<u>Microsimulation of the Toronto Waterfront Revitalization Plan</u>

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TABLE OF CONTENTS

1. Introduction

Mr. Robert Fung, Chair of the Toronto Waterfront Revitalization Corporation (TWRC), has stated that the revitalization of Toronto's waterfront is an infrastructure project driving an economic model that will help re-define Canada in the global economy. It will transform the waterfront into an international architectural, cultural, entertainment and recreational calling card, and most importantly, provide the people of Toronto, Ontario, and Canada with the great waterfront community they need, want and deserve. The revitalized waterfront will contain a network of 500 acres of new and improved public parks and open spaces. Streets will run from the city to bay and lakeside plazas. Lake Ontario Park, a new park the size of Vancouver's Stanley Park, will be built along the Outer Harbour. Mixed-use, sustainable communities will be developed, offering more than 7.6 million square feet of new commercial space and over 40,000 new residential units, including affordable housing. The Portlands District for Creativity and Innovation will be established and will be home to creative, knowledge-based industries, new residential neighbourhoods, and recreational and cultural amenities. Public transport will be the primary mode of travel. Water quality will be improved, and the Don River will have a new mouth to the bay. Contaminated lands will be made safe. An internationally recognized exhibition and entertainment district is proposed for Exhibition Place and Ontario Place.

One of the challenges facing the revitalization vision is the present form of the Gardiner Expressway. The elevated portion of expressway running through downtown Toronto is often regarded as an eyesore as well as a barrier separating the city from its waterfront and inhibiting better use of the waterfront lands. What to do about it, however, is not a simple question to answer. In a continuing effort to address this issue, the TWRC therefore has considered a number of alternative roadway configurations to replace the present expressway that would enhance access to the waterfront without depriving the city of one of its major traffic arteries. To help analyze the alternatives from a traffic operations perspective, the corporation privately retained a research team lead by Dr. Baher Abdulhai, a U of T Professor and the Director of its Intelligent Transportation Systems (ITS) Centre, to micro-simulate the different options using state of the art modeling of traffic networks. In this report, the investigating team presents the details of the approach adopted and the results of the investigation.

2. Objective and Scope

The objective of this investigation is to create a working microsimulation model for and undertake a microsimulation analysis of the Toronto Waterfront roadway system generally south of Queen Street between the Humber River in the West and Port Area in the East with prime focus on the Gardiner-Lake Shore-Front corridor. The investigation includes an assessment and comparison of the base case existing network and three alternative network configurations supplied by the Toronto Waterfront Revitalization Corporation (TWRC). The three alternative approaches were as follows:

(1) Replacement Approach;

(2) Transformation Approach; and

(3) Great Street Approach.

Descriptions of the road networks associated with each of the approaches are summarized below.

Replacement Approach

The idea behind this scheme is to replace the existing structure with roads on the surface, underground, and on the railway embankment, and to do so in a way that retains and if possible enhances traffic performance. East of the Front Street interchange, a four-lane express road runs underground to the north of Fort York from Strachan to Spadina. Similarly, to the east of the central area, a four-lane express road runs on the railway embankment between Jarvis and Cherry, with Lake Shore (at grade) beside it. In the central area between Sapdina and Jarvis, there are two five-lane one-way streets: eastbound on the surface and westbound partly on the surface and partly below grade;

Transformation Approach

The idea behind this scheme is to reduce the barrier effect of the expressway without removing the upper structure, which after all does not physically restrict pedestrian movement at grade, but to remove some of the ramps, which do. Secondly, to attend to the current anti-pedestrian environment below and adjacent to the structure by relocating Lake Shore Boulevard and building beneath the structure, thereby providing frontage to adjacent streets and treating the Gardiner as series of buildings and spaces with a roof carrying traffic. For most of its length, Lake Shore is beside rather than under the Gardiner, and has regular building frontage on one side and building frontage under the Gardiner on the other. Finally, the aesthetic problems are addressed by various architectural enhancements and cladding of the structure; and

Great Street Approach (GSA)

Three variations of the GSA were investigated. The volumes summarized below correspond to Variation 1. The GSA Variation 1 involves maintaining the elevated structure west of Spadina with a pair of transition ramps connecting the elevated section west of Spadina, to the surface east of Spadina. The initial concept had the EB and WB transition ramps separated by Lake Shore Boulevard (LSB), which would operate at-grade between to the two ramps. East of Spadina, the Gardiner and LSB are replaced by a surface transition section to Simcoe, a pair of five-lane one-way streets from Simcoe to Jarvis, and a ten-lane surface boulevard from Jarvis to the Don River.

During the course of the development, a number of variations were assessed in order to determine the preferred design of each approach. The scope of the investigation excluded explicit modeling of transit in the study area. However, transit effects were approximated by employing an average speed on transit routes obtained from a detailed simulation study along King Street completed by the project team for another assignment.

The results of the microsimulation modelling work for each of the approaches are discussed in Section 3. Details on the methodology and assumptions used to build and calibrate the various models are contained in Sections 4 through 10.

3. Results

3.1 Overall Results

The results of the micro-simulation runs for Existing Conditions, the Replacement Approach, the Transformation Approach and the Great Streets Approach (GSA) – Variation 1 are summarized in Tables 3.1 (a.m. peak hour) and 3.2 (p.m. peak hour). The tables compare the traffic operating characteristics using the Measures of Effectiveness (MOE) that are explained in detail in Section 5 of this report. The network used for the GSA Approach – Variation 1 is based on the preferred option which includes a 10-lane boulevard transition section with a landscaped median for the two blocks from Spadina to Simcoe, where Gardiner traffic merges with Lake Shore Boulevard (LSB) traffic. East of Simcoe, the street separates into a pair of 5-lane one-way streets. The streets join at Jarvis, with an 8-lane boulevard cross-section east of Jarvis.

The tables compare travel times/speeds expressed in several ways:

- For <u>all</u> trips modelled during the peak hour; and
- For <u>specific</u> trips, either between selected origin-destination (O-D) pairs, or along selected key routes.

Observations for <u>all</u> trips from Tables 3.1 and 3.2 are summarized as follows:

- There will be increases in overall and average travel times during both the a.m. and p.m. peak hours for all approaches compared to the existing condition;
- The most significant increases to overall and average travel times occur during the a.m. peak hour. Increases range from 14 percent for the Replacement and Transformation Approaches to 25 percent for the GSA – Variation 1. Increases to overall and average travel times during the p.m. peak hour range from approximately 4 percent for the Replacement and Transformation Approaches to 10 percent for the GSA – Variation 1;
- Accordingly the most significant decreases in overall speed also occurred during the a.m. peak hour. Decreases in overall speed during the a.m. peak hour range from 13 percent for the Replacement, 16 percent for the Transformation, to 23 percent for the GSA –Variation 1. For the p.m. peak hour, no decreases in overall speed occurred for the Replacement and Transformation Approaches. A decrease in overall speed of 7 percent occurred in the GSA-Variation 1; and

Table 3.1: Paramics Micro-Simulation Overall Results - A.M. Peak Hour

Measure of Effectiveness	Existing Values	Replacement Approach[1]		Transformation Approach[1]		Great Streets Approach[1,2]	
		Values	Change Relative to Existing	Values	Change Relative to Existing	Values	Change Relative to Existing
Total Travel Time during Peak Hour (min)							
Average	402,973	458,191	14%	460,466	14%	502,227	25%
Minimum	391,124	449,707		450,209		489,195	
Maximum	417,142	467,420		475,404		522,931	
Standard Deviation	7,472	5,014		6,900		6,805	
Average Travel Time during Peak Hour (min)							
Average	8.53	9.70	14%	9.77	14%	10.65	25%
Minimum	8.32	9.53		9.57		10.46	
Maximum	8.82	9.93		10.10		11.04	
Standard Deviation	0.14	0.09		0.15		0.14	
Average Speed during Peak Hour (km/h)							
Average	43.4	37.9	-13%	36.6	-16%	33.5	-23%
Minimum	41.1	36.1		35.0		31.9	
Maximum	45.0	39.1		38.1		34.4	
Standard Deviation	1.1	0.8		0.7		0.6	
O-D Travel Time (min)							
Inbound to Cental Area							
Humber River to King & Bay	14.45	16.78	16%	18.36	27%	17.27	20%
DVP @ Dundas to King & Bay	6.30	6.84	9%	7.09	12%	9.44	50%
Queen & Woodbine to King & Bay	10.88	12.59	16%	12.63	16%	12.41	14%
Outbound from Central Area							
King & Bay to Humber River	13.22	13.05	-1%	15.14	15%	14.68	11%
King & Bay to DVP @ Dundas	7.95	7.29	-8%	7.90	-1%	8.73	10%
King & Bay to Queen & Woodbine	12.83	14.00	9%	12.94	1%	16.55	29%
Key Route Travel Time (min)							
Eastbound Trips							
Humber River to Dufferin via FGE	10.14	9.20	-9%	9.87	-3%	9.53	-6%
Dufferin to Yonge via FGE and GLC[3]	3.30	5.70	73%	5.34	62%	6.62	100%
Yonge to DVP @ Dundas via GLC[3]/DVP	3.90	4.10	5%	4.41	13%	6.64	70%
Total: Humber River to DVP/Dundas	**17.34**	**19.00**	**10%**	**19.62**	**13%**	**22.79**	**31%**
Humber River to Dufferin via FGE	10.14	9.20	-9%	9.87	-3%	9.53	-6%
Dufferin to Yonge via FGE and GLC[3]	3.30	5.70	73%	5.34	62%	6.62	100%
Yonge to Queen/Woodbine via GLC	8.06	9.74	21%	9.67	20%	12.23	52%
Total: Humber River to Queen/Woodbine	**21.50**	**24.65**	**15%**	**24.89**	**16%**	**28.38**	**32%**
Westbound Trips							
DVP @ Dundas to Yonge via DVP/GLC	3.91	4.59	17%	4.38	12%	6.28	60%
Yonge to Dufferin via FGE and GLC	3.14	4.62	47%	5.09	62%	6.12	95%
Dufferin to Humber River via FGE	8.45	6.12	-28%	7.50	-11%	7.50	-11%
Total: DVP/Dundas to Humber River	**15.51**	**15.33**	**-1%**	**16.96**	**9%**	**19.90**	**28%**
Queen/Woodbine to Yonge via GLC	8.95	10.66	19%	11.49	28%	12.74	42%
Yonge to Dufferin via FGE and GLC	3.14	4.62	47%	5.09	62%	6.12	95%
Dufferin to Humber River via FGE	8.45	6.12	-28%	7.50	-11%	7.50	-11%
Total: Queen/Woodbine to Humber River	**20.54**	**21.40**	**4%**	**24.08**	**17%**	**26.36**	**28%**

Notes:
1. All future network alternatives include the Front St. Extension with 4 lanes and grade separation at Strachan
2. The network assumed for the GSA Approach – Variation 1 is based on the preferred option which includes a 10 lanes transition section for the two blocks from Spadina to Simcoe where Gardiner traffic merges with Lake Shore Boulevard (LSB) traffic. East of Simcoe, the street separates into a pair of 5-lane one-way streets. The streets join at Jarvis, with a basic 8-lane cross-section east of
3. "GLC" represents the Gardiner / Lake Shore Boulevard road network that is in place for each of the three approaches between Spadina and the Don Roadway.

Table 3.2: Paramics Micro-Simulation Overall Results - P.M. Peak Hour

Measure of Effectiveness	Existing Values	Replacement Approach[1]		Transformation Approach[1]		Great Streets Approach[1,2]	
		Values	Change Relative to Existing	Values	Change Relative to Existing	Values	Change Relative to Existing
Total Travel Time during Peak Hour (min)							
Average	506,351	524,701	4%	520,292	3%	557,482	10%
Minimum	490,775	505,982		505,786		549,801	
Maximum	522,260	543,751		532,806		566,150	
Standard Deviation	8,518	9,812		8,293		4,307	
Average Travel Time during Peak Hour (min)							
Average	10.71	11.09	4%	10.99	3%	11.78	10%
Minimum	10.43	10.80		10.70		11.59	
Maximum	10.99	11.42		11.29		12.00	
Standard Deviation	0.17	0.17		0.16		0.10	
Average Speed during Peak Hour (km/h)							
Average	36.5	36.0	-1%	36.4	0%	33.8	-7%
Minimum	35.4	34.6		35.4		33.3	
Maximum	38.0	37.1		37.2		34.5	
Standard Deviation	0.7	0.7		0.5		0.3	
O-D Travel Time (min)							
Inbound to Cental Area							
Humber River to King & Bay	14.88	17.16	15%	17.33	16%	16.94	14%
DVP @ Dundas to King & Bay	5.14	5.36	4%	5.67	10%	6.25	22%
Queen & Woodbine to King & Bay	9.72	10.56	9%	10.66	10%	10.99	13%
Outbound from Central Area							
King & Bay to Humber River	18.37	17.43	-5%	18.03	-2%	18.02	-2%
King & Bay to DVP @ Dundas	10.90	9.16	-16%	10.10	-7%	10.62	-3%
King & Bay to Queen & Woodbine	19.51	21.29	9%	21.33	9%	22.06	13%
Key Route Travel Time (min)							
Eastbound Trips							
Humber River to Dufferin via FGE	10.13	7.76	-23%	9.43	-7%	9.41	-7%
Dufferin to Yonge via FGE and GLC[3]	3.71	8.06	117%	6.86	85%	9.41	154%
Yonge to DVP @ Dundas via GLC[3]/DVP	5.74	4.31	-25%	6.42	12%	7.05	23%
Total: Humber River to DVP/Dundas	**19.57**	**20.13**	**3%**	**22.71**	**16%**	**25.86**	**32%**
Humber River to Dufferin via FGE	10.13	7.76	-23%	9.43	-7%	9.41	-7%
Dufferin to Yonge via FGE and GLC[3]	3.71	8.06	117%	6.86	85%	9.41	154%
Yonge to Queen/Woodbine via GLC	12.29	14.35	17%	16.14	31%	16.03	30%
Total: Humber River to Queen/Woodbine	**26.12**	**30.17**	**15%**	**32.42**	**24%**	**34.85**	**33%**
Westbound Trips							
DVP @ Dundas to Yonge via DVP/GLC	4.11	4.21	3%	4.85	18%	6.24	52%
Yonge to Dufferin via FGE and GLC	4.26	5.08	19%	5.63	32%	7.26	70%
Dufferin to Humber River via FGE	9.70	6.92	-29%	8.27	-15%	8.18	-16%
Total: DVP/Dundas to Humber River	**18.07**	**16.21**	**-10%**	**18.75**	**4%**	**21.68**	**20%**
Queen/Woodbine to Yonge via GLC	9.21	9.80	6%	11.05	20%	12.58	37%
Yonge to Dufferin via FGE and GLC	4.26	5.08	19%	5.63	32%	7.26	70%
Dufferin to Humber River via FGE	9.70	6.92	-29%	8.27	-15%	8.18	-16%
Total: Queen/Woodbine to Humber River	**23.18**	**21.80**	**-6%**	**24.96**	**8%**	**28.01**	**21%**

Notes:

1. All future network alternatives include the Front St. Extension with 4 lanes and grade separation at Strachan
2. The network assumed for the GSA Approach – Variation 1 is based on the preferred option which includes a 10 lanes transition section for the two blocks from Spadina to Simcoe where Gardiner traffic merges with Lake Shore Boulevard (LSB) traffic. East of Simcoe, the street separates into a pair of 5-lane one-way streets. The streets join at Jarvis, with a basic 8-lane cross-section east of
3. "GLC" represents the Gardiner / Lake Shore Boulevard road network that is in place for each of the three approaches between Spadina and the Don Roadway.

- The larger impacts to the a.m. peak hour network are likely a result of the fact that under existing conditions, the a.m. peak hour operates significantly better than during the p.m. peak hour. The overall existing travel time is approximately 20 percent lower during the a.m. peak hour. The a.m. peak hour traffic flow is also more "tidal" than the p.m. traffic flow (i.e. there are fewer trips in the non-peak direction). In the morning, most travel is for work purposes and traffic flow is heavier inbound to the central area; however, during the p.m. peak hour, inbound and outbound traffic flows are more balanced reflecting a greater mix of work trips and trips for concerts, sporting events and other sorts of downtown entertainment. Intersection operations are more efficient during the a.m. peak hour under tidal flow conditions since there are fewer conflicting movements competing for limited green time at signalized intersections. Signal timings can provide better coordination under tidal flow conditions.

Observations for selected trips from Tables 3.1 and 3.2 are summarized below. It is important to note that while trips between O-D pairs are important in understanding the effects on certain vehicle trips, the number of trips between each O-D pair represents only a small fraction of the total trips in the network.

- Increases in travel time for specific O-D pairs are generally largest for the GSA – Variation 1. The most significant travel time increase is associated with inbound trips from the zone located at the DVP and Dundas to the zone located at King and Bay during the a.m. peak hour. On average, the increase was 50 percent or just over 3 minutes (from just over 6 minutes to just over 9 minutes) for inbound travel times between these zones;
- Travel time increases were less than 3 minutes compared to the existing travel times for all other O-D pairs (both inbound and outbound) for each of the design approaches;
- Increases in travel times along identified key routes were also generally higher for the GSA – Variation 1 relative to the Replacement and Transformation Approaches;
- For the GSA - Variation 1, the minimum as well as the maximum key route travel time increases occurred during the p.m. peak hour. The minimum increase was approximately 3 ½ minutes for travel along the route from the DVP at Dundas to the Humber River. The maximum increase was approximately 8 ¾ minutes for travel along the route from the Humber River to Queen and Woodbine;

- For the Transformation Approach, the minimum as well as the maximum key route travel time increases also occurred during the p.m. peak hour. The minimum increase was less than one minute for travel along the route from the DVP at Dundas to the Humber River. The maximum increase was just over 6 minutes for travel along the route from the Humber River to Queen and Woodbine; and
- For the Replacement Approach, the maximum key route travel time increase was 4 minutes for the route from the Humber River to Queen and Woodbine. The key route travel time actually decreased by just under 2 minutes for travel along the route from the DVP at Dundas to the Humber River.

The future a.m. and p.m. peak hour link volumes in the study area for the Replacement, Transformation and Great Streets (Variation 1) Approaches are summarized in **Figures 3.l, 3.2** and **3.3** respectively. The intersection turning movement counts projected by the Paramics microsimulation runs are included in the Appendix. The counts represent average turn movement volumes compiled from numerous a.m. and p.m. peak hour model simulation runs.

3.2 Detailed Analysis of GSA – Variation 1 Scenarios

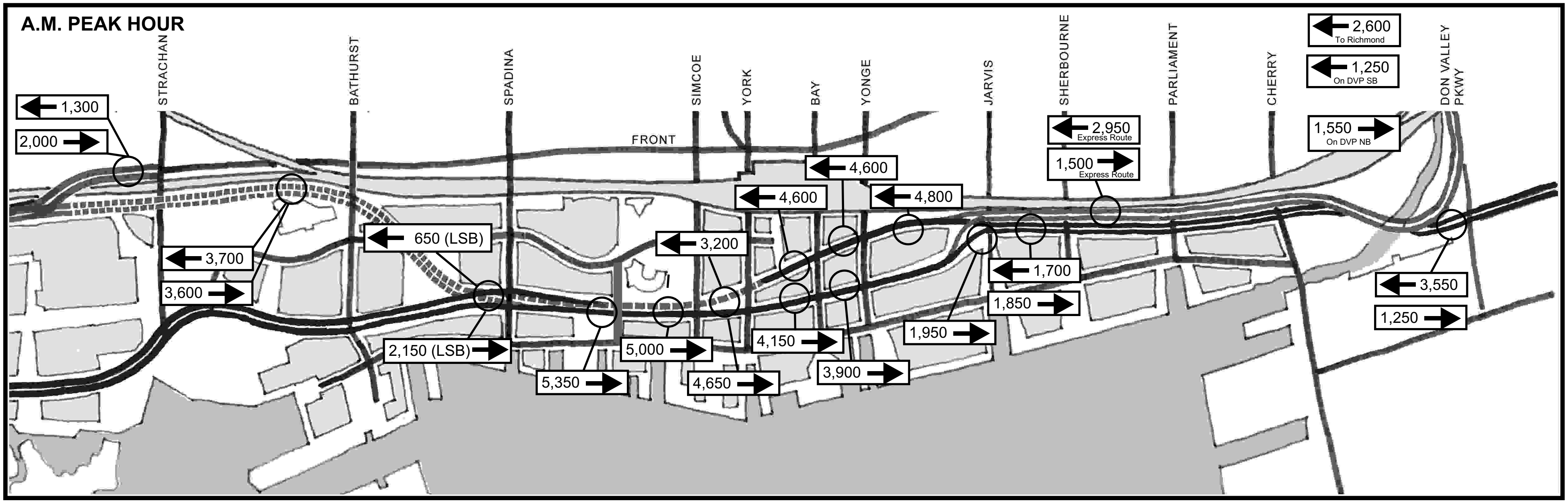
Further analysis was undertaken using the Paramics software for the GSA-Variation 1 to determine the implications of narrowing the proposed at-grade road. Three scenarios were tested, including:

(1) Five lanes in each direction from the Gardiner transition in the west to the DVP connection in the east;

(2) Five lanes in each direction from the Gardiner transition in the west to Jarvis Street in the east and four lanes each way east of Jarvis (Jarvis represents the location where the one-way pairs come together); and

(3) Four lanes in each direction from the Gardiner transition to the Don Roadway in the east.

The tables compare the proposed GSA – Variation 1 with 5 lanes per direction (Scenario 1) to Scenarios 2 and 3 in which specific sections of the future road network are narrowed to 4 lanes per direction. The results of the micro-simulation runs for the three GSA – Variation 1 scenarios are based on the same MOE's used to assess the three approaches. The results are summarized in Tables 3.3 and 3.4.



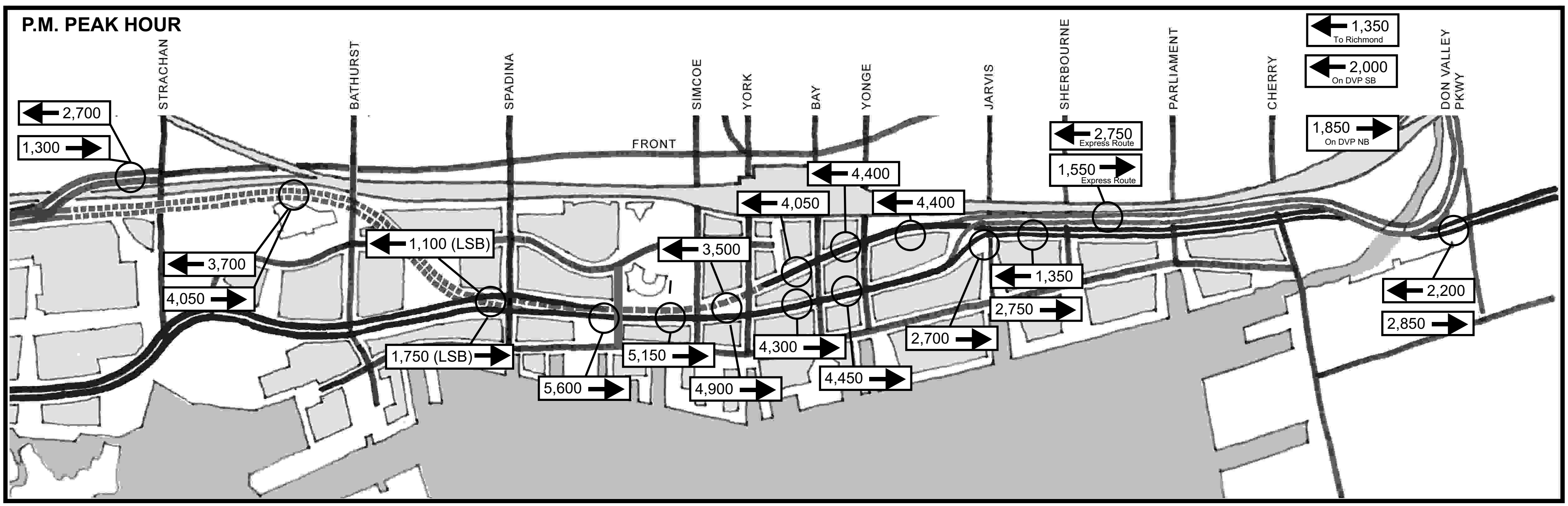
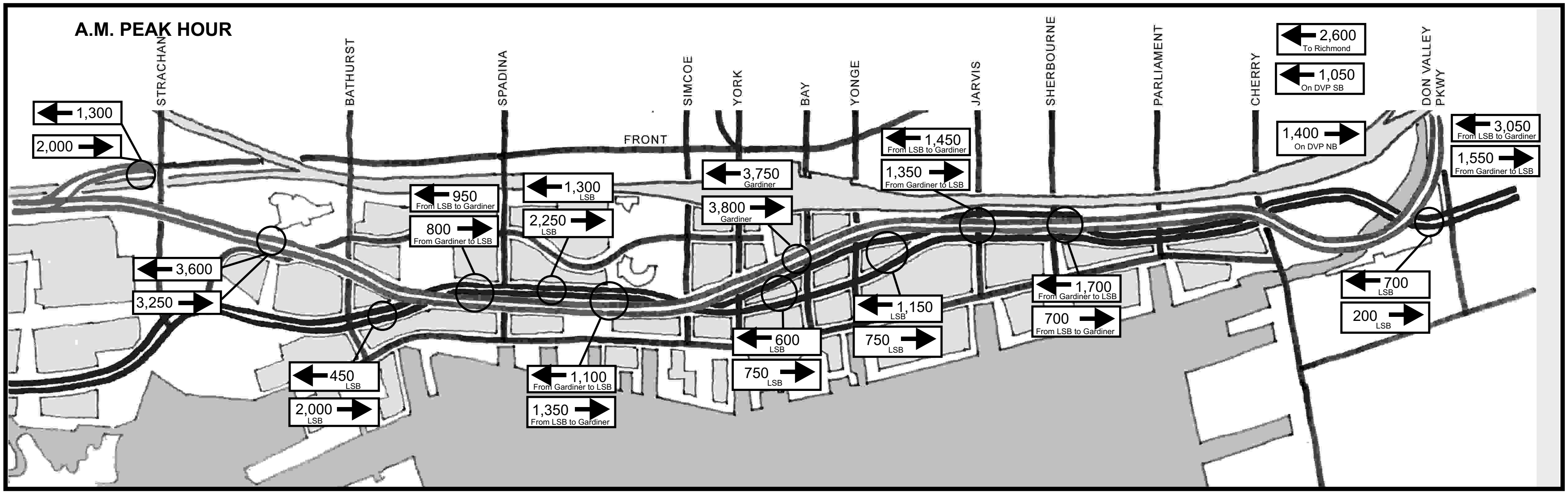


FIGURE 3.1
REPLACEMENT APPROACH - LINK VOLUMES



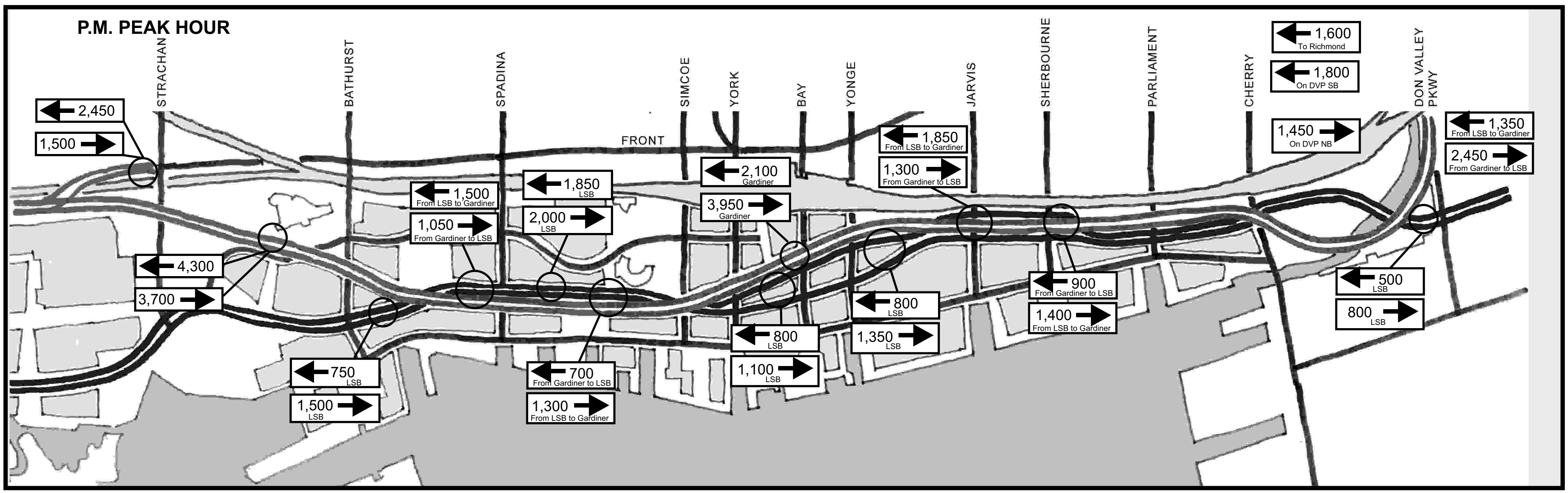


FIGURE3.2
TRANSFORMATION APPROACH - LINK VOLUMES

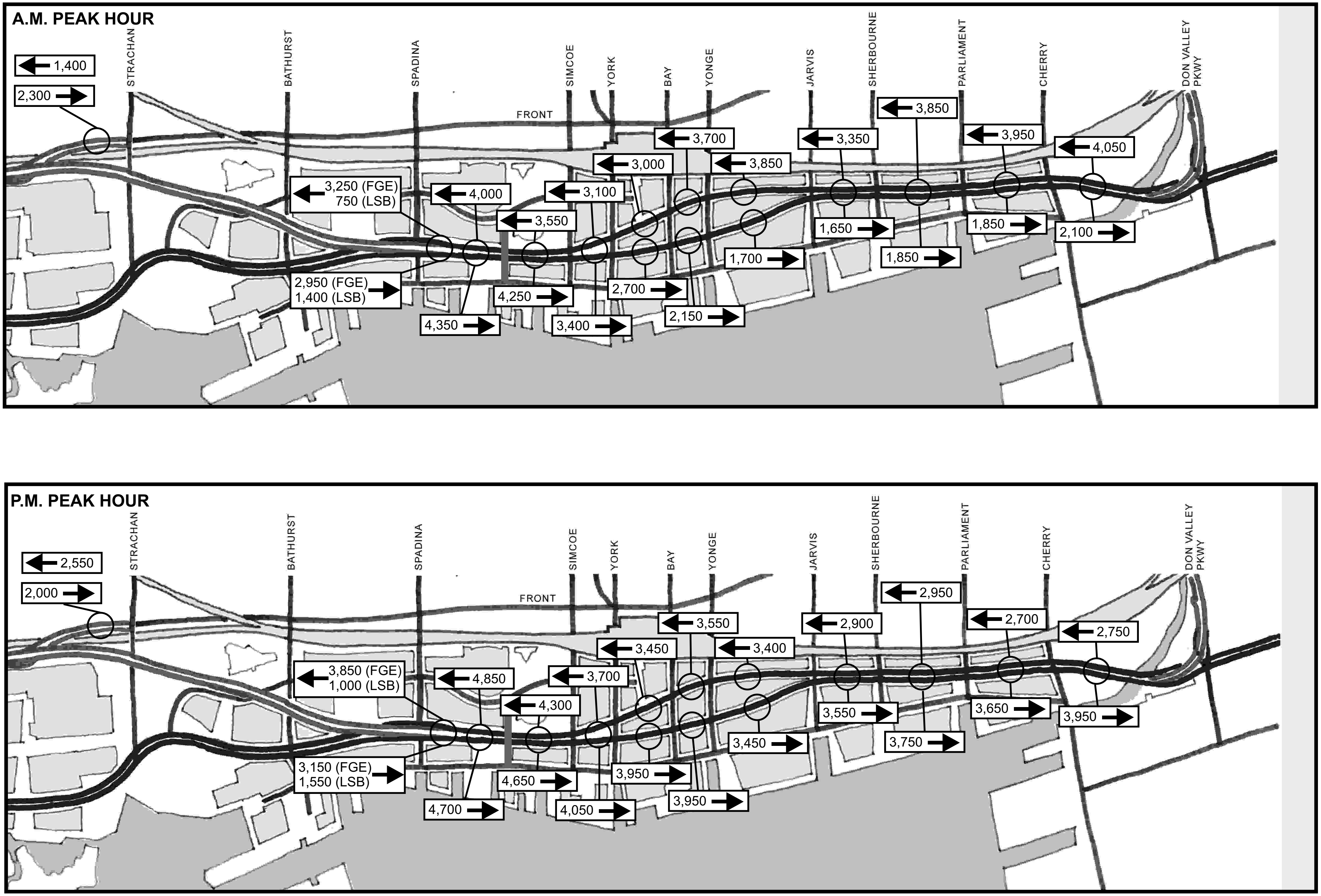


FIGURE 3.3
GREAT STREETS APPROACH VARIATION 1- LINK VOLUMES

Table 3.3: Paramics Micro-Simulation Great Streets Approach (GSA) - Variation 1 - A.M. Peak Hour

Measure of Effectiveness	Scenario 1	Scenario 2		Scenario 3	
	5 Lanes in Each Direction	4 Lanes in Each Direction, East of Jarvis		4 Lanes in Each Direction	
	Values	Values	Change Relative to Scenario 1	Values	Change Relative to Scenario 1
Total Travel Time during Peak Hour (min)					
Average	500,402	502,227	0%	507,939	2%
Minimum	485,732	489,195		495,970	
Maximum	511,947	522,931		520,328	
Standard Deviation	6,260	6,805		6,914	
Average Travel Time during Peak Hour (min)					
Average	10.62	10.65	0%	10.77	1%
Minimum	10.34	10.46		10.56	
Maximum	10.78	11.04		10.98	
Standard Deviation	0.11	0.14		0.12	
Average Speed during Peak Hour (km/h)					
Average	33.7	33.5	-1%	33.0	-2%
Minimum	32.8	31.9		31.7	
Maximum	35.5	34.4		33.9	
Standard Deviation	0.5	0.6		0.6	
Total Trips Completed During Peak Hour					
Average	37682	37649	0%	37527	0%
Minimum	37341	37197		36871	
Maximum	38135	38030		37960	
Standard Deviation	236	247		305	
O-D Travel Time (min)					
Inbound to Cental Area					
Humber River to King & Bay	17.40	17.27	-1%	17.37	0%
DVP @ Dundas to King & Bay	9.54	9.44	-1%	9.61	1%
Queen & Woodbine to King & Bay	12.16	12.41	2%	12.62	4%
Outbound from Central Area					
King & Bay to Humber River	15.10	14.68	-3%	14.92	-1%
King & Bay to DVP @ Dundas	9.01	8.73	-3%	8.91	-1%
King & Bay to Queen & Woodbine	16.62	16.55	0%	16.02	-4%
Key Route Travel Time (min)					
Eastbound Trips					
Humber River to Dufferin via FGE	9.36	9.53	2%	9.35	0%
Dufferin to Yonge via FGE and GLC[3]	6.90	6.62	-4%	7.06	2%
Yonge to DVP @ Dundas via GLC[3]/DVP	6.83	6.64	-3%	6.64	-3%
Total: Humber River to DVP/Dundas	**23.09**	**22.79**	**-1%**	**23.05**	**0%**
Humber River to Dufferin via FGE	9.36	9.53	2%	9.35	0%
Dufferin to Yonge via FGE and GLC[3]	6.90	6.62	-4%	7.06	2%
Yonge to Queen/Woodbine via GLC	12.40	12.23	-1%	12.23	-1%
Total: Humber River to Queen/Woodbine	**28.65**	**28.38**	**-1%**	**28.64**	**0%**
Westbound Trips					
DVP @ Dundas to Yonge via DVP/GLC	6.12	6.28	3%	6.46	6%
Yonge to Dufferin via FGE and GLC	6.13	6.12	0%	6.17	1%
Dufferin to Humber River via FGE	7.50	7.50	0%	7.50	0%
Total: DVP/Dundas to Humber River	**19.74**	**19.90**	**1%**	**20.13**	**2%**
Queen/Woodbine to Yonge via GLC	12.50	12.74	2%	12.94	3%
Yonge to Dufferin via FGE and GLC	6.13	6.12	0%	6.17	1%
Dufferin to Humber River via FGE	7.50	7.50	0%	7.50	0%
Total: Queen/Woodbine to Humber River	**26.13**	**26.36**	**1%**	**26.61**	**2%**

Table 3.4: Paramics Micro-Simulation Great Streets Approach (GSA) - Variation 1 - P.M. Peak Hour

Measure of Effectiveness	Scenario 1	Scenario 2		Scenario 3	
	5 Lanes in Each Direction	4 Lanes in Each Direction, East of Jarvis		4 Lanes in Each Direction	
	Values	Values	Change Relative to Scenario 1	Values	Change Relative to Scenario 1
Total Travel Time during Peak Hour (min)					
Average	560,674	557,482	-1%	573,726	2%
Minimum	548,580	549,801		556,621	
Maximum	571,149	566,150		585,782	
Standard Deviation	5,807	4,307		7,602	
Average Travel Time during Peak Hour (min)					
Average	11.86	11.78	-1%	12.14	2%
Minimum	11.65	11.59		11.83	
Maximum	12.08	12.00		12.33	
Standard Deviation	0.13	0.10		0.13	
Average Speed during Peak Hour (km/h)					
Average	33.5	33.8	1%	32.4	-3%
Minimum	32.5	33.3		31.6	
Maximum	34.4	34.5		33.3	
Standard Deviation	0.6	0.3		0.5	
Total Trips Completed During Peak Hour					
Average	Not Available	Not Available		Not Available	
Minimum	Not Available	Not Available		Not Available	
Maximum	Not Available	Not Available		Not Available	
Standard Deviation	Not Available	Not Available		Not Available	
O-D Travel Time (min)					
Inbound to Cental Area					
Humber River to King & Bay	17.64	16.94	-4%	18.47	5%
DVP @ Dundas to King & Bay	6.08	6.25	3%	6.43	6%
Queen & Woodbine to King & Bay	10.93	10.99	1%	11.41	4%
Outbound from Central Area					
King & Bay to Humber River	18.03	18.02	0%	18.55	3%
King & Bay to DVP @ Dundas	10.55	10.62	1%	10.86	3%
King & Bay to Queen & Woodbine	21.56	22.06	2%	21.88	1%
Key Route Travel Time (min)					
Eastbound Trips					
Humber River to Dufferin via FGE	9.61	9.41	-2%	9.59	0%
Dufferin to Yonge via FGE and GLC[3]	10.06	9.41	-7%	9.97	-1%
Yonge to DVP @ Dundas via GLC[3]/DVP	7.00	7.05	1%	7.05	1%
Total: Humber River to DVP/Dundas	**26.67**	**25.86**	**-3%**	**26.62**	**0%**
Humber River to Dufferin via FGE	9.61	9.41	-2%	9.59	0%
Dufferin to Yonge via FGE and GLC[3]	10.06	9.41	-7%	9.97	-1%
Yonge to Queen/Woodbine via GLC	15.73	16.03	2%	15.29	-3%
Total: Humber River to Queen/Woodbine	**35.40**	**34.85**	**-2%**	**34.86**	**-2%**
Westbound Trips					
DVP @ Dundas to Yonge via DVP/GLC	6.15	6.24	2%	6.35	3%
Yonge to Dufferin via FGE and GLC	7.28	7.26	0%	7.52	3%
Dufferin to Humber River via FGE	8.18	8.18	0%	8.17	0%
Total: DVP/Dundas to Humber River	**21.61**	**21.68**	**0%**	**22.04**	**2%**
Queen/Woodbine to Yonge via GLC	12.47	12.58	1%	12.70	2%
Yonge to Dufferin via FGE and GLC	7.28	7.26	0%	7.52	3%
Dufferin to Humber River via FGE	8.18	8.18	0%	8.17	0%
Total: Queen/Woodbine to Humber River	**27.93**	**28.01**	**0%**	**28.39**	**2%**

Observations for all trips from Tables 3.3 and 3.4 are summarized as follows:

- In general, the effect during the a.m. and p.m. peak hours of narrowing to 8 lanes east of Jarvis (Scenario 2) was negligible. There was a noticeable effect as a result of reducing the number of lanes across the entire GLC section (Scenario 3);
- Total and average travel times for Scenario 2 were unchanged during the a.m. and p.m. peak hours from those observed for Scenario 1. Total and average travel times increased by 2 percent for Scenario 3; and
- There was a negligible change in average speed during the a.m. and p.m. peak hours for Scenario 2. The average speed decreased by 2 percent (a.m. peak) and 3 percent (p.m. peak) for Scenario 3.

Observations for selected trips from Tables 3.3 and 3.4 are summarized below.

- The maximum travel time increase for trips between O-D pairs in Scenario 2 occurred during the p.m. peak hour for travel between a zone located in the area of the DVP/Dundas interchange and the Central Area (represented by a zone in the area of the King/Bay intersection). The travel time increased by 3 percent or less than half a minute *;
- The maximum travel time increase for trips between O-D pairs in Scenario 3 also occurred during the p.m. peak hour for travel between a zone located in the area of the Humber River and the Central Area (represented by a zone in the area of the King/Bay intersection). The travel time increased by 5 percent or just under a minute *; and
- Increases in key route travel times during the a.m. and p.m. peak hours were negligible for Scenario 2 and were approximately 2 percent for Scenario 3 *.

**It is important to also consider the ability of the network to accommodate demand. Small travel time changes may reflect diversion of a larger number of trips to other routes or non-completion of trips during the peak hour (i.e. peak spreading, which would be problematic given the existing pattern of high demand throughout the day). These isolated results should not be taken as conclusive without consideration of demand.*

The intersection turning movement counts projected by the Paramics microsimulation runs for the three “Great Street” approaches are included in the Appendix.

3.3 Analysis of the GSA – Variation 1 Link Volumes

The original MOE's were developed to test the macroscopic impacts of GLC approaches (i.e. Replacement, Transformation or Great Streets) which had significantly different road network characteristics. As shown above, the MOE's are not as effective for testing microscopic, approach specific changes that are relatively minor with respect to the size of the entire road network.

Therefore, projected turning movement volumes were extracted from the model in an effort to better understand the magnitude of traffic demand projected on the links of the GSA – Variation 1 road network. The link volumes provide additional insight with respect to the lanes requirements for the projected vehicle volumes. The future a.m. and p.m. link volumes are summarized in Figure 10.3.

The road network associated with the GSA – Variation 1 is best described in three sections:

1. Transition Section – located between the new Spadina transition ramps and Simcoe Street. This section serves a highly functional transportation role and has limited urban design opportunities;
2. Central Section – located between Simcoe Street and Jarvis Street. In the Central Section, the Great Street will be a pair of 5 lane one-way streets providing access to the central waterfront area. The major street links providing pedestrian and vehicle access to the downtown core area are located in this section. There is the opportunity for a high level of urban design as well as a substantial amount of development; and
3. Eastern Section – located between Jarvis Street and the Don Roadway. This section will be a two-way road that is 8 lanes wide. There is the opportunity for a high level of urban design. However this section does not include the same number of north-south road links to the central city, and therefore does not provide as much access.

The following points are noted from Figure 3.3:

- The highest volumes in the study area will occur in the Transition section where Gardiner and Lake Shore traffic merge into a single surface roadway. The highest volumes occur during the p.m. peak hour with approximately 4,700 vehicles per hour (vph) eastbound and 4,850 vph westbound;
- The eastbound link volumes decrease significantly east of York Street during the a.m. peak hour as traffic is distributed to the north-south streets such as

Simcoe, York, Bay and Yonge that cross under the rail corridor to connect to the core area. However, eastbound link volumes remain high (a minimum of 3,450 vph on each link) across the entire study area during the p.m. peak hour;

- The reverse trend is observed for westbound link volumes. Westbound link volumes are high (a minimum of 3,100 vph on each link) across the entire study area during the a.m. peak hour. During the p.m. peak hour, link volumes are lower in the east and increase through and west of the central area (Yonge, Bay, York and Simcoe);
- The lane capacities in the Transition section are comparatively higher than those observed in the Central section. This reflects the functional role of this section and the limited number of permitted turn movements. Traffic movements are primarily through trips either from or towards the elevated Gardiner structure. The observed per lane demand is approximately 950 vehicles per hour per lane;
- In the Central section, the observed lane capacity decreases relative to the capacity observed in the Transition section. This reflects the increased number of turn movements and overall increased friction resulting from vehicle weaving. The observed per lane demand is approximately 800 vehicles per hour per lane; and
- In the Eastern section, the observed lane capacity is higher than was observed for the Central section. Most trips in this section are through or westbound right turn trips which maximize the amount of east-west green-time available at intersections. The observed per lane demand is approximately 950 vehicles per hour per lane.

4. The Analysis Approach: Dynamic Transportation Network Microsimulation

Conventional static traffic assignment tools are widely utilized for transportation network analysis at the planning level. However, they are generally inadequate if operational details are of interest. For analysis of traffic operations under realistically dynamic conditions, modern traffic simulation approaches are more appropriate. The prime objective for using traffic simulators is for dynamic transportation analysis, control and management. More specifically, simulators can play two distinct roles: [1] as an off-line evaluation/design tool and [2] as an on-line control/guidance tool. Both roles cover numerous Advanced Traffic Management and Information Systems (ATMIS) applications such as network design and performance analysis, provision of traveler information and route guidance, a wide variety of surface street and freeway adaptive control (adaptive signal control, adaptive ramp metering, lane use control, etc.), incident detection and management, automated toll collection, assessment of environmental impact of transport design and management, to name a few. The off-line role is simpler, since the demand for real-time operation/computation is not as large as it is for the on-line role. If a simulator is fast enough, however, it could be used for both functions off-line as well as on-line.

Transportation networks are, by default, dynamic systems that exhibit continuous changes in both the supply/performance and the demand/behavior conceptual sides. Unexpected events, incidents for example, inevitably occur and therefore change the supply side of the network. Any intervention by the Traffic Operations Centre (TOC) in charge, possibly in the form of updating control measures, further changes the supply side. Such changes motivate drivers to change their behavior in several ways, including en-route and/or pre-trip route re-choice, within the day, or from day to day. Similar dynamics take place regarding drivers' choice of departure times in response to the dynamically changing supply conditions. The collective user behavior and response in this fashion give rise to dynamic demand profiles. Therefore, for any simulation model to prove useful for dynamic transport management, it should be capable of:

1. Capturing the dynamics of supply, in terms of the detailed configuration of the transportation network and its performance in response to demands and TMC control functions implementation.
2. Capturing the dynamics of demand, in terms of dynamic user behavior in response to observed supply, either directly or via traveler information systems.
3. Capturing the complex dynamic interaction between supply and demand.
4. Performing faster than real-time to allow for pro-active (based on predicted conditions) rather reactive (based on observed conditions) dynamic transport management.

The above is a condensed conceptualization of dynamic transportation network management within which microsimulation plays a central modeling and design role.

The following details the highlights of the key components of the overall modeling approach used in this project. The modeling approach is divided into three categories: [1] supply/control related, [2] demand/behavior related, and [3] environmental-aspects related.

It is very important to emphasize that the role of a successful simulation model as we discuss herein is not restricted to the mere replication of reality in terms of counts, speeds and vehicle movements matching observations. Rather we envision and adopt a broader scope to develop a simulation-based dynamic traffic modeling and management tool that can replicate observed conditions, forecast future conditions, respond to policy changes, and also help design control and management strategies as well. (i.e. A comprehensive simulation-based traffic management laboratory). Not all capabilities of the model will be used within the scope of the current analysis project however, it can certainly be utilized in future phases.

4.1 Supply/Control

4.1.1 Modeling Detailed Integrated Networks

Both freeways and surface streets, and the seamless interaction between the two are modeled. Roadway network representation in the model is very detailed and comprehensive, covering the entire range of roadway categories, from minor roads, to arterial roads, to freeways. The modeler defines any number of categories as necessary; each with associated attributes such as the number of lanes, lane width, speed limit, type (urban street, or freeway), grade, cost factors to inflate or deflate the actual cost of travel on any particular road category, headway factors to increase or decrease the target headway on chosen links, tolls if applicable, together with a set of geometry related parameters. Links as well as lanes can been dedicated or barred to a certain class of vehicles. A postscript or GIS map is utilized and displayed in the background, over which nodes and links are placed. This significantly reduces the burden of network coding and editing as well as enhances the match between the resulting model and the real network.

Transit networks, route, and bus stops: bus/streetcar routes, service frequency, the exact locations of bus stops and terminals on links, can be explicitly modeled (beyond the scope of this project). Exclusive lanes could be dedicated to transit vehicles.

4.1.2 Surveillance

Point devices: points on the network are specified where statistics can be gathered. This is an emulation of a point detector, ranging from conventional loops to more recent types of detectors, such as ultrasonic, microwave, laser, etc. Collectable statistics include: flow, gaps, occupancy and lane changing. A similar approach is used for actuating signal in that approaching vehicles are detected using a point device.

Point-to-point measurements: although not explicitly named ‘probes’, individual vehicles can be traced through the network, and statistics gathered such as headway, speed, position, and acceleration. This is sufficient to emulate probe vehicles and or transit vehicles in a network equipped with continuous two-way communication capabilities such as GPS-based tracking devices.

4.1.3 Control devices

Traffic signals: Pre-timed signals can be coded through the Graphical User Interface (GUI). Through the GUI, signal timing details at each intersection are input such as cycle lengths, phases, and prioritization of movements. Offsets can also be defined for coordination purposes. Actuated signals and related applications such as signal priority strategies are programmed using an Application Programming Interface. Actuation is achieved by associating signal heads with loop detectors. Each group of loop detectors at the intersection-leg is associated with a phase. A phase could be a set of actions that form a ‘plan’. A signal plan is a set of conditional statements that vary the timings of the signals associated with that plan. Different plans are set using an array of IF-THEN-ELSE statements which control the cycle length, phase length, gap length etc. Although this low-level approach is not simple, it is very general and flexible.

4.1.4 Modeling traveler information and routing for vehicular traffic

The population of drivers or ‘Driver/Vehicle Units’ (DVU) is divided into “informed/familiar” and “uninformed/unfamiliar” units. The percentage of each is controllable. The uninformed/unfamiliar drivers choose routes based on the perceived static cost to their destination, on familiar/major routes only. Informed/familiar drivers have access to dynamically updated costs to the destination, and use them to make turning decisions at each decision point or junction in the network. Travel costs are provided at each junction in the form of a costs-to-destinations table. The source of the updated information is not explicitly identified, i.e. whether it is from in-vehicle units, changeable message signs or simple observation of congestion ahead or otherwise. Nevertheless, the effect of information provision is modeled under the assumption that such information is made available to all informed drivers at all junctions. The rate of information updating, which is definable, controls the ultimate effect on the informed/familiar sub-population of DVU. For instance, if the information update frequency is very low, this resembles the effect of commuters getting familiar with a road network over time. Conversely, if the information update frequency is very high (i.e. every few minutes or so), the effect would resemble the case of drivers with in-vehicle information units, displaying dynamic traffic conditions. Intermediate update frequencies can replicate en-route driver reaction to experienced congestion.

4.1.5 Incident/illegal parking and stopping modeling

Incident/illegal parking and stopping modeling can be modeled as occasional incidents with a pre-defined rate. An incident is modeled as a stopped vehicle. The user defines the types of incidents on each link, their duration and frequency (rate). The effect of having an incident rate applied to a link is that vehicles entering the link are selected at random based on the defined incident frequency, and an incident is applied. When a vehicle has an incident, it is brought to a halt gradually in the inside lane at a random point on the link. Subsequently, other vehicles are forced to manoeuvre around it. The stalled vehicle remains in position for the specified incident duration period before it moves again. Incident modeling has not been applied to the latest Waterfront models.

4.2 Demand/Behavior:

4.2.1 Time-dependent Origin-Destination (O/D) profiles

The model takes as input any number of O/D matrices, typically one for every period of the day. For instance, night-time, morning peak, inter-peak, and afternoon peak. Each O/D matrix specifies the total demand between O/D pairs in the entire period. A profile is specified for each O/D, which is the distribution of the total period's demand divided into 5 minutes intervals. The time-dependant five-minute dynamic demands are then used to release vehicles onto the network accordingly. This investigation considers the morning peak and afternoon peak hours.

4.2.2 Modeling transit demand

Passenger arrival frequency at each stop in passenger per minute and alighting information at each stop (number of passengers getting off at each stop) can be included as inputs. Transit demand has not been explicitly modeled. The impacts of streetcars and buses have been included as part of the link attributes.

4.2.3 O/D prediction

Although not explicitly a part of the integrated model, exogenous O/D update mechanisms will be used to enhance the quality of the available demand data as will be explained later in the report.

4.2.4 Modeling driver's 'travel' choice behavior:

In general, travelers are faced with choices including destination, mode, departure/arrival time, and route. Commuter work-related trips usually have the destination and mode pre-determined, and travelers dynamically choose departure/arrival time windows and routes, based on traffic conditions. Such choice dynamics and consequently traffic dynamics can vary in scope as either 'within-day dynamic' or 'day-to-day dynamic'. Further simplification is typically made by fixing the departure/arrival window and limiting the choice to route selection only. Within-day route choice dynamics in response to information can further be classified as either 'pre-trip' or 'en-route'. In the Waterfront model, route choice modeling is focused on within-day, en-route route choice dynamics only.

4.2.5 Modeling driver's 'driving' behavior

Driving behavior, in terms of car following, lane changing, gap acceptance, awareness and aggressiveness, is the heart of any microscopic simulator. In terms of car following, each Driver-Vehicle Unit (DVU) has a <u>target headway</u> or following distance that varies around a mean value depending on other factors such as weather, highway type, vehicle type, driver aggressiveness and awareness. High aggressiveness, for instance, would allow drivers to accept smaller headways. Similarly, a high awareness value would cause drivers to maintain longer headways near decision points. If a merging DVU is aggressive, it accepts smaller gaps. DVUs either accelerate, cruise, or brake to maintain the target headway stimulated by the perceived relative speed, acceleration, and brake lights of the vehicle ahead. <u>Perception-reaction lag</u> is taken into account. Under light traffic conditions, DVUs flow unconstrained by other vehicles, limited by the lane-specific mean target speed. Lane usage is affected by the vehicle's position relative to its target range of lanes, the latter being consistent with upcoming routing decisions, and the overtaking interactions between nearby vehicles. The target range of lanes is also affected by the DVU aggressiveness and awareness. A higher level of aggression causes a DVU to use the outer high-speed lanes, and a higher level of awareness causes a DVU to adopt the target lane for an impending turn sooner. Overtaking is controlled by varying two tables of thresholds. The lane-awareness threshold table specifies when a vehicle should move out to let a vehicle behind pass. If a DVU's awareness is greater than or equal to the threshold applicable to its current lane, it will move out. The lane-aggressiveness threshold is similar; if a DVU's aggressiveness is greater than the threshold applicable to its lane, it will attempt to overtake. DVU's propensity to change lanes can be controlled by varying the length of time that a vehicle must receive a positive stimulus, i.e. a suitable gap must exist in the target lane for "n" seconds in order for the vehicle to change lanes. To dampen lane-changing oscillations, a waiting period is specified. A vehicle receiving a negative stimulus must wait for the 'wait on failure' period before attempting to change lanes again. A vehicle successfully changing lanes must wait for the 'wait on success' period before attempting another lane-changing maneuver. Lane changing is therefore affected by both the availability and stability of acceptable gaps in the target lane as well as the history of lane changes of the DVU itself. Gap acceptance itself is function of DVU aggressiveness and awareness. The user defines drivers' aggressiveness and awareness by selecting a distribution for each, across the driver population (normal distribution for instance).

4.2.6 Modeling aggregate traffic behavior

Microscopic simulators in general produce more realistic traffic behavior, in terms of congestion propagation and dissipation, as opposed to mesoscopic, or macroscopic simulators. This is because car following and lane changing are explicitly modeled at the level of individual vehicles. Therefore, traffic operations quality indicators such as queue formation and dissipation, shockwave propagation are natural by-products of the modeling approach.

4.2.7 Modeling congestion pricing effect on demand

Congestion pricing is a supply parameter that directly influences demand and routing behavior. It is modeled explicitly in the link cost functions. It directly affects route choice behavior, which is based on travel costs.

4.3 Environmental Aspects

The current model uses simple look-up tables for exhaust pollution, noise pollution, and fuel consumption levels as function of vehicle type, speed and acceleration. Creating these tables was beyond the scope of this modeling exercise.

5. Investigation Steps

The following steps were followed during the course of the investigation:

1. Provision of descriptions for the Waterfront alternative concepts to IntelliCAN by the TWRC.
2. Documentation of background, motivation and significance of the proposed integrated microsimulation approach, as the most promising method to analyze strategically important roadway network configuration alternatives with micro-details.
3. Identification of key measures of effectiveness (MOEs) to be used for all comparisons (developed in consultation with the TWRC).
4. Coding the geometry of each Waterfront concept.
5. Acquisition and coding of signal timing plans for the status quo. Estimates are made for SCOOT controlled areas and future plans using combinations of actuated traffic signal control logic and coordinated pre-timed signalization as reasonable approximations.
6. Estimation of traffic demand for the AM peak using a three step iterative procedure: static equilibrium assignment for the GTA, estimation of *seed* Origin-Destination (O-D) demands using cordons around the study area, and a reverse-assignment O-D estimation procedure using actual turn and link counts (supplied to the team by the TWRC) to produce the final O-D matrix to be used to run the dynamic simulation model.
7. Calibration and refinement of network geometry by extensive visualization of traffic operations in the model and identification of potentially problematic areas followed by implementation of remedial changes. Weekly demonstrations to the TWRC were held to interactively refine the models.
8. Calibration of the model parameters (headway, reaction time, feedback interval, familiarity and perturbation) using an extensive and elaborate Genetic Algorithms approach to minimize discrepancies between simulation model output and field observations (link counts and turning volumes supplied to the team by the TRWC).

9. Preliminary runs of the modeled scenarios with preliminary results in the form of one or two MOE's (average travel time in the network and average delay).
10. The design plans were finalized based the interim results and other developments at the TWRC. The MOE's were also refined and finalized.
11. Final adjustments of any discrepancies in the model. The performance of the model network and its variants are assessed relative to each other and to the base case existing network. The final MOE's were based on detailed runs and stochastic analysis of the alternative configurations. Numerous simulation runs (10-30) per plan were conducted under varying conditions (varying seed). Statistics were gathered from each run.
12. Repeat steps 6 through 11 for the PM peak.
13. Preparation of final report and delivery of final presentation.

6. Measures of Effectiveness

The following Measures of Effectiveness (MOE) were used in the analysis and comparison of each alternative during the AM and PM peaks. The MOE's are described as follows:

1. *Total Travel Time* and *Average Time* (for all vehicle trips in the network in minutes) - include trips between all origin-destination (O-D) pairs within the network that both begin and are completed within the peak hour. Since a trip travel time needs to be recorded from its beginning to its end, the model can only report trips that reach their destination by the end of the peak hour. Also, including data from before the peak hour (i.e. trips that were partially completed during the half-hour warm-up period) is expected to be very unreliable.

2. *Average Speed* (for all vehicle trips in the network in km/h) - is the average speed of all vehicles in the network, reported on a minute-by-minute basis and averaged for the peak hour. As such, it can include all vehicles within the network during the peak hour, regardless of whether the individual trips are completed or not.

3. *O-D Travel Time* (in minutes) - is very similar to the Total and Average Travel times discussed above. Only trips that leave from their origin and reach their destination within the peak hour are included. The number of peak hour trips completed for each O-D pair is also recorded. To provide some context for the data obtained for the O-D pairs, there are approximately 70 O-D trips completed between the Humber River and the King/Bay zone during the a.m. peak hour. While this is one of the larger O-D pairs, it is significantly less than the 37,700 trips completed within the entire system during the a.m. peak hour. It should also noted that based on the relatively small number of completed trips for each O-D pair, minor variations in travel time are likely a result of statistical anomalies associated with the limited number of simulations runs that can be feasibly completed. There were approximately 21 runs for the a.m. peak hour models and 16 runs for the p.m. peak hour models. The O-D pairs were as follows:

   - from the Humber River to King & Bay
   - from King & Bay to the Humber River
   - from the DVP at Dundas to King & Bay
   - from King & Bay to the DVP at Dundas
   - from Queen & Woodbine to King & Bay
   - from King & Bay to Queen & Woodbine

4. *Key Route Travel Time* (in minutes) - is collected along one specific chain of roadway links for a defined route. This data is reported for every feedback interval (i.e. every 2 minutes), and is averaged for the peak hour. In this case, no consideration is given to the origins or destinations of the vehicles. The travel times are collected on a link-by-link basis, and a vehicle does not need to travel the complete route in order to be considered. As such, the link travel times of all vehicles travelling along any portion of the defined route, anytime within the peak hour, can be included. They are recorded regardless of whether they complete the route or trip by the end of the peak hour. It is noted that vehicles that are re-routed away from the defined route as a result of the road network associated with a specific option are not considered. It is also noted that parallel or competing routes between O-D pairs are not considered.

5. *Intersection Turning Movement Volumes* (in vehicles per hour) – were collected during the a.m. and p.m. peak hours for a number of intersections in the model study area.

7. Demand Estimation and Calibration

The estimation of travel demand in the Toronto Waterfront Area was necessary to develop a realistic simulation of traffic at the micro level. A three-step procedure was used to develop estimates of travel demand for the AM and PM peak hours. The estimates are based on Transportation Tomorrow Survey (TTS) data, which is a survey of household trip-making and demographics undertaken across the GTA. This data was adjusted to be consistent with road count data provided within the study area.

The three step procedure is as follows:

- Run a static equilibrium assignment for the Greater Toronto Area (GTA);
- Estimate seed origin-destination (O-D) demands using cordons located around the Toronto Waterfront study area; and
- Adjust the seed O-D demands to reflect actual link counts by applying a gradient O-D adjustment procedure.

These three steps are discussed in greater detail as follows:

7.1 Static Equilibrium Assignment for the Greater Toronto Area (GTA)

The AM Peak period (6:00 a.m. to 8:59 a.m.) and PM Peak period (3:00 p.m. to 5:59 p.m.) travel demand, were obtained for the GTA based on data from the 1996 TTS, a trip diary survey of approximately 5% of households in the GTA. The peak hour trip tables were developed by applying peak hour factors to the peak period travel demand. The appropriate AM and PM peak hour factors (i.e. trips in the peak hour compared to trips in the 3-hour peak period), were determined based on an assessment of TTS auto drive trips into and out of Planning District 1 for 15-minute intervals. Planning District 1 represents a convenient geographic area, which includes the Toronto central business district and the Toronto waterfront. Hourly total trips were generated to determine when the peak hour occurred within each of the peak periods. The appropriate peak hour factors were found to be 45% in the AM Peak period and 38% in the PM peak period. A test assignment of the peak period factors revealed that the PM peak hour factor of 38% resulted in appropriate traffic volumes on major roadways. However, the AM peak hour factor resulted in traffic volumes on the Gardiner Expressway and other major roadways that were significantly higher than the observed existing traffic volumes. Therefore, the AM peak hour factor was reduced to 40%, resulting in more realistic AM peak hour traffic volumes in the Waterfront area.

Static equilibrium assignments were then run in EMME/2 on the GTA road network for the AM and PM peak hours. The process of arriving at an acceptable GTA traffic assignment required a detailed review of the waterfront portion of the EMME/2 GTA network to ensure that the local level traffic was assigned with a satisfactory degree of accuracy.

The following modifications were made to the waterfront portion of the EMME/2 GTA network:

a) Increase the input for the speed and capacity of Lake Shore Boulevard from 50km/h with a capacity of 800 vehicles per hour (vph) to 60 km/hr with a capacity of 1,000vph (Bathurst St. to Yonge St.) and 900vph (Yonge St. to Parliament St.). This modification was made in the AM peak hour only. During the PM peak hour the east-west flows are expected to receive greater competition from north-south traffic, resulting in slower speeds and capacities.

b) Modified Gardiner Expressway and Don Valley Parkway ramp capacities, speeds and number of lanes to better reflect actual lane configurations and observed ramp volume counts.

c) Decreased speed and capacity of Lake Shore Boulevard east ramps entering/exiting the Gardiner Expressway east of the Don Valley Parkway from 110 km/hr with a capacity of 1,800vph to 70 km/hr with a capacity of 1,000vph. This change was made to reflect the removal of this section of the Gardiner Expressway and its replacement with a surface street and connecting ramps.

d) Eastern Avenue exit ramp capacity increased from 1,400vph to 2,000vph to reflect estimated future volumes in the AM peak hour of up to 2,075vph.

e) Increased speed/capacity of Front Street between York St. and Church St. from 40 km/hr with a capacity of 500vph to 50 km/hr with a capacity of 600vph.

f) Increased speed of King Street west of Bay Street from 40 km/hr to 50 km/h to divert trips away from Adelaide, which had too many trips, and attract trips to King and Front Streets, which were under-assigned.

g) Increased capacity on Richmond Street from the Don Valley Parkway to Bay Street from 2 lanes with a capacity of 700vph to 2 lanes with a capacity of 1,000vph to accommodate the observed AM peak hour total volume of 2,100vph.

h) Increased capacity on Lake Shore Boulevard from the Gardiner Expressway ramp (west end of study area to Bathurst Street) to 3 lanes with a capacity of

1,200vph given the existing inbound traffic volume of 4,000vph during the AM peak hour.

The assignment of GTA demand to the EMME/2 GTA network resulted in traffic volumes on major corridors that were reasonably consistent with observed road counts on major roadways in the Waterfront Area. These GTA traffic assignments were used as the basis for developing seed O-D demands for the Toronto Waterfront study area.

7.2 Estimation of Seed Origin-Destination (O-D) Demands Using Cordons Around the Toronto Waterfront Study Area

The Toronto Waterfront Study Area for the traffic microsimulation exercise, discussed later in this report, is approximately defined by cordons located north of Dundas Street, west of the Lakeshore ramps at the Humber River, and east of the intersection of Queen Street East at Woodbine Avenue. These cordons were chosen such that:

- The study area includes major decision points for inbound and outbound traffic;
- There is a "buffer area" surrounding the actual area of interest in the Toronto Waterfront; and
- TTS zone boundaries are respected, allowing the integrity of the O-D demand matrix to be retained in the model.

A total of 45 traffic zones are included in the study area. Each major roadway crossing the study area boundary is considered to be a gateway zone to the study area. A total of 34 gateways are included in the EMME/2 model. The gateways to the study area and the study area boundaries are shown in **Table 7.1** and **Figure 7.1**, respectively.

Table 7.1 – Gateways to the Study Area

Gateway ID	Roadway	Location
1	Lakeshore Blvd. West	East of Parklawn Rd.
2	Gardiner Expressway	East of Parklawn Rd.
3	S. Kingsway Ramp	Just south of The Queensway
4	The Queensway	West of Parkdale
5	Parkside Dr.	North of High Park Blvd.
6	Roncesvalles Ave.	North of High Park Blvd.
7	Dundas St. W.	West of Lansdowne
8	Lansdowne Ave.	North of College
9	College St.	East of Lansdowne
10	Dufferin St.	North of Dundas
11	Ossington Ave.	North of Dundas
12	Bathurst St.	North of Dundas
13	Spadina Ave.	North of Dundas
14	University Ave	North of Dundas
15	Bay St.	North of Dundas
16	Yonge St.	North of Dundas
17	Church St.	North of Dundas
18	Jarvis St.	North of Dundas
19	Sherbourne St.	North of Dundas
20	Parliament St.	North of Dundas
21	River St.	North of Dundas
22	Bayview Ave.	North of Dundas
23	Don Valley Parkway	North of Dundas
24	Broadview Ave.	South of Gerrard
25	Dundas St. E.	CN Rail Crossing
26	Carlaw Ave.	North of Queen
27	Jones Ave.	North of Queen
28	Greenwood Ave.	North of Queen
29	Coxwell Ave.	North of Queen
30	Kingston Rd.	North of Queen
31	Woodbine Ave.	North of Queen
32	Queen Street East	East of Woodbine
33	Island Ferry (Yonge St.)	
34	Island Ferry (Airport)	

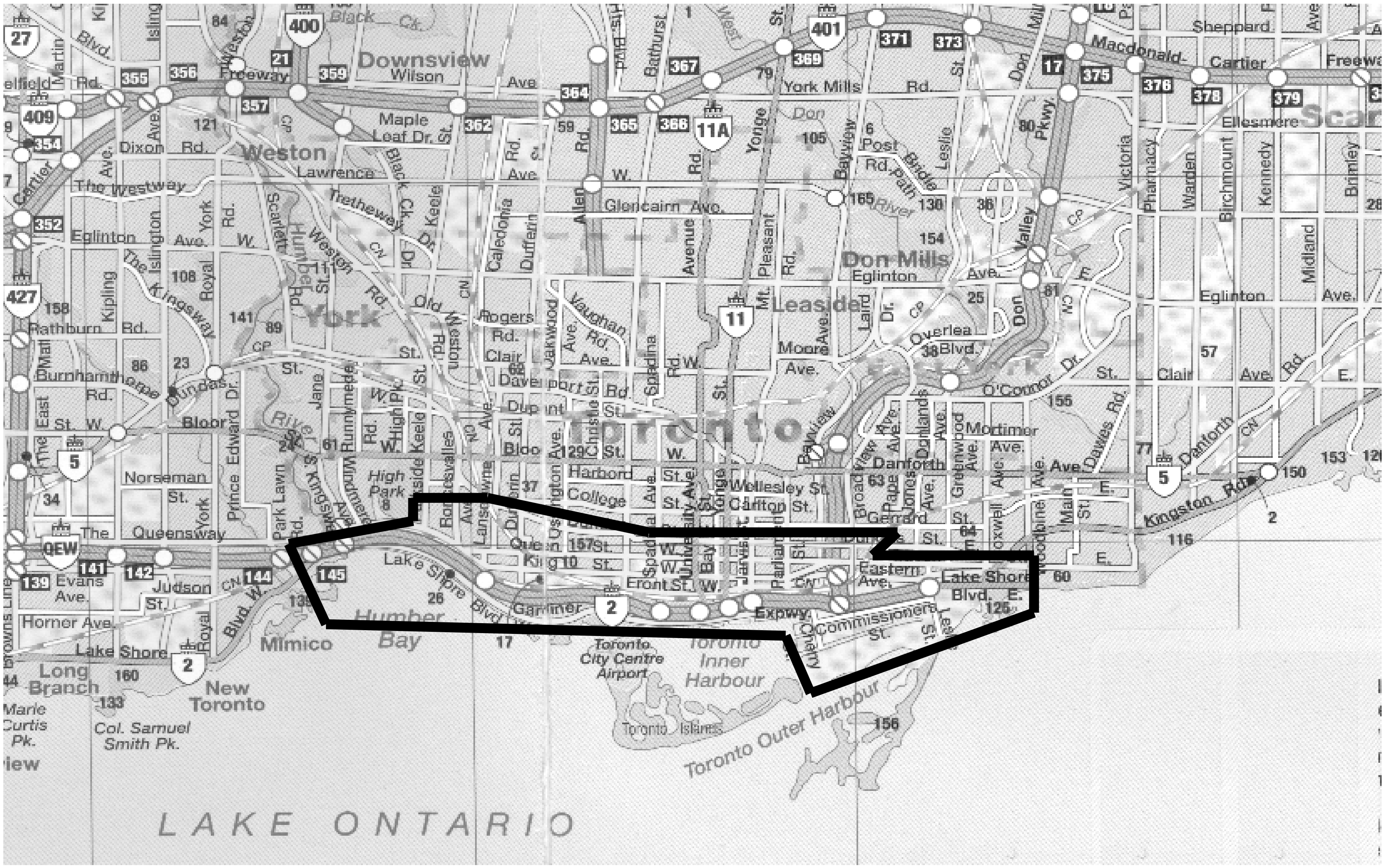


Figure 7.1 – Study Area Boundary

The seed O-D demands are determined from the GTA EMME/2 model by capturing traffic entering, exiting or travelling within the study area. The O-D demands take the form of a study area trip table that includes internal zones and external gateways. Thus, the seed O-D demand matrix represents a "cut out" of the GTA-wide demand that either originates in, is destined for, or simply passes through the study area.

A study area EMME/2 road network was also "cut out" from the GTA regional road network on which additional modifications could be made to better approximate travel demand in the waterfront area. A summary of "unadjusted" seed O-D demand matrices is shown in **Table 7.2**.

Table 7.2a – Summary of Seed O-D Travel Demand – AM Peak Hour

To / From	To Study Area Zones	To External Gateways	Total
From Study Area Zones	1,710	6,360	8,070
From External Gateways	26,020	11,080	37,100
Total	27,730	17,440	45,170

Table 7.2b – Summary of Seed O-D Travel Demand – PM Peak Hour

To / From	To Study Area Zones	To External Gateways	Total
From Study Area Zones	2,200	22,200	24,400
From External Gateways	9,220	10,680	19,900
Total	11,420	32,880	44,300

7.3 Adjustment of the Seed O-D Demands to Reflect Actual Link Counts

It is clear that the there are a number of unavoidable deficiencies in the use of TTS data to estimate total vehicular demand within the Toronto Waterfront study area. The following shortcomings must be addressed to result in an accurate assessment of peak hour demand.

- The seed O-D matrix is based on data from a 5% survey sample. The expansion of a 5% sample results in a matrix that is not as accurate as would be the case with a 100% sample.
- The seed matrix is developed from a regional scale EMME/2 planning model which is not intended to reproduce individual road volumes with a high degree of precision
- The seed matrix does not include commercial vehicle traffic

- There is a recognized under-reporting rate inherent in the TTS data, especially for non-work, non-school trips. In the survey, a single household member is asked to report on the entire households' travel, all of which the survey respondent may not be aware, or willing to report (DMG 1997)
- The TTS data was collected in 1996. Significant growth and changes in traffic patterns are likely to have occurred between 1996 and the time of this investigation.

The most direct method for addressing all of these concerns is to adjust the seed O-D demand matrix to reflect observed road counts. The gradient approach, a set of EMME/2 macros developed by Heinz Spiess (1990), is a computationally efficient method that modifies O-D demand to reflect road counts while making the least necessary change to the seed O-D demand matrix. This is important because it is desirable to maintain as much valuable information from all data sources as possible.

Road counts were obtained from the funding agency for the adjustment of the seed O-D demand matrix. The gradient approach converges most successfully when the majority of trips cross only one link that is to be adjusted to match a road count. Therefore, road counts were assembled for a set of screenlines well within the limits of the study area. The screenline locations are shown in **Figure 7.2a and 7.2b**. It is noted that road counts were not readily available for all roads crossing the screenline, and therefore the adjustment procedure could not include a complete set of screenline counts. Additional counts were used in the adjustment procedure at other locations that were considered to be critical, such as Gardiner Expressway ramps and selected study area gateways. All count locations used for the gradient adjustment procedure of the seed O-D demand are shown in **Figure 7.2a and 7.2b** for the AM and PM peak hours, respectively. All road counts applied in the procedure were collected in the late 1990s or early 2000s and included commercial as well as personal vehicles. It is noted that a larger number of road counts were required to adequately adjust the PM peak hour matrix, than for the AM peak hour matrix. The PM peak hour matrix was more adjustment because there is a greater diversity of travel patterns, due to a greater occurrence of non-work non-school trips in the evening. Furthermore, the degree of non-reporting bias is also known to be greater for these types of trips.

The adjustment procedure resulted an EMME/2 traffic assignment that closely reflects the available road counts. **Tables 7.3 and 7.4** show a comparison of the adjusted screenline traffic volumes to the available road counts for the AM peak and the PM peak hours, respectively. For the AM peak hour, total inbound model traffic is 2.0% greater than the road counts, and total outbound model traffic is

6.7% less than the road counts. For the PM peak hour, total inbound model traffic is 3.4% greater than the road counts and total outbound model traffic is equal to the road counts. Screenline volumes and individual link volumes display a greater variation from the count volumes, however, the differences are considered to be acceptable given the “planning nature” of the EMME/2 modelling software.

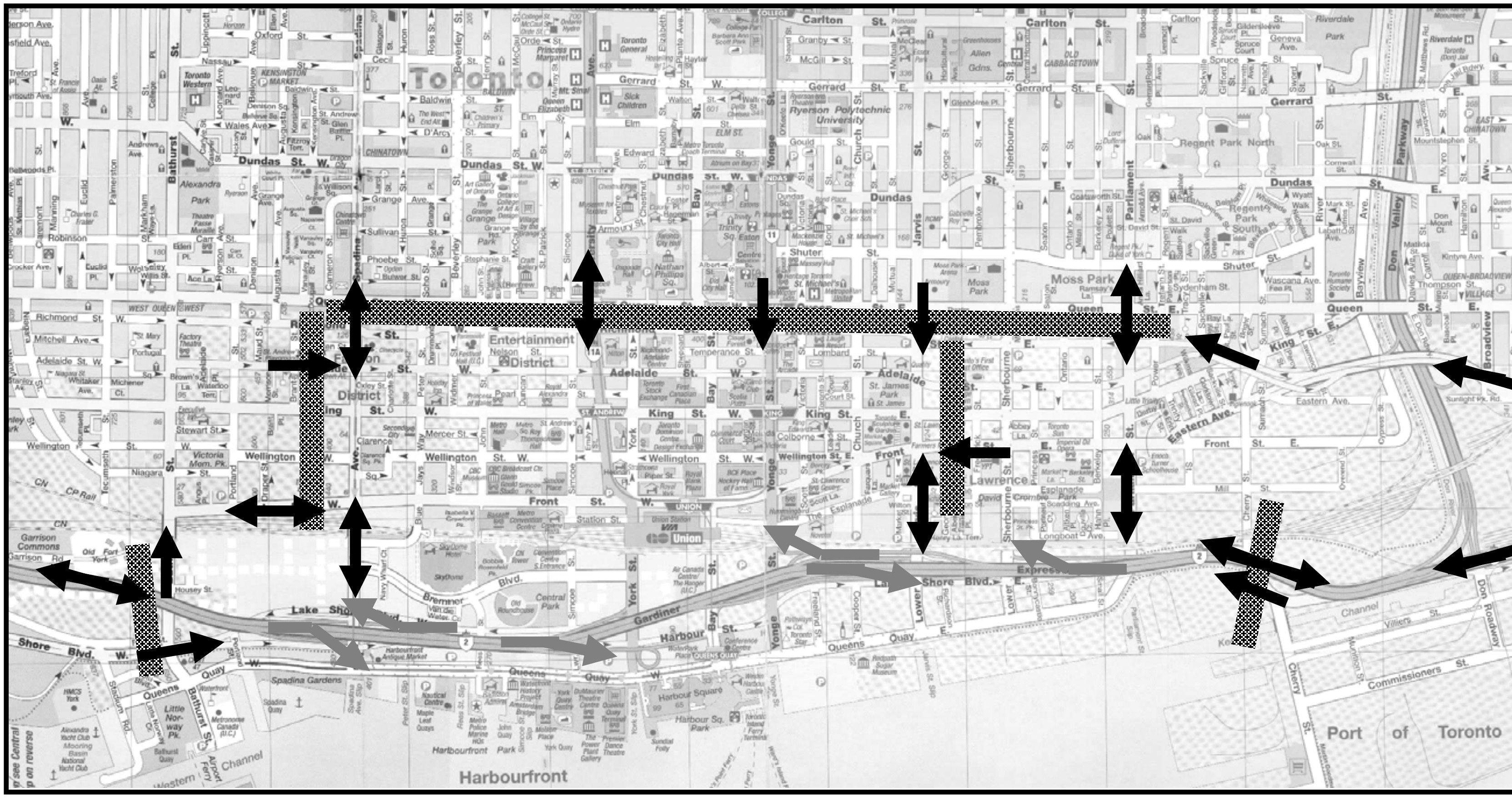


Figure 7.2a – AM Peak Hour – Adjustment Count Locations

Legend

- 2-way count location
- 1-way count location
- Off-ramp count location
- Evaluation screenline

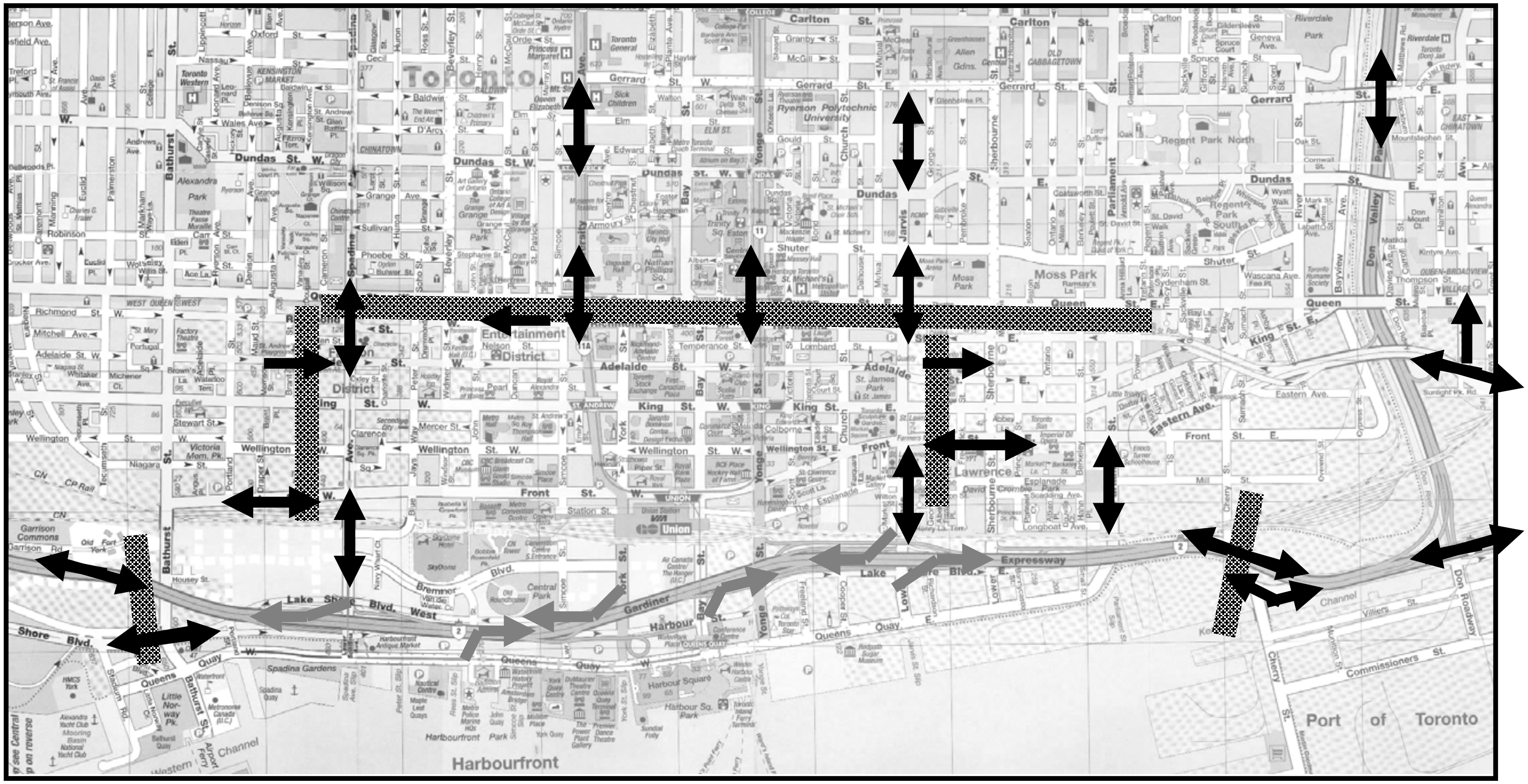


Figure 7.2b – PM Peak Hour – Adjustment Count Locations

Legend

- 2-way count location
- 1-way count location
- On-ramp count location
- Evaluation screenline

Note: Adjustment counts not shown on this map were also applied at the Woodbine, Queen St. East and Kingston Rd. gateways (outbound) and at the Gardiner Expressway gateway (inbound).

The adjustments made to the seed O-D demand matrices are summarized in **Tables 7.5 and 7.6**, for the AM and PM peak hours, respectively. The gradient adjustment procedure results in an overall increase of 5% in the AM peak hour to a total of 47,270 trips. In the PM peak hour the procedure resulted in a 7% increase in total trips to an adjusted total of 47,320 trips. In the AM peak hour, the greatest percentage increases were for trips that were generated internal to the study area (i.e. travelling in the off-peak direction), whereas in the PM peak hour, trips originating outside the study were increased the most (again, the off-peak direction). These changes were expected since most of the traffic growth since 1996 has been in the off-peak direction, where some remaining road capacity has been available in the peak hours. Furthermore, more under-reporting in the original TTS data is expected for non-work travel which makes up a large proportion of off-peak direction travel.

It is to be emphasized that the purpose of the EMME/2 traffic assignment is to produce the best possible demand inputs to Paramics microsimulation model discussed later in this report. The dynamic traffic assignment capabilities of the microsimulation model are superior to those of a static user equilibrium assignment. Therefore, small link-level deficiencies in EMME/2 assignment results are not of great concern provided the overall O-D demand matrix provided for the microsimulation analysis is the best possible given the available data. Overall the final adjusted O-D demand matrices developed as input to the microsimulation model based on the above analysis is considered to be within an acceptable degree of accuracy.

Table 7.3 – Comparison of Model to Observed Screenline AM Traffic

Roadway / Intersection	Dir.	Segment / Approach	Model Volume	Count Volume	Model +/- Trips	Model +/- %
West Screenline						
Inbound						
Lakeshore	EB	West of Bathurst	3954	4000	-46	-1.1%
Gardiner	EB	Jameson to Spadina off-ramp	6091	6000	91	1.5%
Front at Spadina	EB	West Approach	510	630	-120	-19.1%
Adelaide at Spadina	EB	West Approach	1136	1157	-21	-1.8%
Total			**11691**	**11787**	**-96**	**-0.8%**
Outbound						
Lakeshore at Bathurst	WB	West Approach	1257	1205	52	4.3%
Gardiner	WB	Spadina on-ramp to Jameson	4872	4820	52	1.1%
Front at Spadina	WB	West Approach	156	398	-242	-60.8%
Richmond at University	WB	West Approach	636	1474	-838	-56.8%
Total			**5665**	**7897**	**-975**	**-12.4%**
North Screenline						
Inbound						
Adelaide at Spadina	SB	North Approach	1132	1102	30	2.7%
Richmond at University	SB	North Approach	1994	1989	5	0.2%
Richmond at Yonge	SB	North Approach	601	631	-30	-4.8%
Richmond at Jarvis	SB	North Approach	1139	1153	-14	-1.2%
Richmond at Parliament	SB	North Approach	699	371	328	88.4%
Total			**5564**	**5246**	**318**	**6.1%**
Outbound						
Adelaide at Spadina	NB	North Approach	934	902	32	3.6%
Richmond at University	NB	North Approach	1777	1758	19	1.1%
Richmond at Yonge	NB	North Approach	1002	534	468	87.6%
Richmond at Jarvis	NB	North Approach	762	771	-9	-1.1%
Richmond at Parliament	NB	North Approach	313	298	15	5.1%
Total			**4788**	**4263**	**525**	**12.3%**
East Screenline						
Inbound						
Richmond at Parliament	WB	East Approach	1894	2130	-236	-11.1%
Front at Jarvis	WB	East Approach	1320	1103	217	19.7%
Gardiner	WB	DVP to Sherbourne off-ramp	4555	4500	55	1.2%
Lakeshore	WB	East of Parliament	1564	1300	264	20.3%
Total			**9333**	**9033**	**300**	**3.3%**
Outbound						
Adelaide at Jarvis	EB	East Approach	307	928	-621	-66.9%
Front at Jarvis	EB	East Approach	491	423	68	16.1%
Gardiner	EB	Jarvis on-ramp to DVP	2959	2940	19	0.7%
Lakeshore	EB	East of Parliament	625	790	-165	-20.9%
Total			**4382**	**5081**	**-699**	**-13.8%**
Total Inbound			**26587**	**26066**	**521**	**2.0%**
Total Outbound			**16092**	**17241**	**-1149**	**-6.7%**

Table 7.4 – Comparison of Model to Observed Screenline PM Traffic

Roadway / Intersection	Dir.	Segment / Approach	Model Volume	Count Volume	Model +/- Trips	Model +/- %
West Screenline						
Inbound						
Lakeshore	EB	West of Bathurst	1995	1085	910	83.9%
Gardiner	EB	Jameson to Spadina off-ramp	5674	6041	-367	-6.1%
Front at Spadina	EB	West Approach	540	427	113	26.5%
Adelaide at Spadina	EB	West Approach	836	843	-7	-0.8%
Total			**9045**	**8396**	**649**	**7.7%**
Outbound						
Lakeshore at Bathurst	WB	West Approach	2076	2000	76	3.8%
Gardiner	WB	Spadina on-ramp to Jameson	5585	5643	-58	-1.0%
Front at Spadina	WB	West Approach	247	451	-204	-45.3%
Richmond at University	WB	West Approach	1369	1417	-48	-3.4%
Total			**9276**	**9511**	**-235**	**-2.5%**
North Screenline						
Inbound						
Adelaide at Spadina	SB	North Approach	881	863	18	2.1%
Richmond at University	SB	North Approach	1953	2035	-82	-4.0%
Richmond at Yonge	SB	North Approach	681	696	-15	-2.1%
Richmond at Jarvis	SB	North Approach	799	817	-18	-2.2%
Richmond at Parliament	SB	North Approach	195	323	-128	-39.7%
Total			**4509**	**4734**	**-225**	**-4.7%**
Outbound						
Adelaide at Spadina	NB	North Approach	980	913	67	7.4%
Richmond at University	NB	North Approach	1852	1930	-78	-4.0%
Richmond at Yonge	NB	North Approach	675	677	-2	-0.4%
Richmond at Jarvis	NB	North Approach	1024	1076	-52	-4.8%
Richmond at Parliament	NB	North Approach	145	365	-220	-60.2%
Total			**4677**	**4961**	**-284**	**-5.7%**
East Screenline						
Inbound						
Richmond at Parliament	WB	East Approach	925	746	179	24.0%
Front at Jarvis	WB	East Approach	804	848	-44	-5.2%
Gardiner	WB	DVP to Sherbourne off-ramp	3116	3066	50	1.6%
Lakeshore	WB	East of Parliament	519	500	19	3.8%
Total			**5364**	**5160**	**204**	**4.0%**
Outbound						
Adelaide at Jarvis	EB	East Approach	1916	1919	-3	-0.1%
Front at Jarvis	EB	East Approach	1035	1119	-84	-7.5%
Gardiner	EB	Jarvis on-ramp to DVP	4675	4864	-189	-3.9%
Lakeshore	EB	East of Parliament	1593	800	793	99.1%
Total			**9219**	**8702**	**517**	**5.9%**
Total Inbound			**18918**	**18290**	**628**	**3.4%**
Total Outbound			**23172**	**23174**	**-2**	**0.0%**

Table 7.5 – Adjusted O-D Travel Demand (% Change Over Seed O-D Demand) – AM Peak Hour

To From	To Study Area Zones	To External Gateways	Total
From Study Area Zones	2,320 (+36%)	8,270 (+30%)	10,590 (+31%)
From External Gateways	24,900 (-4%)	11,780 (+6%)	36,680 (-1%)
Total	27,220 (-2%)	20,050 (+15%)	47,270 (+5%)

Table 7.6 – Adjusted O-D Travel Demand (%Change Over Seed O-D Demand) – PM Peak Hour

To From	To Study Area Zones	To External Gateways	Total
From Study Area Zones	2,520 (+14%)	20,870 (-6%)	23,390 (-4%)
From External Gateways	10,920 (+18%)	13,010 (+22%)	23,930 (+20%)
Total	13,440 (+18%)	33,880 (+3%)	47,320 (+7%)

8. Network Coding: Geometry and Controls

For the purpose of traffic microsimulation, a properly scaled digital representation of the transportation network is required. To simplify the coding effort, work was initially only performed on the existing network, as a large part of the modelled area is the same for both the base-case and the future scenarios. Only after a certain level of network refinement and calibration was attained for the existing network did work on the future networks commence. This was done to avoid having to apply the same fixes to multiple networks.

8.1 Centreline Data

The microsimulation software can load digital maps or drawings in AutoCAD DXF format, as well as raster images, to be used as a template (or "overlay") for network coding purposes. Coding of the Waterfront microsimulation network began on the basis of the City of Toronto's Digital Centreline data in ESRI Shape File format (maintained by Survey and Mapping Services - Works and Emergency Services). This data source contains geographic linear representations of roadways, railways, waterways, shorelines, and utility corridors, with a variety of attached data attributes. The file was imported into ESRI's ArcInfo software, and superfluous display layers were discarded. From ArcInfo, it was then possible to export the file to DXF format. During this step, appropriate DXF colour specifications were chosen that would be correctly displayed in Paramics, and would not conflict with colours used to display features of the microsimulation network itself.

The original centreline file and the resulting DXF are projected in the Universal Transverse Mercator (UTM) coordinate system (Zone 17; NAD 27), which uses 1-metre units. This DXF was loaded as an overlay in Paramics, with a scale of 1:1 and in the proper position, and used as a guideline for manually coding the microsimulation network. The result was a Paramics network in the proper scale and with the proper UTM coordinates. This simplifies the incorporation of data from other sources, as features will match spatially as long as the same coordinate system is used.

With the DXF overlay in the background, the basic features of the Paramics network were constructed, including links representing roadway segments, and nodes representing intersections. In addition, mid-block (or dummy) nodes, as well as curved links were defined as necessary within Paramics to better reproduce the roadway geometry. In order to expedite the coding process, two persons worked simultaneously. This was facilitated by splitting the initial network coding into two segments, with one person starting at the west end of the study area and working inwards, and another at the east end. The networks were then combined into one using the Paramics Cut and Paste features, and the links in the boundary area were connected. The use of proper UTM coordinates from the onset ensured that the two networks matched well when they were joined.

8.2 Additional Data Sources

The centreline data does not provide a number of attributes that must be defined for each network feature. Data had to be acquired from a number of other sources in order to complete the coding work. Link attributes such as the number of lanes, approximate roadway width, speed limits, etc., were gathered on a number of field visits. The number of lanes available during the AM or PM peak hour was noted, thereby taking parking restrictions into consideration.

A large amount of data was also gathered on-site for the network intersections, such as exact lane configurations, turning restrictions, as well as other information that influences the traffic flow (e.g., signs that denote fully-protected turns). In addition, Paramics provides full 3-D visualization. For this purpose, approximate node heights were estimated for areas of the network that feature grade separation.

The primary focus of data gathering in the field was on highways and arterial roads, as these will have the most significant impact on network performance. Less emphasis was placed on the exact configuration of minor roads, other than the identification of one-way links, and the roadway configuration at the intersections between minor and major roads.

In addition to the field visits, some information about the transportation network could be gleaned from digital aerial photographs. These were primarily of use outside of the downtown core, where the roadways and intersections are not blocked by the shadows of tall buildings.

8.3 Link Categories

Paramics allows the definition of any number of link categories. This feature is primarily provided for the purpose of coding convenience. A specific link category defines a set of characteristics including the number of lanes, link width, speed limit, and link type (urban or limited-access highway). The complete set of attributes for a specific link can quickly be defined during coding by selecting the correct link category. Therefore, individual link attributes do not need to be specified one-by-one in most cases, although that is also possible when there is an unusual combination of attributes for a certain link.

In addition, a certain display colour can be defined for a category or group of categories. The Paramics user interface subsequently gives the option of displaying links using the defined colours rather than default link colour. This is an easy way to highlight and differentiate links with similar characteristics, and is also useful for discovering coding errors. Lastly, a link class (major or minor), or alternately a cost factor, can be defined for each link category. Either of these features may be used to effect more realistic routing patterns. For example, a category can be defined to represent local roads that may often feature certain impediments that are not explicitly modelled, yet that reduce the effective speed and increase the effective cost in reality.

For the Waterfront network, a system of link categories was developed which differentiates according to the link characteristics listed above (i.e., number of lanes, width, speed, type), but also distinguishes according to the approved Road Classification System of the City of Toronto (see http://www.city.toronto.on.ca/transportation/road_class.htm). This was useful for display purposes, as well as for experimenting with link speeds and cost factors during network calibration, in order to produce a more realistic distribution of traffic between local and major roads. With all the possible combinations of link attributes that exist in the Waterfront network, this resulted in a total of 65 link categories.

8.4 Intersection Geometry

When an intersection is constructed in Paramics, the software by default creates an intersection geometry. For simple intersections, this geometry may be good enough for initial network coding purposes. However, a number of factors may lead to distorted default geometry, such as:

- intersection angles that are not close to 90 degrees;
- different roadway widths for the different arms of the intersection (including one-way streets);
- turn pockets and channels; and
- unusual merging situations.

During the initial coding process, some effort was made so that the intersections would match the various data sources fairly well (i.e., centrelines, aerial photographs, and information collected on site). For example, node locations, as well as curve centrepoints and diameters were adjusted accordingly. Paramics also offers additional features to adjust intersection geometry, namely curb points, as well as stop line position and angle. All of these were altered whenever their default placement was obviously incorrect. However, much more editing of these features was required later, during network refinement and calibration, and will be discussed below.

8.5 Unsignalized Intersections

At unsignalized intersections, every turning movement is assigned a priority of Major, Medium, Minor, or Barred within Paramics. Major movements are free flow and do not need to yield to other streams of traffic. In the network, through and right-turn movements from a major road are given the designation Major.

A Medium priority movement yields right-of-way to Major streams of traffic but has priority over Minor traffic movements. The left-turn movements from a major street onto a minor side street have Medium priority at unsignalized intersections in the network (i.e., they must yield to the opposing traffic, but have right-of-way over vehicles exiting from the minor side street).

Minor priority gives way to both Major and Medium traffic flows while Barred indicates the turn is banned to all vehicle movements. Traffic flows exiting minor side streets, as well as right-turn flows on red, are assigned the minor priority.

All this data was also collected for the Waterfront area during site visits, and unsignalized intersections within the network were coded accordingly.

8.6 Signalized Intersections

Traffic flows at signalized intersections use the same Major, Medium, Minor, or Barred priorities, but the designation for each turning movement can change with each of the phases that are offered at a signal.

Paramics allows for both fixed and actuated signals. The modelling of actuated signals within the Waterfront network was executed in the Paramics plan language, which is similar to a C programming language. The plan language associates particular detectors with specific signals and defines the control parameters for changing the signal settings. A single signal plan can be used for a number of intersections that have the same signal control algorithm, yet have their own parameters such as minimum and maximum green. However, a different signal plan must be defined for every unique signal algorithm.

Within Paramics, a generic detector object can be defined. A detector can be placed anywhere on a link between the entry point at the upstream end of the link and the stop line at the downstream end of the link. Loop detectors in Paramics can also classify vehicle types. Several types of detector data are available in Paramics, which may be useful for signal actuation and/or general gathering of point statistics:

Gap – the “off” or vacant time between vehicles
Occupancy – the “on” or occupied time
Headway – the time between the leading edges of successive vehicles
Count – the total number of vehicles crossing the loop
Type-count – a count of each type of vehicle crossing the loop
Speed – the instantaneous speed of the passing vehicle
Edges – the raw times at which the vehicle’s presence or absence is detected

8.7 Actuated Signals

The majority of intersections in the Waterfront microsimulation model are controlled by actuated signals with variable cycle lengths. In reality, this portion of Toronto contains mostly fixed-time signals (MTSS), with transit priority on some streets (Dundas St., Queen St., King St., and Bathurst St.). The intersections controlled by MTSS have been manually optimized to some degree over the years, reflecting current network configuration and traffic conditions. In addition, portions of Queens Quay are controlled by AMSS (actuated; no background cycle lengths; transit priority), while Lake Shore Blvd. is controlled by SCOOT/UTC (variable traffic adaptive cycle and phase lengths with offset optimization).

The following factors led to the decision to not attempt to reproduce all the actual MTSS timings and algorithms in the Waterfront microsimulation model:

- As future network scenarios were to be built as part of the project, the current, manually adjusted MTSS timings would no longer be applicable in many cases. It would be quite difficult to devise analogous timing plans for the new intersections, and to change the timings for other intersections based on the new network configuration and traffic patterns.
- Previous microsimulation work has shown that it can be quite time-consuming to decipher MTSS data, and to reproduce its functionality within Paramics.
- As explicit modeling of transit is outside the scope of this project, MTSS transit priority could not have been reproduced in any event.
- Current signal data was not yet available when the coding of the existing network was begun.

Similarly, AMSS cannot be accurately reproduced without explicitly modeling transit. Lastly, the SCOOT optimization algorithm is proprietary, and any attempt to emulate its behaviour within Paramics was beyond the scope of this project.

Emphasis was placed on keeping the current and future scenarios comparable, by consistently implementing one of two actuated signal algorithms. There were some exceptions to this procedure, as describe farther below. Steve Kemp of the Traffic Signal Control Section of the City of Toronto was very helpful in providing data and documentation about all three signal control systems. This information could be used to refine the signal controls in the microsimulation model as necessary.

The actuation algorithm that was developed implements minimum green time to accommodate pedestrian movement. The minimum amount of green time is based on the assumption that each lane is 4 meters in width and that the walking speed for pedestrians is 1 m/s. This was the assumption implemented for all minor roads, as well as all major roads when crossing more than 5 lanes of traffic. However, for major streets that cross 5 lanes of traffic or less, the minimum green time is 20 seconds. The algorithm also implements a maximum green time that roughly corresponds to the fixed time intervals that are used in MTSS.

The cycle lengths vary, as influenced by the flow that is registered by loop detectors in the model. Furthermore, the actuation algorithm differentiates between major-major intersections and major-minor intersections. The maximum cycle length for most intersections is 72 seconds.

8.7.1 Major/Minor intersection algorithm

For the major/minor intersection algorithm (see **Figure 8.1**), the major street does not end its green phase before the maximum green time unless the minor street signal is called by the occupancy of a vehicle for a period of approximately 6 seconds. (This will also allow vehicles on the minor street to turn right on red and clear the detectors without calling a minor street green, if possible.) Also, it should be noted that the minor street still receives a green phase if the signal for the major street has exceeded the maximum green time and no vehicle has been detected on the minor street, i.e., the minor street would get at least the minimum green time every cycle (this allows for pedestrian crossing). The extension of the green phase for the minor road beyond the minimum green is based on the gap between vehicles. If the gap between two cars following each other on the minor road exceeds three seconds, the minor green terminates and switches to the major street.

8.7.2 Major/Major intersection algorithm

The algorithm for a major/major intersection (see **Figure 8.2**) is based on loop detector data that is fed into the signal from all approaches, as well as a minimum green time and a maximum green time, which are predefined for the signal. After the minimum green time of the active green signal is reached, the algorithm starts checking if any cross-street detector is occupied. If a vehicle is detected on the cross street, the active green signal receives an additional 3 second extension. If a cross-street detector is still occupied after the 3 seconds, and the gaps between vehicles traveling through the active green signal are greater than 3 seconds, the active green signal will end before the maximum green time. The parameters are varied based on the width, speed, and importance of the streets; for example, larger gaps between vehicles may be allowed.

Figure 8.1. Major/Minor actuated signal algorithm (detectors only on minor street)

Major Green Signal (**MGS**) Minor Green Signal (**MinorGS**)

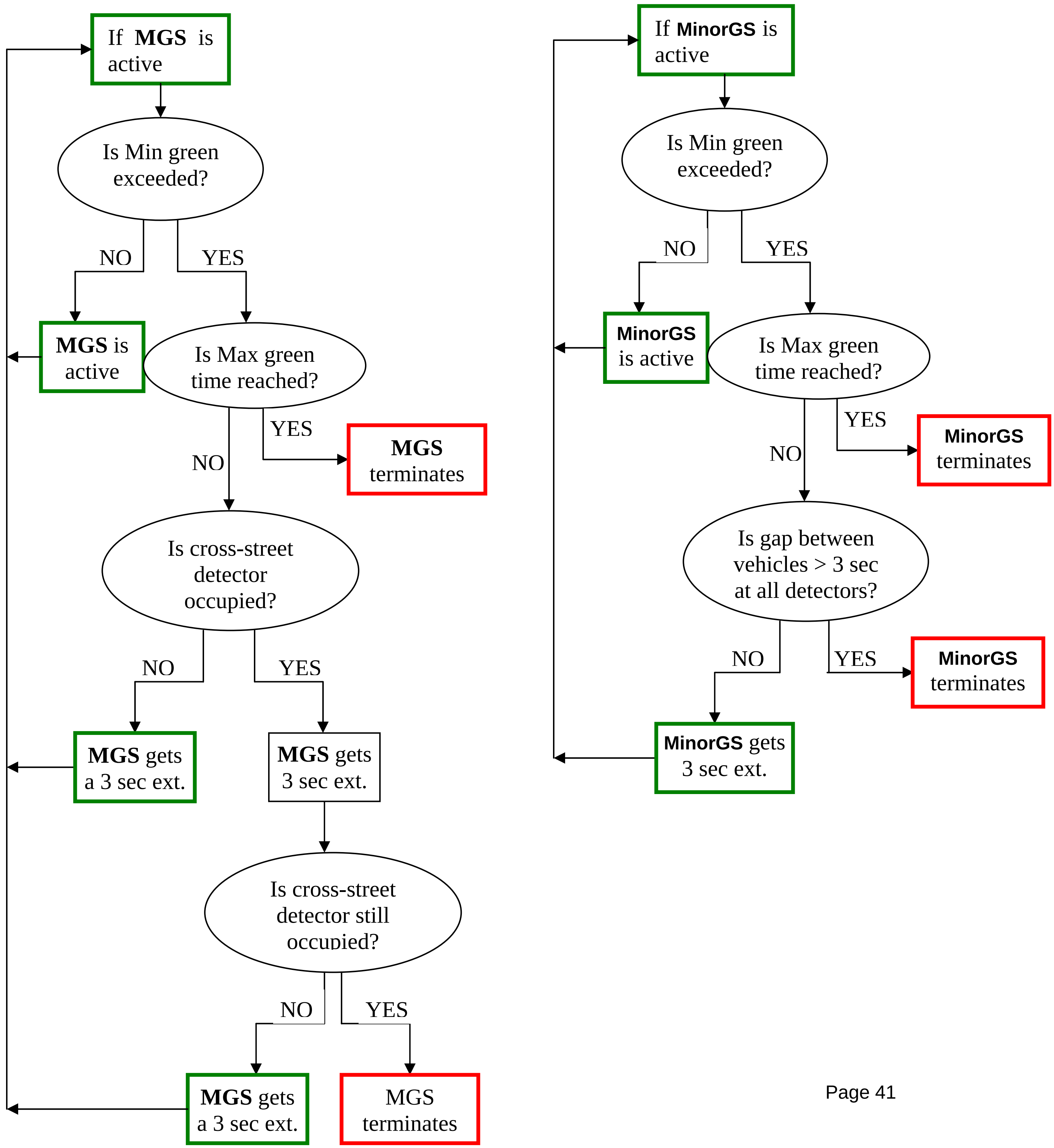
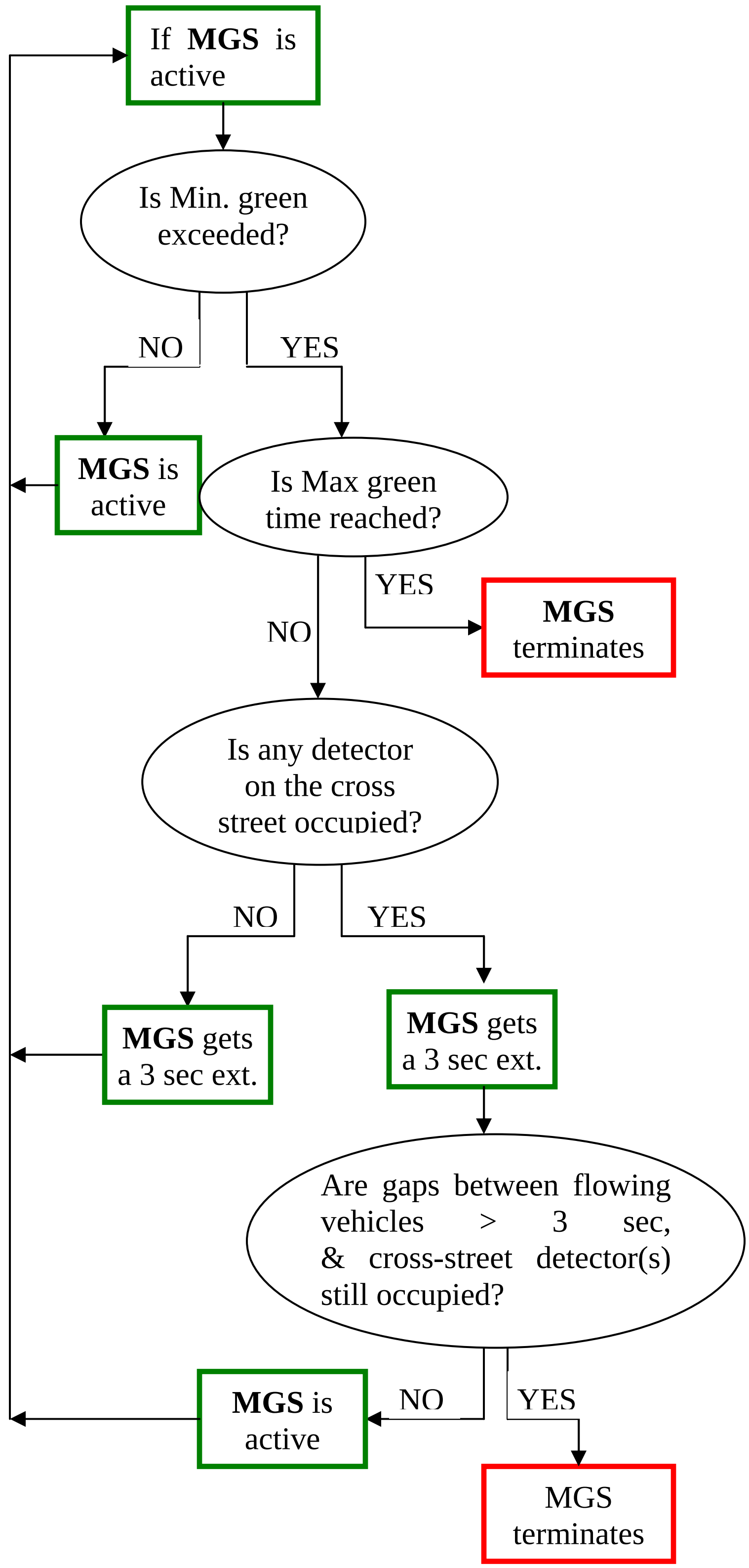


Figure 8.2. Major/Major intersection algorithm (fully actuated signals, same logic is applied to both approaching roads)



8.8 Exceptional signal operation

A number of traffic signals in the Waterfront microsimulation network feature special methods of operation, in order to better reproduce reality. The most common change was with regard to special phases, such as protected lefts (flashing advance green, or green arrow). The default actuation algorithms as described above could not perform adequately without providing such phases. Therefore, the traffic signal data for all signals was reviewed in order to find any additional phases. Such phases were modeled as fixed or callable, as was the case in MTSS, and given a fixed green time that matched the respective MTSS timing.

In addition, the intersection of Bathurst St., Lake Shore Blvd. West, and Fleet St. includes special phasing to reproduce the significant impact of streetcar operations at this location. Transportation engineers from the City of Toronto suggested that a streetcar passes through this intersection approximately once every two cycles during the peak hour. The streetcar receives its own phase, and no other vehicular movement is allowed, with the exception of right turns on red. To reflect this in the model, one cycle was coded in the model for the intersection that contains two regular cycles, followed by a 15-second fixed phase where all movements at the intersection are barred – again, with the exception of right turns on red.

An attempt was also made to replicate the effect of very heavy pedestrian flow, for example, at the intersection of Front St. West, University Ave., and York St. During the afternoon peak period, there is heavy pedestrian traffic crossing the intersection. The pedestrian movements primarily interfere with vehicles from the east or west approaches that are attempting to make a turn. As a result, right or left turn movements for the east/west direction are restricted, especially at the beginning of the green phase. To reproduce this in the model, the 38-second east/west signal was split into two phases measuring 18 seconds and 20 seconds. During the first 18 seconds, only through movements are allowed, and vehicles are not allowed to make right or left turns.

A number of intersections in the Waterfront microsimulation model were coded as fixed-time signals, without using one of the actuation algorithms described above. These are locations where offset transitioning proved to be crucial:

- Three intersections of eastbound Lake Shore Blvd West, at Windermere Ave., Ellis Ave., and Colborne Lodge Drive, are coordinated by implementing fixed timing with offsets.

- Signals on Richmond Street also feature offset progression, using fixed timing with offsets.
- For the PM peak network Adelaide Street also utilizes fixed timing with offsets.

8.9 Zones and Traffic Demand within Paramics

In order to load the travel demand (as described in Section 6) within Paramics, a corresponding zone system had to be constructed in the microsimulation model. By default, any link whose midpoint lies inside the bounded area of a zone will be defined as a location where vehicles are released and/or absorbed by the zone. Note that the two directions of a bi-directional link may be associated with two different zones if the zone boundary coincides with the centreline of the link. If more than one link exists within a zone, the default release of vehicles will occur in proportion to the length and the number of lanes for each link. However, the percentage release for individual links can also be fixed as necessary to achieve better results.

Paramics requires accurate digital definitions of the zone boundaries for all internal zones. The 1996 GTA traffic zone boundaries in ArcInfo format formed the basis for the boundaries. From ArcInfo, the appropriate zones were exported to a text file ("ungenerate" command). A program was written to convert this text file to the zone file layout required by Paramics. This zone file could be directly loaded into Paramics, providing for all zones internal to the network. The external "gateway" zones could then be added manually, around the gateway links at the edge of the network. Finally, another program was written to convert the demand output from EMME/2 to the appropriate text file layout for Paramics.

Note that centroid connectors could be defined within Paramics in order to load the travel demand onto the network, similar to EMME/2. However, the default (and preferred) method of loading demand was chosen for this study, so as to avoid the inaccuracies associated with centroid connectors.

8.10 Coding of Future Network Scenarios

As mentioned above, coding of the future network scenarios did not commence until the existing network had been extensively calibrated, as described in the following sections. However, the coding process will be described in this section.

The existing and Replace Option were modelled in 2002 and early in 2003. The Retain (or Transformation) and Remove (or Great Streets) Options were modeled in 2004 as a continuation of the previous work. The Origin-Destination (OD) matrix, OD zones, and modelling parameters utilized were consistent as those use for the previous modeling work.

The future networks were built based on information provided via a combination of AutoCAD drawings, other digital drawings, hand sketches, and verbal explanations. Numerous review meetings were held to confirm the exact configurations for each option. All of these steps were analogous to the modeling and review procedures employed for the previous modeling work, so that the team can safely say that all network alternatives have been afforded a fair review and assessment.

Signal timings were not available for the future plans. For the Replace Option in the unmodified areas, the same signal plans were used as in the existing network. Due to the increased reliance on surface streets in the future scenarios, a common cycle length with offset progression was utilized for most of the new intersections. On the new Lakeshore Blvd and the Front St. Extension, 110-second cycle lengths were implemented, while 90-second cycles were used on Bremner Blvd.

9. Manual Calibration

After the initial network coding was complete, a lengthy process of network refinement and calibration was required. Various methods of manual calibration are described in this section, ranging from small improvements at individual nodes, to network-wide parameters that needed to be adjusted; in addition, automated calibration using genetic algorithms is presented in the next section. Although the initial sequence of network refinement did follow the order as presented here, in the end the methods were also applied in an iterative fashion. For example, after network-wide parameters were adjusted, new problems would often appear at individual intersections, requiring further work both at the local and the network-wide level.

9.1 Geometric Refinement and Calibration

During the initial network coding process, care was taken to build the network well, based on the overlays and other data sources. However, as demand was subsequently loaded on the network, a fair bit of unusual behaviour could be observed, and vehicles did not flow realistically in many locations. This is to be expected in microsimulation models, especially given the size and complexity of the Waterfront network, the somewhat unusual roadway configurations that exist in many locations, and the very heavy traffic flow that needs to be reproduced during the peak periods.

Throughout the calibration process, less emphasis was placed on achieving correct flows near the study area boundary. As in any model, accuracy is hard to achieve in the peripheral areas. The extent of the microsimulation model was chosen so as to have a significant border that lies outside the core area of interest of the TWRC. Nevertheless, it was necessary to ensure that inaccuracies near the boundary were not so extreme so as to significantly impact the whole network; an example is the refinement of gateway zones as discussed below.

Very significant improvements were achieved through geometric network refinement and calibration. This consists of running the initial network many times and looking for any unusual behaviour or results. One may discover problems visually, by gradually panning through the study area and observing the individual vehicles, signals, etc, via the Paramics graphical user interface. In addition, a variety of statistical outputs can be gathered to support this calibration effort. Errors may be due to inexact coding of the network, or also due to inadequacies of the microsimulation software that one needs to circumvent. Throughout the calibration process, one must however resist the temptation to eliminate all congestion in the network, as congestion obviously occurs in reality.

9.1.1 Node and link refinement

For geometric network refinement and calibration, one must initially review all the previous coding steps, from basic network construction, to intersection and traffic signal coding, and identify possible errors. Information gathered on a number of additional site visits helped to solve some problems related to incorrect lane or merging configuration, turns that are barred in reality, and similar factors. The respective link and node characteristics within the microsimulation model were altered accordingly.

Upon observing vehicles traveling through the network, many node locations also had to be adjusted to provide for a smooth flow of traffic. In addition, the link attributes "wide end" and "wide start" were set as necessary. Setting one of these attributes creates a triangular hatched area at the centre of the roadway, and is used to change the way that lanes are aligned before and after a node. This can help to provide a smooth flow of traffic through the intersection, and/or assist with the correct choice of lanes.

One must consider that two nodes upstream from an intersection, vehicles decide which turn to make at the intersection. Making these upstream links fairly long helps vehicles to choose the correct lane as early as possible. On the other hand, once the choice of routing for that intersection is made, the vehicle will not re-route again until after the intersection. Therefore, any cost feedback that is received in the meantime will no longer have an effect at this specific intersection, and a vehicle may persist to make a turn onto a link that has become badly congested in the meantime. A compromise must always be found between these different principles, and the correct approach varies from location to location. While calibrating the Waterfront network, it was necessary to remove mid-block nodes in some locations, and add additional nodes in other locations, in order to improve the reliability of the model.

9.1.2 Curbs and stop lines

Each uni-directional link has an inside and outside curb point, both at the start of the link and at the end, for a total of four curb points per link. (The geometry of a regular, four-arm intersection, with two-way links extending in all directions, is therefore defined by a total of 16 immediately adjacent curb points.) When nodes and links are constructed, Paramics computes a default location for each curb point based on node location, link widths and intersection angles. The curb points can however be manually moved away from their default locations if necessary, breaking the default connection between nodes and links on the one hand, and curb points on the other hand.

By default, locus points are defined along a line joining each pair of curbs so that for each lane on a link a locus point is drawn at the centre of the lane. Therefore, at the beginning and end of each link, there will be as many locus points as there are lanes, and these points will be spaced equidistant between a pair of curbs. The locus points also have an angle, which by default is exactly perpendicular to the line joining a pair of curb points. Vehicles travel along a link from entry locus point to exit locus point. Vehicles also have to pass through these locus points as they move through a junction. For example, if locus points for the in and out links of a 90 degree turn are very close to each other, then vehicles making that turn are forced to traverse the curve very slowly. These locus points are labeled "stoplines" within Paramics – a somewhat misleading term, as there is one stopline per lane, both at the beginning and the end of each link. Both the position and angle of the stoplines can be adjusted manually, thereby breaking the default relationship between curb points on the one hand, and stoplines on the other.

For geometric network calibration, extensive editing of curb points and/or stoplines was required. Adjusting these features can help to resolve the following:

- Unusually slow or erratic turning movements
- Looping outside the roadway (can occur when the stoplines before and after a node are too close, or perhaps even reversed)
- Incorrect lane choice (due to poor lane alignment)
- Poor intersection layout, where a narrow road intersects a wider road. By default, the stoplines on the narrow road may be set back too far from the intersection, making it difficult for vehicles from the narrow road to travel through the intersection, especially when yielding to cross traffic.

9.1.3 Nextlanes

When a vehicle reaches the end of a link, Paramics calculates the range of lanes suitable for the vehicle on the next link. However, it is possible for the user to override this default range and specify the exact lane(s) on the next link for each lane of traffic on the current link, by providing "nextlanes" specifications at the node. Collected lane usage and turning restriction information were used to rectify any lane choice problems that were observed in the Waterfront network. However, it is often preferable to correct lane choice problems by attempting to improve roadway and intersection geometry first (e.g., node and curb location; stopline position and angle; wide end or wide start; signposting). Only in certain situations is the "brute force" method of specifying nextlanes really necessary; dropping or adding a lane on the right side of the road is a typical example.

9.1.4 Signposting

Signposting is a fairly complicated, yet frequently neglected feature within Paramics. It is defined as a link attribute, and specifies how far upstream a vehicle becomes aware of a decision point or obstacle that may necessitate a lane change. A decision point could be an intersection that offers a choice of exits, or a mid-block node where a lane is dropped or added. Signposting consists of two distance values: the first is the number of metres before the end of the link that a vehicle becomes aware of the approaching decision point, and can therefore begin to switch lanes if necessary. The second number within the signposting specification is the distance in metres beyond the initial signpost over which vehicles will try to switch into the correct lane. Note that vehicles are not forced to change lanes within that range. Factors such as vehicle speed, as well as the vehicle density in the target lane, can lead vehicles to switch lanes too late, or not at all, despite the signposting specification.

Changing signposting values within the Waterfront network had a very significant impact on network reliability. Great care must be taken, as either of the two signposting values can easily be set too high, or too low, depending on the situation. The default signposting values assigned by Paramics are 250,1 for urban (surface) roads, and 750,1 for highways. If the links are not long enough to allow these values, then the maximum possible distance will be chosen for the first value. Note that signposting can extend past one or more mid-block (or "dummy") node(s), as long as there is no change in the number of lanes, no obstacle, and no other type of choice to be made at the mid-block nodes.

Before an exit ramp from a heavily traveled highway, it is usually best to specify a high signposting value, with a high lane change range (perhaps 2000,1000 metres). The same is true for a change in the number of lanes on a highway, especially if a lane is dropped. This will give vehicles enough time to switch lanes, and will prevent that too many vehicles attempt to switch at the same location, which may otherwise cause too much disruption in traffic flow, shockwaves, and excessive congestion. The exact values to use will differ from case to case, based on vehicle density and speed on the highway, number of lanes on the highway, the percentage of vehicles that want to exit, and the link length. The signposting should definitely not extend back all the way to a previous on-ramp, or a previous node where the number of lanes change. Otherwise vehicles may attempt to jump straight into the correct lane at the previous node. Vehicles may have difficulties merging onto the highway if they wait for very large, multi-lane gaps. In addition, the mainline traffic may be unduly affected by the erratic lane changing.

The situation for urban (surface) roads is similar. Signposting will also more likely play an important role in a heavily traveled network, such as the Waterfront peak-period models. Signposting before an intersection that offers a choice of exits should be fairly high, with a lane change range. The distance between intersections often played a great role in the Waterfront network. In many cases, the default values assigned by Paramics were too long, and caused problems. The default is usually 250,1, but if a link is not that long, then Paramics will choose the highest value possible, extending all the way back to the previous node, e.g., 120,1. This could cause traffic breakdown if a vehicle entering the link at the previous node had to yield to other vehicles. The yielding vehicle may want to jump across a few lanes immediately upon entering the signposted link. If the traffic flow with the right of way is not very light, then the yielding vehicle may never find a sufficiently large gap, causing traffic breakdown on the intersection approach with the minor priority. At intersections with all-way stop signs, this could in fact cause all four intersection approaches to break down.

The optimal values had to be chosen on a case-by-case basis, often after some testing. Setting the signposting too low can also cause problems. Vehicles that wish to make a turn may not manage to switch into the correct lane before the downstream intersection, causing delays for through traffic, illegal double lefts or rights, or the like. The results can be catastrophic if the downstream intersection features a fully protected, actuated left-turn signal. Left-turning vehicles may get stuck in the through lanes, with no vehicle ever calling the left turn signal. (Paramics Version 4 apparently has added new features to avoid such behaviour.) The chosen signposting values vary widely from case to case, and might be something like 200,50, or 150,30, or 50,5. Again, factors such as vehicle density and speed, roadway width, percentage of vehicles wanting to turn, and link length have to be taken into account.

A special situation exists where a lane is added as a left-turn or right-turn pocket. In this case, the upstream link before the added lane should have signposting defined as described in the previous case. The widened link itself should however have the maximum signposting defined for the first value, and 1 metre for the lane-change range (e.g., 50,1). This is to ensure that the turn pocket is fully utilized: turning vehicles should enter the added lane immediately, in order to avoid getting stuck in the wrong lane and blocking through traffic.

9.1.5 Traffic signal refinement

Traffic signal operations also required extensive refinements throughout the course of this study. For example, the actuated signal algorithms were adjusted to ensure that they were operating correctly. In addition, information from the real-life signal operations helped to improve the model reliability in a number of locations after this data was made available.

9.1.6 Traffic zones and travel demand

Zone boundaries and travel demand were also reviewed to identify errors and improve model operations. The internal zone boundaries were adjusted in a few locations to better reflect traffic flow patterns. For example, unrealistically heavy left-turn demand could be rectified at a few intersections by slightly adjusting adjacent zone boundaries. This might for example allow the zone to be reached via a through movement instead of a left turn, thereby better reflecting the real-life access situation.

A number of the external or gateway zones required some adjustment as well. Significant difficulties were initially encountered for eastbound traffic in the Gardiner gateway zone, at the west end of the network. The eastbound traffic heading towards downtown is very heavy at this spot. Initially there was an unrealistic amount of traffic breakdown within the zone itself. After traffic within the zone approaches total standstill, “virtual congestion” occurs, where there is no remaining roadway space in the origin zone for Paramics to release additional vehicles. Excessive congestion and unreleased vehicles resulted in flows that were too low downstream of the gateway zone, when compared with traffic counts.

Increasing the length of the gateway zone and link helped to provide more room for the release of vehicles. In addition, moving the east end of the zone boundary back from the downstream off-ramp to Lakeshore Blvd. West, and increasing the signposting distance allowed vehicles to select their correct lane earlier, avoiding excessive amounts of congestion ahead of the diverge. The optimal lane-change range (second value of the signposting specification) is unusual in this situation: it was set to 1 metre. As vehicles are released randomly throughout the gateway zone, they should immediately receive the impulse to switch to the correct lane. Specifying a large lane-change range would lead to some vehicles switching lanes in the wrong direction initially, and then switching back again a short time later. (For example, aggressive drivers may have the propensity to switch to the left lane immediately, only to switch back again.) In this model boundary situation, excessive lane changing had to be avoided in order to prevent serious problems. Changing system-wide parameters (see below) also helped to keep traffic flowing enough to ensure that a reasonable number of vehicles were released to the downstream links.

Similar, adjustments had to be made to some of the other gateways with large demand. In addition, the GTA EMME/2 network that was used to extract travel demand for this study area only contains highways and large arterials, and at the boundary only these links had a gateway demand assigned initially. As a result, some gateway zones were expanded to include adjacent roadways as additional gateway links. In many cases it is realistic that these adjacent links release at least a few vehicles, especially where the side street is signalized. In addition, this enabled a slight reduction in flow if the amount of traffic on the main gateway link was initially excessively high and congested. Demand reassignment was compared with traffic counts, information from site visits, and prior knowledge of the network. Depending on the volume from the different gateway zones and the nature of the neighbouring side streets, a minimum of 85% of original traffic was still released on the main road of the gateway zone.

9.1.7 End stop time

End Stop Time was another factor specified at the local (link) level to improve network operations. This feature was introduced towards the very end of the modeling process, after all the local and network-wide refinements had been attempted, to solve some localized routing problems that were persisting. Within the afternoon peak models, the downtown network had difficulty handling the heavy demand being released within a very small area. As the major roads became congested, the cost feedback function would reroute significant numbers of vehicles onto small side roads. The vehicles usually had to merge back onto a major road to continue their journey. Those priority intersections would sometimes become completely overloaded before cost feedback could again make the side roads appear less attractive. (Note also that a delay at an intersection is not reported back to the cost feedback function until at least one vehicle has completed a turn; if no vehicle can complete the turn, the route is not penalized at all!)

These difficulties on side roads created frequent gridlock as the vehicles blocked back to the major roadways. Note also that even after cost feedback updates the route costs, some vehicles may continue to be forced to take a badly congested side road, for example, for the purpose of access or egress to a certain zone. Also, in the case of “unfamiliar” drivers, the route may have been attractive at free-flow speeds, and the vehicle will not be informed of the congestion that has developed, as it does not receive the updated route costs.

End Stop Time is used to simulate an impediment at the end of a link that requires every vehicle to stop. In the case of the afternoon peak models, it was used to replicate stop signs on the side roads at the intersections with major roads in the downtown area. In addition to the delay that occurs in reality at such stop signs when the major road is heavily traveled, one must consider the additional effect of heavy pedestrian traffic downtown during the afternoon peak. End Stop Time can be specified as a single value that is applied to all vehicles, or as a range of seconds that each vehicle will stop, depending on a random distribution. A range of 1 to 3 seconds was used for the downtown area of the afternoon peak Waterfront networks.

End Stop Time helped to resolve the gridlock problems on side roads because it is included in the calculation of initial free-flow speeds, and is seen by all drivers. Side roads became slightly less attractive, but were still available if truly necessary. For short side roads the End Stop Time can also be more effective than the use of cost factors; since cost factors are used multiplicatively, they do have much effect for short roads.

9.2 Manual Calibration of Network-Wide Parameters

A number of system-wide microsimulation parameters had to be manually adjusted in order to improve the modeling results. (These are in addition to the factors subject to genetic parameter calibration, which is described in the next section.)

9.2.1 Timestep detail

Although Paramics is a microsimulation model, it still divides the simulation into discrete time steps. This is the minimum unit of temporal resolution for all processes in the model. All calculations happen at most once per timestep. For example, the positions of all vehicles are updated with the respective frequency, and the driver-vehicle units receive all necessary information at the same time: their own speed, the speed and location of the next vehicle ahead of them, gap information, etc. If the timestep detail is increased, traffic can flow more smoothly at given values of speed and density.

Timestep detail has the most significant impact on highway traffic, especially if speed and density are high. With the default value of 2 timesteps per second, the existing volumes on the Gardiner could not be reproduced, especially at the western boundary of the Waterfront network. However, increasing the timestep detail has a significant impact on simulation performance. After a significant amount of testing, 5 timesteps per second was found to be an appropriate compromise between computational efficiency and simulation accuracy, as judged by the successful modeling of the Gardiner traffic volumes.

9.2.2 Demand profile

With the help of genetic optimization of microsimulation parameters, it became apparent that dynamic feedback assignment was crucial for the successful microsimulation of the heavily traveled Waterfront network. One negative side effect of dynamic feedback can be network volatility. If congestion develops suddenly, and a large percentage of drivers receive the updated route costs, the system can be destabilized if a large volume of traffic is assigned to a new route during a few successive feedback intervals. If this new route is not able to handle such a volume of traffic, congestion can suddenly appear in a new location, and traffic may be reassigned yet again. Specific links in the network that connect between alternate routes may become hopelessly overloaded, and the volatility itself can lower the overall system capacity, due to lane changing, weaving, etc.

It was possible to reduce the impact of this phenomenon by gradually increasing the demand loaded on the network, thereby allowing congestion to develop slowly. A half-hour warm-up period had been specified previously for the Waterfront simulation model, as it is not realistic to start the peak-hour simulation with an empty network. (Results for this half hour are discarded, and only the full peak hour is analyzed.) A demand profile was applied to this half hour, so that the 100% demand level is reached gradually; this is illustrated in **Figure 9.1**.

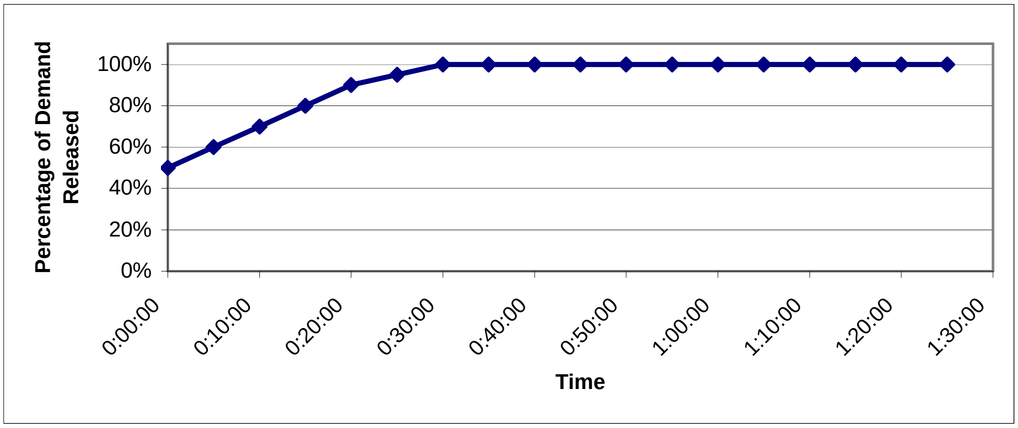


Figure 9.1: Profile of Demand Release on Network. Note: 100% corresponds to 1/12 of the normal peak-hour demand, i.e., for a five-minute period.

9.2.3 Streetcar routes

There are a number of streetcar routes within the Waterfront network, specifically on Queen, King, Dundas, Bathurst, Broadview, and Roncesvalles. These routes, compared to non-streetcar thoroughfares, experience lower operating speeds as a result of the shared right-of-way with the streetcar. Most significant is that at most streetcar stops, vehicles may not pass the streetcar while passengers are boarding or alighting. Since explicit modeling of transit is beyond the scope of this project, vehicle speeds and flows along the streetcar routes were initially much too high.

From a previous project, where the King St. streetcar route was microsimulated in detail, the average speed for all vehicle types along a streetcar route was known to be 25 km/h. A new set of link categories was established for the Waterfront network and used for the coding of all links with streetcar routes operating on a shared right-of-way. The speed limit of these links was adjusted in an iterative fashion until the correct average operating speed was achieved. This in turn made these routes less attractive, and some traffic assigned to parallel routes, thereby more closely reproducing reality.

10. Genetic Parameter Calibration

Once the model development and manual calibration processes are complete, the next step is to calibrate the model parameters. As described earlier, a microscopic traffic model is composed of a number of sub-models the most important of which are a car-following model, a lane-changing model, and a route-choice model. Several parameters control the behavior of those models, the most significant of which are: mean headway, mean reaction time (both affect car-following and gap acceptance etc.), feedback interval (affecting how drivers react to congestion either visible congestion or farther downstream congestion through an exogenous information source), perturbation (which is the random error in travel time perception by the users, affecting stochastic assignment amongst alternate routes), and familiarity (the percentage of drivers familiar with network who also make use of congestion information by re-routing).

Optimization of the overall model performance involves the selection of the 'best' set of values for the above parameters that maximize the model's performance via minimizing a "misfit" function. "Misfit" is used here to denote the error between the model output and observations from the real roadway system. Best values (loosely interpreted as optimal) can be obtained using genetic algorithms, achieving a combinatorial optimization of parameters of the target system (microsimulation) through minimizing a misfit function. It is notable that the search space is a multi-dimensional one where the values of the parameters can be conceived as coordinates, and the 'fitness' representing goodness of fit as a hilly surface. The process of seeking an optimum point, either a global or the best attainable local optimum, should involve some systematic search method to avoid ad-hoc selection of the model parameters and ensure robustness of the results. A very common optimization challenge is how to thoroughly traverse the whole search space to get to a global peak in case of unevenly distributed, non-uniform, multiple-peak space. To solve such problems, one probably resorts to either traditional analytical gradients or numerical search methods. The traditional methods may fail to achieve good results, particularly due to potential entrapment in local minima. In the recent years, Genetic Algorithms have gained popularity as a generic, systems independent optimization tool and have shown to do quite well.

In this investigation, we make use of GENOSIM: a generic traffic microsimulation parameter optimization tool using Genetic Algorithms (GA), developed at the ITS Centre of the University of Toronto by Tao and Abdulhai (2002). GENOSIM is developed as a pilot software that employs state of the art in combinatorial parametric optimization to automate the tedious task of hand-calibrating traffic microsimulation models, in pursuit of a fast, systematic and robust calibration process. The employed global search technique, Genetic Algorithms, can be integrated with any dynamic traffic microscopic simulation tool. Genetic Algorithms in GENOSIM manipulate the values of those control parameters and search for an optimal set of values that minimize the discrepancy between simulation output and real field data (turn counts).

10.1 Model Calibration and Combinatorial Parametric Optimization

The overall traffic simulation model is a microscopic description of underlying driving behavior, via a set of internal models with a number of parameters. By changing parameter values, the simulation outcome will be different. Generally, the quality of simulation and parameter specification can be evaluated by comparing, under given experimental conditions, observed data from the real network (field counts) with simulation results. The simulation is said to be accurate if the error between the simulation results and the observed data is small enough. It is robust if a slight change in the experimental condition results in minimal oscillations in the simulated result.

Therefore, the definition of parameter calibration or optimization here refers to minimizing the "misfit" by fine-tuning parameter values, thus adjusting simulation results. By iterative search using genetic algorithms, combinatorial parameter values could be eventually optimized so that discrepancy between the real system and its virtual replica is minimized.

Once parameters are found that adequately fit modeled to real systems' output, then the models can be applied to testing any scenario one whishes to test. It could be used as a summary way of describing reality, to make reliable predictions about further yet unobserved data, and perhaps even to give explicative power to the model to formulate efficient policy, evaluate different scenarios and aid real-time traffic control and operation.

10.2 Genetic Algorithms as a Parametric Optimization Tool

During the past three decades, the grown demand on combinatorial optimization problems put genetic algorithms in a significant position. Genetic Algorithms have been quite widely and successfully applied to numerous optimization problems.

Genetic Algorithms (GAs) are a stochastic search method based on the principles and mechanisms of natural selection and 'survival of the fittest' from natural evolution. GAs has come to be a popular optimization method since introduced in 1970s by Holland's study of adaptation in artificial and natural systems (Holland 1975). By simulating natural evolutionary processes, a GA can effectively search the problem domain thoroughly on population-based solutions rather than a single solution, and employ heuristics to evolve better solution. The facility of restarting the iterative search from a wide variety of starting points provides some safeguard against entrapment on a local optima, thus making GAs prevail over conventional search methods. A GA performs a multi-directional search by maintaining a population of potential solutions and encourages information formation and exchange between these directions. The population undergoes a simulated evolution: at each generation the relatively "good" solutions reproduce, while the relatively "bad" solutions die. To distinguish between different solutions, an objective function is used for evaluation that plays the role of environment.

Various conventional optimization techniques have been developed and implemented in practical applications, such as analytical methods (least mean-squares or maximum likelihood estimates), various types of hill climbing, randomized search and trial and error. However, many models and their misfit functions cannot be expressed either in an analytically soluble form or with differentiable error function suitable for gradient-guided search techniques. Conventional approaches can therefore easily fail in obtaining the global optimum in complex search space situations in practice. For many such cases that cannot be optimized analytically, various "hill-climbing" or "valley-descending" techniques have been used to search toward an optimum in iterative loop. But, for problems which have multiple local optima, both the iterative incremental step and steepest descent methods lead to a danger of entrapment on local optima and saddle points (Everett 1995). In addition, some conventional optimization methods suffer from lack of prior information on the system parameters or cannot easily be applied to nonlinear systems.

Genetic Algorithms have been found to be particularly effective and powerful in exploring and exploiting poorly understood or non-differentiable spaces for optimization and machine learning. It has also been successfully applied to systems identification and parameter estimation (Kristinsson and Dumont, 1992, Tan el al, 1995). For this type of problem, genetic algorithms have the advantage that all parts of the feasible space are potentially available for exploration and exploitation. So the global optima stands a better chance of being attained. Overall, Genetic Algorithms have unique advantages and charisma in solving the issues of combinatorial parametric optimization.

10.3 Representation

Chromosomes: One distinct element in the GA is the chromosome that is encoded as a single solution. A single solution here means one set of values of combinatorial parameters for the simulation model. One chromosome is subdivided into genes. Associated with each chromosome is a misfit value, which determines its chance to survive and produce offspring.

Genes: A gene, a bit string, is a binary representation of a single parameter value, which must have an upper and lower bound declared. The length of the bit string is of paramount importance. It determines how precise a point the GA could reach in the search space. The longer the binary bit string is, the better, however at the expense of high computation cost. In this research, a 16 or 8 bit is used for each gene to attempt to make every possible point in the search space reachable from the initial population through genetic operators.

10.4 GA Architectures

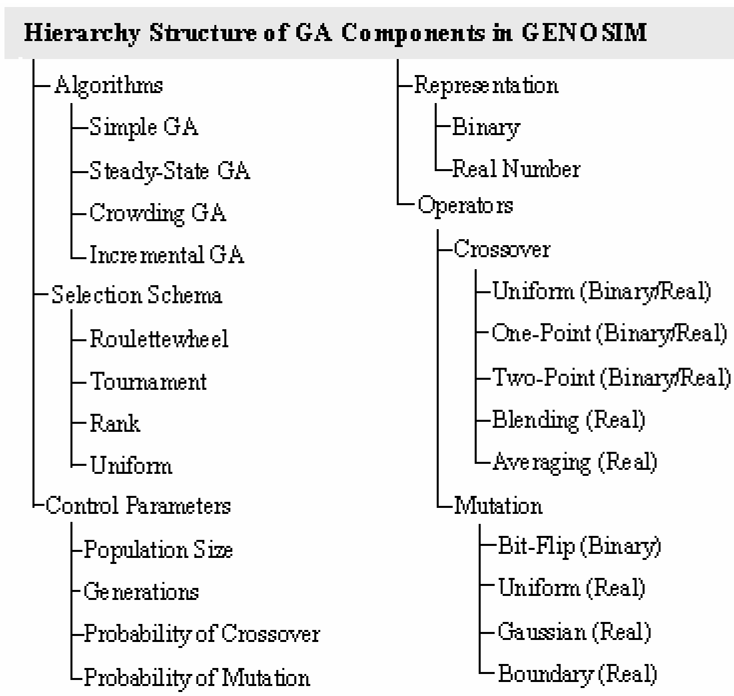
Four types of GAs are implemented in GENOSIM: Simple GA, Steady-state GA, Crowding GA and Incremental GA.

Simple GA: The simple genetic algorithm is a very common implementation. It uses non-overlapping populations. In each generation, the entire population is replaced with new individuals. If the elitism mechanism is specified, the best individual will be carried over from one generation to the next to increase converge speed. The best individual is more likely to be selected for mating (Vemuri and Cedeno, 1995).

Steady-State GA: The steady-state genetic algorithm uses overlapping populations. In each generation, a portion of the population is replaced by the newly generated individuals. The steady-state algorithm is another standard genetic algorithm. If only one or two individuals may be replaced in each generation, it is so-called Incremental GA. At the other extreme, the steady-state algorithm becomes a simple genetic algorithm when the entire population is replaced (Vemuri and Cedeno, 1995).

Crowding-Based GA: Crowding is a generalization of pre-selection. In crowding GA, selection and reproduction are the same as in the SGA; but replacement is a distinct feature. Before replacement, the new offspring will execute a comparison with individuals of the population using a distance function as a measure of similarity. The population member that is most similar to the offspring is replaced by the offspring. This procedure is repeated. This strategy maintains the diversity in the population and slows down premature convergence of the traditional GA, thus making crowding GA prevail over the others. In most cases, it can find the global optimum in a multi-dimensional search space (Vemuri and Cedeno, 1995). **Figure 10.1** below shows the components of GENOSIM.

FIGURE 10.1 - Hierarchy of GA Components in GENOSIM



10.5 Integration of GAs with Paramics

To integrate GAs with the simulation environment, two aspects must be taken into account. The first is the combinatorial parameter configuration that the GA will manipulate. Each parameter must have its domain declared. This is the range of useful values that the parameter may take. The sets of parameter values shape up the solutions for the simulation models, and it is these solution sets that the GA will try to optimize.

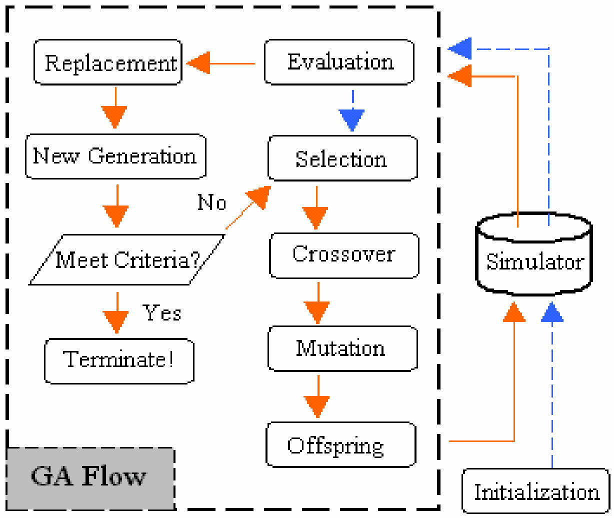
The second is the evaluation of the solution set. At the end of a simulation run, the model outcomes are compared against real target values. The closer to the target value, the better the solution set is. The deviations from the targets are aggregated to a total misfit value. A misfit of zero is a perfect solution.

Figure 10.2 illustrates the working logic of GENOSIM. The Genetic Algorithm begins with initializing a population of chromosomes where each chromosome represents a set of combinatorial parameters. Each chromosome is decoded to produce a set of values for the combinatorial parameters of the simulation model, which are passed to Paramics models via a text configuration file. A simulation run is then automatically triggered based on that configuration. The GA iterative loop halts until the simulation stops and results are generated. Then the simulation outcome is read into GA objective function from the output text files and converted to a misfit value corresponding to that chromosome. Therefore, to evaluate each new chromosome, one simulation run is necessary. The total number of simulation runs is determined by the population size and the total number of new chromosomes produced through all generations. The misfit is calculated based on the difference between model output from various configurations and corresponding observed data. Based on the misfit value of each chromosome in the population, the GA conducts genetic operations, e.g. selection, crossover, mutation and replacement to produce a new generation of solutions. The GA continues until a stopping rule is met. Usually, the stopping rule is determined by either convergence or reaching a pre-specified maximum number of generations. In GENOSIM, the stopping rule is simply coded as the maximum number of generations set by the user.

10.6 Objective/Misfitness Function

One-hour turning counts at selected signalized intersections were employed for fitness computation. **Figure 10.3** shows the four functional forms used in GENOSIM. In this investigation, GRE was used because it gave the best results in previous studies by the developers.

FIGURE 10.2 - Flow of Integration of GAs and Paramics



$$Misfit = \frac{1}{n}\sum_{i=1}^{n}\left| Q_{real} - Q_{sim} \right|$$ Point Mean Absolute Error (PMAE)

$$Misfit = \frac{\sum_{i=1}^{n}\left| Q_{real} - Q_{sim} \right|}{\sum_{i=1}^{n} Q_{real}}$$ Global Relative Error (GRE)

$$Misfit = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(Q_{real} - Q_{sim} \right)^{2}}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n} Q_{real}^{2}} + \sqrt{\frac{1}{n}\sum_{i=1}^{n} Q_{sim}^{2}}}$$ Theil's Inequality Coefficient (Pindyck and Rubinfeld 1981)

$$Misfit = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\frac{Q_{real} - Q_{sim}}{Q_{real}} \right)^{2}} \times 100^{2}$$ Point Mean Relative Error (PMRE)

Where

Qreal = actual values of turning counts at each observation location

Qsim = simulation values of turning counts at each replication location

n = number of time-space points

FIGURE 10.3 - Four Objective Functional Forms

10.7 Calibrated Output

After attaining convergence as explained above, the model's output is compared to field counts at selected key locations. **Table 10.1** shows the corresponding optimal values of the calibrated simulation parameters. Finally, **Table 10.2** compares the models output after calibration to real turn counts supplied by the TWRC.

TABLE 10.1: Genosim Calibrated Parameters Output.

Parameter	Value
Mean Headway	0.74 seconds
Mean Reaction Time	0.61 seconds
Familiarity	75%
Perturbation	10%
Feedback	120 seconds

TABLE 10.2: Comparison of Model Turn Counts Output After Calibration & Real Turn Data Supplied by TWRC.

Location	Loop Detector Data	Available Data	Model Output
Richmond off-ramp	1747[1]	*2130*	2288
Yonge off-ramp From Gardiner WB	-	*1295*	1157
York off-ramp From Gardiner EB	801[2]	*1500*	1146
Spadina off-ramp From Gardiner EB	1467[3]	*1340*	1587
*Lakeshore EB to Lakeshore EB**	-	*2520*	2297
*Lakeshore EB to Fleet EB (Bath. NB)**	-	*1115*	877
Gardiner EB Approaching Spad.	5850[4]	*6065*	5976
*Gardiner EB – Lakeshore split ***	5100[5]	*5100*	5357
*Lakeshore-split from Gardiner EB ***	-	*2625*	1914
Richmond WB through Parliament	-	*2075*	2294
British Columbia to on ram-Gardiner EB	-	*120*	125
Lakeshore EB to on ramp Gardiner	-	*520*	445

1) The number shown is the maximum hourly flow. The maximum 5-minute interval flow is 1803.
2) The minimum, average, and maximum count are 750, 801, and 848, respectively.
3) The minimum, average, and maximum counts are1076, 1467, and 1750, respectively.
4) The number shown is the maximum 5-minute interval flow. The maximum hourly flow is 5791 vehicles/hour.
5) The maximum 5-minute interval flow is 5491. The maximum hourly flow is 5278 and the average hourly flow is 5020 vehicles/hour.

It should be noted that data for Yonge off-ramp could not be obtained due to inability to locate the detector and match the data with it.

* This is for the intersection of Fleet and Lakeshore located west of Bathurst/Lakeshore and east of Strachan/Lakeshore.

** This is the split of Gardiner and Lakeshore at the Humber River in the west end of the modeled network.

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APPENDIX

REPLACEMENT APPROACH PROJECTED TURNING MOVEMENT VOLUMES

IntelliCAN Transportation Systems Inc. Date: June 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options: "Replace" Option or Replacement Approach
(With grade separation at FSE & Strachan, downtown Front & Wellington as in Existing, and a 4-lane FSE.)
Modelled Intersection Turning Movement Volumes for the one hour AM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	1985	1768	2155	85.3
Gardiner ContPastRampToFSE EB T	3578	3211	3844	141.4
Gardiner RampFromFSE WB T	1306	1214	1381	39.5
Gardiner BeforeRampFromFSE WB T	3704	3613	3835	53.3
Strachan FSE_Dufferin_Link NB L	34	15	45	8.3
Strachan FSE_Dufferin_Link NB T	176	139	233	25.5
Strachan FSE_Dufferin_Link NB R	42	31	57	6.5
FSE_Dufferin_Link Strachan EB L	386	306	497	50.5
FSE_Dufferin_Link Strachan EB T	345	315	386	16.9
FSE_Dufferin_Link Strachan EB R	197	150	265	32.6
Strachan FSE_Dufferin_Link SB L	97	75	121	12.2
Strachan FSE_Dufferin_Link SB T	157	105	193	23.4
Strachan FSE_Dufferin_Link SB R	85	64	101	11.9
FSE_Dufferin_Link Strachan WB L	27	18	36	5.2
FSE_Dufferin_Link Strachan WB T	142	127	171	13.0
FSE_Dufferin_Link Strachan WB R	126	71	233	46.6
FSE FSE_Dufferin_Link EB L	120	69	222	46.5
FSE FSE_Dufferin_Link EB T	1930	1690	2143	89.9
FSE_Dufferin_Link FSE SB L	413	377	437	15.8
FSE_Dufferin_Link FSE SB R	62	32	86	13.4
FSE FSE_Dufferin_Link WB T	1216	1101	1293	42.8
FSE FSE_Dufferin_Link WB R	178	150	202	13.8
Strachan Lakeshore EB L	167	138	215	18.7
Strachan Lakeshore EB T	2652	2483	2804	88.3
Strachan Lakeshore EB R	NA	NA	NA	NA
Strachan Lakeshore NB L	NA	NA	NA	NA
Strachan Lakeshore NB T	NA	NA	NA	NA
Strachan Lakeshore NB R	NA	NA	NA	NA
Strachan Lakeshore WB L	NA	NA	NA	NA
Strachan Lakeshore WB T	595	529	643	26.9
Strachan Lakeshore WB R	NA	NA	NA	NA
Strachan Lakeshore SB L	NA	NA	NA	NA
Strachan Lakeshore SB T	NA	NA	NA	NA
Strachan Lakeshore SB R	37	28	49	5.5
Bathurst Front NB L	249	216	277	15.0
Bathurst Front NB T	91	70	115	10.7
Bathurst Front NB R	65	34	89	13.7
Front Bathurst EB L	315	261	365	26.9
Front Bathurst EB T	1685	1494	1971	96.8
Front Bathurst EB R	180	136	231	25.3
Bathurst Front SB L	82	53	114	17.7
Bathurst Front SB T	106	81	141	16.6
Bathurst Front SB R	409	341	479	35.2
Front Bathurst WB L	55	44	74	7.6
Front Bathurst WB T	998	894	1087	47.6
Front Bathurst WB R	21	9	36	7.7
Bathurst Lakeshore_Fleet EB L	50	32	62	6.7
Bathurst Lakeshore_Fleet EB T	2299	2208	2418	53.2
Bathurst Lakeshore_Fleet EB R	294	243	334	24.9
Bathurst Lakeshore_Fleet NB L	31	20	46	6.2
Bathurst Lakeshore_Fleet NB T	8	2	12	2.6
Bathurst Lakeshore_Fleet NB R	46	26	71	12.4
Bathurst Lakeshore_Fleet WB L	6	3	11	2.3
Bathurst Lakeshore_Fleet WB T	459	414	490	21.6
Bathurst Lakeshore_Fleet WB R	80	68	100	9.0
Bathurst Lakeshore_Fleet SB L	171	121	211	21.8

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst Lakeshore_Fleet SB T	38	12	58	11.8
Bathurst Lakeshore_Fleet SB R	47	34	62	7.1
Spadina Front NB L	142	134	148	4.1
Spadina Front NB T	413	295	521	64.9
Spadina Front NB R	161	118	218	27.2
Front Spadina EB L	475	443	506	16.6
Front Spadina EB T	1006	847	1165	88.7
Front Spadina EB R	83	62	105	10.9
Spadina Front SB L	97	80	114	9.3
Spadina Front SB T	198	152	227	18.8
Spadina Front SB R	260	211	304	24.9
Front Spadina WB L	68	51	81	8.2
Front Spadina WB T	640	590	743	37.7
Front Spadina WB R	11	5	19	4.0
Spadina Lakeshore EB L	338	312	367	17.1
Spadina Lakeshore EB T	1721	1633	1812	50.3
Spadina Lakeshore EB R	78	57	106	13.4
Spadina Lakeshore NB L	21	14	36	5.5
Spadina Lakeshore NB T	29	19	39	4.4
Spadina Lakeshore NB R	77	58	92	8.1
Spadina Lakeshore WB L	11	6	18	2.8
Spadina Lakeshore WB T	598	539	658	25.6
Spadina Lakeshore WB R	433	391	484	25.0
Spadina Lakeshore SB L	338	306	393	26.8
Spadina Lakeshore SB T	28	15	44	8.1
Spadina Lakeshore SB R	55	38	71	8.2
Express_Route Rees EB L	568	476	666	52.6
Express_Route Rees EB T	4795	4488	4944	104.4
Express_Route Rees EB R	NA	NA	NA	NA
Express_Route Rees NB L	NA	NA	NA	NA
Express_Route Rees NB T	41	23	54	7.8
Express_Route Rees NB R	63	46	83	9.9
Express_Route Rees WB L	NA	NA	NA	NA
Express_Route Rees WB T	NA	NA	NA	NA
Express_Route Rees WB R	NA	NA	NA	NA
Express_Route Rees SB L	97	67	134	16.0
Express_Route Rees SB T	41	29	57	5.7
Express_Route Rees SB R	NA	NA	NA	NA
Express_Route Simcoe EB L	234	183	284	28.2
Express_Route Simcoe EB T	4446	4178	4630	113.9
Express_Route Simcoe EB R	313	212	367	32.7
Express_Route Simcoe NB L	151	106	190	18.5
Express_Route Simcoe NB T	14	3	34	6.6
Express_Route Simcoe NB R	125	98	159	14.7
Express_Route Simcoe WB L	NA	NA	NA	NA
Express_Route Simcoe WB T	330	237	384	39.2
Express_Route Simcoe WB R	18	6	35	6.7
Express_Route Simcoe SB L	100	68	138	19.0
Express_Route Simcoe SB T	20	10	33	5.2
Express_Route Simcoe SB R	425	373	481	28.9
Express_Route_Eastbound York EB L	707	619	760	37.2
Express_Route_Eastbound York EB T	3709	3500	3901	116.5
Express_Route_Eastbound York EB R	237	204	272	18.3
Express_Route_Eastbound York NB L	NA	NA	NA	NA
Express_Route_Eastbound York NB T	48	28	65	8.9
Express_Route_Eastbound York NB R	281	246	318	20.2
Express_Route_Eastbound York WB L	NA	NA	NA	NA
Express_Route_Eastbound York WB T	NA	NA	NA	NA
Express_Route_Eastbound York WB R	NA	NA	NA	NA
Express_Route_Eastbound York SB L	287	255	311	15.7
Express_Route_Eastbound York SB T	69	48	93	13.2
Express_Route_Eastbound York SB R	338	237	399	40.7
Express_Route_Eastbound Bay EB L	491	427	552	32.9
Express_Route_Eastbound Bay EB T	3408	3249	3591	94.8

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Express_Route_Eastbound Bay EB R	238	207	277	19.2
Express_Route_Eastbound Bay NB L	NA	NA	NA	NA
Express_Route_Eastbound Bay NB T	242	208	271	15.0
Express_Route_Eastbound Bay NB R	239	201	276	21.0
Express_Route_Eastbound Bay WB L	NA	NA	NA	NA
Express_Route_Eastbound Bay WB T	NA	NA	NA	NA
Express_Route_Eastbound Bay WB R	NA	NA	NA	NA
Express_Route_Eastbound Bay SB L	210	181	234	15.0
Express_Route_Eastbound Bay SB T	74	55	97	10.1
Express_Route_Eastbound Bay SB R	NA	NA	NA	NA
Express_Route_Westbound Bay EB L	NA	NA	NA	NA
Express_Route_Westbound Bay EB T	NA	NA	NA	NA
Express_Route_Westbound Bay EB R	NA	NA	NA	NA
Express_Route_Westbound Bay NB LtoYOrk	36	20	49	7.6
Express_Route_Westbound Bay NB LtoExpress	273	248	304	17.0
Express_Route_Westbound Bay NB T	441	385	499	30.9
Express_Route_Westbound Bay NB R	NA	NA	NA	NA
Express_Route_Westbound Bay WB L	191	157	216	12.9
Express_Route_Westbound Bay WB TtoYork	491	433	542	26.2
Express_Route_Westbound Bay WB TtoExpress	3192	3098	3319	63.8
Express_Route_Westbound Bay WB R	722	667	780	34.0
Express_Route_Westbound Bay SB L	NA	NA	NA	NA
Express_Route_Westbound Bay SB T	84	63	107	10.5
Express_Route_Westbound Bay SB RtoYork	41	23	57	8.7
Express_Route_Westbound Bay SB RtoExpress	325	294	365	17.6
Express_Route_Eastbound Yonge EB L	369	328	415	25.9
Express_Route_Eastbound Yonge EB T	3170	3022	3396	86.7
Express_Route_Eastbound Yonge EB R	349	295	380	21.1
Express_Route_Eastbound Yonge NB L	NA	NA	NA	NA
Express_Route_Eastbound Yonge NB T	192	159	221	18.7
Express_Route_Eastbound Yonge NB R	210	181	241	16.4
Express_Route_Eastbound Yonge WB L	NA	NA	NA	NA
Express_Route_Eastbound Yonge WB T	NA	NA	NA	NA
Express_Route_Eastbound Yonge WB R	NA	NA	NA	NA
Express_Route_Eastbound Yonge SB L	87	72	112	8.7
Express_Route_Eastbound Yonge SB T	144	131	157	5.9
Express_Route_Eastbound Yonge SB R	NA	NA	NA	NA
Express_Route_Westbound Yonge EB L	NA	NA	NA	NA
Express_Route_Westbound Yonge EB T	NA	NA	NA	NA
Express_Route_Westbound Yonge EB R	NA	NA	NA	NA
Express_Route_Westbound Yonge NB L	358	322	393	20.5
Express_Route_Westbound Yonge NB T	203	170	242	21.6
Express_Route_Westbound Yonge NB R	NA	NA	NA	NA
Express_Route_Westbound Yonge WB_FromExpress L	NA	NA	NA	NA
Express_Route_Westbound Yonge WB_FromExpress T	NA	NA	NA	NA
Express_Route_Westbound Yonge WB_FromExpress R	732	606	828	58.0
Express_Route_Westbound Yonge WB L	141	124	158	7.7
Express_Route_Westbound Yonge WB T	3930	3763	4119	99.7
Express_Route_Westbound Yonge WB R	NA	NA	NA	NA
Express_Route_Westbound Yonge SB L	NA	NA	NA	NA
Express_Route_Westbound Yonge SB T	78	64	97	8.3
Express_Route_Westbound Yonge SB R	307	274	352	19.4
Lakeshore Jarvis EB L	230	193	284	21.8
Lakeshore Jarvis EB T	1651	1512	1898	95.1
Lakeshore Jarvis EB R	55	32	73	12.0
Lakeshore Jarvis NB L	156	111	197	21.3
Lakeshore Jarvis NB T	45	26	67	9.7
Lakeshore Jarvis NB R	116	91	151	13.2
Lakeshore Jarvis WB L	NA	NA	NA	NA
Lakeshore Jarvis WB T	1290	1157	1433	77.5
Lakeshore Jarvis WB R	429	382	482	28.1
Lakeshore Jarvis SB L	103	83	128	11.0
Lakeshore Jarvis SB T	53	34	68	8.9
Lakeshore Jarvis SB R	421	376	468	20.9

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Lakeshore Don_Roadway EB L	141	111	167	12.0
Lakeshore Don_Roadway EB T	1002	917	1117	48.3
Lakeshore Don_Roadway EB R	84	57	127	16.4
Lakeshore Don_Roadway NB L	212	151	249	26.2

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Lakeshore Don_Roadway NB T	36	26	54	6.9
Lakeshore Don_Roadway NB R	38	20	55	9.2
Lakeshore Don_Roadway WB L	89	37	120	17.8
Lakeshore Don_Roadway WB T	3346	3179	3555	116.9
Lakeshore Don_Roadway WB R	101	80	115	8.8
Lakeshore Don_Roadway SB L	137	116	156	11.1
Lakeshore Don_Roadway SB T	11	5	21	4.6
Lakeshore Don_Roadway SB R	231	209	268	17.8
Jarvis Richmond EB L	NA	NA	NA	NA
Jarvis Richmond EB T	NA	NA	NA	NA
Jarvis Richmond EB R	NA	NA	NA	NA
Jarvis Richmond NB L	208	174	232	14.2
Jarvis Richmond NB T	242	207	291	21.4
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond WB L	314	265	373	27.9
Jarvis Richmond WB T	1983	1802	2074	77.9
Jarvis Richmond WB R	99	53	125	16.0
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	322	286	358	22.0
Jarvis Richmond SB R	348	303	406	21.1
Jarvis Adelaide EB L	74	55	95	11.8
Jarvis Adelaide EB T	212	165	247	17.4
Jarvis Adelaide EB R	111	90	129	11.6
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	394	339	452	28.8
Jarvis Adelaide NB R	46	27	58	6.6
Jarvis Adelaide WB L	NA	NA	NA	NA
Jarvis Adelaide WB T	NA	NA	NA	NA
Jarvis Adelaide WB R	NA	NA	NA	NA
Jarvis Adelaide SB L	139	125	154	7.2
Jarvis Adelaide SB T	425	369	485	31.4
Jarvis Adelaide SB R	NA	NA	NA	NA
Jarvis Front EB L	38	24	57	8.2
Jarvis Front EB T	111	71	133	17.6
Jarvis Front EB R	47	35	65	6.7
Jarvis Front NB L	181	151	230	20.3
Jarvis Front NB T	323	291	361	20.3
Jarvis Front NB R	93	64	113	11.7
Jarvis Front WB L	85	63	109	10.8
Jarvis Front WB T	1071	973	1162	39.4
Jarvis Front WB R	62	47	83	9.4
Jarvis Front SB L	93	77	127	11.1
Jarvis Front SB T	247	213	270	17.0
Jarvis Front SB R	160	129	192	16.9
Parliament Richmond EB L	NA	NA	NA	NA
Parliament Richmond EB T	NA	NA	NA	NA
Parliament Richmond EB R	NA	NA	NA	NA
Parliament Richmond NB L	286	263	317	12.9
Parliament Richmond NB T	182	157	215	16.4
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond WB L	46	27	81	12.4
Parliament Richmond WB T	2083	1983	2173	46.6
Parliament Richmond WB R	195	144	276	27.3
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	49	36	63	6.8
Parliament Richmond SB R	156	133	188	13.7

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament Adelaide EB L	103	76	128	12.8
Parliament Adelaide EB T	69	50	101	14.0
Parliament Adelaide EB R	100	78	123	13.4
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	366	335	405	17.4
Parliament Adelaide NB R	6	0	17	3.8
Parliament Adelaide WB L	NA	NA	NA	NA
Parliament Adelaide WB T	NA	NA	NA	NA
Parliament Adelaide WB R	NA	NA	NA	NA
Parliament Adelaide SB L	2	0	7	1.8
Parliament Adelaide SB T	94	68	137	16.9
Parliament Adelaide SB R	NA	NA	NA	NA
Eastern Broadview EB L	105	88	123	9.1
Eastern Broadview EB T	293	203	373	43.7
Eastern Broadview EB R	0	0	0	0.0
Eastern Broadview NB L	2	0	6	1.7
Eastern Broadview NB T	1	0	3	0.9
Eastern Broadview NB R	NA	NA	NA	NA
Eastern Broadview WB L	0	0	0	0.0
Eastern Broadview WB T	1153	1028	1278	63.9
Eastern Broadview WB R	82	62	117	15.7
Eastern Broadview SB L	104	81	130	13.9
Eastern Broadview SB T	0	0	0	0.0
Eastern Broadview SB R	412	357	473	30.2
Eastern CrossingDVP WB T	1576	1462	1765	84.7
DVP RampToRichmond SB R	2609	2541	2669	35.2
DVP AfterRampToRichmond SB T	1245	1168	1360	47.9
DVPOffRamp ToEastern WB T	169	143	194	14.8
DVPOffRamp ToRichmond WB R	2325	2231	2396	39.0
Eastern PastRampToDVP EB T	389	313	479	43.5
Eastern ToDVPOnRamp EB R	68	56	79	7.0
Adelaide ToDVPOnRamp EB T	37	23	53	9.5
DVP RampFrEasternTotal NB T	105	86	129	11.3
DVP BeforeRampFrEastern NB T	1559	1483	1651	43.7
Bathurst King NB L	3	0	5	1.5
Bathurst King NB T	299	211	343	27.4
Bathurst King NB R	50	29	91	14.0
King Bathurst EB L	190	135	254	32.0
King Bathurst EB T	544	485	614	43.1
King Bathurst EB R	102	77	137	15.1
Bathurst King SB L	78	60	114	12.1
Bathurst King SB T	286	254	327	21.0
Bathurst King SB R	24	16	34	5.6
King Bathurst WB L	81	64	113	12.6
King Bathurst WB T	24	3	50	10.6
King Bathurst WB R	18	9	30	5.9
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	237	220	267	14.3
Bathurst Queen NB R	82	60	102	9.3
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	556	491	611	32.4
Queen Bathurst EB R	192	167	216	13.0
Bathurst Queen SB L	NA	NA	NA	NA
Bathurst Queen SB T	270	235	295	15.8
Bathurst Queen SB R	22	16	30	4.1
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	107	90	133	10.9
Queen Bathurst WB R	29	20	38	5.3

IntelliCAN Transportation Systems Inc. Date: June 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options: "Replace" Option or Replacement Approach
(With grade separation at FSE & Strachan, downtown Front & Wellington as in Existing, and a 4-lane FSE.)
Modelled Intersection Turning Movement Volumes for the one hour PM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB T	1284	1072	1533	128.6
Gardiner ContPastRampToFSE EB T	3717	3302	4002	203.9
Gardiner RampFromFSE WB T	2691	2550	2791	64.5
Gardiner BeforeRampFromFSE WB T	4053	3853	4266	115.2
Strachan FSE_Dufferin_Link NB L	104	69	143	19.4
Strachan FSE_Dufferin_Link NB T	297	237	339	31.7
Strachan FSE_Dufferin_Link NB R	173	127	230	28.8
FSE_Dufferin_Link Strachan EB L	237	186	283	24.7
FSE_Dufferin_Link Strachan EB T	229	205	253	14.3
FSE_Dufferin_Link Strachan EB R	172	134	213	18.2
Strachan FSE_Dufferin_Link SB L	266	204	326	34.8
Strachan FSE_Dufferin_Link SB T	98	72	126	17.1
Strachan FSE_Dufferin_Link SB R	69	43	93	14.8
FSE_Dufferin_Link Strachan WB L	53	43	62	6.1
FSE_Dufferin_Link Strachan WB T	283	249	312	16.6
FSE_Dufferin_Link Strachan WB R	121	83	158	18.5
FSE FSE_Dufferin_Link EB L	101	70	136	18.9
FSE FSE_Dufferin_Link EB T	1177	968	1431	125.2
FSE_Dufferin_Link FSE SB L	282	255	321	20.0
FSE_Dufferin_Link FSE SB R	385	276	498	55.9
FSE FSE_Dufferin_Link WB T	2284	2166	2385	55.9
FSE FSE_Dufferin_Link WB R	354	303	391	22.5
Strachan Lakeshore EB L	288	232	341	27.7
Strachan Lakeshore EB T	2117	2020	2205	61.0
Strachan Lakeshore EB R	NA	NA	NA	NA
Strachan Lakeshore NB L	NA	NA	NA	NA
Strachan Lakeshore NB T	NA	NA	NA	NA
Strachan Lakeshore NB R	NA	NA	NA	NA
Strachan Lakeshore WB L	NA	NA	NA	NA
Strachan Lakeshore WB T	1177	1078	1327	59.4
Strachan Lakeshore WB R	NA	NA	NA	NA
Strachan Lakeshore SB L	NA	NA	NA	NA
Strachan Lakeshore SB T	NA	NA	NA	NA
Strachan Lakeshore SB R	95	65	122	13.5
Bathurst Front NB L	242	210	273	15.8
Bathurst Front NB T	99	69	125	13.3
Bathurst Front NB R	36	16	52	10.2
Front Bathurst EB L	242	217	261	13.5
Front Bathurst EB T	930	756	1170	114.1
Front Bathurst EB R	246	201	307	29.9
Bathurst Front SB L	27	20	37	4.7
Bathurst Front SB T	98	80	133	12.2
Bathurst Front SB R	607	542	725	42.3
Front Bathurst WB L	144	127	164	10.5
Front Bathurst WB T	1923	1710	2024	84.6
Front Bathurst WB R	44	30	56	7.1
Bathurst Lakeshore_Fleet EB L	128	98	153	13.1
Bathurst Lakeshore_Fleet EB T	1624	1504	1748	59.7
Bathurst Lakeshore_Fleet EB R	305	271	357	23.8
Bathurst Lakeshore_Fleet NB L	78	54	100	11.4
Bathurst Lakeshore_Fleet NB T	27	17	36	5.1
Bathurst Lakeshore_Fleet NB R	90	61	108	12.8
Bathurst Lakeshore_Fleet WB L	16	10	23	3.4
Bathurst Lakeshore_Fleet WB T	808	695	876	49.8

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst Lakeshore_Fleet WB R	142	124	176	12.2
Bathurst Lakeshore_Fleet SB L	177	150	217	16.3
Bathurst Lakeshore_Fleet SB T	45	36	59	6.2
Bathurst Lakeshore_Fleet SB R	139	112	173	16.3
Spadina Front NB L	148	139	154	3.9
Spadina Front NB T	479	414	543	32.7
Spadina Front NB R	132	98	189	24.7
Front Spadina EB L	264	249	279	7.8
Front Spadina EB T	410	243	625	101.2
Front Spadina EB R	93	65	148	19.7
Spadina Front SB L	106	68	130	15.4
Spadina Front SB T	375	309	440	29.2
Spadina Front SB R	546	449	609	37.7
Front Spadina WB L	209	181	234	12.0
Front Spadina WB T	1161	1022	1293	74.8
Front Spadina WB R	57	41	79	10.9
Spadina Lakeshore EB L	177	144	206	15.4
Spadina Lakeshore EB T	1466	1371	1578	59.7
Spadina Lakeshore EB R	117	95	134	11.8
Spadina Lakeshore NB L	39	26	51	6.5
Spadina Lakeshore NB T	37	25	55	7.2
Spadina Lakeshore NB R	118	93	143	14.3
Spadina Lakeshore WB L	56	45	68	6.9
Spadina Lakeshore WB T	887	810	981	49.8
Spadina Lakeshore WB R	317	293	340	13.3
Spadina Lakeshore SB L	409	380	467	20.2
Spadina Lakeshore SB T	62	50	76	7.7
Spadina Lakeshore SB R	166	155	181	8.4
Express_Route Rees EB L	733	647	826	50.3
Express_Route Rees EB T	4868	4514	5186	188.0
Express_Route Rees EB R	NA	NA	NA	NA
Express_Route Rees NB L	NA	NA	NA	NA
Express_Route Rees NB T	43	33	52	5.4
Express_Route Rees NB R	144	111	184	20.3
Express_Route Rees WB L	NA	NA	NA	NA
Express_Route Rees WB T	NA	NA	NA	NA
Express_Route Rees WB R	NA	NA	NA	NA
Express_Route Rees SB L	187	158	240	24.9
Express_Route Rees SB T	164	122	199	23.3
Express_Route Rees SB R	NA	NA	NA	NA
Express_Route Simcoe EB L	233	166	285	34.3
Express_Route Simcoe EB T	4430	4054	4784	198.9
Express_Route Simcoe EB R	511	452	575	34.1
Express_Route Simcoe NB L	133	119	152	9.5
Express_Route Simcoe NB T	12	8	16	2.1
Express_Route Simcoe NB R	258	219	301	23.6
Express_Route Simcoe WB L	NA	NA	NA	NA
Express_Route Simcoe WB T	327	272	453	45.2
Express_Route Simcoe WB R	17	8	24	4.7
Express_Route Simcoe SB L	240	159	286	29.6
Express_Route Simcoe SB T	80	62	98	10.9
Express_Route Simcoe SB R	667	534	772	69.7
Express_Route_Eastbound York EB L	930	719	1119	102.9
Express_Route_Eastbound York EB T	3502	3313	3744	121.1
Express_Route_Eastbound York EB R	465	418	507	26.3
Express_Route_Eastbound York NB L	NA	NA	NA	NA
Express_Route_Eastbound York NB T	34	19	64	10.8
Express_Route_Eastbound York NB R	365	312	395	20.4
Express_Route_Eastbound York WB L	NA	NA	NA	NA
Express_Route_Eastbound York WB T	NA	NA	NA	NA
Express_Route_Eastbound York WB R	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Express_Route_Eastbound York SB L	494	450	559	25.0
Express_Route_Eastbound York SB T	114	89	138	15.0
Express_Route_Eastbound York SB R	339	277	458	45.3
Express_Route_Eastbound Bay EB L	396	314	460	36.2
Express_Route_Eastbound Bay EB T	3503	3337	3747	113.1
Express_Route_Eastbound Bay EB R	406	333	447	32.1
Express_Route_Eastbound Bay NB L	NA	NA	NA	NA
Express_Route_Eastbound Bay NB T	174	157	200	12.5
Express_Route_Eastbound Bay NB R	476	433	559	33.9
Express_Route_Eastbound Bay WB L	NA	NA	NA	NA
Express_Route_Eastbound Bay WB T	NA	NA	NA	NA
Express_Route_Eastbound Bay WB R	NA	NA	NA	NA
Express_Route_Eastbound Bay SB L	469	429	502	23.1
Express_Route_Eastbound Bay SB T	144	122	165	10.9
Express_Route_Eastbound Bay SB R	NA	NA	NA	NA
Express_Route_Westbound Bay EB L	NA	NA	NA	NA
Express_Route_Westbound Bay EB T	NA	NA	NA	NA
Express_Route_Westbound Bay EB R	NA	NA	NA	NA
Express_Route_Westbound Bay NB LtoYOrk	25	13	37	5.6
Express_Route_Westbound Bay NB LtoExpress	186	170	211	13.1
Express_Route_Westbound Bay NB T	359	292	416	33.6
Express_Route_Westbound Bay NB R	NA	NA	NA	NA
Express_Route_Westbound Bay WB L	274	248	310	17.4
Express_Route_Westbound Bay WB TtoYork	329	289	387	27.9
Express_Route_Westbound Bay WB TtoExpress	3524	3436	3621	58.1
Express_Route_Westbound Bay WB R	205	183	240	15.4
Express_Route_Westbound Bay SB L	NA	NA	NA	NA
Express_Route_Westbound Bay SB T	335	306	395	22.0
Express_Route_Westbound Bay SB RtoYork	33	21	51	9.0
Express_Route_Westbound Bay SB RtoExpress	445	421	476	15.9
Express_Route_Eastbound Yonge EB L	419	368	471	21.9
Express_Route_Eastbound Yonge EB T	3519	3372	3701	103.3
Express_Route_Eastbound Yonge EB R	522	473	560	23.7
Express_Route_Eastbound Yonge NB L	NA	NA	NA	NA
Express_Route_Eastbound Yonge NB T	172	152	196	11.6
Express_Route_Eastbound Yonge NB R	529	469	586	23.7
Express_Route_Eastbound Yonge WB L	NA	NA	NA	NA
Express_Route_Eastbound Yonge WB T	NA	NA	NA	NA
Express_Route_Eastbound Yonge WB R	NA	NA	NA	NA
Express_Route_Eastbound Yonge SB L	199	175	220	11.7
Express_Route_Eastbound Yonge SB T	180	140	211	17.7
Express_Route_Eastbound Yonge SB R	NA	NA	NA	NA
Express_Route_Westbound Yonge EB L	NA	NA	NA	NA
Express_Route_Westbound Yonge EB T	NA	NA	NA	NA
Express_Route_Westbound Yonge EB R	NA	NA	NA	NA
Express_Route_Westbound Yonge NB L	341	303	379	21.2
Express_Route_Westbound Yonge NB T	248	205	291	20.8
Express_Route_Westbound Yonge NB R	NA	NA	NA	NA
Express_Route_Westbound Yonge WB_FromExpress L	NA	NA	NA	NA
Express_Route_Westbound Yonge WB_FromExpress T	NA	NA	NA	NA
Express_Route_Westbound Yonge WB_FromExpress R	510	434	626	48.1
Express_Route_Westbound Yonge WB L	198	151	218	16.8
Express_Route_Westbound Yonge WB T	3667	3561	3785	69.2
Express_Route_Westbound Yonge WB R	NA	NA	NA	NA
Express_Route_Westbound Yonge SB L	NA	NA	NA	NA
Express_Route_Westbound Yonge SB T	172	149	188	10.9
Express_Route_Westbound Yonge SB R	371	339	404	17.3
Lakeshore Jarvis EB L	374	324	429	25.0
Lakeshore Jarvis EB T	2200	1993	2347	90.9
Lakeshore Jarvis EB R	145	107	190	26.5
Lakeshore Jarvis NB L	131	109	162	13.4

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Lakeshore Jarvis NB T	60	40	81	12.1
Lakeshore Jarvis NB R	258	235	293	15.1
Lakeshore Jarvis WB L	NA	NA	NA	NA
Lakeshore Jarvis WB T	1152	1036	1233	53.4
Lakeshore Jarvis WB R	174	148	207	16.7
Lakeshore Jarvis SB L	304	273	334	19.7
Lakeshore Jarvis SB T	79	52	110	14.7
Lakeshore Jarvis SB R	389	338	456	29.2
Lakeshore Don_Roadway EB L	240	209	279	19.4
Lakeshore Don_Roadway EB T	2442	2148	2747	156.7
Lakeshore Don_Roadway EB R	166	88	241	38.9
Lakeshore Don_Roadway NB L	195	179	207	9.5
Lakeshore Don_Roadway NB T	16	8	27	4.2
Lakeshore Don_Roadway NB R	172	123	225	23.7
Lakeshore Don_Roadway WB L	41	32	54	6.3
Lakeshore Don_Roadway WB T	1549	1494	1600	29.3
Lakeshore Don_Roadway WB R	25	20	36	4.3
Lakeshore Don_Roadway SB L	219	178	248	18.2
Lakeshore Don_Roadway SB T	32	21	54	9.4
Lakeshore Don_Roadway SB R	469	420	503	23.0
Jarvis Richmond EB L	NA	NA	NA	NA
Jarvis Richmond EB T	NA	NA	NA	NA
Jarvis Richmond EB R	NA	NA	NA	NA
Jarvis Richmond NB L	141	117	165	13.1
Jarvis Richmond NB T	973	868	1040	41.0
Jarvis Richmond NB R	NA			
Jarvis Richmond WB L	125	96	169	18.4
Jarvis Richmond WB T	700	618	739	28.5
Jarvis Richmond WB R	143	121	167	10.8
Jarvis Richmond SB L	NA			
Jarvis Richmond SB T	453	416	491	21.9
Jarvis Richmond SB R	271	235	298	18.8
Jarvis Adelaide EB L	480	432	531	30.2
Jarvis Adelaide EB T	1004	950	1134	59.5
Jarvis Adelaide EB R	197	170	220	13.3
Jarvis Adelaide NB L	NA			
Jarvis Adelaide NB T	571	534	633	27.0
Jarvis Adelaide NB R	148	126	176	15.7
Jarvis Adelaide WB L	NA	NA	NA	NA
Jarvis Adelaide WB T	NA	NA	NA	NA
Jarvis Adelaide WB R	NA	NA	NA	NA
Jarvis Adelaide SB L	301	262	356	21.8
Jarvis Adelaide SB T	323	283	363	21.0
Jarvis Adelaide SB R	NA	NA	NA	NA
Jarvis Front EB L	213	192	233	11.3
Jarvis Front EB T	532	460	604	36.6
Jarvis Front EB R	146	137	159	6.2
Jarvis Front NB L	71	62	91	8.6
Jarvis Front NB T	400	361	430	17.6
Jarvis Front NB R	165	135	193	15.4
Jarvis Front WB L	157	133	180	13.2
Jarvis Front WB T	337	289	364	19.9
Jarvis Front WB R	94	79	114	10.9
Jarvis Front SB L	281	246	314	16.4
Jarvis Front SB T	353	319	391	20.0
Jarvis Front SB R	106	83	124	10.3
Parliament Richmond EB L	NA	NA	NA	NA
Parliament Richmond EB T	NA	NA	NA	NA
Parliament Richmond EB R	NA	NA	NA	NA
Parliament Richmond NB L	105	82	122	10.5
Parliament Richmond NB T	303	270	335	18.9
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond WB L	56	43	69	6.8
Parliament Richmond WB T	787	761	817	18.0
Parliament Richmond WB R	113	87	135	10.8
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	76	61	93	9.0

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament Richmond SB R	68	52	82	8.5

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament Adelaide EB L	222	192	255	15.3
Parliament Adelaide EB T	680	632	749	36.5
Parliament Adelaide EB R	273	243	319	17.1
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	183	162	223	16.2
Parliament Adelaide NB R	14	9	17	2.2
Parliament Adelaide WB L	NA	NA	NA	NA
Parliament Adelaide WB T	NA	NA	NA	NA
Parliament Adelaide WB R	NA	NA	NA	NA
Parliament Adelaide SB L	20	14	27	4.0
Parliament Adelaide SB T	124	102	145	10.5
Parliament Adelaide SB R	NA	NA	NA	NA
Eastern Broadview EB L	347	311	379	19.4
Eastern Broadview EB T	1023	899	1150	75.6
Eastern Broadview EB R	0	0	0	0.0
Eastern Broadview NB L	1	0	3	0.8
Eastern Broadview NB T	1	0	3	0.9
Eastern Broadview NB R	0	0	0	0.0
Eastern Broadview WB L	0	0	0	0.0
Eastern Broadview WB T	145	112	167	13.9
Eastern Broadview WB R	44	26	52	7.5
Eastern Broadview SB L	88	61	116	17.8
Eastern Broadview SB T	0	0	0	0.0
Eastern Broadview SB R	100	83	120	10.3
Eastern CrossingDVP WB T	257	229	294	17.2
DVP RampToRichmond SB R	1368	1304	1436	34.9
DVP AfterRampToRichmond SB T	2022	1960	2075	32.8
DVPOffRamp ToEastern WB T	473	425	532	28.0
DVPOffRamp ToRichmond WB R	895	864	942	21.8
Eastern PastRampToDVP EB T	1379	1210	1507	88.6
Eastern ToDVPOnRamp EB R	246	195	295	24.4
Adelaide ToDVPOnRamp EB T	642	584	709	36.6
DVP RampFrEasternTotal NB T	891	815	980	45.2
DVP BeforeRampFrEastern NB T	1866	1797	1941	41.9
Bathurst King NB L	23	11	32	5.7
Bathurst King NB T	288	252	325	21.8
Bathurst King NB R	60	46	75	9.8
King Bathurst EB L	258	211	307	29.3
King Bathurst EB T	245	177	298	33.2
King Bathurst EB R	78	56	110	13.2
Bathurst King SB L	91	71	114	12.9
Bathurst King SB T	363	319	444	32.6
Bathurst King SB R	102	87	119	9.1
King Bathurst WB L	238	203	277	19.4
King Bathurst WB T	181	128	262	36.8
King Bathurst WB R	79	65	91	8.5
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	493	461	532	19.5
Bathurst Queen NB R	130	104	172	16.9
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	339	273	382	27.7
Queen Bathurst EB R	124	105	141	10.0
Bathurst Queen SB L	NA	NA	NA	NA
Bathurst Queen SB T	175	148	204	14.2
Bathurst Queen SB R	60	45	73	8.5
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	517	444	593	43.6
Queen Bathurst WB R	142	115	179	15.9

TRANSFORMATION APPROACH
PROJECTED TURNING MOVEMENT VOLUMES

IntelliCAN Transportation Systems Inc. Date: June 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options: "Retain" Option or Transformation Approach
(Including Gardiner ramp improvements)
Modelled Intersection Turning Movement Volumes for the one hour AM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	1999	1735	2160	84.5
Gardiner ContPastRampToFSE EB T	3240	2977	3660	159.3
Gardiner RampFromFSE WB T	1274	1201	1346	39.5
Gardiner BeforeRampFromFSE WB T	3602	3487	3676	49.5
GardinerOffRamp ToLsbBefSpadina EB L	576	481	683	62.5
GardinerOffRamp ToSpadinaSB EB T	243	125	290	35.7
GardinerOnRamp WestOfSpadina WB T	971	884	1211	76.0
GardinerOnRamp EastOfRees EB T	1366	1302	1429	33.9
GardinerOffRamp EastOfRees WB R	1075	1014	1135	35.7
GardinerOffRamp Jarvis EB R	1331	1240	1453	62.0
GardinerOnRamp Jarvis WB T	1440	1366	1531	44.9
GardinerOnRamp Sherbourne EB T	713	667	770	25.3
Gardiner BeforeRampFromSherb EB T	2216	2103	2351	59.0
GardinerOffRamp Sherbourne WB R	1701	1575	1824	60.1
Gardiner ContPastRampToSherb WB T	2375	2254	2477	66.2
GardinerOffRamp DVP EB L	1391	1326	1458	39.9
Gardiner ToLSBPastDVP EB T	1527	1425	1613	43.9
GardinerOnRamp DVP WB T	1022	929	1227	60.2
Gardiner FromLSBPastDVP WB T	3052	2928	3134	48.6
Bathurst LakeShore NB L	30	19	41	5.7
Bathurst LakeShore NB T	11	3	20	4.1
Bathurst LakeShore NB R	39	27	55	7.7
LakeShore Bathurst EB L	128	87	164	15.1
LakeShore Bathurst EB T	1822	1704	1959	60.6
LakeShore Bathurst EB R	378	322	419	27.5
Bathurst LakeShore SB L	140	125	160	10.5
Bathurst LakeShore SB T	32	16	48	9.6
Bathurst LakeShore SB R	94	70	115	12.1
LakeShore Bathurst WB L	6	2	11	2.7
LakeShore Bathurst WB T	379	344	417	17.9
LakeShore Bathurst WB R	83	68	101	9.2
Spadina LakeShore NB L	154	119	197	19.7
Spadina LakeShore NB T	31	20	46	6.6
Spadina LakeShore NB R	114	78	158	17.7
LakeShore Spadina EB L	398	326	495	41.1
LakeShore Spadina EB T	1837	1693	1991	86.7
LakeShore Spadina EB R	NA	NA	NA	NA
Spadina LakeShore SB L	319	287	349	18.0
Spadina LakeShore SB T	29	18	39	5.2
Spadina LakeShore SB R	400	357	435	24.7
LakeShore Spadina wB L	5	1	10	1.7
LakeShore Spadina WB T	931	806	1273	105.6
LakeShore Spadina WB R	373	326	426	25.4
Rees LakeShore NB L	96	81	136	11.6
Rees LakeShore NB T	49	22	67	10.0
Rees LakeShore NB R	193	171	222	11.2
LakeShore Rees EB L	27	16	66	10.0
LakeShore Rees EB T	1778	1669	1924	66.5
LakeShore Rees EB R	78	61	144	17.3
Rees LakeShore SB L	256	219	287	17.7
Rees LakeShore SB T	30	13	47	8.3
Rees LakeShore SB R	134	92	201	24.3
LakeShore Rees WB L	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Rees WB T	1072	954	1384	99.3
LakeShore Rees WB R	631	501	699	46.2
Simcoe LakeShore NB L	52	39	68	7.2
Simcoe LakeShore NB T	44	26	70	12.8
Simcoe LakeShore NB R	38	21	65	9.7
LakeShore Simcoe EB L	132	89	192	26.2
LakeShore Simcoe EB T	730	665	804	34.6
LakeShore Simcoe EB R	23	15	34	5.1
Simcoe LakeShore SB L	17	11	27	3.6
Simcoe LakeShore SB T	25	13	36	5.1
Simcoe LakeShore SB R	84	57	127	16.8
LakeShore Simcoe WB L	51	30	60	6.7
LakeShore Simcoe WB T	490	448	573	27.7
LakeShore Simcoe WB R	38	28	47	5.5
York LakeShore NB L	NA	NA	NA	NA
York LakeShore NB T	84	57	123	15.9
York LakeShore NB R	NA	NA	NA	NA
LakeShore York EB L	221	183	274	21.3
York LakeShore SB L	NA	NA	NA	NA
York LakeShore SB T	136	112	156	12.8
York LakeShore SB R	133	111	165	14.2
LakeShore York WB L	NA	NA	NA	NA
LakeShore York WB T	465	417	528	24.2
LakeShore York WB R	121	100	147	11.8
Bay LakeShore NB L	117	103	133	9.1
Bay LakeShore NB T	270	242	310	17.1
Bay LakeShore NB R	NA	NA	NA	NA
Bay LakeShore SB L	NA	NA	NA	NA
Bay LakeShore SB T	141	124	169	9.8
Bay LakeShore SB R	140	124	175	12.0
LakeShore Bay WB L	100	74	117	9.6
LakeShore Bay WB T	407	369	445	20.4
LakeShore Bay WB R	148	131	178	11.9
Yonge LakeShore NB L	122	98	151	13.0
Yonge LakeShore NB T	126	91	149	15.2
Yonge LakeShore NB R	NA	NA	NA	NA
Yonge LakeShore SB L	NA	NA	NA	NA
Yonge LakeShore SB T	143	117	165	11.2
Yonge LakeShore SB R	104	86	128	10.6
LakeShore Yonge WB L	53	44	60	4.9
LakeShore Yonge WB T	416	370	474	26.8
LakeShore Yonge WB R	675	575	813	55.0
Jarvis LakeShore NB L	174	138	248	27.3
Jarvis LakeShore NB T	347	313	386	20.1
Jarvis LakeShore NB R	NA	NA	NA	NA
LakeShore Jarvis EB L	NA	NA	NA	NA
LakeShore Jarvis EB T	NA	NA	NA	NA
LakeShore Jarvis EB R	NA	NA	NA	NA
Jarvis LakeShore SB L	NA	NA	NA	NA
Jarvis LakeShore SB T	62	42	72	7.1
Jarvis LakeShore SB R	757	691	782	19.7
LakeShore Jarvis WB L	NA	NA	NA	NA
LakeShore Jarvis WB T	1692	1555	1845	91.3
LakeShore Jarvis WB R	590	546	666	32.1
Sherbourne LakeShore NB L	120	96	156	15.4
Sherbourne LakeShore NB T	50	27	74	12.6
Sherbourne LakeShore NB R	NA	NA	NA	NA
LakeShore Sherbourne EB L	NA	NA	NA	NA
LakeShore Sherbourne EB T	NA	NA	NA	NA
LakeShore Sherbourne EB R	NA	NA	NA	NA
Sherbourne LakeShore SB L	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Sherbourne LakeShore SB T	35	18	58	11.0

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Sherbourne LakeShore SB R	115	90	129	10.9
LakeShore Sherbourne WB L	NA	NA	NA	NA
LakeShore Sherbourne WB T	724	616	824	60.5
FromGardinerOffRamp Sherbourne WB T	1291	1192	1429	52.0
FromGardinerOffRamp Sherbourne WB R	415	376	473	25.9
Parliament LakeShore NB L	135	115	160	13.0
Parliament LakeShore NB T	28	15	37	6.3
Parliament LakeShore NB R	51	33	70	9.1
LakeShore Parliament EB L	271	240	312	18.7
LakeShore Parliament EB T	290	239	334	19.2
LakeShore Parliament EB R	29	18	35	4.2
Parliament LakeShore SB L	35	21	52	7.4
Parliament LakeShore SB T	53	35	70	8.1
Parliament LakeShore SB R	145	116	179	20.7
LakeShore Parliament WB L	120	99	147	14.2
LakeShore Parliament WB T	435	350	498	36.9
LakeShore Parliament WB R	95	81	110	8.4
Cherry LakeShore NB L	82	53	124	16.9
Cherry LakeShore NB T	55	32	83	13.0
Cherry LakeShore NB R	1	0	3	0.9
LakeShore Cherry EB L	19	11	28	4.4
LakeShore Cherry EB T	142	117	168	14.7
LakeShore Cherry EB R	203	150	228	17.7
Cherry LakeShore SB L	11	6	20	3.8
Cherry LakeShore SB T	92	79	119	9.7
Cherry LakeShore SB R	85	60	105	12.9
LakeShore Cherry WB L	3	0	4	1.1
LakeShore Cherry WB T	627	544	689	33.9
LakeShore Cherry WB R	85	60	107	11.9
DonRoadway LakeShore NB L	51	24	79	12.6
DonRoadway LakeShore NB T	61	50	77	7.5
DonRoadway LakeShore NB R	9	4	15	2.9
LakeShore DonRoadway EB L	NA	NA	NA	NA
LakeShore DonRoadway EB T	178	134	207	17.1
LakeShore DonRoadway EB R	46	36	56	6.6
DonRoadway LakeShore SB L	65	38	105	16.2
DonRoadway LakeShore SB T	81	38	107	17.0
DonRoadway LakeShore SB R	59	43	77	8.7
LakeShore DonRoadway WB L	NA	NA	NA	NA
LakeShore DonRoadway WB T	575	518	639	31.1
LakeShore DonRoadway WB R	86	72	113	9.3
York Harbour NB L	NA	NA	NA	NA
York Harbour NB T	84	56	123	16.1
York Harbour NB R	125	105	149	10.6
Harbour York EB L	NA	NA	NA	NA
Harbour York EB T	511	454	545	20.6
Harbour York EB R	77	54	92	9.0
York Harbour SB L	94	73	113	11.3
York Harbour SB T	41	34	54	4.5
York Harbour SB R	NA	NA	NA	NA
Bay Harbour NB L	NA	NA	NA	NA
Bay Harbour NB T	187	159	223	15.5
Bay Harbour NB R	101	84	120	10.6
Harbour Bay EB L	202	172	225	14.9
Harbour Bay EB T	453	410	493	19.2
Harbour Bay EB R	84	64	100	8.9
Bay Harbour SB L	152	130	171	10.4
Bay Harbour SB T	88	75	110	8.7
Bay Harbour SB R	NA	NA	NA	NA
Yonge Harbour NB L	NA	NA	NA	NA
Yonge Harbour NB T	114	88	138	15.9

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Yonge Harbour NB R	109	86	123	9.9
Harbour Yonge EB L	134	107	152	12.6
Harbour Yonge EB T	526	481	558	19.4
Harbour Yonge EB R	85	73	104	8.9
Yonge Harbour SB L	120	98	145	10.5
Yonge Harbour SB T	91	75	110	8.2
Yonge Harbour SB R	NA	NA	NA	NA
Cooper Harbour NB L	NA	NA	NA	NA
Cooper Harbour NB T	NA	NA	NA	NA
Cooper Harbour NB R	32	23	41	5.3
Harbour Cooper EB L	NA	NA	NA	NA
Harbour Cooper EB T	670	635	725	24.5
Harbour Cooper EB R	37	31	51	4.9
Jarvis Harbour NB L	NA	NA	NA	NA
Jarvis Harbour NB T	108	86	131	13.0
Jarvis Harbour NB R	57	45	71	8.1
Harbour Jarvis EB L	NA	NA	NA	NA
Harbour Jarvis EB T	690	664	752	24.5
Harbour Jarvis EB R	16	6	24	4.6
FromGardinerOffRamp Jarvis EB L	413	356	518	38.8
FromGardinerOffRamp Jarvis EB T	920	873	1002	35.9
Jarvis Harbour SB L	55	35	66	6.5
Jarvis Harbour SB T	8	2	14	3.2
Jarvis Harbour SB R	NA	NA	NA	NA
Sherbourne Harbour NB L	NA	NA	NA	NA
Sherbourne Harbour NB T	88	65	116	14.0
Sherbourne Harbour NB R	66	42	95	11.6
Harbour Sherbourne EB L	81	63	109	10.5
Harbour Sherbourne EB T	1192	1134	1246	29.6
Harbour Sherbourne EB R	44	33	59	6.4
Sherbourne Harbour SB L	23	10	44	8.2
Sherbourne Harbour SB T	11	5	21	4.2
Sherbourne Harbour SB R	NA	NA	NA	NA
Bathurst Front NB L	235	216	261	12.0
Bathurst Front NB T	94	79	113	8.4
Bathurst Front NB R	87	66	108	12.2
Front Bathurst EB L	290	249	341	19.8
Front Bathurst EB T	1786	1376	2011	138.8
Front Bathurst EB R	146	105	211	23.6
Bathurst Front SB L	71	48	101	12.8
Bathurst Front SB T	129	101	149	13.5
Bathurst Front SB R	413	363	494	38.1
Front Bathurst WB L	82	64	97	8.7
Front Bathurst WB T	1031	897	1154	65.5
Front Bathurst WB R	31	16	50	8.5
Spadina Front NB L	148	127	157	8.2
Spadina Front NB T	556	435	637	50.0
Spadina Front NB R	258	167	365	46.6
Front Spadina EB L	475	453	500	13.5
Front Spadina EB T	1115	774	1272	111.2
Front Spadina EB R	79	60	96	8.7
Spadina Front SB L	98	82	114	7.2
Spadina Front SB T	261	213	304	20.6
Spadina Front SB R	225	182	260	17.9
Front Spadina WB L	163	145	194	12.3
Front Spadina WB T	706	647	796	40.1
Front Spadina WB R	11	5	17	3.5
Parliament Front NB L	270	237	334	23.7
Parliament Front NB T	238	198	321	23.4
Parliament Front NB R	118	88	154	15.4
Front Parliament EB L	35	22	45	6.4

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Front Parliament EB T	214	169	249	19.0
Front Parliament EB R	40	29	54	7.0
Parliament Front SB L	37	19	52	8.0
Parliament Front SB T	52	38	66	6.5
Parliament Front SB R	91	73	145	16.3
Front Parliament WB L	94	78	112	8.6
Front Parliament WB T	1404	1262	1506	58.1
Front Parliament WB R	207	166	241	15.7
Parliament Richmond NB L	287	249	311	15.0
Parliament Richmond NB T	201	130	304	33.6
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	48	36	65	8.5
Parliament Richmond SB R	130	102	149	13.0
Richmond Parliament WB L	49	25	134	27.7
Richmond Parliament WB T	1972	1594	2088	113.4
Richmond Parliament WB R	246	201	294	27.1
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	411	342	475	29.3
Parliament Adelaide NB R	4	0	10	2.6
Adelaide Parliament EB L	80	55	98	11.6
Adelaide Parliament EB T	61	41	76	9.0
Adelaide Parliament EB R	90	73	112	10.0
Parliament Adelaide SB L	1	0	5	1.4
Parliament Adelaide SB T	97	67	198	31.6
Parliament Adelaide SB R	NA	NA	NA	NA
Jarvis Richmond NB L	251	208	284	18.2
Jarvis Richmond NB T	199	151	250	21.5
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	381	349	468	25.9
Jarvis Richmond SB R	321	244	371	28.2
Richmond Jarvis WB L	303	204	367	35.4
Richmond Jarvis WB T	1879	1188	2099	219.9
Richmond Jarvis WB R	98	48	150	23.4
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	434	356	502	33.2
Jarvis Adelaide NB R	41	34	52	5.4
Adelaide Jarvis EB L	54	43	73	7.6
Adelaide Jarvis EB T	207	180	231	15.5
Adelaide Jarvis EB R	138	121	164	12.6
Jarvis Adelaide SB L	162	141	196	12.2
Jarvis Adelaide SB T	486	407	557	39.3
Jarvis Adelaide SB R	NA	NA	NA	NA
Eastern CrossingDVP WB T	1658	1465	1745	62.5
DVP RampToRichmond SB R	2575	2433	2637	45.9
DVP AfterRampToRichm SB T	1244	1177	1492	65.8
DVPOffRamp ToEastern WB T	199	145	306	31.8
DVPOffRamp ToRichmond WB R	2262	2018	2329	71.9
Eastern PastRampToDVP EB T	284	238	332	23.3
Eastern ToDVPOnRamp EB R	61	49	73	7.0
Adelaide ToDVPOnRamp EB T	31	17	44	6.8
DVP RampFrEasternTotal NB T	93	71	113	10.4
DVP BeforeRampFrEastern NB T	1539	1471	1629	43.1
Bathurst King NB L	5	2	9	2.1
Bathurst King NB T	278	240	302	19.1
Bathurst King NB R	54	25	83	14.1
King Bathurst EB L	208	147	268	35.1
King Bathurst EB T	600	524	705	41.9
King Bathurst EB R	97	78	120	12.5
Bathurst King SB L	124	98	147	15.9

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst King SB T	290	250	324	19.5
Bathurst King SB R	24	12	36	5.7
King Bathurst WB L	122	104	143	12.1
King Bathurst WB T	37	16	56	10.3
King Bathurst WB R	20	9	29	5.1
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	236	199	261	17.4
Bathurst Queen NB R	99	81	114	8.3
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	616	542	718	36.4
Queen Bathurst EB R	179	157	206	12.9
Bathurst Queen SB L	NA	NA	NA	NA
Bathurst Queen SB T	283	240	312	21.2
Bathurst Queen SB R	24	14	31	4.1
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	109	78	127	10.8
Queen Bathurst WB R	29	20	37	4.6

IntelliCAN Transportation Systems Inc. Date: June 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options: "Retain" Option or Transformation Approach
(Including Gardiner ramp improvements)
Modelled Intersection Turning Movement Volumes for the one hour PM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	1476	1191	1721	147.5
Gardiner ContPastRampToFSE EB T	3682	3106	4053	204.2
Gardiner RampFromFSE WB T	2466	2174	2614	100.0
Gardiner BeforeRampFromFSE WB T	4304	4023	4463	130.2
GardinerOffRamp ToLsbBefSpadina EB L	540	419	686	69.2
GardinerOffRamp ToSpadinaSB EB T	505	449	588	40.8
GardinerOnRamp WestOfSpadina WB T	1505	1320	1731	105.6
GardinerOnRamp EastOfRees EB T	1313	1166	1466	87.3
GardinerOffRamp EastOfRees WB R	688	629	717	19.5
GardinerOffRamp Jarvis EB R	1315	1027	1496	123.1
GardinerOnRamp Jarvis WB T	1865	1792	1945	50.2
GardinerOnRamp Sherbourne EB T	1410	1257	1533	82.8
Gardiner BeforeRampFromSherb EB T	2529	2096	2905	186.2
GardinerOffRamp Sherbourne WB R	879	810	930	36.1
Gardiner ContPastRampToSherb WB T	1788	1694	1858	51.9
GardinerOffRamp DVP EB L	1430	1284	1656	81.3
Gardiner ToLSBPastDVP EB T	2456	2156	2756	133.9
GardinerOnRamp DVP WB T	1321	1240	1390	42.1
Gardiner FromLSBPastDVP WB T	1357	1297	1444	33.1
Bathurst LakeShore NB L	73	53	98	11.4
Bathurst LakeShore NB T	31	21	52	6.9
Bathurst LakeShore NB R	77	59	94	10.4
LakeShore Bathurst EB L	178	145	217	17.5
LakeShore Bathurst EB T	1287	1208	1422	56.2
LakeShore Bathurst EB R	265	225	290	17.5
Bathurst LakeShore SB L	144	119	171	12.8
Bathurst LakeShore SB T	31	23	44	5.2
Bathurst LakeShore SB R	188	154	217	17.8
LakeShore Bathurst WB L	13	10	19	2.5
LakeShore Bathurst WB T	615	553	651	25.4
LakeShore Bathurst WB R	107	87	132	11.7
Spadina LakeShore NB L	228	201	255	15.4
Spadina LakeShore NB T	33	22	48	6.7
Spadina LakeShore NB R	110	87	138	12.3
LakeShore Spadina EB L	367	296	409	24.7
LakeShore Spadina EB T	1555	1402	1710	75.1
LakeShore Spadina EB R	NA	NA	NA	NA
Spadina LakeShore SB L	345	316	381	15.3
Spadina LakeShore SB T	76	55	91	8.8
Spadina LakeShore SB R	554	456	638	48.9
LakeShore Spadina wB L	48	33	61	7.6
LakeShore Spadina WB T	1497	1365	1601	67.0
LakeShore Spadina WB R	319	291	345	15.2
Rees LakeShore NB L	156	120	202	19.1
Rees LakeShore NB T	108	81	164	18.8
Rees LakeShore NB R	330	272	380	27.0
LakeShore Rees EB L	81	60	119	15.6
LakeShore Rees EB T	1741	1610	1879	71.3
LakeShore Rees EB R	189	162	216	16.2
Rees LakeShore SB L	318	295	363	18.8
Rees LakeShore SB T	84	70	106	10.5
Rees LakeShore SB R	225	144	273	31.3
LakeShore Rees WB L	NA	NA	NA	NA
LakeShore Rees WB T	1405	1306	1514	49.5

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Rees WB R	329	298	384	21.7
Simcoe LakeShore NB L	60	47	78	6.9
Simcoe LakeShore NB T	61	42	83	10.1
Simcoe LakeShore NB R	146	107	173	14.9
LakeShore Simcoe EB L	149	127	195	20.1
LakeShore Simcoe EB T	844	797	884	23.2
LakeShore Simcoe EB R	89	67	114	13.2
Simcoe LakeShore SB L	95	69	129	13.2
Simcoe LakeShore SB T	138	104	170	17.2
Simcoe LakeShore SB R	247	206	350	33.7
LakeShore Simcoe WB L	111	92	132	10.6
LakeShore Simcoe WB T	694	625	756	31.2
LakeShore Simcoe WB R	59	49	73	7.0
York LakeShore NB L	NA	NA	NA	NA
York LakeShore NB T	107	81	129	14.7
York LakeShore NB R	NA	NA	NA	NA
LakeShore York EB L	274	251	294	10.6
York LakeShore SB L	NA	NA	NA	NA
York LakeShore SB T	431	400	461	15.3
York LakeShore SB R	277	241	316	21.7
LakeShore York WB L	NA	NA	NA	NA
LakeShore York WB T	679	645	730	24.8
LakeShore York WB R	129	112	143	7.6
Bay LakeShore NB L	113	96	129	11.2
Bay LakeShore NB T	263	226	309	18.2
Bay LakeShore NB R	NA	NA	NA	NA
Bay LakeShore SB L	NA	NA	NA	NA
Bay LakeShore SB T	354	326	387	16.6
Bay LakeShore SB R	331	303	372	17.7
LakeShore Bay WB L	168	137	198	15.3
LakeShore Bay WB T	486	460	508	15.5
LakeShore Bay WB R	103	80	123	11.1
Yonge LakeShore NB L	166	138	196	14.3
Yonge LakeShore NB T	205	147	303	35.8
Yonge LakeShore NB R	NA	NA	NA	NA
Yonge LakeShore SB L	NA	NA	NA	NA
Yonge LakeShore SB T	269	233	330	27.3
Yonge LakeShore SB R	196	153	223	18.0
LakeShore Yonge WB L	78	58	95	11.2
LakeShore Yonge WB T	425	385	459	16.0
LakeShore Yonge WB R	273	214	302	25.9
Jarvis LakeShore NB L	157	92	214	28.6
Jarvis LakeShore NB T	605	407	689	68.2
Jarvis LakeShore NB R	NA	NA	NA	NA
LakeShore Jarvis EB L	NA	NA	NA	NA
LakeShore Jarvis EB T	NA	NA	NA	NA
LakeShore Jarvis EB R	NA	NA	NA	NA
Jarvis LakeShore SB L	NA	NA	NA	NA
Jarvis LakeShore SB T	191	177	206	8.5
Jarvis LakeShore SB R	923	838	998	43.6
LakeShore Jarvis WB L	NA	NA	NA	NA
LakeShore Jarvis WB T	1527	1468	1589	35.6
LakeShore Jarvis WB R	280	247	330	22.8
Sherbourne LakeShore NB L	167	142	218	18.4
Sherbourne LakeShore NB T	133	76	182	25.1
Sherbourne LakeShore NB R	NA	NA	NA	NA
LakeShore Sherbourne EB L	NA	NA	NA	NA
LakeShore Sherbourne EB T	NA	NA	NA	NA
LakeShore Sherbourne EB R	NA	NA	NA	NA
Sherbourne LakeShore SB L	NA	NA	NA	NA
Sherbourne LakeShore SB T	106	48	168	35.3

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Sherbourne LakeShore SB R	195	146	236	29.2
LakeShore Sherbourne WB L	NA	NA	NA	NA
LakeShore Sherbourne WB T	674	623	722	33.0
FromGardinerOffRamp Sherbourne WB T	744	669	806	33.4
FromGardinerOffRamp Sherbourne WB R	139	117	176	14.9
Parliament LakeShore NB L	129	109	147	11.7
Parliament LakeShore NB T	98	67	151	20.9
Parliament LakeShore NB R	193	160	240	22.6
LakeShore Parliament EB L	294	209	359	39.6
LakeShore Parliament EB T	401	350	460	30.9
LakeShore Parliament EB R	104	83	124	12.2
Parliament LakeShore SB L	91	67	112	13.5
Parliament LakeShore SB T	80	67	97	7.0
Parliament LakeShore SB R	178	154	199	13.8
LakeShore Parliament WB L	107	89	132	10.8
LakeShore Parliament WB T	357	325	392	20.4
LakeShore Parliament WB R	70	56	79	5.1
Cherry LakeShore NB L	148	127	160	9.4
Cherry LakeShore NB T	64	48	77	8.2
Cherry LakeShore NB R	8	4	15	2.8
LakeShore Cherry EB L	41	18	54	10.8
LakeShore Cherry EB T	624	533	697	43.2
LakeShore Cherry EB R	87	57	139	19.1
Cherry LakeShore SB L	110	64	162	26.9
Cherry LakeShore SB T	42	26	59	10.7
Cherry LakeShore SB R	49	38	61	7.7
LakeShore Cherry WB L	8	4	16	3.3
LakeShore Cherry WB T	433	387	468	20.5
LakeShore Cherry WB R	75	60	91	8.3
DonRoadway LakeShore NB L	84	73	99	7.8
DonRoadway LakeShore NB T	27	15	44	6.2
DonRoadway LakeShore NB R	86	61	107	11.4
LakeShore DonRoadway EB L	NA	NA	NA	NA
LakeShore DonRoadway EB T	704	598	783	60.1
LakeShore DonRoadway EB R	92	78	110	8.7
DonRoadway LakeShore SB L	169	152	195	12.2
DonRoadway LakeShore SB T	93	61	119	16.6
DonRoadway LakeShore SB R	87	73	102	8.1
LakeShore DonRoadway WB L	NA	NA	NA	NA
LakeShore DonRoadway WB T	339	314	383	16.6
LakeShore DonRoadway WB R	24	14	35	5.7
York Harbour NB L	NA	NA	NA	NA
York Harbour NB T	107	81	129	14.3
York Harbour NB R	231	188	264	19.9
Harbour York EB L	NA	NA	NA	NA
Harbour York EB T	594	565	620	16.3
Harbour York EB R	219	179	247	18.9
York Harbour SB L	280	246	318	16.2
York Harbour SB T	151	128	161	8.9
York Harbour SB R	NA	NA	NA	NA
Bay Harbour NB L	NA	NA	NA	NA
Bay Harbour NB T	164	146	195	12.8
Bay Harbour NB R	264	234	296	15.3
Harbour Bay EB L	214	189	262	16.5
Harbour Bay EB T	672	623	713	25.0
Harbour Bay EB R	218	182	244	15.0
Bay Harbour SB L	321	300	354	14.2
Bay Harbour SB T	200	171	231	13.3
Bay Harbour SB R	NA	NA	NA	NA
Yonge Harbour NB L	NA	NA	NA	NA
Yonge Harbour NB T	134	98	211	25.9

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Yonge Harbour NB R	291	251	335	20.8
Harbour Yonge EB L	230	178	274	24.0
Harbour Yonge EB T	839	804	889	26.3
Harbour Yonge EB R	217	185	247	14.7
Yonge Harbour SB L	204	172	237	18.7
Yonge Harbour SB T	154	133	185	14.4
Yonge Harbour SB R	NA	NA	NA	NA
Cooper Harbour NB L	NA	NA	NA	NA
Cooper Harbour NB T	NA	NA	NA	NA
Cooper Harbour NB R	106	80	130	13.8
Harbour Cooper EB L	NA	NA	NA	NA
Harbour Cooper EB T	1215	1146	1324	44.1
Harbour Cooper EB R	149	119	172	15.0
Jarvis Harbour NB L	NA	NA	NA	NA
Jarvis Harbour NB T	125	90	179	23.1
Jarvis Harbour NB R	159	128	203	20.5
Harbour Jarvis EB L	NA	NA	NA	NA
Harbour Jarvis EB T	1254	1145	1354	53.3
Harbour Jarvis EB R	82	57	108	12.5
FromGardinerOffRamp Jarvis EB L	640	455	745	73.3
FromGardinerOffRamp Jarvis EB T	678	508	849	77.9
Jarvis Harbour SB L	178	167	196	8.1
Jarvis Harbour SB T	18	12	23	3.2
Jarvis Harbour SB R	NA	NA	NA	NA
Sherbourne Harbour NB L	NA	NA	NA	NA
Sherbourne Harbour NB T	145	111	172	16.7
Sherbourne Harbour NB R	301	221	392	56.3
Harbour Sherbourne EB L	158	116	191	18.1
Harbour Sherbourne EB T	1816	1592	1960	90.1
Harbour Sherbourne EB R	146	110	171	17.1
Sherbourne Harbour SB L	82	35	133	27.2
Sherbourne Harbour SB T	24	12	37	9.0
Sherbourne Harbour SB R	NA	NA	NA	NA
Bathurst Front NB L	216	190	234	14.1
Bathurst Front NB T	103	82	124	11.2
Bathurst Front NB R	70	50	93	10.9
Front Bathurst EB L	334	291	368	20.7
Front Bathurst EB T	1098	824	1324	126.4
Front Bathurst EB R	218	160	267	28.0
Bathurst Front SB L	32	17	47	8.1
Bathurst Front SB T	131	107	157	14.6
Bathurst Front SB R	643	548	708	46.3
Front Bathurst WB L	170	146	208	15.2
Front Bathurst WB T	1725	1591	1792	63.5
Front Bathurst WB R	45	32	56	6.5
Spadina Front NB L	139	127	153	7.2
Spadina Front NB T	510	435	573	42.8
Spadina Front NB R	153	128	180	12.0
Front Spadina EB L	409	358	432	18.6
Front Spadina EB T	547	414	677	76.3
Front Spadina EB R	99	85	123	11.4
Spadina Front SB L	95	71	111	11.7
Spadina Front SB T	492	446	564	34.6
Spadina Front SB R	506	421	606	45.6
Front Spadina WB L	240	213	262	12.6
Front Spadina WB T	1002	920	1142	56.2
Front Spadina WB R	63	35	83	11.5
Parliament Front NB L	102	81	119	11.8
Parliament Front NB T	187	165	213	14.6
Parliament Front NB R	224	165	273	31.5
Front Parliament EB L	118	98	136	9.4

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Front Parliament EB T	1098	1018	1202	51.8
Front Parliament EB R	105	86	120	10.1
Parliament Front SB L	241	208	291	24.8
Parliament Front SB T	131	115	152	12.6
Parliament Front SB R	100	73	119	13.8
Front Parliament WB L	135	107	151	13.1
Front Parliament WB T	776	709	837	35.6
Front Parliament WB R	89	71	104	8.4
Parliament Richmond NB L	128	101	161	15.2
Parliament Richmond NB T	295	271	347	19.5
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	69	56	94	11.1
Parliament Richmond SB R	59	42	70	6.2
Richmond Parliament WB L	51	36	66	8.1
Richmond Parliament WB T	846	804	895	25.1
Richmond Parliament WB R	128	106	150	11.7
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	221	182	250	17.3
Parliament Adelaide NB R	13	8	20	2.8
Adelaide Parliament EB L	197	166	234	15.5
Adelaide Parliament EB T	554	415	665	61.5
Adelaide Parliament EB R	249	216	286	21.2
Parliament Adelaide SB L	18	7	35	7.6
Parliament Adelaide SB T	114	88	131	11.2
Parliament Adelaide SB R	NA	NA	NA	NA
Jarvis Richmond NB L	192	161	233	21.6
Jarvis Richmond NB T	966	893	1062	45.8
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	473	425	550	33.8
Jarvis Richmond SB R	288	231	329	24.9
Richmond Jarvis WB L	161	130	190	16.5
Richmond Jarvis WB T	811	753	874	37.4
Richmond Jarvis WB R	157	146	187	9.4
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	640	552	708	48.4
Jarvis Adelaide NB R	153	114	179	18.4
Adelaide Jarvis EB L	472	406	505	30.9
Adelaide Jarvis EB T	985	880	1098	54.8
Adelaide Jarvis EB R	225	183	266	22.7
Jarvis Adelaide SB L	296	265	327	18.3
Jarvis Adelaide SB T	392	310	447	38.1
Jarvis Adelaide SB R	NA	NA	NA	NA
Eastern CrossingDVP WB T	290	258	333	21.3
DVP RampToRichmond SB R	1598	1521	1660	40.7
DVP AfterRampToRichm SB T	1798	1706	1873	46.3
DVPOffRamp ToEastern WB T	631	580	679	32.7
DVPOffRamp ToRichmond WB R	964	927	1008	25.9
Eastern PastRampToDVP EB T	1323	1209	1452	56.8
Eastern ToDVPOnRamp EB R	429	361	518	44.8
Adelaide ToDVPOnRamp EB T	519	382	637	63.5
DVP RampFrEasternTotal NB T	946	806	1086	85.4
DVP BeforeRampFrEastern NB T	1484	1325	1703	80.7
Bathurst King NB L	NA	NA	NA	NA
Bathurst King NB T	404	328	472	33.2
Bathurst King NB R	79	59	106	13.1
King Bathurst EB L	355	283	417	34.8
King Bathurst EB T	272	186	355	40.5
King Bathurst EB R	65	42	87	12.4
Bathurst King SB L	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst King SB T	451	354	508	35.6
Bathurst King SB R	96	67	127	14.5
King Bathurst WB L	302	244	351	25.2
King Bathurst WB T	234	162	325	43.9
King Bathurst WB R	93	69	123	12.7
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	505	449	561	31.7
Bathurst Queen NB R	140	117	180	15.8
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	381	311	455	35.8
Queen Bathurst EB R	122	96	150	15.2
Bathurst Queen SB L	NA	NA	NA	NA
Bathurst Queen SB T	174	135	200	16.0
Bathurst Queen SB R	73	54	93	8.9
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	613	528	690	38.3
Queen Bathurst WB R	161	125	190	17.3

GREAT STREET APPROACH
10-LANE CROSS-SECTION
PROJECTED TURNING MOVEMENT VOLUMES

IntelliCAN Transportation Systems Inc. Date: November 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options - Remove Option or Great Streets Alternative (10 Lanes)

Modelled Intersection Turning Movement Volumes for the one hour AM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	2312	2053	2464	108.6
Gardiner ContPastRampToFSE EB T	2767	2481	2996	133.8
Gardiner RampFromFSE WB T	1399	1343	1480	34.6
Gardiner BeforeRampFromFSE WB T	3267	3156	3411	56.2
RampFromGardiner OverSpadina EB T	2758	2538	3000	122.0
RampToGardiner OverSpadina WB T	3294	3186	3440	54.1
Bathurst LakeShore NB L	41	31	57	6.6
Bathurst LakeShore NB T	14	9	22	3.0
Bathurst LakeShore NB R	50	31	64	9.3
LakeShore Bathurst EB L	76	53	92	10.8
LakeShore Bathurst EB T	2177	2101	2319	51.4
LakeShore Bathurst EB R	328	293	366	20.4
Bathurst LakeShore SB L	178	142	207	15.1
Bathurst LakeShore SB T	48	32	70	8.1
Bathurst LakeShore SB R	78	63	93	8.2
LakeShore Bathurst WB L	10	4	15	3.4
LakeShore Bathurst WB T	458	422	501	20.6
LakeShore Bathurst WB R	102	86	114	8.1
Spadina LakeShore NB L	30	16	41	5.8
Spadina LakeShore NB T	42	26	55	8.7
Spadina LakeShore NB R	75	50	98	10.8
LakeShore Spadina EB L	466	431	529	26.4
LakeShore Spadina EB T	1377	1288	1440	43.5
LakeShore Spadina EB R	108	90	143	12.7
Spadina LakeShore SB L	197	153	227	15.0
Spadina LakeShore SB T	24	13	35	6.7
Spadina LakeShore SB R	100	78	128	12.6
LakeShore Spadina WB L	4	0	8	1.8
LakeShore Spadina WB T	487	442	527	24.5
LakeShore Spadina WB R	279	258	304	13.1
Rees LakeShore NB L	218	182	251	19.3
Rees LakeShore NB T	26	7	48	11.2
Rees LakeShore NB R	50	29	72	11.2
LakeShoreCont Rees EB L	NA	NA	NA	NA
LakeShoreCont Rees EB T	1405	1295	1488	58.9
LakeShoreFrFGE Rees EB T	2707	2521	2976	120.1
LakeShoreCont Rees EB R	223	184	261	19.6
Rees LakeShore SB L	43	32	61	8.2
Rees LakeShore SB T	27	15	39	5.8
Rees LakeShore SB R	347	321	378	13.1
LakeShore Rees WB L	NA	NA	NA	NA
LakeShore Rees WB T	3496	3364	3614	64.4
LakeShore Rees WB R	107	90	125	10.5
Simcoe LakeShore NB L	134	105	162	15.8
Simcoe LakeShore NB T	25	11	47	9.3
Simcoe LakeShore NB R	104	65	144	21.3
LakeShore Simcoe EB L	159	121	193	19.9
LakeShore Simcoe EB T	3473	3188	3745	147.5
LakeShore Simcoe EB R	601	555	638	22.2
Simcoe LakeShore SB L	29	18	48	8.2
Simcoe LakeShore SB T	25	12	40	7.5
Simcoe LakeShore SB R	440	378	488	23.3
LakeShore Simcoe WB L	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB T	3023	2874	3139	62.1

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB R	104	72	133	16.1
York LakeShore NB L	NA	NA	NA	NA
York LakeShore NB T	462	414	504	22.1
York LakeShore NB R	NA	NA	NA	NA
LakeShore York EB L	277	255	297	8.9
York LakeShore SB L	NA	NA	NA	NA
York LakeShore SB T	136	118	164	11.3
York LakeShore SB R	527	467	586	28.7
LakeShore York WB L	NA	NA	NA	NA
LakeShore York WB T	2692	2572	2798	68.1
LakeShore York WB R	345	313	395	22.6
Bay LakeShore NB L	194	143	217	16.9
Bay LakeShore NB T	547	329	628	65.5
Bay LakeShore NB R	NA	NA	NA	NA
Bay LakeShore SB L	NA	NA	NA	NA
Bay LakeShore SB T	94	71	119	10.6
Bay LakeShore SB R	385	343	418	19.2
LakeShore Bay WB L	209	138	244	24.3
LakeShore Bay WB T	3063	2959	3197	64.2
LakeShore Bay WB R	440	413	513	25.7
Yonge LakeShore NB L	289	253	324	18.7
Yonge LakeShore NB T	295	248	353	31.6
Yonge LakeShore NB R	NA	NA	NA	NA
Yonge LakeShore SB L	NA	NA	NA	NA
Yonge LakeShore SB T	69	49	87	8.6
Yonge LakeShore SB R	316	280	355	19.1
LakeShore Yonge WB L	185	145	216	17.3
LakeShore Yonge WB T	3104	2977	3290	73.8
LakeShore Yonge WB R	613	549	703	39.6
Cooper LakeShore NB L	132	104	163	14.9
Cooper LakeShore NB T	NA	NA	NA	NA
Cooper LakeShore NB R	NA	NA	NA	NA
LakeShore Cooper WB L	97	61	129	15.4
LakeShore Cooper WB T	3517	3362	3616	71.6
LakeShore Cooper WB R	NA	NA	NA	NA
Jarvis LakeShore NB L	178	154	208	12.4
Jarvis LakeShore NB T	64	43	91	14.5
Jarvis LakeShore NB R	160	104	204	27.5
LakeShore Jarvis EB L	84	56	123	16.8
LakeShore Jarvis EB T	1408	1237	1546	65.4
LakeShore Jarvis EB R	81	59	108	11.6
Jarvis LakeShore SB L	79	58	98	11.1
Jarvis LakeShore SB T	54	31	75	10.2
Jarvis LakeShore SB R	454	367	519	31.2
LakeShore Jarvis WB L	NA	NA	NA	NA
LakeShore Jarvis WB T	3036	2921	3118	62.5
LakeShore Jarvis WB R	535	495	591	24.6
Sherbourne LakeShore NB L	113	82	139	13.1
Sherbourne LakeShore NB T	41	26	65	11.2
Sherbourne LakeShore NB R	239	201	282	22.1
LakeShore Sherbourne EB L	NA	NA	NA	NA
LakeShore Sherbourne EB T	1362	1227	1472	58.5
LakeShore Sherbourne EB R	114	90	135	12.1
Sherbourne LakeShore SB L	27	11	48	9.4
Sherbourne LakeShore SB T	34	15	47	9.2
Sherbourne LakeShore SB R	136	105	170	15.3
LakeShore Sherbourne WB L	337	284	368	21.1
LakeShore Sherbourne WB T	3327	3215	3507	71.5
LakeShore Sherbourne WB R	465	407	530	33.5
Parliament LakeShore NB L	218	190	249	15.3
Parliament LakeShore NB T	35	20	50	9.2

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament LakeShore NB R	144	84	171	22.6
LakeShore Parliament EB L	102	88	117	8.5
LakeShore Parliament EB T	1427	1332	1525	56.1
LakeShore Parliament EB R	143	106	196	20.5
Parliament LakeShore SB L	29	17	39	5.5
Parliament LakeShore SB T	63	43	77	9.6
Parliament LakeShore SB R	255	220	297	20.0
LakeShore Parliament WB L	NA	NA	NA	NA
LakeShore Parliament WB T	3621	3499	3935	100.5
LakeShore Parliament WB R	565	514	625	28.1
Cherry LakeShore NB L	131	110	158	12.1
Cherry LakeShore NB T	NA	NA	NA	NA
Cherry LakeShore NB R	415	355	486	35.5
LakeShore Cherry EB L	NA	NA	NA	NA
LakeShore Cherry EB T	1583	1488	1725	56.3
LakeShore Cherry EB R	69	47	86	10.7
LakeShore Cherry WB L	251	232	263	9.4
LakeShore Cherry WB T	3352	3267	3489	57.5
LakeShore Cherry WB R	NA	NA	NA	NA
LakeShore atCherryRampFrDVP WB T	634	577	869	60.2
DonRoadway LakeShore NB L	173	150	208	13.4
DonRoadway LakeShore NB T	30	21	41	5.6
DonRoadway LakeShore NB R	66	52	80	6.9
LakeShore DonRoadway EB L	NA	NA	NA	NA
LakeShore DonRoadway EB T	888	828	958	33.3
LakeShore DonRoadway EB R	66	46	87	9.8
DonRoadway LakeShore SB L	23	14	34	5.8
DonRoadway LakeShore SB T	14	6	22	4.2
DonRoadway LakeShore SB R	164	133	198	13.9
LakeShore DonRoadway WB L	156	125	196	19.4
LakeShore DonRoadway WB T	3299	3212	3415	46.4
LakeShore DonRoadway WB R	133	115	149	9.5
York Harbour NB L	NA	NA	NA	NA
York Harbour NB T	59	41	75	7.1
York Harbour NB R	210	141	256	25.6
Harbour York EB L	398	342	441	24.6
Harbour York EB T	2423	2193	2675	134.7
Harbour York EB R	543	439	603	37.1
York Harbour SB L	85	68	104	10.8
York Harbour SB T	37	24	46	4.9
York Harbour SB R	NA	NA	NA	NA
Bay Harbour NB L	NA	NA	NA	NA
Bay Harbour NB T	168	122	194	15.8
Bay Harbour NB R	235	196	281	19.3
Harbour Bay EB L	561	342	643	65.3
Harbour Bay EB T	1641	1449	1805	99.9
Harbour Bay EB R	418	369	480	32.6
Bay Harbour SB L	171	116	198	18.9
Bay Harbour SB T	145	98	179	18.2
Bay Harbour SB R	NA	NA	NA	NA
Yonge Harbour NB L	NA	NA	NA	NA
Yonge Harbour NB T	184	157	231	16.8
Yonge Harbour NB R	246	202	301	19.0
Harbour Yonge EB L	402	340	450	29.7
Harbour Yonge EB T	1351	1222	1469	65.1
Harbour Yonge EB R	339	271	372	21.8
Yonge Harbour SB L	120	95	144	11.0
Yonge Harbour SB T	150	116	170	13.8
Yonge Harbour SB R	NA	NA	NA	NA
Bathurst Front NB L	183	158	204	13.5
Bathurst Front NB T	93	76	114	11.4

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst Front NB R	109	75	143	17.4
Front Bathurst EB L	287	258	321	15.3
Front Bathurst EB T	1885	1665	2111	123.0
Front Bathurst EB R	209	167	256	27.4
Bathurst Front SB L	80	67	115	13.2
Bathurst Front SB T	102	71	129	14.6
Bathurst Front SB R	400	307	476	39.1
Front Bathurst WB L	78	66	99	8.5
Front Bathurst WB T	1172	1087	1260	48.3
Front Bathurst WB R	32	22	46	6.8
Spadina Front NB L	133	122	148	7.1
Spadina Front NB T	265	221	297	17.6
Spadina Front NB R	158	128	192	17.7
Front Spadina EB L	439	409	482	16.0
Front Spadina EB T	1280	1102	1525	96.1
Front Spadina EB R	72	49	91	8.7
Spadina Front SB L	103	89	128	7.9
Spadina Front SB T	125	103	151	12.3
Spadina Front SB R	294	248	331	20.0
Front Spadina WB L	78	64	94	7.7
Front Spadina WB T	767	703	833	39.3
Front Spadina WB R	15	1	21	4.9
Parliament Front NB L	485	438	543	29.3
Parliament Front NB T	269	231	318	23.9
Parliament Front NB R	76	62	96	8.1
Front Parliament EB L	45	35	61	6.7
Front Parliament EB T	493	377	629	58.9
Front Parliament EB R	45	34	66	7.6
Parliament Front SB L	69	51	83	9.2
Parliament Front SB T	75	60	94	9.4
Parliament Front SB R	120	95	163	17.5
Front Parliament WB L	122	108	151	10.2
Front Parliament WB T	1276	1181	1343	47.0
Front Parliament WB R	187	160	214	13.4
Parliament Richmond NB L	300	249	334	23.1
Parliament Richmond NB T	160	132	190	16.5
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	52	40	68	8.2
Parliament Richmond SB R	130	84	150	13.7
Richmond Parliament WB L	81	49	193	29.7
Richmond Parliament WB T	2001	1743	2136	88.4
Richmond Parliament WB R	255	188	319	33.9
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	378	310	431	25.9
Parliament Adelaide NB R	8	1	18	4.7
Adelaide Parliament EB L	86	69	123	12.8
Adelaide Parliament EB T	139	95	182	21.0
Adelaide Parliament EB R	155	119	199	20.2
Parliament Adelaide SB L	3	1	7	2.0
Parliament Adelaide SB T	132	95	255	34.0
Parliament Adelaide SB R	NA	NA	NA	NA
Jarvis Richmond NB L	249	170	285	22.6
Jarvis Richmond NB T	222	188	257	19.1
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	307	277	357	18.1
Jarvis Richmond SB R	334	281	386	29.2
Richmond Jarvis WB L	328	268	394	27.1
Richmond Jarvis WB T	1930	1462	2139	155.2
Richmond Jarvis WB R	85	59	107	13.4

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	421	347	493	30.4
Jarvis Adelaide NB R	54	39	65	8.4
Adelaide Jarvis EB L	84	62	109	10.6
Adelaide Jarvis EB T	297	262	368	23.1
Adelaide Jarvis EB R	110	89	143	13.3
Jarvis Adelaide SB L	162	132	186	12.4
Jarvis Adelaide SB T	412	363	477	35.5
Jarvis Adelaide SB R	NA	NA	NA	NA
Eastern CrossingDVP WB T	1601	1402	1786	97.7
DVP RampToRichmond SB R	2622	2576	2653	17.8
DVP AfterRampToRichm SB T	970	880	1314	85.9
DVPOffRamp ToEastern WB T	183	134	248	26.5
DVPOffRamp ToRichmond WB R	2333	2191	2390	46.7
Eastern PastRampToDVP EB T	531	416	618	54.8
Eastern ToDVPOnRamp EB R	167	134	215	17.5
Adelaide ToDVPOnRamp EB T	98	52	137	21.3
DVP RampFrEasternTotal NB T	265	211	310	29.4
DVP BeforeRampFrEastern NB T	1169	1083	1218	34.3
Bathurst King NB L	5	0	10	2.4
Bathurst King NB T	275	239	327	24.3
Bathurst King NB R	54	29	80	14.0
King Bathurst EB L	177	142	234	20.9
King Bathurst EB T	618	468	706	45.7
King Bathurst EB R	102	80	124	12.3
Bathurst King sB L	97	62	132	16.5
Bathurst King sB T	276	229	317	25.0
Bathurst King sB R	28	15	45	7.7
King Bathurst WB L	78	60	121	14.1
King Bathurst WB T	40	16	74	16.0
King Bathurst WB R	26	11	38	6.5
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	230	195	276	18.0
Bathurst Queen NB R	110	91	137	11.2
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	666	603	769	35.3
Queen Bathurst EB R	198	172	229	14.4
Bathurst Queen sB L	NA	NA	NA	NA
Bathurst Queen sB T	280	245	306	16.3
Bathurst Queen sB R	24	12	32	4.7
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	130	112	143	10.4
Queen Bathurst WB R	32	21	43	5.7
QueensQuay WestOfBathurst EB T	101	76	145	16.9
QueensQuay WestOfBathurst WB T	8	4	14	2.6
QueensQuay WestOfBathurst WB R	7	1	13	2.8
Bremner WestOfBathurst EB T	701	644	731	22.3
Bremner WestOfBathurst WB T	267	234	294	15.6
DundasW WestOfBathurst EB T	762	705	815	32.9
DundasW WestOfBathurst WB T	82	66	96	8.5

IntelliCAN Transportation Systems Inc. Date: November 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options - Remove Option or Great Streets Alternative (10 Lanes)

Modelled Intersection Turning Movement Volumes for the one hour PM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	1985	1649	2239	140.5
Gardiner ContPastRampToFSE EB T	2772	2113	3149	281.8
Gardiner RampFromFSE WB T	2546	2447	2654	64.2
Gardiner BeforeRampFromFSE WB T	3893	3722	4025	87.6
RampFromGardiner OverSpadina EB T	2707	2170	3010	251.8
RampToGardiner OverSpadina WB T	3907	3750	4042	86.1
Bathurst LakeShore NB L	81	61	96	7.1
Bathurst LakeShore NB T	35	24	43	4.9
Bathurst LakeShore NB R	109	91	131	12.3
LakeShore Bathurst EB L	156	135	183	13.9
LakeShore Bathurst EB T	1573	1429	1657	56.9
LakeShore Bathurst EB R	307	262	350	29.2
Bathurst LakeShore SB L	211	181	251	19.1
Bathurst LakeShore SB T	59	48	74	6.8
Bathurst LakeShore SB R	170	145	200	14.4
LakeShore Bathurst WB L	18	9	26	5.3
LakeShore Bathurst WB T	721	661	797	32.2
LakeShore Bathurst WB R	131	113	150	12.0
Spadina LakeShore NB L	32	19	47	7.2
Spadina LakeShore NB T	41	28	60	7.7
Spadina LakeShore NB R	153	124	182	17.0
LakeShore Spadina EB L	245	204	291	27.1
LakeShore Spadina EB T	1403	1262	1502	61.1
LakeShore Spadina EB R	151	110	198	18.4
Spadina LakeShore SB L	292	265	338	16.8
Spadina LakeShore SB T	49	38	69	8.6
Spadina LakeShore SB R	192	165	213	12.9
LakeShore Spadina WB L	48	38	64	7.4
LakeShore Spadina WB T	707	652	759	26.4
LakeShore Spadina WB R	249	229	273	15.5
Rees LakeShore NB L	262	218	321	29.5
Rees LakeShore NB T	26	12	40	8.0
Rees LakeShore NB R	135	104	158	15.5
LakeShoreCont Rees EB L	NA	NA	NA	NA
LakeShoreCont Rees EB T	1566	1436	1643	58.5
LakeShoreFrFGE Rees EB T	2686	2188	3040	244.1
LakeShoreCont Rees EB R	268	215	313	28.1
Rees LakeShore SB L	158	122	197	21.3
Rees LakeShore SB T	65	51	78	8.7
Rees LakeShore SB R	456	412	516	31.0
LakeShore Rees WB L	NA	NA	NA	NA
LakeShore Rees WB T	4135	3891	4226	84.7
LakeShore Rees WB R	157	121	180	13.9
Simcoe LakeShore NB L	125	91	163	17.5
Simcoe LakeShore NB T	13	9	18	3.2
Simcoe LakeShore NB R	237	179	302	41.8
LakeShore Simcoe EB L	143	112	168	15.1
LakeShore Simcoe EB T	3904	3483	4267	228.9
LakeShore Simcoe EB R	481	416	542	39.2
Simcoe LakeShore SB L	86	50	114	17.0
Simcoe LakeShore SB T	48	28	65	11.4
Simcoe LakeShore SB R	504	404	610	52.5
LakeShore Simcoe WB L	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB T	3596	3460	3755	79.2

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB R	88	61	109	15.1
York LakeShore NB L	NA	NA	NA	NA
York LakeShore NB T	280	222	359	42.4
York LakeShore NB R	NA	NA	NA	NA
LakeShore York EB L	290	221	383	37.4
York LakeShore SB L	NA	NA	NA	NA
York LakeShore SB T	496	433	529	24.3
York LakeShore SB R	514	405	567	43.9
LakeShore York WB L	NA	NA	NA	NA
LakeShore York WB T	3287	3122	3446	99.0
LakeShore York WB R	186	145	216	20.2
Bay LakeShore NB L	207	180	227	13.9
Bay LakeShore NB T	450	342	545	49.7
Bay LakeShore NB R	NA	NA	NA	NA
Bay LakeShore SB L	NA	NA	NA	NA
Bay LakeShore SB T	264	232	290	17.9
Bay LakeShore SB R	617	549	663	41.2
LakeShore Bay WB L	304	273	338	18.2
LakeShore Bay WB T	3071	2917	3226	81.6
LakeShore Bay WB R	162	127	198	19.0
Yonge LakeShore NB L	282	250	299	14.5
Yonge LakeShore NB T	354	282	407	32.2
Yonge LakeShore NB R	NA	NA	NA	NA
Yonge LakeShore SB L	NA	NA	NA	NA
Yonge LakeShore SB T	153	118	173	15.7
Yonge LakeShore SB R	499	412	553	34.2
LakeShore Yonge WB L	217	185	236	11.5
LakeShore Yonge WB T	2806	2662	2914	72.5
LakeShore Yonge WB R	334	268	389	29.9
Cooper LakeShore NB L	124	98	153	15.3
Cooper LakeShore NB T	NA	NA	NA	NA
Cooper LakeShore NB R	NA	NA	NA	NA
LakeShore Cooper WB L	148	131	168	10.7
LakeShore Cooper WB T	3108	2944	3220	82.0
LakeShore Cooper WB R	NA	NA	NA	NA
Jarvis LakeShore NB L	122	95	144	14.0
Jarvis LakeShore NB T	51	27	73	13.5
Jarvis LakeShore NB R	303	237	371	40.4
LakeShore Jarvis EB L	273	238	335	27.8
LakeShore Jarvis EB T	2963	2764	3154	114.1
LakeShore Jarvis EB R	184	151	222	18.5
Jarvis LakeShore SB L	182	147	216	18.2
Jarvis LakeShore SB T	49	33	77	13.6
Jarvis LakeShore SB R	435	357	539	51.0
LakeShore Jarvis WB L	NA	NA	NA	NA
LakeShore Jarvis WB T	2704	2579	2873	84.1
LakeShore Jarvis WB R	282	245	307	20.0
Sherbourne LakeShore NB L	137	113	167	12.4
Sherbourne LakeShore NB T	51	25	74	11.6
Sherbourne LakeShore NB R	296	235	353	30.0
LakeShore Sherbourne EB L	NA	NA	NA	NA
LakeShore Sherbourne EB T	3306	3113	3516	121.8
LakeShore Sherbourne EB R	248	207	293	19.9
Sherbourne LakeShore SB L	111	82	135	15.9
Sherbourne LakeShore SB T	61	49	71	7.6
Sherbourne LakeShore SB R	189	127	227	26.2
LakeShore Sherbourne WB L	170	145	188	11.4
LakeShore Sherbourne WB T	2641	2507	2794	88.8
LakeShore Sherbourne WB R	176	121	234	26.5
Parliament LakeShore NB L	144	130	164	11.5
Parliament LakeShore NB T	39	12	62	14.3

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament LakeShore NB R	221	171	249	24.9
LakeShore Parliament EB L	314	258	365	27.4
LakeShore Parliament EB T	3214	2998	3408	126.9
LakeShore Parliament EB R	205	155	253	25.3
Parliament LakeShore SB L	112	84	133	13.0
Parliament LakeShore SB T	72	59	84	7.8
Parliament LakeShore SB R	303	267	334	21.2
LakeShore Parliament WB L	NA	NA	NA	NA
LakeShore Parliament WB T	2507	2326	2674	86.1
LakeShore Parliament WB R	226	204	265	17.3
Cherry LakeShore NB L	139	114	185	15.7
Cherry LakeShore NB T	NA	NA	NA	NA
Cherry LakeShore NB R	344	255	389	32.2
LakeShore Cherry EB L	NA	NA	NA	NA
LakeShore Cherry EB T	3450	3247	3663	117.5
LakeShore Cherry EB R	144	115	166	17.8
LakeShore Cherry WB L	212	181	234	17.3
LakeShore Cherry WB T	1609	1506	1716	59.5
LakeShore Cherry WB R	NA	NA	NA	NA
LakeShore atCherryRampFrDVP WB T	945	902	996	26.3
DonRoadway LakeShore NB L	197	180	220	13.2
DonRoadway LakeShore NB T	15	9	23	4.0
DonRoadway LakeShore NB R	238	154	320	45.3
LakeShore DonRoadway EB L	NA	NA	NA	NA
LakeShore DonRoadway EB T	2381	2222	2549	94.1
LakeShore DonRoadway EB R	127	69	252	47.6
DonRoadway LakeShore SB L	170	136	200	17.1
DonRoadway LakeShore SB T	38	16	60	11.8
DonRoadway LakeShore SB R	257	235	277	11.5
LakeShore DonRoadway WB L	23	11	40	7.3
LakeShore DonRoadway WB T	1375	1297	1500	60.6
LakeShore DonRoadway WB R	25	15	32	4.2
York Harbour NB L	NA	NA	NA	NA
York Harbour NB T	41	29	62	8.2
York Harbour NB R	392	320	465	32.4
Harbour York EB L	237	179	323	40.4
Harbour York EB T	3130	2764	3438	197.6
Harbour York EB R	578	446	669	51.1
York Harbour SB L	351	300	375	17.7
York Harbour SB T	118	87	140	14.2
York Harbour SB R	NA	NA	NA	NA
Bay Harbour NB L	NA	NA	NA	NA
Bay Harbour NB T	170	139	197	12.4
Bay Harbour NB R	546	488	601	32.7
Harbour Bay EB L	479	378	587	52.0
Harbour Bay EB T	2941	2659	3222	150.8
Harbour Bay EB R	403	319	441	32.0
Bay Harbour SB L	343	320	368	12.3
Bay Harbour SB T	232	197	261	18.5
Bay Harbour SB R	NA	NA	NA	NA
Yonge Harbour NB L	NA	NA	NA	NA
Yonge Harbour NB T	145	115	172	14.2
Yonge Harbour NB R	454	402	481	20.3
Harbour Yonge EB L	483	409	540	35.6
Harbour Yonge EB T	2884	2579	3244	154.2
Harbour Yonge EB R	489	419	554	40.7
Yonge Harbour SB L	177	162	210	14.1
Yonge Harbour SB T	200	172	244	18.4
Yonge Harbour SB R	NA	NA	NA	NA
Bathurst Front NB L	233	198	263	13.8
Bathurst Front NB T	87	66	102	9.6

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst Front NB R	86	66	105	11.3
Front Bathurst EB L	312	271	345	19.4
Front Bathurst EB T	1544	1404	1692	90.5
Front Bathurst EB R	226	190	263	20.1
Bathurst Front SB L	41	30	50	6.5
Bathurst Front SB T	118	102	130	8.9
Bathurst Front SB R	644	525	705	44.0
Front Bathurst WB L	168	140	196	14.4
Front Bathurst WB T	1703	1614	1803	58.1
Front Bathurst WB R	50	34	64	8.1
Spadina Front NB L	143	138	155	5.0
Spadina Front NB T	239	190	280	21.9
Spadina Front NB R	146	109	202	20.6
Front Spadina EB L	786	754	827	18.3
Front Spadina EB T	611	528	702	41.5
Front Spadina EB R	103	84	123	10.2
Spadina Front SB L	108	89	125	9.2
Spadina Front SB T	240	203	268	19.0
Spadina Front SB R	685	574	788	69.0
Front Spadina WB L	329	302	356	14.9
Front Spadina WB T	716	673	765	27.3
Front Spadina WB R	48	36	63	8.0
Parliament Front NB L	170	147	191	11.3
Parliament Front NB T	192	169	215	10.7
Parliament Front NB R	223	175	265	21.6
Front Parliament EB L	104	91	121	8.4
Front Parliament EB T	1186	1061	1312	69.3
Front Parliament EB R	119	97	140	12.3
Parliament Front SB L	267	232	291	16.4
Parliament Front SB T	177	148	198	13.1
Parliament Front SB R	117	90	156	15.6
Front Parliament WB L	158	140	173	8.7
Front Parliament WB T	781	686	874	51.2
Front Parliament WB R	105	84	142	14.9
Parliament Richmond NB L	159	141	179	11.2
Parliament Richmond NB T	286	250	323	20.9
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	79	65	95	9.0
Parliament Richmond SB R	72	54	88	9.4
Richmond Parliament WB L	81	60	104	10.9
Richmond Parliament WB T	992	921	1043	32.1
Richmond Parliament WB R	152	139	174	10.0
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	239	214	261	14.6
Parliament Adelaide NB R	15	6	25	5.3
Adelaide Parliament EB L	204	172	240	19.9
Adelaide Parliament EB T	708	568	782	50.3
Adelaide Parliament EB R	271	230	297	22.1
Parliament Adelaide SB L	24	16	38	5.9
Parliament Adelaide SB T	149	125	175	13.9
Parliament Adelaide SB R	NA	NA	NA	NA
Jarvis Richmond NB L	151	127	196	19.2
Jarvis Richmond NB T	979	862	1041	52.7
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	427	361	479	32.5
Jarvis Richmond SB R	291	228	324	25.7
Richmond Jarvis WB L	187	156	223	19.2
Richmond Jarvis WB T	916	795	965	40.3
Richmond Jarvis WB R	156	136	193	17.5

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	548	473	598	37.0
Jarvis Adelaide NB R	177	133	213	24.2
Adelaide Jarvis EB L	518	470	580	26.8
Adelaide Jarvis EB T	992	904	1102	56.5
Adelaide Jarvis EB R	177	150	209	14.9
Jarvis Adelaide SB L	317	256	369	25.2
Jarvis Adelaide SB T	320	273	386	23.5
Jarvis Adelaide SB R	NA	NA	NA	NA
Eastern CrossingDVP WB T	389	351	414	16.3
DVP RampToRichmond SB R	1806	1714	1863	49.1
DVP AfterRampToRichm SB T	1603	1526	1680	36.1
DVPOffRamp ToEastern WB T	652	577	744	44.3
DVPOffRamp ToRichmond WB R	1159	1076	1219	32.9
Eastern PastRampToDVP EB T	1617	1458	1776	90.8
Eastern ToDVPOnRamp EB R	402	312	469	35.6
Adelaide ToDVPOnRamp EB T	669	551	743	49.0
DVP RampFrEasternTotal NB T	1073	956	1195	65.8
DVP BeforeRampFrEastern NB T	1344	1269	1425	48.4
Bathurst King NB L	NA	NA	NA	NA
Bathurst King NB T	371	313	411	27.7
Bathurst King NB R	66	40	85	10.9
King Bathurst EB L	351	290	433	39.2
King Bathurst EB T	281	190	355	47.6
King Bathurst EB R	77	52	112	12.7
Bathurst King SB L	NA	NA	NA	NA
Bathurst King SB T	452	384	515	33.3
Bathurst King SB R	98	74	113	11.3
King Bathurst WB L	301	270	349	22.3
King Bathurst WB T	257	205	323	36.9
King Bathurst WB R	104	84	124	11.3
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	502	447	587	34.5
Bathurst Queen NB R	153	126	180	16.0
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	379	302	444	39.0
Queen Bathurst EB R	132	111	164	14.3
Bathurst Queen SB L	NA	NA	NA	NA
Bathurst Queen SB T	183	151	211	17.7
Bathurst Queen SB R	76	55	95	11.5
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	642	562	722	39.8
Queen Bathurst WB R	154	124	182	14.2
QueensQuay WestOfBathurst EB T	108	88	137	14.1
QueensQuay WestOfBathurst WB T	40	31	59	6.9
QueensQuay WestOfBathurst WB R	34	23	41	4.7
Bremner WestOfBathurst EB T	727	693	787	22.8
Bremner WestOfBathurst WB T	612	571	675	27.5
DundasW WestOfBathurst EB T	361	298	407	28.2
DundasW WestOfBathurst WB T	635	572	676	23.5

GREAT STREET APPROACH
8-LANE CROSS-SECTION, EAST OF JARVIS
PROJECTED TURNING MOVEMENT VOLUMES

IntelliCAN Transportation Systems Inc. Date: November 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options - Remove Option or Great Street Alternative (8 Lanes - East of Jarvis)

Modelled Intersection Turning Movement Volumes for the one hour AM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	2310	2174	2616	89.7
Gardiner ContPastRampToFSE EB T	2773	2155	2944	174.9
Gardiner RampFromFSE WB T	1391	1321	1478	41.3
Gardiner BeforeRampFromFSE WB T	3230	3125	3382	62.9
RampFromGardiner OverSpadina EB T	2775	2179	2949	170.0
RampToGardiner OverSpadina WB T	3259	3173	3403	60.7
Bathurst LakeShore NB L	42	32	55	6.8
Bathurst LakeShore NB T	14	7	20	3.5
Bathurst LakeShore NB R	51	38	72	10.0
LakeShore Bathurst EB L	71	60	86	6.2
LakeShore Bathurst EB T	2175	2098	2263	44.6
LakeShore Bathurst EB R	322	276	386	25.8
Bathurst LakeShore SB L	175	147	198	15.3
Bathurst LakeShore SB T	48	28	64	9.7
Bathurst LakeShore SB R	84	68	103	8.4
LakeShore Bathurst WB L	9	4	18	3.8
LakeShore Bathurst WB T	465	428	493	18.1
LakeShore Bathurst WB R	103	91	127	8.4
Spadina LakeShore NB L	28	19	38	4.9
Spadina LakeShore NB T	39	23	54	8.0
Spadina LakeShore NB R	73	52	97	12.8
LakeShore Spadina EB L	465	418	508	27.3
LakeShore Spadina EB T	1387	1294	1480	48.0
LakeShore Spadina EB R	104	81	139	14.1
Spadina LakeShore SB L	196	168	211	11.9
Spadina LakeShore SB T	22	15	30	4.6
Spadina LakeShore SB R	102	77	124	11.6
LakeShore Spadina WB L	6	3	9	1.7
LakeShore Spadina WB T	488	459	513	15.7
LakeShore Spadina WB R	272	242	306	13.6
Rees LakeShore NB L	220	171	253	20.9
Rees LakeShore NB T	28	9	41	7.0
Rees LakeShore NB R	55	39	83	9.1
LakeShoreCont Rees EB L	NA	NA	NA	NA
LakeShoreCont Rees EB T	1411	1237	1506	61.1
LakeShoreFrFGE Rees EB T	2729	2178	2894	159.7
LakeShoreCont Rees EB R	224	173	289	22.0
Rees LakeShore SB L	45	33	57	7.1
Rees LakeShore SB T	26	16	46	7.0
Rees LakeShore SB R	351	308	401	21.2
LakeShore Rees WB L	NA	NA	NA	NA
LakeShore Rees WB T	3450	3331	3571	57.7
LakeShore Rees WB R	106	87	128	11.1
Simcoe LakeShore NB L	129	100	161	15.4
Simcoe LakeShore NB T	22	9	39	8.2
Simcoe LakeShore NB R	113	69	140	18.2
LakeShore Simcoe EB L	152	122	190	18.8
LakeShore Simcoe EB T	3521	2871	3706	200.7
LakeShore Simcoe EB R	594	558	633	19.5
Simcoe LakeShore SB L	25	14	40	6.6
Simcoe LakeShore SB T	29	13	50	8.7
Simcoe LakeShore SB R	439	397	509	28.5
LakeShore Simcoe WB L	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB T	2983	2874	3050	54.9

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB R	110	87	132	11.1
York LakeShore NB L	NA	NA	NA	NA
York LakeShore NB T	464	404	509	24.4
York LakeShore NB R	NA	NA	NA	NA
LakeShore York EB L	280	270	297	6.7
York LakeShore SB L	NA	NA	NA	NA
York LakeShore SB T	129	111	150	10.1
York LakeShore SB R	540	501	594	22.1
LakeShore York WB L	NA	NA	NA	NA
LakeShore York WB T	2642	2530	2715	53.2
LakeShore York WB R	348	317	389	18.4
Bay LakeShore NB L	198	127	234	21.5
Bay LakeShore NB T	536	343	618	51.8
Bay LakeShore NB R	NA	NA	NA	NA
Bay LakeShore SB L	NA	NA	NA	NA
Bay LakeShore SB T	94	80	111	7.9
Bay LakeShore SB R	386	293	424	26.7
LakeShore Bay WB L	215	151	248	22.3
LakeShore Bay WB T	3029	2913	3130	49.6
LakeShore Bay WB R	432	401	463	19.0
Yonge LakeShore NB L	284	256	323	15.5
Yonge LakeShore NB T	304	251	346	26.2
Yonge LakeShore NB R	NA	NA	NA	NA
Yonge LakeShore SB L	NA	NA	NA	NA
Yonge LakeShore SB T	68	50	80	7.6
Yonge LakeShore SB R	313	277	349	17.9
LakeShore Yonge WB L	182	146	217	14.4
LakeShore Yonge WB T	3071	2976	3177	53.1
LakeShore Yonge WB R	610	515	700	34.1
Cooper LakeShore NB L	149	122	170	14.1
Cooper LakeShore NB T	NA	NA	NA	NA
Cooper LakeShore NB R	NA	NA	NA	NA
LakeShore Cooper WB L	94	60	113	13.4
LakeShore Cooper WB T	3469	3339	3632	68.9
LakeShore Cooper WB R	NA	NA	NA	NA
Jarvis LakeShore NB L	188	160	224	13.0
Jarvis LakeShore NB T	73	44	102	16.1
Jarvis LakeShore NB R	169	132	214	22.3
LakeShore Jarvis EB L	85	65	100	9.3
LakeShore Jarvis EB T	1529	1320	1676	77.4
LakeShore Jarvis EB R	67	53	87	9.0
Jarvis LakeShore SB L	87	76	104	7.7
Jarvis LakeShore SB T	45	24	62	8.6
Jarvis LakeShore SB R	621	583	657	24.2
LakeShore Jarvis WB L	NA	NA	NA	NA
LakeShore Jarvis WB T	2814	2713	2971	68.2
LakeShore Jarvis WB R	542	512	583	18.3
Sherbourne LakeShore NB L	126	95	151	14.0
Sherbourne LakeShore NB T	41	20	53	8.1
Sherbourne LakeShore NB R	254	196	351	36.0
LakeShore Sherbourne EB L	NA	NA	NA	NA
LakeShore Sherbourne EB T	1542	1410	1631	59.5
LakeShore Sherbourne EB R	102	70	126	12.2
Sherbourne LakeShore SB L	30	12	64	10.2
Sherbourne LakeShore SB T	31	21	43	6.6
Sherbourne LakeShore SB R	145	115	178	14.6
LakeShore Sherbourne WB L	323	285	364	19.8
LakeShore Sherbourne WB T	3083	2960	3254	77.6
LakeShore Sherbourne WB R	458	396	524	34.7
Parliament LakeShore NB L	220	189	244	13.8
Parliament LakeShore NB T	33	12	50	7.5

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament LakeShore NB R	142	116	189	16.9
LakeShore Parliament EB L	90	68	102	7.8
LakeShore Parliament EB T	1659	1490	1820	83.4
LakeShore Parliament EB R	111	91	131	12.5
Parliament LakeShore SB L	35	22	67	8.9
Parliament LakeShore SB T	66	51	85	7.4
Parliament LakeShore SB R	253	214	301	23.2
LakeShore Parliament WB L	NA	NA	NA	NA
LakeShore Parliament WB T	3367	3203	3619	107.1
LakeShore Parliament WB R	562	515	627	27.3
Cherry LakeShore NB L	94	59	118	16.8
Cherry LakeShore NB T	NA	NA	NA	NA
Cherry LakeShore NB R	257	168	354	40.7
LakeShore Cherry EB L	NA	NA	NA	NA
LakeShore Cherry EB T	1824	1664	1984	83.4
LakeShore Cherry EB R	55	42	74	7.8
LakeShore Cherry WB L	277	240	307	13.2
LakeShore Cherry WB T	3165	2933	3396	111.9
LakeShore Cherry WB R	NA	NA	NA	NA
LakeShore atCherryRampFrDVP WB T	598	561	668	31.4
DonRoadway LakeShore NB L	162	135	195	15.4
DonRoadway LakeShore NB T	31	24	38	4.7
DonRoadway LakeShore NB R	51	38	65	6.1
LakeShore DonRoadway EB L	NA	NA	NA	NA
LakeShore DonRoadway EB T	930	861	1019	37.9
LakeShore DonRoadway EB R	77	57	102	9.2
DonRoadway LakeShore SB L	21	10	33	5.2
DonRoadway LakeShore SB T	13	6	23	4.4
DonRoadway LakeShore SB R	151	132	173	11.7
LakeShore DonRoadway WB L	191	148	238	20.8
LakeShore DonRoadway WB T	3162	2954	3366	109.0
LakeShore DonRoadway WB R	135	120	151	10.0
York Harbour NB L	NA	NA	NA	NA
York Harbour NB T	61	45	70	6.8
York Harbour NB R	229	200	271	20.7
Harbour York EB L	399	351	447	24.9
Harbour York EB T	2492	1887	2683	169.6
Harbour York EB R	531	403	577	43.7
York Harbour SB L	78	64	94	8.2
York Harbour SB T	32	22	50	6.4
York Harbour SB R	NA	NA	NA	NA
Bay Harbour NB L	NA	NA	NA	NA
Bay Harbour NB T	167	121	212	21.0
Bay Harbour NB R	235	156	259	22.7
Harbour Bay EB L	558	355	630	56.1
Harbour Bay EB T	1708	1426	1896	97.8
Harbour Bay EB R	433	335	485	34.0
Bay Harbour SB L	177	119	212	18.4
Bay Harbour SB T	147	121	173	13.8
Bay Harbour SB R	NA	NA	NA	NA
Yonge Harbour NB L	NA	NA	NA	NA
Yonge Harbour NB T	171	143	195	14.0
Yonge Harbour NB R	261	220	299	21.1
Harbour Yonge EB L	416	367	461	24.5
Harbour Yonge EB T	1405	1159	1587	85.9
Harbour Yonge EB R	346	240	395	34.0
Yonge Harbour SB L	118	101	135	9.2
Yonge Harbour SB T	147	128	161	9.3
Yonge Harbour SB R	NA	NA	NA	NA
Bathurst Front NB L	175	149	204	14.4
Bathurst Front NB T	95	80	116	9.4

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst Front NB R	100	52	123	15.6
Front Bathurst EB L	280	247	331	19.5
Front Bathurst EB T	1967	1796	2098	75.5
Front Bathurst EB R	198	156	243	22.6
Bathurst Front SB L	89	61	115	13.6
Bathurst Front SB T	104	82	128	10.5
Bathurst Front SB R	404	362	457	26.6
Front Bathurst WB L	82	70	107	7.5
Front Bathurst WB T	1164	1064	1246	46.6
Front Bathurst WB R	35	20	47	6.4
Spadina Front NB L	135	115	149	8.1
Spadina Front NB T	260	239	281	10.7
Spadina Front NB R	145	119	182	17.4
Front Spadina EB L	443	421	465	11.7
Front Spadina EB T	1353	1193	1449	64.3
Front Spadina EB R	72	56	92	9.7
Spadina Front SB L	99	78	119	9.3
Spadina Front SB T	125	103	146	11.2
Spadina Front SB R	302	262	341	20.3
Front Spadina WB L	82	66	103	8.9
Front Spadina WB T	759	598	844	48.5
Front Spadina WB R	14	5	20	4.2
Parliament Front NB L	475	433	514	24.3
Parliament Front NB T	268	234	315	29.5
Parliament Front NB R	75	56	85	6.6
Front Parliament EB L	46	30	61	6.6
Front Parliament EB T	484	377	536	44.2
Front Parliament EB R	48	37	59	6.0
Parliament Front SB L	66	41	88	10.0
Parliament Front SB T	83	65	101	8.5
Parliament Front SB R	126	108	157	13.2
Front Parliament WB L	123	101	144	13.1
Front Parliament WB T	1278	1169	1414	61.9
Front Parliament WB R	190	156	224	19.0
Parliament Richmond NB L	307	284	338	13.3
Parliament Richmond NB T	154	123	185	17.0
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	54	45	68	6.3
Parliament Richmond SB R	141	125	170	11.9
Richmond Parliament WB L	80	45	126	20.5
Richmond Parliament WB T	2036	1929	2092	43.4
Richmond Parliament WB R	243	212	283	17.2
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	376	348	410	17.8
Parliament Adelaide NB R	9	4	19	4.0
Adelaide Parliament EB L	89	61	112	12.3
Adelaide Parliament EB T	133	76	170	22.2
Adelaide Parliament EB R	152	108	185	16.3
Parliament Adelaide SB L	3	0	10	2.4
Parliament Adelaide SB T	132	99	195	23.4
Parliament Adelaide SB R	NA	NA	NA	NA
Jarvis Richmond NB L	245	200	270	15.1
Jarvis Richmond NB T	220	187	267	20.4
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	314	268	370	28.6
Jarvis Richmond SB R	351	289	392	25.0
Richmond Jarvis WB L	345	287	417	39.2
Richmond Jarvis WB T	1980	1788	2097	77.9
Richmond Jarvis WB R	95	68	123	14.7

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	407	356	441	17.8
Jarvis Adelaide NB R	54	42	72	7.5
Adelaide Jarvis EB L	79	56	107	13.4
Adelaide Jarvis EB T	289	218	345	28.7
Adelaide Jarvis EB R	116	95	143	13.3
Jarvis Adelaide SB L	161	129	194	16.5
Jarvis Adelaide SB T	436	372	507	34.9
Jarvis Adelaide SB R	NA	NA	NA	NA
Eastern CrossingDVP WB T	1631	1430	1946	121.7
DVP RampToRichmond SB R	2644	2603	2671	18.0
DVP AfterRampToRichm SB T	903	816	969	33.0
DVPOffRamp ToEastern WB T	180	149	239	19.5
DVPOffRamp ToRichmond WB R	2358	2280	2404	28.1
Eastern PastRampToDVP EB T	521	429	600	53.4
Eastern ToDVPOnRamp EB R	169	132	231	26.5
Adelaide ToDVPOnRamp EB T	95	50	127	19.9
DVP RampFrEasternTotal NB T	264	218	334	27.3
DVP BeforeRampFrEastern NB T	1183	1026	1248	49.0
Bathurst King NB L	4	1	10	2.4
Bathurst King NB T	279	249	337	22.2
Bathurst King NB R	55	35	89	12.6
King Bathurst EB L	173	138	207	17.4
King Bathurst EB T	604	538	705	45.8
King Bathurst EB R	102	79	159	16.7
Bathurst King sB L	91	62	113	12.0
Bathurst King sB T	269	234	322	21.8
Bathurst King sB R	30	10	47	8.5
King Bathurst WB L	79	58	99	10.5
King Bathurst WB T	39	17	68	13.2
King Bathurst WB R	24	13	32	5.6
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	237	194	270	19.3
Bathurst Queen NB R	109	86	128	11.3
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	634	559	740	39.5
Queen Bathurst EB R	196	163	252	18.5
Bathurst Queen sB L	NA	NA	NA	NA
Bathurst Queen sB T	274	253	329	20.4
Bathurst Queen sB R	26	19	34	3.8
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	129	109	161	12.3
Queen Bathurst WB R	31	23	42	4.4
QueensQuay WestOfBathurst EB T	95	68	133	16.0
QueensQuay WestOfBathurst WB T	8	3	16	3.0
QueensQuay WestOfBathurst WB R	5	1	10	2.8
Bremner WestOfBathurst EB T	674	602	751	36.0
Bremner WestOfBathurst WB T	270	223	315	23.3
DundasW WestOfBathurst EB T	757	698	831	36.7
DundasW WestOfBathurst WB T	84	71	99	7.8

IntelliCAN Transportation Systems Inc. Date: November 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options - Remove Option or Great Street Alternative (8 Lanes - East of Jarvis)

Modelled Intersection Turning Movement Volumes for the one hour PM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	1978	1611	2294	174.5
Gardiner ContPastRampToFSE EB T	2983	2327	3452	309.1
Gardiner RampFromFSE WB T	2525	2336	2633	70.2
Gardiner BeforeRampFromFSE WB T	3920	3865	4048	43.8
RampFromGardiner OverSpadina EB T	2918	2303	3313	291.8
RampToGardiner OverSpadina WB T	3936	3861	4040	50.2
Bathurst LakeShore NB L	79	67	94	7.5
Bathurst LakeShore NB T	35	18	41	5.9
Bathurst LakeShore NB R	107	88	126	13.2
LakeShore Bathurst EB L	150	128	175	12.6
LakeShore Bathurst EB T	1555	1452	1684	63.5
LakeShore Bathurst EB R	282	234	364	29.7
Bathurst LakeShore SB L	204	164	230	17.3
Bathurst LakeShore SB T	60	44	86	11.3
Bathurst LakeShore SB R	173	149	194	10.6
LakeShore Bathurst WB L	16	8	22	3.5
LakeShore Bathurst WB T	733	692	783	24.4
LakeShore Bathurst WB R	124	103	146	12.9
Spadina LakeShore NB L	36	28	45	4.4
Spadina LakeShore NB T	37	29	54	7.5
Spadina LakeShore NB R	152	124	186	17.6
LakeShore Spadina EB L	247	214	300	21.7
LakeShore Spadina EB T	1401	1295	1490	54.0
LakeShore Spadina EB R	137	121	156	9.1
Spadina LakeShore SB L	285	270	298	8.8
Spadina LakeShore SB T	45	32	60	7.7
Spadina LakeShore SB R	194	168	227	14.1
LakeShore Spadina WB L	47	30	61	7.6
LakeShore Spadina WB T	705	663	762	27.2
LakeShore Spadina WB R	244	225	266	11.4
Rees LakeShore NB L	279	230	320	25.5
Rees LakeShore NB T	26	11	32	5.6
Rees LakeShore NB R	127	99	164	21.6
LakeShoreCont Rees EB L	NA	NA	NA	NA
LakeShoreCont Rees EB T	1554	1353	1663	73.8
LakeShoreFrFGE Rees EB T	2855	2263	3239	284.4
LakeShoreCont Rees EB R	270	231	294	19.5
Rees LakeShore SB L	151	127	187	18.4
Rees LakeShore SB T	62	37	83	12.2
Rees LakeShore SB R	468	445	512	21.9
LakeShore Rees WB L	NA	NA	NA	NA
LakeShore Rees WB T	4123	3986	4238	65.3
LakeShore Rees WB R	159	129	181	15.3
Simcoe LakeShore NB L	122	87	153	19.6
Simcoe LakeShore NB T	17	7	24	4.0
Simcoe LakeShore NB R	227	182	290	29.6
LakeShore Simcoe EB L	138	113	161	12.7
LakeShore Simcoe EB T	4039	3545	4389	286.7
LakeShore Simcoe EB R	478	392	528	32.2
Simcoe LakeShore SB L	85	54	109	13.3
Simcoe LakeShore SB T	49	33	75	10.7
Simcoe LakeShore SB R	519	404	598	55.6
LakeShore Simcoe WB L	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB T	3581	3390	3776	94.1

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB R	91	53	123	17.8
York LakeShore NB L	NA	NA	NA	NA
York LakeShore NB T	271	173	335	37.3
York LakeShore NB R	NA	NA	NA	NA
LakeShore York EB L	289	244	327	27.5
York LakeShore SB L	NA	NA	NA	NA
York LakeShore SB T	499	458	547	23.7
York LakeShore SB R	506	444	582	33.1
LakeShore York WB L	NA	NA	NA	NA
LakeShore York WB T	3284	3139	3447	90.1
LakeShore York WB R	169	141	198	15.8
Bay LakeShore NB L	199	175	219	11.3
Bay LakeShore NB T	498	405	576	43.3
Bay LakeShore NB R	NA	NA	NA	NA
Bay LakeShore SB L	NA	NA	NA	NA
Bay LakeShore SB T	272	237	317	18.6
Bay LakeShore SB R	634	558	727	42.6
LakeShore Bay WB L	295	251	328	17.5
LakeShore Bay WB T	3073	2952	3199	70.2
LakeShore Bay WB R	158	129	179	14.4
Yonge LakeShore NB L	290	265	319	16.3
Yonge LakeShore NB T	379	306	459	44.3
Yonge LakeShore NB R	NA	NA	NA	NA
Yonge LakeShore SB L	NA	NA	NA	NA
Yonge LakeShore SB T	150	125	184	14.4
Yonge LakeShore SB R	475	407	519	29.2
LakeShore Yonge WB L	212	183	244	17.5
LakeShore Yonge WB T	2818	2679	2924	58.0
LakeShore Yonge WB R	349	306	386	19.5
Cooper LakeShore NB L	131	114	150	12.0
Cooper LakeShore NB T	NA	NA	NA	NA
Cooper LakeShore NB R	NA	NA	NA	NA
LakeShore Cooper WB L	170	136	202	18.3
LakeShore Cooper WB T	3131	2948	3231	76.2
LakeShore Cooper WB R	NA	NA	NA	NA
Jarvis LakeShore NB L	125	104	146	10.0
Jarvis LakeShore NB T	50	23	85	14.6
Jarvis LakeShore NB R	303	250	363	36.5
LakeShore Jarvis EB L	315	273	357	26.1
LakeShore Jarvis EB T	2979	2786	3176	115.9
LakeShore Jarvis EB R	171	129	201	17.7
Jarvis LakeShore SB L	185	158	202	11.4
Jarvis LakeShore SB T	49	33	62	7.4
Jarvis LakeShore SB R	599	485	730	71.3
LakeShore Jarvis WB L	NA	NA	NA	NA
LakeShore Jarvis WB T	2583	2401	2701	85.8
LakeShore Jarvis WB R	311	288	371	21.4
Sherbourne LakeShore NB L	137	109	155	12.1
Sherbourne LakeShore NB T	51	22	72	13.1
Sherbourne LakeShore NB R	310	178	377	42.6
LakeShore Sherbourne EB L	NA	NA	NA	NA
LakeShore Sherbourne EB T	3334	3074	3550	134.0
LakeShore Sherbourne EB R	231	179	291	25.7
Sherbourne LakeShore SB L	118	80	147	19.7
Sherbourne LakeShore SB T	52	37	68	8.9
Sherbourne LakeShore SB R	181	129	219	24.3
LakeShore Sherbourne WB L	182	155	204	12.6
LakeShore Sherbourne WB T	2561	2425	2670	65.1
LakeShore Sherbourne WB R	208	176	241	18.6
Parliament LakeShore NB L	148	130	173	12.2
Parliament LakeShore NB T	44	27	67	10.7

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament LakeShore NB R	212	153	267	29.2
LakeShore Parliament EB L	278	217	317	25.1
LakeShore Parliament EB T	3290	3032	3482	121.5
LakeShore Parliament EB R	204	150	237	25.7
Parliament LakeShore SB L	112	76	130	14.8
Parliament LakeShore SB T	71	52	83	8.8
Parliament LakeShore SB R	293	241	338	26.0
LakeShore Parliament WB L	NA	NA	NA	NA
LakeShore Parliament WB T	2477	2409	2595	54.3
LakeShore Parliament WB R	220	183	266	20.0
Cherry LakeShore NB L	121	93	145	14.1
Cherry LakeShore NB T	NA	NA	NA	NA
Cherry LakeShore NB R	392	264	479	49.0
LakeShore Cherry EB L	NA	NA	NA	NA
LakeShore Cherry EB T	3549	3311	3751	122.2
LakeShore Cherry EB R	101	72	138	16.1
LakeShore Cherry WB L	222	189	250	14.1
LakeShore Cherry WB T	1582	1531	1647	29.6
LakeShore Cherry WB R	NA	NA	NA	NA
LakeShore atCherryRampFrDVP WB T	943	892	992	29.9
DonRoadway LakeShore NB L	199	167	225	17.3
DonRoadway LakeShore NB T	16	10	25	4.0
DonRoadway LakeShore NB R	150	132	183	16.1
LakeShore DonRoadway EB L	NA	NA	NA	NA
LakeShore DonRoadway EB T	2442	2186	2710	135.0
LakeShore DonRoadway EB R	164	94	222	32.3
DonRoadway LakeShore SB L	159	139	190	13.9
DonRoadway LakeShore SB T	45	25	64	9.8
DonRoadway LakeShore SB R	269	255	296	9.6
LakeShore DonRoadway WB L	44	21	66	10.5
LakeShore DonRoadway WB T	1352	1320	1397	18.6
LakeShore DonRoadway WB R	26	18	31	3.7
York Harbour NB L	NA	NA	NA	NA
York Harbour NB T	44	28	64	8.4
York Harbour NB R	400	363	437	21.3
Harbour York EB L	222	140	278	34.2
Harbour York EB T	3250	2834	3548	223.2
Harbour York EB R	592	479	661	53.8
York Harbour SB L	354	328	383	14.9
York Harbour SB T	120	99	144	14.3
York Harbour SB R	NA	NA	NA	NA
Bay Harbour NB L	NA	NA	NA	NA
Bay Harbour NB T	164	148	174	8.6
Bay Harbour NB R	550	499	594	31.1
Harbour Bay EB L	527	426	617	48.1
Harbour Bay EB T	3023	2734	3232	157.6
Harbour Bay EB R	400	356	462	30.9
Bay Harbour SB L	350	321	369	11.5
Bay Harbour SB T	218	177	264	24.7
Bay Harbour SB R	NA	NA	NA	NA
Yonge Harbour NB L	NA	NA	NA	NA
Yonge Harbour NB T	153	123	177	12.8
Yonge Harbour NB R	454	422	505	25.9
Harbour Yonge EB L	507	441	569	42.2
Harbour Yonge EB T	2953	2671	3152	139.2
Harbour Yonge EB R	493	396	561	41.6
Yonge Harbour SB L	172	156	204	13.1
Yonge Harbour SB T	198	164	236	17.3
Yonge Harbour SB R	NA	NA	NA	NA
Bathurst Front NB L	227	202	250	13.4
Bathurst Front NB T	85	68	107	9.6

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst Front NB R	86	59	129	20.8
Front Bathurst EB L	325	298	377	22.7
Front Bathurst EB T	1578	1328	1803	131.3
Front Bathurst EB R	208	177	275	25.3
Bathurst Front SB L	37	22	48	6.4
Bathurst Front SB T	124	103	139	9.5
Bathurst Front SB R	662	561	719	45.0
Front Bathurst WB L	173	149	195	11.8
Front Bathurst WB T	1652	1510	1754	55.0
Front Bathurst WB R	52	34	78	11.7
Spadina Front NB L	140	125	149	6.8
Spadina Front NB T	245	203	304	26.9
Spadina Front NB R	138	106	169	17.7
Front Spadina EB L	795	723	844	38.2
Front Spadina EB T	620	538	778	61.6
Front Spadina EB R	90	62	118	13.2
Spadina Front SB L	107	89	123	8.0
Spadina Front SB T	250	220	299	20.2
Spadina Front SB R	651	580	722	46.3
Front Spadina WB L	312	282	337	15.0
Front Spadina WB T	702	666	756	25.8
Front Spadina WB R	52	44	62	4.3
Parliament Front NB L	161	136	200	16.2
Parliament Front NB T	188	166	212	12.4
Parliament Front NB R	215	155	267	28.0
Front Parliament EB L	106	85	134	13.0
Front Parliament EB T	1149	986	1300	73.7
Front Parliament EB R	124	89	153	16.4
Parliament Front SB L	274	242	306	17.9
Parliament Front SB T	186	163	239	19.7
Parliament Front SB R	117	95	141	11.6
Front Parliament WB L	159	148	179	8.9
Front Parliament WB T	741	580	881	83.1
Front Parliament WB R	103	80	136	15.8
Parliament Richmond NB L	161	146	201	14.2
Parliament Richmond NB T	289	246	344	22.4
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	85	63	105	12.5
Parliament Richmond SB R	76	67	90	6.1
Richmond Parliament WB L	80	66	98	8.4
Richmond Parliament WB T	990	929	1073	39.7
Richmond Parliament WB R	157	139	173	10.7
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	241	220	280	17.0
Parliament Adelaide NB R	16	8	26	5.7
Adelaide Parliament EB L	209	174	239	17.2
Adelaide Parliament EB T	727	509	800	69.5
Adelaide Parliament EB R	271	205	319	30.8
Parliament Adelaide SB L	24	14	42	6.5
Parliament Adelaide SB T	153	128	186	15.6
Parliament Adelaide SB R	NA	NA	NA	NA
Jarvis Richmond NB L	159	130	187	13.3
Jarvis Richmond NB T	960	881	1019	44.2
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	425	383	457	20.0
Jarvis Richmond SB R	308	273	350	18.2
Richmond Jarvis WB L	201	144	250	31.5
Richmond Jarvis WB T	923	867	992	30.6
Richmond Jarvis WB R	158	119	176	15.3

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	558	503	591	27.3
Jarvis Adelaide NB R	187	144	212	20.2
Adelaide Jarvis EB L	505	423	564	38.9
Adelaide Jarvis EB T	1039	897	1136	63.3
Adelaide Jarvis EB R	183	154	216	18.0
Jarvis Adelaide SB L	318	282	340	16.0
Jarvis Adelaide SB T	336	279	395	35.3
Jarvis Adelaide SB R	NA	NA	NA	NA
Eastern CrossingDVP WB T	385	340	433	21.8
DVP RampToRichmond SB R	1781	1700	1847	39.3
DVP AfterRampToRichm SB T	1597	1520	1659	38.3
DVPOffRamp ToEastern WB T	629	530	726	54.0
DVPOffRamp ToRichmond WB R	1157	1083	1229	43.0
Eastern PastRampToDVP EB T	1612	1426	1683	64.3
Eastern ToDVPOnRamp EB R	406	358	501	35.8
Adelaide ToDVPOnRamp EB T	685	488	759	66.9
DVP RampFrEasternTotal NB T	1091	870	1249	81.0
DVP BeforeRampFrEastern NB T	1365	1276	1433	43.6
Bathurst King NB L	NA	NA	NA	NA
Bathurst King NB T	381	344	470	29.9
Bathurst King NB R	72	59	88	8.1
King Bathurst EB L	346	300	415	32.6
King Bathurst EB T	265	201	321	32.6
King Bathurst EB R	79	60	96	11.2
Bathurst King SB L	NA	NA	NA	NA
Bathurst King SB T	447	402	505	30.2
Bathurst King SB R	90	67	119	14.4
King Bathurst WB L	313	287	333	15.4
King Bathurst WB T	264	196	332	34.8
King Bathurst WB R	112	86	132	13.0
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	507	468	549	22.9
Bathurst Queen NB R	150	114	201	20.8
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	372	325	432	29.5
Queen Bathurst EB R	130	113	158	11.3
Bathurst Queen SB L	NA	NA	NA	NA
Bathurst Queen SB T	177	144	216	17.7
Bathurst Queen SB R	76	62	95	9.5
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	631	568	712	38.5
Queen Bathurst WB R	160	140	183	11.8
QueensQuay WestOfBathurst EB T	105	78	122	11.9
QueensQuay WestOfBathurst WB T	37	18	54	8.4
QueensQuay WestOfBathurst WB R	36	28	48	5.4
Bremner WestOfBathurst EB T	712	665	750	27.7
Bremner WestOfBathurst WB T	606	558	638	22.1
DundasW WestOfBathurst EB T	336	273	396	35.9
DundasW WestOfBathurst WB T	659	600	702	27.5

GREAT STREET APPROACH
8-LANE CROSS-SECTION, EAST OF SPADINA
PROJECTED TURNING MOVEMENT VOLUMES

IntelliCAN Transportation Systems Inc. Date: November 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options: Remove Option or Great Streets Alternative (8 Lanes - East of Spadina)

Modelled Intersection Turning Movement Volumes for the one hour AM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	2343	2115	2530	97.1
Gardiner ContPastRampToFSE EB T	2660	2529	2833	84.7
Gardiner RampFromFSE WB T	1417	1286	1492	50.9
Gardiner BeforeRampFromFSE WB T	3165	3009	3290	65.9
RampFromGardiner OverSpadina EB T	2665	2506	2840	88.6
RampToGardiner OverSpadina WB T	3187	3009	3315	65.0
Bathurst LakeShore NB L	41	25	58	7.1
Bathurst LakeShore NB T	13	7	20	3.6
Bathurst LakeShore NB R	48	29	63	9.7
LakeShore Bathurst EB L	79	59	107	11.6
LakeShore Bathurst EB T	2124	2031	2249	49.2
LakeShore Bathurst EB R	357	318	401	25.3
Bathurst LakeShore SB L	170	130	222	20.4
Bathurst LakeShore SB T	52	34	73	10.2
Bathurst LakeShore SB R	80	61	110	10.2
LakeShore Bathurst WB L	11	6	16	3.0
LakeShore Bathurst WB T	458	380	489	25.5
LakeShore Bathurst WB R	103	82	130	10.4
Spadina LakeShore NB L	33	22	53	7.6
Spadina LakeShore NB T	46	30	64	7.9
Spadina LakeShore NB R	61	36	90	14.4
LakeShore Spadina EB L	490	424	539	27.4
LakeShore Spadina EB T	1266	1216	1359	43.2
LakeShore Spadina EB R	114	93	142	11.3
Spadina LakeShore SB L	188	166	213	14.0
Spadina LakeShore SB T	25	16	49	7.6
Spadina LakeShore SB R	102	81	122	9.6
LakeShore Spadina WB L	4	0	8	2.0
LakeShore Spadina WB T	477	404	512	24.7
LakeShore Spadina WB R	267	226	303	18.2
Rees LakeShore NB L	219	172	276	21.9
Rees LakeShore NB T	26	13	37	6.3
Rees LakeShore NB R	36	20	52	8.7
LakeShoreCont Rees EB L	NA	NA	NA	NA
LakeShoreCont Rees EB T	1238	1178	1307	36.3
LakeShoreFrFGE Rees EB T	2627	2471	2834	93.3
LakeShoreCont Rees EB R	243	192	315	33.9
Rees LakeShore SB L	44	25	63	7.9
Rees LakeShore SB T	28	18	43	6.9
Rees LakeShore SB R	366	331	402	19.0
LakeShore Rees WB L	NA	NA	NA	NA
LakeShore Rees WB T	3349	3057	3470	83.1
LakeShore Rees WB R	96	77	114	10.2
Simcoe LakeShore NB L	141	103	175	19.1
Simcoe LakeShore NB T	20	4	36	7.5
Simcoe LakeShore NB R	108	80	150	18.3
LakeShore Simcoe EB L	157	86	199	23.9
LakeShore Simcoe EB T	3272	3029	3470	118.5
LakeShore Simcoe EB R	547	497	614	24.0
Simcoe LakeShore SB L	32	18	51	7.8
Simcoe LakeShore SB T	27	13	53	10.5
Simcoe LakeShore SB R	422	383	465	20.7
LakeShore Simcoe WB L	NA	NA	NA	NA
LakeShore Simcoe WB T	2880	2538	2980	88.6

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB R	103	66	133	16.3
York LakeShore NB L	NA	NA	NA	NA
York LakeShore NB T	443	388	489	23.7
York LakeShore NB R	NA	NA	NA	NA
LakeShore York EB L	285	269	295	7.8
York LakeShore SB L	NA	NA	NA	NA
York LakeShore SB T	127	115	140	8.6
York LakeShore SB R	512	470	556	20.8
LakeShore York WB L	NA	NA	NA	NA
LakeShore York WB T	2569	2193	2692	97.2
LakeShore York WB R	335	304	368	16.3
Bay LakeShore NB L	212	167	239	16.4
Bay LakeShore NB T	529	454	603	38.1
Bay LakeShore NB R	NA	NA	NA	NA
Bay LakeShore SB L	NA	NA	NA	NA
Bay LakeShore SB T	92	71	108	8.9
Bay LakeShore SB R	393	357	442	21.2
LakeShore Bay WB L	193	160	226	18.1
LakeShore Bay WB T	2875	2487	3021	105.4
LakeShore Bay WB R	411	363	474	27.4
Yonge LakeShore NB L	317	277	346	20.0
Yonge LakeShore NB T	286	223	326	20.5
Yonge LakeShore NB R	NA	NA	NA	NA
Yonge LakeShore SB L	NA	NA	NA	NA
Yonge LakeShore SB T	68	58	94	9.3
Yonge LakeShore SB R	317	265	368	23.3
LakeShore Yonge WB L	150	115	179	13.1
LakeShore Yonge WB T	2823	2357	2933	122.5
LakeShore Yonge WB R	523	420	566	34.0
Cooper LakeShore NB L	156	126	197	19.9
Cooper LakeShore NB T	NA	NA	NA	NA
Cooper LakeShore NB R	NA	NA	NA	NA
LakeShore Cooper WB L	81	62	106	11.3
LakeShore Cooper WB T	3232	2685	3399	140.1
LakeShore Cooper WB R	NA	NA	NA	NA
Jarvis LakeShore NB L	177	159	200	10.9
Jarvis LakeShore NB T	55	24	84	17.6
Jarvis LakeShore NB R	165	100	213	29.2
LakeShore Jarvis EB L	89	66	107	12.3
LakeShore Jarvis EB T	1527	1393	1649	62.6
LakeShore Jarvis EB R	75	62	96	8.4
Jarvis LakeShore SB L	87	68	109	11.8
Jarvis LakeShore SB T	50	39	69	7.8
Jarvis LakeShore SB R	437	351	524	35.6
LakeShore Jarvis WB L	NA	NA	NA	NA
LakeShore Jarvis WB T	2760	2387	2914	109.7
LakeShore Jarvis WB R	513	413	565	33.1
Sherbourne LakeShore NB L	133	105	170	16.7
Sherbourne LakeShore NB T	46	26	72	11.0
Sherbourne LakeShore NB R	252	211	301	25.6
LakeShore Sherbourne EB L	NA	NA	NA	NA
LakeShore Sherbourne EB T	1532	1389	1669	69.4
LakeShore Sherbourne EB R	106	81	124	11.9
Sherbourne LakeShore SB L	35	18	60	10.5
Sherbourne LakeShore SB T	31	23	45	5.8
Sherbourne LakeShore SB R	138	115	162	14.2
LakeShore Sherbourne WB L	335	287	416	26.1
LakeShore Sherbourne WB T	3012	2622	3164	122.7
LakeShore Sherbourne WB R	458	377	528	37.2
Parliament LakeShore NB L	217	180	252	19.6
Parliament LakeShore NB T	31	18	49	7.0

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament LakeShore NB R	144	107	197	22.4
LakeShore Parliament EB L	93	73	110	10.1
LakeShore Parliament EB T	1647	1497	1760	66.5
LakeShore Parliament EB R	110	90	138	12.2
Parliament LakeShore SB L	33	20	56	7.9
Parliament LakeShore SB T	67	53	83	8.3
Parliament LakeShore SB R	241	205	274	23.3
LakeShore Parliament WB L	NA	NA	NA	NA
LakeShore Parliament WB T	3334	3120	3471	104.6
LakeShore Parliament WB R	577	487	624	33.1
Cherry LakeShore NB L	92	29	118	21.1
Cherry LakeShore NB T	NA	NA	NA	NA
Cherry LakeShore NB R	248	171	319	38.8
LakeShore Cherry EB L	NA	NA	NA	NA
LakeShore Cherry EB T	1802	1640	1915	66.2
LakeShore Cherry EB R	58	44	77	9.0
LakeShore Cherry WB L	283	260	310	14.9
LakeShore Cherry WB T	3159	2913	3335	108.5
LakeShore Cherry WB R	NA	NA	NA	NA
LakeShore atCherryRampFrDVP WB T	590	508	673	43.4
DonRoadway LakeShore NB L	164	128	196	17.1
DonRoadway LakeShore NB T	31	21	39	4.6
DonRoadway LakeShore NB R	52	41	75	8.9
LakeShore DonRoadway EB L	NA	NA	NA	NA
LakeShore DonRoadway EB T	929	869	974	26.3
LakeShore DonRoadway EB R	77	60	114	12.3
DonRoadway LakeShore SB L	21	14	26	4.2
DonRoadway LakeShore SB T	14	7	25	4.4
DonRoadway LakeShore SB R	156	129	185	15.0
LakeShore DonRoadway WB L	192	141	254	25.0
LakeShore DonRoadway WB T	3157	2996	3300	90.2
LakeShore DonRoadway WB R	133	113	164	11.9
York Harbour NB L	NA	NA	NA	NA
York Harbour NB T	51	34	66	7.5
York Harbour NB R	236	177	277	23.4
Harbour York EB L	386	346	430	23.5
Harbour York EB T	2306	2118	2460	92.8
Harbour York EB R	469	408	507	29.2
York Harbour SB L	84	70	98	8.6
York Harbour SB T	33	24	49	5.5
York Harbour SB R	NA	NA	NA	NA
Bay Harbour NB L	NA	NA	NA	NA
Bay Harbour NB T	190	153	225	16.0
Bay Harbour NB R	244	220	272	14.5
Harbour Bay EB L	539	447	603	38.4
Harbour Bay EB T	1606	1482	1698	63.8
Harbour Bay EB R	399	350	446	22.4
Bay Harbour SB L	166	132	198	16.5
Bay Harbour SB T	131	110	159	12.8
Bay Harbour SB R	NA	NA	NA	NA
Yonge Harbour NB L	NA	NA	NA	NA
Yonge Harbour NB T	226	192	266	21.6
Yonge Harbour NB R	236	210	270	16.5
Harbour Yonge EB L	380	344	417	18.2
Harbour Yonge EB T	1349	1239	1440	58.9
Harbour Yonge EB R	333	286	368	21.6
Yonge Harbour SB L	88	69	105	10.2
Yonge Harbour SB T	145	124	167	12.0
Yonge Harbour SB R	NA	NA	NA	NA
Bathurst Front NB L	176	148	199	12.8
Bathurst Front NB T	98	81	122	9.9

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst Front NB R	100	76	137	15.3
Front Bathurst EB L	277	253	347	21.0
Front Bathurst EB T	1933	1645	2164	114.8
Front Bathurst EB R	213	178	266	24.0
Bathurst Front SB L	84	53	114	15.8
Bathurst Front SB T	99	71	118	13.1
Bathurst Front SB R	407	365	460	26.7
Front Bathurst WB L	80	67	96	8.4
Front Bathurst WB T	1174	1027	1264	51.9
Front Bathurst WB R	33	15	49	8.6
Spadina Front NB L	131	119	143	6.9
Spadina Front NB T	266	232	300	19.8
Spadina Front NB R	158	135	183	15.4
Front Spadina EB L	437	397	464	17.2
Front Spadina EB T	1306	1118	1508	105.2
Front Spadina EB R	74	57	94	8.4
Spadina Front SB L	100	84	115	7.8
Spadina Front SB T	131	110	167	14.7
Spadina Front SB R	303	265	360	24.2
Front Spadina WB L	85	68	99	8.7
Front Spadina WB T	756	678	853	40.8
Front Spadina WB R	14	8	18	2.6
Parliament Front NB L	472	388	534	34.8
Parliament Front NB T	267	222	308	18.6
Parliament Front NB R	69	49	80	7.8
Front Parliament EB L	39	28	54	6.6
Front Parliament EB T	472	379	571	46.3
Front Parliament EB R	46	27	71	10.4
Parliament Front SB L	65	49	76	6.9
Parliament Front SB T	82	74	99	7.6
Parliament Front SB R	124	90	170	18.3
Front Parliament WB L	118	86	140	13.4
Front Parliament WB T	1264	1132	1413	73.0
Front Parliament WB R	190	154	215	15.0
Parliament Richmond NB L	301	264	329	16.2
Parliament Richmond NB T	160	130	192	17.2
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	52	38	67	7.9
Parliament Richmond SB R	135	105	157	13.5
Richmond Parliament WB L	84	56	147	26.1
Richmond Parliament WB T	2025	1879	2102	55.1
Richmond Parliament WB R	245	196	294	22.2
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	367	331	386	15.9
Parliament Adelaide NB R	8	1	20	4.7
Adelaide Parliament EB L	89	63	113	13.3
Adelaide Parliament EB T	145	102	198	27.6
Adelaide Parliament EB R	155	108	186	20.1
Parliament Adelaide SB L	3	0	7	1.7
Parliament Adelaide SB T	135	99	209	30.6
Parliament Adelaide SB R	NA	NA	NA	NA
Jarvis Richmond NB L	249	218	286	18.7
Jarvis Richmond NB T	225	185	267	22.4
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	296	258	365	31.4
Jarvis Richmond SB R	334	250	396	38.4
Richmond Jarvis WB L	353	287	404	28.3
Richmond Jarvis WB T	1957	1669	2165	126.2
Richmond Jarvis WB R	93	64	124	14.8
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	416	363	462	27.5
Jarvis Adelaide NB R	55	42	66	7.0

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Adelaide Jarvis EB L	83	60	106	12.6
Adelaide Jarvis EB T	304	246	351	26.8
Adelaide Jarvis EB R	113	86	141	11.8
Jarvis Adelaide SB L	149	118	182	17.6
Jarvis Adelaide SB T	437	372	500	29.6
Jarvis Adelaide SB R	NA	NA	NA	NA
Eastern CrossingDVP WB T	1615	1466	1873	108.0
DVP RampToRichmond SB R	2642	2605	2682	17.6
DVP AfterRampToRichm SB T	897	801	993	49.0
DVPOffRamp ToEastern WB T	180	143	217	20.7
DVPOffRamp ToRichmond WB R	2358	2304	2409	25.6
Eastern PastRampToDVP EB T	499	428	575	44.9
Eastern ToDVPOnRamp EB R	166	122	214	23.4
Adelaide ToDVPOnRamp EB T	103	66	149	22.3
DVP RampFrEasternTotal NB T	269	222	301	17.3
DVP BeforeRampFrEastern NB T	1157	1083	1220	36.8
Bathurst King NB L	4	1	10	2.5
Bathurst King NB T	291	253	329	22.2
Bathurst King NB R	62	39	95	14.2
King Bathurst EB L	164	131	210	18.7
King Bathurst EB T	618	496	697	42.8
King Bathurst EB R	105	72	131	16.4
Bathurst King sB L	91	71	117	13.0
Bathurst King sB T	268	207	326	28.7
Bathurst King sB R	28	17	42	6.1
King Bathurst WB L	79	61	97	10.3
King Bathurst WB T	44	12	69	17.2
King Bathurst WB R	26	12	35	5.6
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	232	199	249	13.2
Bathurst Queen NB R	120	88	142	13.2
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	676	621	733	35.5
Queen Bathurst EB R	195	154	226	17.3
Bathurst Queen sB L	NA	NA	NA	NA
Bathurst Queen sB T	276	241	310	19.2
Bathurst Queen sB R	26	19	35	4.2
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	126	94	167	14.0
Queen Bathurst WB R	33	25	41	3.8
QueensQuay WestOfBathurst EB T	116	90	145	18.2
QueensQuay WestOfBathurst WB T	7	1	15	2.5
QueensQuay WestOfBathurst WB R	7	3	14	2.6
Bremner WestOfBathurst EB T	698	640	761	30.0
Bremner WestOfBathurst WB T	265	243	295	15.7
DundasW WestOfBathurst EB T	768	697	864	33.1
DundasW WestOfBathurst WB T	87	70	116	11.0

IntelliCAN Transportation Systems Inc. Date: November 2004

Gardiner Expressway / Lake Shore Boulevard Scoping Study
Microsimulation of configuration options: Remove Option or Great Streets Alternative (8 Lanes - East of Spadina)

Modelled Intersection Turning Movement Volumes for the one hour PM peak

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Gardiner OffRampToFSE EB R	1967	1759	2187	121.4
Gardiner ContPastRampToFSE EB T	2800	2441	3070	203.1
Gardiner RampFromFSE WB T	2524	2304	2639	87.3
Gardiner BeforeRampFromFSE WB T	3751	3620	3874	78.7
RampFromGardiner OverSpadina EB T	2660	2294	2867	168.1
RampToGardiner OverSpadina WB T	3753	3613	3869	78.5
Bathurst LakeShore NB L	79	67	88	7.2
Bathurst LakeShore NB T	38	23	56	8.2
Bathurst LakeShore NB R	77	42	99	14.7
LakeShore Bathurst EB L	169	142	192	12.9
LakeShore Bathurst EB T	1319	1096	1479	84.0
LakeShore Bathurst EB R	319	239	386	33.4
Bathurst LakeShore SB L	170	148	194	16.7
Bathurst LakeShore SB T	64	45	117	18.5
Bathurst LakeShore SB R	165	142	194	12.9
LakeShore Bathurst WB L	23	13	41	6.4
LakeShore Bathurst WB T	684	619	742	31.1
LakeShore Bathurst WB R	122	96	140	11.6
Spadina LakeShore NB L	36	23	49	5.6
Spadina LakeShore NB T	55	32	77	12.2
Spadina LakeShore NB R	64	43	104	18.1
LakeShore Spadina EB L	225	172	301	30.5
LakeShore Spadina EB T	987	835	1061	65.6
LakeShore Spadina EB R	110	81	136	16.5
Spadina LakeShore SB L	205	142	236	22.9
Spadina LakeShore SB T	38	21	80	13.5
Spadina LakeShore SB R	160	119	208	22.5
LakeShore Spadina WB L	41	31	50	4.9
LakeShore Spadina WB T	662	611	727	25.9
LakeShore Spadina WB R	239	216	266	16.6
Rees LakeShore NB L	258	194	309	28.9
Rees LakeShore NB T	25	11	43	7.1
Rees LakeShore NB R	130	66	156	23.1
LakeShoreCont Rees EB L	NA	NA	NA	NA
LakeShoreCont Rees EB T	1052	859	1141	68.5
LakeShoreFrFGE Rees EB T	2600	2214	2825	185.0
LakeShoreCont Rees EB R	167	118	222	32.9
Rees LakeShore SB L	169	126	205	21.5
Rees LakeShore SB T	68	54	91	10.4
Rees LakeShore SB R	458	415	505	28.2
LakeShore Rees WB L	NA	NA	NA	NA
LakeShore Rees WB T	3902	3737	4044	76.2
LakeShore Rees WB R	140	118	169	14.8
Simcoe LakeShore NB L	130	96	200	25.4
Simcoe LakeShore NB T	15	4	36	8.2
Simcoe LakeShore NB R	193	135	263	35.6
LakeShore Simcoe EB L	143	118	163	12.4
LakeShore Simcoe EB T	3376	2669	3580	231.0
LakeShore Simcoe EB R	410	323	562	54.1
Simcoe LakeShore SB L	89	66	125	16.2
Simcoe LakeShore SB T	50	18	69	14.8
Simcoe LakeShore SB R	424	358	506	42.3
LakeShore Simcoe WB L	NA	NA	NA	NA

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB T	3434	3207	3610	103.6

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
LakeShore Simcoe WB R	83	53	113	16.8
York LakeShore NB L	NA	NA	NA	NA
York LakeShore NB T	222	149	305	44.4
York LakeShore NB R	NA	NA	NA	NA
LakeShore York EB L	243	187	300	40.1
York LakeShore SB L	NA	NA	NA	NA
York LakeShore SB T	451	401	493	25.6
York LakeShore SB R	496	430	582	42.0
LakeShore York WB L	NA	NA	NA	NA
LakeShore York WB T	3133	2890	3349	126.0
LakeShore York WB R	186	147	210	17.2
Bay LakeShore NB L	212	187	251	17.6
Bay LakeShore NB T	420	308	476	44.5
Bay LakeShore NB R	NA	NA	NA	NA
Bay LakeShore SB L	NA	NA	NA	NA
Bay LakeShore SB T	258	236	282	13.6
Bay LakeShore SB R	647	591	712	35.7
LakeShore Bay WB L	267	235	286	16.1
LakeShore Bay WB T	2898	2622	3126	139.7
LakeShore Bay WB R	146	126	178	13.6
Yonge LakeShore NB L	302	276	323	15.2
Yonge LakeShore NB T	333	266	385	31.6
Yonge LakeShore NB R	NA	NA	NA	NA
Yonge LakeShore SB L	NA	NA	NA	NA
Yonge LakeShore SB T	158	136	179	12.5
Yonge LakeShore SB R	484	412	534	31.5
LakeShore Yonge WB L	198	175	236	19.4
LakeShore Yonge WB T	2571	2243	2722	130.4
LakeShore Yonge WB R	299	254	332	22.3
Cooper LakeShore NB L	131	109	173	17.9
Cooper LakeShore NB T	NA	NA	NA	NA
Cooper LakeShore NB R	NA	NA	NA	NA
LakeShore Cooper WB L	149	113	181	18.5
LakeShore Cooper WB T	2879	2601	3069	128.7
LakeShore Cooper WB R	NA	NA	NA	NA
Jarvis LakeShore NB L	125	83	146	14.4
Jarvis LakeShore NB T	50	28	90	16.2
Jarvis LakeShore NB R	278	197	337	37.0
LakeShore Jarvis EB L	268	217	308	24.0
LakeShore Jarvis EB T	2758	2424	3103	146.5
LakeShore Jarvis EB R	178	143	205	15.4
Jarvis LakeShore SB L	176	151	199	12.3
Jarvis LakeShore SB T	50	34	64	9.1
Jarvis LakeShore SB R	407	322	488	42.3
LakeShore Jarvis WB L	NA	NA	NA	NA
LakeShore Jarvis WB T	2507	2320	2659	96.7
LakeShore Jarvis WB R	289	234	340	28.4
Sherbourne LakeShore NB L	128	108	139	9.0
Sherbourne LakeShore NB T	44	26	67	10.7
Sherbourne LakeShore NB R	306	257	384	31.8
LakeShore Sherbourne EB L	NA	NA	NA	NA
LakeShore Sherbourne EB T	3106	2780	3461	153.1
LakeShore Sherbourne EB R	234	187	280	22.6
Sherbourne LakeShore SB L	111	85	144	17.8
Sherbourne LakeShore SB T	59	41	86	13.2
Sherbourne LakeShore SB R	198	144	242	26.3
LakeShore Sherbourne WB L	186	166	203	11.7
LakeShore Sherbourne WB T	2462	2234	2609	93.9
LakeShore Sherbourne WB R	194	151	231	21.7
Parliament LakeShore NB L	146	126	164	9.8
Parliament LakeShore NB T	39	24	62	10.6

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Parliament LakeShore NB R	206	148	235	24.2
LakeShore Parliament EB L	274	227	303	23.0
LakeShore Parliament EB T	3080	2850	3373	139.8
LakeShore Parliament EB R	200	149	252	24.2
Parliament LakeShore SB L	110	82	146	17.1
Parliament LakeShore SB T	69	54	87	9.7
Parliament LakeShore SB R	278	242	302	16.5
LakeShore Parliament WB L	NA	NA	NA	NA
LakeShore Parliament WB T	2391	2159	2533	90.7
LakeShore Parliament WB R	235	200	274	20.3
Cherry LakeShore NB L	129	98	173	16.2
Cherry LakeShore NB T	NA	NA	NA	NA
Cherry LakeShore NB R	374	302	468	44.8
LakeShore Cherry EB L	NA	NA	NA	NA
LakeShore Cherry EB T	3324	3091	3558	136.2
LakeShore Cherry EB R	109	81	136	14.5
LakeShore Cherry WB L	223	194	254	16.2
LakeShore Cherry WB T	1555	1407	1613	58.1
LakeShore Cherry WB R	NA	NA	NA	NA
LakeShore atCherryRampFrDVP WB T	893	801	961	46.4
DonRoadway LakeShore NB L	190	161	218	15.2
DonRoadway LakeShore NB T	13	6	19	3.8
DonRoadway LakeShore NB R	219	163	267	27.2
LakeShore DonRoadway EB L	NA	NA	NA	NA
LakeShore DonRoadway EB T	2354	2144	2536	88.3
LakeShore DonRoadway EB R	126	86	187	27.9
DonRoadway LakeShore SB L	177	161	197	10.9
DonRoadway LakeShore SB T	36	25	45	5.3
DonRoadway LakeShore SB R	257	239	284	13.6
LakeShore DonRoadway WB L	29	7	58	14.7
LakeShore DonRoadway WB T	1346	1175	1472	68.9
LakeShore DonRoadway WB R	27	18	41	5.4
York Harbour NB L	NA	NA	NA	NA
York Harbour NB T	31	17	43	6.2
York Harbour NB R	398	315	453	39.2
Harbour York EB L	193	117	261	41.9
Harbour York EB T	2710	2038	2930	203.7
Harbour York EB R	515	415	577	46.4
York Harbour SB L	333	287	387	24.6
York Harbour SB T	120	104	142	12.3
York Harbour SB R	NA	NA	NA	NA
Bay Harbour NB L	NA	NA	NA	NA
Bay Harbour NB T	178	158	206	14.8
Bay Harbour NB R	516	439	608	38.6
Harbour Bay EB L	446	320	512	48.5
Harbour Bay EB T	2603	2085	2830	173.0
Harbour Bay EB R	360	266	408	28.8
Bay Harbour SB L	331	306	348	11.6
Bay Harbour SB T	202	178	227	11.6
Bay Harbour SB R	NA	NA	NA	NA
Yonge Harbour NB L	NA	NA	NA	NA
Yonge Harbour NB T	171	155	190	10.9
Yonge Harbour NB R	427	372	462	27.3
Harbour Yonge EB L	459	383	512	27.5
Harbour Yonge EB T	2573	2084	2834	185.4
Harbour Yonge EB R	455	400	498	29.5
Yonge Harbour SB L	172	153	187	10.7
Yonge Harbour SB T	189	153	232	20.7
Yonge Harbour SB R	NA	NA	NA	NA
Bathurst Front NB L	223	203	243	8.5
Bathurst Front NB T	100	70	127	15.3

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Bathurst Front NB R	102	73	133	19.3
Front Bathurst EB L	325	284	364	25.6
Front Bathurst EB T	1557	1425	1751	103.6
Front Bathurst EB R	228	177	289	28.4
Bathurst Front SB L	44	28	62	8.7
Bathurst Front SB T	122	113	135	7.4
Bathurst Front SB R	664	596	728	36.6
Front Bathurst WB L	169	149	195	14.0
Front Bathurst WB T	1693	1486	1834	96.7
Front Bathurst WB R	49	34	65	7.4
Spadina Front NB L	140	126	159	9.5
Spadina Front NB T	246	196	277	23.0
Spadina Front NB R	144	126	176	12.8
Front Spadina EB L	792	692	851	34.1
Front Spadina EB T	647	570	748	48.9
Front Spadina EB R	97	81	132	12.0
Spadina Front SB L	108	94	122	6.5
Spadina Front SB T	233	192	278	22.6
Spadina Front SB R	684	526	793	73.2
Front Spadina WB L	316	276	349	19.2
Front Spadina WB T	707	648	755	30.9
Front Spadina WB R	48	35	71	9.4
Parliament Front NB L	167	129	196	17.0
Parliament Front NB T	187	163	211	14.1
Parliament Front NB R	208	175	263	25.9
Front Parliament EB L	99	83	111	9.2
Front Parliament EB T	1191	1012	1288	85.9
Front Parliament EB R	115	87	132	13.2
Parliament Front SB L	278	244	318	21.0
Parliament Front SB T	177	150	236	22.7
Parliament Front SB R	118	86	157	18.7
Front Parliament WB L	146	126	163	10.3
Front Parliament WB T	774	638	871	72.7
Front Parliament WB R	118	96	132	12.0
Parliament Richmond NB L	169	145	191	15.3
Parliament Richmond NB T	281	238	301	16.7
Parliament Richmond NB R	NA	NA	NA	NA
Parliament Richmond SB L	NA	NA	NA	NA
Parliament Richmond SB T	84	62	118	14.4
Parliament Richmond SB R	72	44	93	11.9
Richmond Parliament WB L	88	65	110	12.5
Richmond Parliament WB T	1012	803	1093	70.0
Richmond Parliament WB R	157	129	176	11.6
Parliament Adelaide NB L	NA	NA	NA	NA
Parliament Adelaide NB T	238	214	261	12.9
Parliament Adelaide NB R	18	9	26	5.1
Adelaide Parliament EB L	211	180	229	14.5
Adelaide Parliament EB T	716	599	833	76.2
Adelaide Parliament EB R	289	235	328	24.7
Parliament Adelaide SB L	25	17	37	5.7
Parliament Adelaide SB T	159	127	189	20.0
Parliament Adelaide SB R	NA	NA	NA	NA
Jarvis Richmond NB L	162	142	199	12.0
Jarvis Richmond NB T	928	824	1008	44.6
Jarvis Richmond NB R	NA	NA	NA	NA
Jarvis Richmond SB L	NA	NA	NA	NA
Jarvis Richmond SB T	419	378	474	25.7
Jarvis Richmond SB R	308	272	354	21.2
Richmond Jarvis WB L	188	124	227	20.0
Richmond Jarvis WB T	907	642	986	81.5
Richmond Jarvis WB R	148	112	170	17.6

Turning movement	Average volume for all runs	Minimum	Maximum	Standard Deviation
Jarvis Adelaide NB L	NA	NA	NA	NA
Jarvis Adelaide NB T	527	481	569	24.3
Jarvis Adelaide NB R	177	142	210	16.8
Adelaide Jarvis EB L	494	388	585	42.4
Adelaide Jarvis EB T	1026	861	1139	70.7
Adelaide Jarvis EB R	177	150	216	17.9
Jarvis Adelaide SB L	320	263	366	27.8
Jarvis Adelaide SB T	320	280	364	27.5
Jarvis Adelaide SB R	NA	NA	NA	NA
Eastern CrossingDVP WB T	395	328	440	31.3
DVP RampToRichmond SB R	1847	1761	1904	43.8
DVP AfterRampToRichm SB T	1548	1436	1623	53.6
DVPOffRamp ToEastern WB T	654	540	759	59.2
DVPOffRamp ToRichmond WB R	1196	1107	1272	50.2
Eastern PastRampToDVP EB T	1634	1518	1782	93.9
Eastern ToDVPOnRamp EB R	401	349	451	30.6
Adelaide ToDVPOnRamp EB T	679	557	796	72.8
DVP RampFrEasternTotal NB T	1080	940	1250	78.8
DVP BeforeRampFrEastern NB T	1259	1098	1334	58.9
Bathurst King NB L	NA	NA	NA	NA
Bathurst King NB T	388	328	447	31.8
Bathurst King NB R	73	30	94	16.4
King Bathurst EB L	372	315	420	28.1
King Bathurst EB T	292	247	347	30.3
King Bathurst EB R	88	70	115	12.8
Bathurst King SB L	NA	NA	NA	NA
Bathurst King SB T	459	418	495	22.4
Bathurst King SB R	92	68	116	12.8
King Bathurst WB L	300	271	318	15.3
King Bathurst WB T	262	204	366	37.6
King Bathurst WB R	110	86	127	9.4
Bathurst Queen NB L	NA	NA	NA	NA
Bathurst Queen NB T	494	444	549	31.0
Bathurst Queen NB R	163	100	208	23.5
Queen Bathurst EB L	NA	NA	NA	NA
Queen Bathurst EB T	399	249	473	50.2
Queen Bathurst EB R	143	123	178	13.9
Bathurst Queen SB L	NA	NA	NA	NA
Bathurst Queen SB T	195	168	217	12.5
Bathurst Queen SB R	77	57	93	11.2
Queen Bathurst WB L	NA	NA	NA	NA
Queen Bathurst WB T	630	473	700	54.4
Queen Bathurst WB R	145	127	175	13.7
QueensQuay WestOfBathurst EB T	127	99	161	16.9
QueensQuay WestOfBathurst WB T	30	18	40	6.1
QueensQuay WestOfBathurst WB R	32	23	42	5.2
Bremner WestOfBathurst EB T	740	669	791	36.9
Bremner WestOfBathurst WB T	600	535	669	37.5
DundasW WestOfBathurst EB T	378	306	494	43.8
DundasW WestOfBathurst WB T	636	569	693	29.6