

**Midtown Oakville Transportation and Stormwater  
Municipal Class EA Final Report June 2014**

**APPENDIX C  
TRAFFIC ANALYSIS**

**APPENDIX C1**  
**Capacity Analysis**

**Appendix C1 Midtown Oakville**  
Trip Generation

				35% Transit Reduction & 40% Internal Capture of Retail Trips					
				Morning Peak Hour			Afternoon Peak Hour		
Block ID	Use	Units	Size (Sq. ft)	In	Out	Total	In	Out	Total
2N	Residential	750		30	138	168	114	72	186
	Residential	380		18	76	94	61	39	100
	Residential	322		13	59	72	49	31	80
3N	Residential	317		15	66	81	50	34	84
	Residential	127		6	27	34	22	13	34
	Retail		33,572	27	18	45	98	61	159
	Residential	259		18	75	94	52	31	83
4N1	Residential	490		23	106	130	82	51	134
	Arena		187,230	0	0	0	135	164	299
	Residential	122		9	35	44	25	14	39
	Retail		8,608	9	6	15	31	19	50
	Residential	265		13	57	70	45	27	72
	Retail		16,140	13	9	22	47	30	77
	civic		488,370	192	24	216	32	144	176
	Office		154,020	159	22	181	30	142	171
2S	Residential	623		25	114	139	94	60	154
	Residential	393		19	78	98	63	38	101
	Residential	570		27	105	132	86	55	142
3S	Residential	598		24	110	134	91	57	148
	Retail		18,077	14	9	23	41	42	82
	Residential	262		13	58	71	44	27	71
	Retail		17,862	14	9	22	40	42	82
	Retail		59,718	47	30	77	150	156	306
	Office		179,048	179	24	203	33	158	190
	Office		260,480	242	34	275	44	208	252
4S	Retail		22,780	18	11	30	58	59	117
	Office		22,780	23	3	26	4	22	26
4N1	Office		113,960	125	18	142	24	116	140
	Office		166,740	170	22	192	30	150	180
	Office		188,080	186	26	212	33	164	197
	Office		177,540	176	24	200	31	155	186
	Arena		90,100	0	0	0	65	79	144
5N	Educational		151,400	108	22	130	26	144	170
	Educational		202,750	138	28	166	24	135	159
	Office		113,640	125	17	142	24	116	140
	Retail		113,640	41	26	67	175	107	282
5S	Educational		29,060	20	4	24	3	19	22
	Office		56,620	62	8	70	12	58	70
6N	office		56,620	62	8	70	12	58	70
6S	office		113,640	125	17	142	24	116	140
7S	Residential	160		6	30	36	24	16	40
8S	Residential	325		16	67	83	52	34	86
	Retail		86,800	59	38	97	193	201	394
			Total	2,609	1,658	4,269	2,373	3,464	5,835

**Appendix C1 Midtown Oakville Class EA**  
**Trip Distribution**

Direction	To/From	Residential Use						Retail Use						Office Use					
		Weekday AM		Weekday PM		Weekday AM		Weekday PM		Weekday AM		Weekday PM		Weekday AM		Weekday PM			
		IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT		
East	Iroquois Shore Road	4%	5%	4%	5%	2%	2%	2%	2%	2%	2%	3%	3%	2%	2%	3%	2%		
	Highway 403 Eastbound	24%	14%	24%	14%	16%	16%	16%	16%	2%	2%	24%	24%	41%	41%	24%	41%		
	South Service Road East	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%	0%	0%	0%	0%	0%	0%		
	Cornwall Road	10%	10%	10%	10%	6%	3%	6%	3%	5%	3%	7%	7%	6%	6%	7%	6%		
	Leighland Ave	8%	8%	8%	8%	9%	8%	9%	8%	10%	6%	7%	7%	4%	4%	7%	4%		
West	Highway 403 Westbound	10%	27%	10%	27%	15%	16%	15%	16%	15%	16%	32%	32%	21%	21%	32%	21%		
	Speers Road	13%	15%	13%	15%	21%	21%	21%	21%	21%	21%	14%	14%	11%	11%	14%	11%		
	South Service Road West/Lyons Lane	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
North	Trafalgar Road	26%	18%	26%	18%	26%	26%	26%	26%	26%	11%	11%	14%	14%	11%	14%			
South	Trafalgar Road	4%	2%	4%	2%	3%	6%	3%	6%	3%	2%	2%	1%	1%	2%	1%			
<b>Total</b>		<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>		

Source: Oakville GO Station Parking Expansion Feasibility and Transportation Impact Study by IBI Group, July 2009

## Appendix C1 Midtown Oakville Class EA

### Traffic Operations Analysis Summary

Intersection	Existing		2031 Do Nothing	
	AM Peak	PM Peak	AM Peak	PM Peak
	LOS (V/C)	LOS (V/C)	LOS (V/C)	LOS (V/C)
Trafalgar Road / White Oaks Boulevard	B (0.41)	C (0.77)	C (0.67)	C (0.86)
Trafalgar Road / Leighland Avenue-Iroquois Shore Road	D (0.64)	C (0.79)	F (1.02)	F (1.22)
Trafalgar Road / North Service Road-QEW WB Off Ramp	C (0.67)	C (0.79)	F (1.55)	F (1.78)
Trafalgar Road / QEW EB Off Ramp	B (0.57)	C (0.69)	F (1.83)	F (1.54)
Trafalgar Road / Cross Avenue	C (0.59)	C (0.75)	F (4.03)	F (2.93)
Trafalgar Road / Cornwall Road	D (0.72)	F (0.84)	F (1.17)	F (1.44)
Cross Avenue / Argus Road	B (0.28)	B (0.35)	F (4.84)	F (5.80)
Cross Avenue / Lyons Lane	C (0.46)	E (0.85)	F (1.57)	F (1.42)
Cross Avenue / Speers Road-Cornwall Road	A (0.61)	F (0.99)	F (1.45)	F (1.46)
Cornwall Road / Old Mill Road	B (0.29)	C (0.44)	E (0.70)	C (0.88)
Cornwall Road / Reynolds Street	A (0.37)	B (0.49)	A (0.50)	B (0.67)
Cornwall Road / Chartwell Road	B (0.51)	B (0.52)	F (0.79)	F (0.68)
Iroquois Shore Road / North Service Road	C (0.36)	C (0.81)	C (0.40)	D (0.89)
Iroquois Shore Road / Eighth Line	B (0.59)	F (0.66)	C (0.67)	F (0.73)

Traffic Operations Analysis Summary

Intersection	2031 Preferred Network	
	AM Peak	PM Peak
	LOS (V/C)	LOS (V/C)
Trafalgar Road & White Oaks Boulevard	C (0.72)	C (0.76)
Trafalgar Road & Leighland Avenue / Iroquois Shore Road	C (0.76)	C (0.79)
Trafalgar Road & North Service Road / QEW WB Off Ramp	C (0.85)	C (0.87)
Trafalgar Road & QEW EB Off Ramp	D (0.99)	C (0.77)
Trafalgar Road & Cross Avenue	E (0.98)	E (1.03)
Trafalgar Road & Cornwall Road	E (0.81)	E (0.90)
Cross Avenue & Argus Road	F (1.60)	F (2.16)
Cross Avenue & Lyons Lane	C (0.58)	E (0.96)
Cross Avenue & Speers Road / Cornwall Road	F (1.04)	F (1.40)
Cornwall Road & Old Mill Road	B (0.65)	C (0.84)
Cornwall Road & Reynolds Street	A (0.44)	B (0.64)
Cornwall Road & Chartwell Road	B (0.37)	D (0.77)
Iroquois Shore Road & North Service Road	A (0.24)	A (0.18)
Iroquois Shore Road & Eighth Line	C (0.80)	E (0.94)
N-S Crossing & White Oaks Boulevard	A (0.45)	A (0.49)
N-S Crossing & Iroquois Shore Road	D (0.75)	C (0.64)
N-S Crossing & Cross Avenue	C (0.92)	C (0.83)
Cross Avenue & EB QEW Off Ramp	B (0.76)	B (0.50)
Cross Avenue & Chartwell Road	B (0.37)	D (0.78)
North Service Road & Eighth Line	A (0.24)	A (0.18)
Royal Windsor Drive & WB QEW Off Ramp	B (0.59)	A (0.46)
Royal Windsor Drive & EB QEW On Ramp	C (0.82)	E (1.02)
Royal Windsor Drive & The Canadian Road	A (0.55)	C (0.80)

# HCM Signalized Intersection Capacity Analysis

## 1: Leighland Avenue & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	98	414	740	41	103	136	1213	542	178	979	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.90	1.00	1.00	0.99	1.00	1.00	0.94
Flpb, ped/bikes	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
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)	1717	1902	1595	3437	1847	1417	1736	5043	1565	1789	5092	1524
Flt Permitted	0.73	1.00	1.00	0.95	1.00	1.00	0.22	1.00	1.00	0.12	1.00	1.00
Satd. Flow (perm)	1320	1902	1595	3437	1847	1417	395	5043	1565	221	5092	1524
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	28	98	414	740	41	103	136	1213	542	178	979	37
RTOR Reduction (vph)	0	0	0	0	0	73	0	0	0	0	0	21
Lane Group Flow (vph)	28	98	414	740	41	30	136	1213	542	178	979	16
Confl. Peds. (#/hr)	17		5	5		17	16		2	2		16
Heavy Vehicles (%)	0%	1%	1%	3%	4%	4%	5%	4%	3%	2%	3%	1%
Turn Type	pm+pt		Free	Prot		Perm	pm+pt		Free	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		Free			8	2		Free	6		6
Actuated Green, G (s)	20.4	15.5	120.0	22.9	33.5	33.5	55.8	45.2	120.0	61.4	48.0	48.0
Effective Green, g (s)	24.4	17.5	120.0	24.9	35.5	35.5	55.8	48.2	120.0	61.4	51.0	51.0
Actuated g/C Ratio	0.20	0.15	1.00	0.21	0.30	0.30	0.46	0.40	1.00	0.51	0.42	0.42
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.5	3.5		3.5	3.5	3.5	3.5	5.0		3.5	5.0	5.0
Lane Grp Cap (vph)	291	277	1595	713	546	419	302	2026	1565	288	2164	648
v/s Ratio Prot	0.01	0.05		c0.22	0.02		0.04	0.24		c0.07	0.19	
v/s Ratio Perm	0.01		0.26			0.02	0.17		c0.35	c0.25		0.01
v/c Ratio	0.10	0.35	0.26	1.04	0.08	0.07	0.45	0.60	0.35	0.62	0.45	0.02
Uniform Delay, d1	38.7	46.2	0.0	47.6	30.4	30.4	19.2	28.3	0.0	19.5	24.6	20.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.09	0.68	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.9	0.4	110.7	0.1	0.1	1.2	1.2	0.6	4.2	0.7	0.1
Delay (s)	38.9	47.1	0.4	158.3	30.5	30.5	22.2	20.3	0.6	23.7	25.2	20.1
Level of Service	D	D	A	F	C	C	C	C	A	C	C	C
Approach Delay (s)		10.9			137.5			14.8			24.9	
Approach LOS		B			F			B			C	

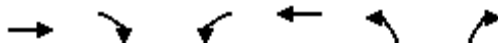
### Intersection Summary

HCM Average Control Delay	41.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 2: Iroquois Shore Road & North Service Road

6/3/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↑	↑	↑↑	↑↑	
Volume (vph)	371	384	47	760	138	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	
Frbp, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.98	
Flt Protected	1.00	1.00	0.95	1.00	0.96	
Satd. Flow (prot)	1865	1585	1772	3544	1640	
Flt Permitted	1.00	1.00	0.36	1.00	0.96	
Satd. Flow (perm)	1865	1585	671	3544	1640	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	371	384	47	760	138	26
RTOR Reduction (vph)	0	236	0	0	6	0
Lane Group Flow (vph)	371	148	47	760	158	0
Confl. Peds. (#/hr)					14	
Heavy Vehicles (%)	3%	3%	3%	3%	10%	10%
Turn Type		Perm	pm+pt			
Protected Phases	2		3	2	4	
Permitted Phases		2	2			
Actuated Green, G (s)	35.8	35.8	39.2	35.8	43.8	
Effective Green, g (s)	37.8	37.8	37.2	37.8	45.8	
Actuated g/C Ratio	0.39	0.39	0.38	0.39	0.47	
Clearance Time (s)	6.0	6.0	3.0	6.0	6.0	
Vehicle Extension (s)	3.5	3.5	3.0	3.5	3.5	
Lane Grp Cap (vph)	719	611	282	1367	766	
v/s Ratio Prot	0.20		c0.00	c0.21	c0.10	
v/s Ratio Perm		0.09	0.06			
v/c Ratio	0.52	0.24	0.17	0.56	0.21	
Uniform Delay, d1	23.1	20.4	28.1	23.5	15.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.7	0.9	0.3	1.6	0.6	
Delay (s)	25.7	21.3	28.4	25.2	16.0	
Level of Service	C	C	C	C	B	
Approach Delay (s)	23.5			25.4	16.0	
Approach LOS	C			C	B	

### Intersection Summary

HCM Average Control Delay	23.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	98.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	42.1%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Unsignalized Intersection Capacity Analysis

## 4: Iroquois Shore Road & Eighth Line

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	370	26	14	11	98	795
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	370	26	14	11	98	795
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total (vph)	396	25	98	795		
Volume Left (vph)	370	14	0	0		
Volume Right (vph)	26	0	0	795		
Hadj (s)	0.22	0.59	0.03	-0.57		
Departure Headway (s)	4.4	5.6	4.9	3.2		
Degree Utilization, x	0.49	0.04	0.13	0.71		
Capacity (veh/h)	794	593	672	1120		
Control Delay (s)	11.7	8.8	8.7	13.8		
Approach Delay (s)	11.7	8.8	13.2			
Approach LOS	B	A	B			
Intersection Summary						
Delay			12.7			
HCM Level of Service			B			
Intersection Capacity Utilization			59.2%	ICU Level of Service	B	
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 7: North Service Road & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖		↗	↖	↑	↗		↑↑↑			↑↑↑	
Volume (vph)	0	0	206	545	21	430	0	1468	0	0	2132	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	3.0	4.0	4.0		4.0			4.0	
Lane Util. Factor			1.00	1.00	1.00	1.00		0.91			0.86	
Frbp, ped/bikes			1.00	1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes			1.00	1.00	1.00	1.00		1.00			1.00	
Frt			0.85	1.00	1.00	0.85		1.00			1.00	
Flt Protected			1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (prot)			1633	1825	1642	1585		5043			6416	
Flt Permitted			1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (perm)			1633	1825	1642	1585		5043			6416	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	206	545	21	430	0	1468	0	0	2132	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	206	545	21	430	0	1468	0	0	2133	0
Confl. Peds. (#/hr)							17					
Heavy Vehicles (%)	0%	0%	0%	0%	17%	3%	0%	4%	7%	0%	3%	0%
Turn Type	custom		custom	pm+pt		Free						
Protected Phases				3	8			2			6	
Permitted Phases	4		4	8		Free						
Actuated Green, G (s)			20.4	36.0	36.0	120.0		72.0			72.0	
Effective Green, g (s)			22.4	36.0	38.0	120.0		74.0			74.0	
Actuated g/C Ratio			0.19	0.30	0.32	1.00		0.62			0.62	
Clearance Time (s)			6.0	3.0	6.0			6.0			6.0	
Vehicle Extension (s)			3.5	3.0	3.5			4.5			4.5	
Lane Grp Cap (vph)			305	548	520	1585		3110			3957	
v/s Ratio Prot				c0.10	0.01			0.29			c0.33	
v/s Ratio Perm			0.13	0.19		0.27						
v/c Ratio			0.68	0.99	0.04	0.27		0.47			0.54	
Uniform Delay, d1			45.4	41.9	28.4	0.0		12.4			13.2	
Progression Factor			1.00	1.00	1.00	1.00		1.00			1.16	
Incremental Delay, d2			6.2	71.3	0.0	0.4		0.5			0.4	
Delay (s)			51.6	113.2	28.4	0.4		13.0			15.7	
Level of Service			D	F	C	A		B			B	
Approach Delay (s)		51.6			62.7			13.0			15.7	
Approach LOS		D			E			B			B	

### Intersection Summary

HCM Average Control Delay	26.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	7.0
Intersection Capacity Utilization	83.9%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 8: Highway 403 EB Offramp & Trafalgar Road

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↶↶	↷		↶↶↶	↶↶↶	
Volume (vph)	681	540	0	1066	992	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		0.91	0.91	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	3471	1601		5142	5043	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	3471	1601		5142	5043	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	681	540	0	1066	992	0
RTOR Reduction (vph)	0	50	0	0	0	0
Lane Group Flow (vph)	681	490	0	1066	992	0
Confl. Peds. (#/hr)			3			3
Heavy Vehicles (%)	2%	2%	4%	2%	4%	3%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	42.1	42.1		28.7	28.7	
Effective Green, g (s)	44.1	44.1		30.7	30.7	
Actuated g/C Ratio	0.53	0.53		0.37	0.37	
Clearance Time (s)	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.5	3.5		4.5	4.5	
Lane Grp Cap (vph)	1849	853		1907	1870	
v/s Ratio Prot	0.20			0.21	0.20	
v/s Ratio Perm		0.31				
v/c Ratio	0.37	0.57		0.56	0.53	
Uniform Delay, d1	11.3	13.0		20.7	20.4	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.6	2.8		0.5	0.5	
Delay (s)	11.8	15.9		21.2	20.9	
Level of Service	B	B		C	C	
Approach Delay (s)	13.6			21.2	20.9	
Approach LOS	B			C	C	

### Intersection Summary

HCM Average Control Delay	18.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	82.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.9%	ICU Level of Service	B
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 10: Cross Avenue & Lyons Lane

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	59	208	375	254	130	7	22	7	21	13	39	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.98		1.00	1.00		1.00	0.99		1.00	0.99	
Flpb, ped/bikes	0.99	1.00		1.00	1.00		0.99	1.00		0.99	1.00	
Frt	1.00	0.90		1.00	0.99		1.00	0.89		1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1804	3236		1819	3614		1810	1683		1815	1750	
Flt Permitted	0.67	1.00		0.36	1.00		0.68	1.00		0.74	1.00	
Satd. Flow (perm)	1263	3236		692	3614		1300	1683		1412	1750	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	59	208	375	254	130	7	22	7	21	13	39	43
RTOR Reduction (vph)	0	207	0	0	4	0	0	19	0	0	39	0
Lane Group Flow (vph)	59	376	0	254	133	0	22	9	0	13	43	0
Confl. Peds. (#/hr)	7		3	3		7	5		3	3		5
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	1	2			2			4				4
Permitted Phases	2			2			4			4		
Actuated Green, G (s)	77.1	42.8		42.8	42.8		7.9	7.9		7.9	7.9	
Effective Green, g (s)	75.1	44.8		44.8	44.8		9.9	9.9		9.9	9.9	
Actuated g/C Ratio	0.75	0.45		0.45	0.45		0.10	0.10		0.10	0.10	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	1129	1450		310	1619		129	167		140	173	
v/s Ratio Prot	c0.02	0.12			0.04			0.01			c0.02	
v/s Ratio Perm	0.02			c0.37			0.02			0.01		
v/c Ratio	0.05	0.26		0.82	0.08		0.17	0.05		0.09	0.25	
Uniform Delay, d1	3.2	17.2		24.1	15.8		41.3	40.8		41.0	41.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.4		24.5	0.1		0.9	0.2		0.4	1.0	
Delay (s)	3.3	17.7		48.6	15.9		42.1	41.0		41.4	42.7	
Level of Service	A	B		D	B		D	D		D	D	
Approach Delay (s)		16.4			37.1			41.5			42.5	
Approach LOS		B			D			D			D	

### Intersection Summary

HCM Average Control Delay	26.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	55.1%	ICU Level of Service	B
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 11: Cross Avenue & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↔		↔	↑	↔	↔	↑↑↑		↔	↑↑↑	
Volume (vph)	401	43	43	23	52	61	102	1198	33	75	1128	329
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	0.98		1.00	1.00	1.00	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		0.98	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.92		1.00	1.00	0.85	1.00	1.00		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3278	1635		1592	1902	1541	1674	5144		1705	4903	
Flt Permitted	0.95	1.00		0.70	1.00	1.00	0.12	1.00		0.14	1.00	
Satd. Flow (perm)	3278	1635		1175	1902	1541	204	5144		253	4903	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	401	43	43	23	52	61	102	1198	33	75	1128	329
RTOR Reduction (vph)	0	33	0	0	0	53	0	2	0	0	39	0
Lane Group Flow (vph)	401	53	0	23	52	8	102	1229	0	75	1418	0
Confl. Peds. (#/hr)			36	36			12		14	14		12
Heavy Vehicles (%)	8%	0%	12%	12%	1%	6%	9%	1%	17%	7%	3%	2%
Turn Type	Prot			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases				8		8	2			6		
Actuated Green, G (s)	16.4	16.0		16.0	8.8	8.8	43.4	34.6		40.6	33.2	
Effective Green, g (s)	16.4	18.0		20.0	10.8	10.8	43.4	36.6		40.6	35.2	
Actuated g/C Ratio	0.19	0.21		0.23	0.12	0.12	0.50	0.42		0.47	0.40	
Clearance Time (s)	4.0	6.0		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	3.0	
Lane Grp Cap (vph)	617	338		313	236	191	250	2159		241	1979	
v/s Ratio Prot	c0.12	0.03		0.01	c0.03		c0.04	0.24		0.03	c0.29	
v/s Ratio Perm				0.01		0.00	0.16			0.12		
v/c Ratio	0.65	0.16		0.07	0.22	0.04	0.41	0.57		0.31	0.72	
Uniform Delay, d1	32.7	28.4		26.3	34.4	33.6	14.5	19.3		14.0	21.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.4	0.2		0.1	0.5	0.1	1.1	0.3		0.7	1.3	
Delay (s)	35.1	28.6		26.4	34.9	33.7	15.6	19.6		14.7	23.1	
Level of Service	D	C		C	C	C	B	B		B	C	
Approach Delay (s)		34.0			32.9			19.3			22.7	
Approach LOS		C			C			B			C	

### Intersection Summary

HCM Average Control Delay	23.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	87.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	65.1%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 18: Cornwall Road & Cross Avenue

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↶	↷↷	↷↶		↶	↷
Volume (vph)	572	874	445	54	11	236
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1733	3476	3345		1644	1471
Flt Permitted	0.40	1.00	1.00		0.95	1.00
Satd. Flow (perm)	723	3476	3345		1644	1471
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	572	874	445	54	11	236
RTOR Reduction (vph)	0	0	10	0	0	216
Lane Group Flow (vph)	572	874	489	0	11	20
Confl. Peds. (#/hr)	26			26	1	
Heavy Vehicles (%)	5%	5%	7%	7%	11%	11%
Turn Type	pm+pt					Perm
Protected Phases	5	2			4	
Permitted Phases	2		6			4
Actuated Green, G (s)	67.8	67.8	42.1		8.2	8.2
Effective Green, g (s)	66.8	69.8	44.1		7.2	7.2
Actuated g/C Ratio	0.79	0.82	0.52		0.08	0.08
Clearance Time (s)	3.0	6.0	6.0		3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	826	2854	1735		139	125
v/s Ratio Prot	c0.18	0.25			0.01	
v/s Ratio Perm	c0.37		0.15			c0.01
v/c Ratio	0.69	0.31	0.28		0.08	0.16
Uniform Delay, d1	3.8	1.8	11.5		35.8	36.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.6	0.3	0.1		0.2	0.6
Delay (s)	6.3	2.1	11.6		36.1	36.7
Level of Service	A	A	B		D	D
Approach Delay (s)		3.8	11.6		36.7	
Approach LOS		A	B		D	

### Intersection Summary

HCM Average Control Delay	9.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	78.4%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 19: Cornwall Road & Old Mill Road

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↗		↙	↘
Volume (vph)	159	726	442	13	109	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00		1.00	0.94
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1823	3544	3496		1825	1532
Flt Permitted	0.33	1.00	1.00		0.95	1.00
Satd. Flow (perm)	629	3544	3496		1825	1532
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	159	726	442	13	109	57
RTOR Reduction (vph)	0	0	3	0	0	31
Lane Group Flow (vph)	159	726	452	0	109	26
Confl. Peds. (#/hr)	4			4		34
Heavy Vehicles (%)	0%	3%	4%	0%	0%	0%
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	33.8	33.8	22.0		34.2	34.2
Effective Green, g (s)	33.8	35.8	24.0		36.2	36.2
Actuated g/C Ratio	0.42	0.45	0.30		0.45	0.45
Clearance Time (s)	4.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	382	1586	1049		826	693
v/s Ratio Prot	0.04	c0.20	0.13		c0.06	
v/s Ratio Perm	0.14					0.02
v/c Ratio	0.42	0.46	0.43		0.13	0.04
Uniform Delay, d1	15.2	15.4	22.5		12.8	12.2
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.7	0.2	0.3		0.3	0.1
Delay (s)	15.9	15.6	22.8		13.1	12.3
Level of Service	B	B	C		B	B
Approach Delay (s)		15.6	22.8		12.8	
Approach LOS		B	C		B	

### Intersection Summary

HCM Average Control Delay	17.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	50.5%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 21: Cornwall Road & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↖↗		↖	↖↗	↖	↖	↖↗		↖↗	↖	↖
Volume (vph)	322	449	64	36	312	646	45	339	8	633	463	98
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	0.95		0.97	1.00	1.00
Frbp, ped/bikes	1.00	1.00		1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3541	3505		1717	3476	1462	1818	3564		3340	1865	1511
Flt Permitted	0.95	1.00		0.46	1.00	1.00	0.50	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3541	3505		836	3476	1462	951	3564		3340	1865	1511
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	322	449	64	36	312	646	45	339	8	633	463	98
RTOR Reduction (vph)	0	9	0	0	0	350	0	2	0	0	0	59
Lane Group Flow (vph)	322	504	0	36	312	296	45	345	0	633	463	39
Confl. Peds. (#/hr)	9		6	6		9	13		9	9		13
Heavy Vehicles (%)	0%	2%	0%	6%	5%	9%	0%	2%	2%	6%	3%	5%
Turn Type	Prot			pm+pt		Perm	pm+pt			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases				8		8		2				6
Actuated Green, G (s)	15.9	32.0		30.7	22.9	22.9	28.4	21.5		24.5	40.1	40.1
Effective Green, g (s)	16.9	34.0		30.7	24.9	24.9	28.4	23.5		25.5	42.1	42.1
Actuated g/C Ratio	0.16	0.32		0.29	0.23	0.23	0.27	0.22		0.24	0.39	0.39
Clearance Time (s)	5.0	6.0		4.0	6.0	6.0	4.0	6.0		5.0	6.0	6.0
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0	3.0	5.0		4.0	5.0	5.0
Lane Grp Cap (vph)	560	1116		305	810	341	309	784		797	735	596
v/s Ratio Prot	c0.09	0.14		0.01	0.09		0.01	0.10		c0.19	c0.25	
v/s Ratio Perm				0.03		c0.20	0.03					0.03
v/c Ratio	0.57	0.45		0.12	0.39	0.87	0.15	0.44		0.79	0.63	0.06
Uniform Delay, d1	41.6	29.0		27.7	34.5	39.4	29.5	36.0		38.2	26.1	20.1
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	1.7	0.4		0.2	0.4	25.4	0.2	0.8		6.1	2.4	0.1
Delay (s)	43.4	29.4		27.9	34.9	64.8	29.7	36.8		44.2	28.5	20.2
Level of Service	D	C		C	C	E	C	D		D	C	C
Approach Delay (s)		34.8			54.1			36.0			36.2	
Approach LOS		C			D			D			D	

### Intersection Summary

HCM Average Control Delay	41.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	106.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.5%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 22: Cornwall Road & Reynolds Street

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑		↑	↑		↑	↑	
Volume (vph)	5	801	284	36	839	13	128	7	39	12	4	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes		1.00	0.91	1.00	1.00		1.00	0.95		1.00	0.97	
Flpb, ped/bikes		1.00	1.00	0.98	1.00		0.97	1.00		0.95	1.00	
Frt		1.00	0.85	1.00	1.00		1.00	0.87		1.00	0.87	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3475	1412	1735	3529		1660	1483		1622	1507	
Flt Permitted		0.95	1.00	0.33	1.00		0.74	1.00		0.73	1.00	
Satd. Flow (perm)		3304	1412	603	3529		1288	1483		1241	1507	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	801	284	36	839	13	128	7	39	12	4	27
RTOR Reduction (vph)	0	0	66	0	0	0	0	33	0	0	23	0
Lane Group Flow (vph)	0	806	218	36	852	0	128	13	0	12	8	0
Confl. Peds. (#/hr)	29		22	22		29	17		32	32		17
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	7%	7%	7%	7%	7%	7%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		2			2			4			4	
Permitted Phases	2		2	2			4			4		
Actuated Green, G (s)		90.2	90.2	90.2	90.2		17.8	17.8		17.8	17.8	
Effective Green, g (s)		92.2	92.2	92.2	92.2		19.8	19.8		19.8	19.8	
Actuated g/C Ratio		0.77	0.77	0.77	0.77		0.16	0.16		0.16	0.16	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		4.0	4.0	4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2539	1085	463	2711		213	245		205	249	
v/s Ratio Prot				0.24				0.01			0.01	
v/s Ratio Perm		c0.24	0.15	0.06			c0.10			0.01		
v/c Ratio		0.32	0.20	0.08	0.31		0.60	0.05		0.06	0.03	
Uniform Delay, d1		4.3	3.8	3.4	4.2		46.4	42.2		42.2	42.1	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.3	0.4	0.3	0.3		4.8	0.1		0.1	0.1	
Delay (s)		4.6	4.2	3.8	4.5		51.2	42.3		42.4	42.1	
Level of Service		A	A	A	A		D	D		D	D	
Approach Delay (s)		4.5			4.5			48.9			42.2	
Approach LOS		A			A			D			D	

### Intersection Summary

HCM Average Control Delay	8.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.9%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 23: Cornwall Road & Chartwell Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	498	182	40	507	25	200	43	43	37	35	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.92		1.00	0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1722	1812	1502	1702	1783		1737	1692		1807	1760	
Flt Permitted	0.27	1.00	1.00	0.31	1.00		0.71	1.00		0.70	1.00	
Satd. Flow (perm)	497	1812	1502	549	1783		1307	1692		1334	1760	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	19	498	182	40	507	25	200	43	43	37	35	30
RTOR Reduction (vph)	0	0	104	0	3	0	0	24	0	0	17	0
Lane Group Flow (vph)	19	498	78	40	529	0	200	62	0	37	48	0
Confl. Peds. (#/hr)			4	4			1					1
Heavy Vehicles (%)	6%	6%	6%	7%	7%	7%	5%	5%	5%	1%	1%	1%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		4			4			2				2
Permitted Phases	4		4	4			2			2		
Actuated Green, G (s)	26.1	26.1	26.1	26.1	26.1		26.8	26.8		26.8	26.8	
Effective Green, g (s)	28.0	28.0	28.0	28.0	28.0		29.0	29.0		29.0	29.0	
Actuated g/C Ratio	0.43	0.43	0.43	0.43	0.43		0.45	0.45		0.45	0.45	
Clearance Time (s)	5.9	5.9	5.9	5.9	5.9		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	214	781	647	236	768		583	755		595	785	
v/s Ratio Prot		0.27			c0.30			0.04			0.03	
v/s Ratio Perm	0.04		0.05	0.07			c0.15			0.03		
v/c Ratio	0.09	0.64	0.12	0.17	0.69		0.34	0.08		0.06	0.06	
Uniform Delay, d1	10.9	14.5	11.1	11.4	15.0		11.8	10.3		10.3	10.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.8	4.0	0.4	1.6	5.1		1.6	0.2		0.2	0.2	
Delay (s)	11.8	18.5	11.5	12.9	20.1		13.4	10.6		10.5	10.4	
Level of Service	B	B	B	B	C		B	B		B	B	
Approach Delay (s)		16.5			19.6			12.5			10.4	
Approach LOS		B			B			B			B	

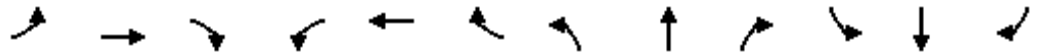
### Intersection Summary

HCM Average Control Delay	16.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.7%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 24: Cross Avenue & Argus Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	
Volume (vph)	28	395	13	36	431	16	47	1	35	57	6	302
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.98		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		0.99	1.00	
Frt	1.00	1.00		1.00	0.99		1.00	0.85		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1754	3421		909	3593		903	816		1779	1570	
Flt Permitted	0.33	1.00		0.51	1.00		0.52	1.00		0.73	1.00	
Satd. Flow (perm)	610	3421		490	3593		490	816		1374	1570	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	28	395	13	36	431	16	47	1	35	57	6	302
RTOR Reduction (vph)	0	4	0	0	3	0	0	17	0	0	148	0
Lane Group Flow (vph)	28	404	0	36	444	0	47	19	0	57	160	0
Confl. Peds. (#/hr)	1		3	3		1	12		4	4		12
Confl. Bikes (#/hr)									4			
Heavy Vehicles (%)	4%	3%	100%	100%	1%	0%	100%	0%	100%	2%	17%	1%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	29.1	29.1		22.3	22.3		38.9	38.9		38.9	38.9	
Effective Green, g (s)	28.1	31.1		24.3	24.3		40.9	40.9		40.9	40.9	
Actuated g/C Ratio	0.35	0.39		0.30	0.30		0.51	0.51		0.51	0.51	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	5.0	4.0		5.0	5.0		2.5	2.5		4.0	4.0	
Lane Grp Cap (vph)	254	1330		149	1091		251	417		702	803	
v/s Ratio Prot	0.00	c0.12			c0.12			0.02			c0.10	
v/s Ratio Perm	0.03			0.07			0.10			0.04		
v/c Ratio	0.11	0.30		0.24	0.41		0.19	0.05		0.08	0.20	
Uniform Delay, d1	17.6	16.9		20.9	22.1		10.6	9.8		10.0	10.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.4	0.2		1.8	0.5		1.7	0.2		0.2	0.6	
Delay (s)	18.0	17.1		22.7	22.6		12.2	10.0		10.2	11.2	
Level of Service	B	B		C	C		B	A		B	B	
Approach Delay (s)		17.2			22.6			11.2			11.0	
Approach LOS		B			C			B			B	

### Intersection Summary

HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.28		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	60		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 27: McCraney Street & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	194	75	405	134	44	31	171	873	300	87	655	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.98	1.00	0.99		1.00	0.99		1.00	0.98	
Flpb, ped/bikes	0.98	1.00	1.00	0.99	1.00		0.99	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.94		1.00	0.96		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1761	1921	1554	1726	1755		1777	4873		1822	4945	
Flt Permitted	0.70	1.00	1.00	0.70	1.00		0.31	1.00		0.23	1.00	
Satd. Flow (perm)	1293	1921	1554	1268	1755		576	4873		439	4945	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	194	75	405	134	44	31	171	873	300	87	655	113
RTOR Reduction (vph)	0	0	317	0	23	0	0	32	0	0	11	0
Lane Group Flow (vph)	194	75	88	134	52	0	171	1141	0	87	757	0
Confl. Peds. (#/hr)	16		7	7			16	39		4	4	39
Heavy Vehicles (%)	2%	0%	3%	5%	1%	2%	2%	3%	2%	0%	2%	3%
Turn Type	Perm		Perm	Perm			pm+pt			Perm		
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	25.4	25.4	25.4	25.4	25.4		90.6	90.6		75.9	75.9	
Effective Green, g (s)	28.4	28.4	28.4	28.4	28.4		91.6	93.6		78.9	78.9	
Actuated g/C Ratio	0.22	0.22	0.22	0.22	0.22		0.70	0.72		0.61	0.61	
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0		5.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	282	420	339	277	383		505	3509		266	3001	
v/s Ratio Prot		0.04			0.03		0.03	c0.23			0.15	
v/s Ratio Perm	c0.15		0.06	0.11			c0.21			0.20		
v/c Ratio	0.69	0.18	0.26	0.48	0.13		0.34	0.33		0.33	0.25	
Uniform Delay, d1	46.7	41.3	42.1	44.4	40.9		6.7	6.7		12.5	11.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	7.1	0.2	0.4	1.3	0.2		0.4	0.2		3.3	0.2	
Delay (s)	53.8	41.5	42.5	45.7	41.1		7.1	6.9		15.8	12.1	
Level of Service	D	D	D	D	D		A	A		B	B	
Approach Delay (s)		45.6			44.1			6.9			12.4	
Approach LOS		D			D			A			B	

### Intersection Summary

HCM Average Control Delay	19.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	80.3%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 35: QEW SW ramp & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations								↑↑↑	↑		↑↑↑	↑
Volume (veh/h)	0	0	0	0	0	0	0	1468	321	0	1913	970
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	0	0	0	0	0	0	0	1468	321	0	1913	970
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh												
Upstream signal (m)								293			28	
pX, platoon unblocked	0.85	0.85	0.82	0.85	0.85	0.93	0.82			0.93		
vC, conflicting volume	2402	3381	638	2106	3381	489	1913			1468		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1498	2652	0	1149	2652	204	1326			1252		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	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 %	100	100	100	100	100	100	100			100		
cM capacity (veh/h)	72	19	884	130	19	750	421			515		
<b>Direction, Lane #</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>NB 4</b>	<b>SB 1</b>	<b>SB 2</b>	<b>SB 3</b>	<b>SB 4</b>				
Volume Total	489	489	489	321	638	638	638	970				
Volume Left	0	0	0	0	0	0	0	0				
Volume Right	0	0	0	321	0	0	0	970				
cSH	1700	1700	1700	1700	1700	1700	1700	1700				
Volume to Capacity	0.29	0.29	0.29	0.19	0.38	0.38	0.38	0.57				
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Lane LOS												
Approach Delay (s)	0.0						0.0					
Approach LOS												
<b>Intersection Summary</b>												
Average Delay			0.0									
Intersection Capacity Utilization			63.4%		ICU Level of Service				B			
Analysis Period (min)			60									

# HCM Signalized Intersection Capacity Analysis

## 1: Leightland Avenue & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	127	101	312	721	286	167	270	1773	927	134	1064	134
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.96
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
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)	1766	1921	1596	3471	1902	1527	1807	5142	1601	1825	5142	1531
Flt Permitted	0.58	1.00	1.00	0.95	1.00	1.00	0.13	1.00	1.00	0.10	1.00	1.00
Satd. Flow (perm)	1086	1921	1596	3471	1902	1527	239	5142	1601	200	5142	1531
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	127	101	312	721	286	167	270	1773	927	134	1064	134
RTOR Reduction (vph)	0	0	0	0	0	124	0	0	0	0	0	88
Lane Group Flow (vph)	127	101	312	721	286	43	270	1773	927	134	1064	46
Confl. Peds. (#/hr)	28		3	3		28	10					10
Heavy Vehicles (%)	2%	0%	1%	2%	1%	2%	1%	2%	2%	0%	2%	2%
Turn Type	pm+pt		Free	Prot		Perm	pm+pt		Free	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		Free			8	2		Free	6		6
Actuated Green, G (s)	25.9	13.3	120.0	28.5	29.2	29.2	59.2	43.7	120.0	50.0	38.5	38.5
Effective Green, g (s)	29.9	15.3	120.0	30.5	31.2	31.2	59.2	46.7	120.0	50.0	41.5	41.5
Actuated g/C Ratio	0.25	0.13	1.00	0.25	0.26	0.26	0.49	0.39	1.00	0.42	0.35	0.35
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.5	3.5		3.5	3.5	3.5	3.5	5.0		3.5	5.0	5.0
Lane Grp Cap (vph)	353	245	1596	882	495	397	336	2001	1601	239	1778	529
v/s Ratio Prot	0.04	0.05		c0.21	0.15		c0.11	c0.34		0.05	0.21	
v/s Ratio Perm	0.05		0.20			0.03	0.28		c0.58	0.18		0.03
v/c Ratio	0.36	0.41	0.20	0.82	0.58	0.11	0.80	0.89	0.58	0.56	0.60	0.09
Uniform Delay, d1	36.4	48.2	0.0	42.1	38.7	33.8	25.3	34.2	0.0	26.9	32.4	26.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.38	0.48	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	1.3	0.3	6.4	1.8	0.1	9.3	4.3	1.0	3.3	1.5	0.3
Delay (s)	37.2	49.5	0.3	48.5	40.4	34.0	44.1	20.5	1.0	30.2	33.9	26.8
Level of Service	D	D	A	D	D	C	D	C	A	C	C	C
Approach Delay (s)		18.2			44.5			16.6			32.8	
Approach LOS		B			D			B			C	

### Intersection Summary

HCM Average Control Delay	25.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.8%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 2: Iroquois Shore Road & North Service Road

6/3/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↑	↑	↑↑	↑↑	
Volume (vph)	781	115	17	549	490	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	
Frbp, ped/bikes	1.00	0.97	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	1.00	1.00	0.95	1.00	0.95	
Satd. Flow (prot)	1865	1540	1789	3579	1788	
Flt Permitted	1.00	1.00	0.10	1.00	0.95	
Satd. Flow (perm)	1865	1540	197	3579	1788	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	781	115	17	549	490	19
RTOR Reduction (vph)	0	62	0	0	1	0
Lane Group Flow (vph)	781	53	17	549	508	0
Confl. Peds. (#/hr)		5	5		7	
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Turn Type		Perm	pm+pt			
Protected Phases	2		3	2	4	
Permitted Phases		2	2			
Actuated Green, G (s)	39.2	39.2	41.2	39.2	33.8	
Effective Green, g (s)	41.2	41.2	39.2	41.2	35.8	
Actuated g/C Ratio	0.46	0.46	0.44	0.46	0.40	
Clearance Time (s)	6.0	6.0	3.0	6.0	6.0	
Vehicle Extension (s)	3.5	3.5	3.0	3.5	3.5	
Lane Grp Cap (vph)	854	705	103	1638	711	
v/s Ratio Prot	c0.42		c0.00	0.15	c0.28	
v/s Ratio Perm		0.03	0.07			
v/c Ratio	0.91	0.07	0.17	0.34	0.71	
Uniform Delay, d1	22.8	13.7	39.8	15.6	22.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	20.0	0.2	0.8	0.6	6.3	
Delay (s)	42.7	13.9	40.6	16.2	29.0	
Level of Service	D	B	D	B	C	
Approach Delay (s)	39.0			16.9	29.0	
Approach LOS	D			B	C	

### Intersection Summary

HCM Average Control Delay	30.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 4: Iroquois Shore Road & Eighth Line

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	788	11	31	126	18	572
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	788	11	31	126	18	572
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total (vph)	799	157	18	572		
Volume Left (vph)	788	31	0	0		
Volume Right (vph)	11	0	0	572		
Hadj (s)	0.22	0.07	0.00	-0.60		
Departure Headway (s)	4.7	5.9	6.1	3.2		
Degree Utilization, x	1.04	0.26	0.03	0.51		
Capacity (veh/h)	777	605	574	1116		
Control Delay (s)	140.8	10.9	9.3	9.5		
Approach Delay (s)	140.8	10.9	9.5			
Approach LOS	F	B	A			
Intersection Summary						
Delay			77.5			
HCM Level of Service			F			
Intersection Capacity Utilization			66.0%	ICU Level of Service	C	
Analysis Period (min)			60			



# HCM Signalized Intersection Capacity Analysis

## 7: North Service Road & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖		↗	↖	↗	↗		↑↑↑			↑↑↑	
Volume (vph)	20	0	245	463	151	515	0	2507	0	0	2090	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	3.0	4.0	4.0		4.0			4.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00		0.91			0.86	
Frbp, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	
Frt	1.00		0.85	1.00	1.00	0.85		1.00			1.00	
Flt Protected	0.95		1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (prot)	1825		1617	1825	1812	1541		5142			6414	
Flt Permitted	0.66		1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (perm)	1270		1617	1825	1812	1541		5142			6414	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	0	245	463	151	515	0	2507	0	0	2090	7
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	20	0	245	463	151	515	0	2507	0	0	2097	0
Confl. Peds. (#/hr)							31					
Heavy Vehicles (%)	0%	0%	1%	0%	6%	6%	0%	2%	5%	0%	3%	0%
Turn Type	custom		custom	pm+pt		Free						
Protected Phases				3	8			2			6	
Permitted Phases	4		4	8		Free						
Actuated Green, G (s)	26.4		26.4	43.0	43.0	120.0		66.0			69.0	
Effective Green, g (s)	28.4		28.4	43.0	44.0	120.0		68.0			68.0	
Actuated g/C Ratio	0.24		0.24	0.36	0.37	1.00		0.57			0.57	
Clearance Time (s)	6.0		6.0	3.0	5.0			6.0			3.0	
Vehicle Extension (s)	3.5		3.5	3.0	3.5			4.5			4.5	
Lane Grp Cap (vph)	301		383	654	664	1541		2914			3635	
v/s Ratio Prot				c0.07	0.08			c0.49			0.33	
v/s Ratio Perm	0.02		0.15	0.18		0.33						
v/c Ratio	0.07		0.64	0.71	0.23	0.33		0.86			0.58	
Uniform Delay, d1	35.5		41.2	33.1	26.3	0.0		22.0			16.7	
Progression Factor	1.00		1.00	1.00	1.00	1.00		1.00			1.54	
Incremental Delay, d2	0.4		8.2	3.6	0.8	0.6		3.1			0.5	
Delay (s)	35.9		49.4	36.7	27.1	0.6		25.1			26.3	
Level of Service	D		D	D	C	A		C			C	
Approach Delay (s)		48.4			18.9			25.1			26.3	
Approach LOS		D			B			C			C	

### Intersection Summary

HCM Average Control Delay	25.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	7.0
Intersection Capacity Utilization	81.2%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 8: Highway 403 EB Offramp & Trafalgar Road

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖↗	↗		↑↑↑	↑↑↑	
Volume (vph)	849	370	0	2055	1102	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		0.91	0.91	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	3506	1617		5142	5142	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	3506	1617		5142	5142	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	849	370	0	2055	1102	0
RTOR Reduction (vph)	0	51	0	0	0	0
Lane Group Flow (vph)	849	319	0	2055	1102	0
Confl. Peds. (#/hr)	1					
Heavy Vehicles (%)	1%	1%	0%	2%	2%	3%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	42.0	42.0		64.1	64.1	
Effective Green, g (s)	44.0	44.0		66.1	66.1	
Actuated g/C Ratio	0.37	0.37		0.56	0.56	
Clearance Time (s)	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.5	3.5		4.5	4.5	
Lane Grp Cap (vph)	1306	602		2878	2878	
v/s Ratio Prot	c0.24			c0.40	0.21	
v/s Ratio Perm		0.20				
v/c Ratio	0.65	0.53		0.71	0.38	
Uniform Delay, d1	30.7	29.0		19.1	14.6	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.6	3.3		1.0	0.1	
Delay (s)	33.2	32.3		20.1	14.7	
Level of Service	C	C		C	B	
Approach Delay (s)	32.9			20.1	14.7	
Approach LOS	C			C	B	

### Intersection Summary

HCM Average Control Delay	22.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	118.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 10: Cross Avenue & Lyons Lane

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	168	501	79	33	913	50	465	9	28	65	4	212
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.99	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.89		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	3576		1825	3615		1819	1679		1814	1611	
Flt Permitted	0.16	1.00		0.35	1.00		0.55	1.00		0.73	1.00	
Satd. Flow (perm)	304	3576		673	3615		1051	1679		1399	1611	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	168	501	79	33	913	50	465	9	28	65	4	212
RTOR Reduction (vph)	0	11	0	0	3	0	0	17	0	0	126	0
Lane Group Flow (vph)	168	569	0	33	960	0	465	20	0	65	90	0
Confl. Peds. (#/hr)	6					6	3		4	4		3
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	1	2			2			4			4	
Permitted Phases	2			2			4			4		
Actuated Green, G (s)	58.6	49.7		49.7	49.7		46.4	46.4		46.4	46.4	
Effective Green, g (s)	56.6	51.7		51.7	51.7		48.4	48.4		48.4	48.4	
Actuated g/C Ratio	0.47	0.43		0.43	0.43		0.40	0.40		0.40	0.40	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	5.0		5.0	5.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	244	1541		290	1557		424	677		564	650	
v/s Ratio Prot	c0.05	0.16			0.27			0.01			0.06	
v/s Ratio Perm	c0.28			0.05			c0.44			0.05		
v/c Ratio	0.69	0.37		0.11	0.62		1.10	0.03		0.12	0.14	
Uniform Delay, d1	21.5	23.1		20.4	26.5		35.8	21.6		22.4	22.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.2	0.7		0.8	1.9		213.3	0.0		0.1	0.1	
Delay (s)	29.7	23.8		21.2	28.3		249.1	21.6		22.5	22.7	
Level of Service	C	C		C	C		F	C		C	C	
Approach Delay (s)		25.1			28.1			232.4			22.7	
Approach LOS		C			C			F			C	

### Intersection Summary

HCM Average Control Delay	67.2	HCM Level of Service	E
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 11: Cross Avenue & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↔		↔	↑	↔	↔	↔↔↔		↔	↔↔↔	
Volume (vph)	792	60	103	124	92	168	127	1541	31	90	1154	228
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	0.96		1.00	1.00	0.95	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		0.98	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.91		1.00	1.00	0.85	1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3437	1615		1747	1902	1539	1722	5159		1772	4938	
Flt Permitted	0.95	1.00		0.65	1.00	1.00	0.10	1.00		0.11	1.00	
Satd. Flow (perm)	3437	1615		1203	1902	1539	184	5159		198	4938	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	792	60	103	124	92	168	127	1541	31	90	1154	228
RTOR Reduction (vph)	0	51	0	0	0	149	0	2	0	0	24	0
Lane Group Flow (vph)	792	112	0	124	92	19	127	1570	0	90	1358	0
Confl. Peds. (#/hr)	8		36	36		8	18		8	8		18
Heavy Vehicles (%)	3%	0%	6%	2%	1%	1%	6%	1%	15%	3%	1%	13%
Turn Type	Prot			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases				8		8	2			6		
Actuated Green, G (s)	29.0	27.6		19.6	10.1	10.1	49.7	39.4		46.1	37.6	
Effective Green, g (s)	29.0	29.6		23.6	12.1	12.1	49.7	41.4		46.1	39.6	
Actuated g/C Ratio	0.27	0.28		0.22	0.11	0.11	0.46	0.39		0.43	0.37	
Clearance Time (s)	4.0	6.0		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	3.0	
Lane Grp Cap (vph)	932	447		324	215	174	234	1996		210	1828	
v/s Ratio Prot	c0.23	0.07		0.04	c0.05		c0.05	c0.30		0.03	0.27	
v/s Ratio Perm				0.04		0.01	0.20			0.15		
v/c Ratio	0.85	0.25		0.38	0.43	0.11	0.54	0.79		0.43	0.74	
Uniform Delay, d1	36.9	30.1		35.0	44.2	42.6	20.3	28.9		21.7	29.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	7.9	0.3		0.8	1.4	0.3	2.6	2.2		1.4	1.7	
Delay (s)	44.8	30.4		35.7	45.6	42.9	22.9	31.1		23.1	31.0	
Level of Service	D	C		D	D	D	C	C		C	C	
Approach Delay (s)		42.4			41.2			30.5			30.5	
Approach LOS		D			D			C			C	

### Intersection Summary

HCM Average Control Delay	33.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	107.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 18: Cornwall Road & Cross Avenue

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↶	↶↶	↶↶		↶	↶
Volume (vph)	309	649	945	23	50	1058
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1772	3544	3563		1789	1597
Flt Permitted	0.10	1.00	1.00		0.95	1.00
Satd. Flow (perm)	179	3544	3563		1789	1597
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	309	649	945	23	50	1058
RTOR Reduction (vph)	0	0	1	0	0	18
Lane Group Flow (vph)	309	649	967	0	50	1040
Confl. Peds. (#/hr)	20			20	2	3
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Turn Type	pm+pt				pm+ov	
Protected Phases	5	2			4	5
Permitted Phases	2		6			4
Actuated Green, G (s)	95.4	95.4	38.6		10.6	64.4
Effective Green, g (s)	94.4	97.4	40.6		9.6	62.4
Actuated g/C Ratio	0.82	0.85	0.35		0.08	0.54
Clearance Time (s)	3.0	6.0	6.0		3.0	3.0
Vehicle Extension (s)	3.5	3.5	3.5		5.0	3.5
Lane Grp Cap (vph)	878	3002	1258		149	922
v/s Ratio Prot	0.16	0.18			0.03	c0.52
v/s Ratio Perm	0.13		c0.27			0.13
v/c Ratio	0.35	0.22	0.77		0.34	1.13
Uniform Delay, d1	12.5	1.6	33.0		49.7	26.3
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.1	0.2	3.0		2.8	246.8
Delay (s)	13.7	1.8	36.1		52.5	273.1
Level of Service	B	A	D		D	F
Approach Delay (s)		5.6	36.1		263.1	
Approach LOS		A	D		F	

### Intersection Summary

HCM Average Control Delay	109.4	HCM Level of Service	F
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.7%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 19: Cornwall Road & Old Mill Road

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	64	635	857	57	146	111
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	3614	3538		1825	1617
Flt Permitted	0.14	1.00	1.00		0.95	1.00
Satd. Flow (perm)	261	3614	3538		1825	1617
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	64	635	857	57	146	111
RTOR Reduction (vph)	0	0	6	0	0	62
Lane Group Flow (vph)	64	635	908	0	146	49
Confl. Peds. (#/hr)	13			13	1	
Heavy Vehicles (%)	2%	1%	2%	0%	0%	1%
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	34.9	34.9	24.9		33.1	33.1
Effective Green, g (s)	34.9	36.9	26.9		35.1	35.1
Actuated g/C Ratio	0.44	0.46	0.34		0.44	0.44
Clearance Time (s)	4.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	228	1667	1190		801	709
v/s Ratio Prot	0.02	c0.18	c0.26		c0.08	
v/s Ratio Perm	0.10					0.03
v/c Ratio	0.28	0.38	0.76		0.18	0.07
Uniform Delay, d1	15.7	14.1	23.7		13.7	13.0
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.7	0.1	3.0		0.5	0.2
Delay (s)	16.4	14.2	26.7		14.2	13.2
Level of Service	B	B	C		B	B
Approach Delay (s)		14.4	26.7		13.8	
Approach LOS		B	C		B	
<b>Intersection Summary</b>						
HCM Average Control Delay			20.3		HCM Level of Service	C
HCM Volume to Capacity ratio			0.44			
Actuated Cycle Length (s)			80.0		Sum of lost time (s)	12.0
Intersection Capacity Utilization			47.2%		ICU Level of Service	A
Analysis Period (min)			60			
c Critical Lane Group						

# HCM Signalized Intersection Capacity Analysis

## 21: Cornwall Road & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↕↔		↔	↕↕	↔	↔	↕↔		↔↔	↕	↔
Volume (vph)	384	331	66	65	477	723	85	535	31	502	520	352
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	0.95		0.97	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	1.00	0.94	1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		0.99	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3437	3431		1795	3510	1475	1824	3544		3437	1902	1562
Flt Permitted	0.95	1.00		0.52	1.00	1.00	0.19	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3437	3431		979	3510	1475	371	3544		3437	1902	1562
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	384	331	66	65	477	723	85	535	31	502	520	352
RTOR Reduction (vph)	0	13	0	0	0	320	0	4	0	0	0	229
Lane Group Flow (vph)	384	384	0	65	477	403	85	562	0	502	520	123
Confl. Peds. (#/hr)	33		9	9		33	9		12	12		9
Heavy Vehicles (%)	3%	3%	3%	1%	4%	4%	0%	2%	2%	3%	1%	2%
Turn Type	Prot			pm+pt		Perm	pm+pt			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases				8		8	2					6
Actuated Green, G (s)	18.0	32.0		37.0	25.0	25.0	41.4	28.4		21.7	38.1	38.1
Effective Green, g (s)	19.0	34.0		37.0	27.0	27.0	41.4	30.4		22.7	40.1	40.1
Actuated g/C Ratio	0.17	0.30		0.32	0.23	0.23	0.36	0.26		0.20	0.35	0.35
Clearance Time (s)	5.0	6.0		4.0	6.0	6.0	4.0	6.0		5.0	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
Lane Grp Cap (vph)	567	1014		400	823	346	298	936		678	663	544
v/s Ratio Prot	c0.11	0.11		0.02	0.14		0.03	0.16		c0.15	c0.27	
v/s Ratio Perm				0.04		c0.27	0.07					0.08
v/c Ratio	0.68	0.38		0.16	0.58	1.16	0.29	0.60		0.74	0.78	0.23
Uniform Delay, d1	45.2	32.2		27.5	39.0	44.0	26.1	37.0		43.4	33.6	26.5
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	6.6	1.1		0.9	3.0	329.9	2.4	2.9		4.5	6.3	0.2
Delay (s)	51.8	33.2		28.4	42.0	373.9	28.5	39.9		47.9	40.0	26.7
Level of Service	D	C		C	D	F	C	D		D	D	C
Approach Delay (s)		42.3			231.0			38.4			39.5	
Approach LOS		D			F			D			D	

### Intersection Summary

HCM Average Control Delay	99.4	HCM Level of Service	F
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	115.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 22: Cornwall Road & Reynolds Street

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗	↖	↑↑		↗	↖		↗	↖	
Volume (vph)	6	732	126	56	958	18	247	18	20	5	11	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes		1.00	0.97	1.00	1.00		1.00	0.98		1.00	0.99	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00		0.98	1.00	
Frt		1.00	0.85	1.00	1.00		1.00	0.92		1.00	0.87	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3542	1533	1800	3602		1736	1657		1739	1610	
Flt Permitted		0.95	1.00	0.34	1.00		0.71	1.00		0.73	1.00	
Satd. Flow (perm)		3358	1533	647	3602		1299	1657		1340	1610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	6	732	126	56	958	18	247	18	20	5	11	60
RTOR Reduction (vph)	0	0	40	0	1	0	0	15	0	0	45	0
Lane Group Flow (vph)	0	738	86	56	975	0	247	23	0	5	26	0
Confl. Peds. (#/hr)	3		4	4		3	1		12	12		1
Heavy Vehicles (%)	3%	3%	3%	1%	1%	1%	5%	5%	5%	3%	3%	3%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		2			2			4			4	
Permitted Phases	2		2	2			4			4		
Actuated Green, G (s)		79.7	79.7	79.7	79.7		28.3	28.3		28.3	28.3	
Effective Green, g (s)		81.7	81.7	81.7	81.7		30.3	30.3		30.3	30.3	
Actuated g/C Ratio		0.68	0.68	0.68	0.68		0.25	0.25		0.25	0.25	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		4.0	4.0	4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2286	1044	440	2452		328	418		338	407	
v/s Ratio Prot				c0.27				0.01			0.02	
v/s Ratio Perm		0.22	0.06	0.09			c0.19			0.00		
v/c Ratio		0.32	0.08	0.13	0.40		0.75	0.06		0.01	0.06	
Uniform Delay, d1		7.8	6.5	6.7	8.4		41.4	34.0		33.7	34.1	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.4	0.2	0.6	0.5		10.0	0.1		0.0	0.1	
Delay (s)		8.2	6.6	7.3	8.9		51.4	34.1		33.7	34.1	
Level of Service		A	A	A	A		D	C		C	C	
Approach Delay (s)		8.0			8.8			49.1			34.1	
Approach LOS		A			A			D			C	

### Intersection Summary

HCM Average Control Delay	14.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.6%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 23: Cornwall Road & Chartwell Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	445	143	49	621	31	140	27	34	12	21	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.92		1.00	0.90	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1738	1830	1555	1772	1852		1722	1661		1825	1729	
Flt Permitted	0.16	1.00	1.00	0.36	1.00		0.72	1.00		0.72	1.00	
Satd. Flow (perm)	299	1830	1555	668	1852		1298	1661		1378	1729	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	27	445	143	49	621	31	140	27	34	12	21	42
RTOR Reduction (vph)	0	0	81	0	3	0	0	19	0	0	23	0
Lane Group Flow (vph)	27	445	62	49	649	0	140	42	0	12	40	0
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	6%	6%	6%	0%	0%	0%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		4			4			2			2	
Permitted Phases	4		4	4			2			2		
Actuated Green, G (s)	26.1	26.1	26.1	26.1	26.1		26.8	26.8		26.8	26.8	
Effective Green, g (s)	28.0	28.0	28.0	28.0	28.0		29.0	29.0		29.0	29.0	
Actuated g/C Ratio	0.43	0.43	0.43	0.43	0.43		0.45	0.45		0.45	0.45	
Clearance Time (s)	5.9	5.9	5.9	5.9	5.9		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	129	788	670	288	798		579	741		615	771	
v/s Ratio Prot		0.24			c0.35			0.03			0.02	
v/s Ratio Perm	0.09		0.04	0.07			c0.11			0.01		
v/c Ratio	0.21	0.56	0.09	0.17	0.81		0.24	0.06		0.02	0.05	
Uniform Delay, d1	11.6	13.9	11.0	11.4	16.2		11.2	10.2		10.1	10.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.7	3.0	0.3	1.3	9.6		1.0	0.1		0.1	0.1	
Delay (s)	15.3	16.9	11.2	12.6	25.8		12.2	10.4		10.1	10.3	
Level of Service	B	B	B	B	C		B	B		B	B	
Approach Delay (s)		15.5			24.9			11.6			10.3	
Approach LOS		B			C			B			B	

### Intersection Summary

HCM Average Control Delay	18.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 24: Cross Avenue & Argus Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	31	761	25	35	386	26	23	0	36	158	2	134
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0		4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00		1.00	1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Frt	1.00	1.00		1.00	0.99		1.00		0.85	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)	1817	3488		913	3570		913		816	1804	1609	
Flt Permitted	0.36	1.00		0.29	1.00		0.67		1.00	0.95	1.00	
Satd. Flow (perm)	696	3488		275	3570		644		816	1804	1609	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	31	761	25	35	386	26	23	0	36	158	2	134
RTOR Reduction (vph)	0	4	0	0	7	0	0	0	18	0	65	0
Lane Group Flow (vph)	31	782	0	35	405	0	23	0	18	158	71	0
Confl. Peds. (#/hr)	13					13				1		
Heavy Vehicles (%)	0%	1%	100%	100%	1%	0%	100%	0%	100%	1%	50%	1%
Turn Type	pm+pt			Perm			custom		custom		Perm	
Protected Phases	7	4			8							6
Permitted Phases	4			8			2		2		6	
Actuated Green, G (s)	29.0	29.0		23.2	23.2		39.0		39.0	39.0	39.0	
Effective Green, g (s)	28.0	31.0		25.2	25.2		41.0		41.0	41.0	41.0	
Actuated g/C Ratio	0.35	0.39		0.32	0.32		0.51		0.51	0.51	0.51	
Clearance Time (s)	3.0	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	1352		87	1125		330		418	925	825	
v/s Ratio Prot	0.00	c0.22			0.11							0.04
v/s Ratio Perm	0.04			0.13			0.04		0.02	c0.09		
v/c Ratio	0.12	0.58		0.40	0.36		0.07		0.04	0.17	0.09	
Uniform Delay, d1	17.6	19.3		21.5	21.2		9.9		9.7	10.4	9.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.6		3.1	0.2		0.4		0.2	0.4	0.2	
Delay (s)	17.7	20.0		24.5	21.4		10.3		9.9	10.8	10.1	
Level of Service	B	B		C	C		B		A	B	B	
Approach Delay (s)		19.9			21.6			10.1			10.5	
Approach LOS		B			C			B			B	

### Intersection Summary

HCM Average Control Delay	18.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 35: McCraney Street & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	23	211	47	93	258	348	1525	194	32	1074	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0		5.0	7.0		7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.97	1.00	0.98		1.00	0.99		1.00	0.98	
Flpb, ped/bikes	0.99	1.00	1.00	0.98	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.89		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1813	1921	1560	1766	1676		1804	5065		1817	5029	
Flt Permitted	0.25	1.00	1.00	0.74	1.00		0.14	1.00		0.13	1.00	
Satd. Flow (perm)	481	1921	1560	1380	1676		274	5065		245	5029	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	75	23	211	47	93	258	348	1525	194	32	1074	131
RTOR Reduction (vph)	0	0	160	0	18	0	0	10	0	0	10	0
Lane Group Flow (vph)	75	23	51	47	333	0	348	1709	0	32	1195	0
Confl. Peds. (#/hr)	13		18	18		13	67		23	23		67
Heavy Vehicles (%)	0%	0%	1%	1%	0%	0%	1%	1%	1%	0%	1%	1%
Turn Type	Perm		Perm	Perm			pm+pt			Perm		
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	31.2	31.2	31.2	31.2	31.2		84.8	84.8		57.2	57.2	
Effective Green, g (s)	31.2	31.2	31.2	31.2	31.2		84.8	84.8		57.2	57.2	
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24		0.65	0.65		0.44	0.44	
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0		5.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	115	461	374	331	402		445	3304		108	2213	
v/s Ratio Prot		0.01			c0.20		c0.14	0.34			0.24	
v/s Ratio Perm	0.16		0.03	0.03			c0.37			0.13		
v/c Ratio	0.65	0.05	0.14	0.14	0.83		0.78	0.52		0.30	0.54	
Uniform Delay, d1	44.5	38.0	38.8	38.9	46.9		22.8	11.9		23.4	26.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	13.2	0.0	0.2	0.2	14.6		9.2	0.6		7.0	1.0	
Delay (s)	57.7	38.0	39.0	39.1	61.5		32.1	12.4		30.4	27.7	
Level of Service	E	D	D	D	E		C	B		C	C	
Approach Delay (s)		43.5			58.8			15.7			27.8	
Approach LOS		D			E			B			C	

### Intersection Summary

HCM Average Control Delay	25.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	115.0%	ICU Level of Service	H
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 1: Leighland Avenue & Trafalgar Road

6/3/2014



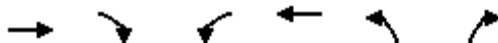
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	98	757	863	41	103	338	1808	635	178	1926	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.90	1.00	1.00	0.99	1.00	1.00	0.94
Flpb, ped/bikes	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
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)	1717	1902	1595	3437	1847	1417	1738	5043	1565	1789	5092	1524
Flt Permitted	0.73	1.00	1.00	0.95	1.00	1.00	0.11	1.00	1.00	0.12	1.00	1.00
Satd. Flow (perm)	1320	1902	1595	3437	1847	1417	195	5043	1565	224	5092	1524
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	28	98	757	863	41	103	338	1808	635	178	1926	37
RTOR Reduction (vph)	0	0	0	0	0	74	0	0	0	0	0	18
Lane Group Flow (vph)	28	98	757	863	41	29	338	1808	635	178	1926	19
Confl. Peds. (#/hr)	17		5	5		17	16		2	2		16
Heavy Vehicles (%)	0%	1%	1%	3%	4%	4%	5%	4%	3%	2%	3%	1%
Turn Type	pm+pt		Free	Prot		Perm	pm+pt		Free	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		Free			8	2		Free	6		6
Actuated Green, G (s)	20.4	15.6	120.0	21.0	31.8	31.8	64.4	43.6	120.0	50.4	33.6	33.6
Effective Green, g (s)	24.4	17.6	120.0	23.0	33.8	33.8	64.4	46.6	120.0	50.4	36.6	36.6
Actuated g/C Ratio	0.20	0.15	1.00	0.19	0.28	0.28	0.54	0.39	1.00	0.42	0.30	0.30
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.5	3.5		3.5	3.5	3.5	3.5	5.0		3.5	5.0	5.0
Lane Grp Cap (vph)	291	279	1595	659	520	399	449	1958	1565	313	1553	465
v/s Ratio Prot	0.01	0.05		c0.25	0.02		c0.17	c0.36		0.08	c0.38	
v/s Ratio Perm	0.01		c0.47			0.02	0.24		0.41	0.16		0.01
v/c Ratio	0.10	0.35	0.47	1.31	0.08	0.07	0.75	0.92	0.41	0.57	1.24	0.04
Uniform Delay, d1	38.7	46.1	0.0	48.5	31.7	31.6	30.9	35.0	0.0	26.3	41.7	29.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.68	0.96	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	0.9	1.0	568.5	0.1	0.1	0.7	1.0	0.1	2.6	438.2	0.2
Delay (s)	38.9	47.0	1.0	617.0	31.7	31.7	52.8	34.5	0.1	28.9	479.9	29.5
Level of Service	D	D	A	F	C	C	D	C	A	C	F	C
Approach Delay (s)		7.3			533.3			28.9			434.6	
Approach LOS		A			F			C			F	

Intersection Summary		
HCM Average Control Delay	228.2	HCM Level of Service
HCM Volume to Capacity ratio	1.02	F
Actuated Cycle Length (s)	120.0	Sum of lost time (s)
Intersection Capacity Utilization	97.2%	ICU Level of Service
Analysis Period (min)	60	F
c Critical Lane Group		

# HCM Signalized Intersection Capacity Analysis

## 2: Iroquois Shore Road & North Service Road

6/3/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↑	↑	↑↑	↑↑	
Volume (vph)	464	384	47	883	138	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	
Frbp, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.98	
Flt Protected	1.00	1.00	0.95	1.00	0.96	
Satd. Flow (prot)	1865	1585	1772	3544	1640	
Flt Permitted	1.00	1.00	0.26	1.00	0.96	
Satd. Flow (perm)	1865	1585	476	3544	1640	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	464	384	47	883	138	26
RTOR Reduction (vph)	0	236	0	0	6	0
Lane Group Flow (vph)	464	148	47	883	158	0
Confl. Peds. (#/hr)					14	
Heavy Vehicles (%)	3%	3%	3%	3%	10%	10%
Turn Type		Perm	pm+pt			
Protected Phases	2		3	2	4	
Permitted Phases		2	2			
Actuated Green, G (s)	35.8	35.8	39.2	35.8	43.8	
Effective Green, g (s)	37.8	37.8	37.2	37.8	45.8	
Actuated g/C Ratio	0.39	0.39	0.38	0.39	0.47	
Clearance Time (s)	6.0	6.0	3.0	6.0	6.0	
Vehicle Extension (s)	3.5	3.5	3.0	3.5	3.5	
Lane Grp Cap (vph)	719	611	212	1367	766	
v/s Ratio Prot	0.25		c0.01	c0.25	c0.10	
v/s Ratio Perm		0.09	0.08			
v/c Ratio	0.65	0.24	0.22	0.65	0.21	
Uniform Delay, d1	24.6	20.4	32.5	24.6	15.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.5	0.9	0.5	2.4	0.6	
Delay (s)	29.1	21.3	33.0	27.0	16.0	
Level of Service	C	C	C	C	B	
Approach Delay (s)	25.6			27.3	16.0	
Approach LOS	C			C	B	

### Intersection Summary

HCM Average Control Delay	25.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	98.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	47.0%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 4: Iroquois Shore Road & Eighth Line

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	463	26	14	11	98	918
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	463	26	14	11	98	918
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total (vph)	489	25	98	918		
Volume Left (vph)	463	14	0	0		
Volume Right (vph)	26	0	0	918		
Hadj (s)	0.23	0.59	0.03	-0.57		
Departure Headway (s)	4.5	5.8	5.2	3.2		
Degree Utilization, x	0.61	0.04	0.14	0.82		
Capacity (veh/h)	793	561	635	1112		
Control Delay (s)	14.3	9.1	9.0	19.8		
Approach Delay (s)	14.3	9.1	18.8			
Approach LOS	B	A	C			
Intersection Summary						
Delay			17.2			
HCM Level of Service			C			
Intersection Capacity Utilization			66.8%	ICU Level of Service	C	
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 7: North Service Road & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖		↗	↖	↗	↗		↑↑↑			↑↑↑	↗
Volume (vph)	0	0	239	1437	21	430	0	2356	913	0	2574	970
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	3.0	4.0	4.0		4.0			4.0	
Lane Util. Factor			1.00	1.00	1.00	1.00		0.91			0.86	
Frbp, ped/bikes			1.00	1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes			1.00	1.00	1.00	1.00		1.00			1.00	
Frt			0.85	1.00	1.00	0.85		0.96			0.96	
Flt Protected			1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (prot)			1633	1825	1642	1585		4793			6202	
Flt Permitted			1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (perm)			1633	1825	1642	1585		4793			6202	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	239	1437	21	430	0	2356	913	0	2574	970
RTOR Reduction (vph)	0	0	0	0	0	0	0	58	0	0	0	0
Lane Group Flow (vph)	0	0	239	1437	21	430	0	3211	0	0	3544	0
Confl. Peds. (#/hr)							17					
Heavy Vehicles (%)	0%	0%	0%	0%	17%	3%	0%	4%	7%	0%	3%	0%
Turn Type	custom		custom	pm+pt		Free						
Protected Phases				3	8			2			6	
Permitted Phases	4		4	8		Free						
Actuated Green, G (s)			26.4	42.0	42.0	120.0		66.0			66.0	
Effective Green, g (s)			28.4	42.0	44.0	120.0		68.0			68.0	
Actuated g/C Ratio			0.24	0.35	0.37	1.00		0.57			0.57	
Clearance Time (s)			6.0	3.0	6.0			6.0			6.0	
Vehicle Extension (s)			3.5	3.0	3.5			4.5			4.5	
Lane Grp Cap (vph)			386	639	602	1585		2716			3514	
v/s Ratio Prot				c0.24	0.01			c0.67			0.57	
v/s Ratio Perm			0.15	0.55		0.27						
v/c Ratio			0.62	2.25	0.03	0.27		1.18			1.03dr	
Uniform Delay, d1			41.0	39.0	24.4	0.0		26.0			26.0	
Progression Factor			1.00	1.00	1.00	1.00		1.00			0.92	
Incremental Delay, d2			3.1	2252.9	0.1	0.4		332.3			19.6	
Delay (s)			44.1	2292.0	24.5	0.4		358.3			43.4	
Level of Service			D	F	C	A		F			D	
Approach Delay (s)		44.1			1744.8			358.3			43.4	
Approach LOS		D			F			F			D	

### Intersection Summary

HCM Average Control Delay	517.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.55		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	7.0
Intersection Capacity Utilization	158.0%	ICU Level of Service	H
Analysis Period (min)	60		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 8: Highway 403 EB Offramp & Trafalgar Road

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↰↰	↱		↑↑↑	↑↑↑	
Volume (vph)	681	1683	0	2559	3330	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		0.91	0.91	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	3471	1601		5142	5043	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	3471	1601		5142	5043	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	681	1683	0	2559	3330	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	681	1683	0	2559	3330	0
Confl. Peds. (#/hr)			3			3
Heavy Vehicles (%)	2%	2%	4%	2%	4%	3%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	42.0	42.0		66.0	66.0	
Effective Green, g (s)	44.0	44.0		68.0	68.0	
Actuated g/C Ratio	0.37	0.37		0.57	0.57	
Clearance Time (s)	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.5	3.5		4.5	4.5	
Lane Grp Cap (vph)	1273	587		2914	2858	
v/s Ratio Prot	0.20			0.50	c0.66	
v/s Ratio Perm		c1.05				
v/c Ratio	0.53	2.87		0.88	1.17	
Uniform Delay, d1	29.9	38.0		22.4	26.0	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.6	3365.5		3.7	301.6	
Delay (s)	31.6	3403.5		26.1	327.6	
Level of Service	C	F		C	F	
Approach Delay (s)	2432.2			26.1	327.6	
Approach LOS	F			C	F	

Intersection Summary				
HCM Average Control Delay		837.0	HCM Level of Service	F
HCM Volume to Capacity ratio		1.83		
Actuated Cycle Length (s)		120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization		175.2%	ICU Level of Service	H
Analysis Period (min)		60		
c	Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 10: Cross Avenue & Lyons Lane

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	
Volume (vph)	79	590	434	346	471	59	119	7	271	211	39	117
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	0.99		1.00	1.00		1.00	0.98		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	
Frt	1.00	0.94		1.00	0.98		1.00	0.85		1.00	0.89	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1819	3376		1825	3573		1812	1612		1820	1678	
Flt Permitted	0.39	1.00		0.16	1.00		0.60	1.00		0.41	1.00	
Satd. Flow (perm)	752	3376		315	3573		1141	1612		789	1678	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	79	590	434	346	471	59	119	7	271	211	39	117
RTOR Reduction (vph)	0	132	0	0	10	0	0	191	0	0	82	0
Lane Group Flow (vph)	79	892	0	346	520	0	119	87	0	211	74	0
Confl. Peds. (#/hr)	7		3	3		7	5		3	3		5
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	1	2			2			4			4	
Permitted Phases	2			2			4			4		
Actuated Green, G (s)	57.5	44.0		44.0	44.0		27.5	27.5		27.5	27.5	
Effective Green, g (s)	55.5	46.0		46.0	46.0		29.5	29.5		29.5	29.5	
Actuated g/C Ratio	0.56	0.46		0.46	0.46		0.30	0.30		0.30	0.30	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	551	1553		145	1644		337	476		233	495	
v/s Ratio Prot	c0.02	0.26			0.15			0.05			0.04	
v/s Ratio Perm	0.06			c1.10			0.10			c0.27		
v/c Ratio	0.14	0.57		2.39	0.32		0.35	0.18		0.91	0.15	
Uniform Delay, d1	10.5	19.8		27.0	17.1		27.7	26.3		33.9	26.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	1.6		2516.4	0.5		0.9	0.3		49.4	0.2	
Delay (s)	11.1	21.4		2543.4	17.6		28.6	26.5		83.3	26.2	
Level of Service	B	C		F	B		C	C		F	C	
Approach Delay (s)		20.6			1015.2			27.1			59.0	
Approach LOS		C			F			C			E	

### Intersection Summary

HCM Average Control Delay	344.3	HCM Level of Service	F
HCM Volume to Capacity ratio	1.57		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.0%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 11: Cross Avenue & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↔		↔	↑	↔	↔	↑↑↑		↔	↑↑↑	
Volume (vph)	1826	88	91	137	72	386	204	1432	475	1686	1692	1634
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	0.97		1.00	1.00	1.00	1.00	0.99		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		0.97	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.92		1.00	1.00	0.85	1.00	0.96		1.00	0.93	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3278	1619		1588	1902	1541	1674	4746		1706	4672	
Flt Permitted	0.95	1.00		0.64	1.00	1.00	0.11	1.00		0.11	1.00	
Satd. Flow (perm)	3278	1619		1077	1902	1541	190	4746		192	4672	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1826	88	91	137	72	386	204	1432	475	1686	1692	1634
RTOR Reduction (vph)	0	29	0	0	0	155	0	50	0	0	144	0
Lane Group Flow (vph)	1826	150	0	137	72	231	204	1857	0	1686	3182	0
Confl. Peds. (#/hr)			36	36			12		14	14		12
Heavy Vehicles (%)	8%	0%	12%	12%	1%	6%	9%	1%	17%	7%	3%	2%
Turn Type	Prot			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases				8		8	2			6		
Actuated Green, G (s)	32.0	36.2		29.0	17.6	17.6	49.7	37.2		50.3	37.5	
Effective Green, g (s)	32.0	38.2		33.0	19.6	19.6	49.7	39.2		50.3	39.5	
Actuated g/C Ratio	0.27	0.32		0.28	0.16	0.16	0.42	0.33		0.42	0.33	
Clearance Time (s)	4.0	6.0		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	3.0	
Lane Grp Cap (vph)	877	517		354	312	253	234	1556		243	1543	
v/s Ratio Prot	c0.56	0.09		0.04	0.04		0.09	0.39		c0.74	0.68	
v/s Ratio Perm				0.06		c0.15	0.27			c2.18		
v/c Ratio	2.08	0.29		0.39	0.23	0.91	0.87	1.19		6.94	2.46dr	
Uniform Delay, d1	43.8	30.5		34.3	43.4	49.2	30.2	40.2		34.2	40.1	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	1951.7	0.3		0.7	0.4	49.2	35.9	355.5		10697.5	1914.3	
Delay (s)	1995.5	30.9		35.0	43.8	98.4	66.1	395.7		10731.7	1954.3	
Level of Service	F	C		D	D	F	E	F		F	F	
Approach Delay (s)		1820.1			77.2			363.8			4907.0	
Approach LOS		F			E			F			F	

### Intersection Summary

HCM Average Control Delay	2988.5	HCM Level of Service	F
HCM Volume to Capacity ratio	4.03		
Actuated Cycle Length (s)	119.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	203.3%	ICU Level of Service	H
Analysis Period (min)	60		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 18: Cornwall Road & Cross Avenue

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↵		↵	↵
Volume (vph)	910	1357	572	176	188	573
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.96		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1736	3476	3268		1644	1471
Flt Permitted	0.25	1.00	1.00		0.95	1.00
Satd. Flow (perm)	466	3476	3268		1644	1471
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	910	1357	572	176	188	573
RTOR Reduction (vph)	0	0	34	0	0	295
Lane Group Flow (vph)	910	1357	714	0	188	278
Confl. Peds. (#/hr)	26			26	1	
Heavy Vehicles (%)	5%	5%	7%	7%	11%	11%
Turn Type	pm+pt					Perm
Protected Phases	5	2			4	
Permitted Phases	2		6			4
Actuated Green, G (s)	56.3	56.3	38.0		19.7	19.7
Effective Green, g (s)	55.3	58.3	40.0		18.7	18.7
Actuated g/C Ratio	0.65	0.69	0.47		0.22	0.22
Clearance Time (s)	3.0	6.0	6.0		3.0	3.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	517	2384	1538		362	324
v/s Ratio Prot	c0.30	0.39			0.11	
v/s Ratio Perm	c0.85		0.22			c0.19
v/c Ratio	1.76	0.57	0.46		0.52	0.86
Uniform Delay, d1	13.2	6.9	15.2		29.2	31.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1376.3	1.0	0.2		1.3	23.5
Delay (s)	1389.5	7.9	15.5		30.5	55.3
Level of Service	F	A	B		C	E
Approach Delay (s)		562.5	15.5		49.2	
Approach LOS		F	B		D	

### Intersection Summary

HCM Average Control Delay	350.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.45		
Actuated Cycle Length (s)	85.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	102.5%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 19: Cornwall Road & Old Mill Road

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↑		↵	↵
Volume (vph)	318	1253	695	169	236	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	0.94
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.97		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1825	3544	3413		1825	1532
Flt Permitted	0.14	1.00	1.00		0.95	1.00
Satd. Flow (perm)	270	3544	3413		1825	1532
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	318	1253	695	169	236	62
RTOR Reduction (vph)	0	0	27	0	0	36
Lane Group Flow (vph)	318	1253	837	0	236	26
Confl. Peds. (#/hr)	4			4		34
Heavy Vehicles (%)	0%	3%	4%	0%	0%	0%
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	36.5	36.5	24.5		31.5	31.5
Effective Green, g (s)	36.5	38.5	26.5		33.5	33.5
Actuated g/C Ratio	0.46	0.48	0.33		0.42	0.42
Clearance Time (s)	4.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	279	1706	1131		764	642
v/s Ratio Prot	c0.11	0.35	0.25		c0.13	
v/s Ratio Perm	c0.41					0.02
v/c Ratio	1.14	0.73	0.74		0.31	0.04
Uniform Delay, d1	17.9	16.6	23.7		15.5	13.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	296.3	1.7	2.6		1.1	0.1
Delay (s)	314.1	18.3	26.3		16.6	13.9
Level of Service	F	B	C		B	B
Approach Delay (s)		78.2	26.3		16.0	
Approach LOS		E	C		B	

### Intersection Summary

HCM Average Control Delay	55.0	HCM Level of Service	E
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 21: Cornwall Road & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↕↔		↔	↕↕	↔	↔	↕↔		↔↔	↕	↔
Volume (vph)	903	605	114	40	518	895	100	414	10	746	507	532
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	0.95		0.97	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frft	1.00	0.98		1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3541	3485		1719	3476	1460	1821	3564		3340	1865	1509
Flt Permitted	0.95	1.00		0.35	1.00	1.00	0.34	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3541	3485		634	3476	1460	648	3564		3340	1865	1509
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	903	605	114	40	518	895	100	414	10	746	507	532
RTOR Reduction (vph)	0	12	0	0	0	315	0	2	0	0	0	325
Lane Group Flow (vph)	903	707	0	40	518	580	100	422	0	746	507	207
Confl. Peds. (#/hr)	9		6	6		9	13		9	9		13
Heavy Vehicles (%)	0%	2%	0%	6%	5%	9%	0%	2%	2%	6%	3%	5%
Turn Type	Prot			pm+pt		Perm	pm+pt			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases				8		8	2					6
Actuated Green, G (s)	21.4	38.4		32.0	24.0	24.0	31.6	22.6		26.2	40.8	40.8
Effective Green, g (s)	22.4	40.4		32.0	26.0	26.0	31.6	24.6		27.2	42.8	42.8
Actuated g/C Ratio	0.19	0.35		0.28	0.22	0.22	0.27	0.21		0.23	0.37	0.37
Clearance Time (s)	5.0	6.0		4.0	6.0	6.0	4.0	6.0		5.0	6.0	6.0
Vehicle Extension (s)	4.0	4.0		4.0	4.0	4.0	3.0	5.0		4.0	5.0	5.0
Lane Grp Cap (vph)	683	1212		249	778	327	267	755		782	687	556
v/s Ratio Prot	c0.26	0.20		0.01	0.15		0.03	0.12		c0.22	c0.27	
v/s Ratio Perm				0.03		c0.40	0.07					0.14
v/c Ratio	1.32	0.58		0.16	0.67	1.77	0.37	0.56		0.95	0.74	0.37
Uniform Delay, d1	46.9	31.0		31.2	41.1	45.1	32.8	41.0		43.9	31.8	26.9
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	590.4	0.9		0.4	2.4	1404.3	0.9	1.5		32.0	5.2	0.9
Delay (s)	637.3	31.9		31.7	43.5	1449.4	33.7	42.5		75.9	37.0	27.8
Level of Service	F	C		C	D	F	C	D		E	D	C
Approach Delay (s)		368.9			909.2			40.8			50.5	
Approach LOS		F			F			D			D	

### Intersection Summary

HCM Average Control Delay	377.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.17		
Actuated Cycle Length (s)	116.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	110.5%	ICU Level of Service	H
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 22: Cornwall Road & Reynolds Street

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑		↑	↑		↑	↑	
Volume (vph)	5	1061	284	36	1298	13	128	7	39	12	4	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes		1.00	0.91	1.00	1.00		1.00	0.95		1.00	0.97	
Flpb, ped/bikes		1.00	1.00	0.99	1.00		0.97	1.00		0.95	1.00	
Frt		1.00	0.85	1.00	1.00		1.00	0.87		1.00	0.87	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3475	1412	1749	3535		1660	1483		1622	1507	
Flt Permitted		0.95	1.00	0.24	1.00		0.74	1.00		0.73	1.00	
Satd. Flow (perm)		3299	1412	448	3535		1288	1483		1241	1507	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	1061	284	36	1298	13	128	7	39	12	4	27
RTOR Reduction (vph)	0	0	66	0	0	0	0	33	0	0	23	0
Lane Group Flow (vph)	0	1066	218	36	1311	0	128	13	0	12	8	0
Confl. Peds. (#/hr)	29		22	22		29	17		32	32		17
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	7%	7%	7%	7%	7%	7%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		2			2			4			4	
Permitted Phases	2		2	2			4			4		
Actuated Green, G (s)		90.2	90.2	90.2	90.2		17.8	17.8		17.8	17.8	
Effective Green, g (s)		92.2	92.2	92.2	92.2		19.8	19.8		19.8	19.8	
Actuated g/C Ratio		0.77	0.77	0.77	0.77		0.16	0.16		0.16	0.16	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		4.0	4.0	4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2535	1085	344	2716		213	245		205	249	
v/s Ratio Prot				c0.37				0.01			0.01	
v/s Ratio Perm		0.32	0.15	0.08			c0.10			0.01		
v/c Ratio		0.42	0.20	0.10	0.48		0.60	0.05		0.06	0.03	
Uniform Delay, d1		4.8	3.8	3.5	5.1		46.4	42.2		42.2	42.1	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.5	0.4	0.6	0.6		4.8	0.1		0.1	0.1	
Delay (s)		5.3	4.2	4.1	5.7		51.2	42.3		42.4	42.1	
Level of Service		A	A	A	A		D	D		D	D	
Approach Delay (s)		5.1			5.7			48.9			42.2	
Approach LOS		A			A			D			D	

### Intersection Summary

HCM Average Control Delay	8.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 23: Cornwall Road & Chartwell Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	696	182	40	874	83	200	43	43	46	35	31
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.92		1.00	0.93	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1722	1812	1502	1704	1772		1737	1692		1807	1758	
Flt Permitted	0.14	1.00	1.00	0.14	1.00		0.71	1.00		0.70	1.00	
Satd. Flow (perm)	259	1812	1502	256	1772		1305	1692		1334	1758	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	696	182	40	874	83	200	43	43	46	35	31
RTOR Reduction (vph)	0	0	104	0	5	0	0	24	0	0	17	0
Lane Group Flow (vph)	21	696	78	40	952	0	200	62	0	46	49	0
Confl. Peds. (#/hr)			4	4			1					1
Heavy Vehicles (%)	6%	6%	6%	7%	7%	7%	5%	5%	5%	1%	1%	1%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		4			4			2				2
Permitted Phases	4		4	4			2			2		
Actuated Green, G (s)	26.1	26.1	26.1	26.1	26.1		26.8	26.8		26.8	26.8	
Effective Green, g (s)	28.0	28.0	28.0	28.0	28.0		29.0	29.0		29.0	29.0	
Actuated g/C Ratio	0.43	0.43	0.43	0.43	0.43		0.45	0.45		0.45	0.45	
Clearance Time (s)	5.9	5.9	5.9	5.9	5.9		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	112	781	647	110	763		582	755		595	784	
v/s Ratio Prot		0.38			c0.54			0.04			0.03	
v/s Ratio Perm	0.08		0.05	0.16			c0.15			0.03		
v/c Ratio	0.19	0.89	0.12	0.36	1.25		0.34	0.08		0.08	0.06	
Uniform Delay, d1	11.5	17.1	11.1	12.5	18.5		11.8	10.3		10.3	10.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.7	17.3	0.4	9.3	457.2		1.6	0.2		0.3	0.2	
Delay (s)	15.2	34.4	11.5	21.8	475.7		13.4	10.6		10.6	10.4	
Level of Service	B	C	B	C	F		B	B		B	B	
Approach Delay (s)		29.3			457.5			12.5			10.5	
Approach LOS		C			F			B			B	

### Intersection Summary

HCM Average Control Delay	212.4	HCM Level of Service	F
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	79.4%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 24: Cross Avenue & Argus Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	54	1147	186	480	1219	77	252	1	518	224	6	355
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	6.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.98		1.00	0.97	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		0.99	1.00		1.00	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.85		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1755	3055		912	3579		905	801		1789	1570	
Flt Permitted	0.11	1.00		0.15	1.00		0.36	1.00		0.18	1.00	
Satd. Flow (perm)	197	3055		145	3579		339	801		346	1570	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	54	1147	186	480	1219	77	252	1	518	224	6	355
RTOR Reduction (vph)	0	16	0	0	5	0	0	46	0	0	228	0
Lane Group Flow (vph)	54	1317	0	480	1291	0	252	473	0	224	133	0
Confl. Peds. (#/hr)	1		3	3		1	12		4	4		12
Confl. Bikes (#/hr)									4			
Heavy Vehicles (%)	4%	3%	100%	100%	1%	0%	100%	0%	100%	2%	17%	1%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	43.2	43.2		34.6	34.6		24.8	24.8		24.8	24.8	
Effective Green, g (s)	42.2	45.2		36.6	36.6		26.8	24.8		26.8	26.8	
Actuated g/C Ratio	0.53	0.57		0.46	0.46		0.34	0.31		0.34	0.34	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	5.0	4.0		5.0	5.0		2.5	2.5		4.0	4.0	
Lane Grp Cap (vph)	194	1726		66	1637		114	248		116	526	
v/s Ratio Prot	0.02	c0.43			0.36			0.59			0.08	
v/s Ratio Perm	0.13			c3.31			c0.74			0.65		
v/c Ratio	0.28	0.76		7.27	0.79		2.21	1.91		1.93	0.25	
Uniform Delay, d1	14.0	13.3		21.7	18.4		26.6	27.6		26.6	19.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.6	2.2		11322.4	3.1		2207.4	1651.5		1707.5	1.2	
Delay (s)	15.6	15.5		11344.1	21.5		2234.0	1679.1		1734.1	20.5	
Level of Service	B	B		F	C		F	F		F	C	
Approach Delay (s)		15.5			3081.7			1860.5			676.6	
Approach LOS		B			F			F			F	

### Intersection Summary

HCM Average Control Delay	1620.9	HCM Level of Service	F
HCM Volume to Capacity ratio	4.84		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	124.2%	ICU Level of Service	H
Analysis Period (min)	60		

c Critical Lane Group



# HCM Signalized Intersection Capacity Analysis

## 27: McCraney Street & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	194	75	405	134	44	31	171	1468	300	87	1602	113
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0		5.0	7.0		7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.98	1.00	0.99		1.00	1.00		1.00	0.99	
Flpb, ped/bikes	0.98	1.00	1.00	0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.94		1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1761	1921	1554	1726	1755		1789	4946		1824	5053	
Flt Permitted	0.71	1.00	1.00	0.71	1.00		0.08	1.00		0.12	1.00	
Satd. Flow (perm)	1312	1921	1554	1287	1755		157	4946		234	5053	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	194	75	405	134	44	31	171	1468	300	87	1602	113
RTOR Reduction (vph)	0	0	323	0	23	0	0	16	0	0	4	0
Lane Group Flow (vph)	194	75	82	134	52	0	171	1752	0	87	1711	0
Confl. Peds. (#/hr)	16		7	7			16	39		4	4	39
Heavy Vehicles (%)	2%	0%	3%	5%	1%	2%	2%	3%	2%	0%	2%	3%
Turn Type	Perm		Perm	Perm			pm+pt			Perm		
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	25.4	25.4	25.4	25.4	25.4		90.6	90.6		74.2	74.2	
Effective Green, g (s)	25.4	25.4	25.4	25.4	25.4		90.6	90.6		74.2	74.2	
Actuated g/C Ratio	0.20	0.20	0.20	0.20	0.20		0.70	0.70		0.57	0.57	
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0		5.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	256	375	304	251	343		253	3447		134	2884	
v/s Ratio Prot		0.04			0.03		c0.06	0.35			0.34	
v/s Ratio Perm	c0.15		0.05	0.10			c0.41			0.37		
v/c Ratio	0.76	0.20	0.27	0.53	0.15		0.68	0.51		0.65	0.59	
Uniform Delay, d1	49.4	43.8	44.4	47.0	43.4		18.5	9.2		19.0	18.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	13.0	0.3	0.5	2.2	0.2		7.2	0.5		24.0	0.9	
Delay (s)	62.4	44.1	44.9	49.2	43.6		25.7	9.8		43.0	19.0	
Level of Service	E	D	D	D	D		C	A		D	B	
Approach Delay (s)		49.8			47.2			11.2			20.2	
Approach LOS		D			D			B			C	

### Intersection Summary

HCM Average Control Delay	22.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 35: QEW SW ramp & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations								↑↑↑	↑		↑↑↑	↑
Volume (veh/h)	0	0	0	0	0	0	0	1468	321	0	1913	970
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	0	0	0	0	0	0	0	1468	321	0	1913	970
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (m)								293			28	
pX, platoon unblocked												
vC, conflicting volume	2402	3381	638	2106	3381	489	1913			1468		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2402	3381	638	2106	3381	489	1913			1468		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	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 %	100	100	100	100	100	100	100			100		
cM capacity (veh/h)	17	7	420	29	7	525	306			456		
<b>Direction, Lane #</b>	<b>NB 1</b>	<b>NB 2</b>	<b>NB 3</b>	<b>NB 4</b>	<b>SB 1</b>	<b>SB 2</b>	<b>SB 3</b>	<b>SB 4</b>				
Volume Total	489	489	489	321	638	638	638	970				
Volume Left	0	0	0	0	0	0	0	0				
Volume Right	0	0	0	321	0	0	0	970				
cSH	1700	1700	1700	1700	1700	1700	1700	1700				
Volume to Capacity	0.29	0.29	0.29	0.19	0.38	0.38	0.38	0.57				
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Lane LOS												
Approach Delay (s)	0.0				0.0							
Approach LOS												
<b>Intersection Summary</b>												
Average Delay			0.0									
Intersection Capacity Utilization			63.4%		ICU Level of Service				B			
Analysis Period (min)			60									

# HCM Signalized Intersection Capacity Analysis

## 1: Leightland Avenue & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	127	101	312	721	286	167	270	1773	927	134	1064	134
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.96
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
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)	1766	1921	1596	3471	1902	1527	1807	5142	1601	1825	5142	1531
Flt Permitted	0.58	1.00	1.00	0.95	1.00	1.00	0.13	1.00	1.00	0.10	1.00	1.00
Satd. Flow (perm)	1086	1921	1596	3471	1902	1527	239	5142	1601	200	5142	1531
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	127	101	312	721	286	167	270	1773	927	134	1064	134
RTOR Reduction (vph)	0	0	0	0	0	124	0	0	0	0	0	88
Lane Group Flow (vph)	127	101	312	721	286	43	270	1773	927	134	1064	46
Confl. Peds. (#/hr)	28		3	3		28	10					10
Heavy Vehicles (%)	2%	0%	1%	2%	1%	2%	1%	2%	2%	0%	2%	2%
Turn Type	pm+pt		Free	Prot		Perm	pm+pt		Free	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		Free			8	2		Free	6		6
Actuated Green, G (s)	25.9	13.3	120.0	28.5	29.2	29.2	59.2	43.7	120.0	50.0	38.5	38.5
Effective Green, g (s)	29.9	15.3	120.0	30.5	31.2	31.2	59.2	46.7	120.0	50.0	41.5	41.5
Actuated g/C Ratio	0.25	0.13	1.00	0.25	0.26	0.26	0.49	0.39	1.00	0.42	0.35	0.35
Clearance Time (s)	6.0	6.0		6.0	6.0	6.0	4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.5	3.5		3.5	3.5	3.5	3.5	5.0		3.5	5.0	5.0
Lane Grp Cap (vph)	353	245	1596	882	495	397	336	2001	1601	239	1778	529
v/s Ratio Prot	0.04	0.05		c0.21	0.15		c0.11	c0.34		0.05	0.21	
v/s Ratio Perm	0.05		0.20			0.03	0.28		c0.58	0.18		0.03
v/c Ratio	0.36	0.41	0.20	0.82	0.58	0.11	0.80	0.89	0.58	0.56	0.60	0.09
Uniform Delay, d1	36.4	48.2	0.0	42.1	38.7	33.8	25.3	34.2	0.0	26.9	32.4	26.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.38	0.48	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	1.3	0.3	6.4	1.8	0.1	9.3	4.3	1.0	3.3	1.5	0.3
Delay (s)	37.2	49.5	0.3	48.5	40.4	34.0	44.1	20.5	1.0	30.2	33.9	26.8
Level of Service	D	D	A	D	D	C	D	C	A	C	C	C
Approach Delay (s)		18.2			44.5			16.6			32.8	
Approach LOS		B			D			B			C	

### Intersection Summary

HCM Average Control Delay	25.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.8%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 2: Iroquois Shore Road & North Service Road

6/3/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↑	↑	↑↑	↑↑	
Volume (vph)	781	115	17	549	490	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	1.00	
Frbp, ped/bikes	1.00	0.97	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.99	
Flt Protected	1.00	1.00	0.95	1.00	0.95	
Satd. Flow (prot)	1865	1540	1789	3579	1788	
Flt Permitted	1.00	1.00	0.10	1.00	0.95	
Satd. Flow (perm)	1865	1540	197	3579	1788	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	781	115	17	549	490	19
RTOR Reduction (vph)	0	62	0	0	1	0
Lane Group Flow (vph)	781	53	17	549	508	0
Confl. Peds. (#/hr)		5	5		7	
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Turn Type		Perm	pm+pt			
Protected Phases	2		3	2	4	
Permitted Phases		2	2			
Actuated Green, G (s)	39.2	39.2	41.2	39.2	33.8	
Effective Green, g (s)	41.2	41.2	39.2	41.2	35.8	
Actuated g/C Ratio	0.46	0.46	0.44	0.46	0.40	
Clearance Time (s)	6.0	6.0	3.0	6.0	6.0	
Vehicle Extension (s)	3.5	3.5	3.0	3.5	3.5	
Lane Grp Cap (vph)	854	705	103	1638	711	
v/s Ratio Prot	c0.42		c0.00	0.15	c0.28	
v/s Ratio Perm		0.03	0.07			
v/c Ratio	0.91	0.07	0.17	0.34	0.71	
Uniform Delay, d1	22.8	13.7	39.8	15.6	22.8	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	20.0	0.2	0.8	0.6	6.3	
Delay (s)	42.7	13.9	40.6	16.2	29.0	
Level of Service	D	B	D	B	C	
Approach Delay (s)	39.0			16.9	29.0	
Approach LOS	D			B	C	

### Intersection Summary

HCM Average Control Delay	30.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 4: Iroquois Shore Road & Eighth Line

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Stop			Stop	Stop	
Volume (vph)	788	11	31	126	18	572
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	788	11	31	126	18	572
Direction, Lane #	EB 1	NB 1	SB 1	SB 2		
Volume Total (vph)	799	157	18	572		
Volume Left (vph)	788	31	0	0		
Volume Right (vph)	11	0	0	572		
Hadj (s)	0.22	0.07	0.00	-0.60		
Departure Headway (s)	4.7	5.9	6.1	3.2		
Degree Utilization, x	1.04	0.26	0.03	0.51		
Capacity (veh/h)	777	605	574	1116		
Control Delay (s)	140.8	10.9	9.3	9.5		
Approach Delay (s)	140.8	10.9	9.5			
Approach LOS	F	B	A			
Intersection Summary						
Delay			77.5			
HCM Level of Service			F			
Intersection Capacity Utilization			66.0%	ICU Level of Service	C	
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 7: North Service Road & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖		↗	↖	↗	↗		↑↑↑			↑↑↑	
Volume (vph)	20	0	245	463	151	515	0	2507	0	0	2090	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	3.0	4.0	4.0		4.0			4.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00		0.91			0.86	
Frbp, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	
Frt	1.00		0.85	1.00	1.00	0.85		1.00			1.00	
Flt Protected	0.95		1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (prot)	1825		1617	1825	1812	1541		5142			6414	
Flt Permitted	0.66		1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (perm)	1270		1617	1825	1812	1541		5142			6414	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	0	245	463	151	515	0	2507	0	0	2090	7
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	20	0	245	463	151	515	0	2507	0	0	2097	0
Confl. Peds. (#/hr)							31					
Heavy Vehicles (%)	0%	0%	1%	0%	6%	6%	0%	2%	5%	0%	3%	0%
Turn Type	custom		custom	pm+pt		Free						
Protected Phases				3	8			2			6	
Permitted Phases	4		4	8		Free						
Actuated Green, G (s)	26.4		26.4	43.0	43.0	120.0		66.0			69.0	
Effective Green, g (s)	28.4		28.4	43.0	44.0	120.0		68.0			68.0	
Actuated g/C Ratio	0.24		0.24	0.36	0.37	1.00		0.57			0.57	
Clearance Time (s)	6.0		6.0	3.0	5.0			6.0			3.0	
Vehicle Extension (s)	3.5		3.5	3.0	3.5			4.5			4.5	
Lane Grp Cap (vph)	301		383	654	664	1541		2914			3635	
v/s Ratio Prot				c0.07	0.08			c0.49			0.33	
v/s Ratio Perm	0.02		0.15	0.18		0.33						
v/c Ratio	0.07		0.64	0.71	0.23	0.33		0.86			0.58	
Uniform Delay, d1	35.5		41.2	33.1	26.3	0.0		22.0			16.7	
Progression Factor	1.00		1.00	1.00	1.00	1.00		1.00			1.54	
Incremental Delay, d2	0.4		8.2	3.6	0.8	0.6		3.1			0.5	
Delay (s)	35.9		49.4	36.7	27.1	0.6		25.1			26.3	
Level of Service	D		D	D	C	A		C			C	
Approach Delay (s)		48.4			18.9			25.1			26.3	
Approach LOS		D			B			C			C	

Intersection Summary		
HCM Average Control Delay	25.4	HCM Level of Service C
HCM Volume to Capacity ratio	0.79	
Actuated Cycle Length (s)	120.0	Sum of lost time (s) 7.0
Intersection Capacity Utilization	81.2%	ICU Level of Service D
Analysis Period (min)	60	
c Critical Lane Group		

# HCM Signalized Intersection Capacity Analysis

## 8: Highway 403 EB Offramp & Trafalgar Road

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↶↶	↷		↶↶↶	↶↶↶	
Volume (vph)	849	370	0	2055	1102	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		0.91	0.91	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	3506	1617		5142	5142	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	3506	1617		5142	5142	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	849	370	0	2055	1102	0
RTOR Reduction (vph)	0	51	0	0	0	0
Lane Group Flow (vph)	849	319	0	2055	1102	0
Confl. Peds. (#/hr)	1					
Heavy Vehicles (%)	1%	1%	0%	2%	2%	3%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	42.0	42.0		64.1	64.1	
Effective Green, g (s)	44.0	44.0		66.1	66.1	
Actuated g/C Ratio	0.37	0.37		0.56	0.56	
Clearance Time (s)	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.5	3.5		4.5	4.5	
Lane Grp Cap (vph)	1306	602		2878	2878	
v/s Ratio Prot	c0.24			c0.40	0.21	
v/s Ratio Perm		0.20				
v/c Ratio	0.65	0.53		0.71	0.38	
Uniform Delay, d1	30.7	29.0		19.1	14.6	
Progression Factor	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.6	3.3		1.0	0.1	
Delay (s)	33.2	32.3		20.1	14.7	
Level of Service	C	C		C	B	
Approach Delay (s)	32.9			20.1	14.7	
Approach LOS	C			C	B	

### Intersection Summary

HCM Average Control Delay	22.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	118.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 10: Cross Avenue & Lyons Lane

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	
Volume (vph)	168	501	79	33	913	50	465	9	28	65	4	212
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	0.99		1.00	0.98	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		0.99	1.00	
Frt	1.00	0.98		1.00	0.99		1.00	0.89		1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1825	3576		1825	3615		1819	1679		1814	1611	
Flt Permitted	0.16	1.00		0.35	1.00		0.55	1.00		0.73	1.00	
Satd. Flow (perm)	304	3576		673	3615		1051	1679		1399	1611	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	168	501	79	33	913	50	465	9	28	65	4	212
RTOR Reduction (vph)	0	11	0	0	3	0	0	17	0	0	126	0
Lane Group Flow (vph)	168	569	0	33	960	0	465	20	0	65	90	0
Confl. Peds. (#/hr)	6					6	3		4	4		3
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt			Perm			Perm			Perm		
Protected Phases	1	2			2			4			4	
Permitted Phases	2			2			4			4		
Actuated Green, G (s)	58.6	49.7		49.7	49.7		46.4	46.4		46.4	46.4	
Effective Green, g (s)	56.6	51.7		51.7	51.7		48.4	48.4		48.4	48.4	
Actuated g/C Ratio	0.47	0.43		0.43	0.43		0.40	0.40		0.40	0.40	
Clearance Time (s)	3.0	6.0		6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.0	5.0		5.0	5.0		4.0	4.0		4.0	4.0	
Lane Grp Cap (vph)	244	1541		290	1557		424	677		564	650	
v/s Ratio Prot	c0.05	0.16			0.27			0.01			0.06	
v/s Ratio Perm	c0.28			0.05			c0.44			0.05		
v/c Ratio	0.69	0.37		0.11	0.62		1.10	0.03		0.12	0.14	
Uniform Delay, d1	21.5	23.1		20.4	26.5		35.8	21.6		22.4	22.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.2	0.7		0.8	1.9		213.3	0.0		0.1	0.1	
Delay (s)	29.7	23.8		21.2	28.3		249.1	21.6		22.5	22.7	
Level of Service	C	C		C	C		F	C		C	C	
Approach Delay (s)		25.1			28.1			232.4			22.7	
Approach LOS		C			C			F			C	

### Intersection Summary

HCM Average Control Delay	67.2	HCM Level of Service	E
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 11: Cross Avenue & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↔		↔	↑	↔	↔	↑↑↑		↔	↑↑↑	
Volume (vph)	792	60	103	124	92	168	127	1541	31	90	1154	228
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		1.00	1.00	1.00	1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	0.96		1.00	1.00	0.95	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		0.98	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.91		1.00	1.00	0.85	1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3437	1615		1747	1902	1539	1722	5159		1772	4938	
Flt Permitted	0.95	1.00		0.65	1.00	1.00	0.10	1.00		0.11	1.00	
Satd. Flow (perm)	3437	1615		1203	1902	1539	184	5159		198	4938	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	792	60	103	124	92	168	127	1541	31	90	1154	228
RTOR Reduction (vph)	0	51	0	0	0	149	0	2	0	0	24	0
Lane Group Flow (vph)	792	112	0	124	92	19	127	1570	0	90	1358	0
Confl. Peds. (#/hr)	8		36	36		8	18		8	8		18
Heavy Vehicles (%)	3%	0%	6%	2%	1%	1%	6%	1%	15%	3%	1%	13%
Turn Type	Prot			pm+pt		Perm	pm+pt			pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases				8		8	2			6		
Actuated Green, G (s)	29.0	27.6		19.6	10.1	10.1	49.7	39.4		46.1	37.6	
Effective Green, g (s)	29.0	29.6		23.6	12.1	12.1	49.7	41.4		46.1	39.6	
Actuated g/C Ratio	0.27	0.28		0.22	0.11	0.11	0.46	0.39		0.43	0.37	
Clearance Time (s)	4.0	6.0		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	3.0	
Lane Grp Cap (vph)	932	447		324	215	174	234	1996		210	1828	
v/s Ratio Prot	c0.23	0.07		0.04	c0.05		c0.05	c0.30		0.03	0.27	
v/s Ratio Perm				0.04		0.01	0.20			0.15		
v/c Ratio	0.85	0.25		0.38	0.43	0.11	0.54	0.79		0.43	0.74	
Uniform Delay, d1	36.9	30.1		35.0	44.2	42.6	20.3	28.9		21.7	29.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	7.9	0.3		0.8	1.4	0.3	2.6	2.2		1.4	1.7	
Delay (s)	44.8	30.4		35.7	45.6	42.9	22.9	31.1		23.1	31.0	
Level of Service	D	C		D	D	D	C	C		C	C	
Approach Delay (s)		42.4			41.2			30.5			30.5	
Approach LOS		D			D			C			C	

Intersection Summary		
HCM Average Control Delay	33.9	HCM Level of Service C
HCM Volume to Capacity ratio	0.75	
Actuated Cycle Length (s)	107.0	Sum of lost time (s) 16.0
Intersection Capacity Utilization	77.2%	ICU Level of Service D
Analysis Period (min)	60	
c Critical Lane Group		

# HCM Signalized Intersection Capacity Analysis

## 18: Cornwall Road & Cross Avenue

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↵	↑↑	↑↵		↵	↵
Volume (vph)	309	649	945	23	50	1058
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1772	3544	3563		1789	1597
Flt Permitted	0.10	1.00	1.00		0.95	1.00
Satd. Flow (perm)	179	3544	3563		1789	1597
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	309	649	945	23	50	1058
RTOR Reduction (vph)	0	0	1	0	0	18
Lane Group Flow (vph)	309	649	967	0	50	1040
Confl. Peds. (#/hr)	20			20	2	3
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Turn Type	pm+pt				pm+ov	
Protected Phases	5	2			4	5
Permitted Phases	2		6			4
Actuated Green, G (s)	95.4	95.4	38.6		10.6	64.4
Effective Green, g (s)	94.4	97.4	40.6		9.6	62.4
Actuated g/C Ratio	0.82	0.85	0.35		0.08	0.54
Clearance Time (s)	3.0	6.0	6.0		3.0	3.0
Vehicle Extension (s)	3.5	3.5	3.5		5.0	3.5
Lane Grp Cap (vph)	878	3002	1258		149	922
v/s Ratio Prot	0.16	0.18			0.03	c0.52
v/s Ratio Perm	0.13		c0.27			0.13
v/c Ratio	0.35	0.22	0.77		0.34	1.13
Uniform Delay, d1	12.5	1.6	33.0		49.7	26.3
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.1	0.2	3.0		2.8	246.8
Delay (s)	13.7	1.8	36.1		52.5	273.1
Level of Service	B	A	D		D	F
Approach Delay (s)		5.6	36.1		263.1	
Approach LOS		A	D		F	

### Intersection Summary

HCM Average Control Delay	109.4	HCM Level of Service	F
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	115.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.7%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 19: Cornwall Road & Old Mill Road

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	64	635	857	57	146	111
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	3614	3538		1825	1617
Flt Permitted	0.14	1.00	1.00		0.95	1.00
Satd. Flow (perm)	261	3614	3538		1825	1617
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	64	635	857	57	146	111
RTOR Reduction (vph)	0	0	6	0	0	62
Lane Group Flow (vph)	64	635	908	0	146	49
Confl. Peds. (#/hr)	13			13	1	
Heavy Vehicles (%)	2%	1%	2%	0%	0%	1%
Turn Type	pm+pt					Perm
Protected Phases	7	4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)	34.9	34.9	24.9		33.1	33.1
Effective Green, g (s)	34.9	36.9	26.9		35.1	35.1
Actuated g/C Ratio	0.44	0.46	0.34		0.44	0.44
Clearance Time (s)	4.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	228	1667	1190		801	709
v/s Ratio Prot	0.02	c0.18	c0.26		c0.08	
v/s Ratio Perm	0.10					0.03
v/c Ratio	0.28	0.38	0.76		0.18	0.07
Uniform Delay, d1	15.7	14.1	23.7		13.7	13.0
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.7	0.1	3.0		0.5	0.2
Delay (s)	16.4	14.2	26.7		14.2	13.2
Level of Service	B	B	C		B	B
Approach Delay (s)		14.4	26.7		13.8	
Approach LOS		B	C		B	

### Intersection Summary

HCM Average Control Delay	20.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	47.2%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 21: Cornwall Road & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔↔	↕↔		↔	↕↕	↔	↔	↕↔		↔↔	↕	↔
Volume (vph)	384	331	66	65	477	723	85	535	31	502	520	352
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	0.95		0.97	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	1.00	0.94	1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		0.99	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3437	3431		1795	3510	1475	1824	3544		3437	1902	1562
Flt Permitted	0.95	1.00		0.52	1.00	1.00	0.19	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3437	3431		979	3510	1475	371	3544		3437	1902	1562
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	384	331	66	65	477	723	85	535	31	502	520	352
RTOR Reduction (vph)	0	13	0	0	0	320	0	4	0	0	0	229
Lane Group Flow (vph)	384	384	0	65	477	403	85	562	0	502	520	123
Confl. Peds. (#/hr)	33		9	9		33	9		12	12		9
Heavy Vehicles (%)	3%	3%	3%	1%	4%	4%	0%	2%	2%	3%	1%	2%
Turn Type	Prot			pm+pt		Perm	pm+pt			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases				8		8	2					6
Actuated Green, G (s)	18.0	32.0		37.0	25.0	25.0	41.4	28.4		21.7	38.1	38.1
Effective Green, g (s)	19.0	34.0		37.0	27.0	27.0	41.4	30.4		22.7	40.1	40.1
Actuated g/C Ratio	0.17	0.30		0.32	0.23	0.23	0.36	0.26		0.20	0.35	0.35
Clearance Time (s)	5.0	6.0		4.0	6.0	6.0	4.0	6.0		5.0	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
Lane Grp Cap (vph)	567	1014		400	823	346	298	936		678	663	544
v/s Ratio Prot	c0.11	0.11		0.02	0.14		0.03	0.16		c0.15	c0.27	
v/s Ratio Perm				0.04		c0.27	0.07					0.08
v/c Ratio	0.68	0.38		0.16	0.58	1.16	0.29	0.60		0.74	0.78	0.23
Uniform Delay, d1	45.2	32.2		27.5	39.0	44.0	26.1	37.0		43.4	33.6	26.5
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	6.6	1.1		0.9	3.0	329.9	2.4	2.9		4.5	6.3	0.2
Delay (s)	51.8	33.2		28.4	42.0	373.9	28.5	39.9		47.9	40.0	26.7
Level of Service	D	C		C	D	F	C	D		D	D	C
Approach Delay (s)		42.3			231.0			38.4			39.5	
Approach LOS		D			F			D			D	

### Intersection Summary

HCM Average Control Delay	99.4	HCM Level of Service	F
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	115.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 22: Cornwall Road & Reynolds Street

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑		↑	↑		↑	↑	
Volume (vph)	6	732	126	56	958	18	247	18	20	5	11	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes		1.00	0.97	1.00	1.00		1.00	0.98		1.00	0.99	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00		0.98	1.00	
Frt		1.00	0.85	1.00	1.00		1.00	0.92		1.00	0.87	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3542	1533	1800	3602		1736	1657		1739	1610	
Flt Permitted		0.95	1.00	0.34	1.00		0.71	1.00		0.73	1.00	
Satd. Flow (perm)		3358	1533	647	3602		1299	1657		1340	1610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	6	732	126	56	958	18	247	18	20	5	11	60
RTOR Reduction (vph)	0	0	40	0	1	0	0	15	0	0	45	0
Lane Group Flow (vph)	0	738	86	56	975	0	247	23	0	5	26	0
Confl. Peds. (#/hr)	3		4	4		3	1		12	12		1
Heavy Vehicles (%)	3%	3%	3%	1%	1%	1%	5%	5%	5%	3%	3%	3%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		2			2			4			4	
Permitted Phases	2		2	2			4			4		
Actuated Green, G (s)		79.7	79.7	79.7	79.7		28.3	28.3		28.3	28.3	
Effective Green, g (s)		81.7	81.7	81.7	81.7		30.3	30.3		30.3	30.3	
Actuated g/C Ratio		0.68	0.68	0.68	0.68		0.25	0.25		0.25	0.25	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		4.0	4.0	4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2286	1044	440	2452		328	418		338	407	
v/s Ratio Prot				c0.27				0.01			0.02	
v/s Ratio Perm		0.22	0.06	0.09			c0.19			0.00		
v/c Ratio		0.32	0.08	0.13	0.40		0.75	0.06		0.01	0.06	
Uniform Delay, d1		7.8	6.5	6.7	8.4		41.4	34.0		33.7	34.1	
Progression Factor		1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.4	0.2	0.6	0.5		10.0	0.1		0.0	0.1	
Delay (s)		8.2	6.6	7.3	8.9		51.4	34.1		33.7	34.1	
Level of Service		A	A	A	A		D	C		C	C	
Approach Delay (s)		8.0			8.8			49.1			34.1	
Approach LOS		A			A			D			C	

### Intersection Summary

HCM Average Control Delay	14.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	73.6%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 23: Cornwall Road & Chartwell Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	445	143	49	621	31	140	27	34	12	21	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.92		1.00	0.90	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1738	1830	1555	1772	1852		1722	1661		1825	1729	
Flt Permitted	0.16	1.00	1.00	0.36	1.00		0.72	1.00		0.72	1.00	
Satd. Flow (perm)	299	1830	1555	668	1852		1298	1661		1378	1729	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	27	445	143	49	621	31	140	27	34	12	21	42
RTOR Reduction (vph)	0	0	81	0	3	0	0	19	0	0	23	0
Lane Group Flow (vph)	27	445	62	49	649	0	140	42	0	12	40	0
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	6%	6%	6%	0%	0%	0%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		4			4			2			2	
Permitted Phases	4		4	4			2			2		
Actuated Green, G (s)	26.1	26.1	26.1	26.1	26.1		26.8	26.8		26.8	26.8	
Effective Green, g (s)	28.0	28.0	28.0	28.0	28.0		29.0	29.0		29.0	29.0	
Actuated g/C Ratio	0.43	0.43	0.43	0.43	0.43		0.45	0.45		0.45	0.45	
Clearance Time (s)	5.9	5.9	5.9	5.9	5.9		6.2	6.2		6.2	6.2	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	129	788	670	288	798		579	741		615	771	
v/s Ratio Prot		0.24			c0.35			0.03			0.02	
v/s Ratio Perm	0.09		0.04	0.07			c0.11			0.01		
v/c Ratio	0.21	0.56	0.09	0.17	0.81		0.24	0.06		0.02	0.05	
Uniform Delay, d1	11.6	13.9	11.0	11.4	16.2		11.2	10.2		10.1	10.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	3.7	3.0	0.3	1.3	9.6		1.0	0.1		0.1	0.1	
Delay (s)	15.3	16.9	11.2	12.6	25.8		12.2	10.4		10.1	10.3	
Level of Service	B	B	B	B	C		B	B		B	B	
Approach Delay (s)		15.5			24.9			11.6			10.3	
Approach LOS		B			C			B			B	

### Intersection Summary

HCM Average Control Delay	18.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	65.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	60		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 24: Cross Avenue & Argus Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	31	761	25	35	386	26	23	0	36	158	2	134
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0		4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00		1.00	1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Frt	1.00	1.00		1.00	0.99		1.00		0.85	1.00	0.85	
Flt Protected	0.95	1.00		0.95	1.00		0.95		1.00	0.95	1.00	
Satd. Flow (prot)	1817	3488		913	3570		913		816	1804	1609	
Flt Permitted	0.36	1.00		0.29	1.00		0.67		1.00	0.95	1.00	
Satd. Flow (perm)	696	3488		275	3570		644		816	1804	1609	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	31	761	25	35	386	26	23	0	36	158	2	134
RTOR Reduction (vph)	0	4	0	0	7	0	0	0	18	0	65	0
Lane Group Flow (vph)	31	782	0	35	405	0	23	0	18	158	71	0
Confl. Peds. (#/hr)	13					13				1		
Heavy Vehicles (%)	0%	1%	100%	100%	1%	0%	100%	0%	100%	1%	50%	1%
Turn Type	pm+pt			Perm			custom		custom		Perm	
Protected Phases	7	4			8							6
Permitted Phases	4			8			2		2		6	
Actuated Green, G (s)	29.0	29.0		23.2	23.2		39.0		39.0	39.0	39.0	
Effective Green, g (s)	28.0	31.0		25.2	25.2		41.0		41.0	41.0	41.0	
Actuated g/C Ratio	0.35	0.39		0.32	0.32		0.51		0.51	0.51	0.51	
Clearance Time (s)	3.0	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	1352		87	1125		330		418	925	825	
v/s Ratio Prot	0.00	c0.22			0.11							0.04
v/s Ratio Perm	0.04			0.13			0.04		0.02	c0.09		
v/c Ratio	0.12	0.58		0.40	0.36		0.07		0.04	0.17	0.09	
Uniform Delay, d1	17.6	19.3		21.5	21.2		9.9		9.7	10.4	9.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.2	0.6		3.1	0.2		0.4		0.2	0.4	0.2	
Delay (s)	17.7	20.0		24.5	21.4		10.3		9.9	10.8	10.1	
Level of Service	B	B		C	C		B		A	B	B	
Approach Delay (s)		19.9			21.6			10.1			10.5	
Approach LOS		B			C			B			B	

### Intersection Summary

HCM Average Control Delay	18.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 35: McCraney Street & Trafalgar Road

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	75	23	211	47	93	258	348	1525	194	32	1074	131
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0		5.0	7.0		7.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.97	1.00	0.98		1.00	0.99		1.00	0.98	
Flpb, ped/bikes	0.99	1.00	1.00	0.98	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.89		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1813	1921	1560	1766	1676		1804	5065		1817	5029	
Flt Permitted	0.25	1.00	1.00	0.74	1.00		0.14	1.00		0.13	1.00	
Satd. Flow (perm)	481	1921	1560	1380	1676		274	5065		245	5029	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	75	23	211	47	93	258	348	1525	194	32	1074	131
RTOR Reduction (vph)	0	0	160	0	18	0	0	10	0	0	10	0
Lane Group Flow (vph)	75	23	51	47	333	0	348	1709	0	32	1195	0
Confl. Peds. (#/hr)	13		18	18		13	67		23	23		67
Heavy Vehicles (%)	0%	0%	1%	1%	0%	0%	1%	1%	1%	0%	1%	1%
Turn Type	Perm		Perm	Perm			pm+pt			Perm		
Protected Phases		4			8		5	2			6	
Permitted Phases	4		4	8			2			6		
Actuated Green, G (s)	31.2	31.2	31.2	31.2	31.2		84.8	84.8		57.2	57.2	
Effective Green, g (s)	31.2	31.2	31.2	31.2	31.2		84.8	84.8		57.2	57.2	
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24		0.65	0.65		0.44	0.44	
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0		5.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	115	461	374	331	402		445	3304		108	2213	
v/s Ratio Prot		0.01			c0.20		c0.14	0.34			0.24	
v/s Ratio Perm	0.16		0.03	0.03			c0.37			0.13		
v/c Ratio	0.65	0.05	0.14	0.14	0.83		0.78	0.52		0.30	0.54	
Uniform Delay, d1	44.5	38.0	38.8	38.9	46.9		22.8	11.9		23.4	26.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	13.2	0.0	0.2	0.2	14.6		9.2	0.6		7.0	1.0	
Delay (s)	57.7	38.0	39.0	39.1	61.5		32.1	12.4		30.4	27.7	
Level of Service	E	D	D	D	E		C	B		C	C	
Approach Delay (s)		43.5			58.8			15.7			27.8	
Approach LOS		D			E			B			C	

### Intersection Summary

HCM Average Control Delay	25.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	115.0%	ICU Level of Service	H
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 1: Leighland Ave & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑	↗	↘↗	↑	↗	↘	↑↑↑	↗	↘	↑↑↑	↗
Volume (vph)	37	432	361	432	86	211	271	1393	164	202	1228	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frpb, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.96
Flpb, ped/bikes	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
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)	1744	3650	1596	3471	1902	1553	1807	5142	1601	1825	5142	1538
Flt Permitted	0.70	1.00	1.00	0.95	1.00	1.00	0.11	1.00	1.00	0.13	1.00	1.00
Satd. Flow (perm)	1287	3650	1596	3471	1902	1553	217	5142	1601	242	5142	1538
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	37	432	361	432	86	211	271	1393	164	202	1228	35
RTOR Reduction (vph)	0	0	0	0	0	4	0	0	0	0	0	23
Lane Group Flow (vph)	37	432	361	432	86	207	271	1393	164	202	1228	12
Confl. Peds. (#/hr)	28		3	3		28	10					10
Heavy Vehicles (%)	2%	0%	1%	2%	1%	2%	1%	2%	2%	0%	2%	2%
Turn Type	Perm		Free	Prot		pm+ov	pm+pt		Free	pm+pt		Perm
Protected Phases		4		3	8	1	5	2		1	6	
Permitted Phases	4		Free			8	2		Free	6		6
Actuated Green, G (s)	13.7	13.7	97.6	14.6	34.3	45.5	49.6	35.1	97.6	43.0	31.8	31.8
Effective Green, g (s)	15.7	15.7	97.6	16.6	36.3	45.5	49.6	38.1	97.6	43.0	34.8	34.8
Actuated g/C Ratio	0.16	0.16	1.00	0.17	0.37	0.47	0.51	0.39	1.00	0.44	0.36	0.36
Clearance Time (s)	6.0	6.0		6.0	6.0	4.0	4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.5	3.5		3.5	3.5	3.5	3.5	5.0		3.5	5.0	5.0
Lane Grp Cap (vph)	207	587	1596	590	707	724	346	2007	1601	288	1833	548
v/s Ratio Prot		c0.12		c0.12	0.05	0.03	c0.12	0.27		0.08	0.24	
v/s Ratio Perm	0.03		0.23			0.10	c0.28		0.10	0.23		0.01
v/c Ratio	0.18	0.74	0.23	0.73	0.12	0.29	0.78	0.69	0.10	0.70	0.67	0.02
Uniform Delay, d1	35.4	39.0	0.0	38.4	20.2	16.0	22.2	24.9	0.0	19.5	26.5	20.4
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	5.1	0.3	5.0	0.1	0.3	12.2	1.4	0.1	8.1	1.3	0.0
Delay (s)	35.9	44.1	0.3	43.4	20.3	16.3	34.4	26.2	0.1	27.6	27.8	20.4
Level of Service	D	D	A	D	C	B	C	C	A	C	C	C
Approach Delay (s)		24.7			32.8			25.1			27.6	
Approach LOS		C			C			C			C	

### Intersection Summary

HCM Average Control Delay	26.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	97.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.7%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 2: Iroquois Shore Rd & N-S Crossing

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗	↗		↗	
Volume (vph)	0	739	0	539	633	20	109	150	424	10	209	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0		3.0	5.0		3.0	6.0	6.0		6.0	
Lane Util. Factor		0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frbp, ped/bikes		1.00		1.00	1.00		1.00	1.00	1.00		1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00	1.00		1.00	
Frt		1.00		1.00	1.00		1.00	1.00	0.85		0.99	
Flt Protected		1.00		0.95	1.00		0.95	1.00	1.00		1.00	
Satd. Flow (prot)		3544		1789	3562		1787	1883	1601		1868	
Flt Permitted		1.00		0.14	1.00		0.31	1.00	1.00		0.98	
Satd. Flow (perm)		3544		260	3562		574	1883	1601		1841	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	739	0	539	633	20	109	150	424	10	209	10
RTOR Reduction (vph)	0	0	0	0	1	0	0	0	298	0	2	0
Lane Group Flow (vph)	0	739	0	539	652	0	109	150	126	0	227	0
Confl. Peds. (#/hr)			5	5			7					
Heavy Vehicles (%)	2%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			pm+pt			pm+pt			Perm	Perm	
Protected Phases		2		1	6		3	8				4
Permitted Phases	2			6			8		8	4		
Actuated Green, G (s)		25.0		72.4	72.4		35.6	35.6	35.6			20.4
Effective Green, g (s)		26.0		73.4	73.4		36.6	35.6	35.6			20.4
Actuated g/C Ratio		0.22		0.61	0.61		0.31	0.30	0.30			0.17
Clearance Time (s)		6.0		4.0	6.0		4.0	6.0	6.0			6.0
Vehicle Extension (s)		5.0		3.0	5.0		3.5	3.0	3.0			3.5
Lane Grp Cap (vph)		768		725	2179		298	559	475			313
v/s Ratio Prot		c0.21		c0.28	0.18		c0.04	0.08				
v/s Ratio Perm				0.18			0.07		0.08			c0.12
v/c Ratio		0.96		0.74	0.30		0.37	0.27	0.26			0.73
Uniform Delay, d1		46.5		24.9	11.1		32.0	32.2	32.2			47.2
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00			1.00
Incremental Delay, d2		38.2		4.2	0.2		0.9	0.3	0.3			8.8
Delay (s)		84.7		29.2	11.2		32.9	32.5	32.5			56.0
Level of Service		F		C	B		C	C	C			E
Approach Delay (s)		84.7			19.3			32.6				56.0
Approach LOS		F			B			C				E

### Intersection Summary

HCM Average Control Delay	42.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 3: Iroquois Shore Rd & local road

6/3/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		
Volume (veh/h)	1173	0	0	1192	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1173	0	0	1192	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)	230			275		
pX, platoon unblocked			0.81	0.84	0.81	
vC, conflicting volume			1173	1769	586	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			731	1180	2	
tC, single (s)			4.1	6.8	6.9	
tC, 2 stage (s)						
tF (s)			2.2	3.5	3.3	
p0 queue free %			100	100	100	
cM capacity (veh/h)			700	153	870	

Direction, Lane #	EB 1	EB 2	WB 1	WB 2
Volume Total	586	586	596	596
Volume Left	0	0	0	0
Volume Right	0	0	0	0
cSH	1700	1700	1700	1700
Volume to Capacity	0.34	0.34	0.35	0.35
Queue Length 95th (m)	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0	0.0
Lane LOS				
Approach Delay (s)	0.0		0.0	
Approach LOS				

Intersection Summary			
Average Delay		0.0	
Intersection Capacity Utilization		36.3%	ICU Level of Service A
Analysis Period (min)		60	

# HCM Signalized Intersection Capacity Analysis

## 4: Iroquois Shore Rd & Eighth Line

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	350	438	460	94	462	188	74	2	94	346	92	658
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.92		1.00	0.96		1.00	0.85		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)	1789	3304		1789	3423		1789	1607		1789	1668	
Flt Permitted	0.17	1.00		0.32	1.00		0.10	1.00		0.69	1.00	
Satd. Flow (perm)	321	3304		597	3423		187	1607		1309	1668	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	350	438	460	94	462	188	74	2	94	346	92	658
RTOR Reduction (vph)	0	150	0	0	36	0	0	54	0	0	227	0
Lane Group Flow (vph)	350	748	0	94	614	0	74	42	0	346	523	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	0%	0%
Turn Type	pm+pt			Perm			pm+pt			Perm		
Protected Phases	5	2		6			7	4		8		
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	52.2	52.2		27.6	27.6		43.3	43.3		36.3	36.3	
Effective Green, g (s)	52.2	54.2		29.6	29.6		43.3	45.3		38.3	38.3	
Actuated g/C Ratio	0.49	0.50		0.28	0.28		0.40	0.42		0.36	0.36	
Clearance Time (s)	4.0	6.0		6.0	6.0		4.0	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)	437	1666		164	943		120	677		466	594	
v/s Ratio Prot	c0.15	0.23			0.18		c0.02	0.03			c0.31	
v/s Ratio Perm	c0.24			0.16			0.23			0.26		
v/c Ratio	0.80	0.45		0.57	0.65		0.62	0.06		0.74	0.88	
Uniform Delay, d1	22.2	17.1		33.5	34.4		26.4	18.5		30.3	32.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	10.9	0.2		4.9	1.6		9.4	0.0		6.5	16.7	
Delay (s)	33.1	17.3		38.4	36.0		35.8	18.5		36.8	49.1	
Level of Service	C	B		D	D		D	B		D	D	
Approach Delay (s)		21.7			36.3			26.0			45.2	
Approach LOS		C			D			C			D	

### Intersection Summary

HCM Average Control Delay	33.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	107.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	110.6%	ICU Level of Service	H
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 6: North Service Road & Eighth Line

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	10	0	0	115	478	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	0	0	115	478	10
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	540	244	488			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	540	244	488			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	100	100			
cM capacity (veh/h)	471	757	1071			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	10	38	77	319	169	
Volume Left	10	0	0	0	0	
Volume Right	0	0	0	0	10	
cSH	471	1071	1700	1700	1700	
Volume to Capacity	0.02	0.00	0.05	0.19	0.10	
Queue Length 95th (m)	0.5	0.0	0.0	0.0	0.0	
Control Delay (s)	12.8	0.0	0.0	0.0	0.0	
Lane LOS	B					
Approach Delay (s)	12.8	0.0		0.0		
Approach LOS	B					
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			23.5%		ICU Level of Service	A
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 7: North Service Rd & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖		↗	↖	↑	↗		↑↑↑			↑↑↑	
Volume (vph)	0	0	225	905	20	356	0	1476	0	0	1107	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			4.0	5.0	4.0	4.0		4.0			4.0	
Lane Util. Factor			1.00	1.00	1.00	1.00		0.91			0.86	
Frbp, ped/bikes			1.00	1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes			1.00	1.00	1.00	1.00		1.00			1.00	
Frt			0.85	1.00	1.00	0.85		1.00			1.00	
Flt Protected			1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (prot)			1617	1825	1812	1541		5142			6415	
Flt Permitted			1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (perm)			1617	1825	1812	1541		5142			6415	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	225	905	20	356	0	1476	0	0	1107	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	225	905	20	356	0	1476	0	0	1108	0
Confl. Peds. (#/hr)							31					
Heavy Vehicles (%)	0%	0%	1%	0%	6%	6%	0%	2%	5%	0%	3%	0%
Turn Type	custom		custom	Perm		Free						
Protected Phases					8			2			6	
Permitted Phases	4		4	8		Free						
Actuated Green, G (s)			66.8	67.8	67.8	120.0		41.2			42.2	
Effective Green, g (s)			68.8	67.8	68.8	120.0		43.2			43.2	
Actuated g/C Ratio			0.57	0.56	0.57	1.00		0.36			0.36	
Clearance Time (s)			6.0	5.0	5.0			6.0			5.0	
Vehicle Extension (s)			3.5	3.5	3.5			4.5			4.5	
Lane Grp Cap (vph)			927	1031	1039	1541		1851			2309	
v/s Ratio Prot					0.01			c0.29			0.17	
v/s Ratio Perm			0.14	c0.50		0.23						
v/c Ratio			0.24	0.88	0.02	0.23		0.80			0.48	
Uniform Delay, d1			12.7	22.5	11.0	0.0		34.5			29.7	
Progression Factor			1.00	1.00	1.00	1.00		0.78			1.00	
Incremental Delay, d2			0.2	9.8	0.0	0.4		2.7			0.7	
Delay (s)			12.9	32.3	11.1	0.4		29.6			30.4	
Level of Service			B	C	B	A		C			C	
Approach Delay (s)		12.9			23.1			29.6			30.4	
Approach LOS		B			C			C			C	

### Intersection Summary

HCM Average Control Delay	26.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	94.9%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 8: QEW EB Offramp & Trafalgar Rd

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↶↶	↷		↑↑↑	↑↑↑	
Volume (vph)	631	969	0	1535	1651	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		0.91	0.91	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	3506	1617		5142	5142	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	3506	1617		5142	5142	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	631	969	0	1535	1651	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	631	969	0	1535	1651	0
Confl. Peds. (#/hr)	1					
Heavy Vehicles (%)	1%	1%	0%	2%	2%	3%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	69.0	69.0		39.0	39.0	
Effective Green, g (s)	71.0	71.0		41.0	41.0	
Actuated g/C Ratio	0.59	0.59		0.34	0.34	
Clearance Time (s)	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.5	3.5		4.5	4.5	
Lane Grp Cap (vph)	2074	957		1757	1757	
v/s Ratio Prot	0.18			0.30	c0.32	
v/s Ratio Perm		c0.60				
v/c Ratio	0.30	1.01		0.87	0.94	
Uniform Delay, d1	12.2	24.5		37.1	38.3	
Progression Factor	1.00	1.00		1.11	0.86	
Incremental Delay, d2	0.4	70.4		4.2	13.3	
Delay (s)	12.6	94.9		45.4	46.1	
Level of Service	B	F		D	D	
Approach Delay (s)	62.5			45.4	46.1	
Approach LOS	E			D	D	

Intersection Summary			
HCM Average Control Delay	51.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	98.6%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 9: Davis Rd &

6/3/2014



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations	↔			↑↑	↑↑	
Volume (vph)	288	223	0	1227	1001	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0			6.0	6.0	
Lane Util. Factor	1.00			0.95	0.95	
Flt	0.94			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1724			3579	3579	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1724			3579	3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	288	223	0	1227	1001	0
RTOR Reduction (vph)	39	0	0	0	0	0
Lane Group Flow (vph)	472	0	0	1227	1001	0

Turn Type						
Protected Phases	4					
Permitted Phases			2		6	
Actuated Green, G (s)	17.4		23.6		23.6	
Effective Green, g (s)	19.4		23.6		23.6	
Actuated g/C Ratio	0.37		0.45		0.45	
Clearance Time (s)	6.0		6.0		6.0	
Vehicle Extension (s)	3.0		3.0		3.0	
Lane Grp Cap (vph)	631		1594		1594	
v/s Ratio Prot	c0.27					
v/s Ratio Perm			c0.34		0.28	
v/c Ratio	0.75		0.77		0.63	
Uniform Delay, d1	14.7		12.4		11.3	
Progression Factor	1.00		1.00		1.00	
Incremental Delay, d2	5.0		2.3		0.8	
Delay (s)	19.6		14.7		12.1	
Level of Service	B		B		B	
Approach Delay (s)	19.6		14.7		12.1	
Approach LOS	B		B		B	

Intersection Summary			
HCM Average Control Delay	14.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	53.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 10: Cross Ave & Lyons Ln

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	74	790	408	325	490	55	112	7	255	198	37	110
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
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)	1816	3650	1633	1825	3650	1564	1819	1921	1603	1818	1921	1605
Flt Permitted	0.47	1.00	1.00	0.12	1.00	1.00	0.73	1.00	1.00	0.67	1.00	1.00
Satd. Flow (perm)	904	3650	1633	224	3650	1564	1403	1921	1603	1287	1921	1605
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	74	790	408	325	490	55	112	7	255	198	37	110
RTOR Reduction (vph)	0	0	286	0	0	31	0	0	180	0	0	74
Lane Group Flow (vph)	74	790	122	325	490	24	112	7	75	198	37	36
Confl. Peds. (#/hr)	6					6	3		4	4		3
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		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)	37.8	33.8	33.8	58.8	50.8	50.8	41.1	33.4	33.4	49.2	37.5	37.5
Effective Green, g (s)	37.8	35.8	35.8	58.8	52.8	52.8	41.1	35.4	35.4	49.2	39.5	39.5
Actuated g/C Ratio	0.31	0.30	0.30	0.49	0.44	0.44	0.34	0.29	0.29	0.41	0.33	0.33
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	5.0	5.0	3.0	4.0	4.0
Lane Grp Cap (vph)	315	1089	487	390	1606	688	507	567	473	580	632	528
v/s Ratio Prot	0.01	0.22		c0.15	0.13		0.01	0.00		c0.03	0.02	
v/s Ratio Perm	0.07		0.07	c0.26		0.02	0.06		0.05	c0.11		0.02
v/c Ratio	0.23	0.73	0.25	0.83	0.31	0.04	0.22	0.01	0.16	0.34	0.06	0.07
Uniform Delay, d1	29.3	37.7	31.9	31.0	21.7	19.1	27.6	29.9	31.3	23.5	27.5	27.6
Progression Factor	1.00	1.00	1.00	0.97	1.25	2.35	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	2.5	0.3	12.2	0.1	0.0	0.2	0.0	0.7	0.4	0.1	0.1
Delay (s)	29.7	40.2	32.2	42.2	27.2	44.9	27.9	30.0	32.0	23.9	27.6	27.7
Level of Service	C	D	C	D	C	D	C	C	C	C	C	C
Approach Delay (s)		37.0			33.9			30.7			25.5	
Approach LOS		D			C			C			C	

### Intersection Summary

HCM Average Control Delay	33.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	68.2%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 11: Cross Ave & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↕	↖	↖↗	↕	↖	↖	↕↖↗	↖	↖	↕↖↗	↖
Volume (vph)	952	776	109	106	700	125	145	871	521	204	1700	715
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frbp, ped/bikes	1.00	1.00	0.94	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	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)	3437	3650	1444	3471	3614	1597	1722	5193	1399	1772	5193	1391
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.13	1.00	1.00	0.14	1.00	1.00
Satd. Flow (perm)	3437	3650	1444	3471	3614	1597	244	5193	1399	255	5193	1391
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	952	776	109	106	700	125	145	871	521	204	1700	715
RTOR Reduction (vph)	0	0	72	0	0	6	0	0	62	0	0	360
Lane Group Flow (vph)	952	776	37	106	700	119	145	871	459	204	1700	355
Confl. Peds. (#/hr)	8		36	36		8	18		8	8		18
Heavy Vehicles (%)	3%	0%	6%	2%	1%	1%	6%	1%	15%	3%	1%	13%
Turn Type	Prot		Perm	Prot		pm+ov	pm+pt		pm+ov	pm+pt		Perm
Protected Phases	7	4		3	8	1	5	2	3	1	6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	32.0	38.3	38.3	15.7	22.0	36.3	35.7	29.7	45.4	48.0	38.0	38.0
Effective Green, g (s)	34.0	40.3	40.3	17.7	24.0	36.3	35.7	31.7	49.4	48.0	40.0	40.0
Actuated g/C Ratio	0.28	0.34	0.34	0.15	0.20	0.30	0.30	0.26	0.41	0.40	0.33	0.33
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0	4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.5	3.5	3.0	3.0	5.0	3.5	3.0	5.0	5.0
Lane Grp Cap (vph)	974	1226	485	512	723	483	146	1372	623	283	1731	464
v/s Ratio Prot	c0.28	0.21		0.03	c0.19	0.03	c0.05	0.17	0.11	0.09	c0.33	
v/s Ratio Perm			0.03			0.05	0.24		0.22	0.20		0.26
v/c Ratio	0.98	0.63	0.08	0.21	0.97	0.25	0.99	0.63	0.74	0.72	0.98	0.77
Uniform Delay, d1	42.6	33.6	27.2	45.0	47.6	31.6	39.8	39.0	29.8	26.7	39.6	35.8
Progression Factor	1.40	1.25	2.50	1.00	1.00	1.00	1.22	1.13	1.28	1.52	1.08	1.64
Incremental Delay, d2	17.8	0.4	0.0	0.2	41.5	0.3	121.9	1.7	3.7	2.7	12.1	3.6
Delay (s)	77.6	42.3	68.0	45.2	89.1	31.8	170.6	45.7	41.8	43.4	54.9	62.3
Level of Service	E	D	E	D	F	C	F	D	D	D	D	E
Approach Delay (s)		62.1			76.4			56.1			56.0	
Approach LOS		E			E			E			E	

### Intersection Summary

HCM Average Control Delay	60.4	HCM Level of Service	E
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	100.7%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 13: Davis Rd & Transit BRT

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	295	749	259	142	742	363	30	30	58	331	100	371
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	6.0	2.0	6.0	4.0	6.0	4.0	4.0	2.0	2.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Flt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	1883	1601	1789	1883	1601
Flt Permitted	0.29	1.00	1.00	0.19	1.00	1.00	0.69	1.00	1.00	0.65	1.00	1.00
Satd. Flow (perm)	550	1883	1601	363	1883	1601	1304	1883	1601	1230	1883	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	295	749	259	142	742	363	30	30	58	331	100	371
RTOR Reduction (vph)	0	0	117	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	295	749	142	142	742	363	30	30	58	331	100	371
Turn Type	Perm		Perm	pm+pt		Perm	Perm		Free	pm+pt		Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4		4	8		8	2		Free	6		6
Actuated Green, G (s)	60.4	60.4	60.4	68.5	68.5	68.5	11.4	11.4	109.9	31.4	31.4	31.4
Effective Green, g (s)	62.4	62.4	60.4	70.5	68.5	70.5	11.4	13.4	109.9	33.4	33.4	31.4
Actuated g/C Ratio	0.57	0.57	0.55	0.64	0.62	0.64	0.10	0.12	1.00	0.30	0.30	0.29
Clearance Time (s)	6.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0		4.0	4.0	4.0
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)	312	1069	880	312	1174	1027	135	230	1601	455	572	457
v/s Ratio Prot		0.40		0.03	c0.39			0.02		0.11	0.05	
v/s Ratio Perm	c0.54		0.09	0.27		0.23	0.02		0.04	0.12		c0.23
v/c Ratio	0.95	0.70	0.16	0.46	0.63	0.35	0.22	0.13	0.04	0.73	0.17	0.81
Uniform Delay, d1	22.2	17.0	12.2	13.4	12.9	9.1	45.2	43.1	0.0	32.9	28.1	36.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	57.2	2.1	0.1	1.1	1.1	0.2	0.8	0.3	0.0	5.9	0.1	11.4
Delay (s)	79.3	19.2	12.3	14.5	14.0	9.3	46.0	43.3	0.0	38.8	28.3	47.9
Level of Service	E	B	B	B	B	A	D	D	A	D	C	D
Approach Delay (s)		31.4			12.7			22.7			41.7	
Approach LOS		C			B			C			D	

### Intersection Summary

HCM Average Control Delay	26.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	109.9	Sum of lost time (s)	14.0
Intersection Capacity Utilization	92.1%	ICU Level of Service	F
Analysis Period (min)	60		













Description: BRT coded in Node 66

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 14: Davis Rd & local road

6/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑							
Volume (veh/h)	101	1037	0	0	1039	0	0	0	0	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	101	1037	0	0	1039	0	0	0	0	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)		330			232							
pX, platoon unblocked	0.94						0.94	0.94		0.94	0.94	0.94
vC, conflicting volume	1039			1037			1758	2278	518	1760	2278	520
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	916			1037			1681	2233	518	1682	2233	364
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	85			100			100	100	100	100	100	100
cM capacity (veh/h)	697			666			52	34	502	51	34	595
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>WB 2</b>								
Volume Total	447	691	520	520								
Volume Left	101	0	0	0								
Volume Right	0	0	0	0								
cSH	697	1700	1700	1700								
Volume to Capacity	0.15	0.41	0.31	0.31								
Queue Length 95th (m)	3.9	0.0	0.0	0.0								
Control Delay (s)	4.1	0.0	0.0	0.0								
Lane LOS	A											
Approach Delay (s)	1.6		0.0									
Approach LOS												
<b>Intersection Summary</b>												
Average Delay			0.8									
Intersection Capacity Utilization			67.0%		ICU Level of Service				C			
Analysis Period (min)			60									

# HCM Signalized Intersection Capacity Analysis

## 15: Davis Rd & Chartwell Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Volume (vph)	4	896	107	0	566	97	574	7	219	10	30	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0	6.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00		0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	0.93	
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1789	3579	1601		3579	1601	1789	1883	1601	1789	1742	
Flt Permitted	0.30	1.00	1.00		1.00	1.00	0.49	1.00	1.00	0.98	1.00	
Satd. Flow (perm)	565	3579	1601		3579	1601	930	1883	1601	1838	1742	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	4	896	107	0	566	97	574	7	219	10	30	30
RTOR Reduction (vph)	0	0	60	0	0	48	0	0	142	0	27	0
Lane Group Flow (vph)	4	896	47	0	566	49	574	7	77	10	33	0
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases	2		2	6		6	8		8	4		
Actuated Green, G (s)	29.5	29.5	29.5		22.9	22.9	29.7	25.1	25.1	4.7	4.1	
Effective Green, g (s)	31.5	31.5	31.5		24.9	24.9	29.7	27.1	25.1	4.7	6.1	
Actuated g/C Ratio	0.44	0.44	0.44		0.35	0.35	0.42	0.38	0.35	0.07	0.09	
Clearance Time (s)	6.0	6.0	6.0		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)	295	1583	708		1252	560	649	717	564	121	149	
v/s Ratio Prot	0.00	c0.25			0.16		c0.27	0.00		0.00	0.02	
v/s Ratio Perm	0.01		0.03			0.03	c0.10		0.05	0.00		
v/c Ratio	0.01	0.57	0.07		0.45	0.09	0.88	0.01	0.14	0.08	0.22	
Uniform Delay, d1	11.7	14.8	11.4		17.9	15.5	18.0	13.7	15.7	31.2	30.3	
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	0.0	0.5	0.0		0.3	0.1	15.9	0.0	0.1	0.3	0.7	
Delay (s)	11.7	15.2	11.4		18.1	15.6	33.9	13.7	15.8	31.5	31.1	
Level of Service	B	B	B		B	B	C	B	B	C	C	
Approach Delay (s)		14.8			17.8			28.8			31.1	
Approach LOS		B			B			C			C	

### Intersection Summary

HCM Average Control Delay	20.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	71.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 16: Davis Rd & QEW EB Button Hook

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↗
Volume (veh/h)	0	1125	583	0	0	80
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	1125	583	0	0	80
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	583				1146	292
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	583				1146	292
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	89
cM capacity (veh/h)	987				193	705
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	562	562	292	292	80	
Volume Left	0	0	0	0	0	
Volume Right	0	0	0	0	80	
cSH	1700	1700	1700	1700	705	
Volume to Capacity	0.33	0.33	0.17	0.17	0.11	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	2.9	
Control Delay (s)	0.0	0.0	0.0	0.0	10.8	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		10.8	
Approach LOS					B	
Intersection Summary						
Average Delay			0.5			
Intersection Capacity Utilization			34.4%		ICU Level of Service	A
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 18: Speers Rd & Cross Ave

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↑↑	↗		↙	↘
Volume (vph)	902	1229	553	353	239	524
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.94		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1772	3544	3328		1789	1593
Flt Permitted	0.10	1.00	1.00		0.95	1.00
Satd. Flow (perm)	181	3544	3328		1789	1593
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	902	1229	553	353	239	524
RTOR Reduction (vph)	0	0	78	0	0	36
Lane Group Flow (vph)	902	1229	828	0	239	488
Confl. Peds. (#/hr)	20			20	2	3
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Turn Type	pm+pt				pm+ov	
Protected Phases	5	2			4	5
Permitted Phases	2		6			4
Actuated Green, G (s)	93.1	93.1	38.1		22.1	74.1
Effective Green, g (s)	92.1	95.1	40.1		24.1	72.1
Actuated g/C Ratio	0.72	0.75	0.32		0.19	0.57
Clearance Time (s)	3.0	6.0	6.0		6.0	3.0
Vehicle Extension (s)	3.5	3.5	3.5		5.0	3.5
Lane Grp Cap (vph)	769	2650	1049		339	903
v/s Ratio Prot	c0.47	0.35			c0.13	0.22
v/s Ratio Perm	c0.38		0.25			0.09
v/c Ratio	1.17	0.46	0.79		0.71	0.54
Uniform Delay, d1	33.1	6.2	39.7		48.2	17.2
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	326.5	0.2	4.3		8.5	0.7
Delay (s)	359.6	6.4	44.0		56.7	17.9
Level of Service	F	A	D		E	B
Approach Delay (s)		155.9	44.0		30.1	
Approach LOS		F	D		C	

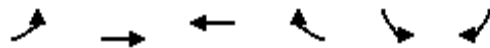
### Intersection Summary

HCM Average Control Delay	103.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	127.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	105.6%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 19: Speers Rd & Old Mill Rd

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↶	↶↶	↶↶		↶	↶
Volume (vph)	299	1193	856	159	222	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	0.99		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	3614	3483		1825	1617
Flt Permitted	0.12	1.00	1.00		0.95	1.00
Satd. Flow (perm)	235	3614	3483		1825	1617
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	299	1193	856	159	222	58
RTOR Reduction (vph)	0	0	14	0	0	45
Lane Group Flow (vph)	299	1193	1001	0	222	13
Confl. Peds. (#/hr)	13			13	1	
Heavy Vehicles (%)	2%	1%	2%	0%	0%	1%
Turn Type	pm+pt					Perm
Protected Phases	5	2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	47.4	47.4	28.1		15.0	15.0
Effective Green, g (s)	47.4	49.4	30.1		17.0	17.0
Actuated g/C Ratio	0.64	0.66	0.40		0.23	0.23
Clearance Time (s)	4.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	469	2400	1409		417	369
v/s Ratio Prot	c0.13	0.33	c0.29		c0.12	
v/s Ratio Perm	0.28					0.01
v/c Ratio	0.64	0.50	0.71		0.53	0.04
Uniform Delay, d1	13.6	6.3	18.5		25.2	22.3
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.9	0.2	1.7		1.3	0.0
Delay (s)	16.5	6.4	20.2		26.5	22.4
Level of Service	B	A	C		C	C
Approach Delay (s)		8.4	20.2		25.7	
Approach LOS		A	C		C	

### Intersection Summary

HCM Average Control Delay	14.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	74.4	Sum of lost time (s)	12.0
Intersection Capacity Utilization	67.8%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 21: Cornwall Rd & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↖↗		↖	↕	↗	↖	↕	↗	↖↗	↕	↗
Volume (vph)	755	678	107	38	545	547	94	330	9	667	477	645
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.97	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	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)	3437	3451		1793	3510	1536	1821	3579	1555	3437	1902	1561
Flt Permitted	0.95	1.00		0.35	1.00	1.00	0.42	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3437	3451		669	3510	1536	802	3579	1555	3437	1902	1561
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	755	678	107	38	545	547	94	330	9	667	477	645
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	7	0	0	353
Lane Group Flow (vph)	755	774	0	38	545	547	94	330	2	667	477	292
Confl. Peds. (#/hr)	33		9	9		33	9		12	12		9
Heavy Vehicles (%)	3%	3%	3%	1%	4%	4%	0%	2%	2%	3%	1%	2%
Turn Type	Prot			Perm		Free	pm+pt		Perm	Prot		Perm
Protected Phases	7	4			8		5	2		1		6
Permitted Phases				8		Free	2		2			6
Actuated Green, G (s)	26.0	53.2		22.2	22.2	120.0	32.2	26.1	26.1	23.7	44.7	44.7
Effective Green, g (s)	27.0	55.2		24.2	24.2	120.0	32.2	28.1	28.1	24.7	46.7	46.7
Actuated g/C Ratio	0.22	0.46		0.20	0.20	1.00	0.27	0.23	0.23	0.21	0.39	0.39
Clearance Time (s)	5.0	6.0		6.0	6.0		4.0	6.0	6.0	5.0	6.0	6.0
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	5.0	5.0	4.0	5.0	5.0
Lane Grp Cap (vph)	773	1587		135	708	1536	267	838	364	707	740	607
v/s Ratio Prot	c0.22	0.22			c0.16		0.02	0.09		c0.19	c0.25	
v/s Ratio Perm				0.06		0.36	0.08		0.00			0.19
v/c Ratio	0.98	0.49		0.28	0.77	0.36	0.35	0.39	0.01	0.94	0.64	0.48
Uniform Delay, d1	46.2	22.6		40.5	45.3	0.0	33.9	38.8	35.2	47.0	29.9	27.5
Progression Factor	1.00	1.00		1.28	1.21	1.00	1.00	1.00	1.00	1.40	1.52	6.13
Incremental Delay, d2	45.1	0.3		1.5	5.3	0.6	0.8	1.4	0.0	14.6	1.9	1.2
Delay (s)	91.3	22.9		53.5	60.0	0.6	34.7	40.2	35.3	80.2	47.2	170.1
Level of Service	F	C		D	E	A	C	D	D	F	D	F
Approach Delay (s)		56.4			31.0			38.9			103.8	
Approach LOS		E			C			D			F	

### Intersection Summary

HCM Average Control Delay	66.3	HCM Level of Service	E
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.5%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 22: Cornwall Rd & Reynolds St

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑		↑	↑		↑	↑	
Volume (vph)	5	1072	267	34	984	12	120	7	37	11	4	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes		1.00	0.97	1.00	1.00		1.00	0.97		1.00	0.99	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00		0.98	1.00	
Frt		1.00	0.85	1.00	1.00		1.00	0.87		1.00	0.87	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3543	1533	1803	3606		1735	1557		1739	1605	
Flt Permitted		0.95	1.00	0.24	1.00		0.74	1.00		0.73	1.00	
Satd. Flow (perm)		3370	1533	459	3606		1349	1557		1333	1605	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	1072	267	34	984	12	120	7	37	11	4	25
RTOR Reduction (vph)	0	0	59	0	0	0	0	31	0	0	21	0
Lane Group Flow (vph)	0	1077	208	34	996	0	120	13	0	11	8	0
Confl. Peds. (#/hr)	3		4	4		3	1		12	12		1
Heavy Vehicles (%)	3%	3%	3%	1%	1%	1%	5%	5%	5%	3%	3%	3%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		2			2			4			4	
Permitted Phases	2		2	2			4			4		
Actuated Green, G (s)		91.3	91.3	91.3	91.3		16.7	16.7		16.7	16.7	
Effective Green, g (s)		93.3	93.3	93.3	93.3		18.7	18.7		18.7	18.7	
Actuated g/C Ratio		0.78	0.78	0.78	0.78		0.16	0.16		0.16	0.16	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		4.0	4.0	4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2620	1192	357	2804		210	243		208	250	
v/s Ratio Prot					0.28			0.01			0.00	
v/s Ratio Perm		c0.32	0.14	0.07			c0.09			0.01		
v/c Ratio		0.41	0.17	0.10	0.36		0.57	0.05		0.05	0.03	
Uniform Delay, d1		4.4	3.4	3.2	4.1		46.9	43.1		43.1	43.0	
Progression Factor		1.31	3.62	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.3	0.2	0.5	0.4		3.8	0.1		0.1	0.1	
Delay (s)		6.0	12.7	3.7	4.5		50.7	43.2		43.2	43.0	
Level of Service		A	B	A	A		D	D		D	D	
Approach Delay (s)		7.4			4.4			48.7			43.1	
Approach LOS		A			A			D			D	

### Intersection Summary

HCM Average Control Delay	9.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.8%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 23: Cornwall Rd & Chartwell Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖↗		↖	↖↗	↖	↖	↖↗	↖	↖	↖↗	↖
Volume (vph)	171	577	171	38	586	313	188	100	40	120	33	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		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)	1738	3357		1772	3544	1585	1722	3444	1541	1825	3650	1633
Flt Permitted	0.37	1.00		0.37	1.00	1.00	0.43	1.00	1.00	0.70	1.00	1.00
Satd. Flow (perm)	681	3357		686	3544	1585	782	3444	1541	1348	3650	1633
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	171	577	171	38	586	313	188	100	40	120	33	41
RTOR Reduction (vph)	0	14	0	0	0	126	0	0	35	0	0	39
Lane Group Flow (vph)	171	734	0	38	586	187	188	100	5	120	33	2
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	6%	6%	6%	0%	0%	0%
Turn Type	pm+pt			Perm		Perm	pm+pt			Perm	pm+pt	
Protected Phases	5	2			6		3	8			7	4
Permitted Phases	2			6		6	8		8	4		4
Actuated Green, G (s)	89.3	89.3		75.5	75.5	75.5	28.3	13.2	13.2	16.8	5.7	5.7
Effective Green, g (s)	89.3	91.5		77.7	77.7	77.7	28.3	15.4	15.4	16.8	7.9	7.9
Actuated g/C Ratio	0.69	0.70		0.60	0.60	0.60	0.22	0.12	0.12	0.13	0.06	0.06
Clearance Time (s)	4.0	6.2		6.2	6.2	6.2	4.0	6.2	6.2	4.0	6.2	6.2
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)	547	2363		410	2118	947	305	408	183	215	222	99
v/s Ratio Prot	0.02	c0.22			0.17		c0.09	0.03		0.05	0.01	
v/s Ratio Perm	0.19			0.06		0.12	c0.05		0.00	0.02		0.00
v/c Ratio	0.31	0.31		0.09	0.28	0.20	0.62	0.25	0.03	0.56	0.15	0.03
Uniform Delay, d1	7.6	7.3		11.1	12.6	11.9	44.7	52.0	50.7	52.8	57.9	57.4
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	0.3	0.3		0.1	0.1	0.1	3.7	0.3	0.1	3.2	0.3	0.1
Delay (s)	8.0	7.6		11.2	12.7	12.0	48.5	52.3	50.7	55.9	58.2	57.5
Level of Service	A	A		B	B	B	D	D	D	E	E	E
Approach Delay (s)		7.7			12.4			49.9			56.6	
Approach LOS		A			B			D			E	

### Intersection Summary

HCM Average Control Delay	19.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	53.5%	ICU Level of Service	A
Analysis Period (min)	60		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 24: Cross Ave & Argus Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	51	1078	175	451	958	72	237	1	487	211	6	334
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.85	1.00
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)	1808	3614	816	913	3614	1544	913	1921	816	1804	1608	1900
Flt Permitted	0.30	1.00	1.00	0.12	1.00	1.00	0.41	1.00	1.00	0.76	1.00	1.00
Satd. Flow (perm)	569	3614	816	120	3614	1544	392	1921	816	1438	1608	1900
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	51	1078	175	451	958	72	237	1	487	211	6	334
RTOR Reduction (vph)	0	0	102	0	0	34	0	0	250	0	56	0
Lane Group Flow (vph)	51	1078	73	451	958	38	237	1	237	211	284	0
Confl. Peds. (#/hr)	13					13				1		
Heavy Vehicles (%)	0%	1%	100%	100%	1%	0%	100%	0%	100%	1%	50%	1%
Turn Type	Perm		Perm	pm+pt		Perm	custom		custom	Perm		
Protected Phases		2		1	6			8			8	
Permitted Phases	2		2	6		6	4		4	8		
Actuated Green, G (s)	29.0	29.0	29.0	62.0	62.0	62.0	46.0	46.0	46.0	46.0	46.0	46.0
Effective Green, g (s)	31.0	31.0	31.0	61.0	64.0	64.0	48.0	48.0	48.0	48.0	48.0	48.0
Actuated g/C Ratio	0.26	0.26	0.26	0.51	0.53	0.53	0.40	0.40	0.40	0.40	0.40	0.40
Clearance Time (s)	6.0	6.0	6.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	147	934	211	253	1927	823	157	768	326	575	643	643
v/s Ratio Prot		0.30		c0.43	0.27			0.00				0.18
v/s Ratio Perm	0.09		0.09	c0.48		0.02	c0.60		0.29	0.15		
v/c Ratio	0.35	1.15	0.35	1.78	0.50	0.05	1.51	0.00	0.73	0.37	0.44	
Uniform Delay, d1	36.3	44.5	36.3	36.0	17.8	13.4	36.0	21.6	30.4	25.3	26.2	
Progression Factor	0.64	0.70	0.67	1.34	1.30	2.64	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.5	289.3	3.9	1414.8	0.3	0.0	950.0	0.0	8.2	0.4	0.5	
Delay (s)	28.9	320.6	28.2	1462.9	23.4	35.4	986.0	21.6	38.6	25.7	26.7	
Level of Service	C	F	C	F	C	D	F	C	D	C	C	
Approach Delay (s)		270.0			462.3			348.3			26.3	
Approach LOS		F			F			F			C	

### Intersection Summary

HCM Average Control Delay	321.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.60		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	102.2%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 27: MCraney Street & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	182	71	381	126	41	199	161	1218	282	291	958	106
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0		5.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97	1.00	0.99		1.00	0.99	
Flpb, ped/bikes	0.98	1.00	1.00	0.99	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1759	1921	1554	1726	1902	1554	1782	4931		1825	5008	
Flt Permitted	0.73	1.00	1.00	0.71	1.00	1.00	0.26	1.00		0.11	1.00	
Satd. Flow (perm)	1352	1921	1554	1291	1902	1554	481	4931		209	5008	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	182	71	381	126	41	199	161	1218	282	291	958	106
RTOR Reduction (vph)	0	0	199	0	0	166	0	22	0	0	8	0
Lane Group Flow (vph)	182	71	182	126	41	33	161	1478	0	291	1056	0
Confl. Peds. (#/hr)	16		7	7		16	39		4	4		39
Heavy Vehicles (%)	2%	0%	3%	5%	1%	2%	2%	3%	2%	0%	2%	3%
Turn Type	Perm		Perm	Perm		Perm	pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	21.7	21.7	21.7	21.7	21.7	21.7	78.7	69.7		94.3	80.3	
Effective Green, g (s)	21.7	21.7	21.7	21.7	21.7	21.7	78.7	69.7		94.3	80.3	
Actuated g/C Ratio	0.17	0.17	0.17	0.17	0.17	0.17	0.61	0.54		0.73	0.62	
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0		5.0	7.0	
Lane Grp Cap (vph)	226	321	259	215	317	259	381	2644		395	3093	
v/s Ratio Prot		0.04			0.02		0.03	0.30		c0.11	0.21	
v/s Ratio Perm	c0.13		0.12	0.10		0.02	0.23			c0.42		
v/c Ratio	0.81	0.22	0.70	0.59	0.13	0.13	0.42	0.56		0.74	0.34	
Uniform Delay, d1	52.1	46.8	51.1	50.0	46.1	46.1	11.1	20.0		24.1	12.0	
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	30.3	1.6	15.9	11.7	0.8	1.0	3.4	0.9		12.4	0.3	
Delay (s)	82.4	48.4	67.0	61.7	46.9	47.1	14.6	20.8		36.5	12.3	
Level of Service	F	D	E	E	D	D	B	C		D	B	
Approach Delay (s)		69.4			52.1			20.2			17.5	
Approach LOS		E			D			C			B	

### Intersection Summary

HCM Average Control Delay	30.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.9%	ICU Level of Service	D
Analysis Period (min)	60		

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 75: White Oak Boulevard & N-S Crossing

6/3/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	196	10	170	10	50	219
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	196	10	170	10	50	219
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						
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol						
tC, single (s)						
tC, 2 stage (s)						
tF (s)						
p0 queue free %						
cM capacity (veh/h)						

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	206	180	269
Volume Left	196	0	50
Volume Right	10	10	0
cSH	526	1700	1396
Volume to Capacity	0.39	0.11	0.04
Queue Length 95th (m)	14.5	0.0	0.8
Control Delay (s)	16.2	0.0	1.7
Lane LOS	C		A
Approach Delay (s)	16.2	0.0	1.7
Approach LOS	C		

Intersection Summary			
Average Delay		5.8	
Intersection Capacity Utilization	45.3%	ICU Level of Service	A
Analysis Period (min)	60		

# HCM Signalized Intersection Capacity Analysis

## 79: Cross Avenue &

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	950	10	86	10	10	1197
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	4.0
Lane Util. Factor	0.97	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3471	1883	1857		1789	1601
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3471	1883	1857		1789	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	950	10	86	10	10	1197
RTOR Reduction (vph)	0	0	5	0	0	0
Lane Group Flow (vph)	950	10	91	0	10	1197
Turn Type	Prot			Free		
Protected Phases	7	4	8		6	
Permitted Phases				Free		
Actuated Green, G (s)	42.3	56.1	7.8		12.1	80.2
Effective Green, g (s)	42.3	56.1	7.8		12.1	80.2
Actuated g/C Ratio	0.53	0.70	0.10		0.15	1.00
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)	1831	1317	181		270	1601
v/s Ratio Prot	0.27	0.01	0.05		0.01	
v/s Ratio Perm				c0.75		
v/c Ratio	0.52	0.01	0.50		0.04	0.75
Uniform Delay, d1	12.3	3.6	34.4		29.1	0.0
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.1	0.0	2.2		0.3	3.3
Delay (s)	13.4	3.6	36.5		29.3	3.3
Level of Service	B	A	D		C	A
Approach Delay (s)	13.3		36.5		3.5	
Approach LOS	B		D		A	

### Intersection Summary

HCM Average Control Delay	9.1	HCM Level of Service	A
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	80.2	Sum of lost time (s)	0.0
Intersection Capacity Utilization	50.4%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 5: QEW WB Offramp & Iroquois Shore Rd

6/3/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	476	18	726	0	0	878
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	1.00	1.00	0.95			0.95
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	1789	1601	3579			3579
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	1789	1601	3579			3579
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	476	18	726	0	0	878
RTOR Reduction (vph)	0	9	0	0	0	0
Lane Group Flow (vph)	476	9	726	0	0	878
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	21.3	21.3	26.5			26.5
Effective Green, g (s)	23.3	23.3	28.5			28.5
Actuated g/C Ratio	0.39	0.39	0.48			0.48
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)	697	624	1706			1706
v/s Ratio Prot	c0.27		0.20			c0.25
v/s Ratio Perm		0.01				
v/c Ratio	0.68	0.01	0.43			0.51
Uniform Delay, d1	15.2	11.2	10.3			10.9
Progression Factor	1.00	1.00	1.00			1.00
Incremental Delay, d2	2.8	0.0	0.2			0.3
Delay (s)	18.0	11.2	10.4			11.1
Level of Service	B	B	B			B
Approach Delay (s)	17.7		10.4			11.1
Approach LOS	B		B			B

### Intersection Summary

HCM Average Control Delay	12.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	59.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Unsignalized Intersection Capacity Analysis

## 16: Davis Rd & QEW EB Button Hook

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↗
Volume (veh/h)	0	1423	394	0	0	348
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	1423	394	0	0	348
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)			115			
pX, platoon unblocked						
vC, conflicting volume	394				1106	197
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	394				1106	197
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	57
cM capacity (veh/h)	1161				205	811
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	712	712	197	197	348	
Volume Left	0	0	0	0	0	
Volume Right	0	0	0	0	348	
cSH	1700	1700	1700	1700	811	
Volume to Capacity	0.42	0.42	0.12	0.12	0.43	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	17.0	
Control Delay (s)	0.0	0.0	0.0	0.0	12.8	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		12.8	
Approach LOS					B	
Intersection Summary						
Average Delay			2.1			
Intersection Capacity Utilization			42.7%		ICU Level of Service	A
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 17: Iroquois Shore Rd & QEW EB Onramp

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	282	635	436	147	1194	70	77	250	854	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	4.0	4.0	3.0	4.0		4.0	4.0	3.0			
Lane Util. Factor	1.00	0.95	1.00	1.00	0.91		1.00	1.00	1.00			
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85			
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00			
Satd. Flow (prot)	1789	3579	1601	1789	5099		1789	1883	1601			
Flt Permitted	0.19	1.00	1.00	0.22	1.00		0.95	1.00	1.00			
Satd. Flow (perm)	359	3579	1601	413	5099		1789	1883	1601			
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	282	635	436	147	1194	70	77	250	854	0	0	0
RTOR Reduction (vph)	0	0	224	0	6	0	0	0	12	0	0	0
Lane Group Flow (vph)	282	635	212	147	1258	0	77	250	842	0	0	0
Turn Type	pm+pt		Perm	pm+pt		Perm		pm+ov				
Protected Phases	7	4		3	8			2	3			
Permitted Phases	4		4	8		2			2			
Actuated Green, G (s)	39.9	26.1	26.1	56.2	38.4		25.9	25.9	52.0			
Effective Green, g (s)	41.9	28.1	28.1	57.2	40.4		27.9	27.9	54.0			
Actuated g/C Ratio	0.45	0.30	0.30	0.61	0.43		0.30	0.30	0.57			
Clearance Time (s)	4.0	6.0	6.0	4.0	6.0		6.0	6.0	4.0			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0			
Lane Grp Cap (vph)	385	1069	478	647	2189		530	558	919			
v/s Ratio Prot	0.12	0.18		0.07	0.25			0.13	c0.26			
v/s Ratio Perm	c0.21		0.13	0.07		0.04			0.26			
v/c Ratio	0.73	0.59	0.44	0.23	0.57		0.15	0.45	0.92			
Uniform Delay, d1	17.3	28.1	26.7	9.2	20.3		24.3	26.9	18.0			
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00			
Incremental Delay, d2	7.3	0.9	0.7	0.2	0.4		0.1	0.6	16.6			
Delay (s)	24.6	29.0	27.3	9.4	20.7		24.5	27.4	34.6			
Level of Service	C	C	C	A	C		C	C	C			
Approach Delay (s)		27.6			19.5			32.5			0.0	
Approach LOS		C			B			C			A	

### Intersection Summary

HCM Average Control Delay	26.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	94.1	Sum of lost time (s)	9.0
Intersection Capacity Utilization	80.4%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 25: Iroquois Shore Rd & Canadian Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↗↗			↗↗	↘	↘	↗	↘	↘		↘
Volume (vph)	13	1476	0	0	1298	10	88	173	704	6	0	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0	4.0	4.0	0.2	4.0		4.0
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00	1.00	1.00	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00	1.00	0.95		1.00
Satd. Flow (prot)	1789	3579			3579	1601	1789	1883	1601	1789		1601
Flt Permitted	0.11	1.00			1.00	1.00	0.95	1.00	1.00	0.59		1.00
Satd. Flow (perm)	205	3579			3579	1601	1789	1883	1601	1109		1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	13	1476	0	0	1298	10	88	173	704	6	0	24
RTOR Reduction (vph)	0	0	0	0	0	2	0	0	0	0	0	18
Lane Group Flow (vph)	13	1476	0	0	1298	8	88	173	704	6	0	6
Turn Type	pm+pt				Perm		Perm	Free		custom	custom	
Protected Phases	5	2			6			4				
Permitted Phases	2					6	4		Free	7		7
Actuated Green, G (s)	39.8	39.8			34.3	34.3	13.2	13.2	69.2	13.2		13.2
Effective Green, g (s)	39.8	44.2			38.7	38.7	17.0	17.0	69.2	17.0		17.0
Actuated g/C Ratio	0.58	0.64			0.56	0.56	0.25	0.25	1.00	0.25		0.25
Clearance Time (s)	4.0	8.4			8.4	8.4	7.8	7.8		7.8		7.8
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	152	2286			2002	895	439	463	1601	272		393
v/s Ratio Prot	0.00	c0.41			0.36			0.09				
v/s Ratio Perm	0.05					0.00	0.05		c0.44	0.01		0.00
v/c Ratio	0.09	0.65			0.65	0.01	0.20	0.37	0.44	0.02		0.02
Uniform Delay, d1	8.9	7.7			10.5	6.8	20.7	21.7	0.0	19.8		19.8
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	0.2	0.6			0.7	0.0	0.2	0.5	0.9	0.0		0.0
Delay (s)	9.1	8.3			11.3	6.8	20.9	22.2	0.9	19.8		19.8
Level of Service	A	A			B	A	C	C	A	B		B
Approach Delay (s)		8.3			11.2			6.5			19.8	
Approach LOS		A			B			A			B	

### Intersection Summary

HCM Average Control Delay	9.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	69.2	Sum of lost time (s)	0.0
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 44: QEW WB Onramp & Iroquois Shore Rd

6/3/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑	↗		↑↑
Volume (veh/h)	0	0	0	0	0	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	0	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (m)			109			116
pX, platoon unblocked						
vC, conflicting volume	0	0			0	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0	0			0	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	1023	1084			1622	
Direction, Lane #	NB 1	NB 2	NB 3	SB 1	SB 2	
Volume Total	0	0	0	0	0	
Volume Left	0	0	0	0	0	
Volume Right	0	0	0	0	0	
cSH	1700	1700	1700	1700	1700	
Volume to Capacity	0.00	0.00	0.00	0.00	0.00	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	
Lane LOS						
Approach Delay (s)	0.0			0.0		
Approach LOS						
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			57.3%		ICU Level of Service	B
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 1: Leighland Ave & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	166	446	126	316	373	450	263	1720	268	247	1476	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.96
Flpb, ped/bikes	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
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)	1753	3650	1596	3471	1902	1548	1807	5142	1601	1825	5142	1532
Flt Permitted	0.54	1.00	1.00	0.95	1.00	1.00	0.09	1.00	1.00	0.09	1.00	1.00
Satd. Flow (perm)	996	3650	1596	3471	1902	1548	175	5142	1601	179	5142	1532
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	166	446	126	316	373	450	263	1720	268	247	1476	126
RTOR Reduction (vph)	0	0	0	0	0	1	0	0	0	0	0	76
Lane Group Flow (vph)	166	446	126	316	373	449	263	1720	268	247	1476	50
Confl. Peds. (#/hr)	28		3	3		28	10					10
Heavy Vehicles (%)	2%	0%	1%	2%	1%	2%	1%	2%	2%	0%	2%	2%
Turn Type	Perm		Free	Prot		pm+ov	pm+pt		Free	pm+pt		Perm
Protected Phases		4		3	8	1	5	2		1	6	
Permitted Phases	4		Free			8	2		Free	6		6
Actuated Green, G (s)	23.5	23.5	116.1	11.1	40.6	55.7	58.9	43.4	116.1	58.1	43.0	43.0
Effective Green, g (s)	25.5	25.5	116.1	13.1	42.6	55.7	58.9	46.4	116.1	58.1	46.0	46.0
Actuated g/C Ratio	0.22	0.22	1.00	0.11	0.37	0.48	0.51	0.40	1.00	0.50	0.40	0.40
Clearance Time (s)	6.0	6.0		6.0	6.0	4.0	4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.5	3.5		3.5	3.5	3.5	3.5	5.0		3.5	5.0	5.0
Lane Grp Cap (vph)	219	802	1596	392	698	743	307	2055	1601	304	2037	607
v/s Ratio Prot		0.12		c0.09	0.20	0.08	c0.11	c0.33		0.11	0.29	
v/s Ratio Perm	c0.17		0.08			0.21	0.32		c0.17	0.30		0.03
v/c Ratio	0.76	0.56	0.08	0.81	0.53	0.60	0.86	0.84	0.17	0.81	0.72	0.08
Uniform Delay, d1	42.4	40.3	0.0	50.3	28.9	22.1	31.0	31.4	0.0	30.4	29.7	21.9
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	15.7	0.9	0.1	12.9	0.9	1.5	24.9	3.6	0.2	17.5	1.6	0.1
Delay (s)	58.1	41.2	0.1	63.1	29.8	23.6	55.9	35.1	0.2	47.8	31.3	22.0
Level of Service	E	D	A	E	C	C	E	D	A	D	C	C
Approach Delay (s)		38.0			36.6			33.4			32.9	
Approach LOS		D			D			C			C	

### Intersection Summary

HCM Average Control Delay	34.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	116.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.6%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 2: Iroquois Shore Rd & N-S Crossing

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗	↗		↗	
Volume (vph)	10	710	10	354	693	30	319	268	567	20	156	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	4.0		2.0	4.0		2.0	6.0	6.0		6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00	1.00		1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00		1.00	
Frt	1.00	1.00		1.00	0.99		1.00	1.00	0.85		1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00		0.99	
Satd. Flow (prot)	1789	3535		1789	3556		1785	1883	1601		1873	
Flt Permitted	0.38	1.00		0.20	1.00		0.48	1.00	1.00		0.93	
Satd. Flow (perm)	710	3535		379	3556		893	1883	1601		1753	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	10	710	10	354	693	30	319	268	567	20	156	0
RTOR Reduction (vph)	0	1	0	0	2	0	0	0	331	0	0	0
Lane Group Flow (vph)	10	719	0	354	721	0	319	268	236	0	176	0
Confl. Peds. (#/hr)			5	5			7					
Heavy Vehicles (%)	2%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			pm+pt			pm+pt			Perm	Perm	
Protected Phases		2		1	6		3	8				4
Permitted Phases	2			6			8		8	4		
Actuated Green, G (s)	28.7	28.7		50.1	50.1		33.4	33.4	33.4			16.2
Effective Green, g (s)	28.7	30.7		52.1	52.1		35.4	33.4	33.4			16.2
Actuated g/C Ratio	0.30	0.32		0.55	0.55		0.37	0.35	0.35			0.17
Clearance Time (s)	6.0	6.0		4.0	6.0		4.0	6.0	6.0			6.0
Vehicle Extension (s)	5.0	5.0		3.0	5.0		3.5	3.0	3.0			3.5
Lane Grp Cap (vph)	213	1136		493	1940		473	659	560			297
v/s Ratio Prot		c0.20		c0.15	0.20		c0.11	0.14				
v/s Ratio Perm	0.01			0.25			0.14		0.15			c0.10
v/c Ratio	0.05	0.63		0.72	0.37		0.67	0.41	0.42			0.59
Uniform Delay, d1	23.7	27.6		14.7	12.4		23.6	23.5	23.7			36.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00			1.00
Incremental Delay, d2	0.2	1.6		5.1	0.3		3.9	0.4	0.5			3.4
Delay (s)	23.9	29.2		19.8	12.6		27.4	24.0	24.2			40.0
Level of Service	C	C		B	B		C	C	C			D
Approach Delay (s)		29.2			15.0			25.0				40.0
Approach LOS		C			B			C				D

### Intersection Summary

HCM Average Control Delay	23.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	95.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 3: Iroquois Shore Rd & local road

6/3/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑		
Volume (veh/h)	1297	0	0	1077	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1297	0	0	1077	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (m)	230			275		
pX, platoon unblocked			0.84		0.90	0.84
vC, conflicting volume			1297		1836	648
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			965		886	191
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			593		255	685

Direction, Lane #	EB 1	EB 2	WB 1	WB 2
Volume Total	648	648	538	538
Volume Left	0	0	0	0
Volume Right	0	0	0	0
cSH	1700	1700	1700	1700
Volume to Capacity	0.38	0.38	0.32	0.32
Queue Length 95th (m)	0.0	0.0	0.0	0.0
Control Delay (s)	0.0	0.0	0.0	0.0
Lane LOS				
Approach Delay (s)	0.0		0.0	
Approach LOS				

Intersection Summary			
Average Delay		0.0	
Intersection Capacity Utilization		39.2%	ICU Level of Service A
Analysis Period (min)		60	

# HCM Signalized Intersection Capacity Analysis

## 4: Iroquois Shore Rd & Eighth Line

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↖↗		↖	↖↗		↖	↗		↖	↗	
Volume (vph)	655	492	151	94	702	238	161	24	94	160	17	249
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		6.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.96		1.00	0.96		1.00	0.88		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)	1789	3452		1789	3443		1789	1658		1789	1651	
Flt Permitted	0.11	1.00		0.41	1.00		0.18	1.00		0.68	1.00	
Satd. Flow (perm)	215	3452		768	3443		332	1658		1283	1651	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	655	492	151	94	702	238	161	24	94	160	17	249
RTOR Reduction (vph)	0	22	0	0	27	0	0	69	0	0	204	0
Lane Group Flow (vph)	655	621	0	94	913	0	161	49	0	160	62	0
Confl. Peds. (#/hr)	1											
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	0%	0%
Turn Type	pm+pt			Perm			pm+pt			Perm		
Protected Phases	5	2			6		7	4			8	
Permitted Phases	2			6			4			8		
Actuated Green, G (s)	74.1	74.1		31.0	31.0		27.7	27.7		18.7	18.7	
Effective Green, g (s)	74.1	76.1		31.0	33.0		27.7	29.7		20.7	20.7	
Actuated g/C Ratio	0.65	0.67		0.27	0.29		0.24	0.26		0.18	0.18	
Clearance Time (s)	4.0	6.0		6.0	6.0		4.0	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)	681	2308		209	998		145	433		233	300	
v/s Ratio Prot	c0.33	0.18			0.27		c0.05	0.03			0.04	
v/s Ratio Perm	c0.30			0.12			c0.22			0.12		
v/c Ratio	0.96	0.27		0.45	0.91		1.11	0.11		0.69	0.21	
Uniform Delay, d1	30.4	7.6		34.3	39.0		41.7	32.0		43.5	39.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	39.6	0.1		1.5	15.1		285.5	0.1		8.5	0.3	
Delay (s)	70.0	7.7		35.9	54.1		327.3	32.1		52.0	39.9	
Level of Service	E	A		D	D		F	C		D	D	
Approach Delay (s)		39.1			52.5			202.4			44.5	
Approach LOS		D			D			F			D	

### Intersection Summary

HCM Average Control Delay	59.4	HCM Level of Service	E
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	113.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.8%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Unsignalized Intersection Capacity Analysis

## 6: North Service Road & Eighth Line

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	10	10	0	132	261	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	10	0	132	261	10
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	332	136	271			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	332	136	271			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	99	100			
cM capacity (veh/h)	637	888	1289			
Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2	
Volume Total	20	44	88	174	97	
Volume Left	10	0	0	0	0	
Volume Right	10	0	0	0	10	
cSH	742	1289	1700	1700	1700	
Volume to Capacity	0.03	0.00	0.05	0.10	0.06	
Queue Length 95th (m)	0.6	0.0	0.0	0.0	0.0	
Control Delay (s)	10.0	0.0	0.0	0.0	0.0	
Lane LOS	A					
Approach Delay (s)	10.0	0.0		0.0		
Approach LOS	A					
Intersection Summary						
Average Delay			0.5			
Intersection Capacity Utilization			17.5%		ICU Level of Service	A
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 7: North Service Rd & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	0	239	816	142	379	0	1921	0	0	959	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0	3.0	4.0	4.0		4.0			4.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00		0.91			0.86	
Frbp, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	
Frt	1.00		0.85	1.00	1.00	0.85		1.00			1.00	
Flt Protected	0.95		1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (prot)	1825		1617	1825	1812	1541		5142			6411	
Flt Permitted	0.67		1.00	0.95	1.00	1.00		1.00			1.00	
Satd. Flow (perm)	1280		1617	1825	1812	1541		5142			6411	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	19	0	239	816	142	379	0	1921	0	0	959	7
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	19	0	239	816	142	379	0	1921	0	0	966	0
Confl. Peds. (#/hr)							31					
Heavy Vehicles (%)	0%	0%	1%	0%	6%	6%	0%	2%	5%	0%	3%	0%
Turn Type	custom		custom	pm+pt		Free						
Protected Phases				3	8			2			6	
Permitted Phases	4		4	8		Free						
Actuated Green, G (s)	22.3		22.3	57.9	57.9	120.0		51.1			52.1	
Effective Green, g (s)	24.3		24.3	57.9	58.9	120.0		53.1			53.1	
Actuated g/C Ratio	0.20		0.20	0.48	0.49	1.00		0.44			0.44	
Clearance Time (s)	6.0		6.0	3.0	5.0			6.0			5.0	
Vehicle Extension (s)	3.5		3.5	3.0	3.5			4.5			4.5	
Lane Grp Cap (vph)	259		327	881	889	1541		2275			2837	
v/s Ratio Prot				c0.24	0.08			c0.37			0.15	
v/s Ratio Perm	0.01		0.15	0.20		0.25						
v/c Ratio	0.07		0.73	0.93	0.16	0.25		0.84			0.34	
Uniform Delay, d1	38.7		44.8	29.1	16.9	0.0		29.8			22.0	
Progression Factor	1.00		1.00	1.00	1.00	1.00		1.00			1.00	
Incremental Delay, d2	0.1		8.8	19.5	0.1	0.4		4.2			0.3	
Delay (s)	38.9		53.6	48.6	17.0	0.4		34.0			22.3	
Level of Service	D		D	D	B	A		C			C	
Approach Delay (s)		52.5			31.6			34.0			22.3	
Approach LOS		D			C			C			C	

### Intersection Summary

HCM Average Control Delay	31.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	7.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 8: QEW EB Offramp & Trafalgar Rd

6/3/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↶↶	↷		↶↶↶	↶↶↶	
Volume (vph)	786	546	0	1997	1391	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	1.00		0.91	0.91	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	3506	1617		5142	5142	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	3506	1617		5142	5142	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	786	546	0	1997	1391	0
RTOR Reduction (vph)	0	13	0	0	0	0
Lane Group Flow (vph)	786	533	0	1997	1391	0
Confl. Peds. (#/hr)	1					
Heavy Vehicles (%)	1%	1%	0%	2%	2%	3%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	46.7	46.7		61.3	61.3	
Effective Green, g (s)	48.7	48.7		63.3	63.3	
Actuated g/C Ratio	0.41	0.41		0.53	0.53	
Clearance Time (s)	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.5	3.5		4.5	4.5	
Lane Grp Cap (vph)	1423	656		2712	2712	
v/s Ratio Prot	0.22			0.39	0.27	
v/s Ratio Perm		0.33				
v/c Ratio	0.55	0.81		0.74	0.51	
Uniform Delay, d1	27.3	31.6		21.9	18.4	
Progression Factor	1.00	1.00		0.81	1.00	
Incremental Delay, d2	0.5	8.3		0.6	0.7	
Delay (s)	27.8	39.9		18.4	19.1	
Level of Service	C	D		B	B	
Approach Delay (s)	32.8			18.4	19.1	
Approach LOS	C			B	B	

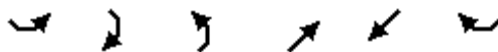
### Intersection Summary

HCM Average Control Delay	22.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 9: Davis Rd. & Davis Rd

6/3/2014



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Volume (vph)	56	28	0	1293	1105	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0			6.0	6.0	
Lane Util. Factor	1.00			0.95	0.95	
Frt	0.95			1.00	1.00	
Flt Protected	0.97			1.00	1.00	
Satd. Flow (prot)	1741			3579	3579	
Flt Permitted	0.97			1.00	1.00	
Satd. Flow (perm)	1741			3579	3579	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	56	28	0	1293	1105	0
RTOR Reduction (vph)	21	0	0	0	0	0
Lane Group Flow (vph)	63	0	0	1293	1105	0
Turn Type						
Protected Phases	4					
Permitted Phases				2	6	
Actuated Green, G (s)	16.0			32.0	32.0	
Effective Green, g (s)	16.0			32.0	32.0	
Actuated g/C Ratio	0.27			0.53	0.53	
Clearance Time (s)	6.0			6.0	6.0	
Vehicle Extension (s)	3.0			3.0	3.0	
Lane Grp Cap (vph)	464			1909	1909	
v/s Ratio Prot	c0.04					
v/s Ratio Perm				c0.36	0.31	
v/c Ratio	0.14			0.68	0.58	
Uniform Delay, d1	16.7			10.2	9.5	
Progression Factor	1.00			1.00	1.00	
Incremental Delay, d2	0.6			2.0	1.3	
Delay (s)	17.4			12.2	10.7	
Level of Service	B			B	B	
Approach Delay (s)	17.4			12.2	10.7	
Approach LOS	B			B	B	

### Intersection Summary

HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	51.6%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 10: Cross Ave & Lyons Ln

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Volume (vph)	220	808	103	82	1492	232	541	8	257	159	4	217
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	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)	1825	3650	1633	1825	3650	1564	1820	1921	1603	1816	1921	1605
Flt Permitted	0.07	1.00	1.00	0.28	1.00	1.00	0.64	1.00	1.00	0.75	1.00	1.00
Satd. Flow (perm)	143	3650	1633	542	3650	1564	1226	1921	1603	1439	1921	1605
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	220	808	103	82	1492	232	541	8	257	159	4	217
RTOR Reduction (vph)	0	0	53	0	0	97	0	0	165	0	0	98
Lane Group Flow (vph)	220	808	50	82	1492	135	541	8	92	159	4	119
Confl. Peds. (#/hr)	6					6	3		4	4		3
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		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)	63.8	55.8	55.8	53.8	49.8	49.8	44.2	32.2	32.2	30.2	22.2	22.2
Effective Green, g (s)	63.8	57.8	57.8	53.8	51.8	51.8	44.2	34.2	34.2	30.2	24.2	24.2
Actuated g/C Ratio	0.53	0.48	0.48	0.45	0.43	0.43	0.37	0.29	0.29	0.25	0.20	0.20
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	5.0	5.0	3.0	4.0	4.0
Lane Grp Cap (vph)	216	1758	787	286	1576	675	541	547	457	387	387	324
v/s Ratio Prot	c0.08	0.22		0.01	0.41		c0.15	0.00		0.03	0.00	
v/s Ratio Perm	c0.46		0.03	0.12		0.09	c0.22		0.06	0.08		0.07
v/c Ratio	1.02	0.46	0.06	0.29	0.95	0.20	1.00	0.01	0.20	0.41	0.01	0.37
Uniform Delay, d1	36.3	20.7	16.6	19.5	32.8	21.2	36.7	30.8	32.5	36.8	38.3	41.3
Progression Factor	1.00	1.00	1.00	1.14	1.10	1.42	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	141.4	0.2	0.0	0.3	10.0	0.1	77.4	0.0	1.0	0.7	0.0	1.0
Delay (s)	177.6	20.9	16.7	22.6	46.2	30.2	114.1	30.9	33.5	37.5	38.3	42.3
Level of Service	F	C	B	C	D	C	F	C	C	D	D	D
Approach Delay (s)		51.0			43.0			87.6			40.2	
Approach LOS		D			D			F			D	

### Intersection Summary

HCM Average Control Delay	53.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	100.1%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 11: Cross Ave & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↖↖	↗	↖↗	↖↖	↗	↖	↖↖↖	↗	↖	↖↖↖	↗
Volume (vph)	1117	819	229	421	492	383	324	1383	403	133	858	743
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frbp, ped/bikes	1.00	1.00	0.94	1.00	1.00	0.99	1.00	1.00	0.98	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	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)	3437	3650	1444	3471	3614	1598	1721	5193	1387	1772	5193	1391
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.16	1.00	1.00	0.12	1.00	1.00
Satd. Flow (perm)	3437	3650	1444	3471	3614	1598	290	5193	1387	226	5193	1391
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1117	819	229	421	492	383	324	1383	403	133	858	743
RTOR Reduction (vph)	0	0	156	0	0	5	0	0	262	0	0	459
Lane Group Flow (vph)	1117	819	73	421	492	379	324	1383	141	133	858	284
Confl. Peds. (#/hr)	8		36	36		8	18		8	8		18
Heavy Vehicles (%)	3%	0%	6%	2%	1%	1%	6%	1%	15%	3%	1%	13%
Turn Type	Prot		Perm	Prot		pm+ov	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4		3	8	1	5	2		1	6	
Permitted Phases			4			8	2		2	6		6
Actuated Green, G (s)	37.0	36.2	36.2	16.8	14.0	26.0	49.0	33.0	33.0	43.0	31.0	31.0
Effective Green, g (s)	39.0	38.2	38.2	16.8	16.0	30.0	49.0	35.0	35.0	47.0	33.0	33.0
Actuated g/C Ratio	0.32	0.32	0.32	0.14	0.13	0.25	0.41	0.29	0.29	0.39	0.28	0.28
Clearance Time (s)	6.0	6.0	6.0	4.0	6.0	6.0	4.0	6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0	3.5	3.5	3.0	3.0	5.0	5.0	3.0	5.0	5.0
Lane Grp Cap (vph)	1117	1162	460	486	482	453	309	1515	405	269	1428	383
v/s Ratio Prot	c0.32	0.22		0.12	c0.14	0.10	c0.14	0.27		0.06	0.17	
v/s Ratio Perm			0.05			0.14	c0.29		0.10	0.14		0.20
v/c Ratio	1.00	0.70	0.16	0.87	1.02	0.84	1.05	0.91	0.35	0.49	0.60	0.74
Uniform Delay, d1	40.5	35.9	29.4	50.5	52.0	42.7	29.5	41.0	33.5	27.5	37.8	39.6
Progression Factor	0.72	1.01	3.43	1.00	1.00	1.00	1.49	1.12	2.31	0.99	1.09	3.03
Incremental Delay, d2	29.9	0.6	0.1	17.8	103.6	14.0	150.8	10.2	2.1	1.2	1.6	10.8
Delay (s)	59.0	36.9	100.9	68.3	155.6	56.7	194.7	55.9	79.6	28.3	42.6	130.8
Level of Service	E	D	F	E	F	E	F	E	E	C	D	F
Approach Delay (s)		55.1			98.0			81.8			79.3	
Approach LOS		E			F			F			E	

### Intersection Summary

HCM Average Control Delay	76.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	97.6%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 13: Davis Rd & Transit BRT

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	418	847	75	44	521	435	25	282	84	199	0	295
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	2.0	2.0	4.0	2.0	6.0	4.0	6.0	4.0	4.0	2.0		6.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	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
Satd. Flow (prot)	1789	1883	1601	1789	1883	1601	1789	1883	1601	1789		1601
Flt Permitted	0.43	1.00	1.00	0.09	1.00	1.00	0.76	1.00	1.00	0.31		1.00
Satd. Flow (perm)	816	1883	1601	179	1883	1601	1426	1883	1601	587		1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	418	847	75	44	521	435	25	282	84	199	0	295
RTOR Reduction (vph)	0	0	31	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	418	847	44	44	521	435	25	282	84	199	0	295
Turn Type	Perm		Perm	pm+pt		Perm	Perm		Free	pm+pt		Perm
Protected Phases		4		3	8			2		1	6	
Permitted Phases	4		4	8		8	2		Free	6		6
Actuated Green, G (s)	59.6	59.6	59.6	65.6	65.6	65.6	25.3	25.3	112.0	34.4		34.4
Effective Green, g (s)	61.6	61.6	59.6	67.6	65.6	67.6	25.3	27.3	112.0	36.4		34.4
Actuated g/C Ratio	0.55	0.55	0.53	0.60	0.59	0.60	0.23	0.24	1.00	0.32		0.31
Clearance Time (s)	4.0	4.0	4.0	4.0	6.0	6.0	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)	449	1036	852	194	1103	966	322	459	1601	267		492
v/s Ratio Prot		0.45		0.01	c0.28			c0.15		c0.05		
v/s Ratio Perm	c0.51		0.03	0.12		0.27	0.02		0.05	0.20		0.18
v/c Ratio	0.93	0.82	0.05	0.23	0.47	0.45	0.08	0.61	0.05	0.75		0.60
Uniform Delay, d1	23.2	20.6	12.6	18.6	13.3	12.1	34.2	37.7	0.0	32.7		33.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	37.0	5.3	0.0	0.6	0.3	0.3	0.1	2.5	0.1	18.9		5.4
Delay (s)	60.2	25.9	12.6	19.2	13.6	12.4	34.3	40.1	0.1	51.7		38.4
Level of Service	E	C	B	B	B	B	C	D	A	D		D
Approach Delay (s)		35.9			13.3			31.1			43.7	
Approach LOS		D			B			C			D	

### Intersection Summary

HCM Average Control Delay	29.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	112.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	91.4%	ICU Level of Service	F
Analysis Period (min)	60		













Description: BRT coded in Node 66

c Critical Lane Group

# HCM Unsignalized Intersection Capacity Analysis

## 14: Davis Rd & local road

6/3/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑							
Volume (veh/h)	0	1130	0	0	639	0	0	0	0	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	0	1130	0	0	639	0	0	0	0	0	0	0
Pedestrians												
Lane Width (m)												
Walking Speed (m/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (m)		357			232							
pX, platoon unblocked												
vC, conflicting volume	639			1130			1450	1769	565	1204	1769	320
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	639			1130			1450	1769	565	1204	1769	320
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	100	100
cM capacity (veh/h)	941			614			92	83	468	140	83	676
<b>Direction, Lane #</b>	<b>EB 1</b>	<b>EB 2</b>	<b>WB 1</b>	<b>WB 2</b>								
Volume Total	565	565	320	320								
Volume Left	0	0	0	0								
Volume Right	0	0	0	0								
cSH	1700	1700	1700	1700								
Volume to Capacity	0.33	0.33	0.19	0.19								
Queue Length 95th (m)	0.0	0.0	0.0	0.0								
Control Delay (s)	0.0	0.0	0.0	0.0								
Lane LOS												
Approach Delay (s)	0.0		0.0									
Approach LOS												
<b>Intersection Summary</b>												
Average Delay			0.0									
Intersection Capacity Utilization			34.6%		ICU Level of Service				A			
Analysis Period (min)			60									



# HCM Signalized Intersection Capacity Analysis

## 15: Davis Rd & Chartwell Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑	↗	↘	↑↑	↗	↘	↑	↗	↘	↗	↘
Volume (vph)	44	1001	723	226	688	171	522	229	233	297	54	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	6.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1789	3579	1601	1789	3579	1601	1789	1883	1601	1789	1825	
Flt Permitted	0.37	1.00	1.00	0.10	1.00	1.00	0.50	1.00	1.00	0.62	1.00	
Satd. Flow (perm)	698	3579	1601	180	3579	1601	932	1883	1601	1160	1825	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	44	1001	723	226	688	171	522	229	233	297	54	14
RTOR Reduction (vph)	0	0	353	0	0	55	0	0	181	0	8	0
Lane Group Flow (vph)	44	1001	370	226	688	116	522	229	52	297	60	0
Turn Type	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm	pm+pt		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2	6		
Actuated Green, G (s)	42.7	39.7	39.7	58.0	49.0	49.0	42.0	24.8	24.8	22.3	9.1	
Effective Green, g (s)	46.7	41.7	41.7	58.0	51.0	51.0	42.0	26.8	24.8	22.3	11.1	
Actuated g/C Ratio	0.42	0.37	0.37	0.52	0.46	0.46	0.38	0.24	0.22	0.20	0.10	
Clearance Time (s)	6.0	6.0	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	3.0	
Lane Grp Cap (vph)	340	1333	596	299	1630	729	571	451	355	305	181	
v/s Ratio Prot	0.01	0.28		c0.10	0.19		c0.24	0.12		0.11	0.03	
v/s Ratio Perm	0.05		0.23	c0.29		0.07	c0.11		0.03	0.08		
v/c Ratio	0.13	0.75	0.62	0.76	0.42	0.16	0.91	0.51	0.15	0.97	0.33	
Uniform Delay, d1	19.5	30.6	28.7	26.1	20.6	17.9	31.0	36.9	35.1	43.4	47.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.2	2.5	2.0	11.1	0.2	0.1	24.8	0.9	0.2	78.4	1.1	
Delay (s)	19.7	33.1	30.7	37.2	20.7	18.0	55.8	37.8	35.3	121.8	48.1	
Level of Service	B	C	C	D	C	B	E	D	D	F	D	
Approach Delay (s)		31.8			23.7			46.7			108.1	
Approach LOS		C			C			D			F	

### Intersection Summary

HCM Average Control Delay	39.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	112.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.1%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 16: Davis Rd & QEW EB Button Hook

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↗
Volume (veh/h)	0	1423	394	0	0	348
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	1423	394	0	0	348
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	394				1106	197
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	394				1106	197
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	57
cM capacity (veh/h)	1161				205	811
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	712	712	197	197	348	
Volume Left	0	0	0	0	0	
Volume Right	0	0	0	0	348	
cSH	1700	1700	1700	1700	811	
Volume to Capacity	0.42	0.42	0.12	0.12	0.43	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	17.0	
Control Delay (s)	0.0	0.0	0.0	0.0	12.8	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		12.8	
Approach LOS					B	
Intersection Summary						
Average Delay			2.1			
Intersection Capacity Utilization			42.7%		ICU Level of Service	A
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 18: Speers Rd & Cross Ave

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↶	↷	↶		↶	↷
Volume (vph)	579	616	1430	205	478	1285
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00		1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.98		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1772	3544	3497		1789	1590
Flt Permitted	0.08	1.00	1.00		0.95	1.00
Satd. Flow (perm)	143	3544	3497		1789	1590
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	579	616	1430	205	478	1285
RTOR Reduction (vph)	0	0	9	0	0	3
Lane Group Flow (vph)	579	616	1626	0	478	1282
Confl. Peds. (#/hr)	20			20	2	3
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Turn Type	pm+pt				pm+ov	
Protected Phases	5	2			4	5
Permitted Phases	2		6			4
Actuated Green, G (s)	90.0	90.0	49.0		28.0	66.0
Effective Green, g (s)	89.0	92.0	51.0		30.0	64.0
Actuated g/C Ratio	0.68	0.71	0.39		0.23	0.49
Clearance Time (s)	3.0	6.0	6.0		6.0	3.0
Vehicle Extension (s)	3.5	3.5	3.5		5.0	3.5
Lane Grp Cap (vph)	562	2508	1372		413	783
v/s Ratio Prot	0.29	0.17			0.27	c0.47
v/s Ratio Perm	0.41		c0.47			0.34
v/c Ratio	1.03	0.25	1.19		1.16	1.64
Uniform Delay, d1	40.2	6.7	39.5		50.0	33.0
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	109.0	0.1	342.1		312.4	1152.9
Delay (s)	149.2	6.8	381.6		362.4	1185.9
Level of Service	F	A	F		F	F
Approach Delay (s)		75.8	381.6		962.6	
Approach LOS		E	F		F	

### Intersection Summary

HCM Average Control Delay	525.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.40		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	132.9%	ICU Level of Service	H
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 19: Speers Rd & Old Mill Rd

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↖	↗↗	↖↗		↖	↗
Volume (vph)	90	1023	1545	79	458	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	0.95		1.00	1.00
Frbp, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	3614	3548		1825	1617
Flt Permitted	0.08	1.00	1.00		0.95	1.00
Satd. Flow (perm)	155	3614	3548		1825	1617
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	90	1023	1545	79	458	130
RTOR Reduction (vph)	0	0	4	0	0	68
Lane Group Flow (vph)	90	1023	1620	0	458	62
Confl. Peds. (#/hr)	13			13	1	
Heavy Vehicles (%)	2%	1%	2%	0%	0%	1%
Turn Type	pm+pt					Perm
Protected Phases	5	2	6		4	
Permitted Phases	2					4
Actuated Green, G (s)	51.5	51.5	44.5		26.1	26.1
Effective Green, g (s)	51.5	53.5	46.5		28.1	28.1
Actuated g/C Ratio	0.57	0.60	0.52		0.31	0.31
Clearance Time (s)	4.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	144	2158	1841		572	507
v/s Ratio Prot	0.02	c0.28	c0.46		c0.25	
v/s Ratio Perm	0.34					0.04
v/c Ratio	0.62	0.47	0.88		0.80	0.12
Uniform Delay, d1	18.1	10.1	19.1		28.2	21.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	8.5	0.2	5.6		8.4	0.1
Delay (s)	26.6	10.3	24.7		36.6	22.1
Level of Service	C	B	C		D	C
Approach Delay (s)		11.6	24.7		33.4	
Approach LOS		B	C		C	

### Intersection Summary

HCM Average Control Delay	21.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	89.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.6%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 21: Cornwall Rd & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖↗	↖↗		↖	↖↗	↖	↖	↖↗	↖	↖↗	↖	↖
Volume (vph)	558	777	109	76	998	711	137	434	36	650	465	449
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	0.95	1.00	0.97	1.00	1.00
Frbp, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.97	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	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)	3437	3460		1795	3510	1536	1822	3579	1555	3437	1902	1561
Flt Permitted	0.95	1.00		0.32	1.00	1.00	0.34	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3437	3460		606	3510	1536	660	3579	1555	3437	1902	1561
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	558	777	109	76	998	711	137	434	36	650	465	449
RTOR Reduction (vph)	0	9	0	0	0	0	0	0	28	0	0	249
Lane Group Flow (vph)	558	877	0	76	998	711	137	434	8	650	465	200
Confl. Peds. (#/hr)	33		9	9		33	9		12	12		9
Heavy Vehicles (%)	3%	3%	3%	1%	4%	4%	0%	2%	2%	3%	1%	2%
Turn Type	Prot			Perm		Free	pm+pt		Perm	Prot		Perm
Protected Phases	7	4			8		5	2		1		6
Permitted Phases				8		Free	2		2			6
Actuated Green, G (s)	19.2	56.2		32.0	32.0	120.0	32.8	25.8	25.8	21.0	40.8	40.8
Effective Green, g (s)	20.2	58.2		34.0	34.0	120.0	32.8	27.8	27.8	22.0	42.8	42.8
Actuated g/C Ratio	0.17	0.49		0.28	0.28	1.00	0.27	0.23	0.23	0.18	0.36	0.36
Clearance Time (s)	5.0	6.0		6.0	6.0		4.0	6.0	6.0	5.0	6.0	6.0
Vehicle Extension (s)	4.0	4.0		4.0	4.0		3.0	5.0	5.0	4.0	5.0	5.0
Lane Grp Cap (vph)	579	1678		172	995	1536	248	829	360	630	678	557
v/s Ratio Prot	c0.16	0.25			c0.28		0.03	0.12		c0.19	c0.24	
v/s Ratio Perm				0.13		0.46	0.12		0.01			0.13
v/c Ratio	0.96	0.52		0.44	1.00	0.46	0.55	0.52	0.02	1.03	0.69	0.36
Uniform Delay, d1	49.5	21.3		35.2	43.0	0.0	34.6	40.3	35.6	49.0	32.9	28.5
Progression Factor	1.00	1.00		0.81	0.89	1.00	1.00	1.00	1.00	1.19	1.48	4.09
Incremental Delay, d2	45.8	0.4		2.0	54.5	0.8	2.7	2.4	0.1	99.3	4.5	1.4
Delay (s)	95.4	21.7		30.6	92.6	0.8	37.3	42.7	35.7	157.9	53.1	118.0
Level of Service	F	C		C	F	A	D	D	D	F	D	F
Approach Delay (s)		50.2			53.4			41.1			115.3	
Approach LOS		D			D			D			F	

### Intersection Summary

HCM Average Control Delay	69.1	HCM Level of Service	E
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.2%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 22: Cornwall Rd & Reynolds St

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↑	↑↑		↑	↑		↑	↑	
Volume (vph)	6	1225	118	53	1497	17	232	17	19	5	10	56
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes		1.00	0.97	1.00	1.00		1.00	0.98		1.00	0.99	
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00		0.98	1.00	
Frt		1.00	0.85	1.00	1.00		1.00	0.92		1.00	0.87	
Flt Protected		1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		3543	1533	1805	3607		1736	1657		1739	1609	
Flt Permitted		0.95	1.00	0.18	1.00		0.71	1.00		0.73	1.00	
Satd. Flow (perm)		3353	1533	346	3607		1304	1657		1343	1609	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	6	1225	118	53	1497	17	232	17	19	5	10	56
RTOR Reduction (vph)	0	0	36	0	1	0	0	14	0	0	30	0
Lane Group Flow (vph)	0	1231	82	53	1513	0	232	22	0	5	36	0
Confl. Peds. (#/hr)	3		4	4		3	1		12	12		1
Heavy Vehicles (%)	3%	3%	3%	1%	1%	1%	5%	5%	5%	3%	3%	3%
Turn Type	Perm		Perm	Perm			Perm			Perm		
Protected Phases		2			2			4			4	
Permitted Phases	2		2	2			4			4		
Actuated Green, G (s)		81.4	81.4	81.4	81.4		26.6	26.6		26.6	26.6	
Effective Green, g (s)		83.4	83.4	83.4	83.4		28.6	28.6		28.6	28.6	
Actuated g/C Ratio		0.70	0.70	0.70	0.70		0.24	0.24		0.24	0.24	
Clearance Time (s)		6.0	6.0	6.0	6.0		6.0	6.0		6.0	6.0	
Vehicle Extension (s)		4.0	4.0	4.0	4.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		2330	1065	240	2507		311	395		320	383	
v/s Ratio Prot				c0.42				0.01			0.02	
v/s Ratio Perm		0.37	0.05	0.15			c0.18			0.00		
v/c Ratio		0.53	0.08	0.22	0.60		0.75	0.05		0.02	0.09	
Uniform Delay, d1		8.8	5.9	6.6	9.6		42.3	35.3		34.9	35.6	
Progression Factor		1.52	4.14	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.6	0.1	2.1	1.1		9.9	0.1		0.0	0.1	
Delay (s)		13.9	24.5	8.7	10.7		52.3	35.3		35.0	35.7	
Level of Service		B	C	A	B		D	D		C	D	
Approach Delay (s)		14.9			10.6			50.0			35.7	
Approach LOS		B			B			D			D	

### Intersection Summary

HCM Average Control Delay	16.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 23: Cornwall Rd & Chartwell Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	227	623	134	46	756	769	132	119	32	629	243	191
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.97		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)	1738	3384		1772	3544	1585	1722	3444	1541	1825	3650	1633
Flt Permitted	0.20	1.00		0.36	1.00	1.00	0.60	1.00	1.00	0.47	1.00	1.00
Satd. Flow (perm)	367	3384		680	3544	1585	1089	3444	1541	899	3650	1633
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	227	623	134	46	756	769	132	119	32	629	243	191
RTOR Reduction (vph)	0	13	0	0	0	450	0	0	29	0	0	132
Lane Group Flow (vph)	227	744	0	46	756	319	132	119	3	629	243	59
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	6%	6%	6%	0%	0%	0%
Turn Type	pm+pt			Perm		Perm	pm+pt			Perm	pm+pt	
Protected Phases	5	2			6		3	8			7	4
Permitted Phases	2			6		6	8		8	4		4
Actuated Green, G (s)	65.8	65.8		47.0	47.0	47.0	19.4	9.8	9.8	51.8	38.2	38.2
Effective Green, g (s)	65.8	68.0		49.2	49.2	49.2	19.4	12.0	12.0	51.8	40.4	40.4
Actuated g/C Ratio	0.51	0.52		0.38	0.38	0.38	0.15	0.09	0.09	0.40	0.31	0.31
Clearance Time (s)	4.0	6.2		6.2	6.2	6.2	4.0	6.2	6.2	4.0	6.2	6.2
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)	342	1770		257	1341	600	209	318	142	629	1134	507
v/s Ratio Prot	c0.08	0.22			0.21		0.05	0.03		c0.29	0.07	
v/s Ratio Perm	c0.26			0.07		0.20	0.05		0.00	c0.11		0.04
v/c Ratio	0.66	0.42		0.18	0.56	0.53	0.63	0.37	0.02	1.00	0.21	0.12
Uniform Delay, d1	21.3	19.0		26.9	31.9	31.4	51.0	55.5	53.7	36.5	33.1	32.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	4.9	0.7		0.3	0.5	0.9	6.3	0.7	0.1	71.8	0.1	0.1
Delay (s)	26.2	19.7		27.3	32.5	32.3	57.2	56.2	53.7	108.2	33.2	32.1
Level of Service	C	B		C	C	C	E	E	D	F	C	C
Approach Delay (s)		21.2			32.3			56.4			77.4	
Approach LOS		C			C			E			E	

### Intersection Summary

HCM Average Control Delay	43.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.0%	ICU Level of Service	E
Analysis Period (min)	60		

c Critical Lane Group

# HCM Signalized Intersection Capacity Analysis

## 24: Cross Ave & Argus Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	109	1302	159	425	754	175	400	0	310	267	2	394
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00	1.00		1.00	1.00	1.00	
Frbp, ped/bikes	1.00	1.00	1.00	1.00	1.00	0.95	1.00		1.00	1.00	1.00	
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00		0.85	1.00	0.85	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95		1.00	0.95	1.00	
Satd. Flow (prot)	1802	3614	816	913	3614	1544	913		816	1804	1614	
Flt Permitted	0.37	1.00	1.00	0.12	1.00	1.00	0.40		1.00	0.95	1.00	
Satd. Flow (perm)	694	3614	816	120	3614	1544	385		816	1804	1614	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	109	1302	159	425	754	175	400	0	310	267	2	394
RTOR Reduction (vph)	0	0	76	0	0	95	0	0	163	0	60	0
Lane Group Flow (vph)	109	1302	83	425	754	80	400	0	147	267	336	0
Confl. Peds. (#/hr)	13					13				1		
Heavy Vehicles (%)	0%	1%	100%	100%	1%	0%	100%	0%	100%	1%	50%	1%
Turn Type	Perm		Perm	pm+pt		Perm	custom		custom	Perm		
Protected Phases		2		1	6							8
Permitted Phases	2		2	6		6	4		4	8		
Actuated Green, G (s)	29.0	29.0	29.0	53.0	53.0	53.0	55.0		55.0	55.0	55.0	
Effective Green, g (s)	31.0	31.0	31.0	52.0	55.0	55.0	57.0		57.0	57.0	57.0	
Actuated g/C Ratio	0.26	0.26	0.26	0.43	0.46	0.46	0.48		0.48	0.48	0.48	
Clearance Time (s)	6.0	6.0	6.0	3.0	6.0	6.0	6.0		6.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	179	934	211	184	1656	708	183		388	857	767	
v/s Ratio Prot		0.36		c0.38	0.21							0.21
v/s Ratio Perm	0.16		0.10	c0.62		0.05	c1.04		0.18	0.15		
v/c Ratio	0.61	1.39	0.39	2.31	0.46	0.11	2.19		0.38	0.31	0.44	
Uniform Delay, d1	39.2	44.5	36.7	36.1	22.2	18.6	31.5		20.2	19.4	20.9	
Progression Factor	0.95	0.97	1.06	0.88	0.58	0.12	1.00		1.00	1.00	1.00	
Incremental Delay, d2	14.7	715.7	5.2	2362.9	0.3	0.1	2152.4		0.6	0.2	0.4	
Delay (s)	51.9	758.6	44.0	2394.6	13.2	2.4	2183.9		20.8	19.6	21.3	
Level of Service	D	F	D	F	B	A	F		C	B	C	
Approach Delay (s)		637.2			759.3			1239.5				20.6
Approach LOS		F			F			F				C

### Intersection Summary

HCM Average Control Delay	680.0	HCM Level of Service	F
HCM Volume to Capacity ratio	2.16		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	119.5%	ICU Level of Service	H
Analysis Period (min)	60		
c Critical Lane Group			



# HCM Signalized Intersection Capacity Analysis

## 27: McCraney Street & Trafalgar Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	71	22	198	243	87	342	327	1858	182	186	1408	123
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0		5.0	7.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91		1.00	0.91	
Frbp, ped/bikes	1.00	1.00	0.97	1.00	1.00	0.98	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	0.99	1.00	1.00	0.98	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1809	1921	1572	1779	1921	1597	1806	5099		1825	5087	
Flt Permitted	0.70	1.00	1.00	0.74	1.00	1.00	0.10	1.00		0.12	1.00	
Satd. Flow (perm)	1334	1921	1572	1391	1921	1597	195	5099		226	5087	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	71	22	198	243	87	342	327	1858	182	186	1408	123
RTOR Reduction (vph)	0	0	151	0	0	128	0	10	0	0	9	0
Lane Group Flow (vph)	71	22	47	243	87	214	327	2030	0	186	1522	0
Confl. Peds. (#/hr)	13		18	18		13	67		23	23		67
Heavy Vehicles (%)	0%	0%	1%	1%	0%	0%	1%	1%	1%	0%	1%	1%
Turn Type	Perm		Perm	Perm		Perm	pm+pt			pm+pt		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)	21.6	21.6	21.6	21.6	21.6	21.6	54.6	42.5		41.1	34.0	
Effective Green, g (s)	21.6	21.6	21.6	21.6	21.6	21.6	54.6	42.5		41.1	34.0	
Actuated g/C Ratio	0.24	0.24	0.24	0.24	0.24	0.24	0.61	0.47		0.46	0.38	
Clearance Time (s)	7.0	7.0	7.0	7.0	7.0	7.0	5.0	7.0		5.0	7.0	
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)	319	460	376	333	460	382	397	2403		229	1917	
v/s Ratio Prot		0.01			0.05		c0.14	c0.40		0.06	0.30	
v/s Ratio Perm	0.05		0.03	c0.17		0.13	0.36			0.31		
v/c Ratio	0.22	0.05	0.13	0.73	0.19	0.56	0.82	0.84		0.81	0.79	
Uniform Delay, d1	27.6	26.4	26.9	31.6	27.3	30.1	22.9	21.0		17.9	25.0	
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	0.4	0.0	0.2	8.2	0.2	1.9	14.4	3.0		22.2	2.4	
Delay (s)	27.9	26.4	27.1	39.8	27.5	32.0	37.3	24.0		40.1	27.4	
Level of Service	C	C	C	D	C	C	D	C		D	C	
Approach Delay (s)		27.2			34.2			25.8			28.8	
Approach LOS		C			C			C			C	

### Intersection Summary

HCM Average Control Delay	28.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	90.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	90.8%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 63: White Oak Boulevard & N-S Crossing

6/3/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	10	50	382	10	100	176
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	50	382	10	100	176
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)						290
pX, platoon unblocked						
vC, conflicting volume	763	387			392	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	763	387			392	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	92			91	
cM capacity (veh/h)	340	661			1167	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	60	392	276
Volume Left	10	0	100
Volume Right	50	10	0
cSH	571	1700	1167
Volume to Capacity	0.11	0.23	0.09
Queue Length 95th (m)	2.7	0.0	2.1
Control Delay (s)	12.0	0.0	3.5
Lane LOS	B		A
Approach Delay (s)	12.0	0.0	3.5
Approach LOS	B		

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		49.1%	ICU Level of Service A
Analysis Period (min)		60	

# HCM Signalized Intersection Capacity Analysis

## 79: Cross Ave &

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↔↔	↑	↔		↔	↔
Volume (vph)	1424	10	100	10	10	455
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0		6.0	4.0
Lane Util. Factor	0.97	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	3471	1883	1860		1789	1601
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	3471	1883	1860		1789	1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	1424	10	100	10	10	455
RTOR Reduction (vph)	0	0	4	0	0	0
Lane Group Flow (vph)	1424	10	106	0	10	455
Turn Type	Prot			Free		
Protected Phases	7	4	8	6		
Permitted Phases				Free		
Actuated Green, G (s)	61.2	77.5	10.3	1.2		
Effective Green, g (s)	61.2	77.5	10.3	1.2		
Actuated g/C Ratio	0.67	0.85	0.11	0.01		
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)	2342	1609	211	24		
v/s Ratio Prot	c0.41	0.01	c0.06	0.01		
v/s Ratio Perm				c0.28		
v/c Ratio	0.61	0.01	0.50	0.42		
Uniform Delay, d1	8.1	1.0	37.8	44.4		
Progression Factor	1.00	1.00	1.00	1.00		
Incremental Delay, d2	1.2	0.0	1.9	11.7		
Delay (s)	9.3	1.0	39.7	56.1		
Level of Service	A	A	D	E		
Approach Delay (s)	9.3		39.7	1.6		
Approach LOS	A		D	A		

### Intersection Summary

HCM Average Control Delay	9.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	90.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	60.6%	ICU Level of Service	B
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 5: QEW WB Offramp & Iroquois Shore Rd

6/3/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	263	185	849	0	0	746
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	1.00	1.00	0.95			0.95
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	1789	1601	3579			3579
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	1789	1601	3579			3579
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	263	185	849	0	0	746
RTOR Reduction (vph)	0	81	0	0	0	0
Lane Group Flow (vph)	263	104	849	0	0	746
Turn Type	Perm					
Protected Phases	8		2			6
Permitted Phases	8					
Actuated Green, G (s)	13.1	13.1	25.1			25.1
Effective Green, g (s)	15.1	15.1	27.1			27.1
Actuated g/C Ratio	0.30	0.30	0.54			0.54
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)	538	482	1932			1932
v/s Ratio Prot	c0.15		c0.24			0.21
v/s Ratio Perm		0.06				
v/c Ratio	0.49	0.22	0.44			0.39
Uniform Delay, d1	14.4	13.1	7.0			6.7
Progression Factor	1.00	1.00	1.00			1.00
Incremental Delay, d2	0.7	0.2	0.2			0.1
Delay (s)	15.1	13.3	7.1			6.8
Level of Service	B	B	A			A
Approach Delay (s)	14.4		7.1			6.8
Approach LOS	B		A			A

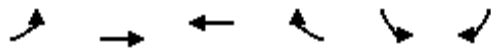
### Intersection Summary

HCM Average Control Delay	8.6	HCM Level of Service	A
HCM Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	50.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 16: Davis Rd & QEW EB Button Hook

6/3/2014



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑			↗
Volume (veh/h)	0	1423	394	0	0	348
Sign Control		Free	Free		Yield	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	1423	394	0	0	348
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage (veh)						
Upstream signal (m)			115			
pX, platoon unblocked						
vC, conflicting volume	394				1106	197
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	394				1106	197
tC, single (s)	4.1				6.8	6.9
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	100				100	57
cM capacity (veh/h)	1161				205	811
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	
Volume Total	712	712	197	197	348	
Volume Left	0	0	0	0	0	
Volume Right	0	0	0	0	348	
cSH	1700	1700	1700	1700	811	
Volume to Capacity	0.42	0.42	0.12	0.12	0.43	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	17.0	
Control Delay (s)	0.0	0.0	0.0	0.0	12.8	
Lane LOS					B	
Approach Delay (s)	0.0		0.0		12.8	
Approach LOS					B	
Intersection Summary						
Average Delay			2.1			
Intersection Capacity Utilization			42.7%		ICU Level of Service	A
Analysis Period (min)			60			

# HCM Signalized Intersection Capacity Analysis

## 17: Iroquois Shore Rd & QEW EB Onramp

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗↗	↖	↖	↗↗↗		↖	↗	↖			
Volume (vph)	22	744	244	494	1282	317	455	867	394	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		5.0	4.0	4.0			
Lane Util. Factor	1.00	0.95	1.00	1.00	0.91		1.00	1.00	1.00			
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85			
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00			
Satd. Flow (prot)	1789	3579	1601	1789	4989		1789	1883	1601			
Flt Permitted	0.15	1.00	1.00	0.13	1.00		0.95	1.00	1.00			
Satd. Flow (perm)	279	3579	1601	251	4989		1789	1883	1601			
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	22	744	244	494	1282	317	455	867	394	0	0	0
RTOR Reduction (vph)	0	0	117	0	35	0	0	0	150	0	0	0
Lane Group Flow (vph)	22	744	127	494	1564	0	455	867	244	0	0	0
Turn Type	Perm		Perm	pm+pt			Perm		Perm			
Protected Phases		4		3	8			2				
Permitted Phases	4		4	8			2		2			
Actuated Green, G (s)	25.0	25.0	25.0	56.0	56.0		52.0	52.0	52.0			
Effective Green, g (s)	27.0	27.0	27.0	57.0	58.0		53.0	54.0	54.0			
Actuated g/C Ratio	0.22	0.22	0.22	0.48	0.48		0.44	0.45	0.45			
Clearance Time (s)	6.0	6.0	6.0	5.0	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)	63	805	360	465	2411		790	847	720			
v/s Ratio Prot		0.21		c0.24	0.31			c0.46				
v/s Ratio Perm	0.08		0.08	c0.27			0.25		0.15			
v/c Ratio	0.35	0.92	0.35	1.06	0.65		0.58	1.02	0.34			
Uniform Delay, d1	39.1	45.5	39.1	35.9	23.3		25.1	33.0	21.4			
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00			
Incremental Delay, d2	3.4	20.7	0.6	158.9	0.6		1.0	87.3	0.3			
Delay (s)	42.5	66.2	39.7	194.7	23.9		26.1	120.3	21.7			
Level of Service	D	E	D	F	C		C	F	C			
Approach Delay (s)		59.3			64.3			72.7			0.0	
Approach LOS		E			E			E			A	

### Intersection Summary

HCM Average Control Delay	66.2	HCM Level of Service	E
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	108.3%	ICU Level of Service	G
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Signalized Intersection Capacity Analysis

## 25: Iroquois Shore Rd & Canadian Rd

6/3/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↗↗			↗↗	↘	↘	↗	↘	↘		↘
Volume (vph)	48	1089	0	0	1607	28	7	321	392	12	0	478
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0	4.0	4.0	0.2	4.0		4.0
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00	1.00	1.00	1.00		1.00
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00	1.00	0.95		1.00
Satd. Flow (prot)	1789	3579			3579	1601	1789	1883	1601	1789		1601
Flt Permitted	0.06	1.00			1.00	1.00	0.95	1.00	1.00	0.34		1.00
Satd. Flow (perm)	118	3579			3579	1601	1789	1883	1601	642		1601
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	48	1089	0	0	1607	28	7	321	392	12	0	478
RTOR Reduction (vph)	0	0	0	0	0	6	0	0	0	0	0	107
Lane Group Flow (vph)	48	1089	0	0	1607	22	7	321	392	12	0	371
Turn Type	pm+pt				Perm		Perm	Free		custom	custom	
Protected Phases	5	2			6			4				
Permitted Phases	2					6	4		Free	7		7
Actuated Green, G (s)	70.9	70.9			59.6	59.6	31.6	31.6	118.7	31.6		31.6
Effective Green, g (s)	70.9	75.3			64.0	64.0	35.4	35.4	118.7	35.4		35.4
Actuated g/C Ratio	0.60	0.63			0.54	0.54	0.30	0.30	1.00	0.30		0.30
Clearance Time (s)	4.0	8.4			8.4	8.4	7.8	7.8		7.8		7.8
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	173	2270			1930	863	534	562	1601	191		477
v/s Ratio Prot	0.02	c0.30			c0.45			0.17				
v/s Ratio Perm	0.15					0.01	0.00		0.24	0.02		c0.23
v/c Ratio	0.28	0.48			0.83	0.02	0.01	0.57	0.24	0.06		0.78
Uniform Delay, d1	20.8	11.4			22.9	12.8	29.3	35.2	0.0	29.8		38.1
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	0.9	0.2			3.3	0.0	0.0	1.4	0.4	0.1		8.3
Delay (s)	21.7	11.6			26.2	12.8	29.4	36.6	0.4	29.9		46.4
Level of Service	C	B			C	B	C	D	A	C		D
Approach Delay (s)		12.0			26.0			16.8			46.0	
Approach LOS		B			C			B			D	

### Intersection Summary

HCM Average Control Delay	22.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	118.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.4%	ICU Level of Service	F
Analysis Period (min)	60		
c Critical Lane Group			

# HCM Unsignalized Intersection Capacity Analysis

## 44: QEW WB Onramp & Iroquois Shore Rd

6/3/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			↑↑	↗		↑↑
Volume (veh/h)	0	0	0	0	0	0
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	0	0	0
Pedestrians						
Lane Width (m)						
Walking Speed (m/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (m)			109			116
pX, platoon unblocked						
vC, conflicting volume	0	0			0	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	0	0			0	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	1023	1084			1622	
Direction, Lane #	NB 1	NB 2	NB 3	SB 1	SB 2	
Volume Total	0	0	0	0	0	
Volume Left	0	0	0	0	0	
Volume Right	0	0	0	0	0	
cSH	1700	1700	1700	1700	1700	
Volume to Capacity	0.00	0.00	0.00	0.00	0.00	
Queue Length 95th (m)	0.0	0.0	0.0	0.0	0.0	
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	
Lane LOS						
Approach Delay (s)	0.0			0.0		
Approach LOS						
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			44.7%		ICU Level of Service	A
Analysis Period (min)			60			



**APPENDIX C2**  
**Microsimulation Analysis**

# Memorandum

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DATE: August 21, 2013  
TO: Lin Rogers – Town of Oakville  
Chris Pascos – MTO  
FROM: Matthew Clark / Rudy Sooklall – Cole Engineering  
CC: Suzette Shiu – Cole Engineering  
OUR REF.#: T11-767  
SUBJECT: Oakville Midtown EA Study  
Microsimulation Calibration and Validation Memorandum

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## 1. Introduction

### 1.1. Background

Cole Engineering Group Ltd (CEG) was retained by the Town of Oakville to develop a Vissim microsimulation model which will be used to assess impacts to traffic operations on the QEW mainline and ramp terminals resulting from changes proposed to the Trafalgar Road and the Royal Windsor Drive interchanges. The proposed changes at the two interchanges were developed as part of the current Oakville Part III Midtown EA to improve access to the Midtown area in the Town of Oakville.

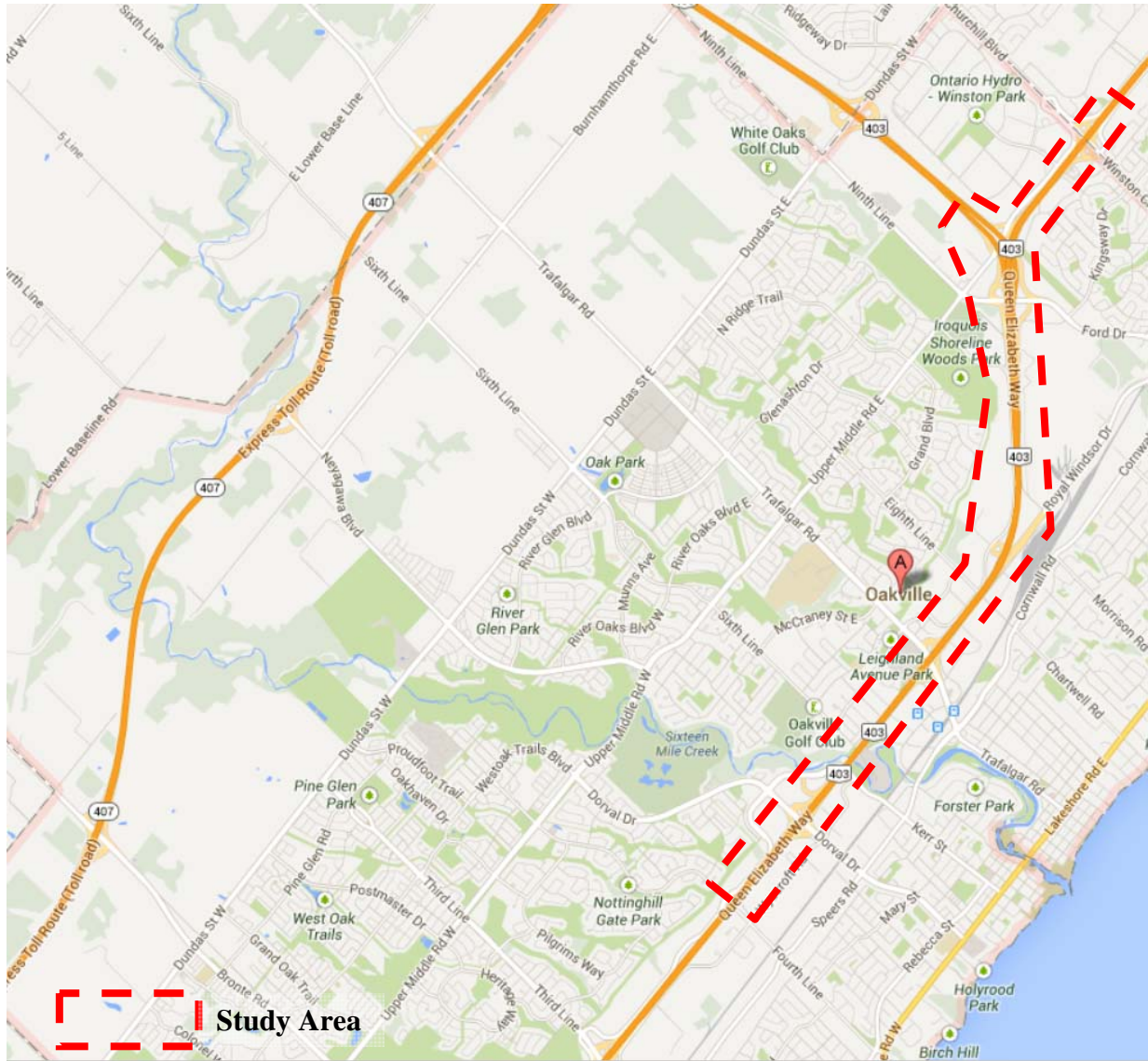
The Vissim model will be used to assess the effects of introducing a new QEW westbound off-ramp at Royal Windsor Drive, a new QEW eastbound on-ramp at Royal Windsor Drive, grade separated eastbound through movement from the Trafalgar off-ramp, and local road network improvements to support the development of Oakville Midtown.

This memorandum summarizes the calibration / validation process for existing AM and PM weekday peak periods Vissim models. The calibrated / validated models will be used to assess future conditions with the transportation improvements proposed for Oakville Midtown.

### 1.2. Study Area

The study network for the microsimulation model was approved by the MTO and includes the QEW mainline west of Dorval Drive Interchange to west of Winston Churchill Boulevard interchange including the QEW / Highway 403 interchange. The Trafalgar segment from Leighland Avenue to Cross Avenue is also included in the study area. **Figure 1** below shows the Vissim model network extents for this study.

Figure 1: Vissim Model Study Area



## **2. Microsimulation Model Development**

Microsimulation models for the weekday AM and weekday PM peak periods were developed using the Vissim software platform. The time period modelled for both peak periods consists of the peak hour and a 15-minute warm up and cool down period on both sides of the peak hour.

### **2.1. Data Collection and Review**

The observed traffic data used in the model development and calibration was obtained from several sources. These sources include QEW mainline and ramp counts from the MTO, intersection turning movement counts from the Region of Halton and the Town of Oakville, and balanced QEW mainline and ramp volumes from McCormick Rankin. Heavy vehicle and high occupancy vehicle (HOV) splits were obtained from the Cordon Count Data Retrieval System (CCDRS).

The available traffic counts for the study area were from several years (2009 to 2012); therefore, the volumes used to calibrate the model were balanced. Travel time surveys were provided by the MTO for 2008 and 2010. Additional travel time surveys were also conducted by Cole Engineering in November 2012 (weekday AM and PM peak periods) and May 2013 (weekday PM peak period).

Signal timing plans were obtained for the following signalized intersections included in the model:

- Trafalgar Road / Cross Avenue
- Trafalgar Road / QEW EB Off Ramp
- Trafalgar Road / QEW WB Off Ramp-North Service Road
- Trafalgar Road / Iroquois Shore Road-Leighland Avenue
- Royal Windsor Drive / South Service Road-The Canadian Road

### **2.2. Existing Travel Demand**

The travel demand for the study area was generated using the Halton Region Emme weekday PM peak model calibrated to Transportation Tomorrow Survey (TTS) 2006 data. The study area comprises of 31 traffic zones (25 input gates) and a traversal OD matrix was extracted from the Emme model for existing conditions. The MTO Systems Analysis and Forecasting Office (SAFO) approved the use of the Region's Emme model for this study.

The travel patterns from the Emme traversal OD matrix were applied to the PM peak hour observed traffic volumes at the gates and the Fratar method was used to rebalance the matrix. The resulting matrix represented current conditions on the QEW. The HOV PM peak hour demand for the study area was obtained by applying a 15% HOV split (based on cordon count data) was applied to the rebalanced matrix.

The PM Peak travel demand was flipped to provide the travel demand patterns for the AM peak. Similar to the PM matrix, the observed AM traffic volumes at the gates were applied to the travel demand patterns obtained from the flipped PM peak hour matrix. The resulting AM peak hour matrix was rebalanced using the Fratar method. The HOV AM peak hour demand for the study area was obtained by applying a 15% HOV split to the rebalanced AM matrix.

Due to the limited route choice within the model network, travel demand was assigned to the network using the static routing function within Vissim. Within the microsimulation study area, there are approximately 21,970 vehicle trips generated during the weekday AM peak hour and 25,715 vehicle trips generated during the weekday PM peak.

### **2.3. Vissim Network**

The Vissim network was coded using a number of sources for background images; GIS shape files, aerial photography, and as-built CAD drawings of the HOV lane section on the QEW provided by the MTO. The ramps at Dorval Drive, Highway 403, Ford Drive, and Winston Churchill Boulevard are modelled as stubs or gates to the network. The four signalized intersections along Trafalgar Road from Leighland Avenue to Cross Avenue, and the signalized intersection at Royal Windsor Drive / South Service Road have been modelled explicitly.

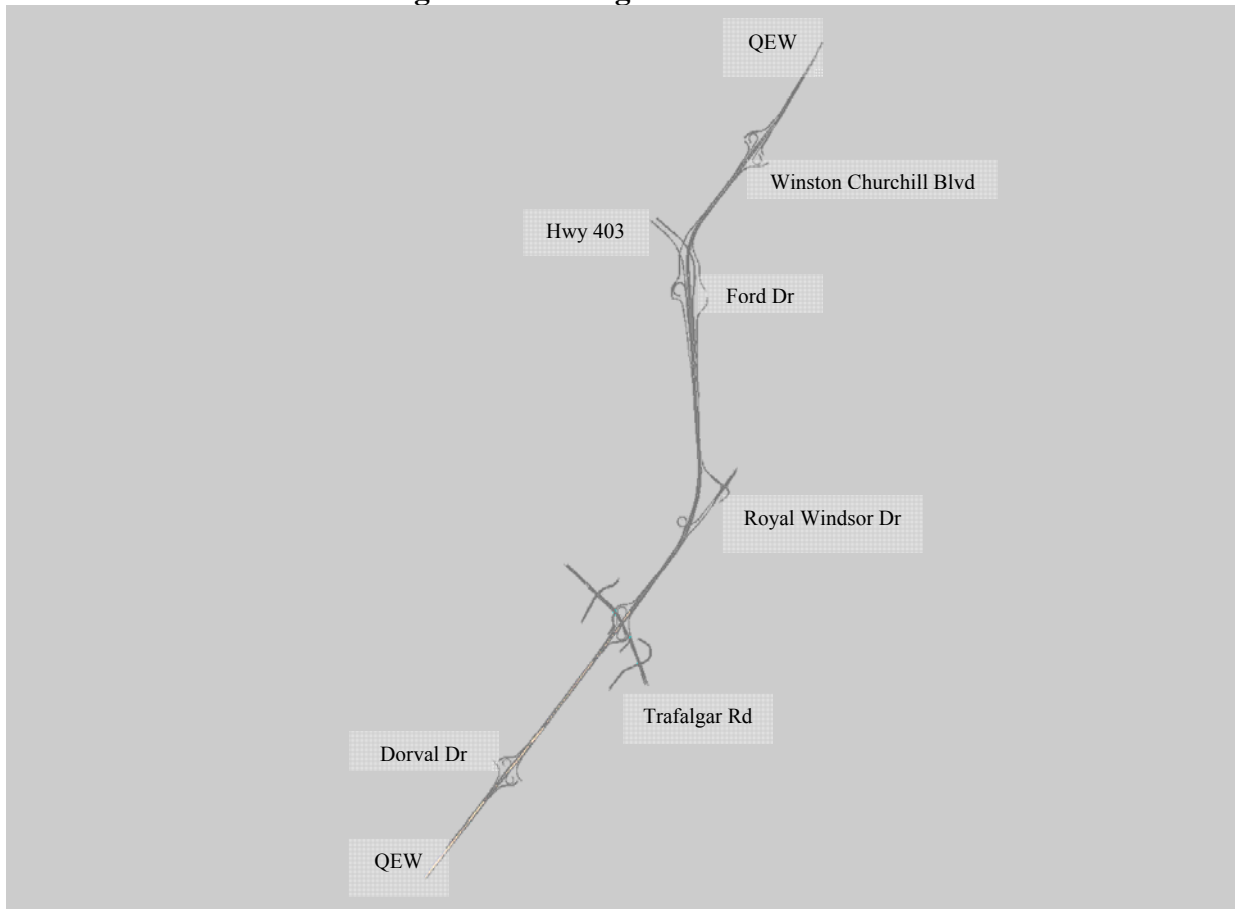
The QEW HOV lanes currently in operation from the Dorval Drive interchange to the Trafalgar Road interchange were explicitly coded in the model. The HOV lane was coded as a segregated link from the mainline with no transfers permitted between the HOV lanes and the QEW mainline except at the permitted locations. Where a transfer point exists, the HOV lane is non segregated to allow HOV traffic to enter/exit the network. The default Freeway driver behaviour (free lane selection) was used to code all mainline and HOV segments, ramps.

The local road network was coded based on the number of lanes, pedestrian crosswalk locations, turning lanes, through lanes, storage lane lengths, and number of receiving lanes. Signal timing plans for the study intersections were explicitly modelled including all turning movements and pedestrian phases using the Ring Barrier Control signal controller in Vissim. The default Urban (motorized) was used to code local road network links.

The demand data used in the models were obtained from the traversal matrices developed, **Section 2.2**, for the weekday AM and PM peak hours.

**Figure 2** shows the Vissim network developed for existing conditions.

**Figure 2: Existing Vissim Network**



#### 2.4. Microsimulation Model Calibration and Validation

It is important that the Vissim model be calibrated and validated to as high a standard as possible. This will ensure the model robustly reflects base traffic conditions and can be used for reliably testing future year and future network scenarios. The criteria used for the calibration and validation of the model are detailed below and are based on the microsimulation guidelines provided by the MTO, from the Federal Highway Administration (FHWA), and a United Kingdom publication, *The Design Manual for Roads and Bridges* (DMRB), Chapter 12.

The GEH statistic typically used in microsimulation studies is a form of the Chi-squared statistic that incorporates both relative and absolute errors and can either be calculated for individual links or be calculated for groups of links (e.g. screenlines). The statistic consists of the following formula:

$$GEH = \sqrt{\frac{(M - C)^2}{0.5(C + M)}} \quad \text{where: 'C' is the observed demand and 'M' is the modelled demand}$$



The calibration criteria recommended in this study are:

- Capacity Calibration
  - Identification of recurring bottlenecks and queues
  - Validation of volume at downstream of bottlenecks (capacity) within 15% of the traffic counts for 85% of cases
- Volume Calibration
  - Measurement of model output volumes within 5% of input volumes (85% of cases)
  - Measurement of GEH statistic of the model generated volumes and the traffic counts within 5% for 85% of cases
  - Percentage of links or ramps with volumes greater than 700 vehicles per hour within 5% for 85% of cases
  - Percentage of links or ramps with volumes less than 700 vehicles per hour within 100 vehicles of observed for 85% of cases
- Travel Time Calibration
  - Average field travel time with 95% confidence interval of model average travel time
  - Visually acceptable model average speed profiles

Validation of travel times on the QEW mainline were also carried out based on the criteria that 85% of segment travel times should be within 15% or 60 seconds of observed travel times.

The calibration and validation results for the Vissim models are documented in the following sections and are based on the average of ten runs.

#### 2.4.1. Model Volume Calibration

The results for the volume calibration are summarized in **Table 1** and **Table 2** for the weekday AM and PM peak hours, respectively. Results are provided at three levels; screenline, ramp and intersection turning movements. The results show the weekday AM and PM peak hour models met the volumes calibration targets for the screenline, ramps and turning movement levels.

Graphical representations of the QEW modelled and observed link volumes for each travel direction are shown in **Figure 3** to **Figure 6** for weekday AM and PM peak hours. The results show that the model was able to closely simulate the observed link volumes on the QEW through the study area.

It can be concluded the model is calibrated based on traffic volumes. Additional traffic demand results are provided in **Appendix A**.

**Table 1: Summary of AM Peak Hour Demand Calibration**

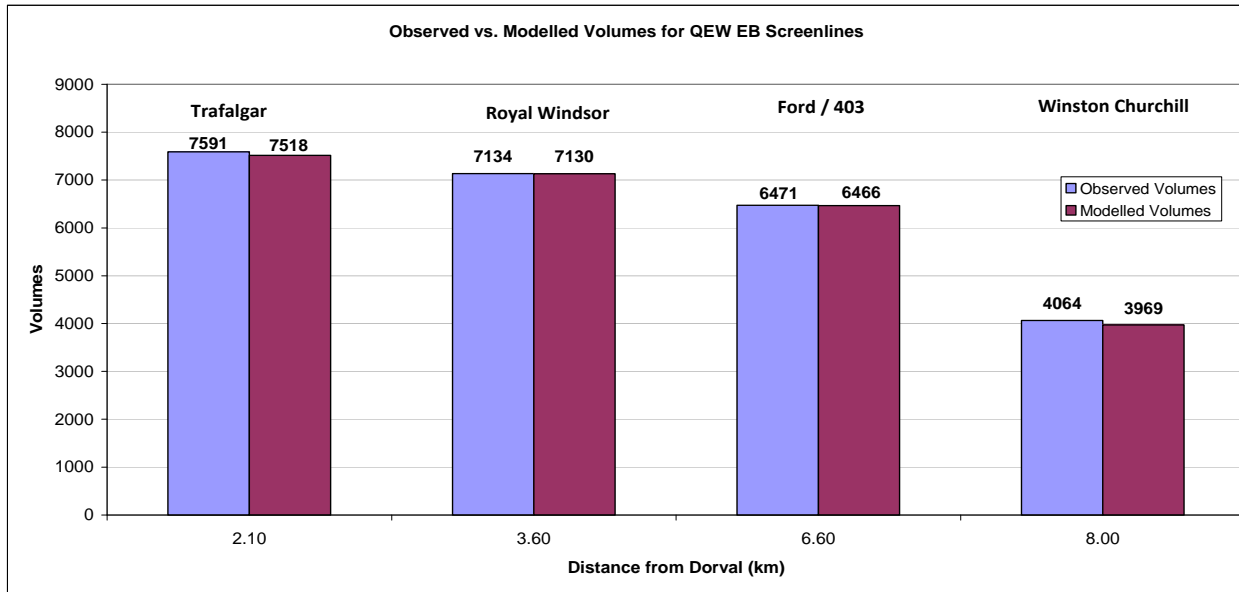
Criteria	Modelled	Target	Check
<b>Input Demand</b>			
Percentage of input volumes within 5% of Modelled / Observed	88%	85%	OK
<b>Screenline Demand</b>			
Percentage of links with GEH $\leq 5$	100%	85%	OK
Percentage of links with volumes > 700 vehicle/hour within 5% Modelled / Observed	94%	85%	OK
Percentage of links with volumes < 700 vehicle/hour within 100 vehicles of Observed	100%	85%	OK
<b>Ramp Demand</b>			
Percentage of ramps with GEH $\leq 5$	96%	85%	OK
Percentage of ramps with volumes > 700 vehicle/hour within 5% Modelled / Observed	88%	85%	OK
Percentage of ramps with volumes < 700 vehicle/hour within 100 vehicles of Observed	100%	85%	OK
<b>Turning Movement (TM) Demand</b>			
Percentage of TM with GEH $\leq 5$	98%	85%	OK
Percentage of TM with GEH $\leq 10$	100%	95%	OK

**Table 2: Summary of PM Peak Hour Demand Calibration**

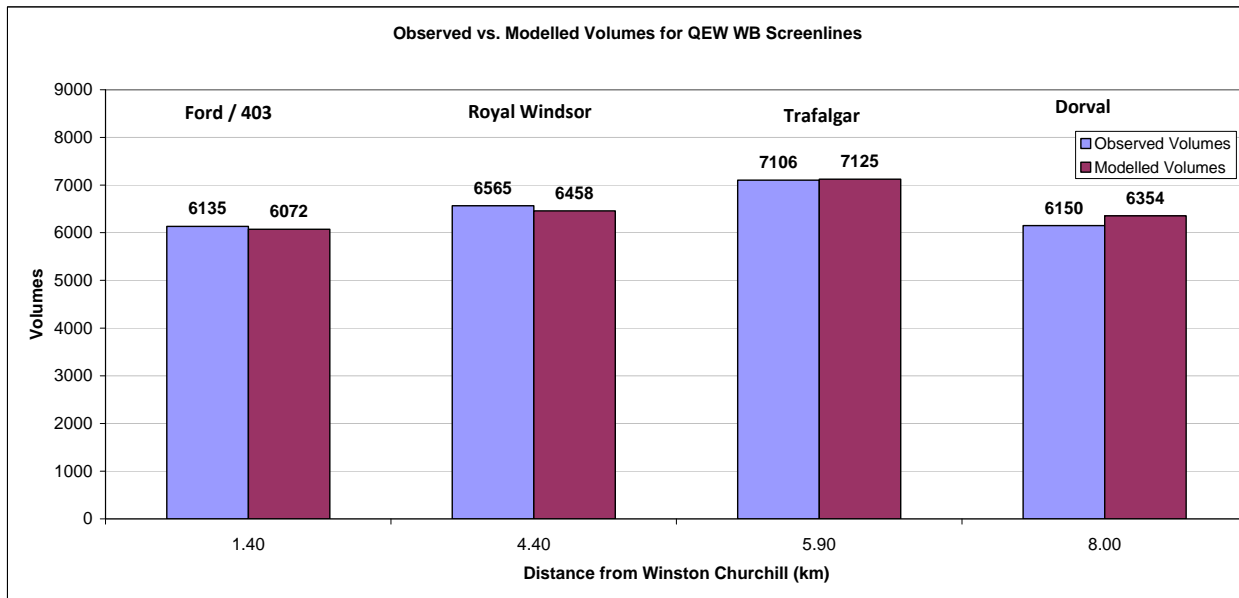
Criteria	Modelled	Target	Check
<b>Input Demand</b>			
Percentage of input volumes within 5% of Modelled / Observed	96%	85%	OK
<b>Screenline Demand</b>			
Percentage of links with GEH $\leq 5$	100%	85%	OK
Percentage of links with volumes > 700 vehicle/hour within 5% Modelled / Observed	100%	85%	OK
Percentage of links with volumes < 700 vehicle/hour within 100 vehicles of Observed	100%	85%	OK
<b>Ramp Demand</b>			
Percentage of ramps with GEH $\leq 5$	100%	85%	OK
Percentage of ramps with volumes > 700 vehicle/hour within 5% Modelled / Observed	100%	85%	OK
Percentage of ramps with volumes < 700 vehicle/hour within 100 vehicles of Observed	100%	85%	OK
<b>Turning Movement (TM) Demand</b>			
Percentage of TM with GEH $\leq 5$	100%	85%	OK
Percentage of TM with GEH $\leq 10$	100%	95%	OK



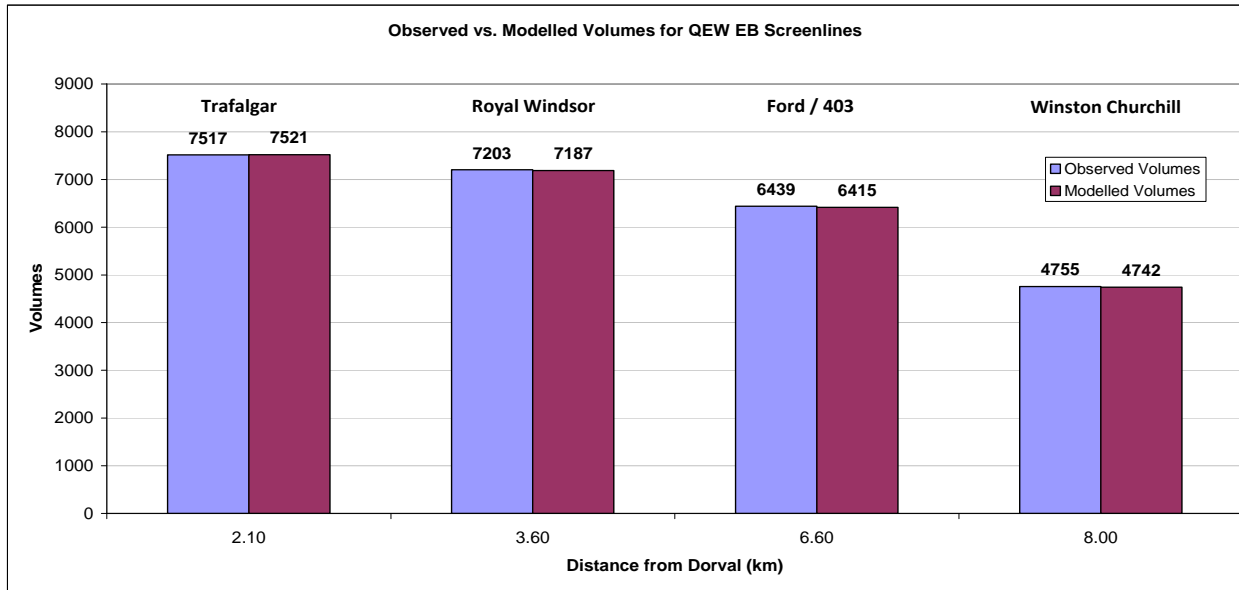
**Figure 3: AM Peak Hour Eastbound QEW Volumes (Modelled versus Observed)**



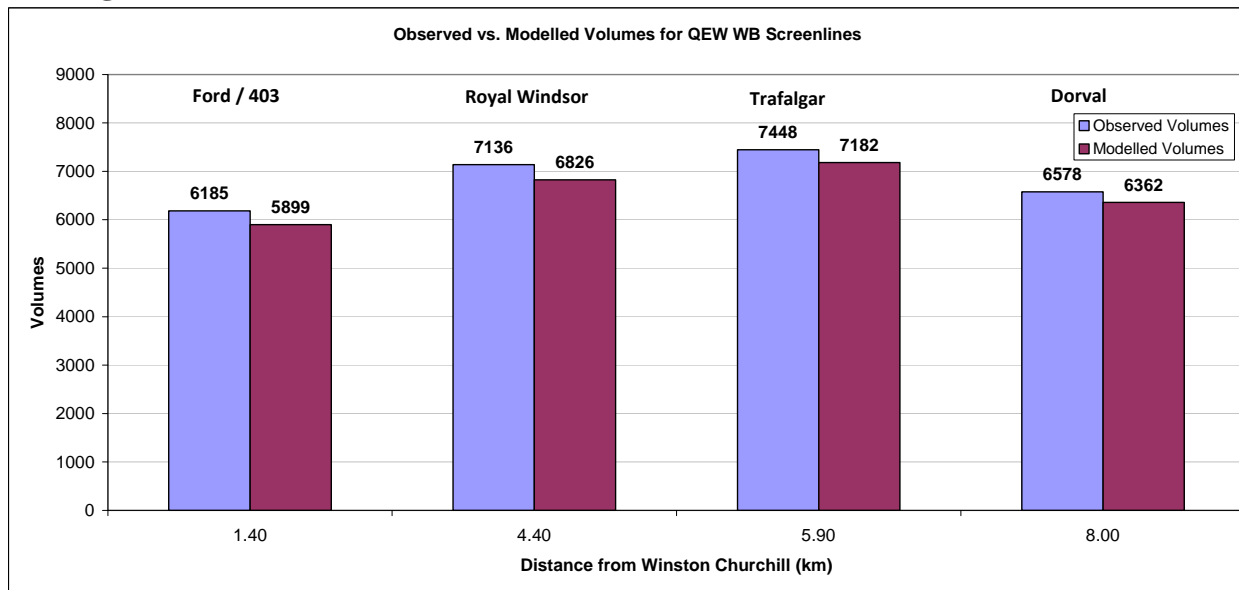
**Figure 4: AM Peak Hour Westbound QEW Volumes (Modelled versus Observed)**



**Figure 5: PM Peak Hour Eastbound QEW Volumes (Modelled versus Observed)**



**Figure 6: PM Peak Hour Westbound QEW Volumes (Modelled versus Observed)**



#### 2.4.2. Model Capacity and Travel Time Calibration

The model capacity and travel calibration was challenging for the QEW section through the study area. Using the default driver behaviour parameters, the model was unable to simulate observed bottlenecks during both the weekday AM and PM peak periods. Differences between the modelled and observed times were more pronounced in the PM model using the default parameters; especially the westbound segment between Ford Drive/Highway 403 and Dorval Drive.

Additional travel time runs were conducted on November 6, 2012 (AM and PM peak periods) and May 30, 2013 (PM peak period) to determine if travel times have improved through the study area. The additional runs confirm congestion at specific location; however, the runs also show that travel times varying through the study area. Adjustments of key driver behaviour parameters are required to calibrate the model to simulate observed bottlenecks on the QEW through the study area.

The research paper “*A Microsimulation Model of a Congested Freeway using VISSIM*” from the University of California written by Gabriel Gomes (PhD candidate), Adolf May (Professor Emeritus) and Roberto Horowitz (Professor) served as the primary reference in adjusting the following Vissim driver behaviour parameters (Wiedemann 99) to calibrate the model:

- CC0 – average desired distance between stopped vehicles (maximum value of 1.7)
- CC1 – desired headway (maximum value of 1.4 seconds)
- CC4 and CC5 – control speed differences during the following state (maximum value -2.0/2.0)

Adjustment to the “Look Ahead” and “Look Back” distance parameters on links were also investigated to simulate the bottlenecks observed under existing conditions. However, these two parameters were not adjusted since they were found not to be suitable for this model.

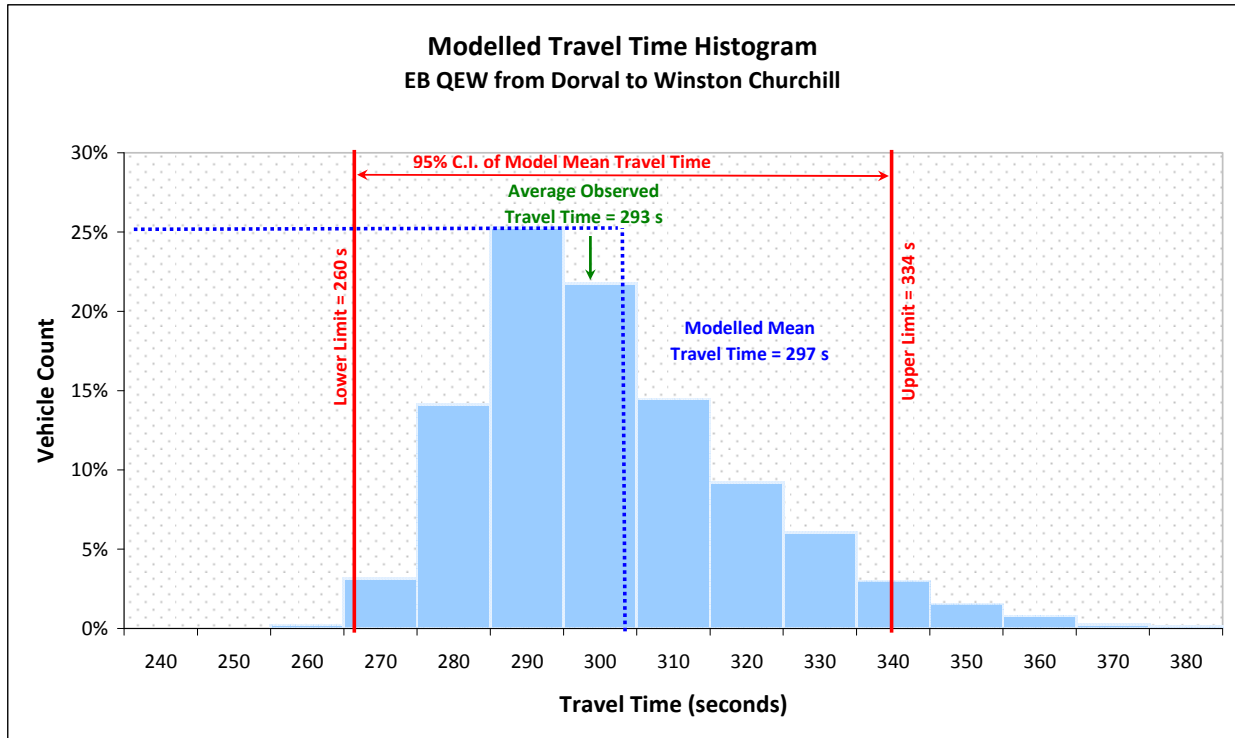
A summary of the driver behaviour parameters adjusted during the calibration process are shown in **Table 3**. As shown in **Table 3**, the adjustments between the AM and PM peak periods are different especially for the CC4/CC5 pair. Calibration of model capacity and congestion were achieved for both the weekday AM and PM peak period models through the adjustment of driver behaviour parameters.

**Table 3: Summary of Changes to Vissim Driver Behaviour Parameters**

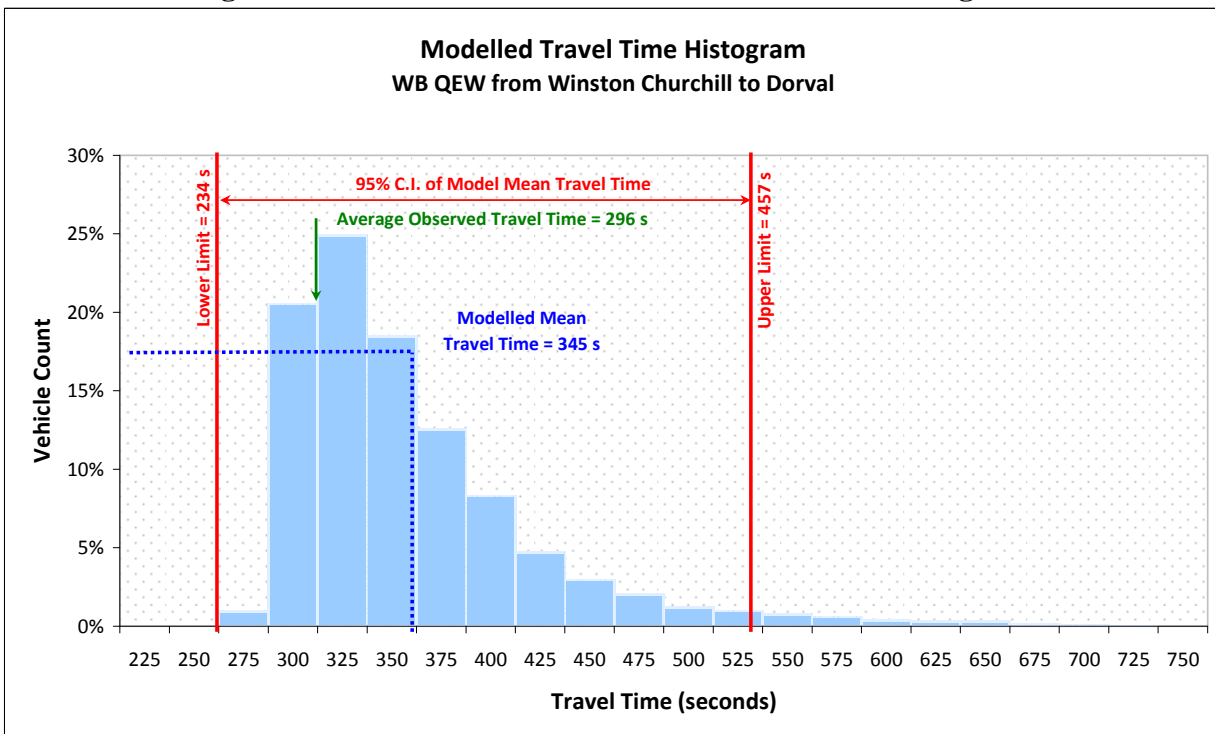
Driver Behaviour	Parameters							
	AM Peak Period				PM Peak Period			
	CC0	CC1	CC4	CC5	CC0	CC1	CC4	CC5
Freeway default (free lane selection)	1.5	0.9	-0.35	0.35	1.5	0.9	-0.35	0.35
Freeway adjusted (free lane selection)	n/a	n/a	n/a	n/a	1.5	0.9	-1.00	1.00
Freeway Curve	1.7	1.1	-0.35	0.35	1.7	1.1	-0.35	0.35
Freeway Merge	1.5	1.0	-0.35	0.35	1.5	1.0	-1.00	1.00
Freeway Diverge	1.5	0.9	-0.35	0.35	1.5	0.9	-1.00	1.00
WB Freeway (RWD)	1.7	1.3	-0.35	0.35	1.7	1.2	-1.00	1.00
Freeway (HOV Access)	1.5	1.2	-0.35	0.35	1.5	1.2	-1.00	1.00

The average field travel times are within the 95% confidence interval of the modelled travel times for both the weekday AM and PM peak hours as shown in **Figure 7** to **Figure 10**.

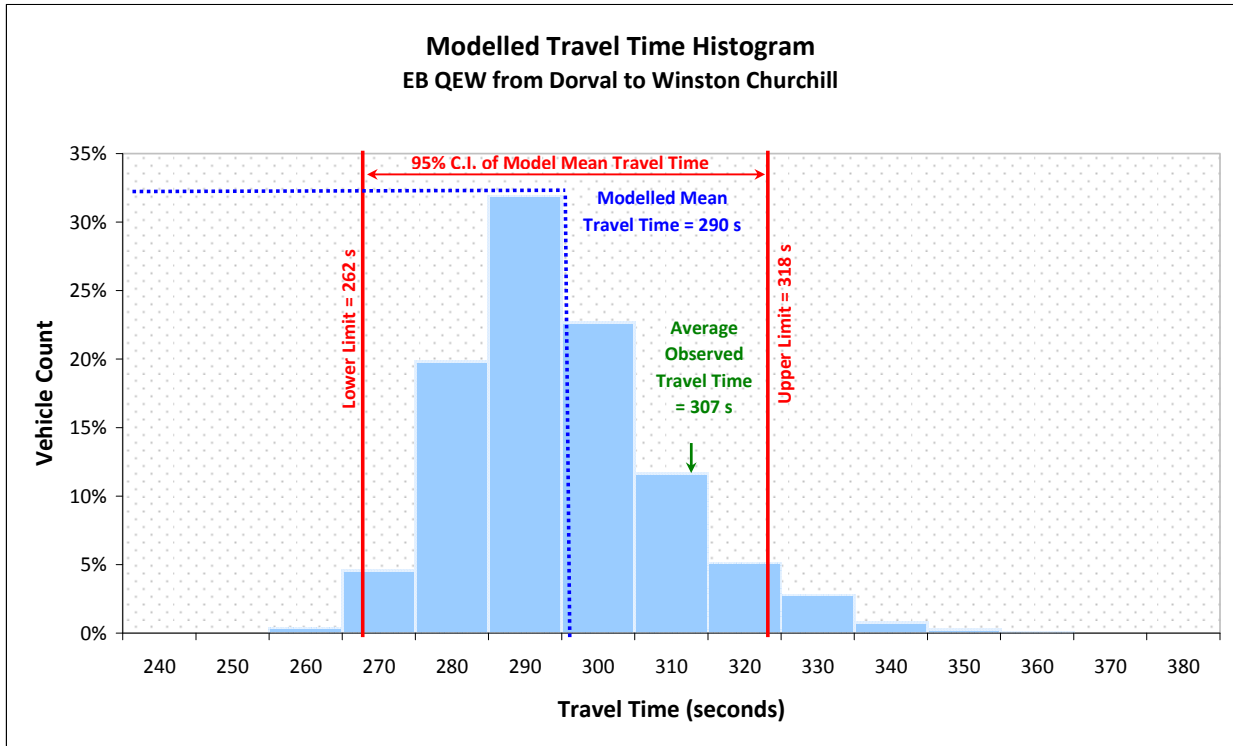
**Figure 7: AM Peak Hour Eastbound Travel Time Histogram**



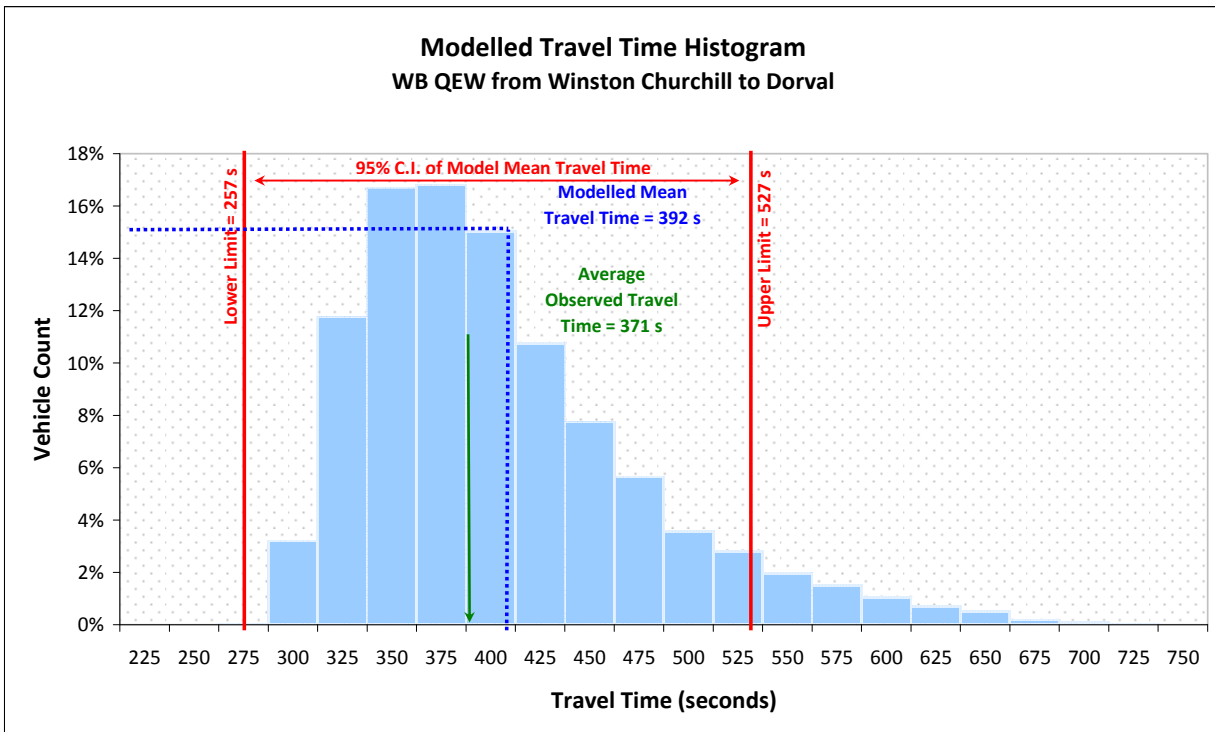
**Figure 8: AM Peak Hour Westbound Travel Time Histogram**



**Figure 9: PM Peak Hour Eastbound Travel Time Histogram**

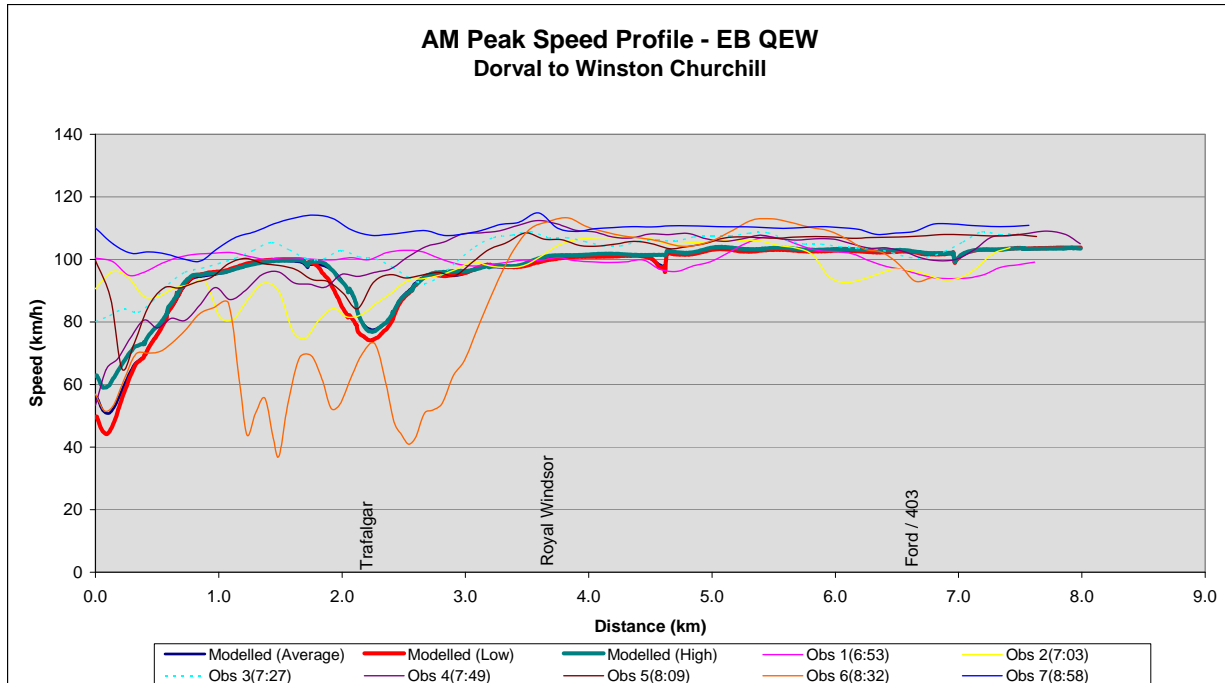


**Figure 10: PM Peak Hour Westbound Travel Time Histogram**

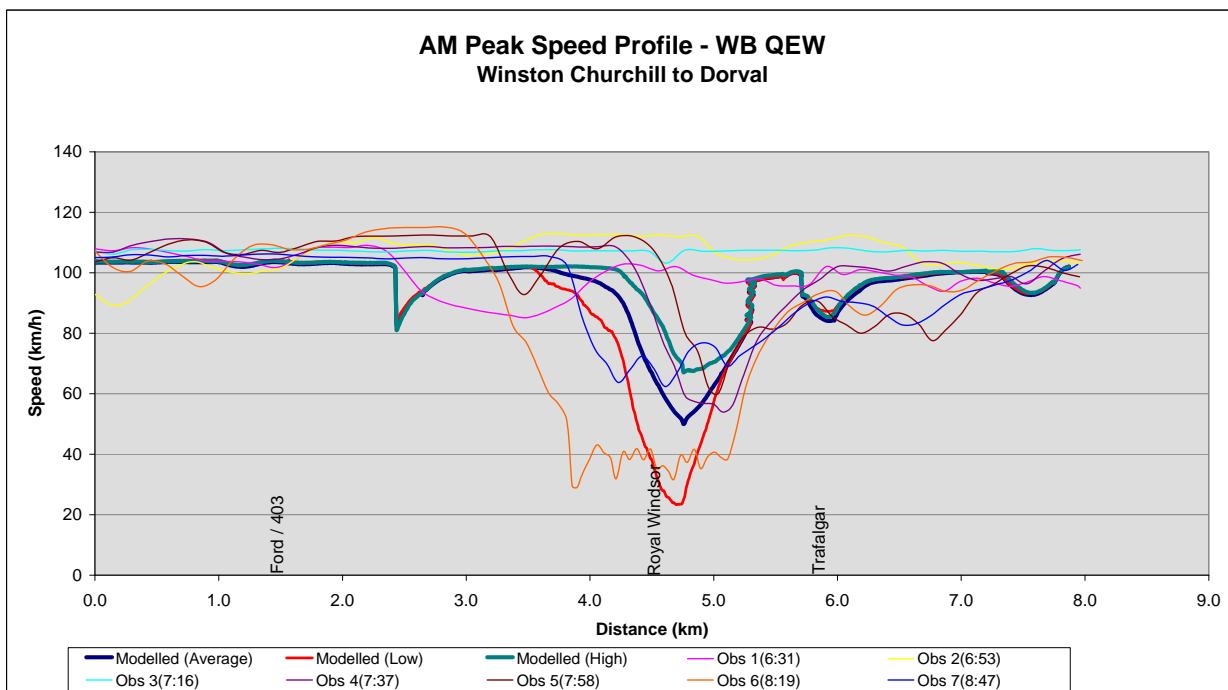


The observed recurring bottlenecks and queues during the weekday AM peak hour were simulated by model and can be seen in the speed profiles plots shown in **Figure 11** and **Figure 12**. It can be concluded that the AM peak period model is calibrated to observed capacity and travel times.

**Figure 11: AM Peak Hour QEW Eastbound Speed Profile**



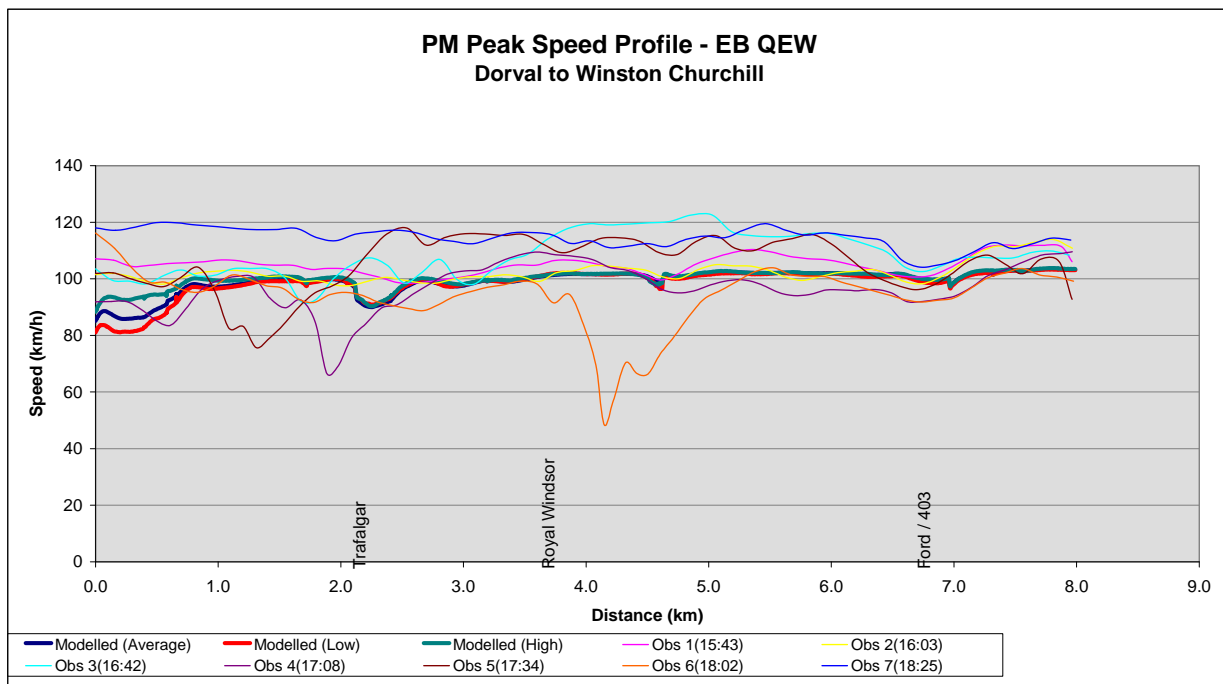
**Figure 12: AM Peak Hour QEW Westbound Speed Profile**



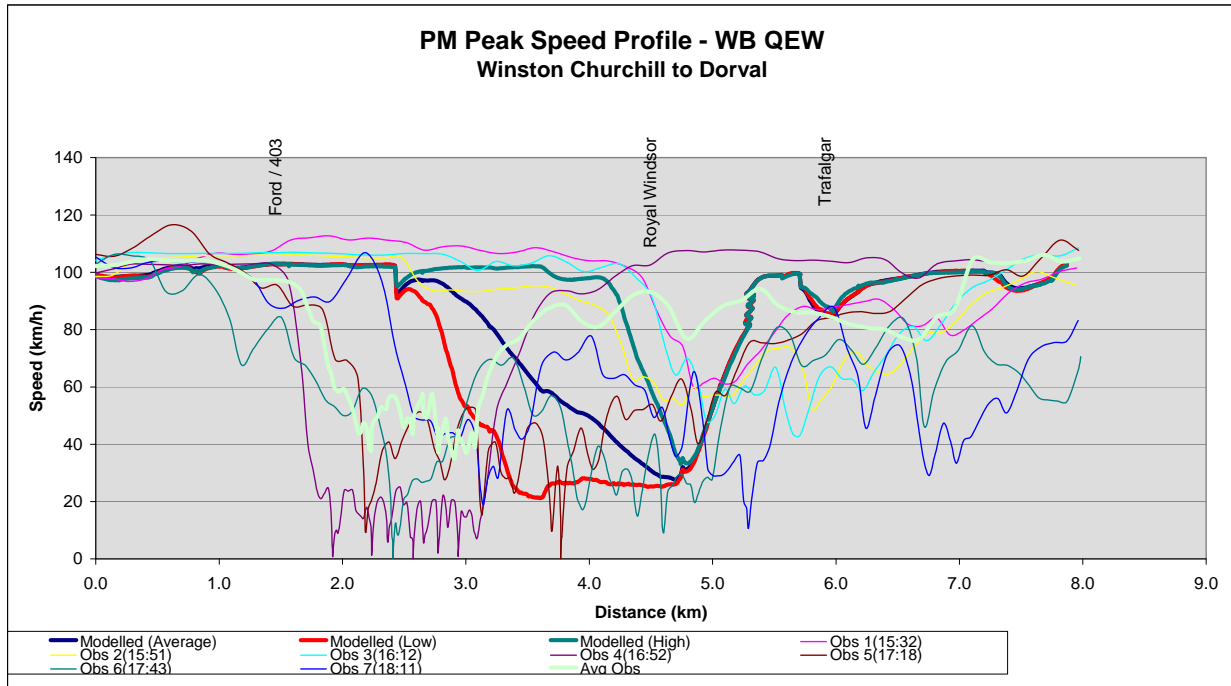
The observed recurring bottlenecks and queues during the weekday PM peak hour were simulated by model and can be seen in the speed profiles plots shown in **Figure 13** to **Figure 16**. The bottlenecks and queues observed during the PM peak hour are more pronounced compared to the AM peak hour, especially in the westbound direction.

It was extremely difficult to calibrate the westbound speed profile during the PM peak hour using the November 2012 counts (**Figure 13** and **Figure 14**); therefore, an additional PM peak period travel time survey was conducted in May 2013 (**Figure 15** to **Figure 16**). The speed profiles for the two travel time runs confirmed westbound recurring queues; however, the magnitude of these queues varies between the two travel time runs. The model captures this variation and as such it can be concluded that the PM peak period model is calibrated to observed capacity and travel times.

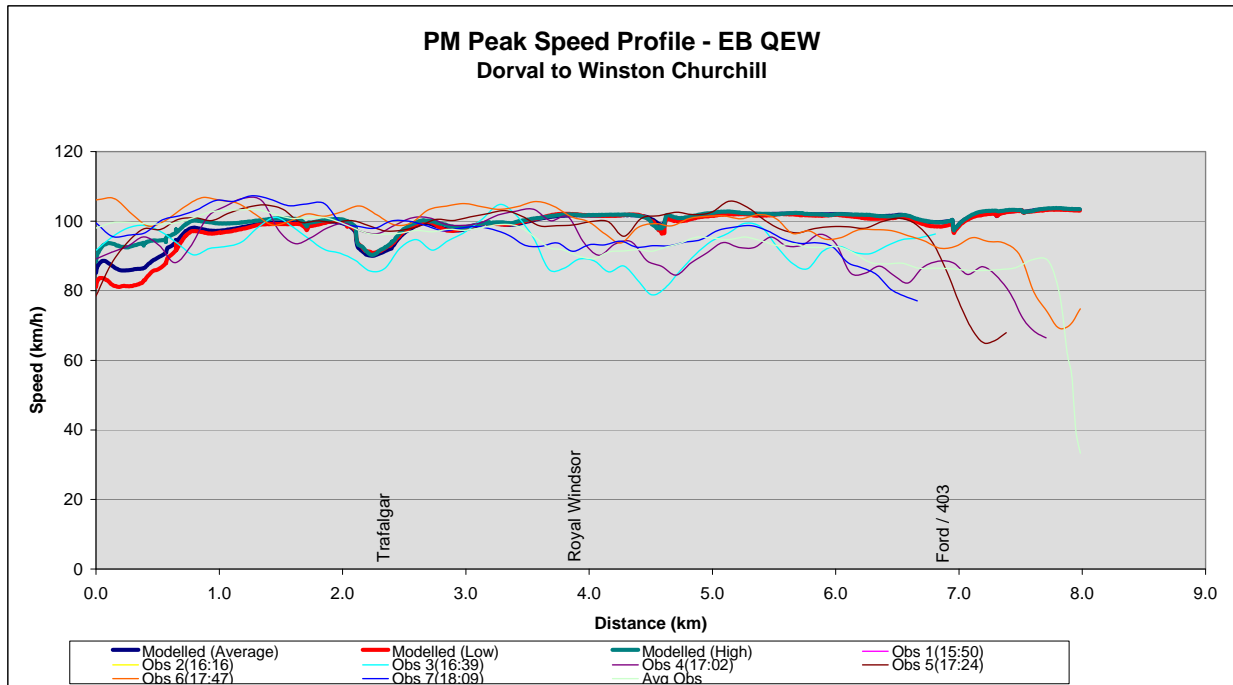
**Figure 13: PM Peak Hour QEW Eastbound Speed Profile (November 2012)**



**Figure 14: PM Peak Hour QEW Westbound Speed Profile (November 2012)**

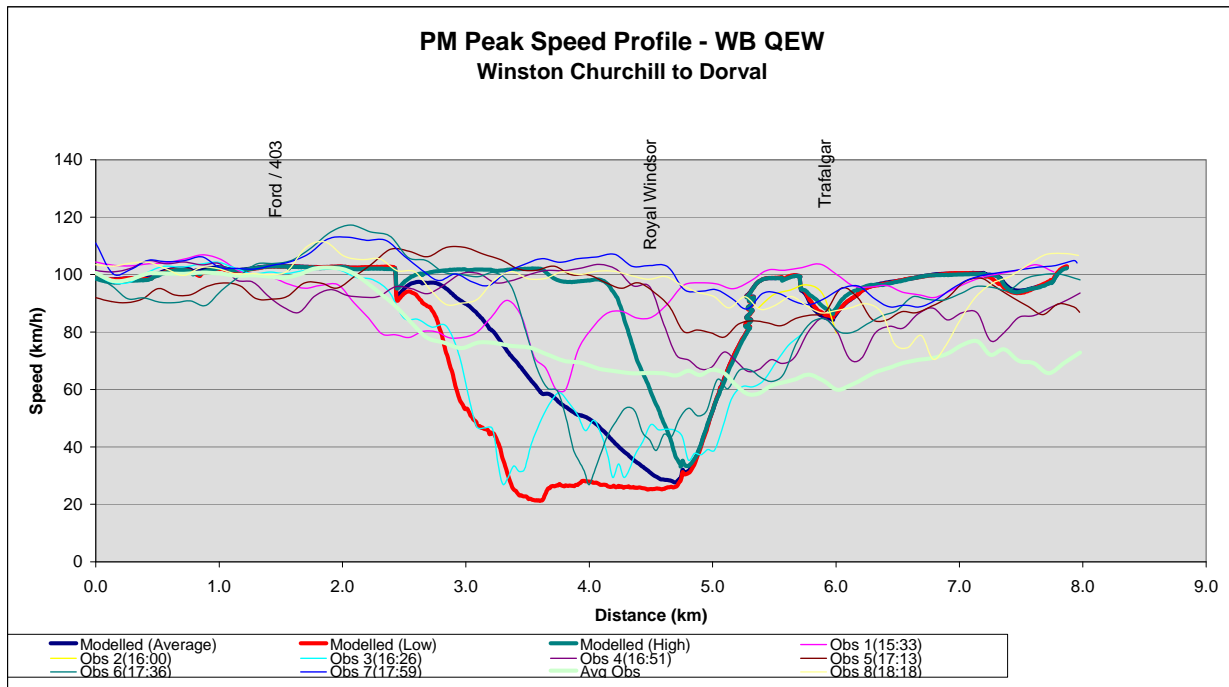


**Figure 15: PM Peak Hour QEW Eastbound Speed Profile (May 2013)**





**Figure 16: PM Peak Hour QEW Westbound Speed Profile (May 2013)**



### 3. Summary of Model Calibration

Based on the results documented in **Section 2.4** and **Appendix A**, the Vissim microsimulation models developed for the weekday AM and PM peak periods are calibrated and validated for existing conditions. All calibration and validations are met are the models can be used with confidence in the assessment of future traffic conditions through the study area.

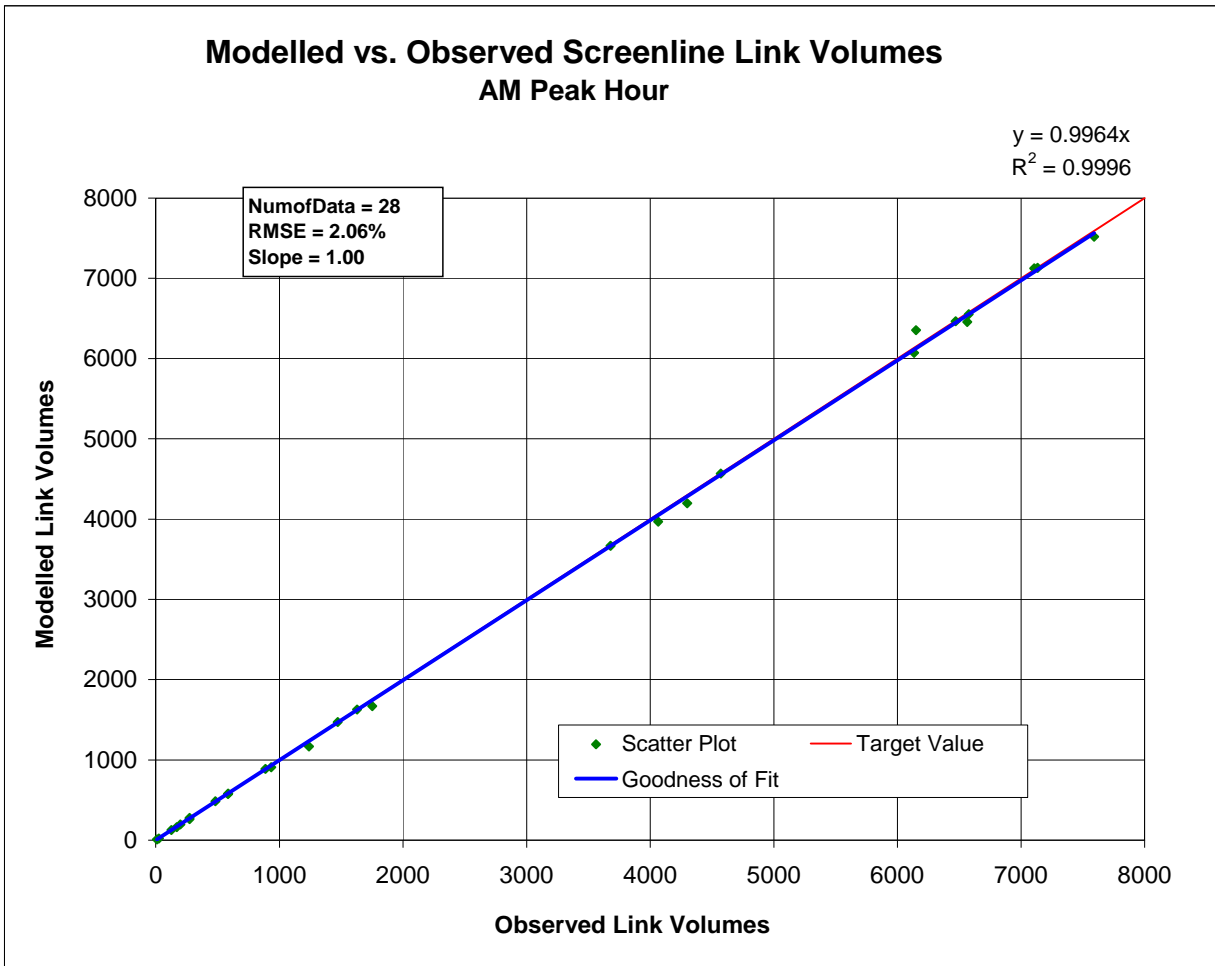
## **Appendix A – Additional Calibration and Validation Results**

## AM Peak Hour Model Results

**Table A- 1: AM Peak Demand Input Calibration (Modelled versus Observed)**

Demand Input	Observed	Average Modelled	Model / Obs	GEH
QEW west of Dorval	6576	6553	1.00	0.28
Dorval S - QEW E	570	570	1.00	0.00
Dorval S - QEW W	148	149	1.01	0.08
Dorval N - QEW E	821	822	1.00	0.03
Dorval N - QEW W	146	146	1.00	0.00
Trafalgar north of Iroquois	1629	1628	1.00	0.02
Leighland west of Trafalgar	587	581	0.99	0.25
Iroquois east of Trafalgar	887	887	1.00	0.00
North Service west of Trafalgar	127	127	1.00	0.00
Argus west of Trafalgar	10	10	1.00	0.00
Cross west of Trafalgar	483	484	1.00	0.05
Trafalgar south of Cross	1472	1472	1.00	0.00
South Service east of Trafalgar	171	163	0.95	0.62
Canadian north of Royal Windsor	41	41	1.00	0.00
South Service south of Royal Windsor	73	72	0.99	0.12
Royal Windsor east of South Service/Canadian	552	553	1.00	0.04
Ford N/S - QEW E	640	644	1.01	0.16
Ford S - QEW W	60	53	0.88	0.93
Ford N - QEW W	61	55	0.90	0.79
403 N - QEW W	2724	2723	1.00	0.02
Winston Churchill S - QEW E	340	340	1.00	0.00
Winston Churchill S - QEW W	110	96	0.87	1.38
Winston Churchill N - QEW E	445	438	0.98	0.33
Winston Churchill N - QEW W	100	101	1.01	0.10
QEW east of Winston Churchill	4570	4567	1.00	0.04

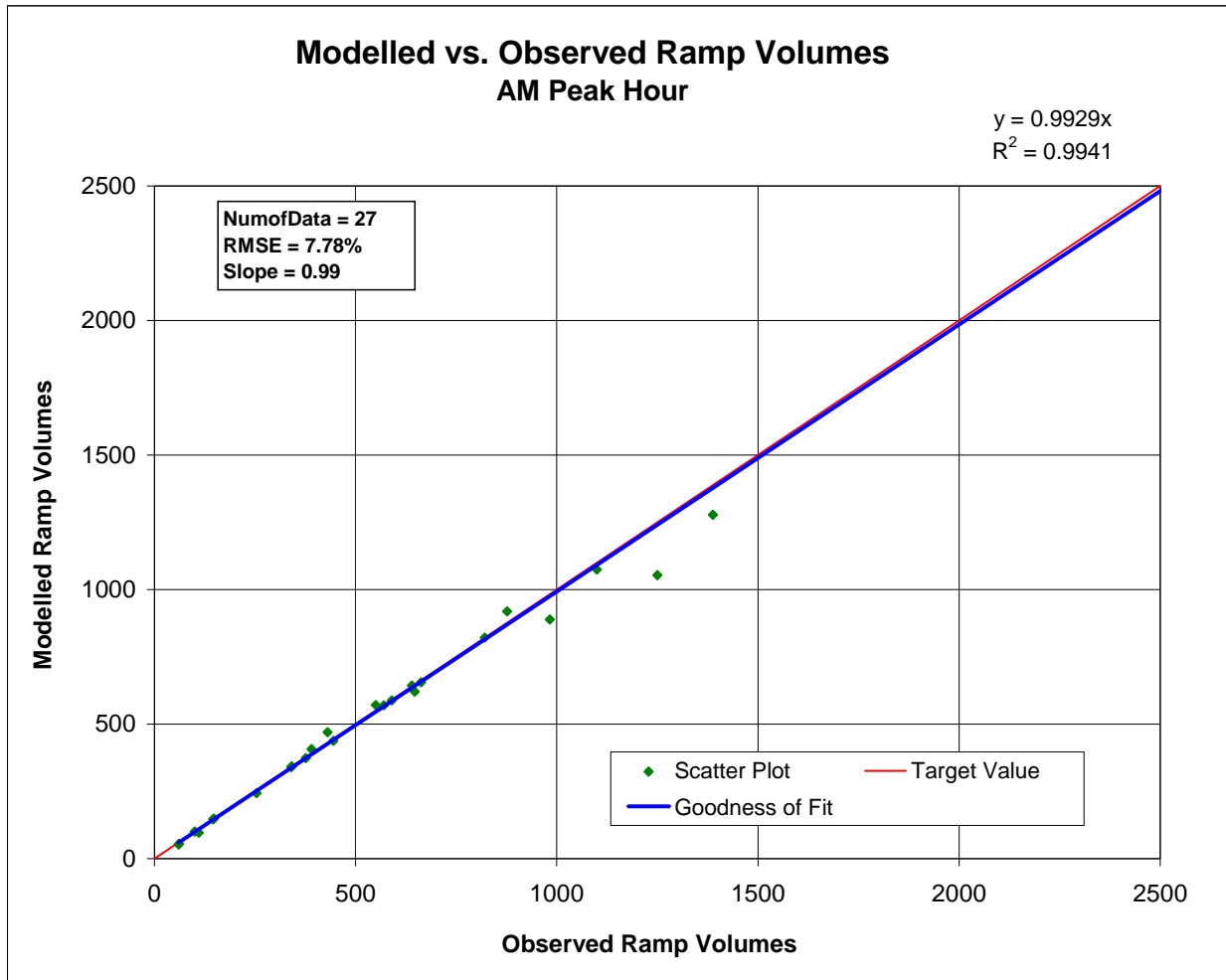
Figure A- 1: AM Peak Hour Screenline Scattergram Plot



**Table A- 2: AM Peak Screenline Calibration (Modelled versus Observed)**

	NORTHBOUND / EASTBOUND				SOUTHBOUND / WESTBOUND			
	Observed	Average Modelled	Model / Obs	GEH	Observed	Average Modelled	Model / Obs	GEH
<b>West of Dorval Drive</b>								
QEW	6576	6553	1.00	0.28	6150	6354	1.03	2.58
<b>Screenline Total</b>	<b>6576</b>	<b>6553</b>	<b>1.00</b>	<b>0.28</b>	<b>6150</b>	<b>6354</b>	<b>1.03</b>	<b>2.58</b>
<b>West of Trafalgar Road</b>								
Leighland Avenue	587	581	0.99	0.25	273	276	1.01	0.18
North Service Road	127	127	1.00	0.00	26	20	0.77	1.25
QEW	7591	7518	0.99	0.84	7106	7125	1.00	0.23
Argus Road	10	10	1.00	0.00	200	195	0.98	0.36
Cross Avenue	483	484	1.00	0.05	584	575	0.98	0.37
<b>Screenline Total</b>	<b>8798</b>	<b>8721</b>	<b>0.99</b>	<b>0.82</b>	<b>8189</b>	<b>8192</b>	<b>1.00</b>	<b>0.03</b>
<b>East of Trafalgar Road</b>								
Iroquois Shore Road	935	909	0.97	0.86	887	887	1.00	0.00
QEW	7134	7130	1.00	0.05	6565	6458	0.98	1.33
South Service Road	274	261	0.95	0.79	171	163	0.95	0.62
<b>Screenline Total</b>	<b>8343</b>	<b>8295</b>	<b>0.99</b>	<b>0.53</b>	<b>7623</b>	<b>7507</b>	<b>0.98</b>	<b>1.33</b>
<b>West of Ford Drive</b>								
QEW	6471	6466	1.00	0.06	6135	6072	0.99	0.81
<b>Screenline Total</b>	<b>6471</b>	<b>6466</b>	<b>1.00</b>	<b>0.06</b>	<b>6135</b>	<b>6072</b>	<b>0.99</b>	<b>0.81</b>
<b>West of Winston Churchill Boulevard</b>								
QEW	4064	3969	0.98	1.50	3680	3669	1.00	0.18
<b>Screenline Total</b>	<b>4064</b>	<b>3969</b>	<b>0.98</b>	<b>1.50</b>	<b>3680</b>	<b>3669</b>	<b>1.00</b>	<b>0.18</b>
<b>East of Winston Churchill Boulevard</b>								
QEW	4299	4196	0.98	1.58	4570	4567	1.00	0.04
<b>Screenline Total</b>	<b>4299</b>	<b>4196</b>	<b>0.98</b>	<b>1.58</b>	<b>4570</b>	<b>4567</b>	<b>1.00</b>	<b>0.04</b>
<b>North of Leighland Avenue</b>								
Trafalgar Road	1239	1167	0.94	2.08	1629	1628	1.00	0.02
<b>Screenline Total</b>	<b>1239</b>	<b>1167</b>	<b>0.94</b>	<b>2.08</b>	<b>1629</b>	<b>1628</b>	<b>1.00</b>	<b>0.02</b>
<b>South of Cross Avenue</b>								
Trafalgar Road	1472	1472	1.00	0.00	1751	1669	0.95	1.98
<b>Screenline Total</b>	<b>1472</b>	<b>1472</b>	<b>1.00</b>	<b>0.00</b>	<b>1751</b>	<b>1669</b>	<b>0.95</b>	<b>1.98</b>

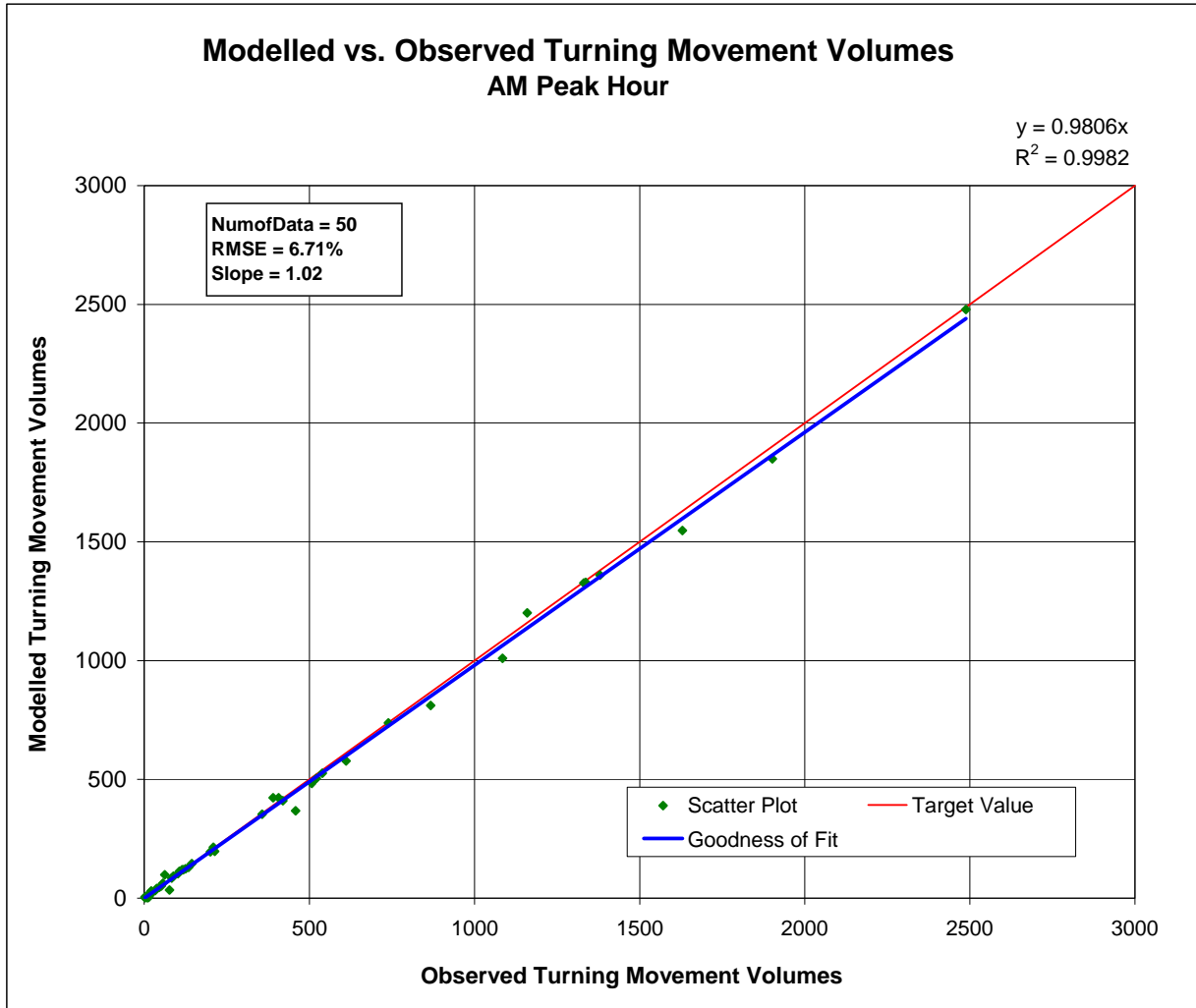
Figure A- 2: AM Peak Hour Ramp Scattergram Plot



**Table A- 3: AM Peak Ramp Calibration (Modelled versus Observed)**

<b>QEW / Dorval Drive</b>	<b>Observed</b>	<b>Average Modelled</b>	<b>Model / Obs</b>	<b>GEH</b>
QEW W - Dorval N/S	376	374	0.99	0.10
QEW E - Dorval N/S	1250	1054	0.84	5.77
Dorval S - QEW E	570	570	1.00	0.00
Dorval S - QEW W	148	149	1.01	0.08
Dorval N - QEW E	821	822	1.00	0.03
Dorval N - QEW W	146	146	1.00	0.00
<b>Interchange Total</b>	<b>3311</b>	<b>3115</b>	<b>0.94</b>	<b>3.46</b>
<b>QEW / Trafalgar Road</b>				
QEW W - Trafalgar N/S	1388	1278	0.92	3.01
QEW E - Trafalgar N/S	983	889	0.90	3.07
Trafalgar S - QEW E	590	588	1.00	0.08
Trafalgar S - QEW W	647	621	0.96	1.03
Trafalgar N - QEW E	341	344	1.01	0.16
Trafalgar N - QEW W	877	919	1.05	1.40
<b>Interchange Total</b>	<b>4826</b>	<b>4639</b>	<b>0.96</b>	<b>2.72</b>
<b>QEW / Royal Windsor Drive</b>				
QEW W - Royal Windsor	663	655	0.99	0.31
Royal Windsor - QEW W	430	470	1.09	1.89
<b>Interchange Total</b>	<b>1093</b>	<b>1125</b>	<b>1.03</b>	<b>0.96</b>
<b>QEW / Ford Drive / Highway 403</b>				
QEW W - Ford N/S	254	244	0.96	0.63
QEW W - Hwy 403 N	2793	2898	1.04	1.97
QEW E - Ford N/S	390	407	1.04	0.85
Hwy 403 N - QEW W	2724	2723	1.00	0.02
Ford N/S - QEW E	640	644	1.01	0.16
Ford S - QEW W	60	53	0.88	0.93
Ford N - QEW W	61	55	0.90	0.79
<b>Interchange Total</b>	<b>6922</b>	<b>7024</b>	<b>1.01</b>	<b>1.22</b>
<b>QEW / Winston Churchill Blvd</b>				
QEW W - Winston Churchill N/S	550	571	1.04	0.89
QEW E - Winston Churchill N/S	1100	1075	0.98	0.76
Winston Churchill S - QEW E	340	340	1.00	0.00
Winston Churchill S - QEW W	110	96	0.87	1.38
Winston Churchill N - QEW E	445	438	0.98	0.33
Winston Churchill N - QEW W	100	101	1.01	0.10
<b>Interchange Total</b>	<b>2645</b>	<b>2621</b>	<b>0.99</b>	<b>0.47</b>

Figure A- 3: AM Peak Hour Turning Movement Scattergram Plot





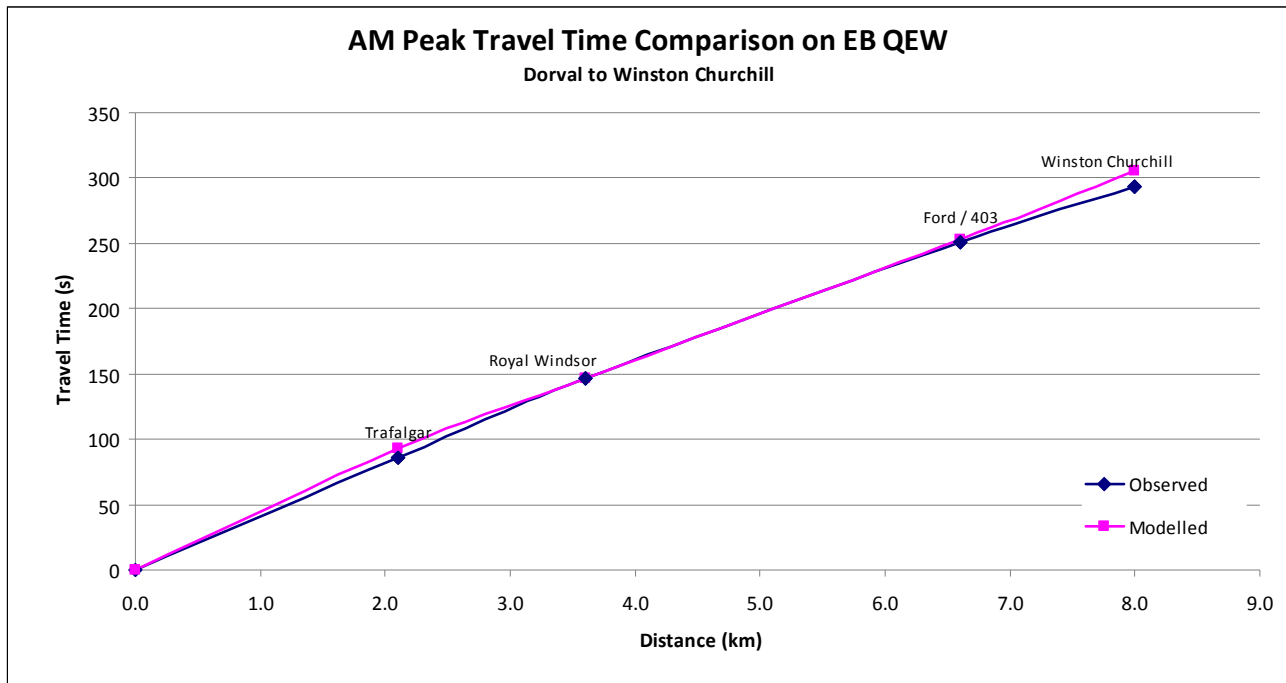
**Table A- 4: AM Peak Turning Movement Calibration (Modelled versus Observed)**

Intersection	TM	Observed	Average Modelled	Model / Obs	GEH
Trafalgar Rd / Leighland Ave-Iroquois Shore Blvd	EBL	52	52	1.00	0.00
	EBT	115	120	1.04	0.46
	EBR	420	410	0.98	0.49
	WBL	739	738	1.00	0.04
	WBT	46	46	1.00	0.00
	WBR	102	103	1.01	0.10
	NBL	144	145	1.01	0.08
	NBT	1085	1009	0.93	2.35
	NBR	611	577	0.94	1.40
	SBL	209	214	1.02	0.34
	SBT	1337	1330	0.99	0.19
	SBR	83	85	1.02	0.22
Trafalgar Rd / North Service Rd N	EBL	2	2	1.00	0.00
	EBR	125	124	0.99	0.09
	WBL	507	483	0.95	1.08
	WBT	18	17	0.94	0.24
	WBR	458	368	0.80	4.43
	NBT	1380	1360	0.99	0.54
	SBT	2488	2478	1.00	0.20
	SBR	8	3	0.38	2.13
Trafalgar Rd / QEW EB Off-ramp	EBL	867	811	0.94	1.93
	EBR	521	504	0.97	0.75
	NBT	1160	1201	1.04	1.19
	SBT	1902	1849	0.97	1.22
Trafalgar Rd / Argus Rd	EBR	10	10	1.00	0.00
	SBR	200	195	0.98	0.36
Trafalgar Rd / Cross Ave-South Service Rd	EBL	357	353	0.99	0.21
	EBT	38	41	1.08	0.48
	EBR	88	92	1.05	0.42
	WBL	33	31	0.94	0.35
	WBT	76	34	0.45	5.66
	WBR	62	98	1.58	4.02
	NBL	118	120	1.02	0.18
	NBT	1331	1327	1.00	0.11
	NBR	23	25	1.09	0.41
	SBL	213	197	0.92	1.12
	SBT	1630	1548	0.95	2.06
Royal Windsor Dr / The Canadian Rd-South Service Rd E	EBL	106	113	1.07	0.67
	EBT	539	526	0.98	0.56
	EBR	18	24	1.33	1.31
	WBL	134	129	0.96	0.44
	WBT	407	422	1.04	0.74
	WBR	11	2	0.18	3.53
	NBL	2	5	2.50	1.60
	NBT	14	5	0.36	2.92
	NBR	57	62	1.09	0.65
	SBL	6	3	0.50	1.41
	SBT	14	8	0.57	1.81
	SBR	21	30	1.43	1.78

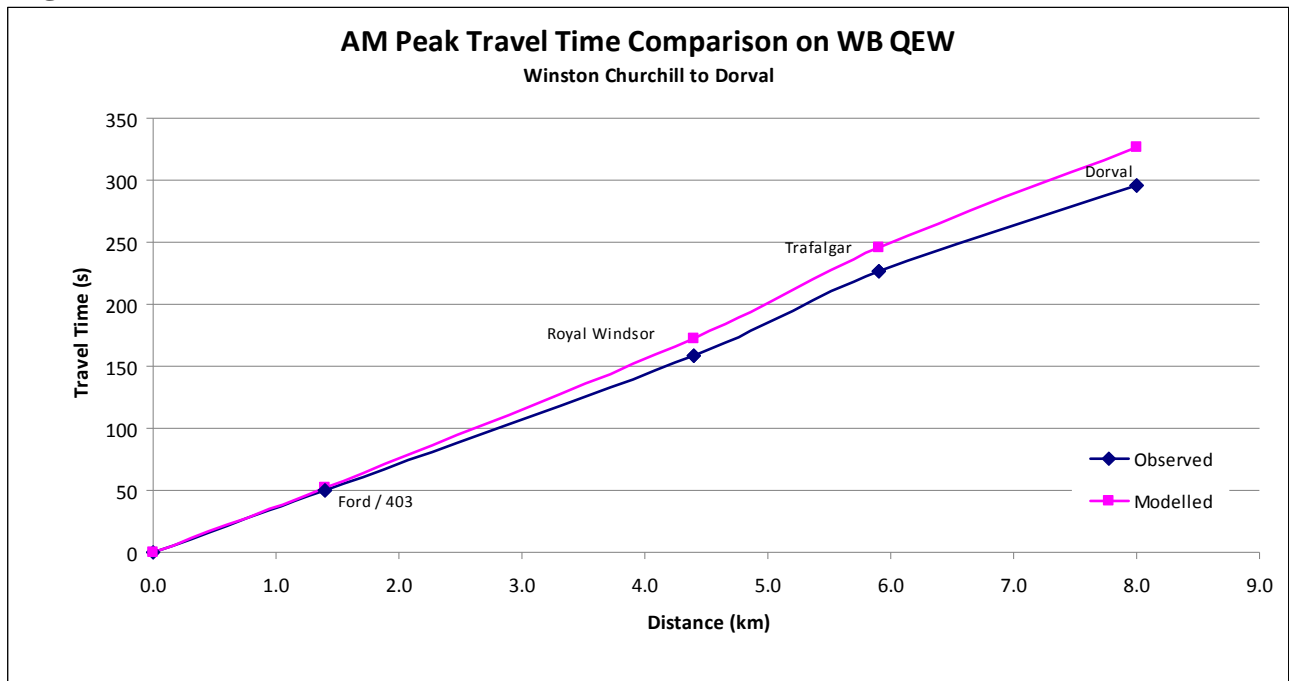
**Table A- 5: AM Peak Hour QEW Travel Time Validation Results**

Segment	Observed Travel Time (s)	Modelled Travel Time (s)	Absolute Difference (s)	Modelled / Observed	GEH
EB QEW - Dorval to Trafalgar	86.0	93.0	7.0	1.08	0.74
EB QEW - Trafalgar to Royal Windsor	61.0	54.1	6.9	0.89	0.91
EB QEW - Royal Windsor to Ford/403	104.0	106.1	2.1	1.02	0.20
EB QEW - Ford/403 to Winston Churchill	42.0	52.3	10.3	1.24	1.49
WB QEW - Winston Churchill to Ford/403	50.0	52.6	2.6	1.05	0.36
WB QEW - Ford/403 to Royal Windsor	108.0	119.9	11.9	1.11	1.11
WB QEW - Royal Windsor to Trafalgar	69.0	73.4	4.4	1.06	0.52
WB QEW - Trafalgar to Dorval	69.0	80.8	11.8	1.17	1.36
<b>QEW Calibration Check</b>				<b>Modelled</b>	<b>Target</b>
Number of segments within 15% Modelled/Observed or within 15 seconds				100%	85%

**Figure A- 4: AM Peak Hour QEW EB Cumulative Travel Time (Modelled versus Observed)**



**Figure A- 5: AM Peak Hour QEW WB Cumulative Travel Time (Modelled versus Observed)**

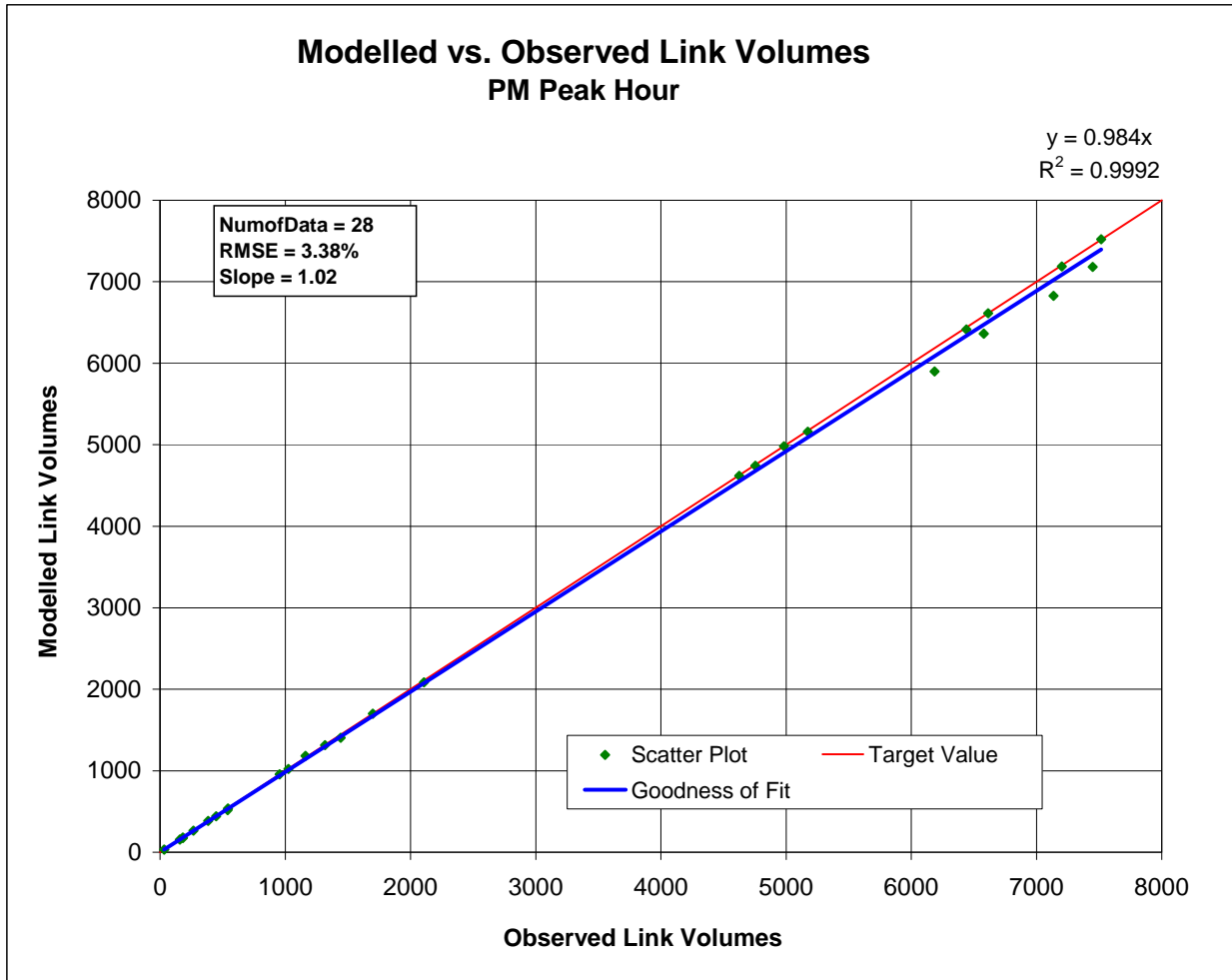


## PM Peak Hour Model Results

**Table A- 6: PM Peak Demand Input Calibration (Modelled versus Observed)**

Demand Input	Observed	Average Modelled	Model / Obs	GEH
QEW west of Dorval	6613	6613	1.00	0.00
Dorval S - QEW E	870	870	1.00	0.00
Dorval S - QEW W	342	344	1.01	0.11
Dorval N - QEW E	499	500	1.00	0.04
Dorval N - QEW W	228	225	0.99	0.20
Trafalgar north of Iroquois	1317	1314	1.00	0.08
Leighland west of Trafalgar	540	517	0.96	1.00
Iroquois east of Trafalgar	1025	1024	1.00	0.03
North Service west of Trafalgar	265	266	1.00	0.06
Argus west of Trafalgar	33	33	1.00	0.00
Cross west of Trafalgar	955	957	1.00	0.06
Trafalgar south of Cross	1699	1699	1.00	0.00
South Service east of Trafalgar	384	384	1.00	0.00
Canadian north of Royal Windsor	522	523	1.00	0.04
South Service south of Royal Windsor	144	144	1.00	0.00
Royal Windsor east of South Service/Canadian	724	726	1.00	0.07
Ford N/S - QEW E	830	830	1.00	0.00
Ford S - QEW W	52	52	1.00	0.00
Ford N - QEW W	129	130	1.01	0.09
403 N - QEW W	2400	2390	1.00	0.20
Winston Churchill S - QEW E	320	319	1.00	0.06
Winston Churchill S - QEW W	150	141	0.94	0.75
Winston Churchill N - QEW E	650	649	1.00	0.04
Winston Churchill N - QEW W	340	341	1.00	0.05
QEW east of Winston Churchill	4983	4982	1.00	0.01

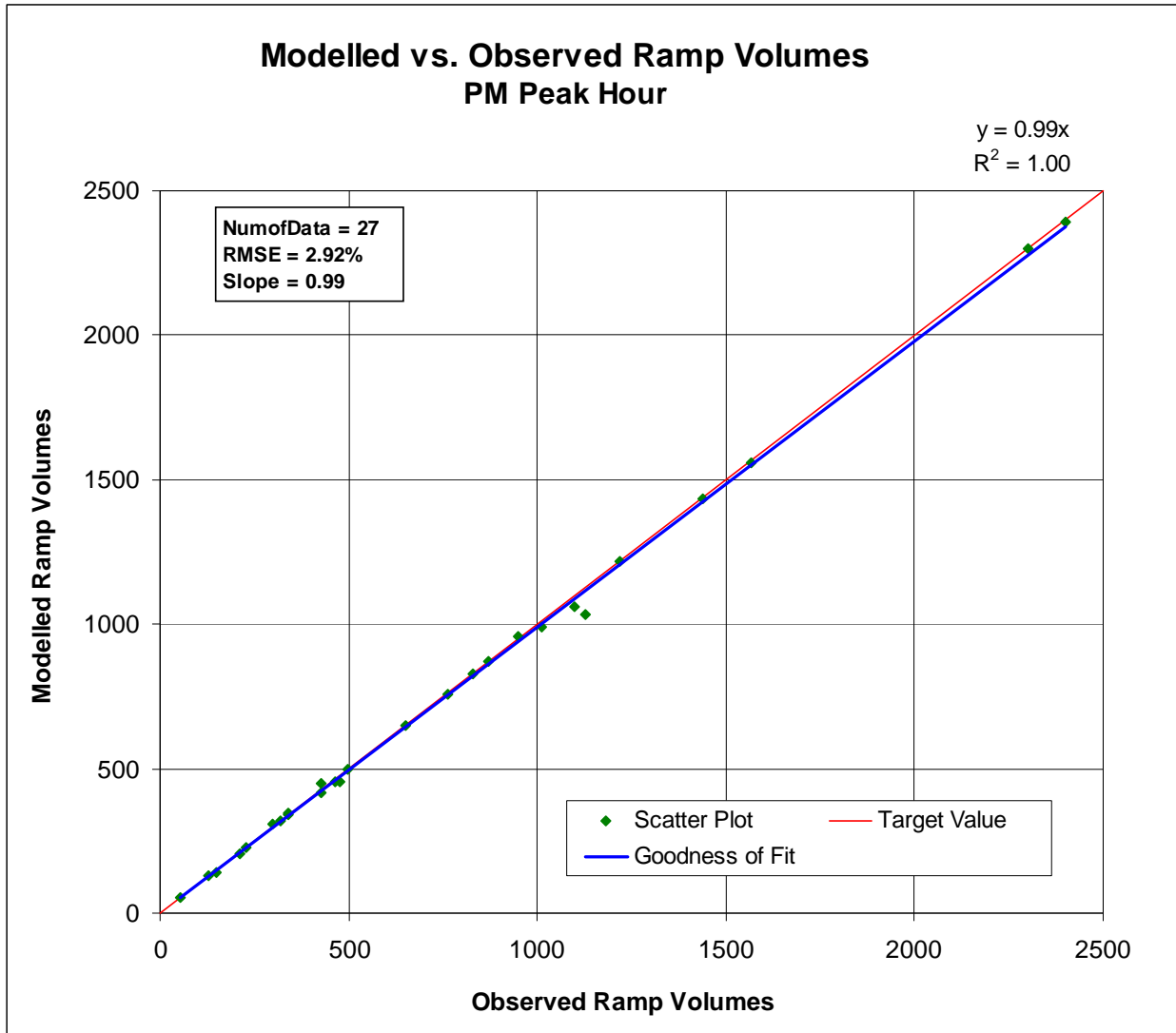
Figure A- 6: PM Peak Hour Screenline Scattergram Plot



**Table A- 7: PM Peak Screenline Calibration (Modelled versus Observed)**

	NORTHBOUND / EASTBOUND				SOUTHBOUND / WESTBOUND			
	Observed	Average Modelled	Model / Obs	GEH	Observed	Average Modelled	Model / Obs	GEH
<b>West of Dorval Drive</b>								
QEW	6613	6613	1.00	0.00	6578	6362	0.97	2.69
<b>Screenline Total</b>	<b>6613</b>	<b>6613</b>	<b>1.00</b>	<b>0.00</b>	<b>6578</b>	<b>6362</b>	<b>0.97</b>	<b>2.69</b>
<b>West of Trafalgar Road</b>								
Leighland Avenue	540	517	0.96	1.00	541	539	1.00	0.09
North Service Road	265	266	1.00	0.06	158	155	0.98	0.24
QEW	7517	7521	1.00	0.05	7448	7182	0.96	3.11
Argus Road	33	33	1.00	0.00	182	181	0.99	0.07
Cross Avenue	955	957	1.00	0.06	447	442	0.99	0.24
<b>Screenline Total</b>	<b>9310</b>	<b>9293</b>	<b>1.00</b>	<b>0.18</b>	<b>8776</b>	<b>8495</b>	<b>0.97</b>	<b>3.02</b>
<b>East of Trafalgar Road</b>								
Iroquois Shore Road	1162	1181	1.02	0.56	1025	1024	1.00	0.03
QEW	7203	7187	1.00	0.19	7136	6826	0.96	3.71
South Service Road	181	176	0.97	0.37	384	384	1.00	0.00
<b>Screenline Total</b>	<b>8546</b>	<b>8545</b>	<b>1.00</b>	<b>0.01</b>	<b>8545</b>	<b>8234</b>	<b>0.96</b>	<b>3.40</b>
<b>West of Ford Drive</b>								
QEW	6439	6415	1.00	0.30	6185	5899	0.95	3.68
<b>Screenline Total</b>	<b>6439</b>	<b>6415</b>	<b>1.00</b>	<b>0.30</b>	<b>6185</b>	<b>5899</b>	<b>0.95</b>	<b>3.68</b>
<b>West of Winston Churchill Boulevard</b>								
QEW	4755	4742	1.00	0.19	5173	5161	1.00	0.17
<b>Screenline Total</b>	<b>4755</b>	<b>4742</b>	<b>1.00</b>	<b>0.19</b>	<b>5173</b>	<b>5161</b>	<b>1.00</b>	<b>0.17</b>
<b>East of Winston Churchill Boulevard</b>								
QEW	4625	4618	1.00	0.10	4983	4982	1.00	0.01
<b>Screenline Total</b>	<b>4625</b>	<b>4618</b>	<b>1.00</b>	<b>0.10</b>	<b>4983</b>	<b>4982</b>	<b>1.00</b>	<b>0.01</b>
<b>North of Leighland Avenue</b>								
Trafalgar Road	2107	2084	0.99	0.50	1317	1314	1.00	0.08
<b>Screenline Total</b>	<b>2107</b>	<b>2084</b>	<b>0.99</b>	<b>0.50</b>	<b>1317</b>	<b>1314</b>	<b>1.00</b>	<b>0.08</b>
<b>South of Cross Avenue</b>								
Trafalgar Road	1699	1699	1.00	0.00	1442	1406	0.98	0.95
<b>Screenline Total</b>	<b>1699</b>	<b>1699</b>	<b>1.00</b>	<b>0.00</b>	<b>1442</b>	<b>1406</b>	<b>0.98</b>	<b>0.95</b>

Figure A- 7: PM Peak Hour Ramp Scattergram Plot

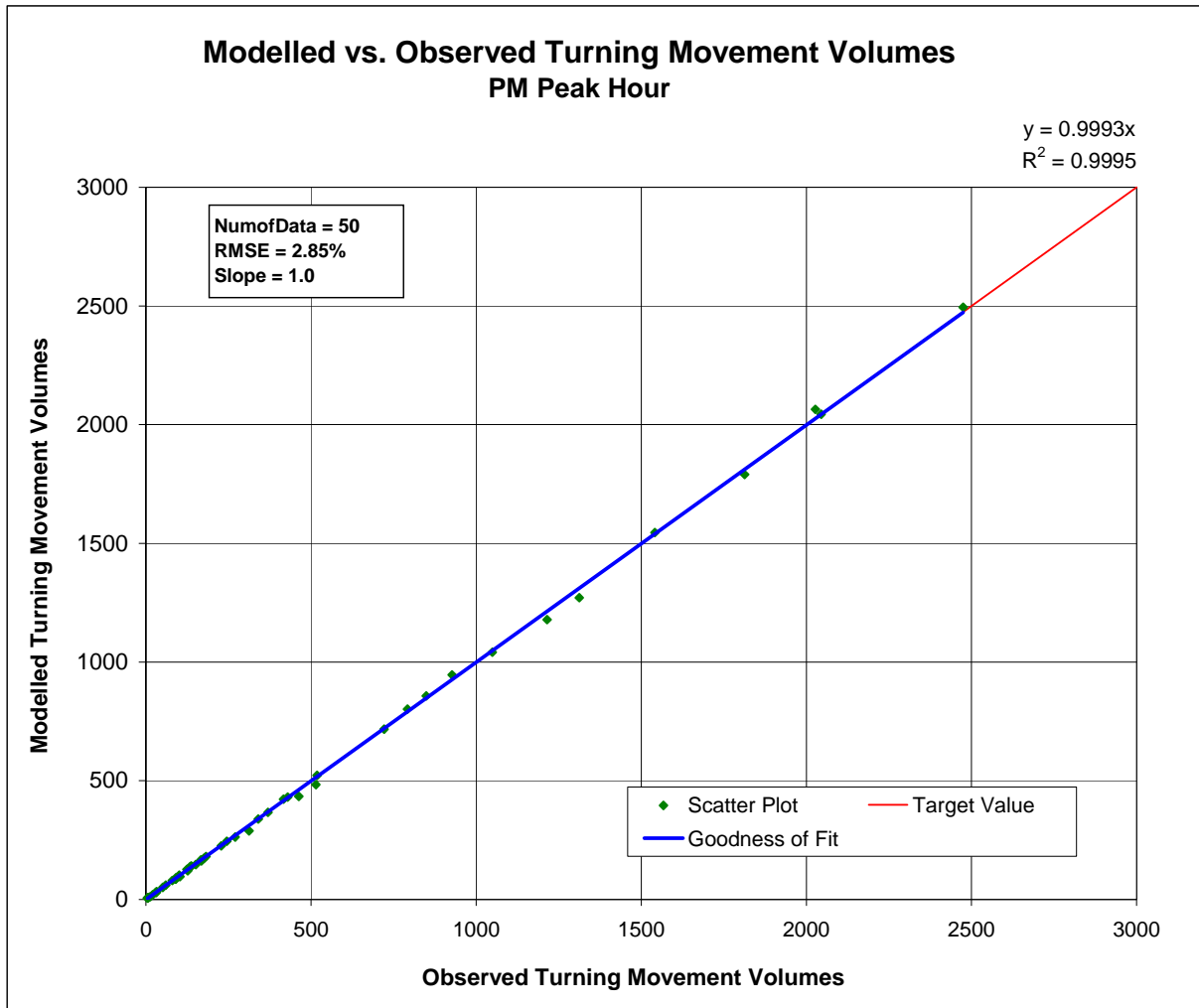


**Table A- 8: PM Peak Ramp Calibration (Modelled versus Observed)**

<b>QEW / Dorval Drive</b>	<b>Observed</b>	<b>Average Modelled</b>	<b>Model / Obs</b>	<b>GEH</b>
QEW W - Dorval N/S	465	455	0.98	0.47
QEW E - Dorval N/S	1440	1436	1.00	0.11
Dorval S - QEW E	870	870	1.00	0.00
Dorval S - QEW W	342	344	1.01	0.11
Dorval N - QEW E	499	500	1.00	0.04
Dorval N - QEW W	228	225	0.99	0.20
<b>Interchange Total</b>	<b>3844</b>	<b>3830</b>	<b>1.00</b>	<b>0.23</b>
<b>QEW / Trafalgar Road</b>				
QEW W - Trafalgar N/S	1219	1216	1.00	0.09
QEW E - Trafalgar N/S	1129	1034	0.92	2.89
Trafalgar S - QEW E	476	453	0.95	1.07
Trafalgar S - QEW W	429	418	0.97	0.53
Trafalgar N - QEW E	429	449	1.05	0.95
Trafalgar N - QEW W	1012	991	0.98	0.66
<b>Interchange Total</b>	<b>4694</b>	<b>4561</b>	<b>0.97</b>	<b>1.96</b>
<b>QEW / Royal Windsor Drive</b>				
QEW W - Royal Windsor	764	759	0.99	0.18
Royal Windsor - QEW W	951	956	1.01	0.16
<b>Interchange Total</b>	<b>1715</b>	<b>1715</b>	<b>1.00</b>	<b>0.00</b>
<b>QEW / Ford Drive / Highway 403</b>				
QEW W - Ford N/S	212	203	0.96	0.62
QEW W - Hwy 403 N	2302	2302	1.00	0.00
QEW E - Ford N/S	1569	1557	0.99	0.30
Hwy 403 N - QEW W	2400	2390	1.00	0.20
Ford N/S - QEW E	830	830	1.00	0.00
Ford S - QEW W	52	52	1.00	0.00
Ford N - QEW W	129	130	1.01	0.09
<b>Interchange Total</b>	<b>7494</b>	<b>7464</b>	<b>1.00</b>	<b>0.35</b>
<b>QEW / Winston Churchill Blvd</b>				
QEW W - Winston Churchill N/S	1100	1058	0.96	1.28
QEW E - Winston Churchill N/S	300	306	1.02	0.34
Winston Churchill S - QEW E	320	319	1.00	0.06
Winston Churchill S - QEW W	150	141	0.94	0.75
Winston Churchill N - QEW E	650	649	1.00	0.04
Winston Churchill N - QEW W	340	341	1.00	0.05
<b>Interchange Total</b>	<b>2860</b>	<b>2814</b>	<b>0.98</b>	<b>0.86</b>



**Figure A- 8: PM Peak Hour Turning Movement Scattergram Plot**



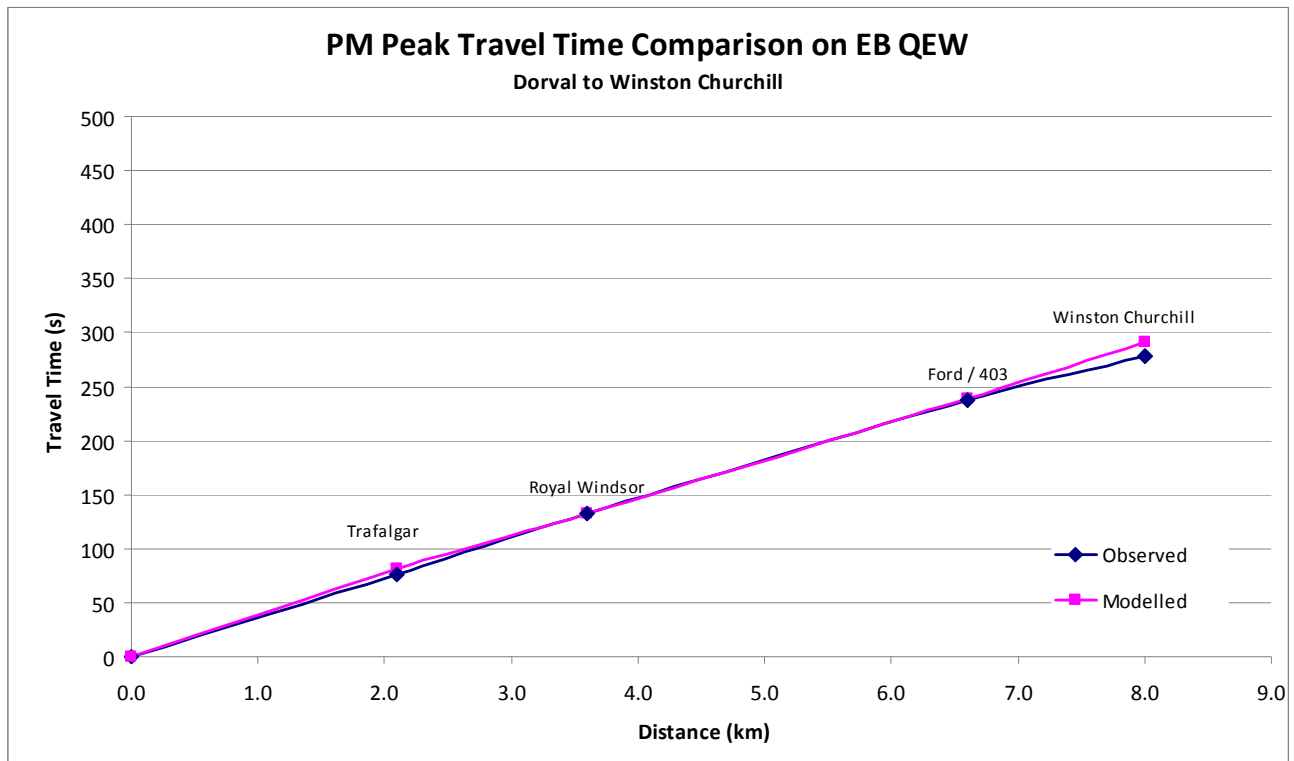
**Table A- 9: PM Peak Turning Movement Calibration (Modelled versus Observed)**

Intersection	TM	Observed	Average Modelled	Model / Obs	GEH
Trafalgar Rd / Leighland Ave-Iroquois Shore Blvd	EBL	127	127	1.00	0.00
	EBT	101	102	1.01	0.10
	EBR	312	289	0.93	1.33
	WBL	721	717	0.99	0.15
	WBT	137	141	1.03	0.34
	WBR	167	166	0.99	0.08
	NBL	270	263	0.97	0.43
	NBT	1813	1790	0.99	0.54
	NBR	927	946	1.02	0.62
	SBL	134	137	1.02	0.26
	SBT	1049	1042	0.99	0.22
	SBR	134	135	1.01	0.09
Trafalgar Rd / North Service Rd N	EBL	20	19	0.95	0.23
	EBR	245	245	1.00	0.00
	WBL	463	434	0.94	1.37
	WBT	151	147	0.97	0.33
	WBR	515	484	0.94	1.39
	NBT	2475	2495	1.01	0.40
	SBT	2045	2044	1.00	0.02
	SBR	7	8	1.14	0.37
Trafalgar Rd / QEW EB Off-ramp	EBL	849	858	1.01	0.31
	EBR	370	367	0.99	0.16
	NBT	2027	2065	1.02	0.84
	SBT	1312	1271	0.97	1.14
Trafalgar Rd / Argus Rd	EBR	33	33	1.00	0.00
	SBR	182	181	0.99	0.07
Trafalgar Rd / Cross Ave-South Service Rd	EBL	792	802	1.01	0.35
	EBT	60	60	1.00	0.00
	EBR	103	96	0.93	0.70
	WBL	124	127	1.02	0.27
	WBT	92	92	1.00	0.00
	WBR	168	163	0.97	0.39
	NBL	127	121	0.95	0.54
	NBT	1541	1546	1.00	0.13
	NBR	31	29	0.94	0.37
	SBL	90	86	0.96	0.43
	SBT	1215	1179	0.97	1.04
	SBR	228	226	0.99	0.13
Royal Windsor Dr / The Canadian Rd-South Service Rd E	EBL	340	339	1.00	0.05
	EBT	417	422	1.01	0.24
	EBR	7	8	1.14	0.37
	WBL	176	173	0.98	0.23
	WBT	518	523	1.01	0.22
	WBR	30	30	1.00	0.00
	NBL	4	6	1.50	0.89
	NBT	51	51	1.00	0.00
	NBR	89	87	0.98	0.21
	SBL	13	12	0.92	0.28
	SBT	80	80	1.00	0.00
	SBR	429	431	1.00	0.10

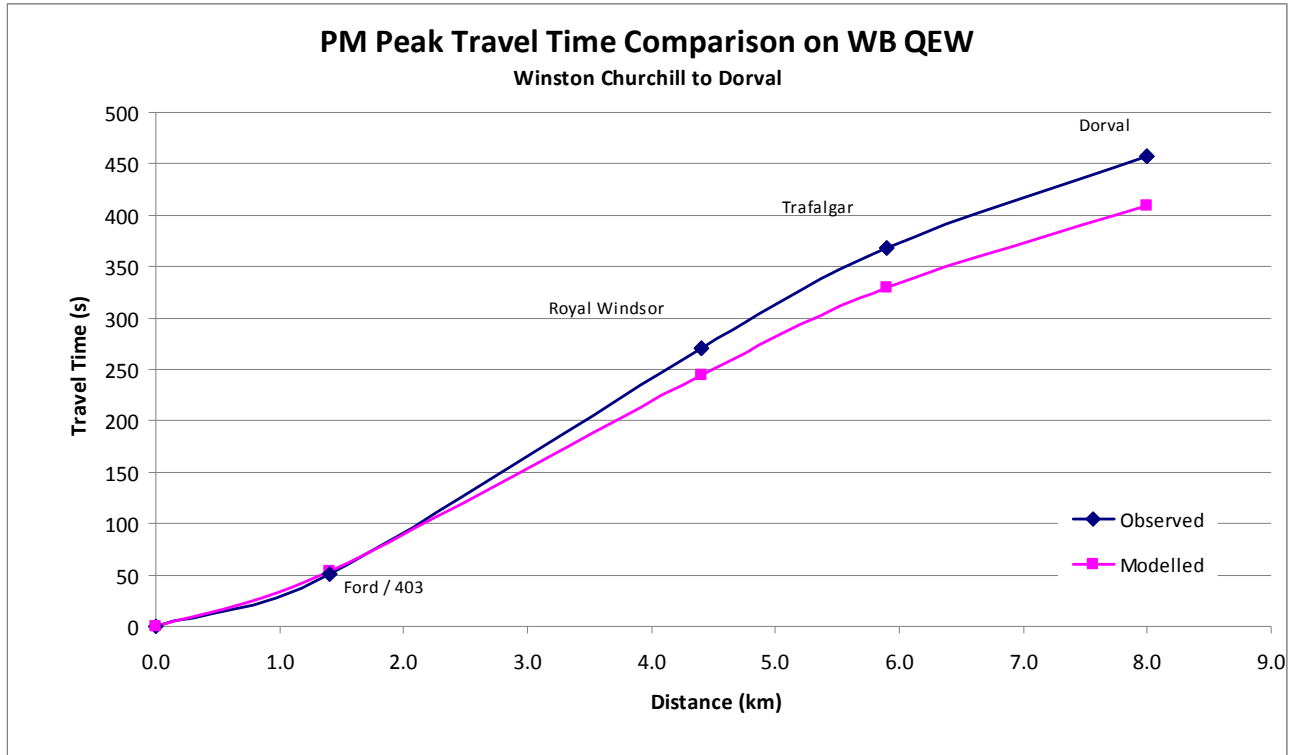
**Table A- 10: PM Peak Hour QEW Travel Time Validation Results**

Segment	Observed Travel Time (s)	Modelled Travel Time (s)	Absolute Difference (s)	Modelled / Observed	GEH
EB QEW - Dorval to Trafalgar	76.0	81.4	5.4	1.07	0.61
EB QEW - Trafalgar to Royal Windsor	57.0	50.8	6.2	0.89	0.84
EB QEW - Royal Windsor to Ford/403	104.0	106.9	2.9	1.03	0.28
EB QEW - Ford/403 to Winston Churchill	41.0	52.6	11.6	1.28	1.69
WB QEW - Winston Churchill to Ford/403	51.0	53.3	2.3	1.04	0.32
WB QEW - Ford/403 to Royal Windsor	219.0	191.6	27.4	0.87	1.91
WB QEW - Royal Windsor to Trafalgar	98.0	84.5	13.5	0.86	1.41
WB QEW - Trafalgar to Dorval	89.0	80.1	8.9	0.90	0.97
<b>QEW Calibration Check</b>				<b>Modelled</b>	<b>Target</b>
Number of segments within 15% Modelled/Observed or within 15 seconds				100%	85%

**Figure A- 9: PM Peak Hour QEW EB Cumulative Travel Time (Modelled versus Observed)**



**Figure A- 10: PM Peak Hour QEW WB Cumulative Travel Time (Modelled versus Observed)**



# Memorandum

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DATE: January 24, 2014

TO: Chris Pascos – MTO  
Lin Rogers – Town of Oakville

FROM: Suzette Shiu / Rudy Sooklall – Cole Engineering

CC: Jason White – MTO  
Joseph Lai – MTO

OUR REF.#: T11-767

SUBJECT: Oakville Midtown EA Study  
2031 Do Nothing Scenario

---

## 1. Introduction

Cole Engineering Group Ltd (CEG) was retained by the Town of Oakville to develop a Vissim microsimulation model to assess impacts to traffic operations on the QEW mainline and ramp terminals resulting from changes proposed to the Trafalgar Road and the Royal Windsor Drive interchanges. An existing conditions Vissim model was developed and calibrated. Following that, a 2031 future conditions Vissim model was developed and the operations of the QEW mainline and ramp terminals documented (submitted to the Ministry of Transportation on December 19, 2013, and updated on January 20, 2014).

The MTO also requested an assessment of a “Do Nothing” Scenario to confirm the need for the infrastructure improvements that have been proposed within Midtown Oakville. A microsimulation model for the “Do Nothing” Scenario had not been developed for Midtown Oakville for the following reasons:

- Under existing conditions, there are already significant capacity constraints on the provincial and municipal network.
- Midtown Oakville is a provincially designated growth centre planned to accommodate 20,000 people and jobs.
- Switching Gears, Oakville’s Transportation Master Plan, identified the need for an integrated network of improvements including transit, active transportation and road capacity improvements in and around Midtown Oakville to accommodate planned growth.

To provide a better understanding of the need and justification for the proposed infrastructure improvements, this memorandum documents the needs and justification identified through the town’s TMP that was completed under the requirements of Phases 1 and 2 of the Class EA process.

## 2. Context

The province's Places to Grow legislation and the Metrolinx Regional Plan identify desired land use and transportation objectives for the Town of Oakville. The Midtown Oakville growth area is the town's most significant centre for intensification. It is a designated "urban growth centre" under Places to Grow and has been identified as an "anchor mobility hub" under Metrolinx Regional Transportation Plan – The Big Move. It is envisioned that Midtown will redevelop as a transit-oriented hub, with new transit connections and development that achieves a minimum gross density of 200 people and jobs per hectare by 2031.

Within the 20-year time horizon, the town is expected to experience capacity constraints given the current percentage of travel by auto, the future growth in transportation demand and the committed transportation improvements. Additional transportation solutions are required to maintain levels of service at acceptable levels.

Based on the operational needs, the socio-economic and natural environment constraints and policy direction of the town, the following problem and opportunity statement was developed for the TMP:

*The Town of Oakville needs a transportation system that will accommodate growth to 2031, incorporating the planning framework from the Livable Oakville Plan and the North Oakville Secondary Plans. An opportunity exists to plan a transportation system which:*

- *is safe, efficient and accessible with choices in mobility,*
- *fosters the use and development of a sustainable transportation network,*
- *provides a public transit system that can offer a real alternative to private automobile use, and*
- *provides a network of on- and off-road pedestrian and cycling facilities that allow the use of active transportation modes as an alternative to the automobile.*

## 3. 2031 "Do Nothing" Scenario

### 3.1. Network

In the Oakville TMP, a future "Do Nothing" (also referred to as Base Case) scenario was developed consisting of only planned QEW mainline improvements (i.e. QEW / Hwy 403 interchange improvements and extension of HOV lanes to Winston Churchill Boulevard).

The Do Nothing Scenario does not include the following proposed changes in the Midtown area:

- New QEW westbound off-ramp at Royal Windsor Drive interchange;
- New QEW eastbound on-ramp at Royal Windsor Drive interchange;
- Grade separated eastbound through movement at the Trafalgar interchange; and,
- Local road network improvements to support the development of Oakville Midtown including the QEW midblock crossing between Royal Windsor and Trafalgar.

### 3.2. Forecasts

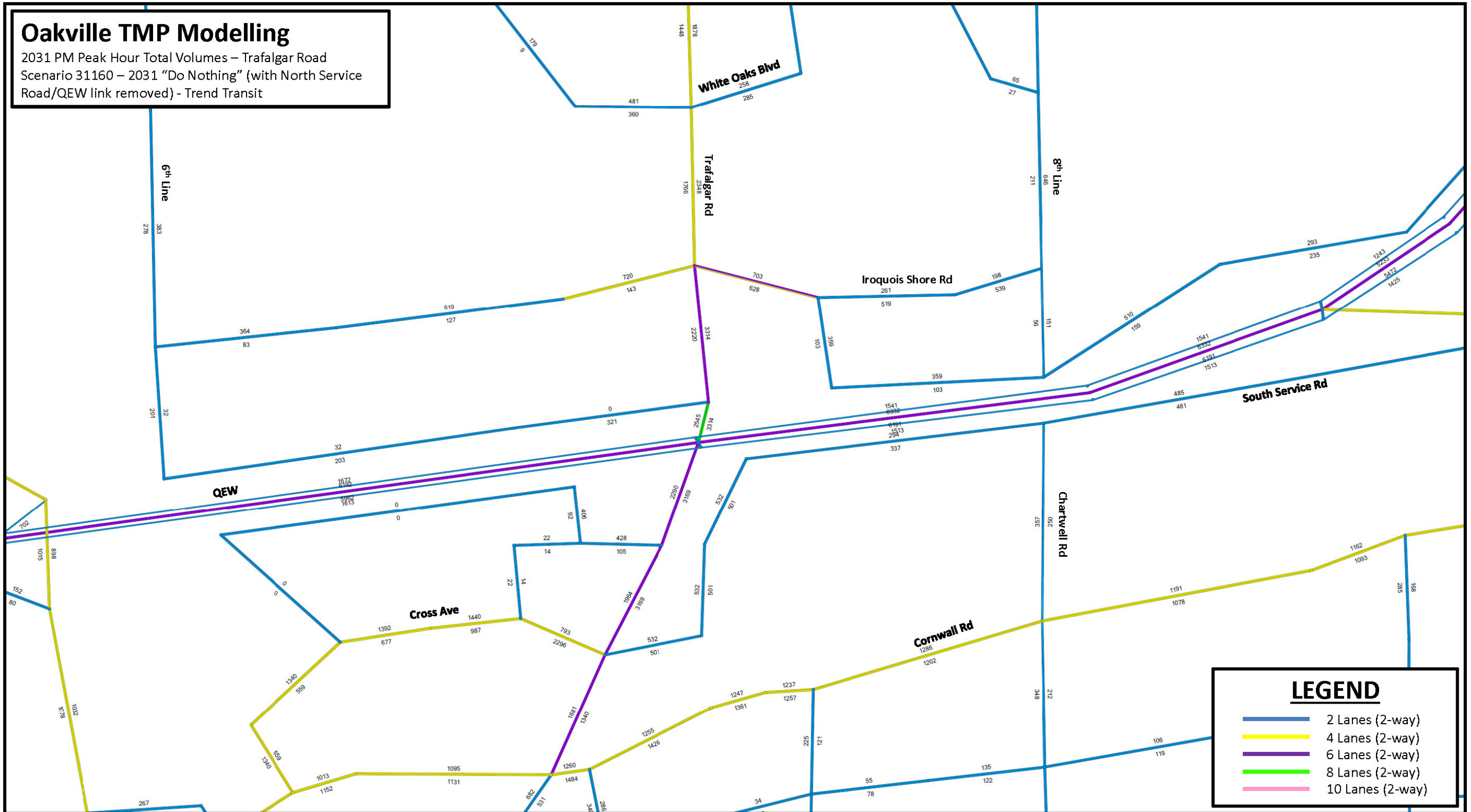
The 2031 travel demand was generated using the Halton Region Emme weekday 2031 PM peak model. [The MTO Systems Analysis and Forecasting Office (SAFO) approved the use of the Region’s Emme model as the basis of the forecasts for the Vissim microsimulation model for this study.]

The future 2031 traffic forecasts summarized in **Table 1** show that traffic volumes on the QEW will continue to be capacity constrained with forecasted demand exceeding the available capacity. North-south demand across the QEW on Trafalgar Road exceeds capacity resulting in congested conditions at the interchange ramp terminals.

**Table 1: 2031 Do Nothing Forecasts**

Link		Link Capacity	2031 Volume	2031 v/c Ratio
<b>QEW Eastbound</b>	west of Trafalgar Road	6,700	7,575	1.13
	east of Trafalgar Road	8,400	7,704	0.92
	east of Royal Windsor Drive	8,400	6,897	0.82
<b>QEW Westbound</b>	west of Trafalgar Road	6,700	7,864	1.17
	east of Trafalgar Road	8,400	7,873	0.94
	east of Royal Windsor Drive	8,400	6,476	0.77
<b>Trafalgar Road Northbound</b>	north of Iroquois Shore Road	1,900	2,348	1.24
	south of Iroquois Shore Road	2,850	3,314	1.16
	north of QEW	3,400	3,314	0.97
	south of QEW	2,550	3,169	1.24
	north of Cross Avenue	2,550	3,169	1.24
	south of Cross Avenue	2,550	1,340	0.53
<b>Trafalgar Road Southbound</b>	north of Iroquois Shore Road	1,900	1,766	0.93
	south of Iroquois Shore Road	2,850	2,220	0.78
	north of QEW	3,400	2,545	0.75
	south of QEW	2,550	2,290	0.90
	north of Cross Avenue	2,550	1,964	0.77
	south of Cross Avenue	2,550	1,681	0.66
<b>Cross Avenue Eastbound</b>	west of Trafalgar Road	1,700	2,296	1.35
	east of Trafalgar Road	500	501	1.00
<b>Cross Avenue Westbound</b>	west of Trafalgar Road	1,700	793	0.47
	east of Trafalgar Road	500	532	1.06

Figure 1: 2031 Do Nothing Forecasts – Emme Plot





#### 4. Summary

Under “Do Nothing” conditions, significant capacity constraints were identified in the town’s TMP in and around the Midtown area. The analysis indicated that the “Do Nothing” transportation network would be congested and could not accommodate the travel demands of planned growth in Midtown.

The capacity constraints in Midtown include:

- Trafalgar Road and Trafalgar Road interchange
- Cross Avenue–South Service Road
- QEW mainline

In order to accommodate planned growth, address capacity needs and meet the strategic direction of the town, the following are the elements were recommended in the town’s TMP:

- TDM growth
- Active Transportation growth
- Transit growth
- Infrastructure Improvements
- Road Network Strategies

The following infrastructure was recommended in the Midtown growth area:

1. Chartwell Road (South Service Road to Cornwall Road) widen to 4 lanes.
2. Cross Avenue Extension from Trafalgar Road to Royal Windsor Drive.
3. Eighth Line (North Service Road to Iroquois Shore Road) widen to 4 lanes.
4. Iroquois Shore Road Extension to Royal Windsor Drive, new 4 lane roadway.
5. Royal Windsor Drive / QEW interchange improvements.
6. Trafalgar Road / QEW interchange improvements.
7. New QEW crossing (Iroquois Shore Road to Cross Avenue).
8. New priority lane / active transportation crossing of the QEW (Iroquois Shore Road to Cross Avenue).

Through the Midtown Oakville Class EA (this study), the above infrastructure requirements were further refined and modified based on detailed analyses and consultation with stakeholders, agencies and the public. The microsimulation modelling assessment of the proposed future network for Midtown is documented in the memorandum dated January 20, 2014.

# Memorandum

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DATE: February 24, 2014  
TO: Lin Rogers – Town of Oakville  
Chris Pascos – MTO  
FROM: Matt Clark / Rudy Sooklall – Cole Engineering  
CC: Suzette Shiu – Cole Engineering  
OUR REF.#: T11-767  
SUBJECT: Oakville Midtown EA Study  
Microsimulation Future Year Updated Memorandum

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## 1. Introduction

### 1.1. Background

Cole Engineering Group Ltd (CEG) was retained by the Town of Oakville to develop a Vissim microsimulation model for Midtown Oakville. The model will be used to assess impacts to traffic operations on the QEW mainline and ramp terminals resulting from changes proposed to the Trafalgar Road and the Royal Windsor Drive interchanges.

The proposed changes at the two interchanges were developed as part of the current Oakville Part III Midtown EA to improve access to the Midtown area in the Town of Oakville. These changes include:

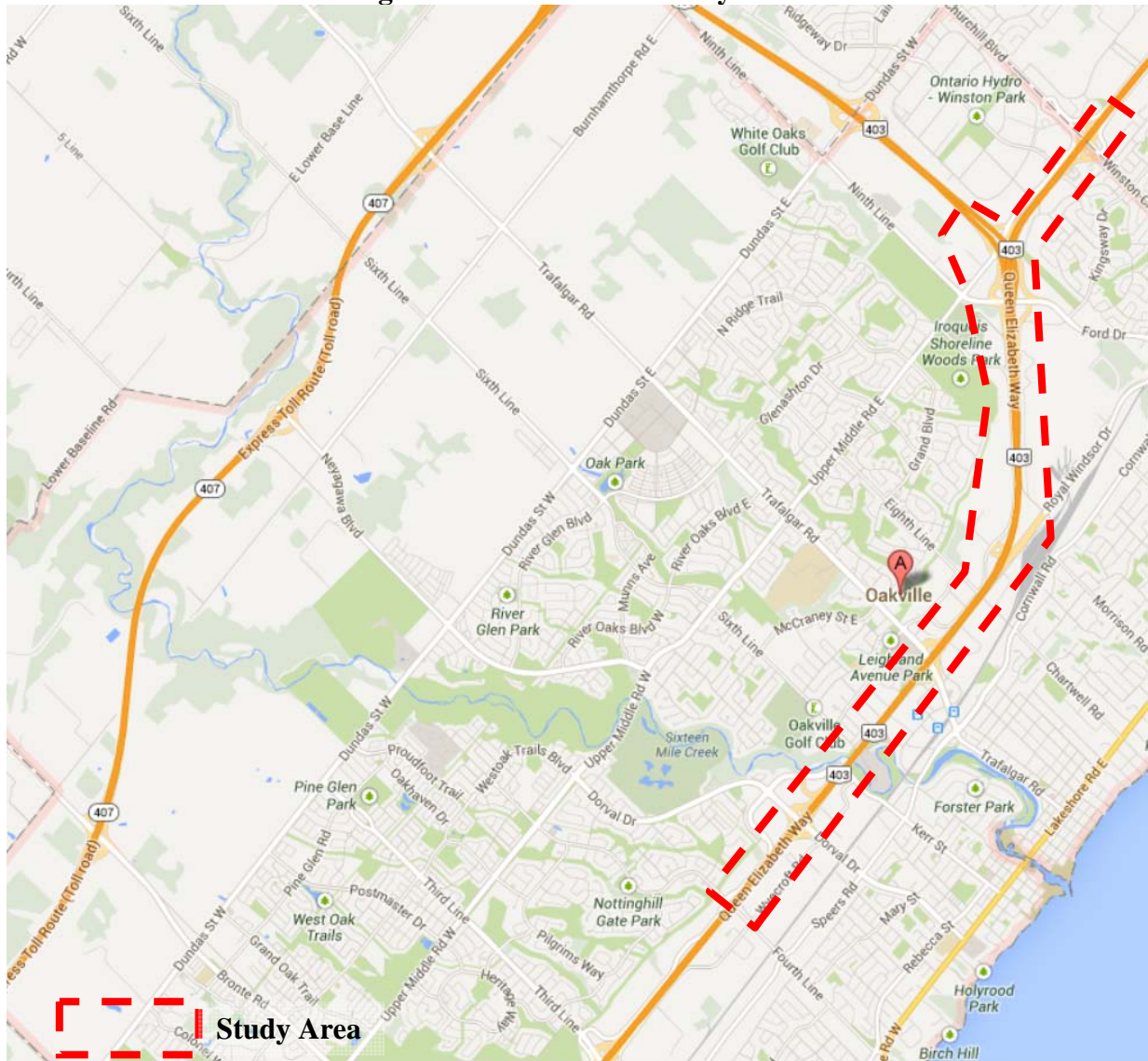
- New QEW westbound off-ramp at Royal Windsor Drive;
- New QEW eastbound on-ramp at Royal Windsor Drive including an auxiliary lane to Ford Drive;
- Grade separated eastbound through movement from the Trafalgar off-ramp; and,
- Local road network improvements to support the development of Oakville Midtown.

This memorandum summarizes anticipated traffic operations on the QEW mainline and at the Trafalgar Road and Royal Windsor Drive interchanges based on the microsimulation modelling conducted for the 2031 AM and PM weekday peak periods. Comments provided by the MTO on the draft microsimulation analysis (memos dated December 19, 2013 and January 20, 2014) are addressed in this updated memo.

### 1.2. Study Area

The study network for the microsimulation model was approved by the MTO and includes the QEW mainline west of Dorval Drive interchange to east of Winston Churchill Boulevard interchange including the QEW / Highway 403 interchange. The Trafalgar segment from Leighland Avenue to Cross Avenue is also included in the study area. **Figure 1** shows the Vissim model network extents for this study.

Figure 1: Vissim Model Study Area



## 2. Microsimulation Model Development

The 2031 future microsimulation model was developed using an existing conditions calibrated and validated microsimulation model as the base. The calibrated and validated model development is documented in a memorandum dated August 13, 2013. The following steps were followed to develop the 2031 future microsimulation model:

1. Planned improvements along the QEW by the 2031 horizon were added to the existing calibrated validated model.
2. The preferred Midtown road network including additions to the Trafalgar Road and Royal Windsor Drive interchanges were coded to model resulting from Step 1.
3. Future travel demand for the future study area transportation network was obtained from the Halton Region 2031 Emme model. The model comprised of the peak hour and a 15-minute warm up and cool down period on both sides of the peak hour.

### 2.1. 2031 Transportation Network

The QEW improvements recommended in the Transportation Environmental Study Report (TESR) commissioned by the MTO for Highway 403 and Queen Elizabeth Way from Trafalgar Road to Winston Churchill Boulevard were coded into the existing calibrated Vissim model. These improvements include:

- Extension of the existing HOV lanes from Trafalgar Road to Winston Churchill Boulevard;
- N-E and E-N ramps at the Highway 403 / Ford Drive interchange; and,
- Core-collector system along QEW to facilitate movements between Ford Drive and Winston Churchill Boulevard and to accommodate the new N-E / E-N ramps.

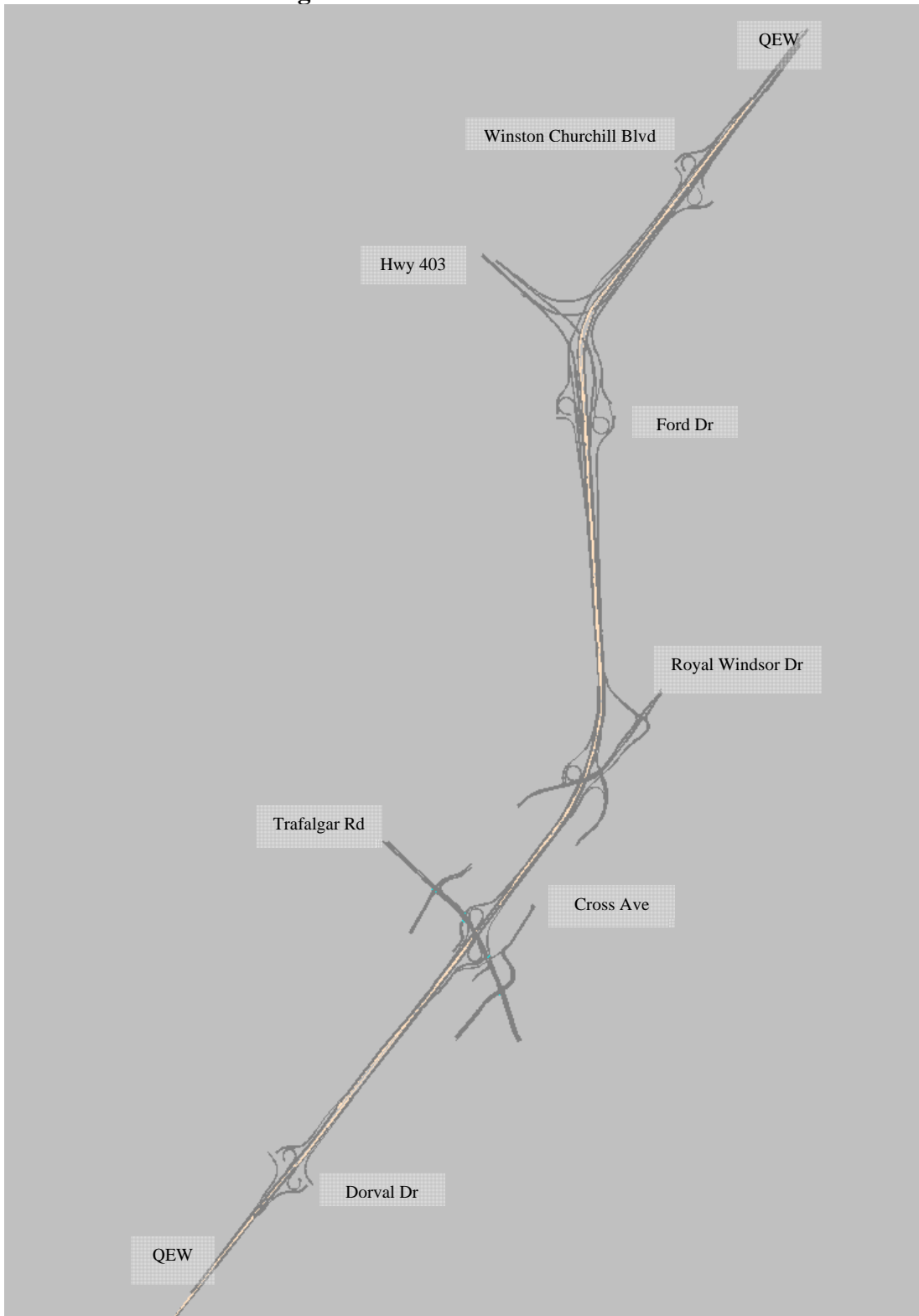
The TESR did not identify any ingress and egress locations for the HOV lanes extension from Trafalgar Road to Winston Churchill Boulevard. However, MTO staff provided the HOV ingress and egress locations at the Royal Windsor Drive Interchange which were included in the 2031 model network along with the existing HOV lanes ingress and egress locations at the Dorval Drive and Trafalgar Road interchanges. Through further discussion with MTO staff, it was agreed that the Trafalgar eastbound HOV access be removed from the 2031 model network.

The preferred Midtown road network was included in the 2031 microsimulation model and the key Midtown road network improvements modelled include:

- New grade separated crossing of Trafalgar Road from the QEW eastbound off-ramp. This connection will provide direct access to the Midtown developments east of Trafalgar Road and south of the QEW;
- New westbound off ramp at the Royal Windsor Drive interchange. This ramp will serve anticipated future demand to Midtown Oakville; and,
- New eastbound on ramp including an auxiliary lane to Ford Drive interchange (the auxiliary lane was agreed to through discussion with MTO staff) at the Royal Windsor Drive interchange to accommodate additional demand from the planned intensification of Midtown Oakville.

**Figure 2** shows the Vissim network developed to evaluate traffic operations for the 2031 future year conditions.

**Figure 2: Future Vissim Network**



## 2.2. 2031 Travel Demand

The 2031 travel demand for the study area was generated using the Halton Region Emme weekday 2031 PM peak model. The MTO Systems Analysis and Forecasting Office (SAFO) approved the use of the Region's Emme model for this study.

The future year study area comprises of 32 traffic zones (27 input gates) and the trend transit split was used for a conservative analysis (higher auto demand). A traversal OD matrix was extracted from the Emme model for 2031 weekday PM conditions. The 2031 weekday PM travel patterns from the Emme traversal OD matrix were expanded and adjusted to replicate OD movements in 2031 with the preferred Midtown local road network and connections to the QEW.

The OD matrix was further refined by increasing the demand along the QEW to match the volumes modelled in MTO's GGH model. The screenline demand along the QEW from the GGH model is generally higher compared to the Halton Region Emme model; therefore, the 2031 demand used in the microsimulation analysis is similar to the demand from the GGH model.

A proposed GTA HOV network is also modelled in the Halton Region Emme 2031 weekday PM peak model and a 2031 traversal OD matrix was obtained for HOV trips through the microsimulation study area. The HOV matrix was expanded and adjusted similar to the general purpose matrix.

The 2031 PM peak hour travel demand was inverted to provide the travel demand patterns for the 2031 AM peak hour. Similar to the 2031 PM matrix, the inverted 2031 AM Matrix was adjusted OD movements in 2031 with the preferred Midtown local road network and connections to the QEW. An HOV 2031 weekday AM peak hour matrix was also developed.

Based on discussions with MTO staff, it was agreed that mainline volumes on the QEW and Highway 403 mainline be increased by 10 to 15% to replicate mainline volumes forecasted TESR commissioned by the MTO for Highway 403. The updated volumes also include adjustments to the ramp volumes at the Dorval Drive interchange.

Similar to the calibrated and validated existing weekday AM and PM models, route choices within the 2031 model network is limited and the travel demand was assigned to the network using the static routing function within Vissim. A comparison of the existing and 2031 travel demand for the microsimulation study area is provided in **Table 1**.

It is noted that the adjustments to replicate the mainline volumes from the TESR resulted in a future AM peak hour travel demand which is similar to the future PM peak demand as shown in **Table 1**. This is a significant change since the existing AM peak hour demand is lower compared to the PM peak hour.

**Table 1: Comparison of Existing and 2031 Travel Demand**

Weekday Peak Hour	Existing Demand (vehicle trips)	2031 Trend Transit Demand (vehicle trips)
AM Peak	21,970	38,158
PM Peak	25,715	38,923

### 2.3. 2031 Microsimulation Analysis Results

Traffic conditions along the QEW and at the ramp terminals were assessed using the following measures of effectiveness from the microsimulation analysis:

- Screenline volumes
- Travel time along the QEW
- Speed contour, lane by lane speed contour plots, and speed profile plots along the QEW
- Ramp terminal queues

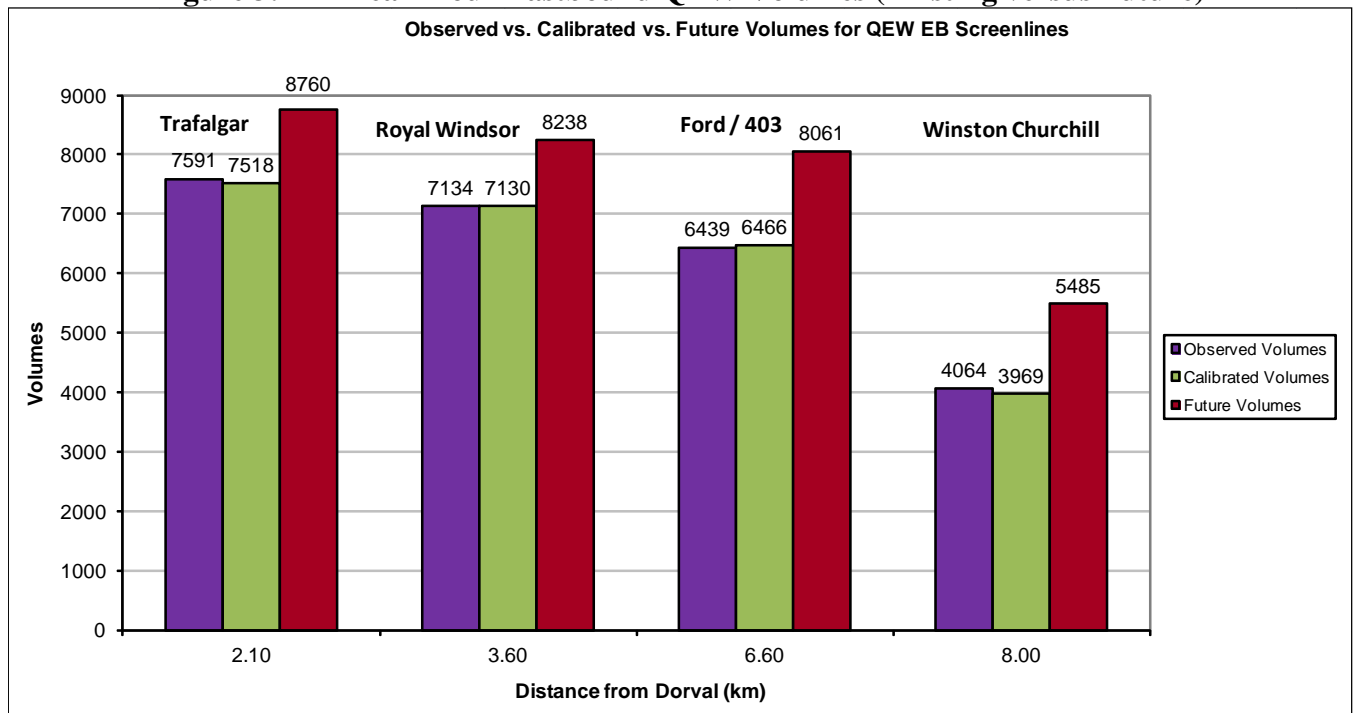
The existing screenline volumes and travel times along the QEW were compared to 2031 modelled volumes and travel times. Speed contour plots for the modelled section of the QEW were created for the weekday AM and PM peak hours in both the eastbound and westbound direction. Lane by lane speed contour plots were created for the QEW segment from Dorval Drive to Highway 403/Ford Drive Dorval.

The modelled 2031 results reported are the average from ten simulation runs.

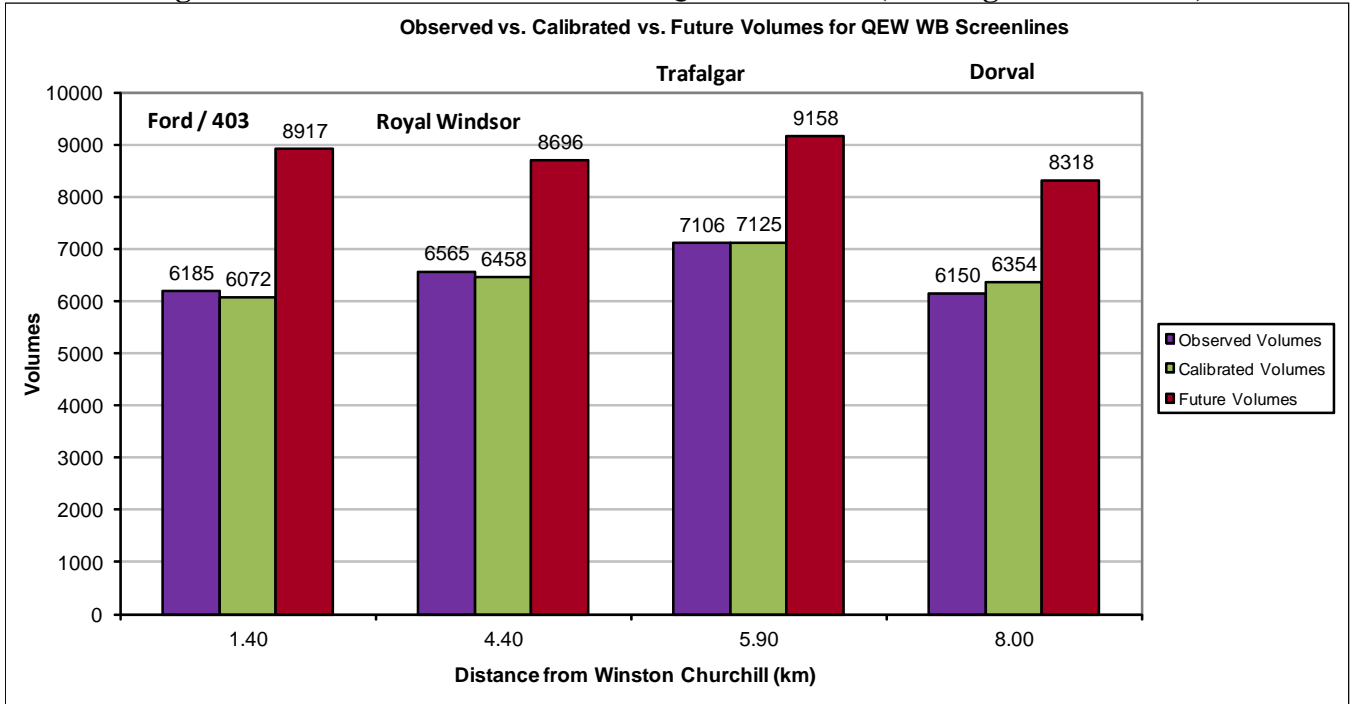
#### 2.3.1. Screenline Volume Comparison

A comparison of QEW directional screenline existing and 2031 volumes is provided in **Figure 3** to **Figure 6** for the weekday AM and PM peak hour demand. The results show the anticipated increase in demand along the QEW with demand east of Trafalgar generally higher as a result of traffic to/from Midtown Oakville. Additional volume comparison results are provided at the screenline, ramp and intersection turning movement levels in **Appendix A**. Mainline volume plots are provided in **Appendix B**.

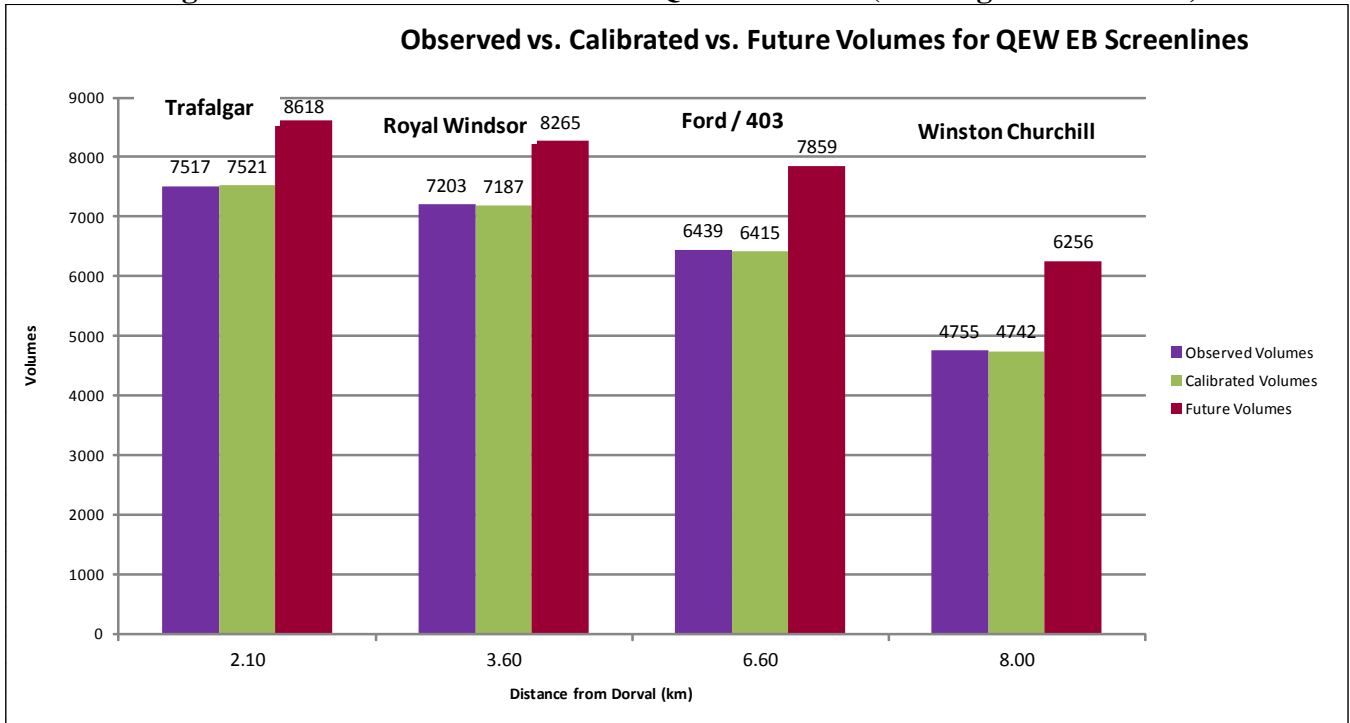
**Figure 3: AM Peak Hour Eastbound QEW Volumes (Existing versus Future)**



**Figure 4: AM Peak Hour Westbound QEW Volumes (Existing versus Future)**

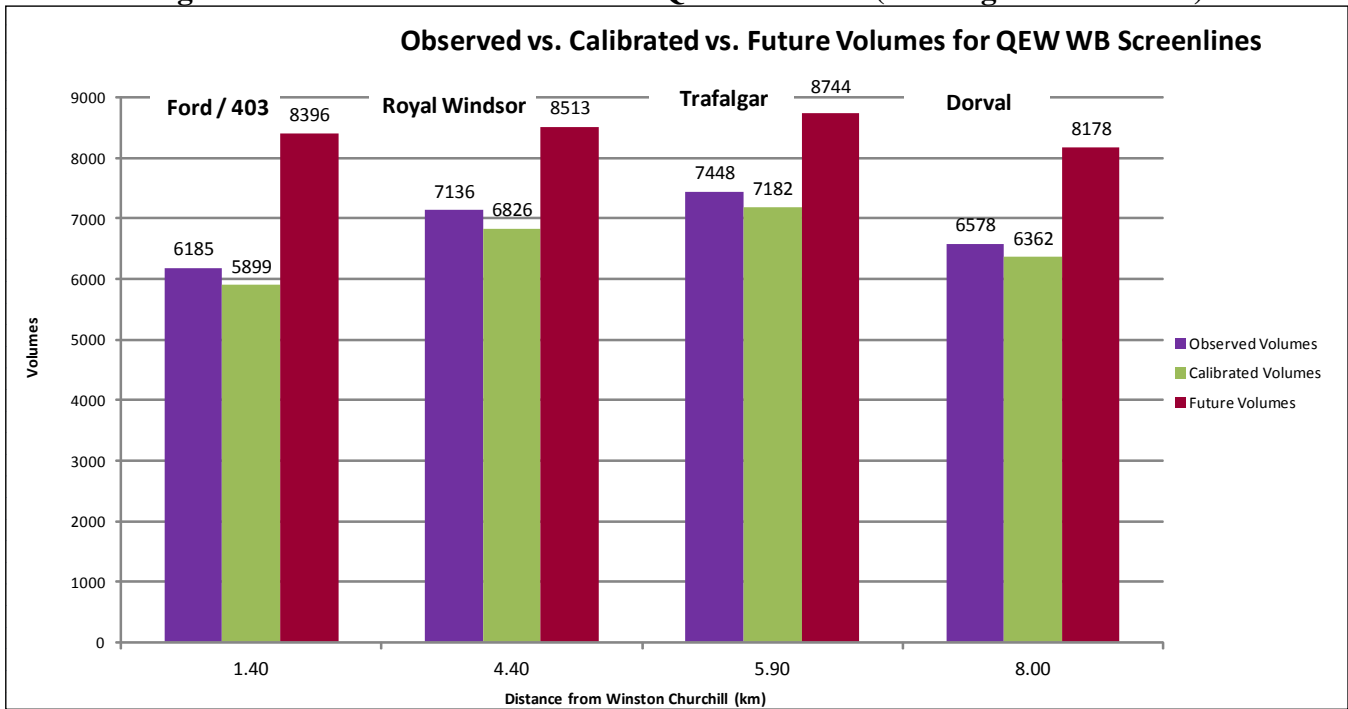


**Figure 5: PM Peak Hour Eastbound QEW Volumes (Existing versus Future)**





**Figure 6: PM Peak Hour Westbound QEW Volumes (Existing versus Future)**

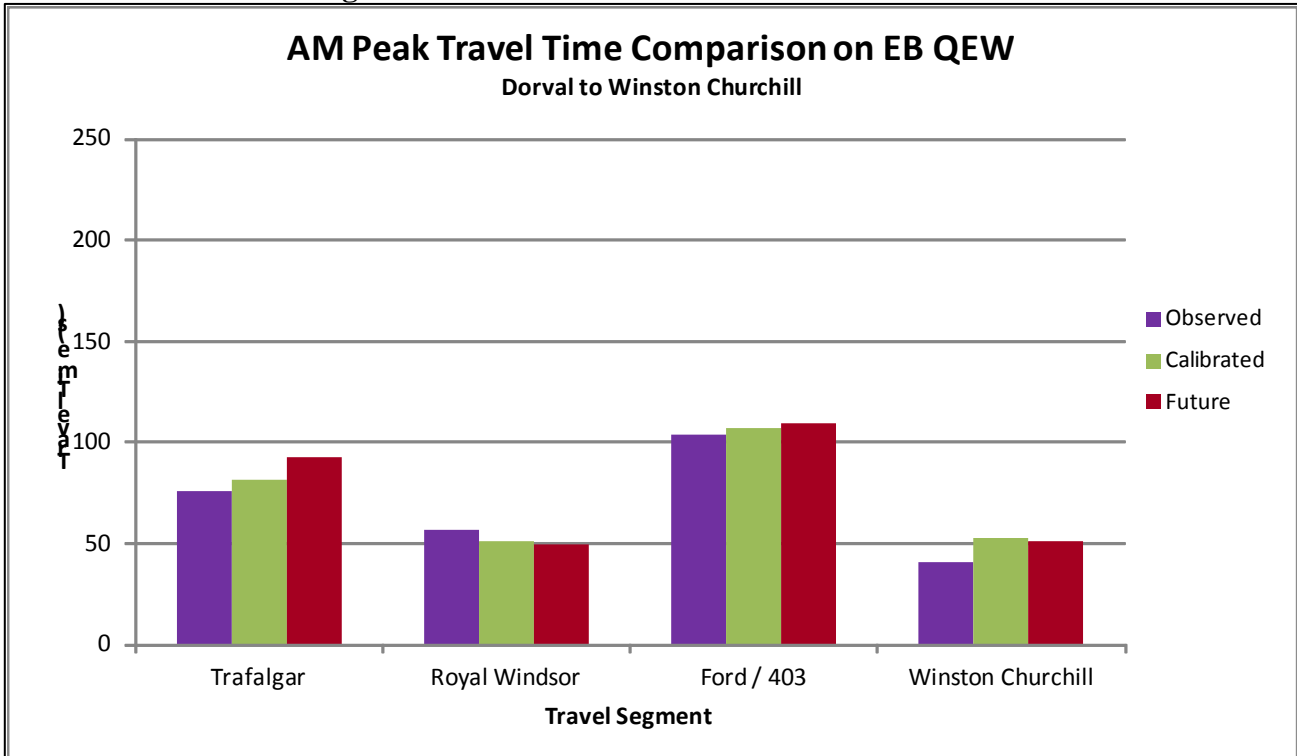


### 2.3.2. Travel Time Comparison

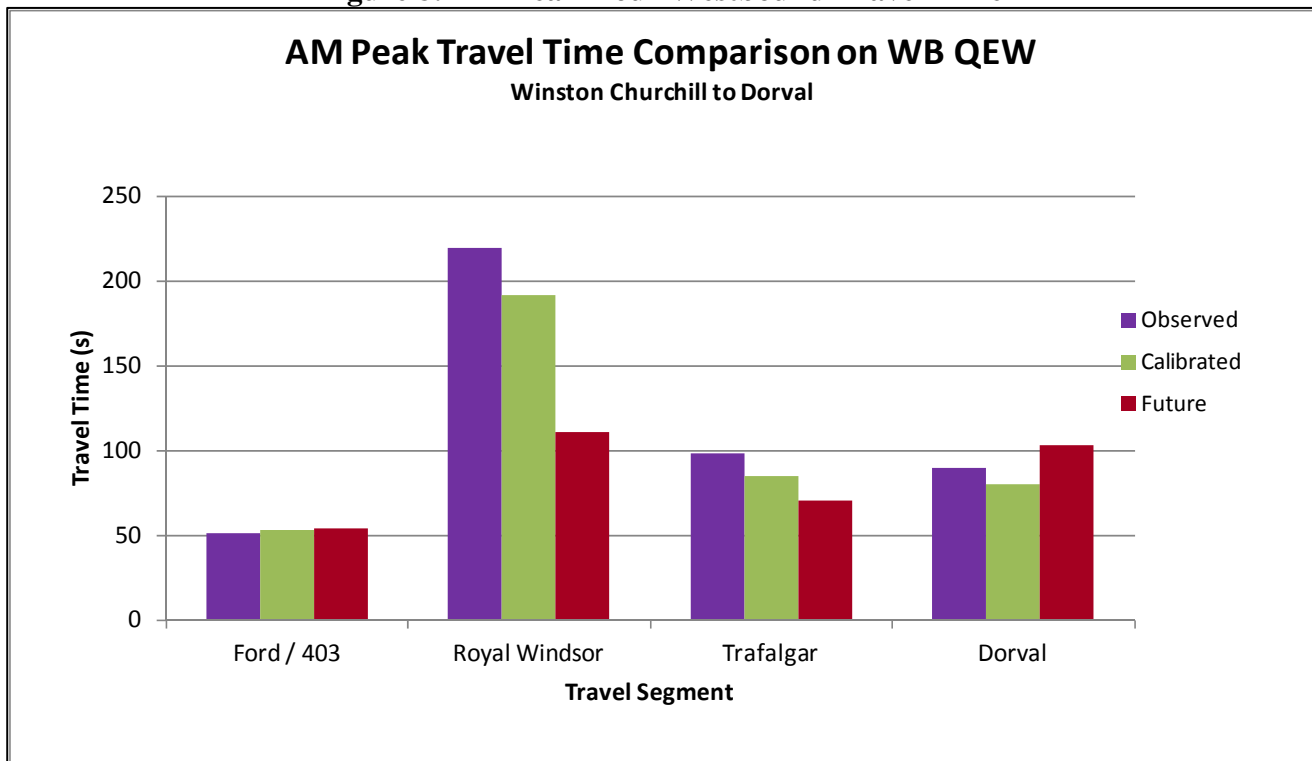
The travel times by direction for segments along QEW modelled for the 2031 horizon were compared to the existing modelled and observed travel times for the weekday AM and PM peak hours. The comparison is charted in **Figure 7** to **Figure 10** and the result show that 2031 travel times are expected to be similar to existing with the exception of the westbound segment from Highway 403/Ford Drive to Trafalgar Road. The existing congestion through this segment was addressed through the improvements identified in the TESR for Highway 403 and Queen Elizabeth Way from Trafalgar Road to Winston Churchill Boulevard; especially through the core-collector system introduced on the QEW between Ford Drive and Winston Churchill Boulevard and the HOV extension.

The core-collector system has separated conflicting N-W and E-W movements at the Highway 403 / Ford Drive interchange. The provision of an auxiliary lane from Royal Windsor Drive westbound on ramp to Trafalgar Road westbound off ramp has also provided relief to existing congestion.

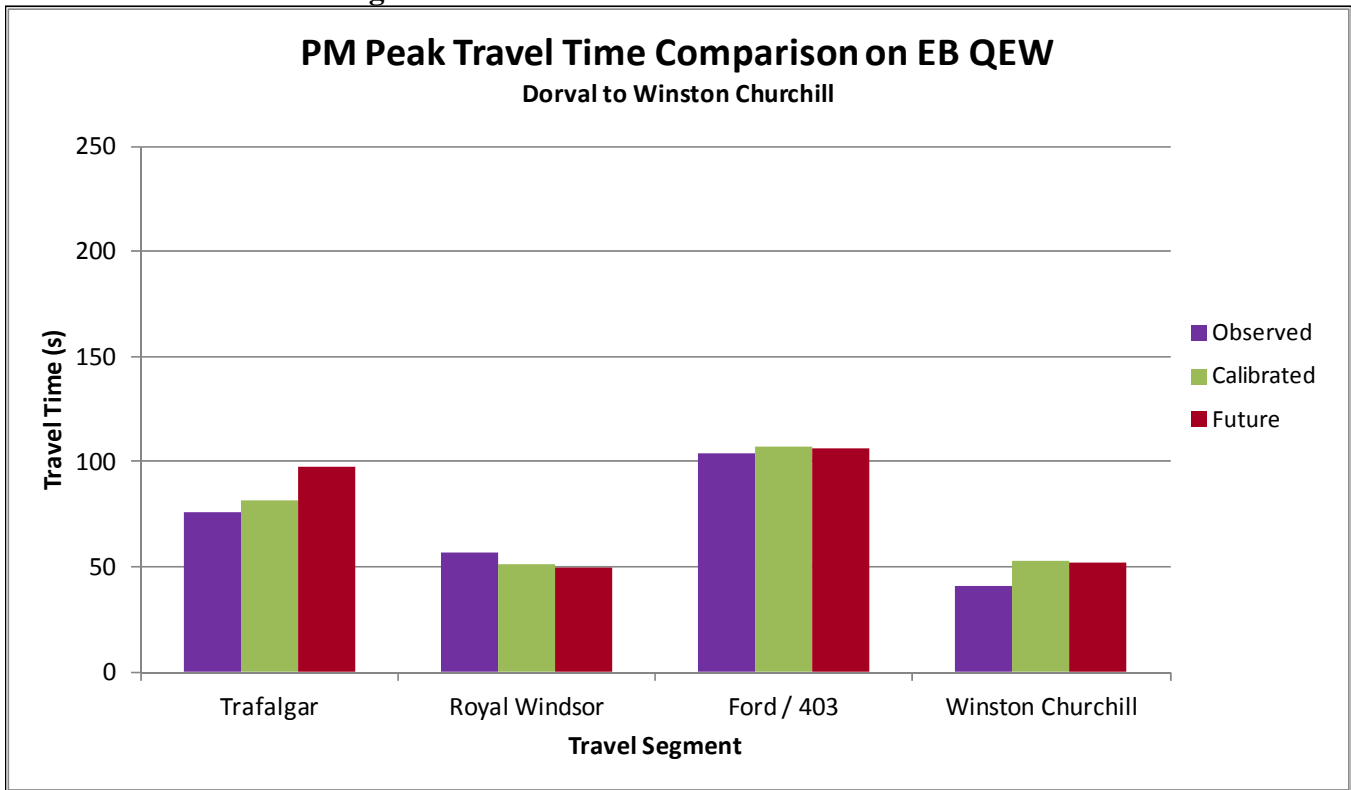
**Figure 7: AM Peak Hour Eastbound Travel Time**



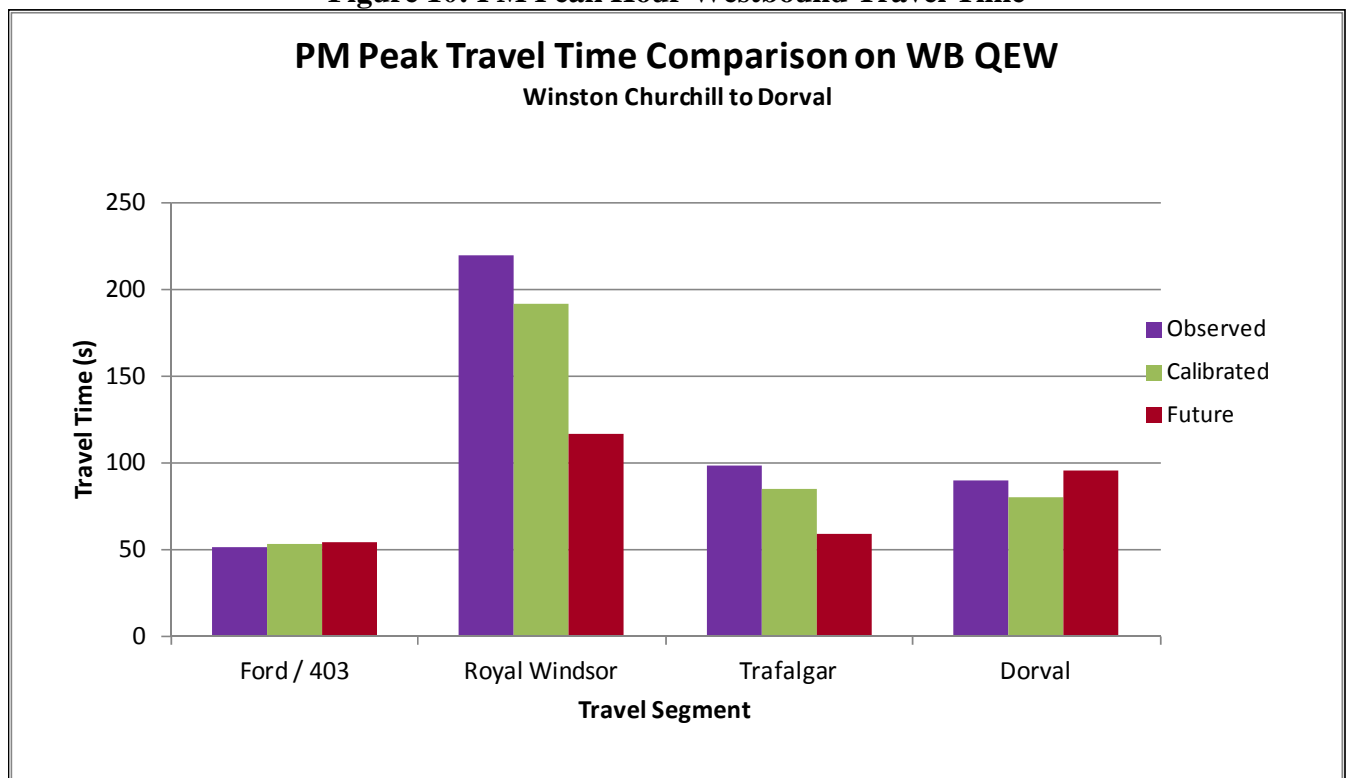
**Figure 8: AM Peak Hour Westbound Travel Time**



**Figure 9: PM Peak Hour Eastbound Travel Time**



**Figure 10: PM Peak Hour Westbound Travel Time**



### 2.3.3. 2031 QEW Mainline Operations

The 2031 QEW mainline operations was assessed using directional speed contour plots, directional lane by lane average speed plots and directional speed profile plots for the weekday AM and PM peak hours. The speed contour plots, directional lane by lane average speed plots and directional speed profile plots were used to identify hot spots or areas with operational issues along the QEW corridor over the peak hour. The speed contour plots, directional lane by lane average speed plots and directional speed profile plots for the QEW are shown in **Figure 11** to **Figure 22** for 2031 traffic conditions.

From the plots, operational constraints are noted at the Dorval Drive interchange in the eastbound direction during both the AM and PM peak hours. Lower speeds are currently experienced at this location especially during the AM peak hour. The localized hot spot anticipated under 2031 conditions is expected due to increased demand along the QEW being served by existing capacity (number of lanes) and high volumes entering from Dorval Drive.

In the westbound direction lower speeds are observed on the QEW segment from the Trafalgar Road interchange to the Dorval interchange during both the AM and PM peak hours. The lower speeds are more pronounced during the AM peak and can be attributed to the interaction between high mainline volumes, entering volumes at Trafalgar and exiting volumes at Dorval.

Lower speeds were observed in the westbound direction on the QEW mainline where Highway 403 traffic merges with QEW mainline traffic. The lower speeds are due to the increase in traffic volumes along the mainline and are localized to the Highway 403 – QEW W merge area.

The inclusion of the auxiliary lane between Royal Windsor Drive and Ford Drive to facilitate merging traffic from the proposed Royal Windsor Drive eastbound on ramp has improved traffic operations through this segment.

Operational constraints were not observed at the westbound off ramp at Royal Windsor Drive with a single lane exit; therefore, a two lane exit was not assessed. Right turn on red is not permitted at the Royal Windsor Drive westbound off ramp.

Figure 11: AM Peak Hour Eastbound QEW Speed Contour Plot

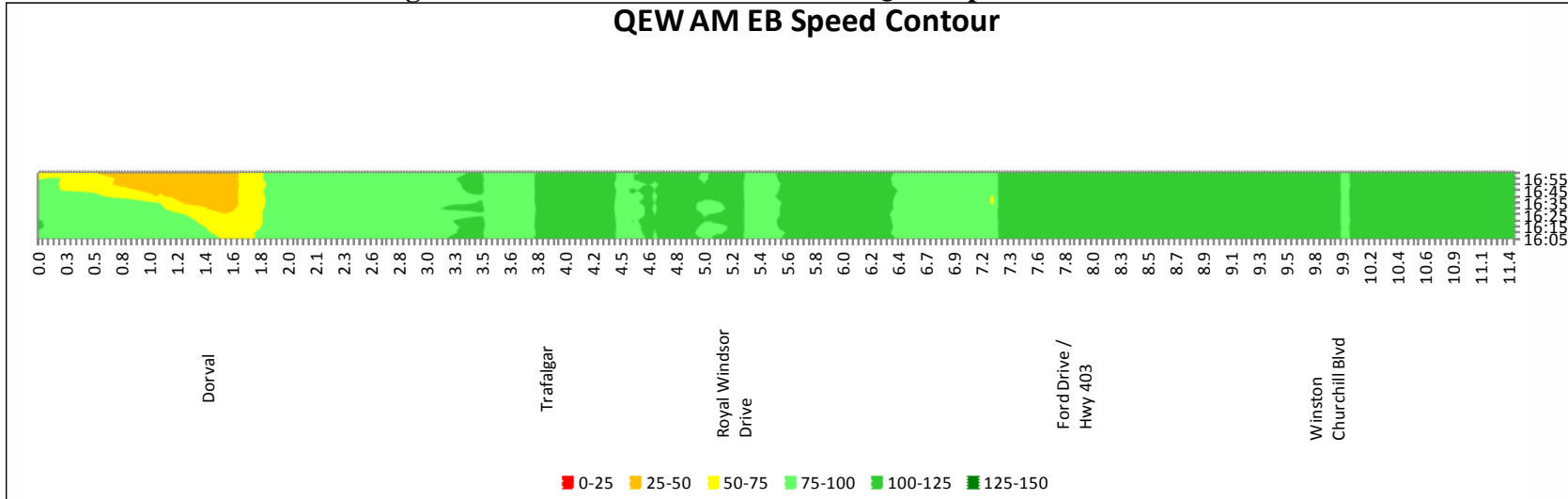


Figure 12: AM Peak Hour Eastbound QEW Lane by Lane Average Speed

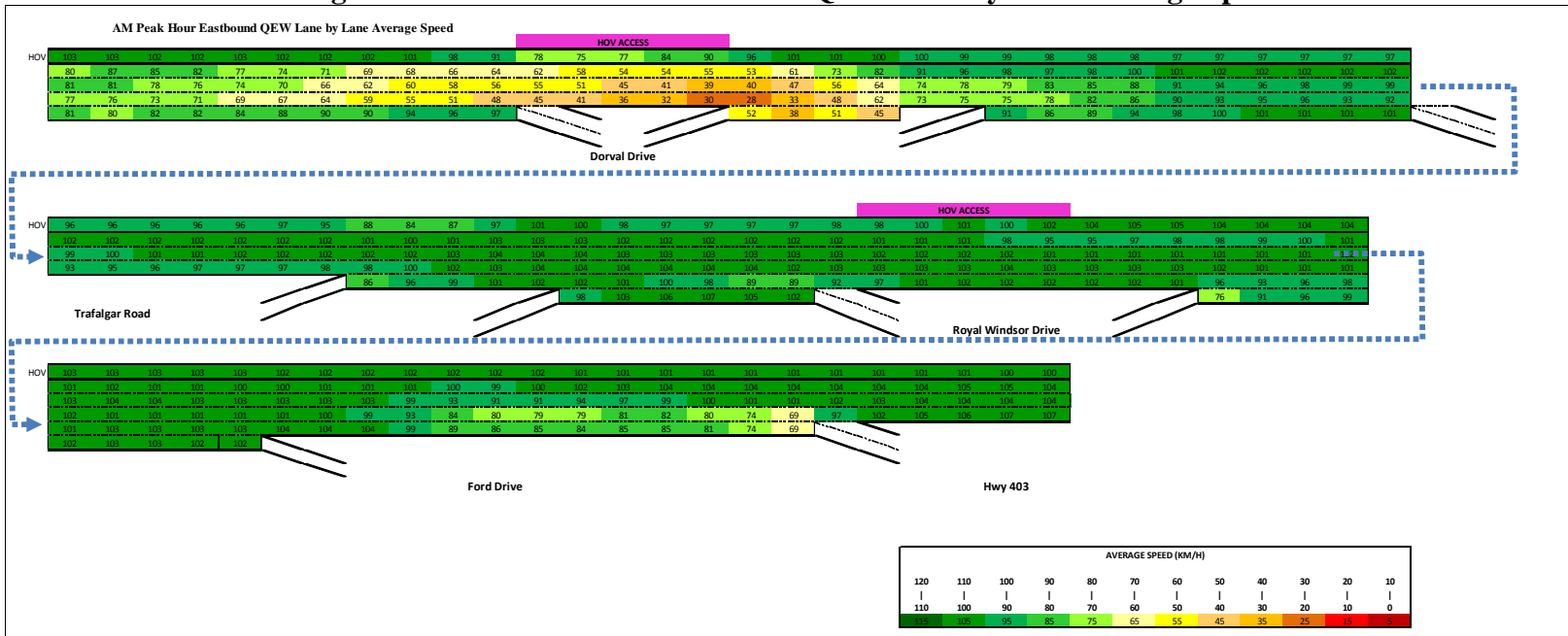


Figure 13: AM Peak Hour Eastbound QEW Speed Profile

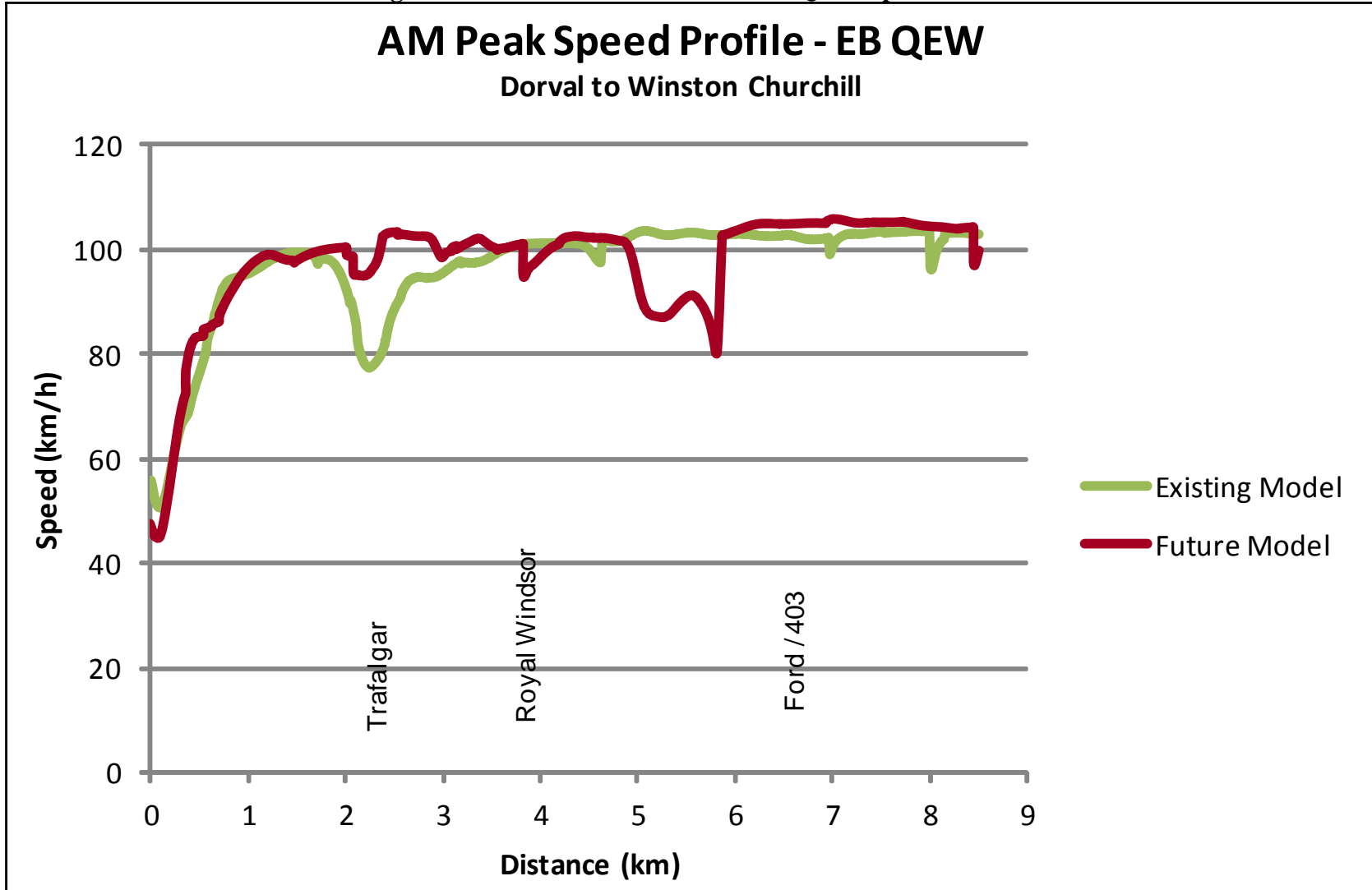


Figure 14: AM Peak Hour Westbound QEW Speed Contour Plot

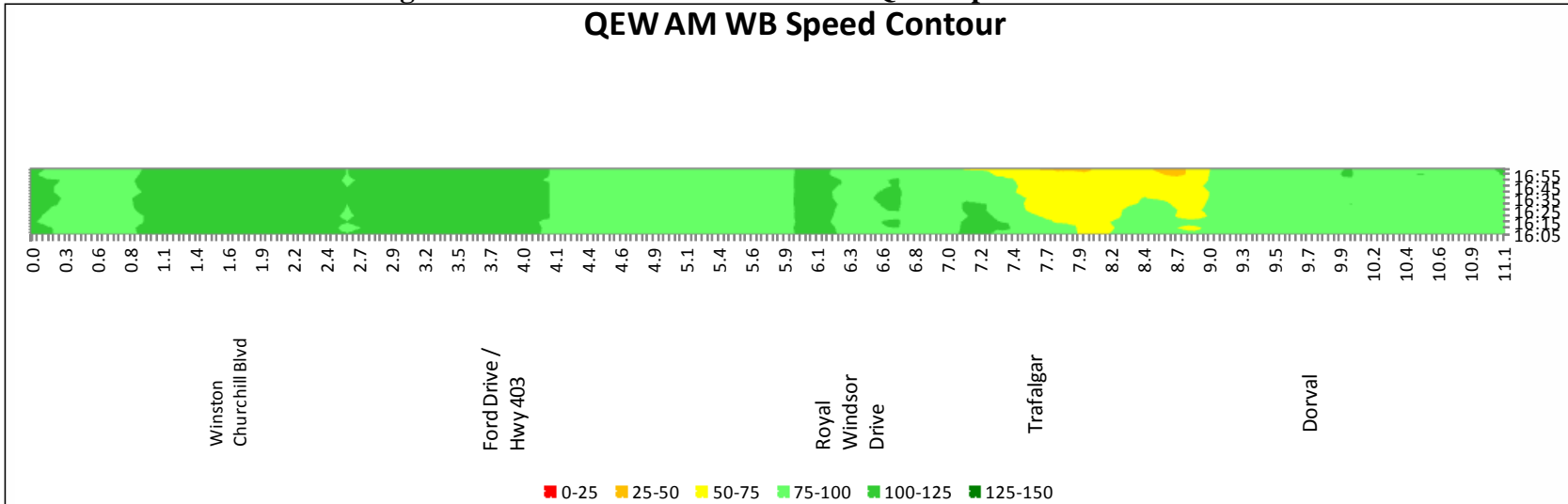


Figure 15: AM Peak Hour Westbound QEW Lane by Lane Average Speed

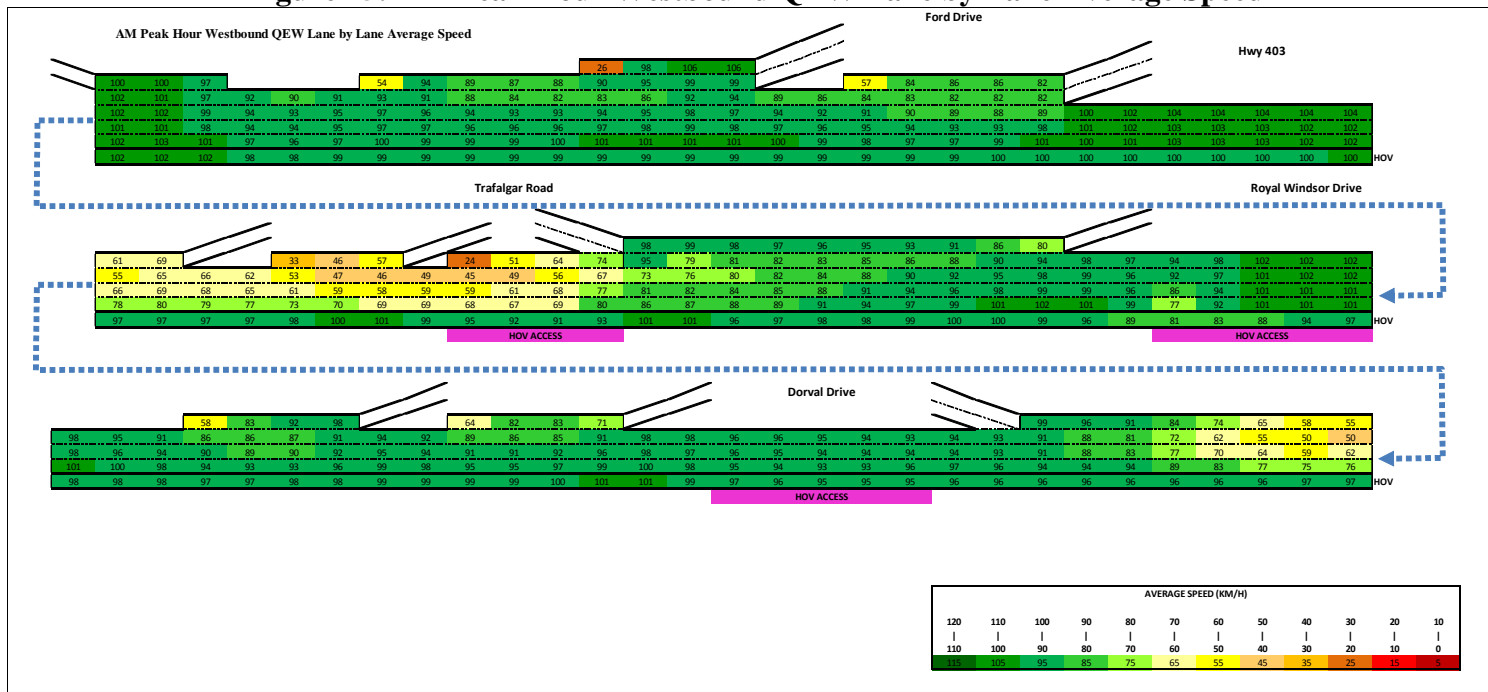


Figure 16: AM Peak Hour Westbound QEW Speed Profile

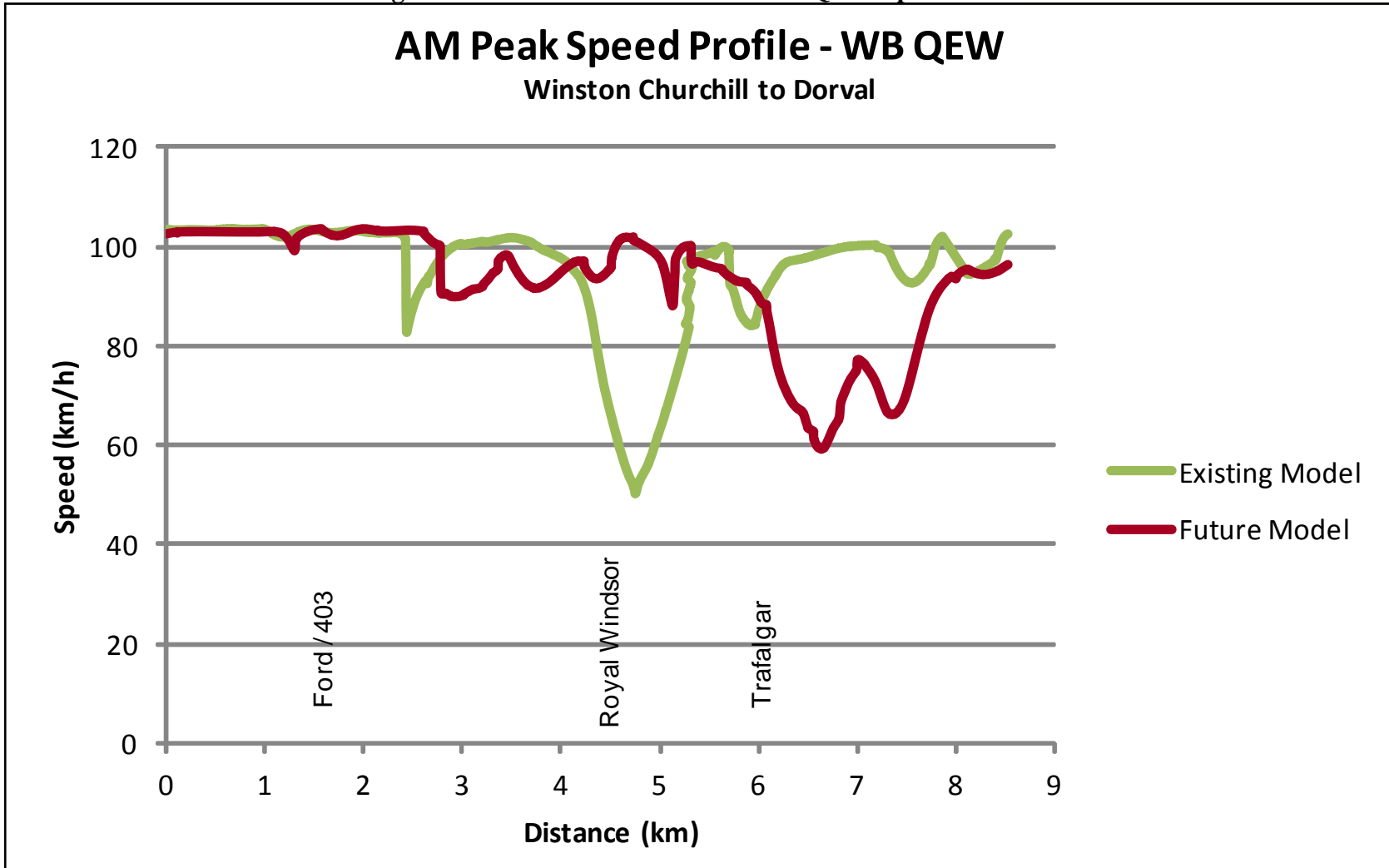




Figure 17: PM Peak Hour Eastbound QEW Speed Contour Plot

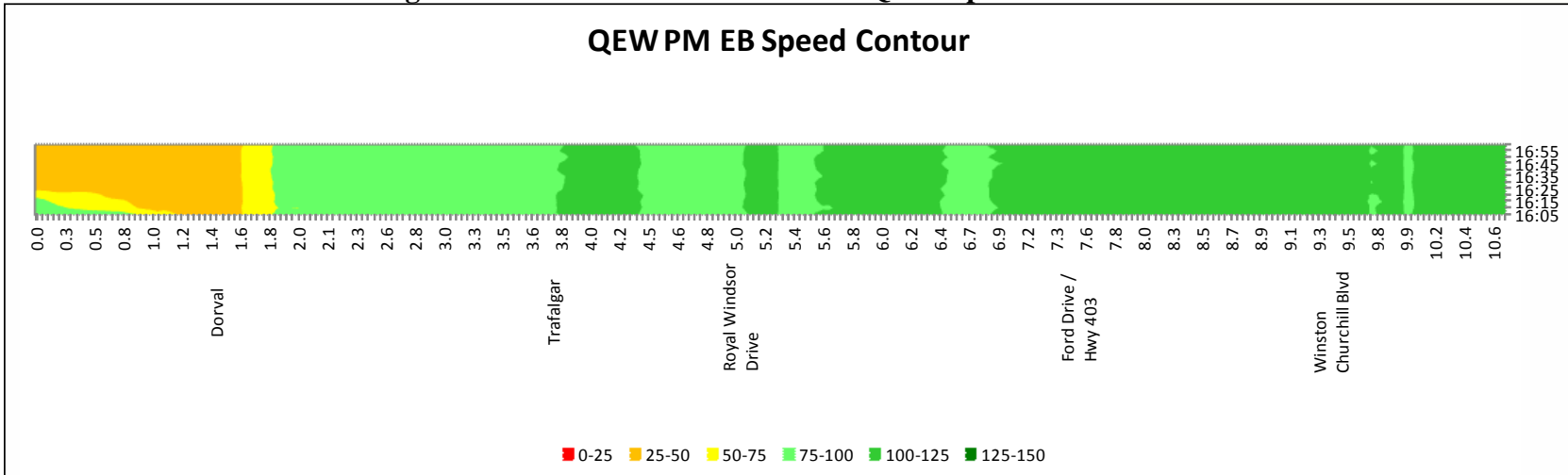


Figure 18: PM Peak Hour Eastbound QEW Lane by Lane Average Speed

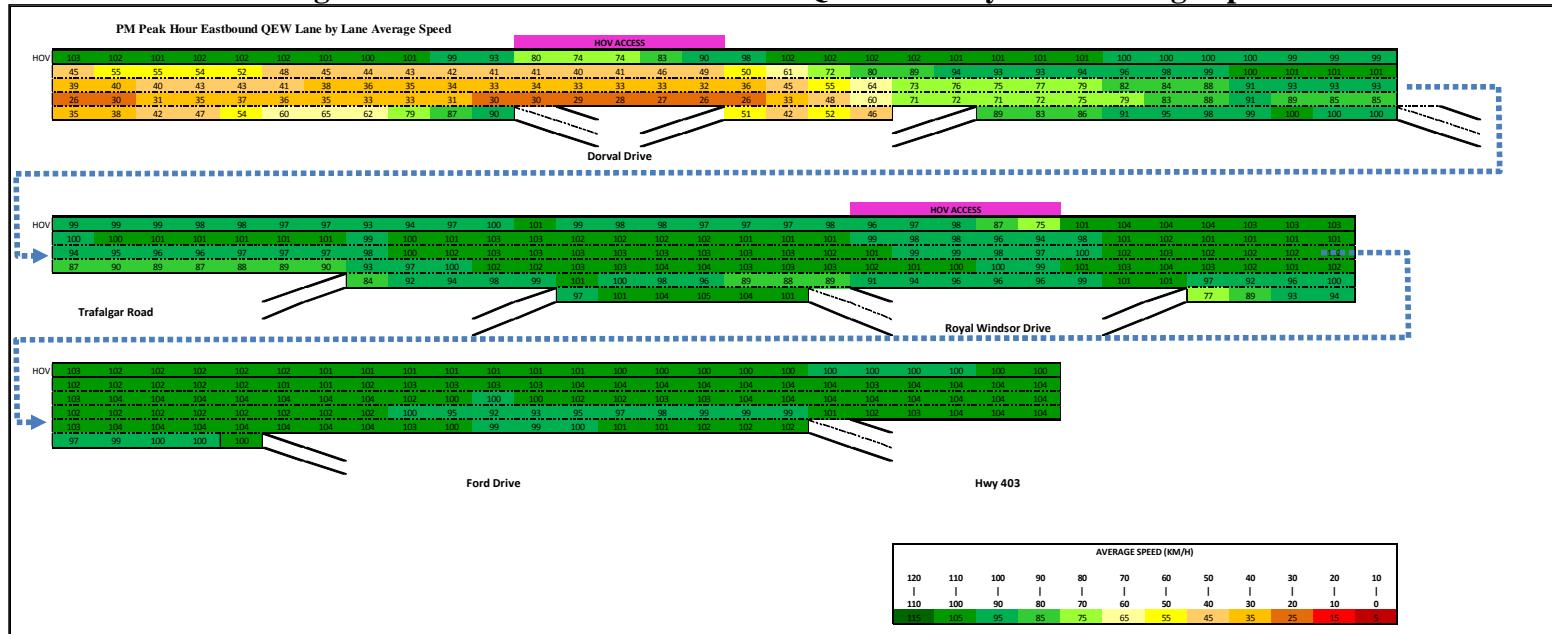


Figure 19: PM Peak Hour Eastbound QEW Speed Profile

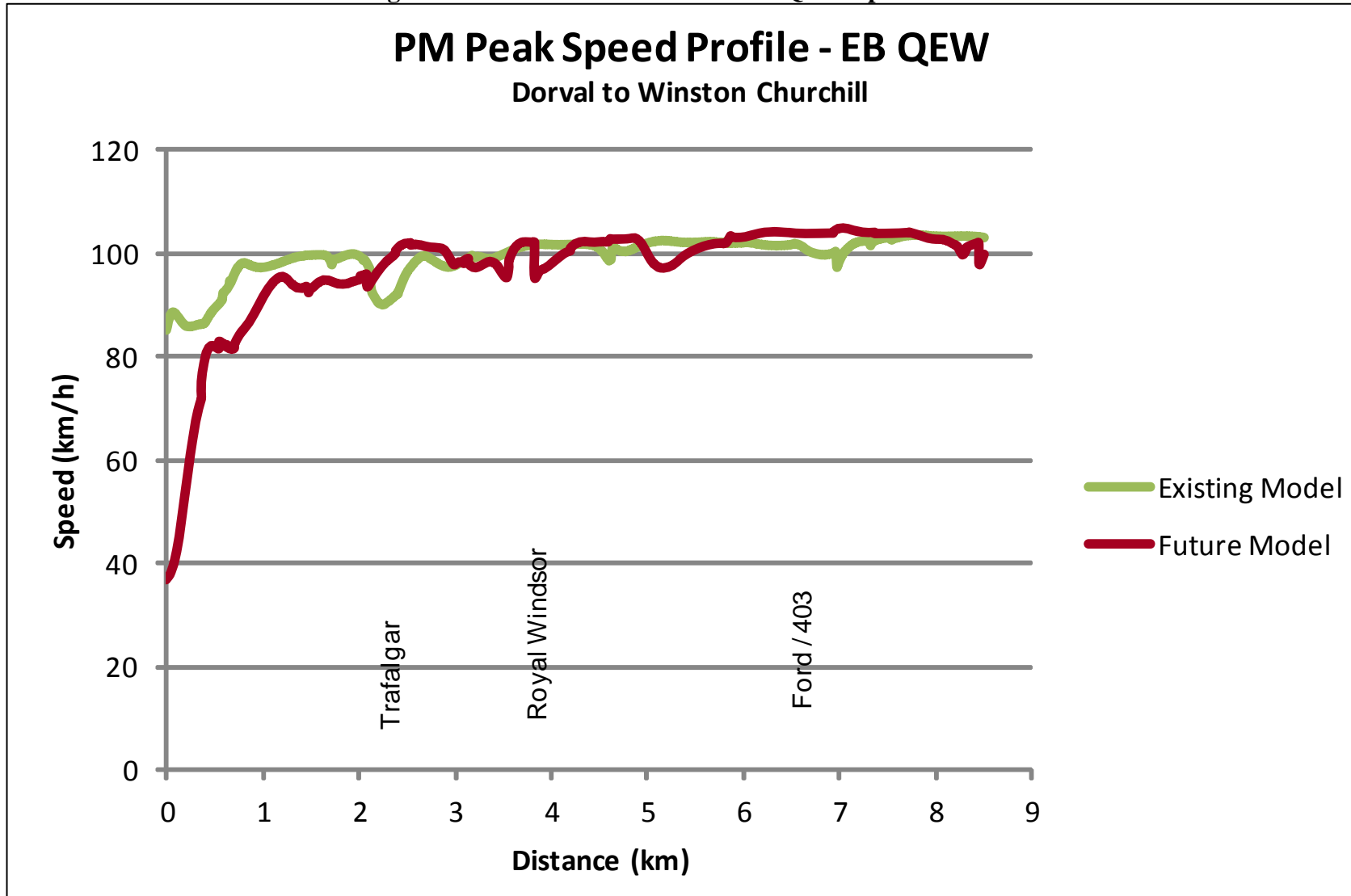


Figure 20: PM Peak Hour Westbound QEW Speed Contour Plot

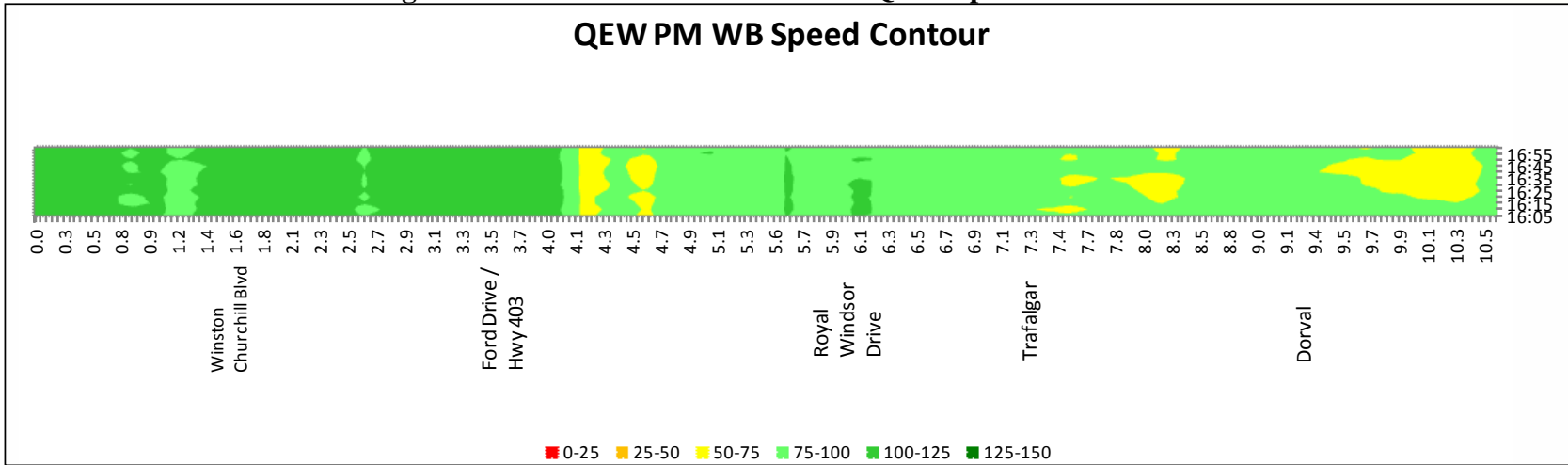


Figure 21: PM Peak Hour Westbound QEW Lane by Lane Average Speed

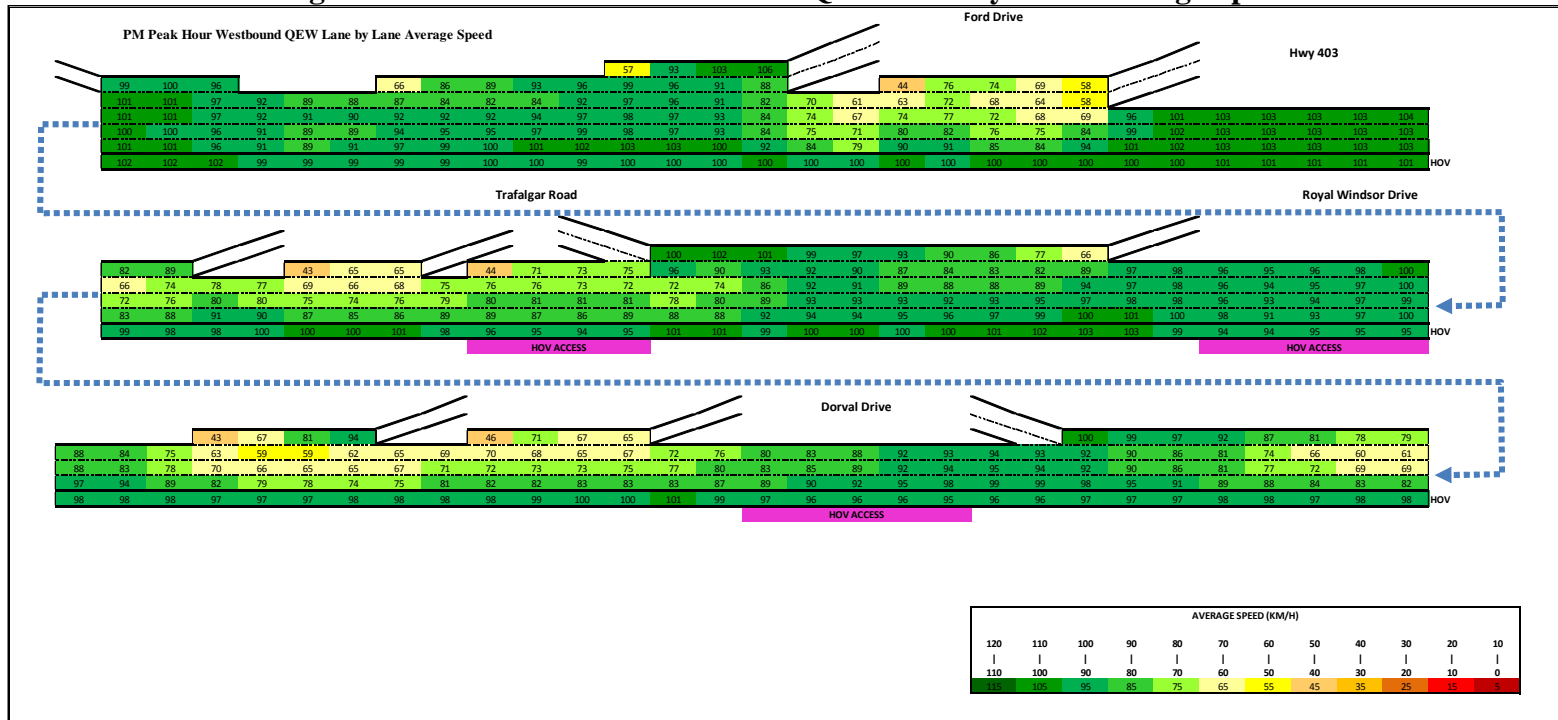
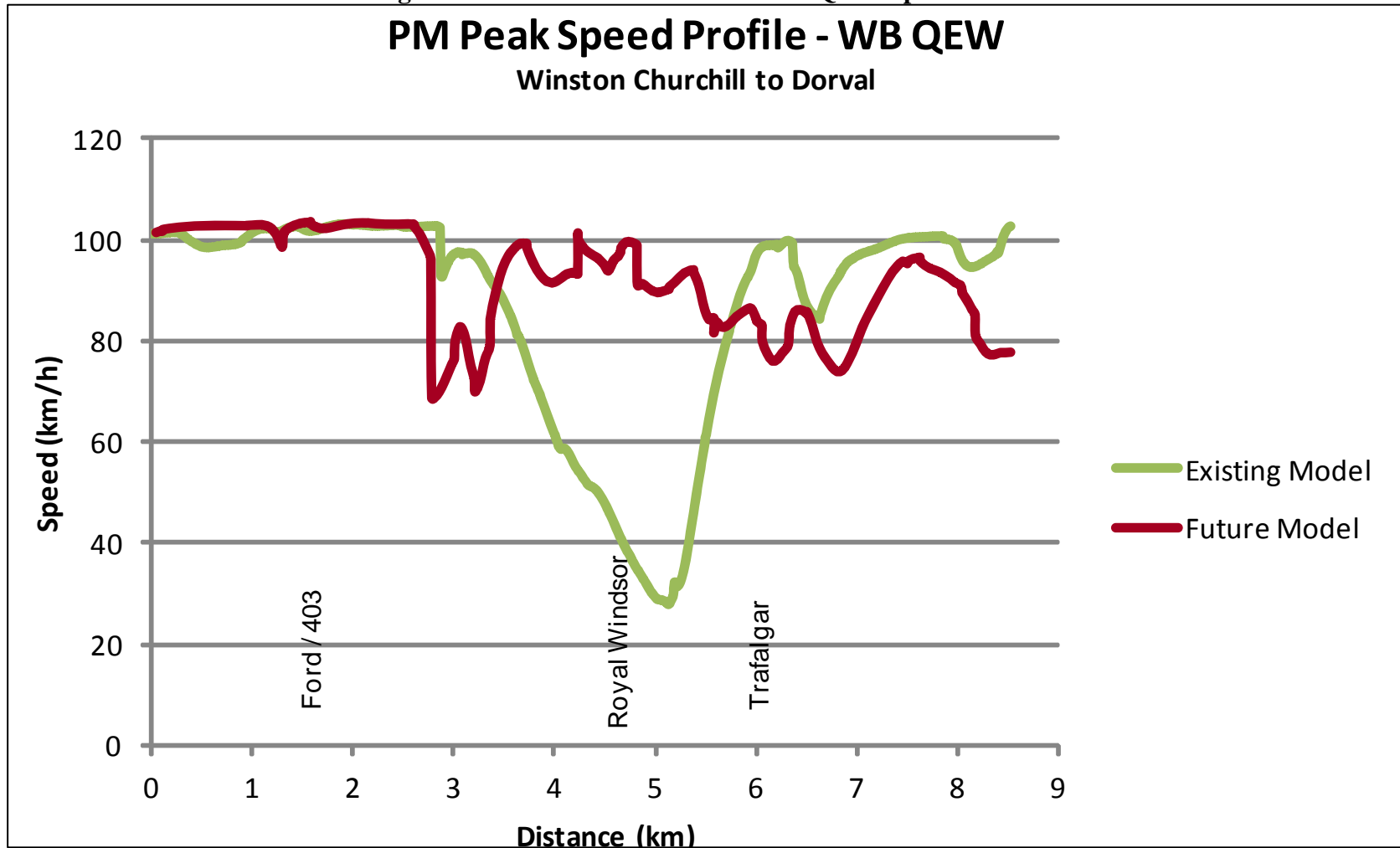


Figure 22: PM Peak Hour Westbound QEW Speed Profile



### 2.3.4. Ramp Terminal Queuing Analysis

A queuing analysis was conducted using data from the microsimulation model to assess the impact of queues at the ramp terminals on mainline operations. From the speed contour plot results it is not anticipated that the ramp terminal operations will impact QEW mainline operations and this is confirmed in **Table 2** where the maximum anticipated queues are not expected to exceed available storage. Queuing is not expected to be an issue at the EB off ramp grade separated crossing of Trafalgar Road intersection with Cross Avenue extension. This intersection will be signalized in 2031 and the modelled queues can be accommodated in the available storage.

**Table 2: 2031 Ramp Terminal Queuing Analysis**

Ramp	Available Storage (m)	AM Peak Hour		PM Peak Hour	
		Average Queue (m)	Maximum Queue (m)	Average Queue (m)	Maximum Queue (m)
Trafalgar EB Off Ramp	325	123	295	40	166
Trafalgar EB Off Ramp to Cross	350	10	96	7	74
Trafalgar WB Off Ramp	300	70	271	48	237
Royal Windsor WB Off Ramp	430	39	173	56	246

### 3. Intersection Operational Analysis

Intersection operations under 2031 conditions were analyzed using the Vissim model and a Synchro 7 model. The Synchro 7 turning movement volumes were obtained from the microsimulation model and signal timing splits were optimized to reflect 2031 conditions. The Vissim model was used to provide turning movement measures of effectiveness for level of service and delay while the Synchro 7 model was used to generate v/c ratios.

The intersections analyzed are:

- Trafalgar Road / Cross Avenue
- Trafalgar Road / QEW EB Off-ramp
- Trafalgar Road / North Service Road
- Trafalgar Road / Leighland Avenue
- Royal Windsor Drive / QEW WB Off-ramp
- Royal Windsor Drive / QEW EB On-ramp
- Royal Windsor Drive / The Canadian Road

The results of the intersection operations are summarized in **Table 3** and detailed Synchro 7 analysis reports are provided in **Appendix C**.

**Table 3: 2031 Intersection Operations**

Intersection	Key Movement	v/c ratio <sup>1</sup>		LOS (Average Delay in seconds) <sup>2</sup>	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Cross Avenue / Trafalgar Road (Signalized)	Overall	<b>1.16</b>	<b>1.00</b>	D (54)	E (56)
	EB left	<b>1.24</b>	0.98	F (177)	F (83)
	EB through	0.49	0.77	D (45)	E (61)
	EB right	0.23	0.06	B (16)	D (39)
	WB left	0.82	0.85	E (69)	D (50)
	WB through	<b>1.21</b>	0.94	F (92)	D (50)
	WB right	0.90	0.64	D (37)	B (14)
	NB left	0.79	<b>1.05</b>	C (33)	F (108)
	NB through	0.69	0.75	C (32)	D (46)
	NB right	0.44	0.33	C (35)	E (64)
	SB left	0.65	0.79	E (57)	E (65)
	SB through	0.56	0.90	C (29)	D (43)
	SB right	<b>1.13</b>	0.38	C (31)	C (32)
	QEWEB Off Ramp / Trafalgar Road (Signalized)	Overall	0.81	0.64	D (38)
EB left		0.65	0.73	C (33)	D (39)
EB right		0.85	0.66	E (71)	B (16)
NB through		0.62	0.57	B (20)	C (24)
SB through		0.78	0.59	D (45)	B (15)
North Service Road / Trafalgar Road (Signalized)	Overall	0.85	0.83	D (36)	C (29)
	EB left	0.11	0.20	D (39)	D (39)
	EB right	0.73	0.80	D (41)	D (49)
	WB left	0.79	0.69	D (43)	C (31)
	WB left-through	0.80	0.71	D (43)	C (32)
	WB right	0.16	0.22	B (12)	A (10)
	NB through	0.65	0.79	B (19)	D (40)
	SB through	0.88	0.86	D (48)	B (19)
SB right	0.01	0.02	C (30)	B (17)	
Leighland Avenue / Trafalgar Road (Signalized)	Overall	0.79	0.81	E (57)	D (46)
	EB left	0.22	0.71	E (68)	C (32)
	EB through	0.54	0.56	F (95)	D (45)
	EB right	0.21	0.14	C (21)	A (2)
	WB left	<b>1.16</b>	0.71	F (83)	F (103)
	WB through	0.63	0.85	C (35)	D (39)
	WB right	0.27	0.61	A (6)	A (9)
	NB left	0.78	0.88	D (53)	D (52)
	NB through	0.80	0.89	D (51)	E (62)
	NB right	0.22	0.17	A (4)	A (8)
	SB left	0.83	0.89	E (66)	D (47)
	SB through	0.79	0.77	E (78)	D (39)
	SB right	0.10	0.10	C (27)	A (10)

<sup>1</sup> v/c ratios were obtained from the Synchro model

<sup>2</sup> Level of Service (LOS) and Average Delays were obtained from the Vissim model

**Table 3: 2031 Intersection Operations Cont'd**

Intersection	Key Movement	v/c ratio <sup>1</sup>		LOS (Average Delay in seconds) <sup>2</sup>	
		AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
QEW WB Off Ramp / Royal Windsor Drive (Signalized)	Overall	0.59	0.43	C (24)	C (26)
	WB left	0.79	0.75	D (37)	C (35)
	WB right	0.21	0.41	D (39)	D (45)
	NB through	0.13	0.23	A (7)	B (13)
	SB left	0.17	0.16	B (14)	B (19)
	SB through	0.40	0.15	B (15)	B (13)
Royal Windsor Drive / QEW EB On Ramp (Signalized)	Overall	0.73	0.86	B (18)	A (10)
	EB left	0.81	0.81	A (<1)	A (<1)
	EB through	0.20	0.08	E (73)	F (108)
	EB right	0.42	0.32	C (32)	C (28)
	WB left	0.73	0.69	C (29)	C (35)
	WB through-right	0.58	0.81	E (64)	D (55)
	NB left	0.46	0.21	D (38)	D (39)
	NB through	0.88	1.07	D (43)	D (53)
	NB right	0.25	0.41	A (8)	B (11)
Royal Windsor Drive / The Canadian Road (Signalized)	Overall	0.53	0.70	B (13)	D (39)
	EB left	0.31	0.19	A (4)	A (3)
	EB through	0.26	0.24	C (32)	D (45)
	WB through	0.61	0.77	B (16)	E (65)
	WB right	0.01	0.03	A (4)	B (17)
	NB left	0.21	0.20	A (7)	A (8)
	NB through	0.49	0.54	D (36)	D (41)
	NB right	0.46	0.39	C (35)	C (35)
	SB left	0.08	0.09	C (35)	D (39)
	SB right	0.16	0.71	A (1)	D (52)

<sup>1</sup> v/c ratios were obtained from the Synchro model

<sup>2</sup> Level of Service (LOS) and Average Delays were obtained from the Vissim model

The intersection operations results documented in **Table 3** for 2031 conditions show that the intersections of Trafalgar Road / Cross Avenue is expected to experience capacity constraints, especially during the weekday AM peak hour. The capacity constraints are due primarily to a high eastbound left turning and westbound through demand. The east-west delays along Cross Avenue will not impact operations on the QEW mainline and at the Trafalgar Road ramp terminals.

The Trafalgar Road / Leighland Avenue intersection is expected to experience a level of service 'F' during the weekday AM peak hour; however, constraints at these two movements will not impact operations on the QEW mainline and at the Trafalgar Road ramp terminals.

A turning movement queuing summary from the Synchro 7 analysis is provided in **Table 4**. Detailed analysis reports are provided in **Appendix C**.

**Table 4: 2031 Intersection Turning Movement Queuing Summary (Synchro)**

Intersection	Key Movement	Available Storage Length (m)	95 <sup>th</sup> Percentile Queue Length (m)	
			AM Peak Hour	PM Peak Hour
Cross Avenue / Trafalgar Road (Signalized)	EB left	120	<b>140</b>	<b>212</b>
	EB through	190	67	146
	EB right	60	35	14
	WB left	90	78	<b>93</b>
	WB through	270	215	110
	WB right	110	<b>190</b>	86
	NB left	115	53	<b>122</b>
	NB through	230	138	122
	NB right	30	<b>83</b>	<b>51</b>
	SB left	45	<b>49</b>	<b>78</b>
	SB through	290	79	160
	SB right	70	<b>342</b>	12
QEW EB Off Ramp / Trafalgar Road (Signalized)	EB left	250	122	116
	EB right	> 300	207	107
	NB through	290	100	125
	SB through	270	187	150
North Service Road / Trafalgar Road (Signalized)	EB left	65	10	19
	EB right	> 300	76	111
	WB left	> 300	188	155
	WB left-through	> 300	195	162
	WB right	100	< 7	< 7
	NB through	270	115	210
	SB through	235	<b>258</b>	<b>247</b>
	SB right	235	<7	<7
Leighland Avenue / Trafalgar Road (Signalized)	EB left	60	21	<b>72</b>
	EB through	230	58	52
	EB right	230	< 7	< 7
	WB left	150	119	67
	WB through	150	92	<b>156</b>
	WB right	20	<b>32</b>	<b>88</b>
	NB left	120	94	84
	NB through	235	176	222
	NB right	220	< 7	< 7
	SB left	85	<b>134</b>	<b>121</b>
	SB through	> 300	197	170
	SB right	80	17	17
QEW WB Off Ramp / Royal Windsor Drive (Signalized)	WB left	> 300	167	136
	WB right	100	29	58
	NB through	235	21	53
	SB left	50	29	25
	SB through	> 300	97	42



**Table 4: 2031 Intersection Turning Movement Queuing Summary (Synchro) Cont'd**

Intersection	Key Movement	Available Storage Length (m)	95 <sup>th</sup> Percentile Queue Length (m)	
			AM Peak Hour	PM Peak Hour
Royal Windsor Drive / QEW EB On Ramp (Signalized)	EB left	160	123	79
	EB through	235	34	17
	EB right	80	28	39
	WB left	195	72	65
	WB through-right	> 300	120	215
	NB left	100	75	39
	NB through	> 300	186	262
	NB right	> 300	39	69
Royal Windsor Drive / The Canadian Road (Signalized)	EB left	75	16	11
	EB through	> 300	31	48
	WB through	> 300	87	216
	WB right	60	< 7	10
	NB left	130	23	37
	NB through	> 300	49	96
	NB right	35	< 7	< 7
	SB left	40	9	12
SB right	90	25	<b>125</b>	

The results from the Synchro analysis show that queuing impacts are restricted to the local road and will not impact QEW mainline traffic operations.

#### **4. Summary of 2031 Traffic Operations**

The microsimulation modelling and Synchro 7 modelling results confirm that the proposed improvements at the Trafalgar Road and Royal Windsor Drive interchanges can accommodate 2031 trend demand during the weekday AM and PM peak hours. The proposed improvements are not expected to significantly impact the QEW mainline operations. The new ramps at Royal Windsor Drive will accommodate some of the demand from the Midtown Oakville planned intensification thereby providing relief to the Trafalgar Road interchange.

This distribution of the Midtown demand across the two interchanges is important to maintain acceptable QEW mainline and ramp terminal operations. For example, during the AM peak hour 865 vehicles are forecasted to make the westbound left turn at the Trafalgar Road off ramp in the future and 525 vehicles will complete the similar movement at the Royal Windsor Drive off ramp. If the westbound off ramp is not provided at Royal Windsor Drive, 1,390 vehicles will need to be accommodated at the Trafalgar Road off ramp westbound left turn. In the PM peak, this number is expected to be around 1,300 vehicles without the Royal Windsor Drive westbound off ramp.

Operational constraints were not observed at the westbound off ramp at Royal Windsor Drive with a single lane exit; therefore, a two lane exit was not assessed. Right turn on red is not permitted at the Royal Windsor Drive westbound off ramp.

Operational constraints impacts anticipated at the Trafalgar intersections at Cross Avenue and Leighland Avenue will be restricted to the local road network and will not impact operations on the QEW mainline and at the Trafalgar Road ramp terminals.

**Appendix A – Additional Microsimulation Analysis Results**

## AM Peak Hour Model Results

**Table A- 1: AM Peak Hour Screenline Comparison**

	NB/EB			SB/WB		
<b>West of Dorval Drive</b>	<b>Observed</b>	<b>Calibrated</b>	<b>Future</b>	<b>Observed</b>	<b>Calibrated</b>	<b>Future</b>
QEW	6576	6553	8201	6150	6354	8318
<b>Screenline Total</b>	<b>6576</b>	<b>6553</b>	<b>8201</b>	<b>6150</b>	<b>6354</b>	<b>8318</b>
<b>West of Trafalgar Road</b>						
Leighland Avenue	587	581	762	273	276	612
North Service Road	127	127	169	26	20	89
QEW	7591	7518	8760	7106	7125	9158
Argus Road	10	10	44	200	195	250
Cross Avenue	483	484	1120	584	575	2010
<b>Screenline Total</b>	<b>8798</b>	<b>8720</b>	<b>10855</b>	<b>8189</b>	<b>8191</b>	<b>12119</b>
<b>East of Trafalgar Road</b>						
Iroquois Shore Road	935	909	1027	887	887	1016
QEW	7134	7130	8238	6565	6458	8696
South Service Road	274	261	1017	171	163	565
<b>Screenline Total</b>	<b>8343</b>	<b>8300</b>	<b>10282</b>	<b>7623</b>	<b>7508</b>	<b>10277</b>
<b>West of Ford Drive</b>						
QEW	6439	6466	8061	6185	6072	8917
<b>Screenline Total</b>	<b>6439</b>	<b>6466</b>	<b>8061</b>	<b>6185</b>	<b>6072</b>	<b>8917</b>
<b>West of Winston Churchill Boulevard</b>						
QEW	4064	3969	5485	3680	3669	6101
<b>Screenline Total</b>	<b>4064</b>	<b>3969</b>	<b>5485</b>	<b>3680</b>	<b>3669</b>	<b>6101</b>
<b>East of Winston Churchill Boulevard</b>						
QEW	4299	4196	5482	4570	4567	6443
<b>Screenline Total</b>	<b>4299</b>	<b>4196</b>	<b>5482</b>	<b>4570</b>	<b>4567</b>	<b>6443</b>
<b>North of Leighland Avenue</b>						
Trafalgar Road	1239	1167	1879	1629	1628	2201
<b>Screenline Total</b>	<b>1239</b>	<b>1167</b>	<b>1879</b>	<b>1629</b>	<b>1628</b>	<b>2201</b>
<b>South of Cross Avenue</b>						
Trafalgar Road	1472	1472	1861	1751	1669	1808
<b>Screenline Total</b>	<b>1472</b>	<b>1472</b>	<b>1861</b>	<b>1751</b>	<b>1669</b>	<b>1808</b>

**Table A- 2: AM Peak Hour Ramp Volume Comparison**

<b>QEW / Dorval Drive</b>	<b>Observed</b>	<b>Calibrated</b>	<b>Future</b>
QEW W - Dorval N/S	376	374	1072
QEW E - Dorval N/S	1250	1054	1546
Dorval S - QEW E	570	570	666
Dorval S - QEW W	148	149	411
Dorval N - QEW E	821	822	1054
Dorval N - QEW W	146	146	273
<b>Interchange Total</b>	<b>3311</b>	<b>3115</b>	<b>5022</b>
<b>QEW / Trafalgar Road</b>			
QEW W - Trafalgar N/S	1388	1278	1696
QEW E - Trafalgar N/S	983	889	1265
Trafalgar S - QEW E	590	588	728
Trafalgar S - QEW W	647	621	736
Trafalgar N - QEW E	341	344	386
Trafalgar N - QEW W	877	919	1105
<b>Interchange Total</b>	<b>4826</b>	<b>4639</b>	<b>5916</b>
<b>QEW / Royal Windsor Drive</b>			
QEW W - Royal Windsor	663	655	994
Royal Windsor - QEW W	430	470	814
QEW E - Royal Windsor			866
Royal Windsor - QEW E			861
QEW W - Cross Ave			38
<b>Interchange Total</b>	<b>1093</b>	<b>1125</b>	<b>3573</b>
<b>QEW / Ford Drive / Highway 403</b>			
QEW W - Ford N/S	254	244	864
QEW W - Hwy 403 N	2793	2898	4410
QEW E - Ford N/S	390	407	701
Hwy 403 N - QEW W	2724	2723	3914
Ford N/S - QEW E	640	644	869
Ford S - QEW E			611
Ford S - QEW W	60	53	92
Ford N - QEW W	61	55	256
QEW E - Hwy 403 N			723
Hwy 403 N - QEW E			638
Ford Drive N - Hwy 403 N			488
<b>Interchange Total</b>	<b>6922</b>	<b>7024</b>	<b>13566</b>
<b>QEW / Winston Churchill Blvd</b>			
QEW W - Winston Churchill N/S	550	571	592
QEW E - Winston Churchill N/S	1100	1075	1123
Winston Churchill S - QEW E	340	340	346
Winston Churchill S - QEW W	110	96	366
Winston Churchill N - QEW E	445	438	457
Winston Churchill N - QEW W	100	101	389
<b>Interchange Total</b>	<b>2645</b>	<b>2621</b>	<b>3273</b>

**Table A- 3: AM Peak Hour Turning Intersection Movement Comparison**

Intersection	TM	Observed	Calibrated	Future
Trafalgar Rd / Leighland Ave-Iroquois Shore Blvd	EBL	52	52	66
	EBT	115	120	348
	EBR	420	410	338
	WBL	739	738	471
	WBT	46	46	267
	WBR	102	103	271
	NBL	144	145	217
	NBT	1085	1009	1545
	NBR	611	577	360
	SBL	209	214	318
	SBT	1337	1330	1747
	SBR	83	85	129
Trafalgar Rd / North Service Rd N	EBL	2	2	13
	EBR	125	124	157
	WBL	507	483	908
	WBT	18	17	78
	WBR	458	368	248
	NBT	1380	1360	1858
	SBT	2488	2478	2514
	SBR	8	3	10
Trafalgar Rd / QEW EB Off-ramp	EBL	867	811	909
	EBT	n/a	n/a	232
	EBR	521	504	554
	NBT	1160	1201	1658
	SBT	1902	1849	2073
Trafalgar Rd / Argus Rd	EBR	10	10	44
	SBR	200	195	250
Trafalgar Rd / Cross Ave-South Service Rd	EBL	357	353	568
	EBT	38	41	399
	EBR	88	92	150
	WBL	33	31	355
	WBT	76	34	949
	WBR	62	98	517
	NBL	118	120	151
	NBT	1331	1327	1296
	NBR	23	25	411
	SBL	213	197	204
	SBT	1630	1548	1301
	SBR	390	422	912
	Royal Windsor Dr / The Canadian Rd-South Service Rd E	EBL	106	113
EBT		539	526	564
EBR		18	24	n/a
WBL		134	129	n/a
WBT		407	422	861
WBR		11	2	21
NBL		2	5	73
NBT		14	5	177
NBR		57	62	738
SBL		6	3	18
SBT		14	8	n/a
SBR		21	30	258
New WB Off Ramp/Iroquois Shore Extension		SBR	n/a	n/a
	SBL	n/a	n/a	611
	EBL	n/a	n/a	94
	EBT	n/a	n/a	699
	WBT	n/a	n/a	230
New EB On Ramp/Iroquois Shore Extension	EBL	n/a	n/a	318
	EBT	n/a	n/a	322
	EBR	n/a	n/a	667
	WBL	n/a	n/a	407
	WBT	n/a	n/a	694
	WBR	n/a	n/a	94
	NBL	n/a	n/a	226
	NBT	n/a	n/a	461
	NBR	n/a	n/a	393

## PM Peak Hour Model Results

**Table A- 4: PM Peak Hour Screenline Comparison**

	NB/EB			SB/WB		
<b>West of Dorval Drive</b>	<b>Observed</b>	<b>Calibrated</b>	<b>Future</b>	<b>Observed</b>	<b>Calibrated</b>	<b>Future</b>
QEW	6613	6613	7848	6578	6362	8178
<b>Screenline Total</b>	<b>6613</b>	<b>6613</b>	<b>7848</b>	<b>6578</b>	<b>6362</b>	<b>8178</b>
<b>West of Trafalgar Road</b>						
Leighland Avenue	540	517	644	541	539	792
North Service Road	265	266	305	158	155	177
QEW	7517	7521	8618	7448	7182	8744
Argus Road	33	33	57	182	181	250
Cross Avenue	955	957	2101	447	442	1210
<b>Screenline Total</b>	<b>9310</b>	<b>9294</b>	<b>11725</b>	<b>8776</b>	<b>8499</b>	<b>11173</b>
<b>East of Trafalgar Road</b>						
Iroquois Shore Road	1162	1181	832	1025	1024	1118
QEW	7203	7187	8265	7136	6826	8513
South Service Road	181	176	1482	384	384	497
<b>Screenline Total</b>	<b>8546</b>	<b>8544</b>	<b>10579</b>	<b>8545</b>	<b>8234</b>	<b>10128</b>
<b>West of Ford Drive</b>						
QEW	6439	6415	7859	6185	5899	8396
<b>Screenline Total</b>	<b>6439</b>	<b>6415</b>	<b>7859</b>	<b>6185</b>	<b>5899</b>	<b>8396</b>
<b>West of Winston Churchill Boulevard</b>						
QEW	4755	4742	6256	5173	5161	6649
<b>Screenline Total</b>	<b>4755</b>	<b>4742</b>	<b>6256</b>	<b>5173</b>	<b>5161</b>	<b>6649</b>
<b>East of Winston Churchill Boulevard</b>						
QEW	4625	4618	5860	4983	4982	6709
<b>Screenline Total</b>	<b>4625</b>	<b>4618</b>	<b>5860</b>	<b>4983</b>	<b>4982</b>	<b>6709</b>
<b>North of Leighland Avenue</b>						
Trafalgar Road	2107	2084	2416	1317	1314	2081
<b>Screenline Total</b>	<b>2107</b>	<b>2084</b>	<b>2416</b>	<b>1317</b>	<b>1314</b>	<b>2081</b>
<b>South of Cross Avenue</b>						
Trafalgar Road	1699	1699	1788	1442	1406	1847
<b>Screenline Total</b>	<b>1699</b>	<b>1699</b>	<b>1788</b>	<b>1442</b>	<b>1406</b>	<b>1847</b>

**Table A- 5: PM Peak Hour Ramp Volume Comparison**

<b>QEW / Dorval Drive</b>	<b>Observed</b>	<b>Calibrated</b>	<b>Future</b>
QEW W - Dorval N/S	465	455	936
QEW E - Dorval N/S	1440	1436	1451
Dorval S - QEW E	870	870	981
Dorval S - QEW W	342	344	491
Dorval N - QEW E	499	500	779
Dorval N - QEW W	228	225	430
<b>Interchange Total</b>	<b>3844</b>	<b>3830</b>	<b>5068</b>
<b>QEW / Trafalgar Road</b>			
QEW W - Trafalgar N/S	1219	1216	1500
QEW E - Trafalgar N/S	1129	1034	1349
Trafalgar S - QEW E	476	453	744
Trafalgar S - QEW W	429	418	513
Trafalgar N - QEW E	429	449	401
Trafalgar N - QEW W	1012	991	1133
<b>Interchange Total</b>	<b>4694</b>	<b>4561</b>	<b>5640</b>
<b>QEW / Royal Windsor Drive</b>			
QEW W - Royal Windsor	764	759	951
Royal Windsor - QEW W	951	956	1003
QEW E - Royal Windsor			896
Royal Windsor - QEW E			915
QEW W - Cross Ave			338
<b>Interchange Total</b>	<b>1715</b>	<b>1715</b>	<b>4103</b>
<b>QEW / Ford Drive / Highway 403</b>			
QEW W - Ford N/S	212	203	1429
QEW W - Hwy 403 N	2302	2302	3087
QEW E - Ford N/S	1569	1557	1597
Hwy 403 N - QEW W	2400	2390	3880
Ford N/S - QEW E	830	830	518
Ford S - QEW E			305
Ford S - QEW W	52	52	76
Ford N - QEW W	129	130	229
QEW E - Hwy 403 N			736
Hwy 403 N - QEW E			1040
Ford Drive N - Hwy 403 N			517
<b>Interchange Total</b>	<b>7494</b>	<b>7464</b>	<b>13414</b>
<b>QEW / Winston Churchill Blvd</b>			
QEW W - Winston Churchill N/S	1100	1058	1136
QEW E - Winston Churchill N/S	300	306	711
Winston Churchill S - QEW E	320	319	355
Winston Churchill S - QEW W	150	141	158
Winston Churchill N - QEW E	650	649	673
Winston Churchill N - QEW W	340	341	492
<b>Interchange Total</b>	<b>2860</b>	<b>2814</b>	<b>3525</b>



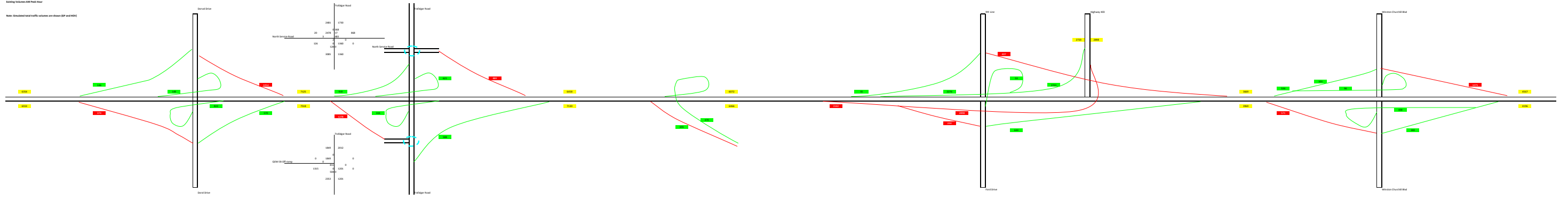
**Table A- 6: PM Peak Hour Turning Intersection Movement Comparison**

Intersection	TM	Observed	Calibrated	Future
Trafalgar Rd / Leighland Ave-Iroquois Shore Blvd	EBL	127	127	144
	EBT	101	102	276
	EBR	312	289	225
	WBL	721	717	367
	WBT	137	141	379
	WBR	167	166	370
	NBL	270	263	274
	NBT	1813	1790	1902
	NBR	927	946	270
	SBL	134	137	287
	SBT	1049	1042	1654
Trafalgar Rd / North Service Rd N	EBL	20	19	37
	EBR	245	245	268
	WBL	463	434	828
	WBT	151	147	161
	WBR	515	484	340
	NBT	2475	2495	2079
	SBT	2045	2044	2226
Trafalgar Rd / QEW EB Off-ramp	SBR	7	8	15
	EBL	849	858	824
	EBT	n/a	n/a	333
	EBR	370	367	349
	NBT	2027	2065	1740
Trafalgar Rd / Argus Rd	SBT	1312	1271	1823
	EBR	33	33	57
	SBR	182	181	250
Trafalgar Rd / Cross Ave-South Service Rd	EBL	792	802	1099
	EBT	60	60	913
	EBR	103	96	89
	WBL	124	127	438
	WBT	92	92	483
	WBR	168	163	250
	NBL	127	121	260
	NBT	1541	1546	1142
	NBR	31	29	379
	SBL	90	86	187
	SBT	1215	1179	1323
Royal Windsor Dr / The Canadian Rd-South Service Rd E	SBR	228	226	467
	EBL	340	339	47
	EBT	417	422	508
	EBR	7	8	n/a
	WBL	176	173	n/a
	WBT	518	523	1333
	WBR	30	30	37
	NBL	4	6	93
	NBT	51	51	258
	NBR	89	87	631
	SBL	13	12	20
	SBT	80	80	n/a
	New WB Off Ramp/Iroquois Shore Extension	SBR	429	431
SBL		n/a	n/a	357
EBL		n/a	n/a	481
EBT		n/a	n/a	78
WBT		n/a	n/a	307
New EB On Ramp/Iroquois Shore Extension	WBT	n/a	n/a	462
	EBL	n/a	n/a	143
	EBT	n/a	n/a	126
	EBR	n/a	n/a	519
	WBL	n/a	n/a	371
	WBT	n/a	n/a	1278
	WBR	n/a	n/a	157
	NBL	n/a	n/a	112
	NBT	n/a	n/a	590
NBR	n/a	n/a	431	

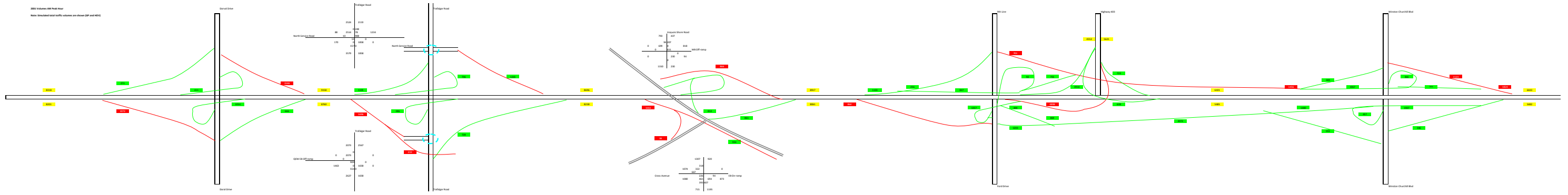
## **Appendix B – Existing and 2031 Mainline Volumes**

Existing Williams Hill Road

Note: Shaded red traffic volumes are shown (SP and 100%)

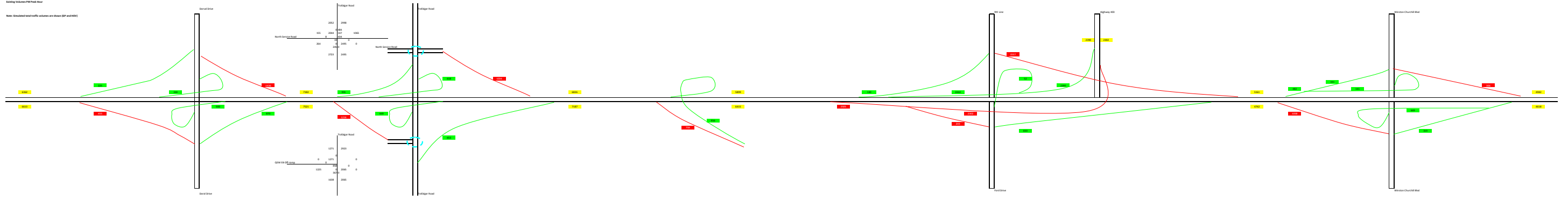


2020 Volume and Peak Hour  
Note: Shaded Red (VPI) indicates an above 80% and 90%

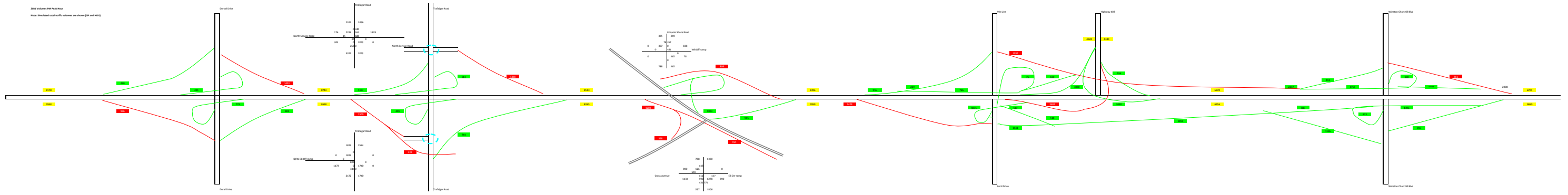


Existing Volume PM Peak Hour

Note: Shaded red traffic volumes are shown (PM and AM)



























2025 Volume Peak Hour  
Note: Shaded Red (SP) indicates an above SP and 90%



## **Appendix C – Synchro 7 Analysis Reports**

HCM Signalized Intersection Capacity Analysis  
101: Cross Ave & Trafalgar Rd

2031 Future Total  
AM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (vph)	568	399	150	355	949	517	151	1296	411	204	1301	912	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	3.0	3.0	5.0	5.0	3.0	5.0	5.0	
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.91	1.00	1.00	0.91	1.00	
Frbp, ped/bikes	1.00	1.00	0.94	1.00	1.00	0.99	1.00	1.00	0.98	1.00	1.00	0.96	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	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)	3437	3650	1444	3471	3614	1599	1721	5193	1395	1772	5193	1391	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.16	1.00	1.00	0.09	1.00	1.00	
Satd. Flow (perm)	3437	3650	1444	3471	3614	1599	296	5193	1395	167	5193	1391	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	568	399	150	355	949	517	151	1296	411	204	1301	912	
RTOR Reduction (vph)	0	0	77	0	0	2	0	0	88	0	0	202	
Lane Group Flow (vph)	568	399	73	355	949	515	151	1296	323	204	1301	710	
Confl. Peds. (#/hr)	8		36	36		8	18		8	8		18	
Heavy Vehicles (%)	3%	0%	6%	2%	1%	1%	6%	1%	15%	3%	1%	13%	
Turn Type	Prot		Perm	Prot		pm+ov	pm+pt		pm+ov	pm+pt		Perm	
Protected Phases	7	4		3	8	1	5	2	3	1	6		
Permitted Phases			4			8	2		2	6		6	
Actuated Green, G (s)	15.0	26.0	26.0	14.0	25.0	40.9	47.1	42.1	56.1	62.0	53.0	53.0	
Effective Green, g (s)	16.0	27.0	27.0	15.0	26.0	42.9	49.1	43.1	58.1	63.0	54.0	54.0	
Actuated g/C Ratio	0.13	0.22	0.22	0.12	0.22	0.36	0.41	0.36	0.48	0.52	0.45	0.45	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	4.0	4.0	6.0	6.0	4.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.5	3.5	3.0	3.0	5.0	3.5	3.0	5.0	5.0	
Lane Grp Cap (vph)	458	821	325	434	783	572	192	1865	734	314	2337	626	
v/s Ratio Prot	c0.17	0.11		0.10	c0.26	c0.13	0.04	0.25	0.06	0.09	0.25		
v/s Ratio Perm			0.05			0.20	0.28		0.18	0.25		c0.51	
v/c Ratio	1.24	0.49	0.23	0.82	1.21	0.90	0.79	0.69	0.44	0.65	0.56	1.13	
Uniform Delay, d1	52.0	40.5	38.0	51.2	47.0	36.5	24.5	32.8	20.3	25.4	24.2	33.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.69	0.86	0.86	
Incremental Delay, d2	451.7	0.5	0.4	12.8	394.3	21.4	21.3	2.2	0.5	2.8	0.6	254.1	
Delay (s)	503.7	40.9	38.3	64.0	441.3	57.9	45.9	35.0	20.8	45.8	21.4	282.5	
Level of Service	F	D	D	E	F	E	D	D	C	D	C	F	
Approach Delay (s)		275.9			258.9			32.8			122.0		
Approach LOS		F			F			C			F		
<b>Intersection Summary</b>													
HCM Average Control Delay			157.4									HCM Level of Service	F
HCM Volume to Capacity ratio			1.16										
Actuated Cycle Length (s)			120.0									Sum of lost time (s)	18.0
Intersection Capacity Utilization			104.5%									ICU Level of Service	G
Analysis Period (min)			60										
c Critical Lane Group													



HCM Signalized Intersection Capacity Analysis  
102: QEW EB Offramp & Trafalgar Rd

2031 Future Total  
AM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖↗	↗		↑↑↑	↑↑↑	
Volume (vph)	909	554	0	1658	2073	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	
Lane Util. Factor	0.97	1.00		0.91	0.91	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	3506	1617		5142	5142	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	3506	1617		5142	5142	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	909	554	0	1658	2073	0
RTOR Reduction (vph)	0	2	0	0	0	0
Lane Group Flow (vph)	909	552	0	1658	2073	0
Confl. Peds. (#/hr)	1					
Heavy Vehicles (%)	1%	1%	0%	2%	2%	3%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	47.0	47.0		61.0	61.0	
Effective Green, g (s)	48.0	48.0		62.0	62.0	
Actuated g/C Ratio	0.40	0.40		0.52	0.52	
Clearance Time (s)	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.5	3.5		4.5	4.5	
Lane Grp Cap (vph)	1402	647		2657	2657	
v/s Ratio Prot	0.26			0.32	c0.40	
v/s Ratio Perm		c0.34				
v/c Ratio	0.65	0.85		0.62	0.78	
Uniform Delay, d1	29.2	32.8		20.7	23.5	
Progression Factor	1.00	1.00		0.90	0.90	
Incremental Delay, d2	1.1	12.1		0.6	2.2	
Delay (s)	30.3	44.9		19.1	23.4	
Level of Service	C	D		B	C	
Approach Delay (s)	35.8			19.1	23.4	
Approach LOS	D			B	C	

Intersection Summary

HCM Average Control Delay	25.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	82.7%	ICU Level of Service	E
Analysis Period (min)	60		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis  
103: North Service Rd & Trafalgar Rd

2031 Future Total  
AM Peak Hour

































Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖		↗	↖	↖	↗		↑↑↑			↑↑↑	↗
Volume (vph)	13	0	157	908	78	248	0	1858	0	0	2514	10
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	4.0	5.0	3.0		5.0			5.0	5.0
Lane Util. Factor	1.00		1.00	0.95	0.95	1.00		0.91			0.91	1.00
Frbp, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	1.00
Frt	1.00		0.85	1.00	1.00	0.85		1.00			1.00	0.85
Flt Protected	0.95		1.00	0.95	0.96	1.00		1.00			1.00	1.00
Satd. Flow (prot)	1825		1617	1734	1735	1541		5142			5092	1633
Flt Permitted	0.47		1.00	0.95	0.96	1.00		1.00			1.00	1.00
Satd. Flow (perm)	904		1617	1734	1735	1541		5142			5092	1633
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	13	0	157	908	78	248	0	1858	0	0	2514	10
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	4
Lane Group Flow (vph)	13	0	157	490	496	248	0	1858	0	0	2514	6
Confl. Peds. (#/hr)							31					
Heavy Vehicles (%)	0%	0%	1%	0%	6%	6%	0%	2%	5%	0%	3%	0%
Turn Type	custom		custom	pm+pt		Free						Perm
Protected Phases				3	8			2			6	
Permitted Phases	4		4	8		Free						6
Actuated Green, G (s)	15.0		15.0	42.0	42.0	120.0		66.0			66.0	66.0
Effective Green, g (s)	16.0		16.0	43.0	43.0	120.0		67.0			67.0	67.0
Actuated g/C Ratio	0.13		0.13	0.36	0.36	1.00		0.56			0.56	0.56
Clearance Time (s)	6.0		6.0	5.0	6.0			6.0			6.0	6.0
Vehicle Extension (s)	3.5		3.5	3.0	3.5			4.5			4.5	4.5
Lane Grp Cap (vph)	121		216	621	622	1541		2871			2843	912
v/s Ratio Prot				0.15	c0.15			0.36			c0.49	
v/s Ratio Perm	0.01		0.10	0.13	0.13	0.16						0.00
v/c Ratio	0.11		0.73	0.79	0.80	0.16		0.65			0.88	0.01
Uniform Delay, d1	45.7		49.9	34.4	34.6	0.0		18.3			23.1	11.8
Progression Factor	1.00		1.00	1.00	1.00	1.00		0.88			0.67	0.70
Incremental Delay, d2	0.5		12.7	6.9	7.7	0.2		1.0			2.9	0.0
Delay (s)	46.2		62.6	41.4	42.2	0.2		17.2			18.4	8.3
Level of Service	D		E	D	D	A		B			B	A
Approach Delay (s)		61.4			33.5			17.2			18.4	
Approach LOS		E			C			B			B	

Intersection Summary		
HCM Average Control Delay	22.5	HCM Level of Service C
HCM Volume to Capacity ratio	0.85	
Actuated Cycle Length (s)	120.0	Sum of lost time (s) 10.0
Intersection Capacity Utilization	98.3%	ICU Level of Service F
Analysis Period (min)	60	
c Critical Lane Group		














HCM Signalized Intersection Capacity Analysis  
104: Leighland Ave & Trafalgar Rd

2031 Future Total  
AM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 		 				  			  		
Volume (vph)	66	348	338	471	267	271	217	1545	360	318	1747	129	
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	5.0	3.0	3.0	6.0	3.0	3.0	6.0	6.0	
Lane Util. Factor	1.00	0.95	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00	
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.96	
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	
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)	1774	3650	1596	3471	1902	1560	1807	5142	1601	1825	5142	1531	
Flt Permitted	0.43	1.00	1.00	0.95	1.00	1.00	0.09	1.00	1.00	0.08	1.00	1.00	
Satd. Flow (perm)	805	3650	1596	3471	1902	1560	170	5142	1601	161	5142	1531	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	66	348	338	471	267	271	217	1545	360	318	1747	129	
RTOR Reduction (vph)	0	0	0	0	0	104	0	0	0	0	0	66	
Lane Group Flow (vph)	66	348	338	471	267	167	217	1545	360	318	1747	63	
Confl. Peds. (#/hr)	28		3	3		28	10					10	
Heavy Vehicles (%)	2%	0%	1%	2%	1%	2%	1%	2%	2%	0%	2%	2%	
Turn Type	pm+pt		Free	Prot		pm+ov	pm+pt		Free	pm+pt		Perm	
Protected Phases	7	4		3	8	1	5	2		1	6		
Permitted Phases	4		Free			8	2		Free	6		6	
Actuated Green, G (s)	29.9	20.3	120.0	13.0	25.7	45.6	57.2	43.8	120.0	67.7	50.3	50.3	
Effective Green, g (s)	31.9	21.3	120.0	14.0	26.7	47.6	59.2	44.8	120.0	68.7	51.3	51.3	
Actuated g/C Ratio	0.27	0.18	1.00	0.12	0.22	0.40	0.49	0.37	1.00	0.57	0.43	0.43	
Clearance Time (s)	4.0	6.0		6.0	6.0	4.0	4.0	7.0		4.0	7.0	7.0	
Vehicle Extension (s)	3.0	3.5		3.5	3.5	3.5	3.5	5.0		3.5	5.0	5.0	
Lane Grp Cap (vph)	300	648	1596	405	423	619	280	1920	1601	382	2198	655	
v/s Ratio Prot	0.02	0.10		c0.14	c0.14	0.05	0.09	0.30		c0.14	0.34		
v/s Ratio Perm	0.04		0.21			0.06	0.29		0.22	c0.33		0.04	
v/c Ratio	0.22	0.54	0.21	1.16	0.63	0.27	0.78	0.80	0.22	0.83	0.79	0.10	
Uniform Delay, d1	33.7	44.9	0.0	53.0	42.2	24.5	28.7	33.7	0.0	33.9	29.8	20.5	
Progression Factor	1.00	1.00	1.00	1.01	0.94	0.68	1.57	0.79	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.4	1.0	0.3	322.2	3.2	0.3	11.5	3.1	0.3	16.6	3.1	0.3	
Delay (s)	34.1	45.8	0.3	376.0	42.8	16.9	56.6	29.7	0.3	50.5	32.9	20.8	
Level of Service	C	D	A	F	D	B	E	C	A	D	C	C	
Approach Delay (s)		24.3			191.4			27.5			34.8		
Approach LOS		C			F			C			C		
<b>Intersection Summary</b>													
HCM Average Control Delay			56.9									HCM Level of Service	E
HCM Volume to Capacity ratio			0.79										
Actuated Cycle Length (s)			120.0									Sum of lost time (s)	8.0
Intersection Capacity Utilization			93.5%									ICU Level of Service	F
Analysis Period (min)			60										
c	Critical Lane Group												





















HCM Signalized Intersection Capacity Analysis  
 105: QEW WB Offramp & Royal Windsor Dr

2031 Future Total  
 AM Peak Hour

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			 			 
Volume (vph)	611	207	230	0	94	699
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	1.00		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	1601	3579		1789	3579
Flt Permitted	0.95	1.00	1.00		0.61	1.00
Satd. Flow (perm)	1789	1601	3579		1146	3579
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	611	207	230	0	94	699
RTOR Reduction (vph)	0	64	0	0	0	0
Lane Group Flow (vph)	611	143	230	0	94	699
Turn Type		Perm			Perm	
Protected Phases	8		2			6
Permitted Phases		8			6	
Actuated Green, G (s)	50.7	50.7	57.3		57.3	57.3
Effective Green, g (s)	51.7	51.7	58.3		58.3	58.3
Actuated g/C Ratio	0.43	0.43	0.49		0.49	0.49
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	771	690	1739		557	1739
v/s Ratio Prot	c0.34		0.06			c0.20
v/s Ratio Perm		0.09			0.08	
v/c Ratio	0.79	0.21	0.13		0.17	0.40
Uniform Delay, d1	29.5	21.3	17.0		17.3	19.7
Progression Factor	1.00	1.00	0.85		1.28	1.31
Incremental Delay, d2	5.8	0.2	0.1		0.6	0.6
Delay (s)	35.4	21.5	14.6		22.7	26.4
Level of Service	D	C	B		C	C
Approach Delay (s)	31.9		14.6			25.9
Approach LOS	C		B			C
<b>Intersection Summary</b>						
HCM Average Control Delay			27.2		HCM Level of Service	C
HCM Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	10.0
Intersection Capacity Utilization			79.7%		ICU Level of Service	D
Analysis Period (min)			60			
c	Critical Lane Group					
























HCM Signalized Intersection Capacity Analysis  
 106: Royal Windsor Dr & QEW EB Onramp

2031 Future Total  
 AM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	318	322	667	407	694	94	226	461	393	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0		5.0	5.0	5.0			
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00			
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85			
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00			
Satd. Flow (prot)	1789	3579	1601	3471	3515		1789	1883	1601			
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00			
Satd. Flow (perm)	1789	3579	1601	3471	3515		1789	1883	1601			
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	318	322	667	407	694	94	226	461	393	0	0	0
RTOR Reduction (vph)	0	0	370	0	8	0	0	0	284	0	0	0
Lane Group Flow (vph)	318	322	297	407	780	0	226	461	109	0	0	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	5	2		1	6			4				
Permitted Phases			2				4		4			
Actuated Green, G (s)	25.5	52.5	52.5	18.2	45.2		32.3	32.3	32.3			
Effective Green, g (s)	26.5	53.5	53.5	19.2	46.2		33.3	33.3	33.3			
Actuated g/C Ratio	0.22	0.45	0.45	0.16	0.39		0.28	0.28	0.28			
Clearance Time (s)	5.0	6.0	6.0	5.0	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)	395	1596	714	555	1353		496	523	444			
v/s Ratio Prot	c0.18	0.09		0.12	c0.22			c0.24				
v/s Ratio Perm			0.19				0.13		0.07			
v/c Ratio	0.81	0.20	0.42	0.73	0.58		0.46	0.88	0.25			
Uniform Delay, d1	44.3	20.2	22.6	48.0	29.2		35.9	41.5	33.6			
Progression Factor	1.05	0.81	0.99	1.00	1.00		1.00	1.00	1.00			
Incremental Delay, d2	11.9	0.3	1.7	5.1	1.8		0.7	19.0	0.3			
Delay (s)	58.2	16.7	24.1	53.1	31.0		36.5	60.4	33.9			
Level of Service	E	B	C	D	C		D	E	C			
Approach Delay (s)		30.6			38.5			45.8			0.0	
Approach LOS		C			D			D			A	
<b>Intersection Summary</b>												
HCM Average Control Delay			37.8			HCM Level of Service			D			
HCM Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			14.0			
Intersection Capacity Utilization			75.7%			ICU Level of Service			D			
Analysis Period (min)			60									
c	Critical Lane Group											

































HCM Signalized Intersection Capacity Analysis  
107: Royal Windsor Dr & The Canadian Rd

2031 Future Total  
AM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		 			 								
Volume (vph)	153	564	0	0	861	21	73	177	738	18	0	258	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	3.0	7.4			7.4	7.4	6.8	6.8	3.0	6.8		6.8	
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00	1.00	1.00	1.00		1.00	
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85	
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00	1.00	0.95		1.00	
Satd. Flow (prot)	1789	3579			3579	1601	1789	1883	1601	1789		1601	
Flt Permitted	0.22	1.00			1.00	1.00	0.95	1.00	1.00	0.65		1.00	
Satd. Flow (perm)	417	3579			3579	1601	1789	1883	1601	1216		1601	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	153	564	0	0	861	21	73	177	738	18	0	258	
RTOR Reduction (vph)	0	0	0	0	0	13	0	0	0	0	0	209	
Lane Group Flow (vph)	153	564	0	0	861	8	73	177	738	18	0	49	
Turn Type	pm+pt					Perm	Perm		Free	custom		custom	
Protected Phases	5	2			6			4					
Permitted Phases	2					6	4		Free	7		7	
Actuated Green, G (s)	41.6	41.6			26.5	26.5	12.4	12.4	70.2	12.4		12.4	
Effective Green, g (s)	42.6	42.6			27.5	27.5	13.4	13.4	70.2	13.4		13.4	
Actuated g/C Ratio	0.61	0.61			0.39	0.39	0.19	0.19	1.00	0.19		0.19	
Clearance Time (s)	4.0	8.4			8.4	8.4	7.8	7.8		7.8		7.8	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0		3.0	
Lane Grp Cap (vph)	490	2172			1402	627	341	359	1601	232		306	
v/s Ratio Prot	0.05	0.16			c0.24			0.09					
v/s Ratio Perm	0.14					0.01	0.04		c0.46	0.01		0.03	
v/c Ratio	0.31	0.26			0.61	0.01	0.21	0.49	0.46	0.08		0.16	
Uniform Delay, d1	6.9	6.4			17.1	13.1	24.0	25.4	0.0	23.3		23.7	
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.4	0.1			0.8	0.0	0.3	1.1	1.0	0.1		0.2	
Delay (s)	7.2	6.5			17.9	13.1	24.3	26.4	1.0	23.5		24.0	
Level of Service	A	A			B	B	C	C	A	C		C	
Approach Delay (s)		6.7			17.8			7.2			23.9		
Approach LOS		A			B			A			C		
<b>Intersection Summary</b>													
HCM Average Control Delay			12.0									HCM Level of Service	B
HCM Volume to Capacity ratio			0.53										
Actuated Cycle Length (s)			70.2									Sum of lost time (s)	7.4
Intersection Capacity Utilization			65.6%									ICU Level of Service	C
Analysis Period (min)			60										
c	Critical Lane Group												

HCM Signalized Intersection Capacity Analysis  
101: Cross Ave & Trafalgar Rd

2031 Future Total  
PM Peak Hour

													
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations	 	 		 	 			  			  		
Volume (vph)	1099	913	89	438	483	250	260	1142	379	187	1323	467	
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	4.0	5.0	5.0	3.0	5.0	3.0	3.0	5.0	5.0	3.0	5.0	5.0	
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.91	1.00	1.00	0.91	1.00	
Frbp, ped/bikes	1.00	1.00	0.94	1.00	1.00	0.99	1.00	1.00	0.98	1.00	1.00	0.96	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	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)	3437	3650	1444	3471	3614	1596	1722	5193	1387	1772	5193	1391	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.11	1.00	1.00	0.12	1.00	1.00	
Satd. Flow (perm)	3437	3650	1444	3471	3614	1596	206	5193	1387	219	5193	1391	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	1099	913	89	438	483	250	260	1142	379	187	1323	467	
RTOR Reduction (vph)	0	0	60	0	0	5	0	0	245	0	0	317	
Lane Group Flow (vph)	1099	913	29	438	483	245	260	1142	134	187	1323	150	
Confl. Peds. (#/hr)	8		36	36		8	18		8	8		18	
Heavy Vehicles (%)	3%	0%	6%	2%	1%	1%	6%	1%	15%	3%	1%	13%	
Turn Type	Prot		Perm	Prot		pm+ov	pm+pt		Perm	pm+pt		Perm	
Protected Phases	7	4		3	8	1	5	2			1	6	
Permitted Phases			4			8	2		2	6		6	
Actuated Green, G (s)	38.0	38.1	38.1	16.9	16.0	26.8	46.2	34.2	34.2	43.8	33.0	33.0	
Effective Green, g (s)	39.0	39.1	39.1	17.9	17.0	28.8	48.2	35.2	35.2	45.8	34.0	34.0	
Actuated g/C Ratio	0.32	0.33	0.33	0.15	0.14	0.24	0.40	0.29	0.29	0.38	0.28	0.28	
Clearance Time (s)	5.0	6.0	6.0	4.0	6.0	4.0	4.0	6.0	6.0	4.0	6.0	6.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.5	3.5	3.0	3.0	5.0	5.0	3.0	5.0	5.0	
Lane Grp Cap (vph)	1117	1189	471	518	512	383	247	1523	407	236	1471	394	
v/s Ratio Prot	c0.32	0.25		0.13	c0.13	0.06	c0.11	0.22		0.08	0.25		
v/s Ratio Perm			0.02			0.09	c0.31		0.10	0.22		0.11	
v/c Ratio	0.98	0.77	0.06	0.85	0.94	0.64	1.05	0.75	0.33	0.79	0.90	0.38	
Uniform Delay, d1	40.2	36.4	27.8	49.7	51.0	40.9	33.5	38.4	33.2	28.1	41.4	34.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.49	0.74	0.51	
Incremental Delay, d2	40.0	3.1	0.1	13.8	38.8	3.5	174.1	3.5	2.2	15.1	8.5	2.3	
Delay (s)	80.2	39.5	27.9	63.5	89.9	44.5	207.5	41.9	35.4	57.0	39.0	19.8	
Level of Service	F	D	C	E	F	D	F	D	D	E	D	B	
Approach Delay (s)		60.3			70.3			64.7			36.2		
Approach LOS		E			E			E			D		
<b>Intersection Summary</b>													
HCM Average Control Delay			56.3									HCM Level of Service	E
HCM Volume to Capacity ratio			1.00										
Actuated Cycle Length (s)			120.0									Sum of lost time (s)	15.0
Intersection Capacity Utilization			99.7%									ICU Level of Service	F
Analysis Period (min)			60										
c Critical Lane Group													

HCM Signalized Intersection Capacity Analysis  
 102: QEW EB Offramp & Trafalgar Rd

2031 Future Total  
 PM Peak Hour



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↖↗	↗		↑↑↑	↑↑↑	
Volume (vph)	824	349	0	1740	1823	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0	
Lane Util. Factor	0.97	1.00		0.91	0.91	
Frbp, ped/bikes	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	
Frt	1.00	0.85		1.00	1.00	
Flt Protected	0.95	1.00		1.00	1.00	
Satd. Flow (prot)	3506	1617		5142	5142	
Flt Permitted	0.95	1.00		1.00	1.00	
Satd. Flow (perm)	3506	1617		5142	5142	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	824	349	0	1740	1823	0
RTOR Reduction (vph)	0	7	0	0	0	0
Lane Group Flow (vph)	824	342	0	1740	1823	0
Confl. Peds. (#/hr)	1					
Heavy Vehicles (%)	1%	1%	0%	2%	2%	3%
Turn Type		Perm				
Protected Phases	4			2	6	
Permitted Phases		4				
Actuated Green, G (s)	37.4	37.4		70.6	70.6	
Effective Green, g (s)	38.4	38.4		71.6	71.6	
Actuated g/C Ratio	0.32	0.32		0.60	0.60	
Clearance Time (s)	6.0	6.0		6.0	6.0	
Vehicle Extension (s)	3.5	3.5		4.5	4.5	
Lane Grp Cap (vph)	1122	517		3068	3068	
v/s Ratio Prot	c0.24			0.34	c0.35	
v/s Ratio Perm		0.21				
v/c Ratio	0.73	0.66		0.57	0.59	
Uniform Delay, d1	36.3	35.2		14.8	15.1	
Progression Factor	1.00	1.00		1.09	1.00	
Incremental Delay, d2	2.7	3.4		0.4	0.9	
Delay (s)	38.9	38.6		16.4	16.0	
Level of Service	D	D		B	B	
Approach Delay (s)	38.8			16.4	16.0	
Approach LOS	D			B	B	

Intersection Summary			
HCM Average Control Delay	21.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	10.0
Intersection Capacity Utilization	67.1%	ICU Level of Service	C
Analysis Period (min)	60		
c Critical Lane Group			



HCM Signalized Intersection Capacity Analysis  
103: North Service Rd & Trafalgar Rd

2031 Future Total  
PM Peak Hour

































Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖		↗	↖	↖	↗		↑↑↑			↑↑↑	↗
Volume (vph)	37	0	268	828	161	340	0	2079	0	0	2226	15
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0		5.0	4.0	5.0	3.0		5.0			5.0	5.0
Lane Util. Factor	1.00		1.00	0.95	0.95	1.00		0.91			0.91	1.00
Frbp, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	1.00
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00		1.00			1.00	1.00
Frt	1.00		0.85	1.00	1.00	0.85		1.00			1.00	0.85
Flt Protected	0.95		1.00	0.95	0.97	1.00		1.00			1.00	1.00
Satd. Flow (prot)	1825		1617	1734	1732	1541		5142			5092	1633
Flt Permitted	0.46		1.00	0.95	0.97	1.00		1.00			1.00	1.00
Satd. Flow (perm)	883		1617	1734	1732	1541		5142			5092	1633
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	37	0	268	828	161	340	0	2079	0	0	2226	15
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	37	0	268	489	500	340	0	2079	0	0	2226	15
Confl. Peds. (#/hr)							31					
Heavy Vehicles (%)	0%	0%	1%	0%	6%	6%	0%	2%	5%	0%	3%	0%
Turn Type	custom		custom	pm+pt		Free						Perm
Protected Phases				3	8			2			6	
Permitted Phases	4		4	8		Free						6
Actuated Green, G (s)	23.7		23.7	47.7	47.7	120.0		60.3			60.3	60.3
Effective Green, g (s)	24.7		24.7	48.7	48.7	120.0		61.3			61.3	61.3
Actuated g/C Ratio	0.21		0.21	0.41	0.41	1.00		0.51			0.51	0.51
Clearance Time (s)	6.0		6.0	5.0	6.0			6.0			6.0	6.0
Vehicle Extension (s)	3.5		3.5	3.0	3.5			4.5			4.5	4.5
Lane Grp Cap (vph)	182		333	704	703	1541		2627			2601	834
v/s Ratio Prot				0.12	c0.12			0.40			c0.44	
v/s Ratio Perm	0.04		c0.17	0.17	0.17	0.22						0.01
v/c Ratio	0.20		0.80	0.69	0.71	0.22		0.79			0.86	0.02
Uniform Delay, d1	39.5		45.4	29.5	29.8	0.0		24.1			25.5	14.5
Progression Factor	1.00		1.00	1.00	1.00	1.00		1.00			0.51	0.75
Incremental Delay, d2	0.7		15.0	3.0	3.6	0.3		2.6			2.9	0.0
Delay (s)	40.2		60.3	32.5	33.4	0.3		26.7			16.0	10.9
Level of Service	D		E	C	C	A		C			B	B
Approach Delay (s)		57.9			24.6			26.7			16.0	
Approach LOS		E			C			C			B	

Intersection Summary		
HCM Average Control Delay	23.8	HCM Level of Service C
HCM Volume to Capacity ratio	0.83	
Actuated Cycle Length (s)	120.0	Sum of lost time (s) 15.0
Intersection Capacity Utilization	99.3%	ICU Level of Service F
Analysis Period (min)	60	
c Critical Lane Group		

HCM Signalized Intersection Capacity Analysis  
104: Leighland Ave & Trafalgar Rd














2031 Future Total  
PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		 		 				  			  	
Volume (vph)	144	276	225	367	379	370	274	1902	270	287	1654	139
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	5.0	3.0	5.0	5.0	3.0	3.0	6.0	3.0	3.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	0.97	1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frbp, ped/bikes	1.00	1.00	0.99	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	0.96
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
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)	1770	3650	1596	3471	1902	1555	1807	5142	1601	1825	5142	1531
Flt Permitted	0.54	1.00	1.00	0.95	1.00	1.00	0.08	1.00	1.00	0.08	1.00	1.00
Satd. Flow (perm)	1000	3650	1596	3471	1902	1555	152	5142	1601	152	5142	1531
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	144	276	225	367	379	370	274	1902	270	287	1654	139
RTOR Reduction (vph)	0	0	0	0	0	14	0	0	0	0	0	77
Lane Group Flow (vph)	144	276	225	367	379	356	274	1902	270	287	1654	62
Confl. Peds. (#/hr)	28		3	3		28	10					10
Heavy Vehicles (%)	2%	0%	1%	2%	1%	2%	1%	2%	2%	0%	2%	2%
Turn Type	pm+pt		Free	Prot		pm+ov	pm+pt		Free	pm+pt		Perm
Protected Phases	7	4		3	8	1	5	2		1	6	
Permitted Phases	4		Free			8	2		Free	6		6
Actuated Green, G (s)	17.2	15.2	120.0	16.8	27.0	43.1	64.5	48.9	120.0	65.5	49.4	49.4
Effective Green, g (s)	18.2	16.2	120.0	17.8	28.0	45.1	66.5	49.9	120.0	67.5	50.4	50.4
Actuated g/C Ratio	0.15	0.13	1.00	0.15	0.23	0.38	0.55	0.42	1.00	0.56	0.42	0.42
Clearance Time (s)	4.0	6.0		6.0	6.0	4.0	4.0	7.0		4.0	7.0	7.0
Vehicle Extension (s)	3.0	3.5		3.5	3.5	3.5	3.5	5.0		3.5	5.0	5.0
Lane Grp Cap (vph)	203	493	1596	515	444	584	313	2138	1601	324	2160	643
v/s Ratio Prot	c0.05	0.08		0.11	c0.20	0.09	0.12	0.37		c0.13	0.32	
v/s Ratio Perm	0.06		0.14			0.14	0.36		c0.17	c0.37		0.04
v/c Ratio	0.71	0.56	0.14	0.71	0.85	0.61	0.88	0.89	0.17	0.89	0.77	0.10
Uniform Delay, d1	48.2	48.6	0.0	48.7	44.0	30.3	34.0	32.5	0.0	35.6	29.8	21.0
Progression Factor	1.00	1.00	1.00	0.93	0.97	0.95	1.64	0.65	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.4	1.5	0.2	4.9	17.1	2.0	20.9	4.6	0.2	31.0	2.7	0.3
Delay (s)	59.6	50.1	0.2	50.4	59.6	30.9	76.8	25.8	0.2	66.6	32.5	21.3
Level of Service	E	D	A	D	E	C	E	C	A	E	C	C
Approach Delay (s)		34.8			47.0			28.7			36.4	
Approach LOS		C			D			C			D	

Intersection Summary		
HCM Average Control Delay	35.1	HCM Level of Service D
HCM Volume to Capacity ratio	0.81	
Actuated Cycle Length (s)	120.0	Sum of lost time (s) 8.0
Intersection Capacity Utilization	99.0%	ICU Level of Service F
Analysis Period (min)	60	
c Critical Lane Group		





















HCM Signalized Intersection Capacity Analysis  
105: QEW WB Offramp & Royal Windsor Dr

2031 Future Total  
PM Peak Hour

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations			 			 
Volume (vph)	481	357	462	0	78	307
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	0.95		1.00	0.95
Frt	1.00	0.85	1.00		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1789	1601	3579		1789	3579
Flt Permitted	0.95	1.00	1.00		0.46	1.00
Satd. Flow (perm)	1789	1601	3579		872	3579
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	481	357	462	0	78	307
RTOR Reduction (vph)	0	125	0	0	0	0
Lane Group Flow (vph)	481	232	462	0	78	307
Turn Type		Perm			Perm	
Protected Phases	8		2			6
Permitted Phases		8			6	
Actuated Green, G (s)	41.8	41.8	66.2		66.2	66.2
Effective Green, g (s)	42.8	42.8	67.2		67.2	67.2
Actuated g/C Ratio	0.36	0.36	0.56		0.56	0.56
Clearance Time (s)	6.0	6.0	6.0		6.0	6.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	638	571	2004		488	2004
v/s Ratio Prot	c0.27		c0.13			0.09
v/s Ratio Perm		0.15			0.09	
v/c Ratio	0.75	0.41	0.23		0.16	0.15
Uniform Delay, d1	34.0	29.0	13.3		12.8	12.7
Progression Factor	1.00	1.00	1.00		1.03	1.00
Incremental Delay, d2	5.2	0.5	0.3		0.6	0.1
Delay (s)	39.2	29.5	13.6		13.7	12.9
Level of Service	D	C	B		B	B
Approach Delay (s)	35.1		13.6			13.0
Approach LOS	D		B			B
<b>Intersection Summary</b>						
HCM Average Control Delay			24.2		HCM Level of Service	C
HCM Volume to Capacity ratio			0.43			
Actuated Cycle Length (s)			120.0		Sum of lost time (s)	10.0
Intersection Capacity Utilization			72.5%		ICU Level of Service	C
Analysis Period (min)			60			
c	Critical Lane Group					

HCM Signalized Intersection Capacity Analysis  
 106: Royal Windsor Dr & QEW EB Onramp

2031 Future Total  
 PM Peak Hour

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	143	126	519	371	1278	157	112	590	431	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	5.0	5.0	4.0	5.0		5.0	5.0	5.0			
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00			
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85			
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00			
Satd. Flow (prot)	1789	3579	1601	3471	3520		1789	1883	1601			
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00			
Satd. Flow (perm)	1789	3579	1601	3471	3520		1789	1883	1601			
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	143	126	519	371	1278	157	112	590	431	0	0	0
RTOR Reduction (vph)	0	0	292	0	8	0	0	0	241	0	0	0
Lane Group Flow (vph)	143	126	227	371	1427	0	112	590	190	0	0	0
Turn Type	Prot		Perm	Prot			Perm		Perm			
Protected Phases	5	2		1	6			4				
Permitted Phases			2				4		4			
Actuated Green, G (s)	10.9	51.5	51.5	17.5	59.1		34.0	34.0	34.0			
Effective Green, g (s)	11.9	52.5	52.5	18.5	60.1		35.0	35.0	35.0			
Actuated g/C Ratio	0.10	0.44	0.44	0.15	0.50		0.29	0.29	0.29			
Clearance Time (s)	4.0	6.0	6.0	5.0	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)	177	1566	700	535	1763		522	549	467			
v/s Ratio Prot	c0.08	0.04		c0.11	c0.41			c0.31				
v/s Ratio Perm			0.14				0.06		0.12			
v/c Ratio	0.81	0.08	0.32	0.69	0.81		0.21	1.07	0.41			
Uniform Delay, d1	52.9	19.7	22.1	48.1	25.1		32.1	42.5	34.2			
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00			
Incremental Delay, d2	27.0	0.1	1.2	4.0	4.3		0.2	171.4	0.6			
Delay (s)	79.9	19.8	23.4	52.0	29.4		32.3	213.9	34.7			
Level of Service	E	B	C	D	C		C	F	C			
Approach Delay (s)		33.0			34.1			127.8			0.0	
Approach LOS		C			C			F			A	
<b>Intersection Summary</b>												
HCM Average Control Delay			62.3			HCM Level of Service			E			
HCM Volume to Capacity ratio			0.86									
Actuated Cycle Length (s)			120.0			Sum of lost time (s)			8.0			
Intersection Capacity Utilization			91.0%			ICU Level of Service			E			
Analysis Period (min)			60									
c	Critical Lane Group											

HCM Signalized Intersection Capacity Analysis  
107: Royal Windsor Dr & The Canadian Rd

2031 Future Total  
PM Peak Hour













Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Volume (vph)	47	508	0	0	1333	37	93	258	631	20	0	413	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost time (s)	3.0	7.4			7.4	7.4	6.8	6.8	3.0	6.8		6.8	
Lane Util. Factor	1.00	0.95			0.95	1.00	1.00	1.00	1.00	1.00		1.00	
Frt	1.00	1.00			1.00	0.85	1.00	1.00	0.85	1.00		0.85	
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00	1.00	0.95		1.00	
Satd. Flow (prot)	1789	3579			3579	1601	1789	1883	1601	1789		1601	
Flt Permitted	0.09	1.00			1.00	1.00	0.95	1.00	1.00	0.47		1.00	
Satd. Flow (perm)	172	3579			3579	1601	1789	1883	1601	886		1601	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Adj. Flow (vph)	47	508	0	0	1333	37	93	258	631	20	0	413	
RTOR Reduction (vph)	0	0	0	0	0	10	0	0	0	0	0	122	
Lane Group Flow (vph)	47	508	0	0	1333	27	93	258	631	20	0	291	
Turn Type	pm+pt					Perm	Perm		Free	custom		custom	
Protected Phases	5	2			6			4					
Permitted Phases	2					6	4		Free	7		7	
Actuated Green, G (s)	57.7	57.7			46.3	46.3	24.0	24.0	97.9	24.0		24.0	
Effective Green, g (s)	58.7	58.7			47.3	47.3	25.0	25.0	97.9	25.0		25.0	
Actuated g/C Ratio	0.60	0.60			0.48	0.48	0.26	0.26	1.00	0.26		0.26	
Clearance Time (s)	4.0	8.4			8.4	8.4	7.8	7.8		7.8		7.8	
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0		3.0	
Lane Grp Cap (vph)	242	2146			1729	774	457	481	1601	226		409	
v/s Ratio Prot	0.02	0.14			c0.37			0.14					
v/s Ratio Perm	0.10					0.02	0.05		c0.39	0.02		c0.18	
v/c Ratio	0.19	0.24			0.77	0.03	0.20	0.54	0.39	0.09		0.71	
Uniform Delay, d1	12.6	9.1			20.8	13.3	28.6	31.4	0.0	27.8		33.2	
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00		1.00	
Incremental Delay, d2	0.4	0.1			2.2	0.0	0.2	1.2	0.7	0.2		5.9	
Delay (s)	13.0	9.2			23.1	13.3	28.9	32.6	0.7	27.9		39.1	
Level of Service	B	A			C	B	C	C	A	C		D	
Approach Delay (s)		9.5			22.8			11.8			38.6		
Approach LOS		A			C			B			D		
<b>Intersection Summary</b>													
HCM Average Control Delay			19.4									HCM Level of Service	B
HCM Volume to Capacity ratio			0.70										
Actuated Cycle Length (s)			97.9									Sum of lost time (s)	14.2
Intersection Capacity Utilization			88.3%									ICU Level of Service	E
Analysis Period (min)			60										
c	Critical Lane Group												

## Queues

2031 Future Total

## 101: Cross Ave &amp; Trafalgar Rd

AM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	568	399	150	355	949	517	151	1296	411	204	1301	912
v/c Ratio	1.24	0.49	0.37	0.82	1.21	0.86	0.77	0.70	0.54	0.64	0.56	1.10
Control Delay	494.9	42.8	17.7	69.4	435.0	49.7	48.5	36.1	14.1	43.8	21.6	214.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	494.9	42.8	17.7	69.4	435.0	49.7	48.5	36.1	14.1	43.8	21.6	214.2
Queue Length 50th (m)	-85.6	43.3	9.7	42.5	-143.7	103.8	17.1	96.0	34.2	36.4	54.3	-186.2
Queue Length 95th (m)	#139.8	66.5	34.6	#77.8	#215.4	#190.0	#52.6	138.3	82.5	m48.6	m79.4	m#341.6
Internal Link Dist (m)		155.8			204.3			118.5				257.5
Turn Bay Length (m)	120.0			25.0			120.0			55.0		
Base Capacity (vph)	458	822	402	434	783	669	197	1864	763	385	2337	828
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	1.24	0.49	0.37	0.82	1.21	0.77	0.77	0.70	0.54	0.53	0.56	1.10

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues  
102: QEW EB Offramp & Trafalgar Rd

2031 Future Total  
AM Peak Hour



Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	909	554	1658	2073
v/c Ratio	0.65	0.85	0.62	0.78
Control Delay	31.3	48.0	19.8	24.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	31.3	48.0	19.8	24.3
Queue Length 50th (m)	84.1	111.4	72.4	127.7
Queue Length 95th (m)	122.1	#206.8	m100.4	m186.8
Internal Link Dist (m)	380.3		257.5	241.6
Turn Bay Length (m)	200.0			
Base Capacity (vph)	1490	689	2656	2656
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.61	0.80	0.62	0.78

Intersection Summary

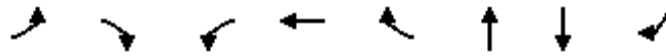
# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues  
103: North Service Rd & Trafalgar Rd

2031 Future Total  
AM Peak Hour



Lane Group	EBL	EBR	WBL	WBT	WBR	NBT	SBT	SBR
Lane Group Flow (vph)	13	157	490	496	248	1858	2514	10
v/c Ratio	0.11	0.73	0.77	0.80	0.16	0.65	0.88	0.01
Control Delay	47.5	71.7	43.4	46.2	0.2	17.5	18.9	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.5	71.7	43.4	46.2	0.2	17.5	18.9	5.2
Queue Length 50th (m)	2.7	35.6	104.8	108.1	0.0	86.4	56.2	0.2
Queue Length 95th (m)	9.7	#76.2	#187.6	#195.3	0.0	114.8m	#257.8	m0.3
Internal Link Dist (m)				208.4		30.3	245.0	
Turn Bay Length (m)	60.0		80.0					
Base Capacity (vph)	128	229	636	637	1541	2871	2843	915
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.69	0.77	0.78	0.16	0.65	0.88	0.01

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



Queues

2031 Future Total

104: Leighland Ave & Trafalgar Rd

AM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	66	348	338	471	267	271	217	1545	360	318	1747	129
v/c Ratio	0.19	0.56	0.21	1.16	0.63	0.36	0.76	0.79	0.22	0.82	0.78	0.18
Control Delay	26.7	48.5	0.3	369.2	47.6	6.8	57.8	30.0	0.3	50.3	33.1	5.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.7	48.5	0.3	369.2	47.6	6.8	57.8	30.0	0.3	50.3	33.1	5.9
Queue Length 50th (m)	10.5	39.9	0.0	-68.5	56.6	10.2	42.1	60.7	0.0	52.7	134.2	1.8
Queue Length 95th (m)	21.0	58.1	0.0	#119.2	91.6	32.4	m#94.3	#176.4	0.0	#133.6	#196.6	17.3
Internal Link Dist (m)		391.6			250.5			245.0				162.4
Turn Bay Length (m)	65.0			170.0		90.0	135.0			140.0		80.0
Base Capacity (vph)	343	821	1596	405	485	750	287	1956	1601	394	2234	731
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.19	0.42	0.21	1.16	0.55	0.36	0.76	0.79	0.22	0.81	0.78	0.18

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

Queues  
105: QEW WB Offramp & Royal Windsor Dr

2031 Future Total  
AM Peak Hour



Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	611	207	230	94	699
v/c Ratio	0.79	0.27	0.13	0.17	0.40
Control Delay	37.4	9.2	16.3	27.0	28.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	37.4	9.2	16.3	27.0	28.7
Queue Length 50th (m)	121.1	13.2	11.3	16.0	64.4
Queue Length 95th (m)	166.7	28.6	21.2	m29.3	m96.8
Internal Link Dist (m)	228.2		92.0		330.9
Turn Bay Length (m)	90.0	30.0		50.0	
Base Capacity (vph)	984	931	1739	557	1739
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.62	0.22	0.13	0.17	0.40

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues  
106: Royal Windsor Dr & QEW EB Onramp

2031 Future Total  
AM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR
Lane Group Flow (vph)	318	322	667	407	788	226	461	393
v/c Ratio	0.81	0.20	0.62	0.73	0.58	0.45	0.88	0.54
Control Delay	63.3	17.5	4.4	56.7	32.1	38.8	64.7	6.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	63.3	17.5	4.4	56.7	32.1	38.8	64.7	6.2
Queue Length 50th (m)	73.9	22.6	10.9	47.0	78.1	43.2	101.9	0.0
Queue Length 95th (m)	#122.9	33.5	27.9	71.8	120.0	75.4	#185.9	38.7
Internal Link Dist (m)		84.9			494.2		107.8	
Turn Bay Length (m)	50.0		40.0	150.0		50.0		
Base Capacity (vph)	462	1595	1083	607	1360	522	549	745
Starvation Cap Reductn	0	0	17	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.20	0.63	0.67	0.58	0.43	0.84	0.53

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

Queues  
107: Royal Windsor Dr & The Canadian Rd

2031 Future Total  
AM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	NBL	NBT	NBR	SBL	SBR
Lane Group Flow (vph)	153	564	861	21	73	177	738	18	258
v/c Ratio	0.30	0.26	0.61	0.03	0.21	0.49	0.46	0.08	0.50
Control Delay	6.1	7.0	19.9	7.0	26.6	31.3	1.0	25.4	7.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	6.1	7.0	19.9	7.0	26.6	31.3	1.0	25.4	7.7
Queue Length 50th (m)	5.8	15.5	43.9	0.0	7.8	19.9	0.0	1.9	0.0
Queue Length 95th (m)	15.8	31.1	87.3	4.8	22.9	48.6	0.0	8.5	25.4
Internal Link Dist (m)		494.2	252.0			462.1			
Turn Bay Length (m)	200.0			50.0	70.0		300.0		
Base Capacity (vph)	613	3543	3061	1372	673	708	1601	457	763
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.16	0.28	0.02	0.11	0.25	0.46	0.04	0.34













Intersection Summary

## Queues

2031 Future Total

## 101: Cross Ave &amp; Trafalgar Rd

PM Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	1099	913	89	438	483	250	260	1142	379	187	1323	467
v/c Ratio	0.98	0.77	0.17	0.85	0.94	0.60	1.04	0.75	0.58	0.78	0.90	0.66
Control Delay	81.3	41.7	6.6	68.2	92.9	43.1	186.6	42.2	9.1	58.6	39.5	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	81.3	41.7	6.6	68.2	92.9	43.1	186.6	42.2	9.1	58.6	39.5	6.1
Queue Length 50th (m)	131.8	101.5	0.0	52.3	60.1	48.4	~50.0	89.4	5.7	23.4	112.4	15.8
Queue Length 95th (m)	#212.0	146.3	14.3	#92.6	#109.6	85.8	#122.2	122.4	50.5	#77.8	#159.6	12.1
Internal Link Dist (m)		165.5			187.4			118.5			257.5	
Turn Bay Length (m)	120.0			25.0			120.0			55.0		
Base Capacity (vph)	1117	1190	531	521	512	417	250	1525	652	243	1471	712
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.98	0.77	0.17	0.84	0.94	0.60	1.04	0.75	0.58	0.77	0.90	0.66

## Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.

Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Queues  
102: QEW EB Offramp & Trafalgar Rd

2031 Future Total  
PM Peak Hour



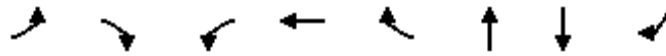
Lane Group	EBL	EBR	NBT	SBT
Lane Group Flow (vph)	824	349	1740	1823
v/c Ratio	0.74	0.67	0.57	0.59
Control Delay	40.2	40.4	17.4	16.9
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	40.2	40.4	17.4	16.9
Queue Length 50th (m)	88.0	68.4	92.6	93.6
Queue Length 95th (m)	116.0	106.9	124.5	149.6
Internal Link Dist (m)	380.3		257.5	235.1
Turn Bay Length (m)	200.0			
Base Capacity (vph)	1344	626	3070	3070
Starvation Cap Reductn	0	0	0	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.61	0.56	0.57	0.59

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues  
103: North Service Rd & Trafalgar Rd

2031 Future Total  
PM Peak Hour



Lane Group	EBL	EBR	WBL	WBT	WBR	NBT	SBT	SBR
Lane Group Flow (vph)	37	268	489	500	340	2079	2226	15
v/c Ratio	0.20	0.80	0.68	0.71	0.22	0.79	0.86	0.02
Control Delay	40.9	66.1	33.9	36.0	0.3	27.6	16.8	12.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.9	66.1	33.9	36.0	0.3	27.6	16.8	12.1
Queue Length 50th (m)	7.1	59.4	94.8	99.3	0.0	146.8	55.8	1.0
Queue Length 95th (m)	18.6	#111.4	154.6	162.4	0.0	#210.1	#247.1	m1.7
Internal Link Dist (m)				208.4		36.8	245.0	
Turn Bay Length (m)	60.0		80.0					
Base Capacity (vph)	206	377	719	750	1541	2625	2599	834
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.18	0.71	0.68	0.67	0.22	0.79	0.86	0.02

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

## Queues

2031 Future Total

## 104: Leighland Ave &amp; Trafalgar Rd

PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	144	276	225	367	379	370	274	1902	270	287	1654	139
v/c Ratio	0.71	0.56	0.14	0.71	0.85	0.59	0.86	0.89	0.17	0.88	0.77	0.19
Control Delay	70.8	53.2	0.2	53.8	64.1	21.9	72.6	26.7	0.2	65.5	33.3	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	70.8	53.2	0.2	53.8	64.1	21.9	72.6	26.7	0.2	65.5	33.3	5.1
Queue Length 50th (m)	31.4	32.2	0.0	43.3	86.2	52.2	55.0	59.1	0.0	50.3	124.5	1.0
Queue Length 95th (m)	#72.0	52.0	0.0	67.2	#155.9	88.2	m#83.6	#221.6	m0.0	#121.1	169.8	17.0
Internal Link Dist (m)		391.6			249.4			245.0				167.2
Turn Bay Length (m)	65.0			170.0		90.0	135.0			80.0		80.0
Base Capacity (vph)	204	517	1596	550	476	628	328	2136	1601	333	2159	720
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.53	0.14	0.67	0.80	0.59	0.84	0.89	0.17	0.86	0.77	0.19

## Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.



Queues  
105: QEW WB Offramp & Royal Windsor Dr

2031 Future Total  
PM Peak Hour



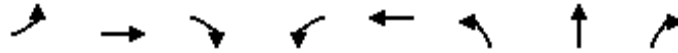
Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	481	357	462	78	307
v/c Ratio	0.75	0.51	0.23	0.16	0.15
Control Delay	41.3	14.4	15.2	17.1	14.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	41.3	14.4	15.2	17.1	14.6
Queue Length 50th (m)	98.3	28.2	27.7	8.7	17.8
Queue Length 95th (m)	135.5	57.8	53.0	m24.6	m42.3
Internal Link Dist (m)	228.2		92.0		330.9
Turn Bay Length (m)	90.0	30.0		50.0	
Base Capacity (vph)	1014	991	2003	488	2003
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.47	0.36	0.23	0.16	0.15

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Queues  
106: Royal Windsor Dr & QEW EB Onramp

2031 Future Total  
PM Peak Hour



Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR
Lane Group Flow (vph)	143	126	519	371	1435	112	590	431
v/c Ratio	0.81	0.08	0.52	0.69	0.81	0.21	1.07	0.61
Control Delay	92.3	20.5	4.0	55.4	29.6	33.5	212.3	12.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	92.3	20.5	4.0	55.4	29.6	33.5	212.3	12.2
Queue Length 50th (m)	33.5	9.0	0.0	42.9	143.6	19.9	~154.5	16.1
Queue Length 95th (m)	#79.2	17.2	38.6	65.4	#214.9	39.1	#261.9	68.6
Internal Link Dist (m)		84.9			494.2		88.2	
Turn Bay Length (m)	50.0		40.0	150.0		50.0		
Base Capacity (vph)	179	1567	993	607	1773	522	549	708
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.80	0.08	0.52	0.61	0.81	0.21	1.07	0.61

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.  
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.  
Queue shown is maximum after two cycles.

Queues  
107: Royal Windsor Dr & The Canadian Rd

2031 Future Total  
PM Peak Hour



Lane Group	EBL	EBT	WBT	WBR	NBL	NBT	NBR	SBL	SBR
Lane Group Flow (vph)	47	508	1333	37	93	258	631	20	413
v/c Ratio	0.15	0.24	0.78	0.05	0.20	0.54	0.39	0.09	0.78
Control Delay	9.1	10.5	26.4	10.1	34.0	39.1	0.7	33.7	34.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	9.1	10.5	26.4	10.1	34.0	39.1	0.7	33.7	34.1
Queue Length 50th (m)	2.9	21.6	110.7	1.7	14.3	43.5	0.0	3.0	46.0
Queue Length 95th (m)	10.7	48.4	216.3	9.7	37.1	96.0	0.0	11.8	124.5
Internal Link Dist (m)		494.2	252.0			462.1			
Turn Bay Length (m)	200.0			50.0	70.0		300.0		
Base Capacity (vph)	310	2955	2580	1160	855	901	1601	423	851
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.17	0.52	0.03	0.11	0.29	0.39	0.05	0.49

Intersection Summary

DATE: March 4, 2014  
 TO: Lin Rogers – Town of Oakville  
 Chris Pascos – MTO  
 FROM: Matt Clark – Cole Engineering  
 CC: Suzette Shiu – Cole Engineering  
 OUR REF.#: T11-767  
 SUBJECT: Oakville Midtown EA Study  
 Microsimulation Future Year Sensitivity Memorandum

## 1. Introduction

### 1.1. Background

Based on discussions with MTO Staff at a Coordination Meeting on February 26, 2014, it was agreed that a sensitivity analysis will be conducted for the Royal Windsor Drive Interchange under 2031 future conditions. The sensitivity analysis will determine the additional volumes required to breakdown operations at the westbound off ramp (single lane exit) and the eastbound left turn (single lane) for the eastbound on ramp.

## 2. Royal Windsor Drive Sensitivity Testing (2031 Horizon)

This section details the sensitivity testing undertaken using the VISSIM model to determine the additional volumes that can be accommodated by the single lane exit westbound off ramp and the single eastbound left turn at the Royal Windsor Drive Interchange. The sensitivity testing was carried out using an iterative process. The results reported are the average of ten microsimulation runs.

### 2.1. Results for Westbound Off Ramp

The results for the westbound off ramp at Royal Windsor Drive are summarized in **Table 1** and **Table 2**. During the AM peak hour, an additional 260 vehicles are required to impact QEW mainline traffic operations. The additional demand needed to impact mainline operations during the AM peak hour is a 30% increase on Midtown forecasted/modelled demand and a 95% increase on the modelled demand documented in the QEW TESR traffic report.

For the PM peak hour, an additional demand of 24% of Midtown forecasted/modelled demand is needed to impact QEW mainline operations and a 160% increase on the modelled demand documented in the QEW TESR traffic report.

**Table 1: 2031 Sensitivity Royal Windsor Drive WB Off Ramp Volumes**

Ramp	AM Peak Hour			PM Peak Hour		
	QEW TESR <sup>1</sup>	Midtown Volumes	Sensitivity Test Volumes	QEW TESR <sup>1</sup>	Midtown Volumes	Sensitivity Test Volumes
Royal Windsor WB Off Ramp	578	866	1,126	426	896	1,110

<sup>1</sup> As per information provided by MTO staff on January 31, 2014.

**Table 2: 2031 Royal Windsor Drive WB Off Ramp Queuing Analysis**

Ramp	Available Storage (m)	AM Peak Hour		PM Peak Hour	
		Average Queue (m)	Maximum Queue (m)	Average Queue (m)	Maximum Queue (m)
Royal Windsor WB Off Ramp	430	39 (66)	173 (378)	56 (42)	246 (251)

xx (xx) Midtown Forecasted Queue (Sensitivity Analysis Queue)

## 2.2. Results for Eastbound Left at Eastbound On Ramp

The results for the single lane eastbound left turn at the Royal Windsor Drive eastbound on ramp are provided in **Table 3**. The sensitivity analysis tested the additional demand required to impact the westbound off ramp, that is, what additional demand is required for the eastbound left turn queue to extend back to the westbound ramp terminal.

Based on the sensitivity analysis, a 42% increase in Midtown forecasted/modelled demand is required to impact the westbound off ramp traffic operations during the AM peak hour. For the PM peak hour, a 61% increase in Midtown forecasted/modelled demand is required to impact the westbound off ramp traffic operations.

**Table 3: 2031 Sensitivity Royal Windsor Drive EBL to QEW EB On Ramp**

Movement	AM Peak Hour		PM Peak Hour	
	Midtown Volumes	Sensitivity Test Volumes	Midtown Volumes	Sensitivity Test Volumes
Eastbound Left Turn	318	451	143	230

## 3. Summary

The microsimulation modelling sensitivity analysis confirms that a significant increase in demand is required to trigger the need for the Royal Windsor Drive westbound off ramp to be a two lane exit from the QEW westbound mainline. The sensitivity analysis also confirms that a significant increase in demand is required to trigger the need for the Royal Windsor Drive eastbound left to QEW eastbound on ramp be protected for a dual left turn.

# Memorandum

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DATE: June 2, 2014  
TO: Lin Rogers – Town of Oakville  
Chris Pascos – MTO  
FROM: Matt Clark – Cole Engineering  
CC: Suzette Shiu – Cole Engineering  
OUR REF.#: T11-767  
SUBJECT: Oakville Midtown EA Study  
Microsimulation Do Nothing Scenario – Revised

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## 1. Introduction

### 1.1. Background

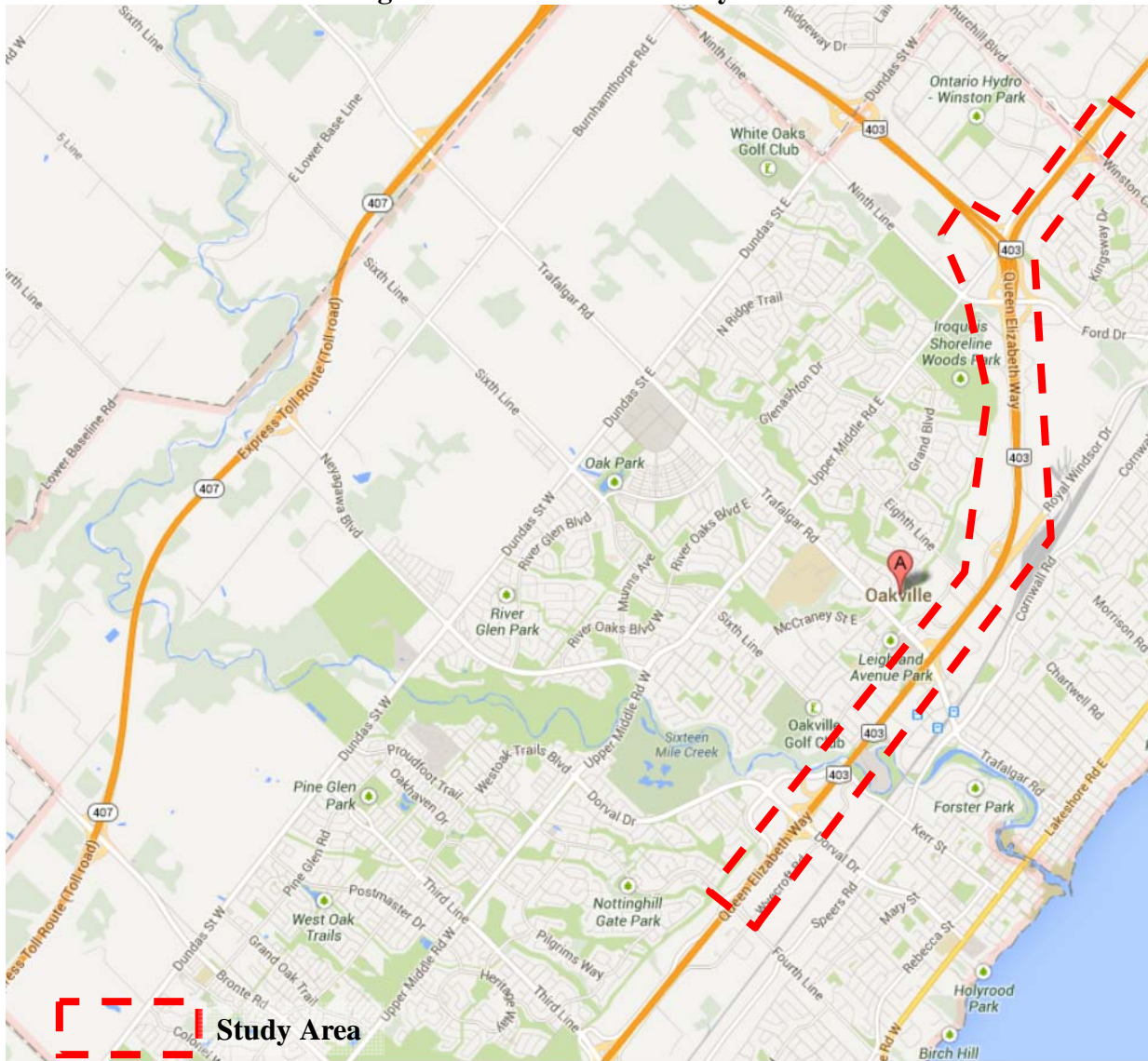
Cole Engineering Group Ltd was retained by the Town of Oakville to develop a Vissim microsimulation model to assess impacts to traffic operations on the QEW mainline and ramp terminals for Midtown Oakville.

This memorandum summarizes anticipated traffic operations on the QEW mainline and at the Trafalgar Road and Royal Windsor Drive interchanges in the “Do Nothing” microsimulation scenario for the 2031 AM and PM weekday peak periods.

### 1.2. Study Area

The study network for the microsimulation model was previously approved by the MTO and includes the QEW mainline from west of Dorval Drive interchange to east of Winston Churchill Boulevard interchange including the QEW / Highway 403 interchange. The Trafalgar Road segment from Leighland Avenue to Cross Avenue is also included in the study area. **Figure 1** shows the network extents for the Vissim model.

Figure 1: Vissim Model Study Area



## 2. Microsimulation Model Development

The 2031 Do Nothing microsimulation model was developed based on the calibrated and validated existing conditions microsimulation model. The calibrated and validated model development is documented in a separate memorandum dated August 13, 2013. The following steps were followed to develop the 2031 Do Nothing microsimulation model:

1. Planned improvements along the QEW by the 2031 horizon were added to the existing calibrated validated model.
2. Future travel demand for the future study area transportation network was obtained from the Halton Region 2031 Emme model. The model comprised of the peak hour and a 15-minute warm up and cool down period on both sides of the peak hour.

### 2.1. 2031 Do Nothing Network

The QEW improvements recommended in the Transportation Environmental Study Report (TESR) commissioned by the MTO for Highway 403 and Queen Elizabeth Way from Trafalgar Road to Winston Churchill Boulevard were coded into the existing calibrated Vissim model. These improvements include:

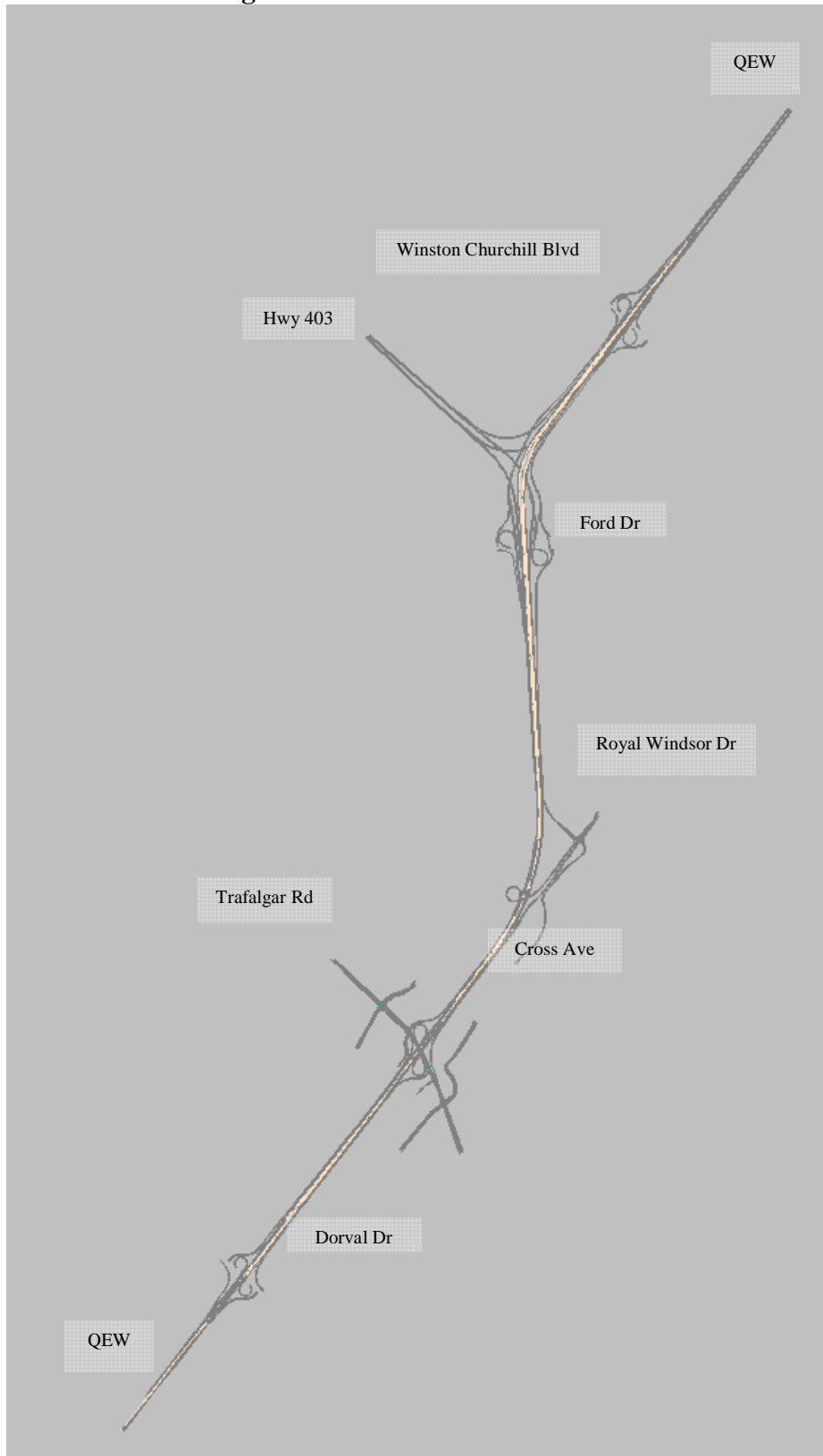
- Extension of the existing HOV lanes from Trafalgar Road to Winston Churchill Boulevard;
- N-E and E-N ramps at the Highway 403 / Ford Drive interchange; and,
- Core-collector system along QEW to facilitate movements between Ford Drive and Winston Churchill Boulevard and to accommodate the new N-E / E-N ramps.

The TESR did not identify any ingress and egress locations for the HOV lanes extension from Trafalgar Road to Winston Churchill Boulevard. However, MTO staff provided the HOV ingress and egress locations at the Royal Windsor Drive Interchange which were included in the 2031 future preferred network along with the existing HOV lanes ingress and egress locations at the Dorval Drive and Trafalgar Road interchanges. Through further discussion with MTO staff, it was agreed that the Trafalgar eastbound HOV access be removed from the 2031 Do Nothing network.

Arterial road network improvements – i.e. new North-South crossing of QEW, extension of Cross Avenue, extension of Royal Windsor Drive – are not included in the 2031 Do Nothing network. **Figure 2** shows the Vissim network developed to evaluate traffic operations for the 2031 Do Nothing conditions.



**Figure 2: Future Vissim Network**



## 2.2. 2031 Do Nothing Travel Demand

The 2031 Do Nothing travel demand for the study area was generated using the Halton Region Emme weekday 2031 PM peak model. The MTO Systems Analysis and Forecasting Office (SAFO) approved the use of the Region's Emme model for this study.

The Do Nothing study area comprises of 31 traffic zones (26 input gates) and the trend transit split was used for a conservative analysis (higher auto demand). A traversal OD matrix was extracted from the Emme model for 2031 Do Nothing weekday PM conditions.

The OD matrix was further refined by increasing the demand along the QEW to match the volumes modelled in MTO's GGH model. The screenline demand along the QEW from the GGH model is generally higher compared to the Halton Region Emme model; therefore, the 2031 demand used in the microsimulation analysis is similar to the demand from the GGH model.

A proposed GTA HOV network is also modelled in the Halton Region Emme 2031 weekday PM peak model and a 2031 traversal OD matrix was obtained for HOV trips through the microsimulation study area. The HOV matrix was expanded and adjusted similar to the general purpose matrix.

The 2031 PM peak hour travel demand was inverted to provide the travel demand patterns for the 2031 AM peak hour. An HOV 2031 weekday AM peak hour matrix was also developed.

Based on discussions with MTO staff, it was agreed that mainline volumes on the QEW and Highway 403 mainline be increased by 10 to 15% to replicate the forecasted mainline volumes in MTO's TESR for Highway 403. The updated volumes also include adjustments to the ramp volumes at the Dorval Drive interchange.

Similar to the calibrated and validated existing weekday AM and PM models, route choices within the 2031 Do Nothing network is limited and the travel demand was assigned to the network using the static routing function within Vissim. A comparison of the existing and 2031 Do Nothing travel demand for the microsimulation study area is provided in **Table 1**.

It is noted that the adjustments to replicate the mainline volumes from the TESR resulted in a Do Nothing AM peak hour travel demand which is similar to the Do Nothing PM peak hour demand as shown in **Table 1**. This is a significant change since the existing AM peak hour demand is lower compared to the existing PM peak hour.

**Table 1: Comparison of Existing and 2031 Do Nothing Travel Demand**

Weekday Peak Hour	Existing Demand (vehicle trips)	2031 Trend Transit Demand (vehicle trips)
AM Peak	21,970	37,918
PM Peak	25,715	38,640

### 2.3. 2031 Microsimulation Analysis Results

Traffic conditions along the QEW and at the ramp terminals were assessed using the following measures of effectiveness from the microsimulation analysis:

- Screenline volumes
- Travel time along the QEW
- Speed contour, lane by lane speed contour plots, and speed profile plots along the QEW
- Ramp terminal queues

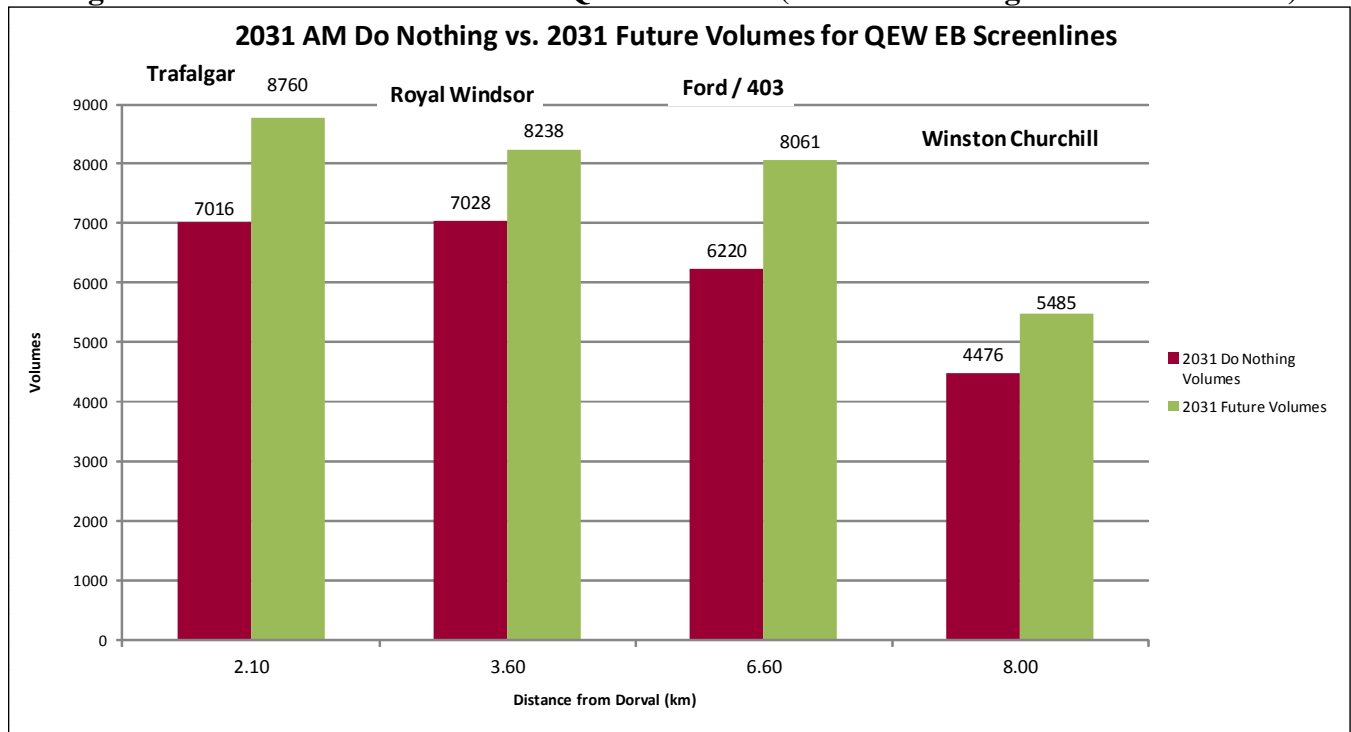
The existing screenline volumes and travel times along the QEW were compared to modelled 2031 Do Nothing volumes and travel times. Speed contour plots for the modelled section of the QEW were created for the weekday AM and PM peak hours in both the eastbound and westbound direction. Lane by lane speed contour plots were created for the QEW segment from Dorval Drive to Highway 403/Ford Drive Dorval.

The modelled 2031 Do Nothing reported results are the average from ten simulation runs.

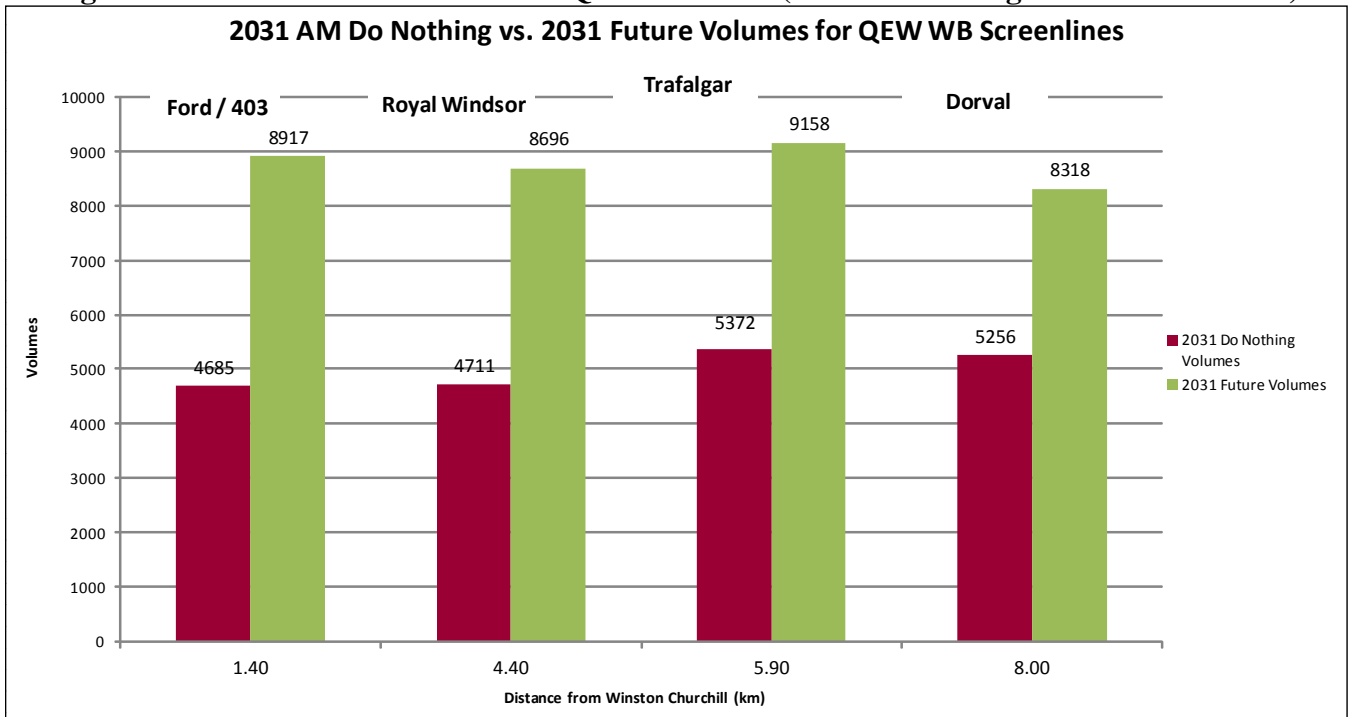
#### 2.3.1. Screenline Volume Comparison

Comparisons of QEW directional screenline 2031 Do Nothing and 2031 Future (preferred network) volumes are provided in **Figure 3** to **Figure 6** for the weekday AM and PM peak hour. The results show the anticipated increase in demand along the QEW with demand east of Trafalgar generally higher as a result of traffic to/from Midtown Oakville. Additional volume comparison results are provided at the screenline, ramp and intersection turning movement levels in **Appendix A**.

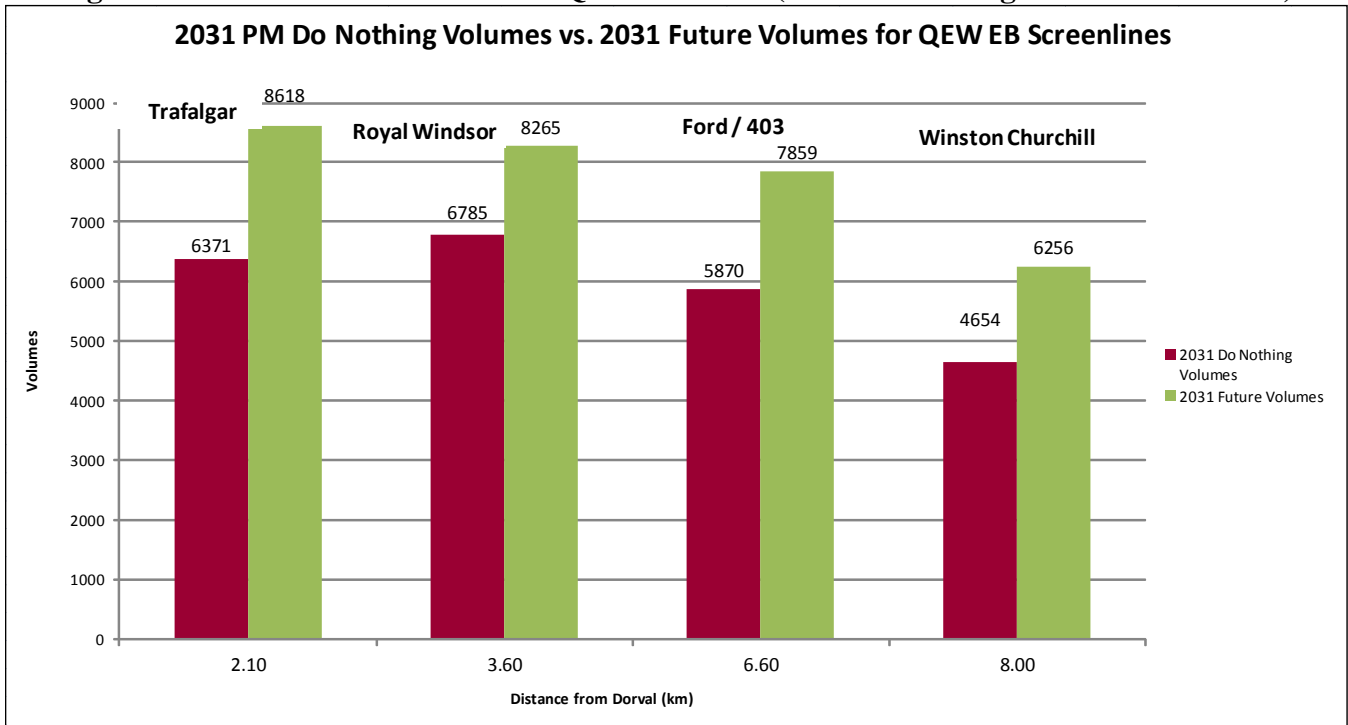
**Figure 3: AM Peak Hour Eastbound QEW Volumes (2031 Do Nothing versus 2031 Future)**



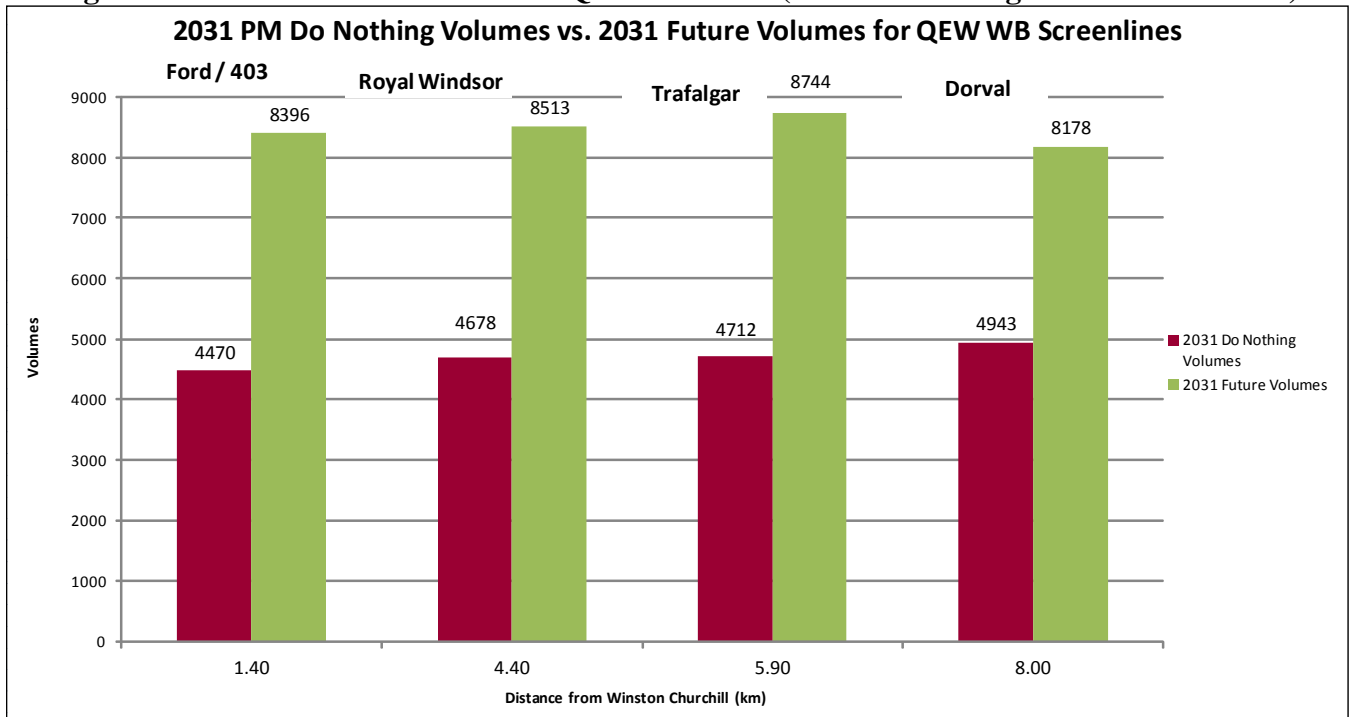
**Figure 4: AM Peak Hour Westbound QEW Volumes (2031 Do Nothing versus 2031 Future)**



**Figure 5: PM Peak Hour Eastbound QEW Volumes (2031 Do Nothing versus 2031 Future)**



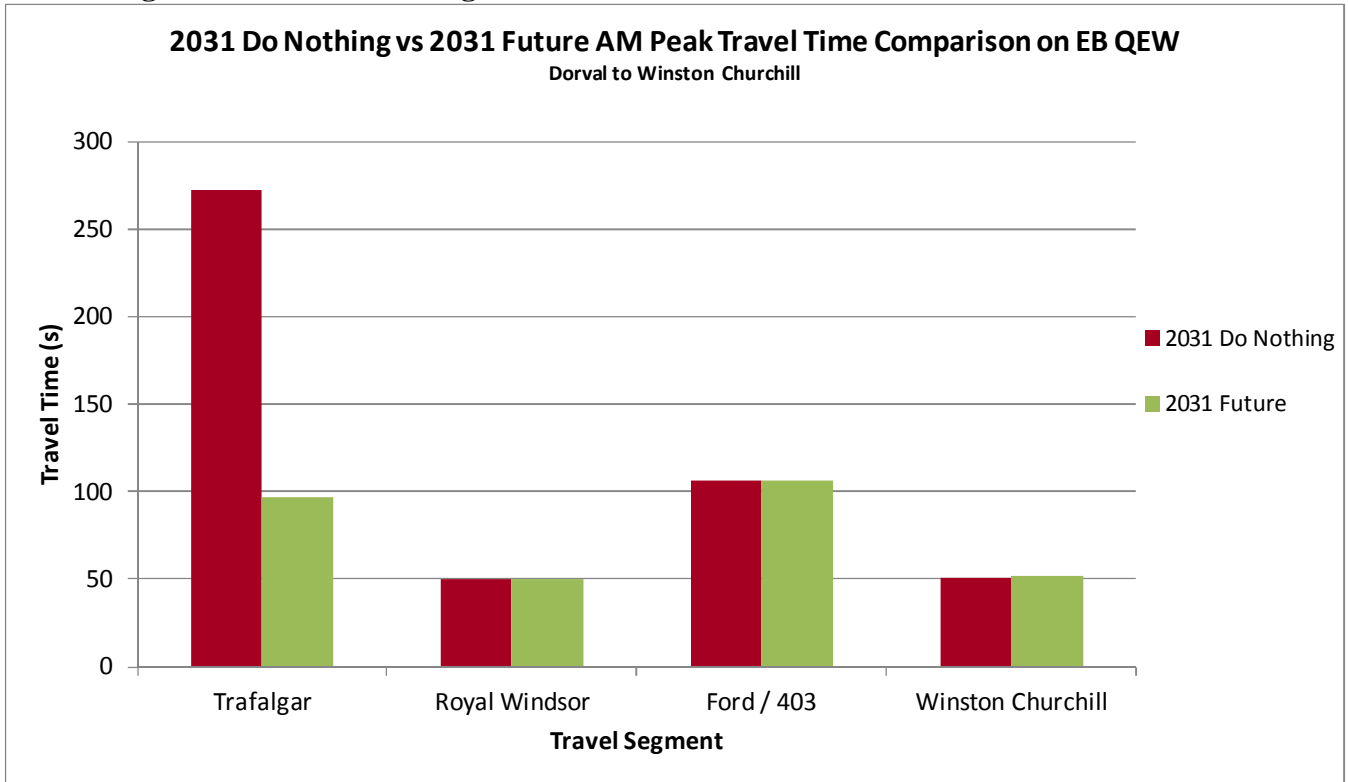
**Figure 6: PM Peak Hour Westbound QEW Volumes (2031 Do Nothing versus 2031 Future)**



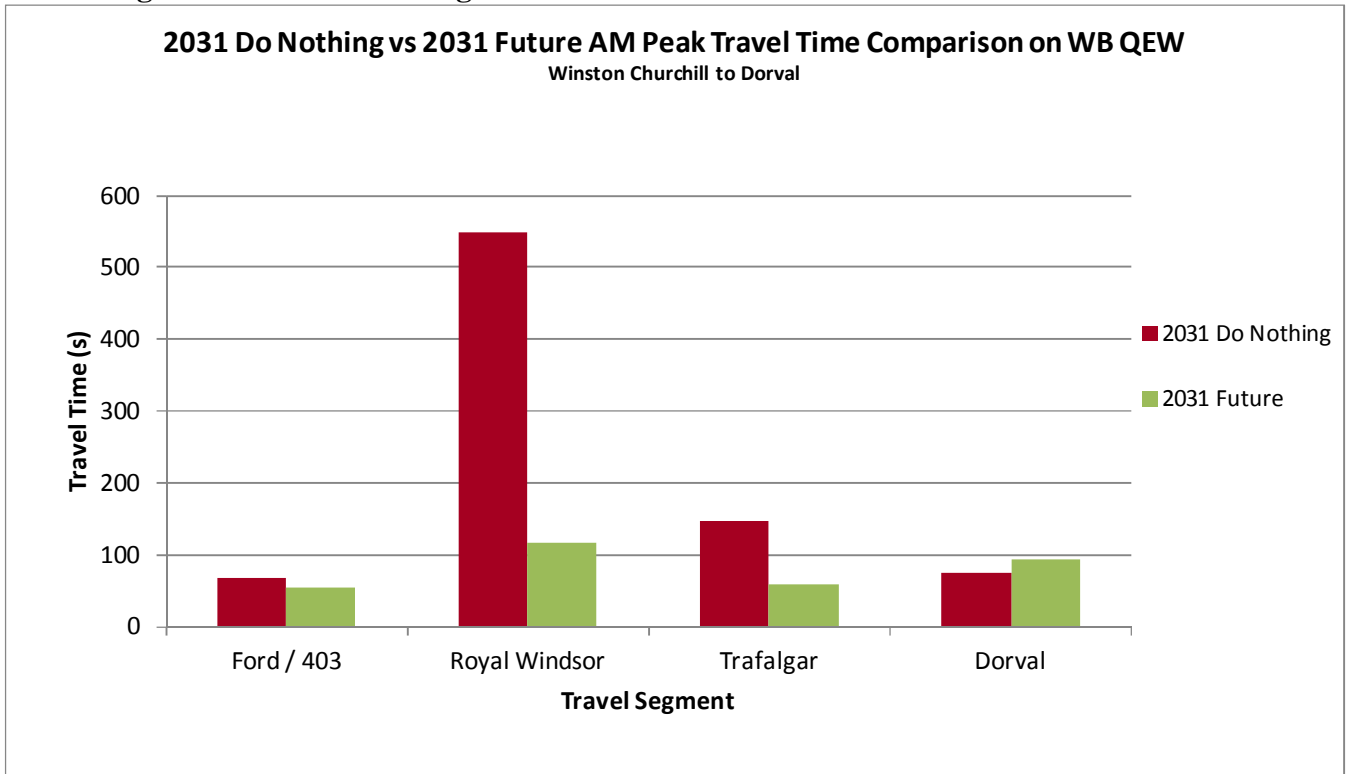
### 2.3.2. Travel Time Comparison

The travel times by direction for segments along QEW modelled for the 2031 Do Nothing scenario were compared to the 2031 Future (preferred network) travel times for the weekday AM and PM peak hours. The comparisons are charted in **Figure 7** to **Figure 10** and the results show the high level of congestion that results from the capacity deficiency at the Trafalgar Road interchange in the Do Nothing scenario. The high travel demands generated by development in Midtown Oakville are limited to Trafalgar Road as the main access/egress to Midtown.

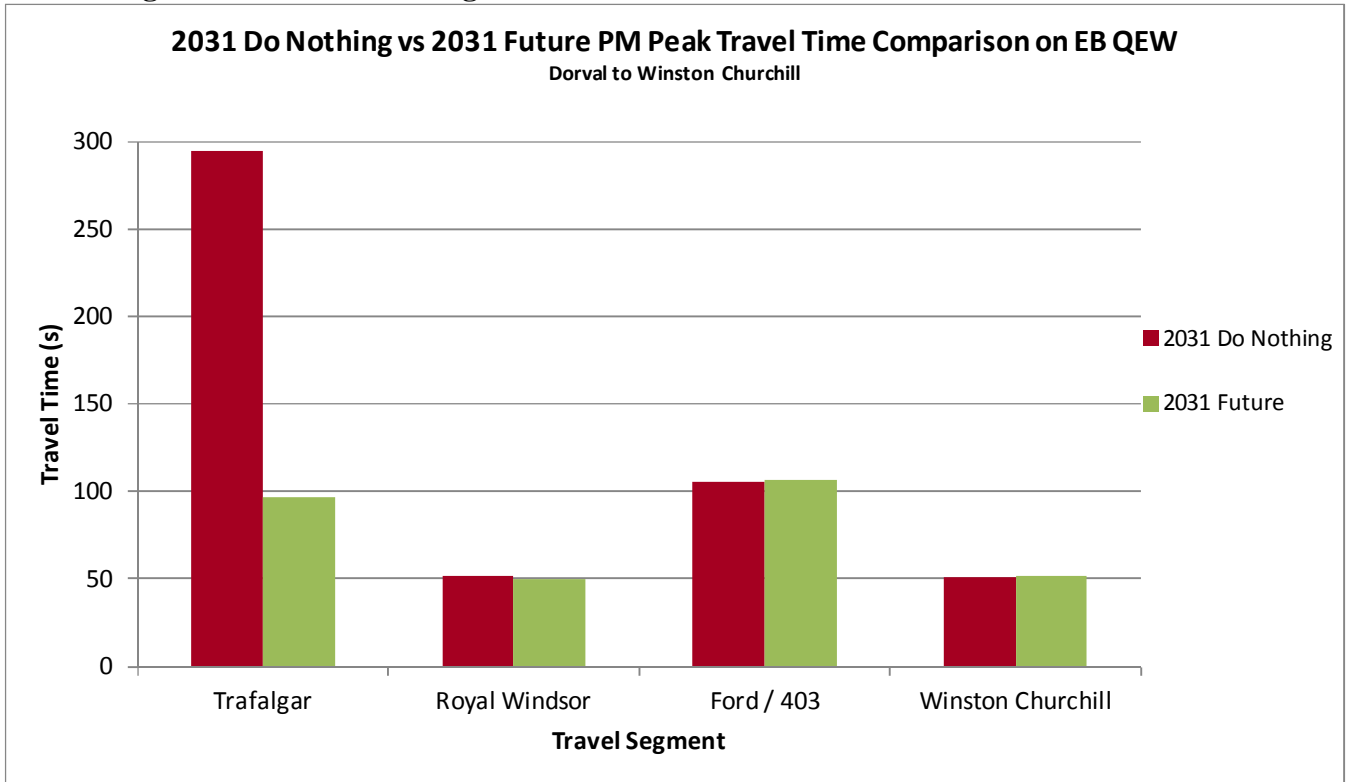
**Figure 7: 2031 Do Nothing vs 2031 Future AM Peak Hour Eastbound Travel Time**



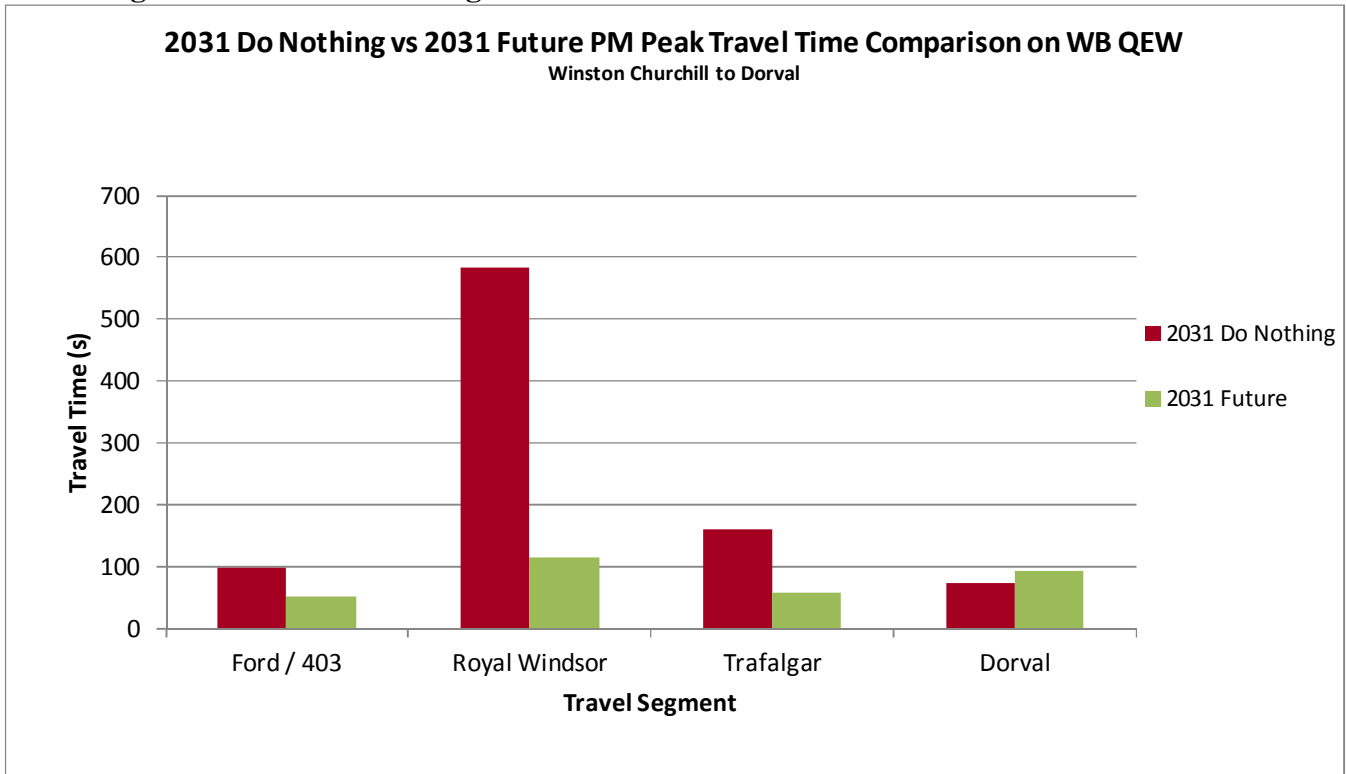
**Figure 8: 2031 Do Nothing vs 2031 Future AM Peak Hour Westbound Travel Time**



**Figure 9: 2031 Do Nothing vs 2031 Future PM Peak Hour Eastbound Travel Time**



**Figure 10: 2031 Do Nothing vs 2031 Future PM Peak Hour Westbound Travel Time**



### 2.3.3. 2031 QEW Mainline Operations

The 2031 Do Nothing QEW mainline operations was assessed using directional speed contour plots, directional lane by lane average speed plots and directional speed profile plots for the weekday AM and PM peak hours. The speed contour plots, directional lane by lane average speed plots and directional speed profile plots were used to identify hot spots or areas with operational issues along the QEW corridor over the peak hour. The speed contour plots, directional lane by lane average speed plots and directional speed profile plots for the QEW are shown in **Figure 11** to **Figure 22** for the 2031 Do Nothing traffic conditions.

From the plots, operational constraints are noted in both the eastbound and westbound directions at the Trafalgar Road interchange as the off ramps are not being able to serve the demand generated by Midtown Oakville. The trigger point for this capacity deficiency is the demand placed upon the southbound left (SBL) at the Trafalgar Road and Cross Avenue intersection which is the primary access to Midtown Oakville. The queue from this SBL turn lane propagates into the through lanes that in turn blocks both of the QEW off ramp terminals. This also affects queue dispersion on both off ramps which in turn results in queues extending back onto the QEW mainline and affect mainline operations.



Figure 11: 2031 Do Nothing AM Peak Hour Eastbound QEW Speed Contour Plot

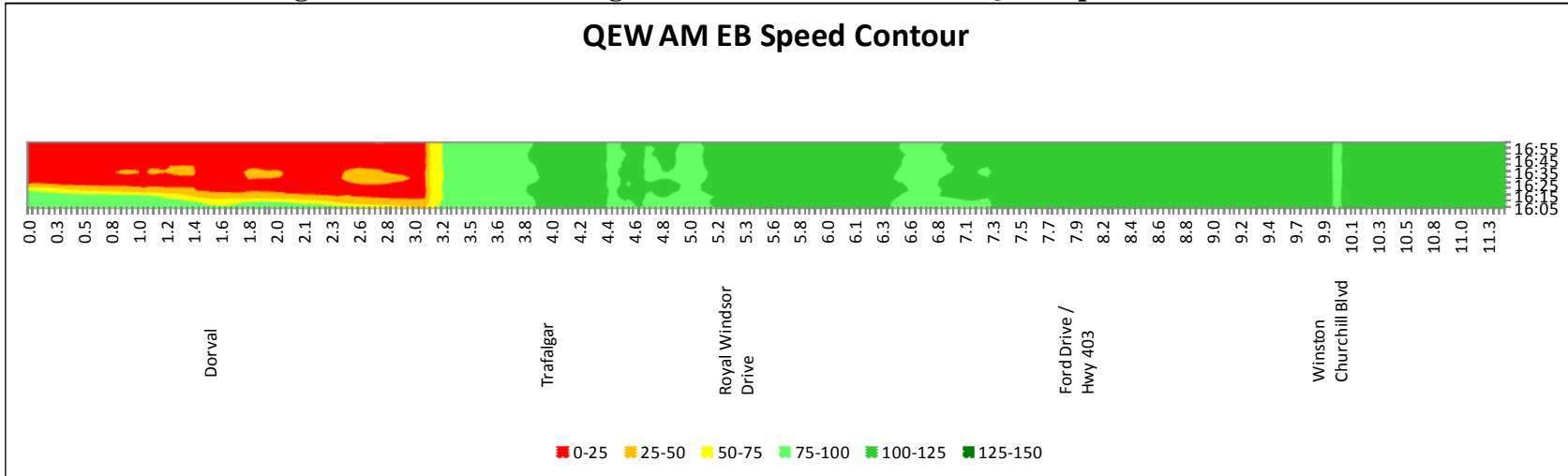


Figure 12: 2031 Do Nothing AM Peak Hour Eastbound QEW Lane by Lane Average Speed

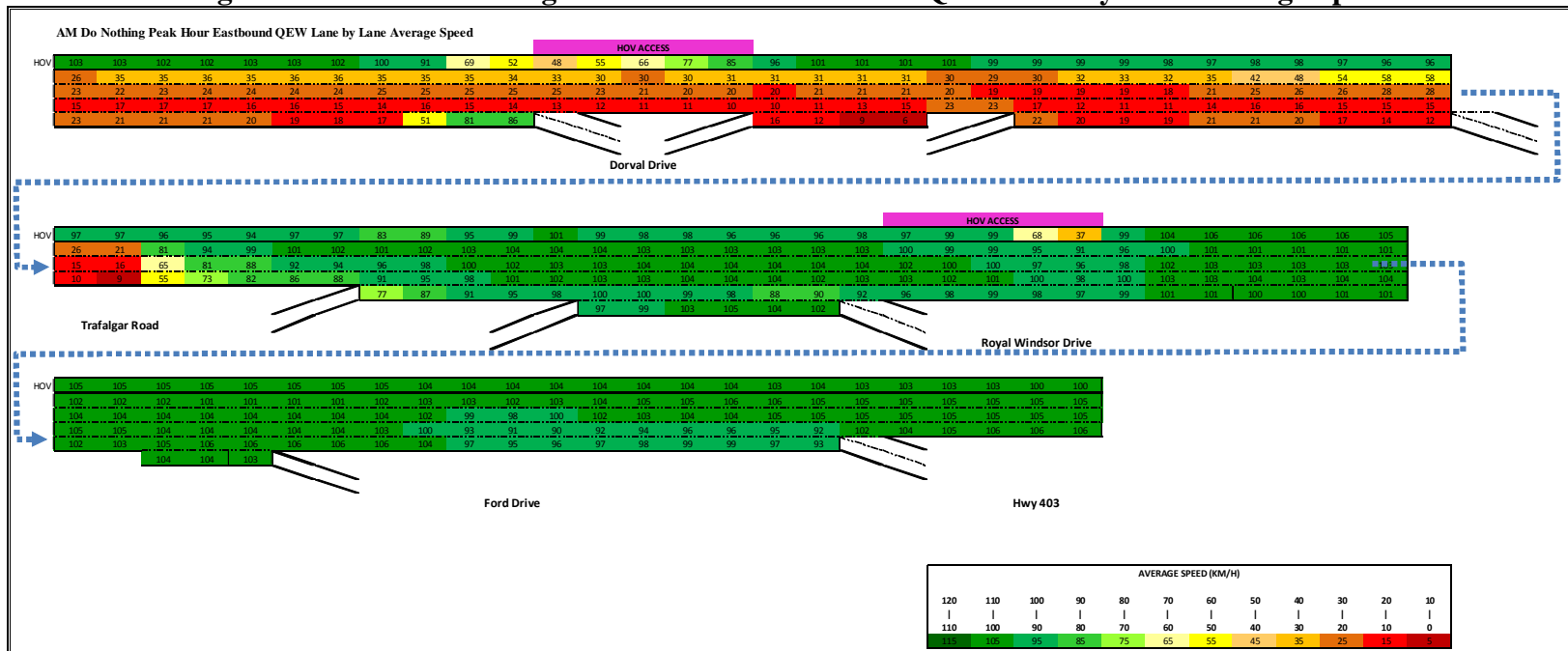


Figure 13: 2031 Do Nothing vs 2031 Future AM Peak Hour Eastbound QEW Speed Profile

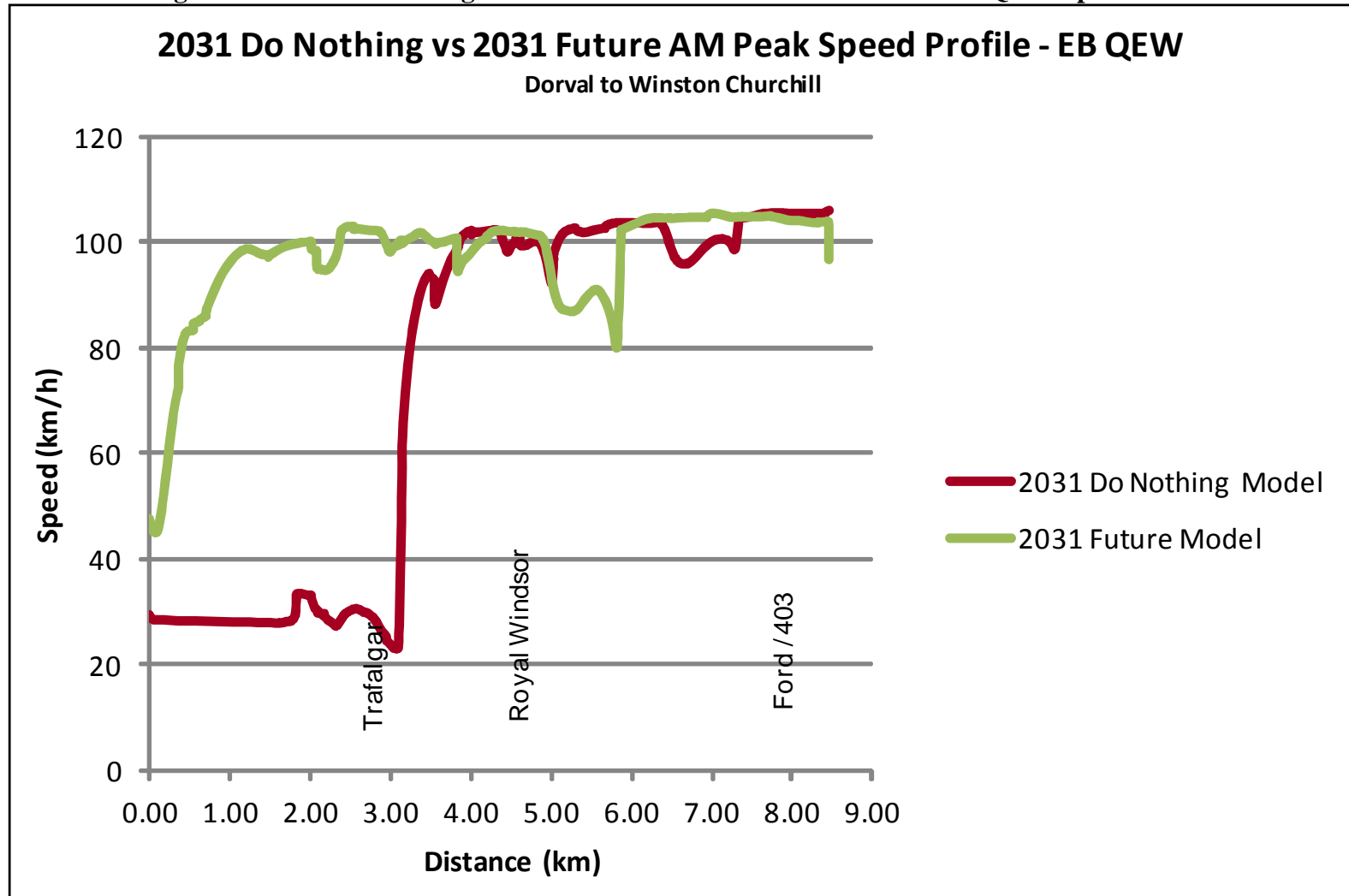


Figure 14: 2031 Do Nothing AM Peak Hour Westbound QEW Speed Contour Plot

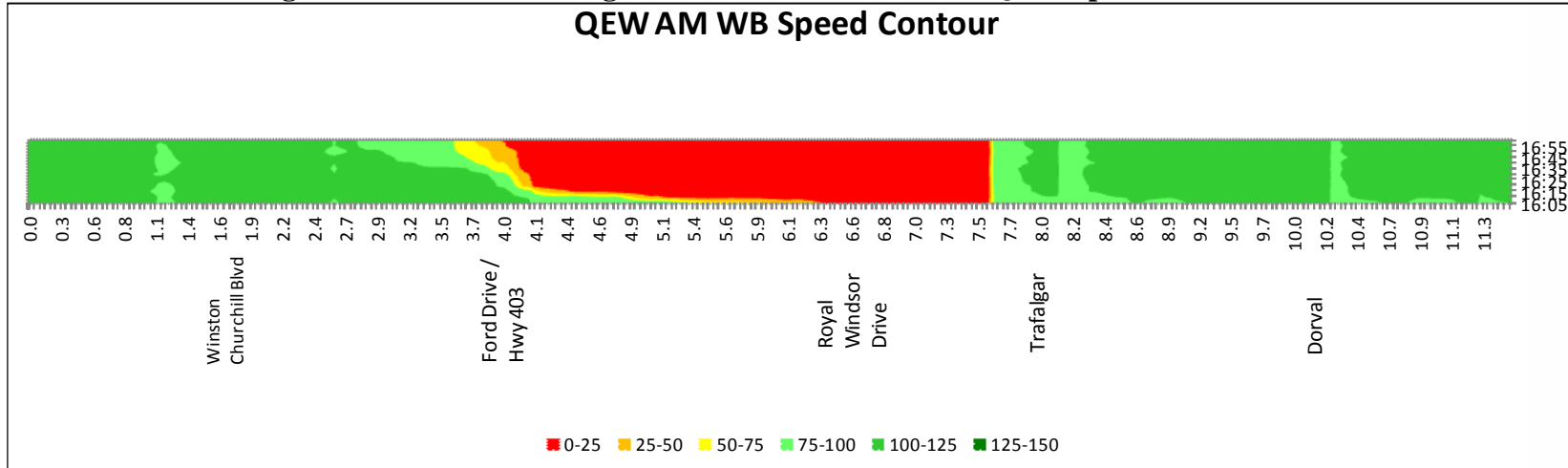


Figure 15: 2031 Do Nothing AM Peak Hour Westbound QEW Lane by Lane Average Speed

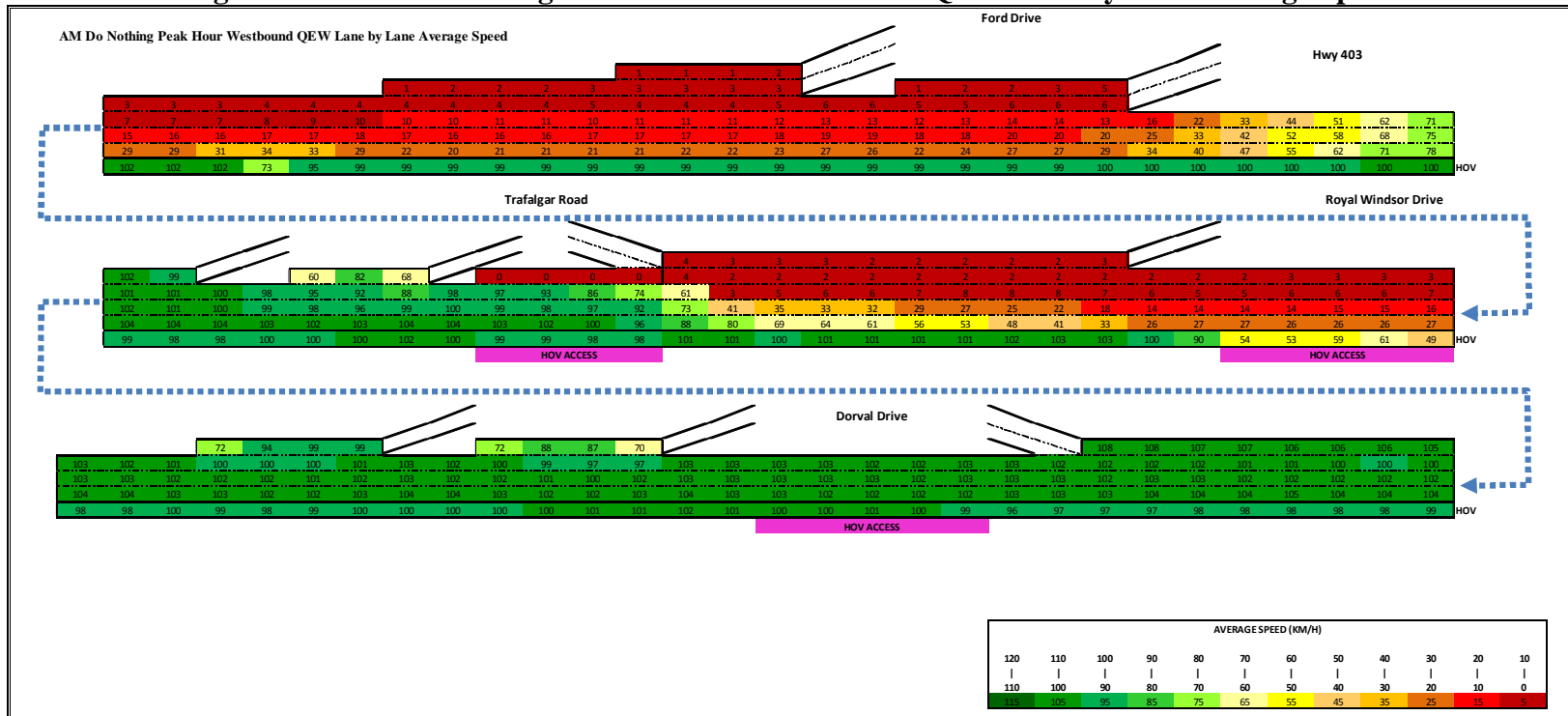


Figure 16: 2031 Do Nothing vs 2031 Future AM Peak Hour Westbound QEW Speed Profile

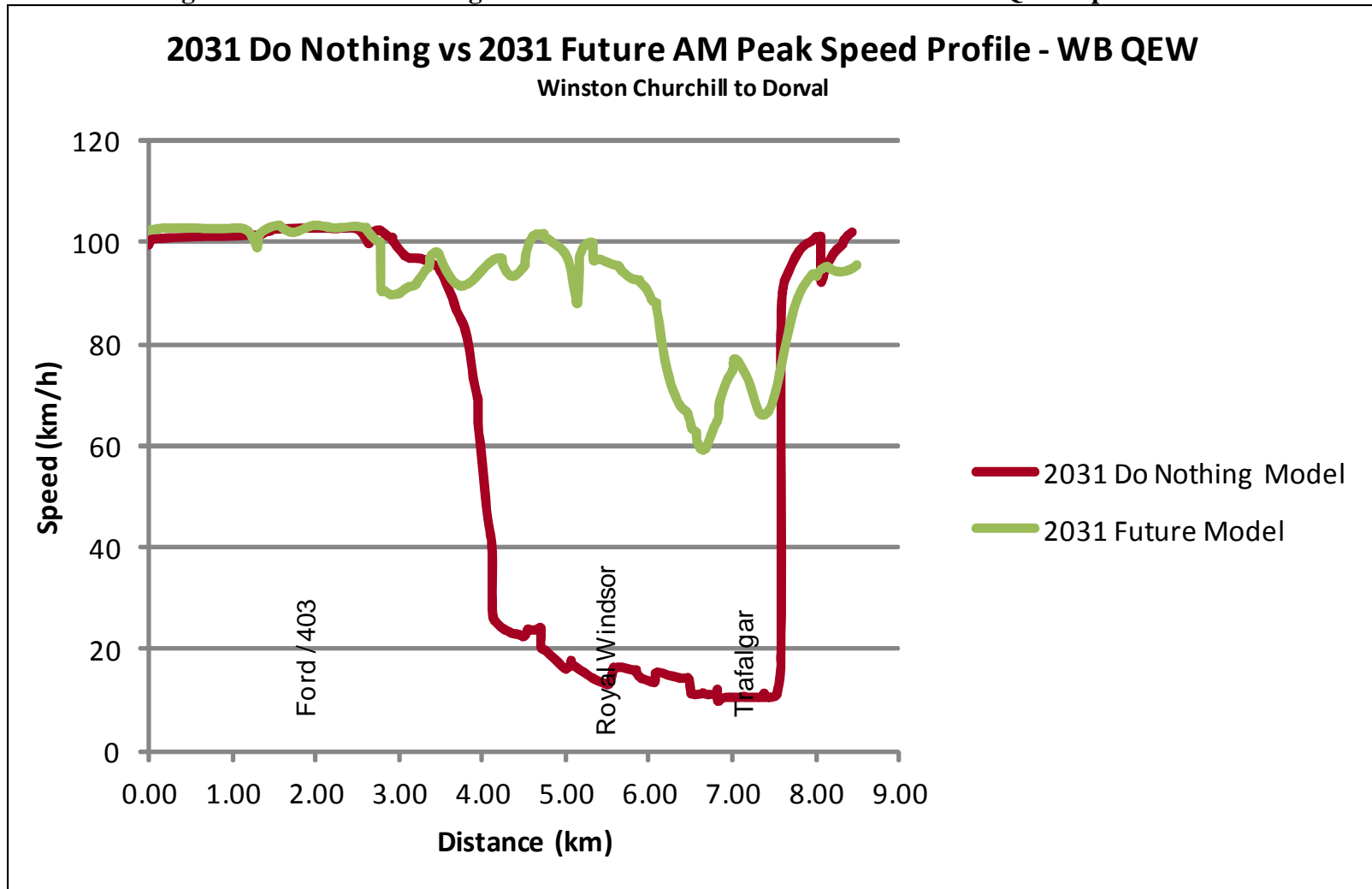


Figure 17: 2031 Do Nothing PM Peak Hour Eastbound QEW Speed Contour Plot

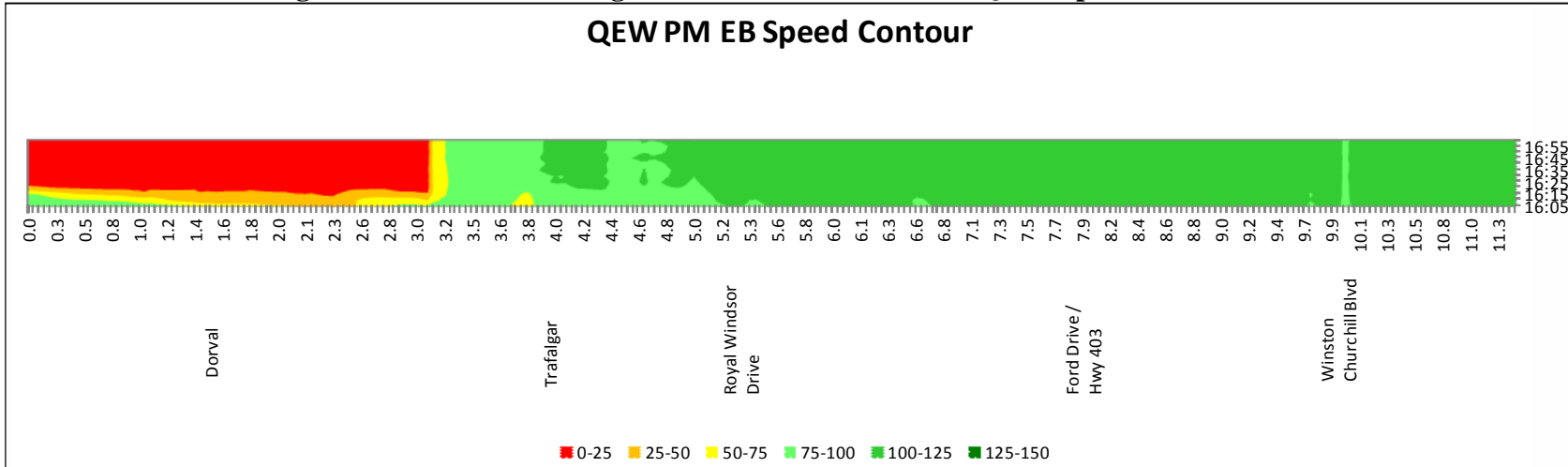


Figure 18: 2031 Do Nothing PM Peak Hour Eastbound QEW Lane by Lane Average Speed

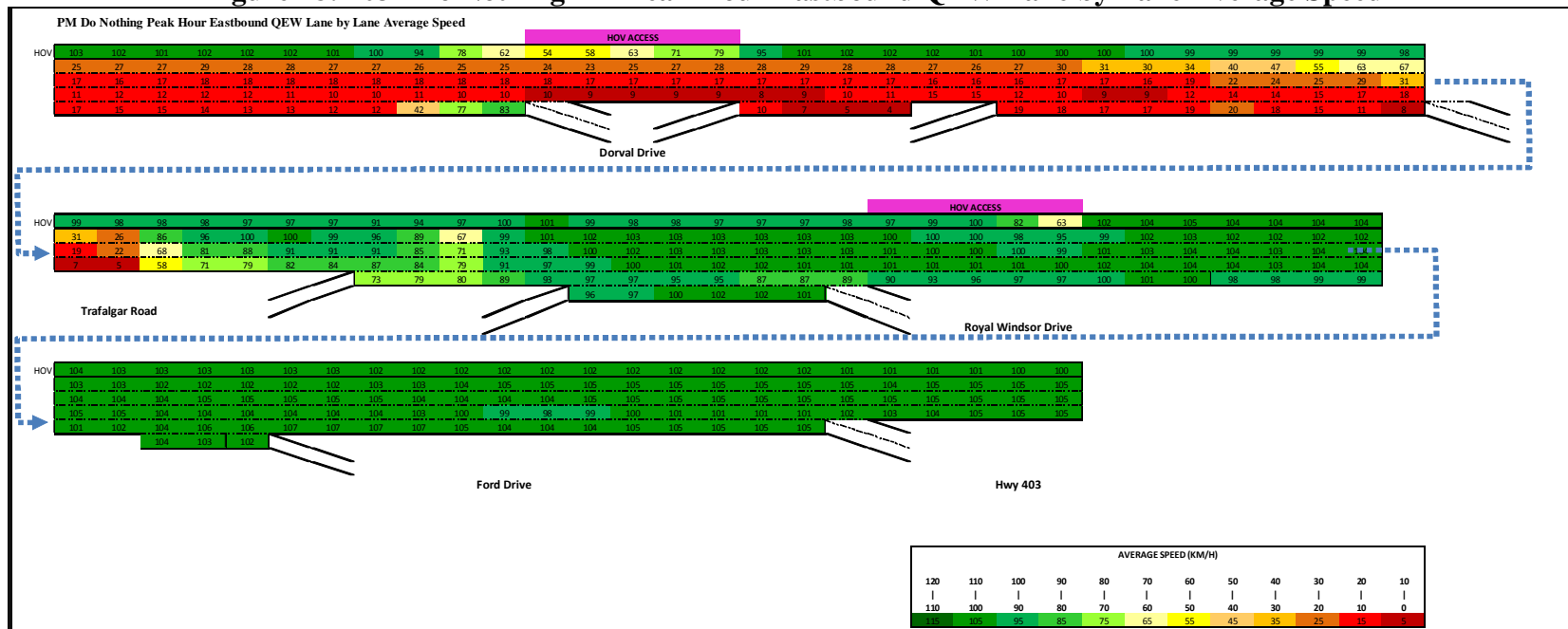


Figure 19: 2031 Do Nothing vs 2031 Future PM Peak Hour Eastbound QEW Speed Profile

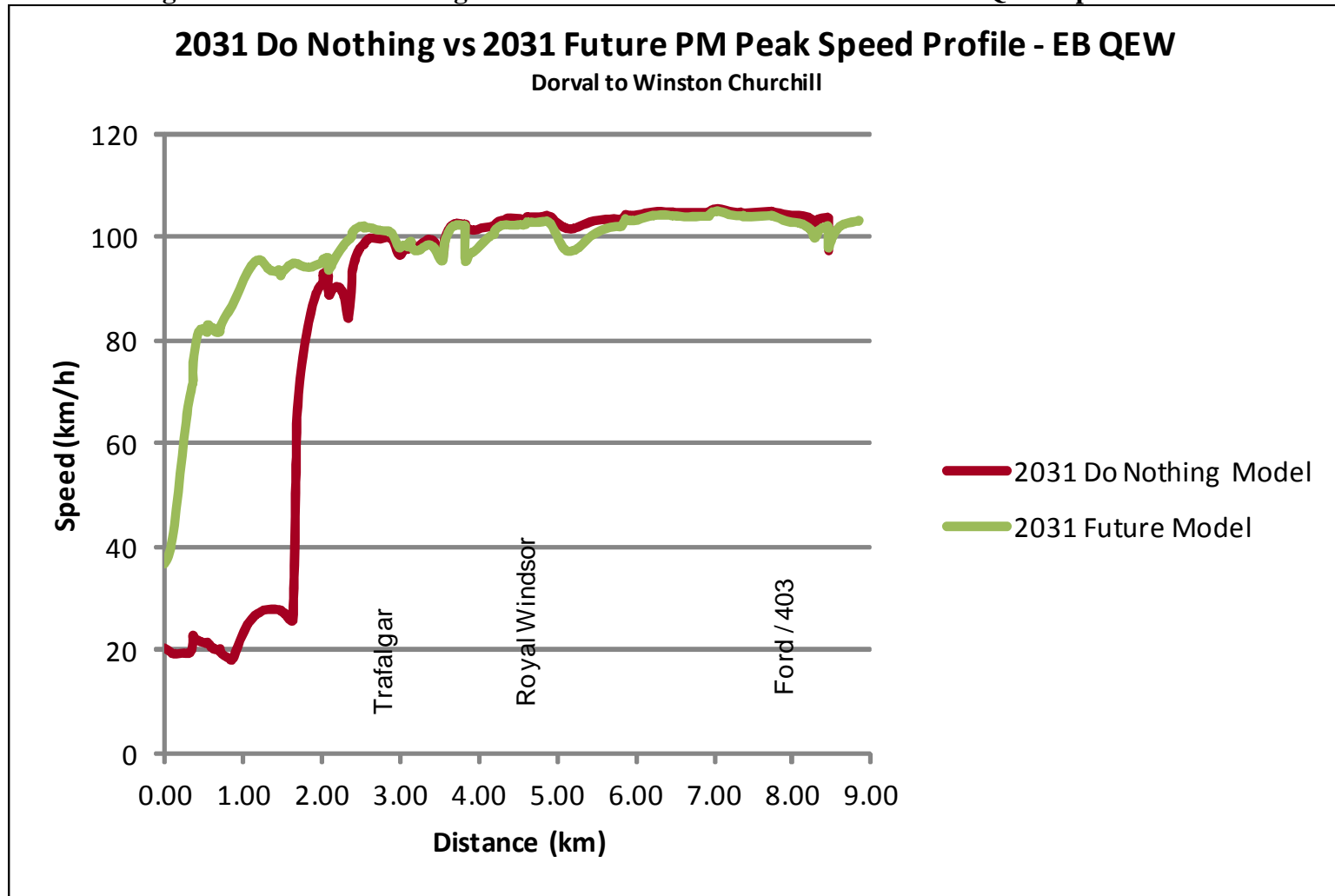


Figure 20: 2031 Do Nothing PM Peak Hour Westbound QEW Speed Contour Plot

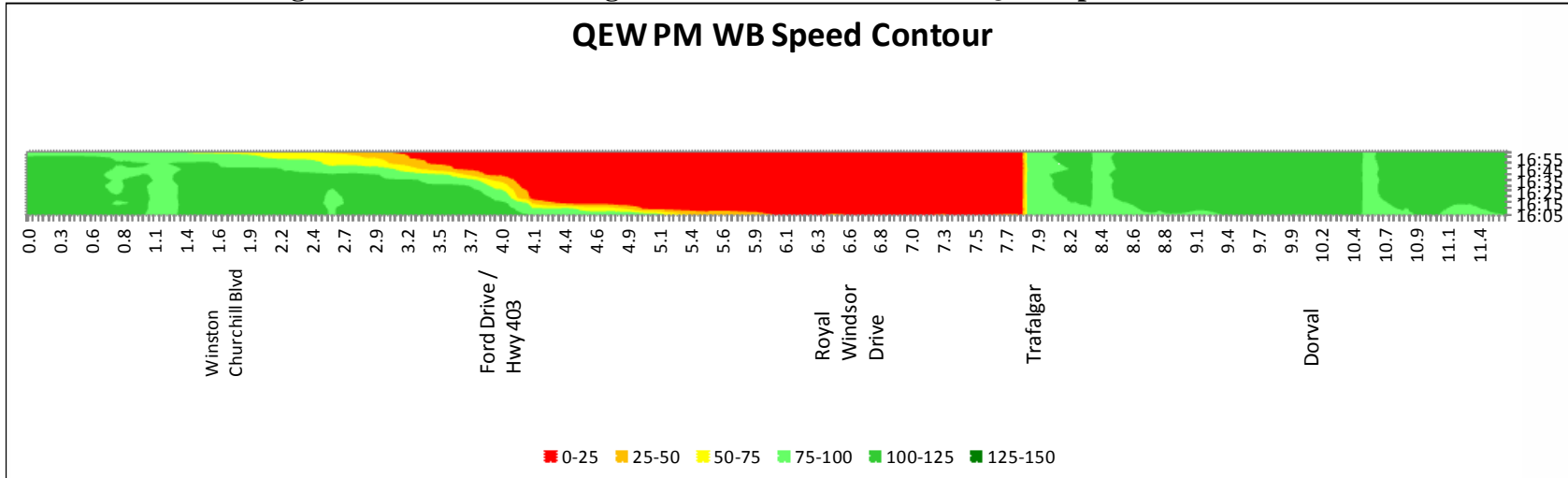


Figure 21: 2031 Do Nothing PM Peak Hour Westbound QEW Lane by Lane Average Speed

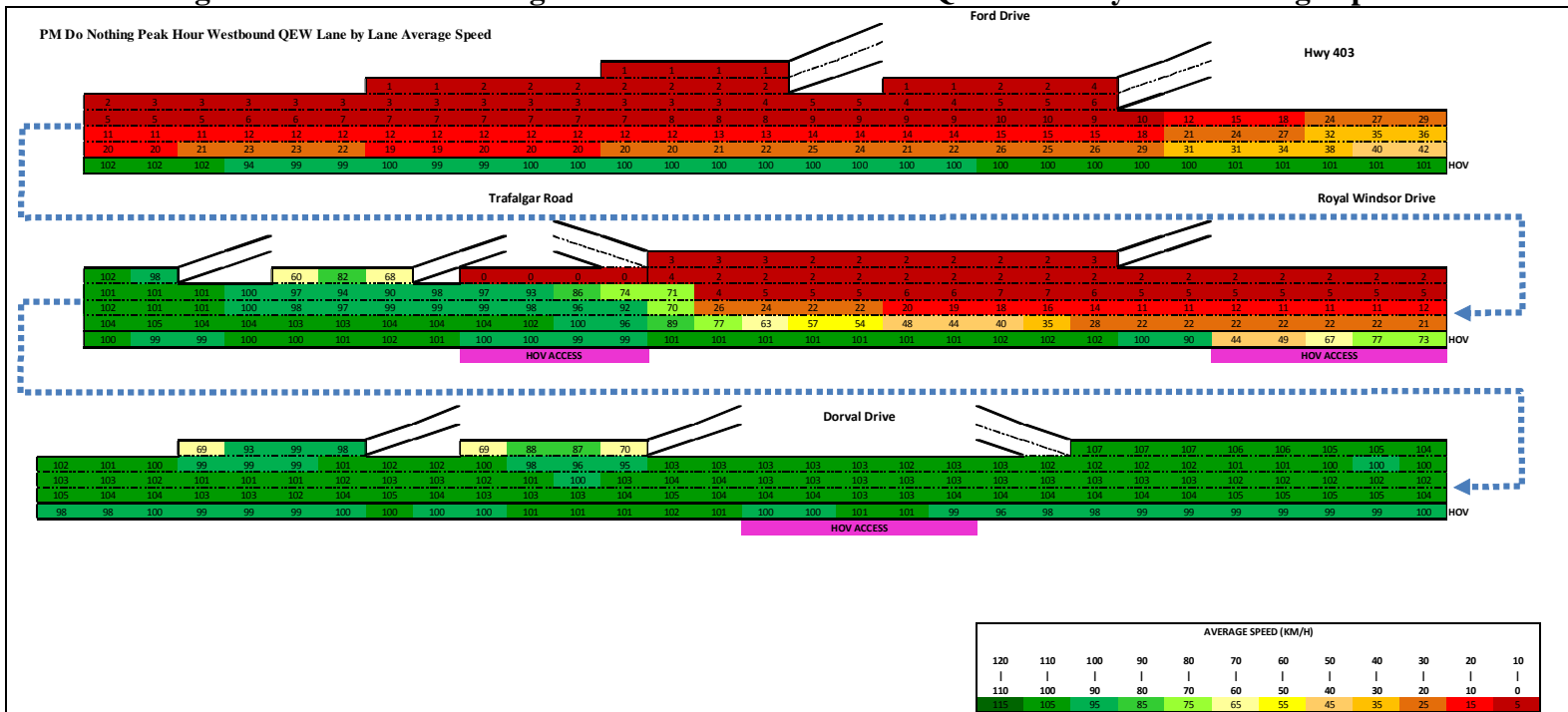
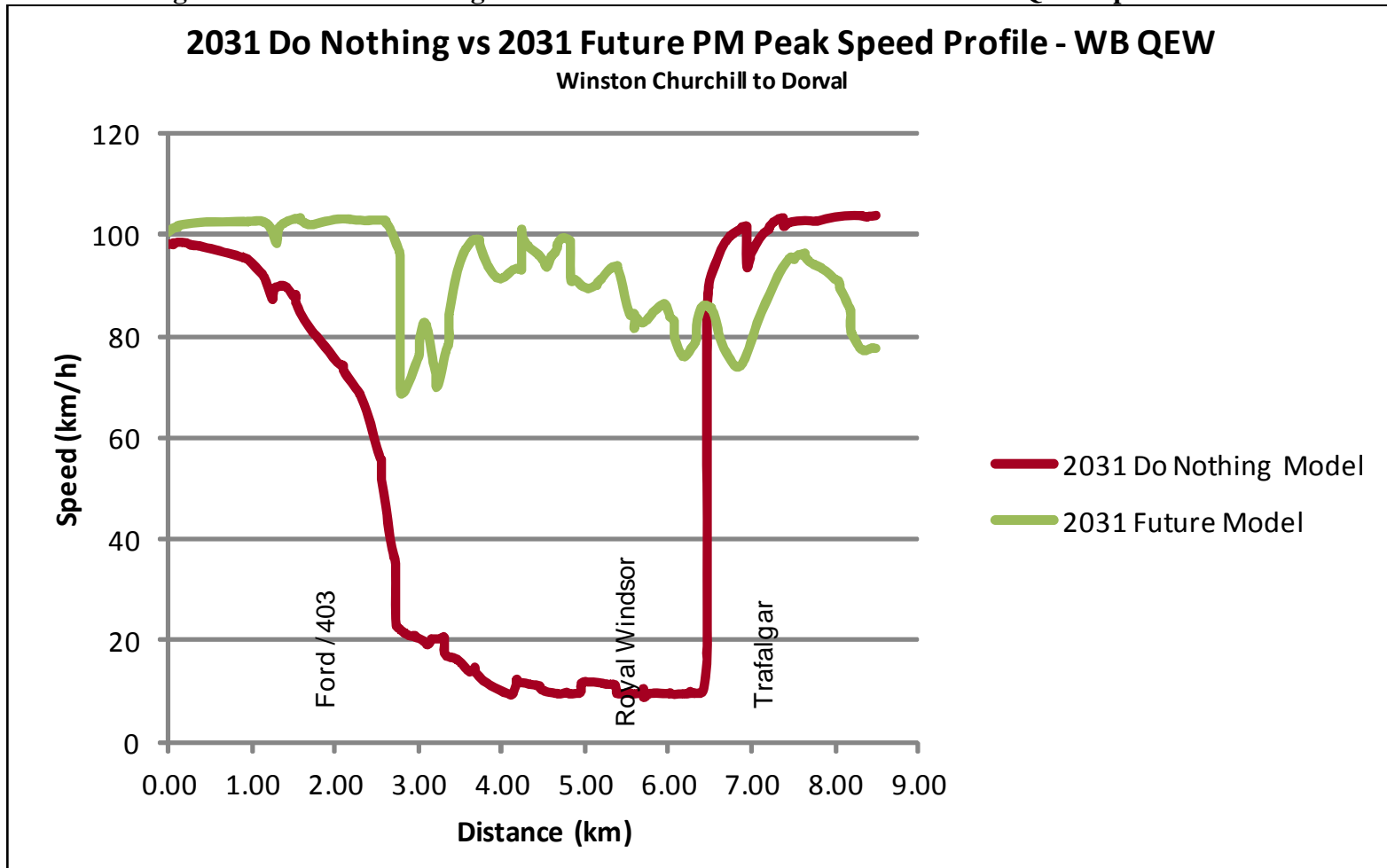


Figure 22: 2031 Do Nothing vs 2031 Future PM Peak Hour Westbound QEW Speed Profile





### 2.3.4. Ramp Terminal Queuing Analysis

A queuing analysis was conducted using data from the microsimulation model to assess the impact of queues at the ramp terminals on mainline operations. From the speed contour plot results it can be seen that queuing from the ramp terminal operations will impact QEW mainline operations and this is confirmed in **Table 2** where the maximum anticipated queues exceed available storage.

**Table 2: 2031 Do Nothing Ramp Terminal Queuing Analysis**

Ramp	Available Storage (m)	AM Peak Hour		PM Peak Hour	
		Average Queue (m)	Maximum Queue (m)	Average Queue (m)	Maximum Queue (m)
Trafalgar EB Off Ramp	325	446	>500	448	>500
Trafalgar WB Off Ramp	300	498	>500	495	>500

## 3. Intersection Operational Analysis

Intersection operations under 2031 Do Nothing conditions were not analyzed. The significant congestion observed from the Vissim model indicates that the intersection operations would fail. The volumes being served at the intersections are low and any resulting Synchro analysis using those volumes would not represent anticipated conditions.

## 4. Summary of 2031 Traffic Operations

The microsimulation modelling results confirm that the Midtown Oakville 2031 Do Nothing network cannot accommodate the demand placed upon it during the weekday AM and PM peak hours. The Midtown demand for the Trafalgar Road interchange causes it to fail and severely impact QEW mainline operations, affecting throughput and journey times.

The results from the 2031 Do Nothing analysis confirms that additional transportation network infrastructure is required to accommodate Midtown Oakville, including alternative routes to/from Midtown and additional access to/from the QEW.

**Appendix A – Additional Microsimulation Analysis Results**

## AM Peak Hour Model Results

**Table A- 1: AM Peak Hour Screenline Comparison**

	NB/EB		SB/WB	
	2031 Do Nothing	2031 Future	2031 Do Nothing	2031 Future
<b>West of Dorval Drive</b>				
QEW	6339	8201	5256	8318
<b>Screenline Total</b>	<b>6339</b>	<b>8201</b>	<b>5256</b>	<b>8318</b>
<b>West of Trafalgar Road</b>				
Leighland Avenue	538	762	320	612
North Service Road	169	169	36	89
QEW	7016	8760	5372	9158
Argus Road	44	44	138	250
Cross Avenue	1128	1120	1472	2010
<b>Screenline Total</b>	<b>8895</b>	<b>10855</b>	<b>7338</b>	<b>12119</b>
<b>East of Trafalgar Road</b>				
Iroquois Shore Road	886	1027	522	1016
QEW	7028	8283	4711	8696
South Service Road	1161	1017	420	565
<b>Screenline Total</b>	<b>9075</b>	<b>10282</b>	<b>5653</b>	<b>10277</b>
<b>West of Ford Drive</b>				
QEW	6220	8061	4685	8917
<b>Screenline Total</b>	<b>6220</b>	<b>8061</b>	<b>4685</b>	<b>8917</b>
<b>West of Winston Churchill Boulevard</b>				
QEW	4476	5485	6056	6101
<b>Screenline Total</b>	<b>4476</b>	<b>5485</b>	<b>6056</b>	<b>6101</b>
<b>East of Winston Churchill Boulevard</b>				
QEW	4581	5482	6427	6443
<b>Screenline Total</b>	<b>4581</b>	<b>5482</b>	<b>6427</b>	<b>6443</b>
<b>North of Leighland Avenue</b>				
Trafalgar Road	1356	1879	1531	2201
<b>Screenline Total</b>	<b>1356</b>	<b>1879</b>	<b>1531</b>	<b>2201</b>
<b>South of Cross Avenue</b>				
Trafalgar Road	1739	1861	1187	1808
<b>Screenline Total</b>	<b>1739</b>	<b>1861</b>	<b>1187</b>	<b>1808</b>

**Table A- 2: AM Peak Hour Ramp Volume Comparison**

<b>QEW / Dorval Drive</b>	<b>2031 Do Nothing</b>	<b>2031 Future</b>
QEW W - Dorval N/S	739	1072
QEW E - Dorval N/S	842	1546
Dorval S - QEW E	665	666
Dorval S - QEW W	412	411
Dorval N - QEW E	990	1054
Dorval N - QEW W	272	273
<b>Interchange Total</b>	<b>3920</b>	<b>5022</b>
<b>QEW / Trafalgar Road</b>		
QEW W - Trafalgar N/S	1296	1696
QEW E - Trafalgar N/S	700	1265
Trafalgar S - QEW E	1014	728
Trafalgar S - QEW W	643	736
Trafalgar N - QEW E	470	386
Trafalgar N - QEW W	688	1105
<b>Interchange Total</b>	<b>4811</b>	<b>5916</b>
<b>QEW / Royal Windsor Drive</b>		
QEW W - Royal Windsor	581	994
Royal Windsor - QEW W	353	814
QEW E - Royal Windsor		866
Royal Windsor - QEW E		861
QEW W - Cross Ave		38
<b>Interchange Total</b>	<b>934</b>	<b>3573</b>
<b>QEW / Ford Drive / Highway 403</b>		
QEW W - Ford N/S	709	864
QEW W - Hwy 403 N	3525	4410
QEW E - Ford N/S	706	701
Hwy 403 N - QEW W	1608	3914
Ford N/S - QEW E	976	869
Ford S - QEW E	612	611
Ford S - QEW W	93	92
Ford N - QEW W	166	256
QEW E - Hwy 403 N	757	723
Hwy 403 N - QEW E	364	638
Ford Drive N - Hwy 403 N	472	488
<b>Interchange Total</b>	<b>9988</b>	<b>13566</b>
<b>QEW / Winston Churchill Blvd</b>		
QEW W - Winston Churchill N/S	485	592
QEW E - Winston Churchill N/S	1111	1123
Winston Churchill S - QEW E	346	346
Winston Churchill S - QEW W	372	366
Winston Churchill N - QEW E	464	457
Winston Churchill N - QEW W	382	389
<b>Interchange Total</b>	<b>3160</b>	<b>3273</b>

**Table A- 3: AM Peak Hour Turning Intersection Movement Comparison**

Intersection	TM	2031 Do Nothing	2031 Future
Trafalgar Rd / Leighland Ave-Iroquois Shore Blvd	EBL	44	66
	EBT	231	348
	EBR	245	338
	WBL	329	471
	WBT	74	267
	WBR	79	271
	NBL	156	217
	NBT	1232	1545
	NBR	434	360
	SBL	221	318
	SBT	1213	1747
Trafalgar Rd / North Service Rd N	EBL	13	13
	EBR	157	157
	WBL	477	908
	WBT	30	78
	WBR	192	248
	NBT	1616	1858
	SBT	1762	2514
	SBR	7	10
Trafalgar Rd / QEW EB Off-ramp	EBL	725	909
	EBT	n/a	232
	EBR	549	554
	NBT	1527	1658
	SBT	1265	2073
Trafalgar Rd / Argus Rd	EBR	44	44
	SBR	138	250
Trafalgar Rd / Cross Ave-South Service Rd	EBL	572	568
	EBT	404	399
	EBR	152	150
	WBL	289	355
	WBT	759	949
	WBR	750	517
	NBL	141	151
	NBT	1225	1296
	NBR	377	411
	SBL	380	204
	SBT	744	1301
Royal Windsor Dr / The Canadian Rd-South Service Rd E	EBL	144	153
	EBT	614	564
	EBR	39	n/a
	WBL	246	n/a
	WBT	227	861
	WBR	12	21
	NBL	172	73
	NBT	99	177
	NBR	277	738
	SBL	14	18
	SBT	6	n/a
SBR	155	258	

## PM Peak Hour Model Results

**Table A- 4: PM Peak Hour Screenline Comparison**

	NB/EB		SB/WB	
	2031 Do Nothing	2031 Future	2031 Do Nothing	2031 Future
<b>West of Dorval Drive</b>				
QEW	5578	7848	4943	8178
<b>Screenline Total</b>	<b>5578</b>	<b>7848</b>	<b>4943</b>	<b>8178</b>
<b>West of Trafalgar Road</b>				
Leighland Avenue	644	644	442	792
North Service Road	305	305	65	177
QEW	6371	8618	4712	8744
Argus Road	57	57	129	250
Cross Avenue	2136	2101	856	1210
<b>Screenline Total</b>	<b>9513</b>	<b>11725</b>	<b>6204</b>	<b>11173</b>
<b>East of Trafalgar Road</b>				
Iroquois Shore Road	1004	832	689	1118
QEW	6785	8265	4678	8513
South Service Road	1598	1482	342	497
<b>Screenline Total</b>	<b>9387</b>	<b>10579</b>	<b>5709</b>	<b>10128</b>
<b>West of Ford Drive</b>				
QEW	5870	7859	4470	8396
<b>Screenline Total</b>	<b>5870</b>	<b>7859</b>	<b>4470</b>	<b>8396</b>
<b>West of Winston Churchill Boulevard</b>				
QEW	4654	6256	6645	6649
<b>Screenline Total</b>	<b>4654</b>	<b>6256</b>	<b>6645</b>	<b>6649</b>
<b>East of Winston Churchill Boulevard</b>				
QEW	4465	5860	6632	6709
<b>Screenline Total</b>	<b>4465</b>	<b>5860</b>	<b>6632</b>	<b>6709</b>
<b>North of Leighland Avenue</b>				
Trafalgar Road	1852	2416	1990	2081
<b>Screenline Total</b>	<b>1852</b>	<b>2416</b>	<b>1990</b>	<b>2081</b>
<b>South of Cross Avenue</b>				
Trafalgar Road	1385	1788	1275	1847
<b>Screenline Total</b>	<b>1385</b>	<b>1788</b>	<b>1275</b>	<b>1847</b>

**Table A- 5: PM Peak Hour Ramp Volume Comparison**

	<b>2031 Do Nothing</b>	<b>2031 Future</b>
<b>QEW / Dorval Drive</b>		
QEW W - Dorval N/S	595	936
QEW E - Dorval N/S	746	1451
Dorval S - QEW E	979	981
Dorval S - QEW W	491	491
Dorval N - QEW E	665	779
Dorval N - QEW W	430	430
<b>Interchange Total</b>	<b>3906</b>	<b>5068</b>
<b>QEW / Trafalgar Road</b>		
QEW W - Trafalgar N/S	1076	1500
QEW E - Trafalgar N/S	642	1349
Trafalgar S - QEW E	1096	744
Trafalgar S - QEW W	451	513
Trafalgar N - QEW E	481	401
Trafalgar N - QEW W	986	1133
<b>Interchange Total</b>	<b>4732</b>	<b>5640</b>
<b>QEW / Royal Windsor Drive</b>		
QEW W - Royal Windsor	463	951
Royal Windsor - QEW W	375	1003
QEW E - Royal Windsor		896
Royal Windsor - QEW E		915
QEW W - Cross Ave		338
<b>Interchange Total</b>	<b>838</b>	<b>4103</b>
<b>QEW / Ford Drive / Highway 403</b>		
QEW W - Ford N/S	1071	1429
QEW W - Hwy 403 N	2366	3087
QEW E - Ford N/S	1556	1597
Hwy 403 N - QEW W	1506	3880
Ford N/S - QEW E	537	518
Ford S - QEW E	305	305
Ford S - QEW W	77	76
Ford N - QEW W	159	229
QEW E - Hwy 403 N	694	736
Hwy 403 N - QEW E	499	1040
Ford Drive N - Hwy 403 N	625	517
<b>Interchange Total</b>	<b>9395</b>	<b>13414</b>
<b>QEW / Winston Churchill Blvd</b>		
QEW W - Winston Churchill N/S	872	1136
QEW E - Winston Churchill N/S	701	711
Winston Churchill S - QEW E	355	355
Winston Churchill S - QEW W	159	158
Winston Churchill N - QEW E	679	673
Winston Churchill N - QEW W	487	492
<b>Interchange Total</b>	<b>3253</b>	<b>3525</b>

**Table A- 6: PM Peak Hour Turning Intersection Movement Comparison**

Intersection	TM	2031 Do Nothing	2031 Future
Trafalgar Rd / Leighland Ave-Iroquois Shore Blvd	EBL	143	144
	EBT	274	276
	EBR	223	225
	WBL	307	367
	WBT	170	379
	WBR	174	370
	NBL	139	274
	NBT	1528	1902
	NBR	457	270
	SBL	269	287
	SBT	1574	1654
Trafalgar Rd / North Service Rd N	SBR	133	139
	EBL	37	37
	EBR	268	268
	WBL	327	828
	WBT	51	161
	WBR	266	340
	NBT	1807	2079
Trafalgar Rd / QEW EB Off-ramp	SBT	2041	2226
	SBR	14	15
	EBL	619	824
	EBT	n/a	333
Trafalgar Rd / Argus Rd	EBR	420	349
	NBT	1619	1740
	SBT	1172	1823
Trafalgar Rd / Argus Rd	EBR	57	57
	SBR	129	250
Trafalgar Rd / Cross Ave-South Service Rd	EBL	1115	1099
	EBT	936	913
	EBR	90	89
	WBL	355	438
	WBT	383	483
	WBR	696	250
	NBL	204	260
	NBT	906	1142
	NBR	282	379
	SBL	382	187
	SBT	834	1323
Royal Windsor Dr / The Canadian Rd-South Service Rd E	SBR	270	467
	EBL	186	47
	EBT	509	508
	EBR	208	n/a
	WBL	129	n/a
	WBT	396	1333
	WBR	16	37
	NBL	36	93
	NBT	39	258
	NBR	389	631
	SBL	14	20
SBT	21	n/a	
SBR	131	413	