
vCu, unblocked vol	919	69			437		
tC, single (s)	6.8	6.9			4.1		
tC, 2 stage (s)	5.8						
tF (s)	3.5	3.3			2.2		
p0 queue free %	98	99			92		
cM capacity (veh/h)	441	891			1017		
Direction, Lane #	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2	SB 3
Volume Total	10	10	392	278	82	314	314
Volume Left	10	0	0	0	82	0	0
Volume Right	0	10	0	82	0	0	0
cSH	441	891	1700	1700	1017	1700	1700
Volume to Capacity	0.02	0.01	0.23	0.16	0.08	0.18	0.18
Queue Length 95th (m)	0.5	0.3	0.0	0.0	2.0	0.0	0.0
Control Delay (s)	13.4	9.1	0.0	0.0	8.8	0.0	0.0
Lane LOS	B	A			A		
Approach Delay (s)	11.2		0.0		1.0		
Approach LOS	B						
Intersection Summary							
Average Delay			0.7				
Intersection Capacity Utilization			34.8%		ICU Level of Service		A
Analysis Period (min)			15				

HCM Signalized Intersection Capacity Analysis

10: Bryne Drive & Caplan Avenue

2043 Total Conditions
Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	96	368	114	57	279	37	136	483	74	20	533	35
Future Volume (vph)	96	368	114	57	279	37	136	483	74	20	533	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.96		1.00	0.98		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	1817		1789	1850		1789	3508		1789	3545	
Flt Permitted	0.39	1.00		0.15	1.00		0.27	1.00		0.40	1.00	
Satd. Flow (perm)	727	1817		280	1850		515	3508		760	3545	
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)	104	400	124	62	303	40	148	525	80	22	579	38
RTOR Reduction (vph)	0	13	0	0	6	0	0	12	0	0	5	0
Lane Group Flow (vph)	104	511	0	62	337	0	148	593	0	22	612	0
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	32.2	26.9		32.2	26.9		39.0	32.4		30.5	27.9	
Effective Green, g (s)	32.2	26.9		32.2	26.9		39.0	32.4		30.5	27.9	
Actuated g/C Ratio	0.37	0.31		0.37	0.31		0.45	0.37		0.35	0.32	
Clearance Time (s)	4.0	6.0		4.0	6.0		4.0	6.0		4.0	6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	333	560		195	570		334	1303		296	1134	
v/s Ratio Prot	0.02	c0.28		c0.02	0.18		c0.04	0.17		0.00	c0.17	
v/s Ratio Perm	0.10			0.10			0.16			0.02		
v/c Ratio	0.31	0.91		0.32	0.59		0.44	0.46		0.07	0.54	
Uniform Delay, d1	18.8	29.0		20.1	25.5		15.4	20.7		18.7	24.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	19.2		0.9	1.7		0.9	1.1		0.1	1.8	
Delay (s)	19.4	48.2		21.1	27.2		16.3	21.9		18.8	26.2	
Level of Service	B	D		C	C		B	C		B	C	
Approach Delay (s)		43.5			26.2			20.8			26.0	
Approach LOS		D			C			C			C	
Intersection Summary												
HCM 2000 Control Delay			28.9	HCM 2000 Level of Service					C			
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			87.2	Sum of lost time (s)					20.0			
Intersection Capacity Utilization			76.3%	ICU Level of Service					D			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

11: Bryne Drive & Maplevue Drive

2043 Total Conditions

Weekday AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	133	1122	185	503	997	362	58	54	227	276	143	124
Future Volume (vph)	133	1122	185	503	997	362	58	54	227	276	143	124
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	5.0		3.0	5.0		3.0	5.0		3.0	5.0	
Lane Util. Factor	1.00	0.91		1.00	0.91		1.00	0.95		1.00	0.95	
Frt	1.00	0.98		1.00	0.96		1.00	0.88		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1789	5033		1789	4937		1789	3145		1789	3329	
Flt Permitted	0.17	1.00		0.12	1.00		0.57	1.00		0.29	1.00	
Satd. Flow (perm)	313	5033		221	4937		1082	3145		538	3329	
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)	145	1220	201	547	1084	393	63	59	247	300	155	135
RTOR Reduction (vph)	0	17	0	0	44	0	0	220	0	0	108	0
Lane Group Flow (vph)	145	1404	0	547	1433	0	63	86	0	300	182	0
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	40.8	31.1		63.1	50.4		17.2	11.0		29.4	20.2	
Effective Green, g (s)	40.8	31.1		63.1	50.4		17.2	11.0		29.4	20.2	
Actuated g/C Ratio	0.40	0.30		0.62	0.49		0.17	0.11		0.29	0.20	
Clearance Time (s)	3.0	5.0		3.0	5.0		3.0	5.0		3.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	264	1527		579	2427		224	337		342	656	
v/s Ratio Prot	0.05	0.28		c0.27	0.29		0.02	0.03		c0.13	0.05	
v/s Ratio Perm	0.17			c0.31			0.03			c0.12		
v/c Ratio	0.55	0.92		0.94	0.59		0.28	0.25		0.88	0.28	
Uniform Delay, d1	20.2	34.5		28.2	18.7		36.8	42.0		31.6	34.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.3	10.4		24.3	1.1		0.7	0.4		21.4	0.2	
Delay (s)	22.5	44.9		52.5	19.7		37.5	42.4		53.1	35.2	
Level of Service	C	D		D	B		D	D		D	D	
Approach Delay (s)		42.8			28.6			41.5			44.3	
Approach LOS		D			C			D			D	
Intersection Summary												
HCM 2000 Control Delay	36.6			HCM 2000 Level of Service			D					
HCM 2000 Volume to Capacity ratio	0.98											
Actuated Cycle Length (s)	102.5			Sum of lost time (s)			16.0					
Intersection Capacity Utilization	92.8%			ICU Level of Service			F					
Analysis Period (min)	15											
c Critical Lane Group												