WORKING
DRAFT

GTA A.M. PEAK MODEL

Documentation
&
Users' Guide

Prepared for the

Toronto Area Transportation Planning
Data Collection Steering Committee

by

Peter Dalton

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Contents

1.0 A.M. Peak Period Model for the GTA

The A.M. Peak Period model is an adaptation of the Simplified GTA model version 3. Figure 1 shows the flow of informatio through the trip generation, mode split and trip distribution components of the model. The primary difference from Version 3 is that all of the data preparation, model execution and basic reporting are done within the emme/2 framework without the use of external spreadsheets. The model formulation and calibration is identical to Version 3 except that an HOV assignment component has been added. Operational procedures and output formats are consistent with the recently created P.M. Peak GTA model.

Figure 1 - Flow Diagram

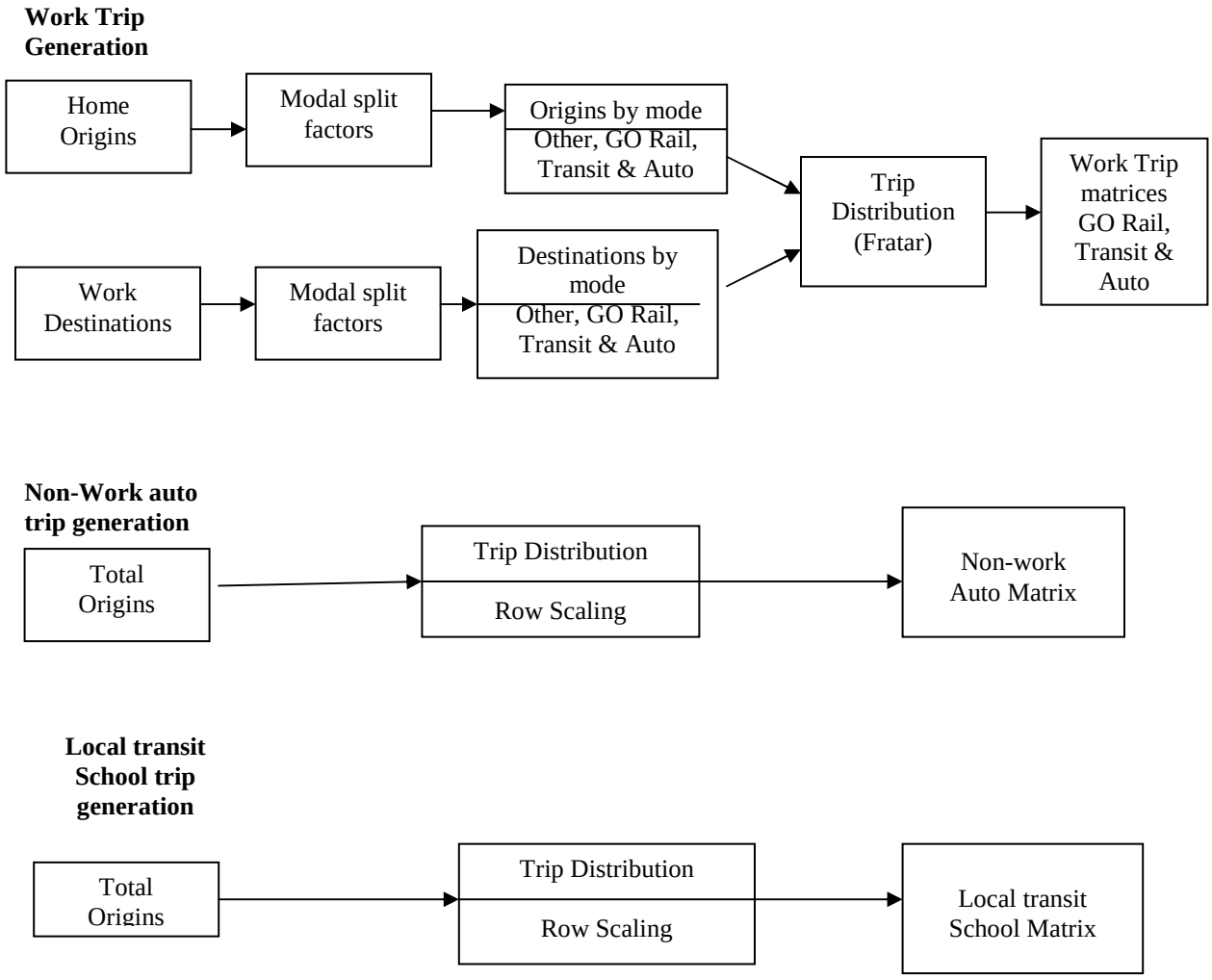

Table 1 provides a summary of the main features of the model. The model has been calibrated using the 1996 TTS data

Table 1 - Features of the A.M. Peak Period Model

Time period	a.m. peak 3 hrs (6:00 - 8:59)
Geographic Scope	GTA, including Hamilton-Wentworth, plus 10 adjacent Counties and Regional Municipalities
Zone system	GTA96 plus 26 external zones (1703 total)
Trip purpose categories	1. Work destinations (all modes) 2. Home to School (local transit only) 3. Non work destinations (Auto only)
Modes	1. Auto (Driver & Passenger) 2. Transit (Excluding GO Rail access) 3. GO Rail 4. Other, primarily walk & cycle (Trips not distributed or assigned)
Special Features	1. Bucket rounding used at all stages for the calculation of trip end control totals and distributed cell values 2. Modified auto trip distribution reflecting projected changes in travel time (Optional). 3. Simulation of HOV lanes including the formation of new car-pools (Optional). 4. Inclusion of an additional auto matrix that may be used to represent GO Rail access, truck movements or external and through trips from outside the simulated area.

The definition of the GTA includes the Regional Municipality of Hamilton-Wentworth in the context of the model and this documentation. The revised GTA model is compatible with the existing Durham region sub-model that uses a more detailed zone system. It is anticipated that similar Regional sub-components may be developed for other areas.

The model produces traffic assignments for auto drivers and local transit. In the trip generation and mode split components the auto mode includes both auto passengers and auto drivers. A subsequent auto occupancy calculation is used to generate the auto driver matrix that is assigned. The mode-split component includes an "other" mode category (Primarily walk and cycle) but the trips are not distributed or assigned. The auto driver matrix may be stratified by auto occupancy permitting the use of multiclass assignments to project HOV lane use.

Bucket rounding is used, wherever applicable, to produce control totals and individual matrix cell values that are integers. The bucket rounding function (bint) is described in full on page 3-67 of the emme/2 User's Manual (Release 8). The advantages of using rounded integer values are:

a) Rounding errors are eliminated as a source of differences when data are exported from emme/2 for external analysis.
b) The size of the data files used to store, or transfer, matrix data is reduced dramatically due to the reduced number of non zero values and the absence of decimal places.
c) The standard output tables produced by emme/2 are more readable and easier to analyse.

The model may be run in two distinct stages. In stage 1 levels of service on the road and transit networks are assumed to remain constant at 1996 levels - an appropriate assumption for the purpose of identifying deficiencies and pressure points in the existing network or the travel "demand" associated with future land

use alternatives. In the 2nd stage of the model, the distribution of auto trips can be modified to reflect planned improvements in the road network and projected changes in levels of service. Changes in the local transit or GO Rail service must be reflected in the input assumptions to the mode split component. Post distribution diversion procedures can be applied to the output matrices to estimate the ridership potential of any major new transit facility such as a busway.

1.1 Trip Generation

Trip generation rates are applied to estimates of population and employment in order to obtain the trip end totals used as input to the subsequent stages of the model. Table 2 shows the categories of trip used in the trip generation component of the model. The home location is assumed to be the trip origin for first trips to work regardless of the actual trip origin given in the TTS database. It is only trips to work that have both origin and destination trip generation rates. A user specified global weighting factor is applied to balance the origins and destinations to the same over all total. The default value of the origin weight has been set to 1. The destination weight is automatically calculated as 1 minus the origin weight.

The following trip categories are not included in the trip generation component of the model:

1. Non work GO Rail trips (6.7% of total a.m. peak GO Rail trips - TTS data)
2. Non work or school local transit trips (5.7% of total a.m. peak transit trips - TTS data)

The model uses global adjustment factors, prior to trip assignment, to correct for this under representation.

Table 2 - Trip Generation Categories

		TTS Trip Total
Employment Based Trip Rates		
	Work trip destinations - all modes	1,347,105
Population Based Trip Rates		
	Work trip origins - all modes	1,347,105
	Non work auto trip origins	577,125
	School trip origins for local transit	125,569

Base case trip generation rates were obtained from the TTS data at an aggregated level. The zone ensemble "gg", in the emme2bank, contains the zone aggregations that are used. The zone aggregations are sub-divisions of Planning Districts with the first digit of a 2-digit number or 2 digits of a 3-digit number, being the planning district number. The aggregations are shown in Figure 2. The total number of aggregations is 83 The trip generation rates used in future forecasts can be based on the same aggregations, a different set of aggregations or individual values for each traffic zone.

Table 3 shows the base case trip generation rates calculated from the TTS data and. The trip rates for areas outside the GTA are for trips to or from the GTA only. There is assumed to be no non-work related local transit trips to or from areas outside the GTA. The number of external observed trips in the TTS database is too small to be meaningful.

Figure 2 - Aggregations Used in Trip Generation

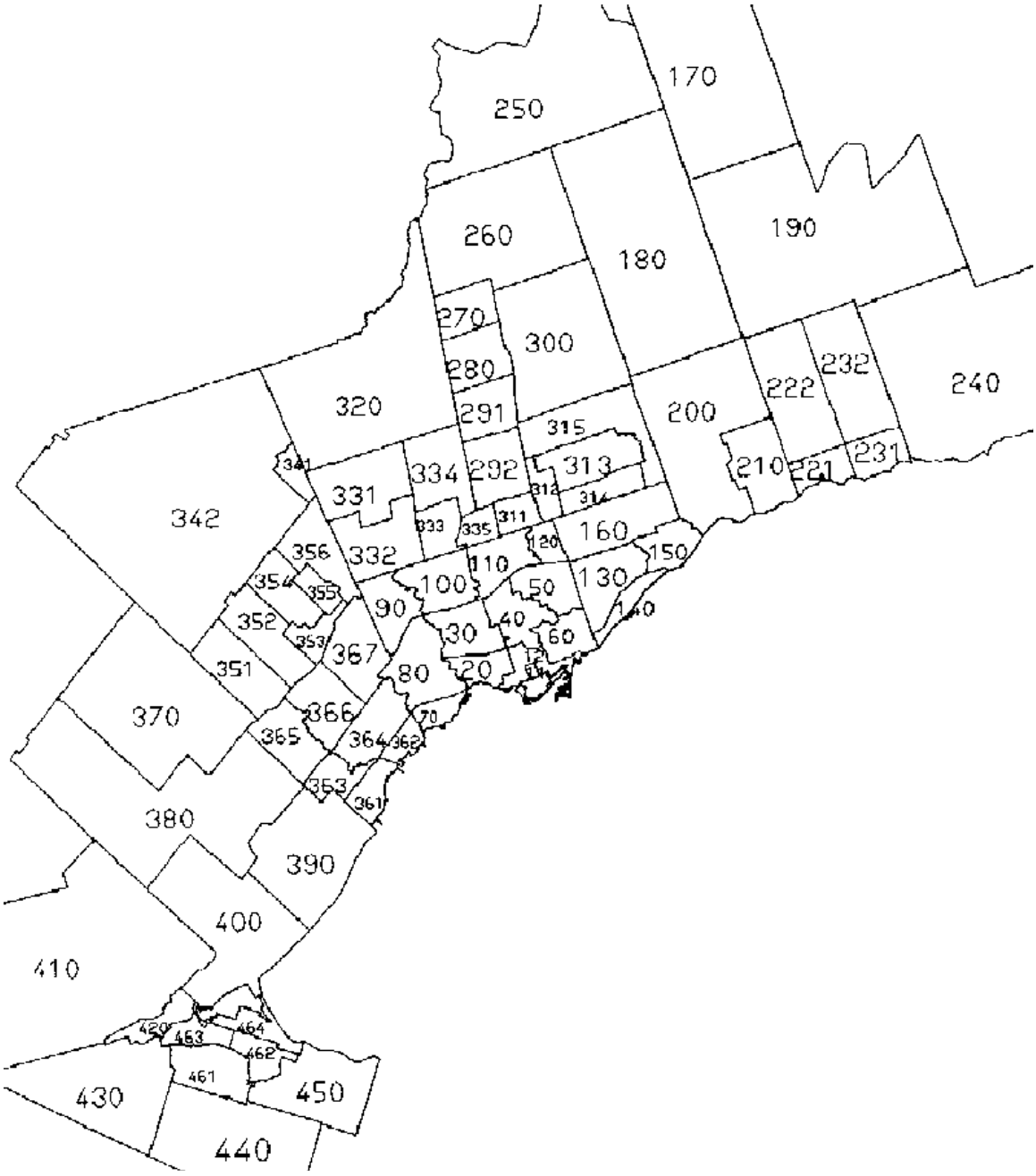

Table 3 - Trip Generation Rates (TTS)

gg	To work		Auto Non work	Local transit
	Origins per 1000 population	Destinations per 1000 employment	origins per 1000 population	School Origins per 1000 population
11	0.287	0.594	0.051	0.045
12	0.426	0.714	0.212	0.028
20	0.276	0.511	0.052	0.041
30	0.252	0.570	0.068	0.051
40	0.314	0.591	0.102	0.026
50	0.253	0.608	0.122	0.037
60	0.279	0.478	0.071	0.042
70	0.287	0.575	0.097	0.033
80	0.252	0.587	0.121	0.039
90	0.261	0.586	0.100	0.043
100	0.245	0.617	0.092	0.051
110	0.256	0.601	0.124	0.038
120	0.263	0.586	0.118	0.042
130	0.250	0.553	0.104	0.042
140	0.264	0.451	0.091	0.039
150	0.280	0.525	0.127	0.045
160	0.257	0.563	0.119	0.043
170	0.198	0.550	0.086	0.000
180	0.250	0.493	0.111	0.000
190	0.246	0.467	0.100	0.000
200	0.299	0.567	0.140	0.017
210	0.299	0.522	0.139	0.016
221	0.262	0.549	0.132	0.014
222	0.283	0.565	0.128	0.011
231	0.223	0.455	0.131	0.017
232	0.240	0.483	0.121	0.023
240	0.249	0.555	0.093	0.002
250	0.247	0.472	0.088	0.002
260	0.274	0.567	0.114	0.000
270	0.296	0.514	0.131	0.011
280	0.295	0.625	0.143	0.007
291	0.301	0.526	0.122	0.003
292	0.286	0.591	0.160	0.019
300	0.298	0.540	0.107	0.001
311	0.301	0.570	0.154	0.017
312	0.262	0.677	0.313	0.016
313	0.288	0.506	0.165	0.009
314	0.275	0.611	0.175	0.029
315	0.253	0.526	0.093	0.014
320	0.301	0.559	0.100	0.000
331	0.238	0.526	0.090	0.010
332	0.304	0.612	0.135	0.014
333	0.253	0.654	0.093	0.014
334	0.324	0.530	0.130	0.011
335	0.272	0.530	0.156	0.015

Table 3 (Cont.) - Trip Generation Rates (TTS)

gg	To work		Auto Non work	Local transit
	Origins per 1000 population	Destinations per 1000 employment	Origins per 1000 population	School Origins per 1000 population
341	0.341	0.563	0.116	0.002
342	0.308	0.593	0.122	0.000
351	0.253	0.526	0.093	0.014
352	0.299	0.527	0.122	0.010
353	0.253	0.601	0.093	0.014
354	0.309	0.511	0.121	0.012
355	0.253	0.510	0.093	0.014
356	0.253	0.526	0.093	0.014
361	0.288	0.530	0.134	0.009
362	0.306	0.551	0.136	0.007
363	0.304	0.573	0.129	0.014
364	0.302	0.554	0.118	0.019
365	0.327	0.606	0.136	0.009
366	0.310	0.672	0.139	0.008
367	0.249	0.592	0.225	0.008
370	0.327	0.546	0.130	0.002
380	0.307	0.580	0.158	0.001
390	0.302	0.563	0.153	0.006
400	0.292	0.540	0.123	0.003
410	0.251	0.602	0.112	0.000
420	0.257	0.517	0.121	0.005
430	0.265	0.533	0.118	0.006
440	0.233	0.526	0.069	0.000
450	0.261	0.536	0.110	0.004
461	0.219	0.463	0.119	0.017
462	0.218	0.461	0.087	0.017
463	0.210	0.551	0.096	0.018
464	0.190	0.533	0.157	0.024
500	0.034	0.023	0.006	
510	0.016	0.011	0.005	
520	0.047	0.018	0.013	
530	0.047	0.021	0.009	
540	0.095	0.043	0.016	
550	0.046	0.029	0.008	
560	0.014	0.016	0.003	
570	0.078	0.055	0.010	
580	0.049	0.034	0.005	
590	0.024	0.018	0.006	
Toronto	0.267	0.598	0.095	
Durham	0.263	0.514	0.124	
York	0.287	0.597	0.147	
Peel	0.304	0.578	0.133	
Halton	0.301	0.554	0.139	
Ham.-Wen.	0.228	0.519	0.108	
Total GTA	0.274	0.581	0.114	
External	0.035	0.022	0.057	

1.2 Mode Split

Figure 3 shows the zone aggregations used in the calibration of the mode split component of the model. Two columns are shown for GO Rail. The first column (1996) contains the values obtained from the 1996 TTS that were used in the calibration of the model. The second column (2000) shows revised values that have been calibrated to match observed GO Rail ridership in May 2000.

The areas not shown have the same aggregations as are used for trip generation (Figure 2). Table 4 shows the base case modal split factors calculated from TTS data. The zone aggregation ensemble "gm" is used. The numbering convention is the same as for the aggregations used in trip generation (i.e. the first 1 or 2 digits are the planning district number). The total number of aggregations is 127. The factors are applied sequentially to determine the subsequent mode shares after the previous mode has been subtracted from the total. The sequence of application is

i) Other (Walk an Cycle)
ii) GO Rail
iii) Local Transit

The remaining trips are assumed to be made by automobile (Driver or passenger).

Mode split factors have to be supplied for both the origins and destinations of home to work trips. The origins and destinations are scaled to a common total, using a user specified weighting factor, prior to calculation of the split for the next mode.

Figure 3 - Zone Aggregations Used for Modal Split

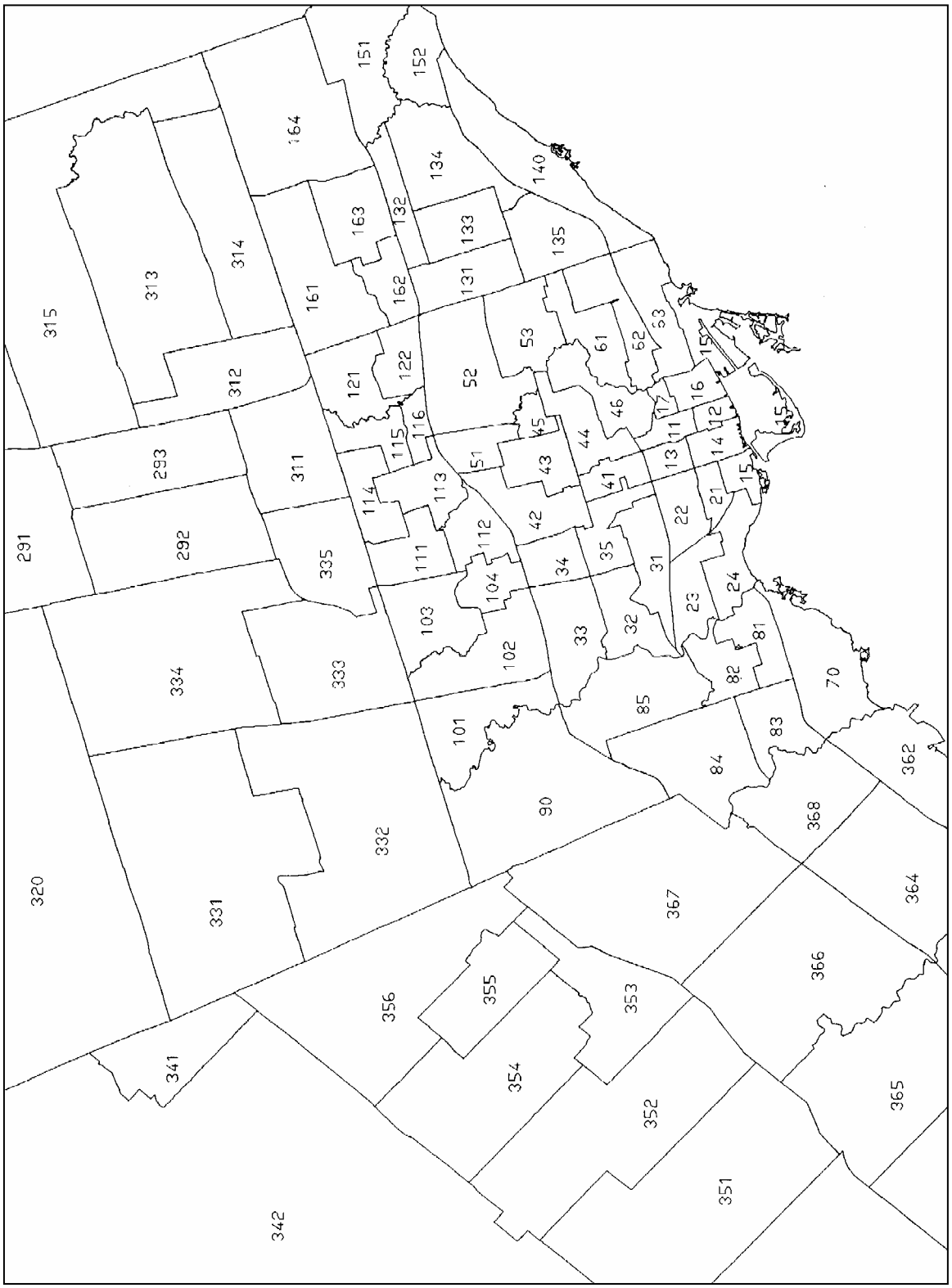

Table 4 - Mode Split Factors

Aggregation gm	group	Home to work Origins (%) Other	GO Rail 1996	GO Rail 2000	Transit	Home to work Destinations (%) Other	GO Rail 1996	GO Rail 2000	Transit
11		31.83	0.23	0.29	55.79	8.35	7.97	10.92	53.80
12		46.97	0.00	0.00	34.97	5.03	22.16	30.35	55.83
13		21.18	0.00	0.00	52.12	12.08	3.97	5.44	50.31
14		32.97	0.62	0.77	40.86	7.37	11.27	15.44	48.64
15		17.30	0.00	0.00	41.46	4.54	2.96	4.05	17.42
16		35.13	0.52	0.64	46.55	7.65	4.78	6.55	31.71
17		22.32	0.38	0.46	56.13	13.31	3.48	4.77	38.59
21		14.05	0.29	0.36	34.76	13.83	1.50	2.05	25.53
22		9.78	0.00	0.00	44.47	8.75	0.88	1.21	28.77
23		5.89	0.00	0.00	41.83	9.39	1.13	1.55	24.01
24		5.47	0.00	0.00	36.60	9.58	0.82	1.12	29.04
31		4.38	0.14	0.17	39.26	6.02	0.00	0.00	24.30
32		3.06	0.00	0.00	33.41	4.19	0.00	0.00	16.16
33		3.19	1.58	1.95	23.53	5.73	0.70	0.96	18.53
34		9.89	0.00	0.00	30.65	2.36	0.17	0.23	24.44
35		4.54	0.00	0.00	42.35	8.11	0.26	0.35	26.50
41		7.97	0.00	0.00	30.38	11.23	0.00	0.00	32.47
42		4.18	0.00	0.00	28.77	5.43	1.25	1.71	23.61
43		6.06	0.21	0.25	37.55	6.34	1.53	2.10	32.04
44		10.07	0.12	0.15	45.45	7.23	3.07	4.21	37.37
45		0.00	0.00	0.00	12.00	5.01	0.00	0.00	22.25
46		4.52	0.00	0.00	33.23	3.66	0.00	0.00	29.06
51		0.00	0.00	0.00	30.95	0.00	0.00	0.00	21.05
52		1.52	0.56	0.69	20.66	1.40	0.00	0.00	14.32
53		3.25	0.00	0.00	27.38	2.18	0.39	0.54	14.98
61		3.66	0.15	0.18	34.39	5.89	1.27	1.74	19.51
62		6.19	0.42	0.52	45.35	10.71	1.16	1.59	27.87
63		6.00	0.37	0.46	34.02	9.60	0.85	1.16	26.70
70		3.97	5.03	6.19	18.05	4.32	0.66	0.90	9.33
81		2.98	0.51	0.62	22.59	1.93	0.38	0.51	11.90
82		2.71	0.34	0.42	23.68	2.17	0.25	0.35	21.41
83		1.06	3.23	3.97	13.33	0.58	0.15	0.21	10.04
84		2.00	0.81	0.99	17.00	2.01	0.19	0.27	6.42
85		1.58	1.14	1.40	17.77	4.28	0.74	1.02	10.46
90		1.41	2.27	2.80	18.21	1.05	0.05	0.07	7.34
101		2.64	0.86	1.05	15.28	1.07	0.00	0.00	12.34
102		1.73	0.11	0.14	24.53	2.59	0.00	0.00	12.06
103		3.66	0.00	0.00	28.50	1.45	0.00	0.00	16.31
104		7.67	0.00	0.00	27.11	0.80	0.00	0.00	12.45
111		3.05	0.00	0.00	22.47	3.59	0.00	0.00	14.48
112		1.97	0.00	0.00	23.19	3.11	0.49	0.67	15.36
113		3.87	0.47	0.58	38.59	1.73	0.82	1.12	25.79
114		2.70	0.00	0.00	30.66	3.42	0.00	0.00	18.03
115	B	1.47	1.91	2.34	23.03	2.74	0.00	0.00	11.06
116	B	1.47	1.91	2.34	23.03	2.74	0.00	0.00	11.06
121		0.69	2.28	2.80	22.93	1.58	0.24	0.33	10.06
122		1.60	0.79	0.97	27.30	2.02	0.46	0.64	10.33
131		2.23	0.59	0.72	24.11	1.84	0.00	0.00	14.76
132		1.31	1.34	1.64	32.83	1.07	0.59	0.81	15.40
133		1.45	1.04	1.28	26.49	2.32	0.31	0.43	13.51
134		1.23	4.33	5.33	22.76	4.80	0.39	0.53	15.59
135		2.08	0.78	0.96	41.48	2.80	0.44	0.60	17.54
140		2.35	4.81	5.92	22.79	5.40	1.63	2.24	10.33
151		1.45	6.25	7.69	14.67	2.49	0.46	0.63	6.29

Table 4 (Cont.) - Mode Split Factors

Aggregation		Home to work Origins (%)				Home to work Destinations (%)			
gm	Group	Other	GO Rail 1996	GO Rail 2000	Transit	Other	GO Rail 1996	GO Rail 2000	Transit
152		1.85	5.96	7.33	22.00	3.89	0.80	1.09	7.19
161		1.23	1.33	1.63	25.17	1.53	0.00	0.00	10.91
162		2.04	0.67	0.82	24.35	1.43	0.00	0.00	17.28
163		1.55	2.83	3.49	24.43	1.07	0.19	0.26	13.71
164		0.74	1.24	1.53	23.18	0.96	0.00	0.00	9.91
170	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
180	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
190	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
200		1.03	9.59	11.79	2.62	1.81	0.32	0.44	1.31
210		1.50	10.71	13.17	2.55	3.01	0.20	0.28	2.58
221		1.47	9.73	11.96	2.04	1.37	0.95	1.30	2.00
222		0.94	7.19	8.84	1.46	2.61	0.48	0.65	0.76
231		4.32	4.25	5.22	3.21	3.34	0.24	0.33	2.01
232		2.64	4.09	5.03	1.70	5.56	0.42	0.57	1.37
240	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
250	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
260	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
270		1.75	3.05	3.76	2.99	2.04	0.00	0.00	1.50
280		1.51	3.43	4.22	4.17	3.22	0.00	0.00	0.97
291		0.85	1.72	2.12	6.14	0.00	0.00	0.00	0.00
292		1.69	3.39	4.17	11.54	2.50	0.24	0.33	4.82
293	C	0.87	3.50	4.31	4.35	0.82	0.17	0.23	3.35
300	C	0.87	3.50	4.31	4.35	0.82	0.17	0.23	3.35
311		1.25	1.82	2.24	13.62	1.81	0.00	0.00	6.89
312		0.00	1.98	2.44	3.14	0.35	0.00	0.00	5.79
313		0.81	3.72	4.57	4.80	1.73	0.00	0.00	2.45
314		0.57	1.52	1.87	15.07	0.24	0.00	0.00	5.44
315		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320		0.91	1.38	1.70	0.47	2.20	0.00	0.00	0.00
331		0.00	2.13	2.62	2.17	0.00	0.00	0.00	5.77
332		0.91	0.64	0.79	5.51	1.27	0.00	0.00	4.03
333		0.00	0.00	0.00	20.00	0.24	0.00	0.00	5.97
334		0.69	2.42	2.98	3.19	1.29	0.00	0.00	1.39
335		0.62	0.78	0.96	14.87	1.70	0.00	0.00	11.65
341	A	3.11	0.41	1.00	1.50	3.87	0.01	0.01	1.60
342	A	3.11	0.41	3.00	1.50	3.87	0.01	0.01	1.60
351	D	1.39	3.26	3.50	4.31	1.73	0.00	0.00	2.95
352	D	1.39	3.26	4.01	4.31	1.73	0.00	0.00	2.95
353	D	1.39	3.26	4.01	4.31	1.73	0.00	0.00	2.95
354	D	1.39	3.26	4.01	4.31	1.73	0.00	0.00	2.95
355	D	1.39	3.26	4.01	4.31	1.73	0.00	0.00	2.95
356	D	1.39	3.26	4.01	4.31	1.73	0.00	0.00	2.95
361		1.12	13.34	16.41	4.21	3.60	0.66	0.90	2.43
362		2.28	7.16	8.80	6.06	2.96	0.41	0.56	5.33
363		1.14	9.67	11.89	6.13	2.12	0.21	0.29	3.98
364		1.28	5.75	7.07	11.73	1.56	0.21	0.29	5.62
365		1.04	6.51	8.00	3.18	1.57	0.09	0.13	2.82
366		0.26	5.30	6.51	6.13	0.47	0.00	0.00	4.15
367		1.36	1.02	1.25	10.62	0.45	0.06	0.08	4.84
368		1.21	2.23	2.75	11.41	2.32	0.16	0.22	6.39
370		1.79	3.02	3.72	0.55	3.86	0.00	0.00	0.00
380		3.62	3.95	4.86	0.69	3.57	0.00	0.00	0.00
390		1.56	13.44	16.53	1.88	1.87	1.04	1.42	1.56
400		1.51	5.41	6.65	1.37	1.58	0.07	0.09	1.74
410	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
420		5.22	1.04	1.27	1.73	10.47	0.00	0.00	4.59
430	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
440	A	3.11	0.41	0.51	1.50	3.87	0.01	0.01	1.60
450		0.98	0.83	1.02	1.39	1.49	0.00	0.00	2.37
461		2.80	0.62	0.76	6.22	4.72	0.00	0.00	4.98
462		3.46	0.69	0.85	9.21	5.53	0.00	0.00	7.00

Table 4 (Cont.) - Mode Split Factors

Aggregation gm	Group	Home to work Origins (%) Other	GO Rail 1996	GO Rail 2000	Transit	Home to work Destinations (%) Other	GO Rail 1996	GO Rail 2000	Transit
463		14.45	1.15	1.41	10.53	8.63	0.20	0.28	10.20
464		13.98	0.00	0.00	5.83	2.49	0.00	0.00	2.31
500		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		3.52	2.44		13.61	3.54	2.46		13.73
	Group								
	A	3.11	0.41		1.50	3.87	0.01		1.60
	B	1.47	1.91		23.03	2.74	0.00		11.06
	C	0.87	3.50		4.35	0.82	0.17		3.35
	D	1.39	3.26		4.31	1.73	0.00		2.95

Zone aggregations for which there are insufficient data in the TTS database have been grouped together as shown by the letters in the group column. The same base case value is used for all the aggregations with the same letter.

1.3 Trip Distribution

Home-to-work trips are distributed by two-dimensional balancing of a "base" matrix to the desired origin and destination zone totals for each of the three modes (auto, GO Rail and local transit). The non-work auto and local transit school trips are distributed by scaling the rows in the applicable "base" matrix to the desired origin totals. The input "base" matrices are not trip matrices. They define an initial probability distribution that is comparable in its role to the impedance component of a gravity model function. The matrices have been derived from the 1996 TTS data and have the following characteristics:

a) When the balancing process is applied to the TTS trip end totals the resulting matrix has an almost identical trip distribution pattern to the TTS data at an aggregate level (e.g.: PD to PD)
b) The observed TTS trip length distribution is closely maintained.
c) The matrices for the auto mode have non-zero values in every row and column. The GO Rail and transit matrices may have zero row and column totals in those areas that currently have no observed ridership (TTS) even at an aggregate level (e.g. Planning District).

Table 5 compares the TTS, the "base" matrices and the resulting simulations with respect to the number of non-zero cells in the trip distribution for each combination of mode and trip purpose. The total number of cells in each matrix is approximately 2.9 million (1703 x 1703). Most of the non-zero cell values in the TTS trip matrices are single observations representing an expanded total of approximately 20 trips (5% sample). The base matrices only have zero values in those areas where there are no observed trips at a more aggregate level (mostly planning district to planning district). The underlying assumption in accepting these zero values is that if there are no trips today, the number of trips is not likely to become significant in the foreseeable future. Bucket rounding greatly reduces the number of non-zero cells in the simulated matrix. Row and/or column totals will be zero for those zones that have a forecast population or employment of zero.

Table 5 - Trip Distribution Matrices

	No. of Trips (1996 TTS)	Number of non zero cells		
		TTS	Base Matrix (Possible O-D pairs)	1996 Simulation (Test 30/9/99)
Home to work auto	1,098,542	42,353	1,715,141	394,111
Home to work GO Rail	39,278	1,574	108,505	15,788
Home to work transit	209,285	8,585	443,790	95,134
Non work auto	577,125	16,671	862,276	170,806
Local transit school	125,659	4,279	148,037	40,682

Stage 2 of the model adjusts the home to work auto distribution to reflect expected changes in level of service. The method of adjustment is described in section 1.5.

1.4 Auto Assignment

Prior to assignment the matrices for the different trip purposes are aggregated. An auto occupancy matrix is used to calculate the number of auto vehicles (auto drivers). The base case auto occupancy factors are shown in Table 6. The factors are the number of auto drivers plus passengers divided by the number of auto drivers in the TTS data. The occupancy factors have been calculated using the same zone aggregations as for trip generation. The boxed in sections denote areas that have been further aggregated to obtain sufficient observations for statistical reliability. Shading is used to denote non-adjacent cells that have been aggregated together. The general criterion for aggregation is to have a minimum expanded total of 5,000 trips within each aggregation. The TTS does not include trip data for persons under the age of 11. Since these people are, of necessity not auto drivers; the occupancy factors are lower than those one would expect to observe on street are.

The total auto vehicle matrix also includes the auto vehicle trips specified in a supplementary auto driver matrix. The supplementary matrix may be adjusted selectively by destination zone or by application of a global factor. At the present time this matrix consists of observed (TTS) auto driver access/egress trips to and from GO Rail and subway stations. The matrix can be modified, in the future, to represent other trips not included in the basic model. Two other potential uses are:

a) The addition of vehicle trips to, from and between the three external cordon stations (401 East of Port Hope, 401 West of Cambridge and the Peace Bridge in Fort Erie)
b) The addition of an auto equivalency matrix representing projected truck movements.

The A.M. peak period auto driver matrix is converted to an A.M. peak hour by applying factors based on 1996 auto travel times. The formula is defined by specifying two points that define lower and upper bounds of travel time and the ratio of peak hour to peak period trips at each of those travel times. The ratio associated with the lower bound is applied to all trips of shorter duration than the lower bound. The ratio associated with the upper bound is applied to all trips of longer duration than the upper bound. The transition between the two points is assumed to be linear. Recommended values, based on the 1996 TTS data are 21 minutes with an associated factor of 0.46 for the lower bound and 53 minutes, with an associted factor of 0.3, for the upper bound. The use of a factor of less 0.33 for the upper bound reflects the higher loadings that are on the network at 9 a.m. relative to 6 a.m.. The resulting accumulation of "incomplete" trips is most notable for long trips (over 45 minutes duration).

The model includes options to stratify the auto driver matrix into separate matrices representing 1, 2 and 3 plus auto occupancy and to estimate the number of new high occupancy vehicles that might be formed as a result of exclusive high occupancy vehicle lanes. These procedures are described in section 1.6.

The model calibration and validation have been performed using tangential volume delay functions. The emme2bank includes volume delay functions to represent the time equivalent of tolls on Highway 407. The implied value of travel time (currently $24 per hour) is based on previous experience in applying the model.

1.5 Trip Length Adjustment

In stage 2 of the model the home to work auto trip distribution is modified to reflect projected changes in level of service on the road network. Simulated travel times for single occupant vehicles from the initial trip distribution are compared with the base year (1996) travel times. An elasticity factor is applied to increase, or decrease, the "impedance" value for each cell in the base matrix used as input to the trip end balancing procedure. The result of the adjustment is to produce an increase in the number of trips between origins and destinations where there is a projected improvement in travel time relative to origins and destinations where travel time is projected to increase. The sensitivity of the adjustment is controlled by a coefficient the default value of which (0.03) has been set based on experience testing the model The default value will produce a trip length distribution that lies approximately midway between one having the

same mean trip length distance and one having the same mean travel time as the observed 1996 trip distribution.

1.6 HOV assignment

The model includes routines to perform an HOV assignment and to estimate the number of new HOVs that might be formed as a result of potential timesavings. Both routines require a road network that has each HOV lane coded as a separate series of nodes and links from the general use lanes. General use links require the mode codes "i" and "j" in addition to the mode code "c". Links restricted to vehicles with two or more occupants require the mode code "i" in addition to the mode code "c". Mode code "c" should be the only auto mode on links restricted to vehicles with 3 more occupants.

The first step in the HOV assignment procedure is to stratify the total auto vehicle matrix into 3 matrices representing 1 occupant, 2 occupant and 3 plus occupant vehicles. The stratification formulae are:

$P_2 = 0.77(1- x)$

$P_3 = 0.105(1 - x)$

Where

x = mean auto occupancy used to convert auto person trips to auto vehicles (Table 6).

P_2 is the proportion of automobiles with two occupants

P_3 is the proportion of automobiles with three or more occupants.

The coefficients have been calibrated to provide a distribution that matches the auto occupancy distribution observed across 31 selected screen lines in the GTA. The observed distribution was obtained from available 1995 and 1996 Cordon Count information for the p.m. peak period. The implied auto occupancy, calculated from the distribution, will be higher than that shown in Table 6 since the calibration takes into account the exclusion of persons under the age of 11 from the other components of the model. The coefficients may be modified if desired and are different from the recommended values for use in the p.m. peak period.

A multiclass assignment produces separate link volumes and travel time matrices for each of the three categories of vehicle (1 person, 2 persons and 3 plus persons). A second procedure uses the difference in travel times between the three categories to estimate the number of new HOVs that might be formed. A factor of .01 is applied to convert both 1 and 2 occupant vehicles to 3 occupant vehicles for each minute of time saving. The factor of .01 (1%) is representative of the observed experience when carpool lanes were first introduced on the Shirley highway in Washington D.C. The factor may be modified to reflect local experience. A second multiclass assignment completes the procedure by assigning the remaining low occupancy vehicles (1 and 2 person). The HOVs are assigned as two classes (original and new).

Table 6 - Base Case Auto Occupancy Factors

Mean auto occupancy - am peak period

	PD1-Metro	PD2-Metro	PD3-Metro	PD4-Metro	PD5-Metro	PD6-Metro	PD7-Metro	PD8-Metro	PD9-Metro	PD10-Metro	PD11-Metro	PD12-Metro	PD13-Metro	PD14-Metro	PD15-Metro	PD16-Metro
PD1-Metro	1.22	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD2-Metro	1.25	1.34	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD3-Metro	1.25	1.20	1.39	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD4-Metro	1.25	1.20	1.20	1.34	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD5-Metro	1.25	1.20	1.20	1.20	1.43	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD6-Metro	1.25	1.20	1.20	1.20	1.20	1.31	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD7-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.42	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD8-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.37	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD9-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.39	1.20	1.20	1.20	1.20	1.20	1.20	1.20
PD10-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.37	1.20	1.20	1.20	1.20	1.20	1.20
PD11-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.41	1.20	1.20	1.20	1.20	1.20
PD12-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.46	1.20	1.20	1.20	1.20
PD13-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.33	1.20	1.20	1.20
PD14-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.42	1.20	1.20
PD15-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.53	1.20
PD16-Metro	1.25	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.52
Brock	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Uxbridge	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Scugog	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Pickering	1.19	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Ajax	1.19	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Whitby	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Oshawa	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Clarington	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Georgina	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
East Gwillimbury	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Newmarket	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Aurora	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Richmond Hill	1.19	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
Whit.-Stouff.	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Markham	1.19	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14
King	1.19	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Vaughan	1.19	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
Caledon	1.20	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Brampton	1.20	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Mississauga	1.20	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
Halton Hills	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Milton	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Oakville	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Burlington	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Flamborough	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Dundas	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Ancaster	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Glanbrook	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Stoney Creek	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Hamilton	1.18	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Total	1.23	1.21	1.22	1.25	1.23	1.22	1.20	1.21	1.16	1.19	1.25	1.18	1.21	1.34	1.31	1.26

Note: Auto occupancy figures exclude passengers under the age of 11

Table 6 (Cont.) - Base Case Auto Occupancy Factors

Mean auto occupancy - am peak period

	Brock	Uxb.	Scu.	Pick.	Ajax	Whit.	Osh.	Clar.	Geor-gina	East Gwil.	New Mar.	Aur.	Rich. Hill	Whit.-Stouff	Mark ham	King
PD1-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD2-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD3-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD4-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD5-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD6-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD7-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD8-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD9-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD10-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD11-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD12-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD13-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD14-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD15-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
PD16-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Brock	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Uxbridge	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Scugog	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Pickering	1.14	1.14	1.14	1.38	1.14	1.14	1.14	1.14	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Ajax	1.14	1.14	1.14	1.14	1.38	1.14	1.14	1.14	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Whitby	1.14	1.14	1.14	1.14	1.14	1.31	1.14	1.14	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Oshawa	1.14	1.14	1.14	1.14	1.14	1.14	1.28	1.14	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Clarington	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Georgina	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
East Gwillimbury	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Newmarket	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.34	1.15	1.15	1.15	1.15	1.15
Aurora	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.15	1.33	1.15	1.15	1.15	1.15
Richmond Hill	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.15	1.15	1.36	1.15	1.15	1.15
Whit.-Stouff.	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Markham	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.44	1.15
King	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Vaughan	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15	1.15	1.15	1.15	1.15	1.15	1.15	1.15
Caledon	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Brampton	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Mississauga	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Halton Hills	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Milton	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Oakville	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Burlington	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Flamborough	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Dundas	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Ancaster	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Glanbrook	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Stoney Creek	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Hamilton	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Total	1.10	1.20	1.14	1.20	1.25	1.20	1.22	1.16	1.17	1.13	1.23	1.23	1.21	1.16	1.24	1.20

Table 6 (Cont.) - Base Case Auto Occupancy Factors

Mean auto occupancy - am peak period

	Vaughan	Caledon	Brampton	Mississauga	Halton Hills	Milton	Oakville	Burlington	Flamborough	Dundas	Ancaster	Glanbrook	Stoney Creek	Hamilton	Total
PD1-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.15
PD2-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.25
PD3-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.25
PD4-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.18
PD5-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.24
PD6-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.23
PD7-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.20
PD8-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.21
PD9-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.25
PD10-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.25
PD11-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.23
PD12-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.30
PD13-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.25
PD14-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.20
PD15-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.28
PD16-Metro	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.29
Brock	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.12
Uxbridge	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.16
Scugog	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.12
Pickering	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.20
Ajax	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.20
Whitby	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.19
Oshawa	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.21
Clarington	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.13
Georgina	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.15
East Gwillimbury	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.16
Newmarket	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.18
Aurora	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.17
Richmond Hill	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.21
Whit.-Stouff.	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.13
Markham	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.26
King	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Vaughan	1.32	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.21
Caledon	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.13
Brampton	1.09	1.09	1.32	1.15	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.23
Mississauga	1.09	1.09	1.13	1.29	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.22
Halton Hills	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.17
Milton	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.18
Oakville	1.09	1.09	1.09	1.09	1.09	1.09	1.28	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.19
Burlington	1.09	1.09	1.09	1.09	1.09	1.09	1.11	1.27	1.09	1.09	1.09	1.09	1.09	1.09	1.17
Flamborough	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.17	1.17	1.17	1.17	1.17	1.17	1.14
Dundas	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.17	1.17	1.17	1.17	1.17	1.17	1.18
Ancaster	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.17	1.17	1.17	1.17	1.17	1.17	1.16
Glanbrook	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.17	1.17	1.17	1.17	1.17	1.17	1.08
Stoney Creek	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.17	1.17	1.17	1.17	1.17	1.17	1.20
Hamilton	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.17	1.17	1.17	1.17	1.17	1.27	1.22
Total	1.19	1.22	1.23	1.20	1.21	1.21	1.19	1.20	1.19	1.18	1.21	1.12	1.19	1.22	1.21

1.7 Transit Assignment

The transit assignment is performed in two stages. GO Rail trips are assigned allowing the use of all transit modes. The integrated GTA network has been modified to include auxiliary transit access links (mode z) between the nodes that represent the GO Rail stations and all of the zone centroids within that stations catchment area. These centroid connectors must be added to any new transit network that is created. The assignment procedure does not "force" trips on to GO Rail if the network provides a more attractive alternative using local transit. The assigned GO Rail volumes may therefore be slightly less than the volumes obtained from the mode split calculations. GO Rail volumes can also be obtained by aggregating the trip matrix to station catchment area (ensemble gs). These volumes will be consistent with the mode-split calculations.

Local transit trips are assigned without permitting the use of mode r or z (GO Rail and GO Rail access). The resulting transit assignment does not include the use of local transit to provide access or egress to GO Rail stations other than in the downtown of Toronto.

A transit network is not needed for Trip Generation, Mode Split and Trip Distribution. The model can therefore be used to analyse future transit demand on an existing network without the need for detailed specification of future service levels on every route. The scenario used for the transit assignment is specified separately from the scenario used for the road assignment. A single integrated network can be used for both assignments or two separate networks can be used. The latter is strongly recommended for most applications.

The transit assignment macro contains the following values for the parameters that have to be specified in order to perform a transit assignment. The same values are used for both the GO rail and local transit components.

Source for effective headways = actual line headways with maximum (option 2)
Maximum effective headway = 15
Source for boarding times = same value for entire network (option 1)
Boarding time = 2
Source for wait time factors = same value for entie network (option 1)
Wait time factor = 0.5
Wait time weight = 2
Auxilliary transit time weight = 1
Boarding time weight = 1

Changing the above values is unlikely to have a significant effect on the assigned volumes but may change the computed travel costs (not saved).

2.0 Validation

Validation of the model consists primarily of comparisons between a 1996 "Base Case" simulation, the 1996 TTS data and available cordon count information. The network used for calibration and validation is the 1996 integrated network developed at the DMG. The validation is documented in full in the "GTA Simplified Model, Version 3.0, Users' Manual" dated October 1998. Sections 2.1 through 2.4 provide a summary of key findings and statistics. The networks have been updated and some of the screen line information re-coded since the validation was performed. The results shown may not be exactly reproducible using the current networks and the updated version of the model.

2.1 Land Use Data

The trip generation rates and mode split factors have been calculated using the population and employment data contained in the 1996 TTS database. The base case simulation uses, as input, population and employment estimates provided by the 6 Regional Municipalities. The population estimates provided by the Regions are based on control totals taken from the 1996 Census. Table 7 provides a comparison of the three sets of data. The total GTA population reported in the TTS is 3% lower than that given by the census. The TTS is known to under represent infants, under the age of 1, and seniors, over the age of 75, many of whom live in collective homes not included in the survey. Since neither of these two categories of people is likely to make any significant number of trips the TTS trip rates will be artificially high when applied to the total population. A global adjustment factor of .98, applied to all the population based trip generation rates, is recommended to adjust for this over representation.

Table 7 - Population Data by Region

	1996 TTS	1996 Census	Base Case
Toronto	2,305,558	2,386,213	2,386,213
Durham	450,354	458,616	458,616
York	567,689	592,445	592,445
Peel	812,512	852,526	852,526
Halton	328,264	339,875	339,875
Hamilton-Wentworth	461,990	467,799	467,799
Total GTA	4,926,367	5,097,474	5,097,474

Employed Labour Force is not calculated or used directly in the model but is clearly a factor in determining trip generation rates. Table 8 compares the TTS and Census data. The Census and TTS occurred at different times of the year, which may account for some of the differences. There may also be some difference due to definition, for example the census includes people who worked the previous week but who were not actually employed on the day of the census. No adjustments to trip rates have been made or are recommended at this time.

Table 8 - Employed Labour Force by Region

	1996 TTS	1996 Census	Difference	
Toronto	1,109,733	1,098,930	10,803	1.0%
Durham	222,151	223,900	(1,749)	-0.8%
York	280,336	297,005	(16,669)	-5.6%
Peel	424,639	437,750	(13,111)	-3.0%
Halton	171,697	180,870	(9,173)	-5.1%
Hamilton-Wentworth	211,196	210,650	546	0.3%
Total GTA	2,419,753	2,449,105	(29,352)	-1.2%

Table 8a provides a comparison of employment data. The same comments, with respect to timing and definitions, apply as for the employed labour force. In addition the TTS employment figures do not include workers who live outside the TTS area. The only Region where that is likely a significant factor is Hamilton-Wentworth due to the close proximity of Brant County and Haldimand-Norfolk. The base case employment estimates are close to the census but the TTS data may provide better representation of traffic conditions in the fall. Consideration should be given to time of year for which simulation is desired when applying the model. If the employment estimates are derived from census data it may be appropriate to apply a global factor to increase the TTS employment base trip rates in order to fully represent transportation demand in the fall. No adjustment was applied in the current validation.

Table 8a - Employment by Region

	1996 TTS	1996 Census	Base Case
Toronto	1,257,005	1,209,010	1,213,270
Durham	149,552	148,545	141,110
York	275,724	267,550	268,690
Peel	389,275	390,755	392,545
Halton	141,390	148,275	148,835
Hamilton-Wentworth	181,219	183,615	184,135
Total GTA	2,394,165	2,347,750	2,348,585

2.2 Trip Generation, Mode Split and Distribution

Applying the TTS home to work trip rates to the base case land use produces an origin trip total, based on 1996 census population, that is 2.9% higher than the destination total based on 1996 census employment. Application of the global adjustment factors that are suggested in section 2.1 would reduce the adjustment that is needed to balance the trip end totals.

Table 9 - Trip Totals and Travel Time Distributions

Trip Category	1996 TTS data			1996 Base Case Simulation		
	Total trips	Minutes by road		Total trips	Minutes by road	
		Mean	S.D		Mean	S.D
Local transit work trips	209,285	19.2	13.8	205,246	19.3	12.7
GO Rail work trips	39,278	51.6	18.5	37,581	50.3	16.4
Total Auto Driver	1,417,878	18.7	17.5	1,436,401	19.0	17.9

Table 9 compares the simulated trip total in each trip category. The mean and standard deviation of trip time shown have been generated using the travel matrix produced by an equilibrium assignment of the TTS data to the road network. The simulation includes trip movements to and from some areas not included in the TTS (Brant, Haldimand-Norfolk and the excluded sections of Northumberland, Peterborough, Simcoe, Dufferin and Wellington Counties). The simulated totals should therefore be slightly higher than the TTS data, particularly for the auto mode. External trips have been excluded from the calculation of the mean travel time and standard deviation in order to provide a consistent comparison.

Table 9 shows that the model is reproducing the observed (TTS) trip length distributions with a high degree of accuracy in all trip categories.

2.3 Comparison of Assignment Results

Table 10 compares the results of the base case simulation with assignments of the TTS data. The linear regression coefficients have been taken from scattergram plots. For an ideal fit the value of a should be 0 and b should be 1.

Table 10 - Comparison of Assigned Volumes

	Network Assignment	
	TTS data	1996 Base Case Simulation
Transit lines	Boardings (000's)	
Subway	252	254
GO Rail	33	33
GO Bus	30	30
Municipal bus	382	389
Streetcar	42	43
Segment volumes	Passenger km (000's)	
Subway	1,691	1,706
GO Rail	1,007	1,018
GO Bus	548	542
Municipal bus	1,675	1,710
Streetcar	108	109
Link volumes (auto)	Vehicle km (millions)*	
Toronto	7.81	7.64
Durham	2.09	2.38
York	3.08	3.33
Peel	4.19	4.27
Halton	2.17	2.35
Hamilton-Wentworth	1.35	1.70

* Excluding centroid connectors and local streets

The number of GO Rail boardings is slightly less than the number of GO Rail trips, as shown in Table 9, because the assignment procedure does not force people to use GO Rail if there is a faster alternative using other modes of transit. The matrix data, aggregated by station assignment, provides a more consistent basis for the analysis of GO Rail ridership than does the assignment results.

The slight over simulation of transit volumes reflects the previously discussed differences in trip totals and land use assumptions. The table shows the simulated distribution of transit trips to sub-modes and individual routes is a close match to the TTS data.

The comparison of link volumes from the auto assignments reveals a slight under simulation in Toronto and over simulation of the other regions, mostly in Halton and Hamilton-Wentworth. These differences are consistent with the differences in land use assumptions (reduced employment in Toronto) and the more complete representation of external trips.

2.4 Comparison with Cordon Counts

The link volumes from the TTS assignments and base case simulation have been extracted from emme/2 and compared with available cordon count information across the inter-regional screen lines within the GTA. Table 11 provides a summary of the total inbound and outbound movements for 4 of the 5 Regions The totals for Durham, York and Peel include trips crossing the external GTA boundary. The Peel totals

include trips to and from Halton. Each screen line is included once only in the GTA total. The cordon count volumes are the observed numbers of private automobiles for the 3-hour period from 6:30 to 9:30 a.m. across the Toronto boundary and from 6:00 to 9:00 a.m. across the other boundaries.

The comparisons show that both the TTS data and the simulation produce volumes that are slightly higher than the observed traffic volumes in the 4 regions. Part of that difference may be due to growth in traffic volumes between 1995 and 1996. The difference between the TTS and simulated volumes can be attributed to more complete representation of external traffic in the simulation.

Table 11 - Cordon Count Summary by Region

		Cordon Count	TTS Assignment	Base case Simulation	Ratios TTS/CC	Sim/TTS	Sim/CC
Toronto							
	In	215,469	248,058	256,145	121%	103%	119%
	Out	136,334	147,218	145,122	108%	98%	106%
Durham							
	In	19,506	15,940	19,178	82%	121%	99%
	Out	46,924	50,928	56,058	109%	112%	122%
York							
	In	109,151	101,768	105,824	93%	106%	99%
	Out	120,212	115,195	121,282	96%	107%	102%
Peel							
	In	128,257	133,255	137,068	104%	104%	108%
	Out	127,683	140,189	143,532	110%	101%	111%
Total GTA		518,590	524,714	544,593	101%	104%	105%

Notes

1. Durham cordon counts taken in 1996, other regions in 1995.
2. The simulation includes more complete representation of external trips than does the TTS data.

3.0 Model Operation

3.1 Initial Set-up

The recommended procedure for setting up the model is to copy the emme2bank, and the associated macros, from the directory that has been used to develop the model. The allocation of 1 Gigabyte of disk space is recommended. The emme2bank itself currently occupies 600 Megabytes of disk space.

3.2 Emme2bank

The emme2bank contains a large amount of TTS data in addition to the base information and base year network needed to run the model.

Matrices

Appendix A contains a listing of the current matrix directory. Table 13 provides a summary of the allocation of numbers by primary function.

Table 13 - Matrix Allocation Table

Matrix ID	Status	Description
Ms		
1-27	User Defined	Input parameters
28-58	Calculated	Performance Indicators
61-68	Calculated	Validation check totals
71-98	Protected	TTS Performance Indicators (for comparison)
99	Reserved	Internal use
mo/md		
1-16	User Defined	Trip rates and mode split factors
18	User Defined	Population/Employment
22-40	Calculated	Trip end totals
41-51	Calculated	Performance Indicators (by zone or link aggregation)
60-75	Protected	Base case trip rates and mode split factors
76-92	Protected	TTS data (for comparison)
97-99	Reserved	Internal use
mf		
1-8	Protected	Base case trip distribution & other matrices
9-10	User Defined	Auto occupancy & extra vehicle matrices
11-34	Calculated	Simulated trip and travel time matrices
35-40	Protected	TTS data

Zone Ensembles

A number of zone ensembles have been pre-defined or allocated for specific purposes as shown in Table 14.

Table 14 - Zone Ensembles

Letter	Description and/or use	Form	
A	Calibration of trip distribution	xx	Not used in running the model.
B	Transfer of data to Regional sub-models	xxxx	GTA zone number for zones which are to be sub-divided New zone number for zones which are to be aggregated or retained
G	Input of Trip generation Rates	xxy	xx - Planning division y - sub-division
M	Input of mode split factors	xxy	xx - Planning division y - sub-division
O	Output of matrices		User defined
P	Planning district	xx	Pre-defined (1-47)
R	Regions	x	Pre-defined (1-7)
S	GO Station catchment areas	xx	Pre-defined
Q	Output of performance indicators		User defined

Volume Delay Functions

The 1996-travel time matrix currently contained in the emme2bank was generated using tangential volume delay functions, also contained in the emme2bank. These times are used as the base reference points when modifying the auto trip distribution to reflect projected changes in level of service. If the volume delay functions are modified the 1996 travel times should be recalculated in order to achieve consistency results if the trip length adjustment procedure is to be applied..

Network Scenarios

It is recommended that a new scenario be created for each model run. Scenario 2 (TTS assignments) should be protected against accidental deletion or modification. The network differs from the network developed at the DMG in that it contains additional centroid connectors (mode z) to simulate auto access to GO stations. Scenario 2 contains the definition of extra attributes that are needed to run the model. The recommended procedure for creating a new network scenario is:

1. Copy scenario 2.
2. Delete the network information (transit lines, turn penalties, links and nodes) from the new scenario.
3. Input the new network data.
4. Add the GO access links (Input file)
5. Re-copy any extra attribute data from scenario 2 that might be needed for post assignment comparisons and analysis (deleting and re-entering the network information may have displaced the extra attribute data with respect to the links to which it is supposed to apply).

An HOV assignment requires the inclusion of modes i and j on all links where use by 1 or 2 person vehicles is permitted.

Extra Attribute Data

Table 15 lists the extra attributes that have to be defined in order to run all of the available modules.

Table 15 - Extra Attributes

Attribute	Type	Required for	Description
@lkagg	Link	Performance Indicators	User defined - current usage: x - for non centroid links within region x xy - for screen line from region x to region y
@per1	Link	HOV assignment	Assigned volume of 1 person vehicles
@per2	Link	HOV assignment	Assigned volume of 2 person vehicles
@per3	Link	HOV assignment	Assigned volume of 3+ person vehicles
@lov	Link	HOV conversion	Assigned volume of remaining LOVs

@hov	Link	HOV conversion	Assigned volume of original HOVs
@nhov	Link	HOV conversion	Assigned volume of new HOVs

3.3 Macros

The macros that run the model have been developed as independent modules. One master macro (ampk.mac) is used to call the modules in the proper sequence. Table 16 lists the macros that are currently operational.

Table 16 - Macros

Macro name	Function
amac.mac	Calls the other macros in the required order
amac0	Selects scenario and sets ID
amac1	Updates matrix input data using an external file
amac2	Work to home trip generation, mode split and distribution
amac4	Non work trip generation and distribution. Matrix aggregation
amac5	Transit assignment
amac6	Road assignment - (no consideration of HOV lanes)
amac7	Performance Indicator and trip end summary report
amac8	Modal split and auto performance report
amac9	Link aggregation report
amac10	Trip length adjustment
amac11	Road assignment with HOV lanes
amac12	Generation of new HOVs

The master macro "ampk.mac" can be edited to include only those macros that are required for a given run. The majority of the macros need to be run in numerical order but do not necessarily have to be run as a single batch process provided that no modifications are made to the emme2bank between runs. The macro "amac0" must be called as the first macro in every run. Output files that need to be saved should be renamed before running the next stage otherwise they will be deleted when the next stage is initiated. The last two report macros, "amac8" and "amac9", may be repeated after the trip length adjustment and/or HOV assignment to obtain before and after summaries.

The macro "amac0" requires three calling arguments defined in the master macro (ampk.mac). Those arguments are:

Arg1 The name used to identify the run (Max 6 alphanumeric characters with no spaces)
Arg2 The emme/2 scenario number to be used for the road assignment
Arg3 The emme/2 scenario number to be used for the transit assignment

Arg2 and Arg3 can have the same value if an integrated road and transit network is available. Arg3 may be omitted if neither of the macros "amac5" (transit assignment) nor "amac7" (performance indicators) are to be run.

The macro "amac1" reads matrix input data contained in the file "x.set", where "x" is the first argument (Arg1) used to call "amac0". The set file may be used to selectively modify the simulation parameters (ms01 through ms26), population (mo18), employment (md18), trip generation rates (mo1, mo3, mo5, and md2) and mode split factors (. Trip generation rates and mode-split factors, if included in the file, may be defined for individual zones or by zone groups contained in any existing zone ensemble.

The master macro "ampk.mac" can be edited to include only those macros that are required for a given run. The easiest way to disable one of the sub-macros is to insert a "/" as the 2nd character of the call line thus making it into a comment line. The HOV and non-HOV road assignment macros are interchangeable depending on whether or not an HOV assignment is required.

The following is a sample listing of the macro (pmpk.mac) required to run the full model including trip length adjustment and an HOV assignment with the generation of new HOVs based on projected time savings.

```
Pmd                      User ID
~<amac0 99base 1999 96   Set run ID and select scenarios
~<amac1                  Import new parameters
~<amac2                  home to work trips
~<amac4                  Non work & total trip
~<amac5                  Transit assignment
~<amac6                  Initial road assignment
~<amac7                  Global Indicators & trip end summary
~<amac8                  Modal split and auto performance report
~<amac9                  Link performance report
~<amac10                 Trip length adjustment
~<amac11                 HOV assignment
~<amac12                 New HOV formation & assignment
~<amac8                  Revised auto performance report
~<amac9                  Revised link performance report
q                        Quit
```

The following command line will execute the above macro in batch mode.

```
emme2 -m ampk.mac batch >&filename&
```

Where "filename" is a temporary file used for output of the internal emme2 dialog.

3.4 Input Data

The basic inputs required for a model run are a network and land use data (population and employment) by zone. The population data must be stored, or input, as origin matrix mo18 and the employment data as destination matrix md18. Revisions to the land use data, trip rates, mode split factors and other input parameters may be included in the "set" file read by the macro amac1. The name of the file used must be of the form aaaaaa.set where aaaaaa is the run identification code (maximum 6 characters) used to identify the matrices and output files. The file must be in the standard batch entry format for emme2 with "t matrices" as the first line. Table 17 provides a list of the other input parameters that can be modified together with recommended values for the years 1996, 1999, 2001, 2011 and 2021.

3.5 Modification of Trip Generation Rates and Mode Split Factors

The base trip generation rates and mode split factors may be modified in one of the following ways prior to running the model.

1. Application of global adjustment factor(s). (See table 17)
2. Matrix calculations to adjust the base case data. The protected matrix data may be used as input. See appendix A to determine the approproate matrix or matrices in which to store the results. Zone groupings may be used to perform selective calculations.
3. Importing new rates or factors to the required matrices.

3.6 Trip Distribution

There is no provision for modification of the trip distribution procedures or parameters other than the stage-2 trip length adjustment as described in section 1.5. The value of the parameter "ms23" controls the amount of trip length adjustment.

Table 17 - Recommended "Base Case" Input Parameter Values

ms	Description	1996	1999	2001	2011	2021
1	Work trip origin factor	0.98	1	1.01	0.96	0.89
2	Work trip destination factor	1	1	1	1	1
3	Auto non work origin factor	0.98	1	1.01	1.13	1.18
4	Transit school origin. factor	0.98	0.98	0.98	0.98	0.98
5	Work trip generation origin weight	1	1	1	1	1
6	Work trip other m/s factor	1	1	1	1	1
7	Work trip GO Rail m/s factor	1	1	1	1	1
8	Work trip transit m/s factor	1	1	1	1	1
9	Origin balance weight - other mode	0.5	0.5	0.5	0.5	0.5
10	Origin balance weight - GO Rail	0.3	0.3	0.3	0.3	0.3
11	Origin balance weight - Local Transit	0.5	0.5	0.5	0.5	0.5
12	GO Rail non work factor	1.07	1.07	1.07	1.07	1.07
13	Local transit excluded factor	1.06	1.06	1.06	1.06	1.06
14	Auto occupancy adjustment factor	1	1	1	1	1
15	Peak hour factor below lower bound	.45	.45	.45	.45	.45
16	Peak hour factor above upper bound	.30	.30	.30	.30	.30
17	Peak hour factor lower bound (mins)	21	21	21	21	21
18	Peak hour factor upper bound (mins)	51	51	51	51	51
19	Background traffic factor	1	1.1	1.15	1.45	1.75
23	Trip length adjustment coefficient	0.03	0.03	0.03	0.03	0.03
24	2 person hov coefficient	1.01	1.01	1.01	1.01	1.01
25	3 person hov coefficient	0.16	0.16	0.16	0.16	0.16
26	hov conversion factor	0.01	0.01	0.01	0.01	0.01

The above factors include adjustments to correct for the under-reporting of population in the TTS relative to the Census. The rationale for the above factors (See appendix C) was developed in conjunction with version 1 of the a.m. peak model.

Factors that need to be considered when defining or modifying the above assumptions

- Bias in the TTS
- Ageing of the population
- Strength of the economy
- Socio-economic trends
- Technology
- Level of service & cost (Transit)
- Cost of driving
- Auto availability
- Driver licensing
- School bus policies
- Environmental policies
- Peak spreading

3.7 Adjustment of Auto Occupancy and Extra Auto Driver Trips

The auto occupancy matrix may be adjusted in the following ways.

1. Application of a global adjustment factor.
2. A matrix calculation using the protected copy of the base case matrix as input
3. Importing a new matrix

3.8 Adjustment of supplementary auto vehicle matrix

The supplementary auto vehicle matrix may be adjusted in the same ways as the vehicle occupancy matrix or destination specific adjustment factors can be applied using the appropriate destination matrix (see appendix A).

3.9 Other Adjustment Factors

Other factors that can be adjusted prior to a model run are:

1. The weight assigned to the origin trip total relative to the destination total.
2. The weight assigned to the origin trip totals by mode relative to the destination total for the same mode.
3. GO Rail non work factor
4. Excluded transit factor

Refer to Appendix A in order to identify the appropriate matrix scalars.

3.10 Model Outputs

The primary outputs from a simulation run are the trip matrices and network assignments. Analysis of the results is possible within emme/2 or selected data may be exported for external analysis. Assignment results will remain in the emme2bank until the applicable scenario is deleted, modified or used for another model run. Subsequent model runs will over write matrix information. Other output information that can be obtained from each model run includes the following reports: These reports are contained in the file "arg1".rep where "arg1" is the first calling argument in the macro "amac0".

1. A report listing the values of all the matrix scalars. This report can be used as a permanent record of the input parameters, control totals, calculated trip totals and global performance indicators. The report is generated by the macro "amac7"

2. The following totals for each zone group defined in zone ensemble "gq"
   - Population.
   - Employment
   - Total trip origins
   - Work trip destinations
   - Non work trip destinations

   The report is generated by the macro "amac7".

3. The following trip end totals for each zone group defined in zone ensemble "gq"
   - GO Rail origins
   - Local transit origins

- Auto person origins
- Auto driver origins
- GO Rail destinations
- Local transit destinations
- Auto person destinations
- Auto driver destinations

The report is generated by the macro "amac7"

4. The following factors calculated for each zone group in zone ensemble "gq"
   - Activity rate (jobs per 1000 population)
   - Origin transit modal split (all trips)
   - Destination transit mode split (all trips)
   - Self-containment (% of all trip origins that have their destination within the same zone group).
   - Mean auto person trip time by origin based on 1996 Levels of Service.
   - Mean auto person trip time by origin based on the projected level of service given by an equilibrium assignment to a future network.
   - Mean auto occupancy by origin

   The report is generated by the macro "amac8"

5. The following totals and averages calculated for the link aggregations defined by the extra attribute "@lkagg". The link aggregations can represent screen lines, geographic areas, categories of road, or any combination of these factors.
   - Number of links
   - Total vehicle km assigned
   - Total vehicle hours assigned
   - Mean speed
   - Capacity utilisation (assigned vehicle km / vehicle km of capacity)
   - Total link volume
   - Volume to capacity ratio

   The calculation of capacity utilisation differs from volume to capacity ratio in that the length of each link in the aggregation weights the result. Capacity utilisation is the appropriate measure to use as the average for a geographic area. Volume to capacity ratio is more appropriate for screen line crossings. The report is generated by the macro "amac9".

The above reports are generated using the standard emme/2 output modules 3.12 and 3.14. There are some limitations inherent in that format.

- The emme/2 report format shows the sum, mean, minimum and maximum values at the end of each table. The mean value shown is an unweighted average of the values that appear in the table.
- Origin and destination vectors are used to store the results of the calculations for each link aggregation. The reference numbers used are incorrectly shown as zone numbers. There is no relationship to actual zones or zone system other than that a zone number must be defined as a centroid in the network in order for it to be available as a valid reference number.

Matrix and link attribute data may be exported for external analysis. Table 15 provides a list of the extra attribute data that is available in addition to the standard link attributes and assignment results. Appendix A contains a complete list of the available matrices.

Appendix A - Emme/2 Matrix Directory

Matrix Directory

Matrix:	Flags:	Modified:	Description:	Value:
ms01: hwof		01-01-18 18:16	Home to work origin factor	.98
ms02: hwdf		01-01-18 18:16	Home to work destination factor	1
ms03: anwof		01-02-20 17:02	Auto non-work origin factor	.98
ms04: trscof		01-02-20 17:02	Local transit school origin factor	.98
ms05: wkorwt		01-02-20 17:02	Work trip generation origin weight	1
ms06: wkotmf		01-02-20 17:02	Work other origin m/s factor	1
ms07: wkgomf		01-02-20 17:02	GO Rail work origin m/s factor	1
ms08: wkltmf		01-02-20 17:02	Local transit work origin m/s factor	1
ms09: wkotwt		01-04-10 09:36	Other mode origin balancing weight	.5
ms10: wkgowt		01-04-10 09:37	GO Rail origin balancing weight	.3
ms11: wkltwt		01-04-10 09:38	Local transit origin balancing weight	.5
ms12: gonwf		01-02-20 17:02	GO Rail non-work factor	1.08
ms13: ltnwf		01-02-20 17:02	Local transit non-work or school factor	1.07
ms14: auoccf		01-02-20 17:02	Auto occupancy adjustment factor	1
ms15: lowfac		01-02-20 17:02	Peak hour factor below lower bound	.45
ms16: hifac		01-02-20 17:02	Peak hour factor above upper bound	.3
ms17: lowbnd		01-02-20 17:02	Peak hour factor lower bound (mins)	21
ms18: hibnd		01-02-20 17:02	Peak hour factor upper bound (mins)	51
ms19: supfac		01-04-15 20:56	Background traffic factor	1
ms23: tladf		01-01-18 18:16	Trip length adjustment coefficient	.03
ms24: hov2p		01-01-18 18:16	2 person hov coefficient	1.01
ms25: hov3p		01-01-18 18:16	3 person hov coefficient	.16
ms26: newhov		01-01-18 18:16	new hov coefficient	.01
ms27: totpop		01-04-15 20:59	1996cn Total population	6899681
ms28: totemp		01-04-15 20:59	1996cn Total employment	3074715
ms29: ratio		01-04-15 20:59	1996cn Employment per 1000 population	445
ms30: tadt		01-04-15 21:06	1996cn Peak hour auto driver trips	604643
ms31: whtot		01-04-15 21:02	1996cn home to work total trips	1385323
ms32: hwot		01-04-15 20:58	1996cn Home to work other trips	47844
ms33: whgot		01-04-15 20:58	1996cn Home to work GO trips	36163
ms34: whtr		01-04-15 20:59	1996cn Home to work transit trip total	201932
ms35: wha		01-04-15 20:59	1996cn home to work auto trips	1099384
ms41: snwat		01-04-15 21:02	1996cn non work auto trips	573552
ms42: sltst		01-04-15 21:03	1996cn local transit school trips	126169
ms46: stadt		01-04-15 21:03	1996cn total auto person trips	1672936
ms47: stgt		01-04-15 21:07	1996cn total GO Rail trips	38906
ms48: sttt		01-04-15 21:08	1996cn total transit trips	350662
ms49: smbrd		01-04-15 21:57	1996cn subway boardings	238343
ms50: smpkm		01-04-15 21:57	1996cn subway passenger km	1643080
ms51: ssbrd		01-04-15 21:57	1996cn streetcar boardings	33607
ms52: sspkm		01-04-15 21:57	1996cn streetcar passenger km	94353
ms53: sbbrd		01-04-15 21:57	1996cn TTC bus boardings	279948
ms54: sbpkm		01-04-15 21:57	1996cn TTC bus passenger km	1187973
ms55: srbrd		01-04-15 21:57	1996cn GO Rail boardings	38614
ms56: srpkm		01-04-15 21:57	1996cn GO Rail passenger km	1190028
ms57: sgbrd		01-04-15 21:57	1996cn GO Bus boardings	30694
ms58: sgpkm		01-04-15 21:57	1996cn GO Bus passenger km	460273
ms61: uwhto		01-04-15 20:58	Unadj. Home to work origin total	1385323776
ms62: uwhtd		01-04-15 20:58	Unadj. Home to work Dest total	1376664576
ms63: uwhoo		01-04-15 20:58	unadjusted home to work other origins	4759064.5
ms64: uwhod		01-04-15 20:58	unadj. home to work other dest.	4809743
ms65: uwhgo		01-04-15 20:58	unadj. home to work GO origins	3736653
ms66: uwhgo		01-04-15 20:58	unadj. home to work GO dest.	3564852
ms67: uwhto		01-04-15 20:59	unadj. home to work transit origins	20347884
ms68: uwhtd		01-04-15 20:59	unadj. home to work transit dest.	20038656
ms70: sobbrd		01-04-15 21:57	1996cn other bus boardings	74573
ms71: sobpkm		01-04-15 21:57	1996cn other bus passenger km	454057
ms99: temp		01-04-15 22:23	assigned volume (vehicles)	150770

Appendix A - Emme/2 Matrix Directory

Matrix:	Flags:	Modified:	Description:
mo01: htwgr		01-02-20 17:02	Base Home to work generation rate
mo03: nwauto		01-02-20 17:02	Base Non-work auto origin rate
mo05: trschr		01-02-20 17:02	Base local transit school rate
mo11: htwom		01-02-20 17:02	Base Home to work other m/s
mo12: htwgm		01-02-20 17:02	Base Home to work GO Rail m/s
mo13: htwtm		01-02-20 17:02	Base Home to work Transit m/s
mo18: cenpop		01-02-20 17:02	1996 Census Population (Nov 99)
mo22: snwao		01-04-15 21:02	1996cn non work auto origins
mo23: sltso		01-04-15 21:03	1996cn local transit school origins
mo27: aut_po		01-04-15 21:03	1996cn total auto person origins
mo28: totgoo		01-04-15 21:06	1996cn total GO Rail origins
mo29: tottro		01-04-15 21:08	1996cn total transit origins
mo31: whto		01-04-15 20:58	1996cn Home to work total origins
mo32: whoto		01-04-15 20:58	1996cn Home to work other origins
mo33: whgoo		01-04-15 20:58	Home to work GO origins
mo34: whtro		01-04-15 20:59	1996cn Home to work transit origins
mo35: whao		01-04-15 20:59	1996cn Home to work auto origins
mo41: torig		01-04-15 21:57	1996cn Total origins
mo42: actrat		01-04-15 22:11	1996cn employment per 1000 population
mo43: auto_o		01-04-15 21:05	1996cn Peak hour auto driver origins
mo44: selfco		01-04-15 22:12	1996cn self containment (% of orig.)
mo45: trorms		01-04-15 22:12	1996cn origin transit m/s (%)
mo46: mt96		01-04-15 22:13	1996cn mean auto person time (96LOS)
mo47: mtequ		01-04-15 22:13	1996cn mean auto person time (equi.)
mo48: vehhr		01-04-15 22:22	1996cn assigned vehicle hours
mo49: autocc		01-04-15 22:13	1996cn mean dest. auto occupancy
mo50: caput		01-04-15 22:23	1996cn capacity utilization (%)
mo51: lkvol		01-04-15 22:23	1996cn total link volume (veh)
mo60: bhwto	/r	01-01-18 18:16	Base home to work origin rate
mo63: bnwao	/r	01-01-18 18:16	Base non work auto origin rate
mo65: bhsto	/r	01-01-18 18:16	Base home to school transit rate
mo70: bhwom	/r	01-01-18 18:16	Base home to work other origin m/s
mo71: bhwgm	/r	01-01-18 18:16	Base home to work GO Rail origin m/s
mo72: bhwtm	/r	01-01-18 18:16	Base home to work transit origin m/s
mo97: temp3		01-04-15 22:13	temp - aggregated auto time (equil.)
mo98: temp2		01-04-15 22:13	temp - auto drivers excl. extras
mo99: temp1		01-04-15 22:13	temp - aggregated auto persons
md02: hwdert		01-02-20 17:02	Base home to work dest. Rate
md11: htwom		01-02-20 17:02	Base Home to work Other m/s
md12: htwgm		01-02-20 17:02	Base+A1088 Home to work GO Rail m/s
md13: htwtm		01-02-20 17:02	Base Home to work Transit m/s
md14: bacfac		01-04-15 20:57	Background Traffic Dest. factors
md18: cenemp		01-02-20 17:02	1996 Census Employment (Nov 99)
md22: snwad		01-04-15 21:02	1996cn non work auto dest.
md23: sltsd		01-04-15 21:03	1996cn local transit school dest.
md27: aut_pd		01-04-15 21:03	1996cn total auto person dest.
md28: totgod		01-04-15 21:06	1996cn total GO Rail dest.
md29: tottrd		01-04-15 21:08	1996cn total transit dest.
md31: whtde		01-04-15 20:58	1996cn Total work destinations
md32: whotd		01-04-15 20:58	1996cn Home to work other destinations
md33: whgod		01-04-15 20:59	Home to work GO destinations
md34: whtrd		01-04-15 20:59	1996cn Home to work transit destinations
md35: whad		01-04-15 20:59	1996cn Home to work auto destinations
md41: nolink		01-04-15 22:22	1996cn number of links
md42: tdest		01-04-15 21:57	1996cn Non-work destinations
md43: auto_d		01-04-15 21:05	1996cn Peak hour auto driver dest.
md45: trdems		01-04-15 22:12	1996cn destination transit m/s (%)
md48: vehkm		01-04-15 22:22	1996cn assigned vehicle km (links)
md49: mspeed		01-04-15 22:22	1996cn mean link speed (kph)
md51: vcrat		01-04-15 22:23	1996cn volume/capacity ratio
md61: bhwd	/r	01-01-18 18:17	Base home to work destination rate
md70: bhwdm	/r	01-01-18 18:17	Base home to work other dest. m/s
md71: bhwgdm	/r	01-01-18 18:17	Base home to work GO Rail dest. m/s
md72: bhwtdm	/r	01-01-18 18:17	Base home to work transit dest. m/s
md98: temp2		01-04-15 22:12	temp - transit (agg)
md99: temp1		01-04-15 22:12	temp - auto + Go + Transit (agg)

Appendix A - Emme/2 Matrix Directory

Matrix:	Flags:	Modified:	Description:
mf01: aubase	/r	01-01-18 18:17	Auto work base distribution
mf02: gobase	/r	01-01-18 18:17	GO Rail base distribution
mf03: ltbase	/r	01-01-18 18:17	Local transit base distribution
mf04: nwbase	/r	01-01-18 18:17	Auto non work base distribution
mf05: scbase	/r	01-01-18 18:17	Local transit school base distribution
mf06: autacc	/r	01-01-18 18:17	TTS auto driver access
mf07: 96time	/r	01-01-18 18:18	1996 auto travel time
mf08: autocc	/r	01-01-18 18:18	Base case auto occupancy
mf09: bauacc		01-01-18 18:18	Base case auto access
mf10: autocc		01-01-18 18:18	Auto occupancy
mf11: swhg		01-04-15 21:00	1996cn home to work GO rail
mf12: swht		01-04-15 21:01	1996cn home to work transit
mf13: swha		01-04-15 21:01	1996cn home to work auto
mf14: snwa		01-04-15 21:02	1996cn non work auto
mf15: sltst		01-04-15 21:02	1996cn local transit school
mf16: stad		01-04-15 21:03	1996cn total auto person
mf17: stg		01-04-15 21:06	1996cn total GO Rail
mf18: stt		01-04-15 21:07	1996cn total transit
mf21: timall		01-04-15 21:57	1996cn auto travel times
mf22: newhov		01-01-18 18:18	96base LOV converted to HOV
mf23: remlv		01-01-18 18:18	96base Remaining LOV after diversion
mf24: t1per		01-01-18 18:18	96base 1 person vehicles
mf25: t2per		01-01-18 18:18	96base two person vehicles
mf26: t3per		01-01-18 18:18	96base 3 plus person vehicles
mf27: tadt		01-04-15 21:04	1996cn Peak hour auto driver trips
mf28: spltf		01-01-18 18:18	Split matrix
mf29: rvwkbs		01-02-20 17:53	adjusted base work driver
mf30: dist		01-01-18 18:19	Straight line distance (km)
mf31: temp		01-04-15 21:01	temp home to work auto
mf32: tim1		01-01-18 18:19	96base Travel times for 1 person veh.
mf33: tim2		01-01-18 18:19	96base Travel times for 2 person veh.
mf34: tim3		01-01-18 18:19	96base Travel times for 3+ person veh.
mf35: autowk	/r	01-01-18 18:19	1996 TTS auto work

Appendix B - Sample Printout of Performance Indicators

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EMME/2 Module:  3.14       Date: 01-04-15 21:57       User: E145/DMG.UTYU..pmd           Page: 4124
 Project:        City of Mississauga
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 MATRICES BY ZONE GROUPS
 ***********************


 Data matrices:         mo18: cenpop    1996 Census Population (Nov 99)          (01-02-20 17:02)
                        md18: cenemp    1996 Census Employment (Nov 99)          (01-02-20 17:02)
                        mo41: torig     1996cn Total origins                     (01-04-15 21:57)
                        md31: whtde     1996cn Total work destinations           (01-04-15 20:58)
                        md42: tdest     1996cn Non-work destinations             (01-04-15 21:57)

 Constraint matrix:     none

 Ensemble:              gq: Mississauga Aggregations                             (01-02-16 12:46)
 Aggregation:           sum

 Submatrix:             all zones


   zone      mo18      md18      mo41      md31      md42
  group    cenpop    cenemp     torig     whtde     tdest

   gq01     43170     13265     17900      7074      5500
   gq02     31625      8390     13667      4652      7229
   gq03     64335     18600     27679     10724      8446
   gq04    195940     63605     82759     35458     21156
   gq05     89995     32270     40917     19681     12300
   gq06     77915     26665     34288     18030      7201
   gq07     39190    119290     18244     71065      9664
   gq08    266745     96475    111374     53075     31803
   gq09     39670     13445     16766      7775      3982
   gq11    152210    368310     58586    238557     45757
   gq12    325600    157850    128728     92906     49476
   gq13   1943805    701940    756897    401957    255202
   gq14    127345     56905     56536     32239     20958
   gq15    209370     91430     87295     50469     26003
   gq16    529835    252470    226764    151927     73260
   gq17    454320    148145    175109     76669     57355
   gq18    462450    184050    155523     96756     58199
   gq19   1846161    721610     76012     16309      6230

    sum   6899681   3074715   2085044   1385323    699721
    avg    383316    170818    115836     76962     38873
    min     31625      8390     13667      4652      3982
    max   1943805    721610    756897    401957    255202
```

Appendix B - Sample Printout of Performance Indicators

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EMME/2 Module:  3.14       Date: 01-04-15 21:58       User: E145/DMG.UTYU..pmd           Page: 4125
Project:        City of Mississauga
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MATRICES BY ZONE GROUPS
**********************

Data matrices:         mo28: totgoo    1996cn total GO Rail origins             (01-04-15 21:06)
                       mo29: tottro    1996cn total transit origins             (01-04-15 21:08)
                       mo27: aut_po    1996cn total auto person origins         (01-04-15 21:03)
                       mo43: auto_o    1996cn Peak hour auto driver origins     (01-04-15 21:05)
                       md28: totgod    1996cn total GO Rail dest.               (01-04-15 21:06)
                       md29: tottrd    1996cn total transit dest.               (01-04-15 21:08)
                       md27: aut_pd    1996cn total auto person dest.           (01-04-15 21:03)
                       md43: auto_d    1996cn Peak hour auto driver dest.       (01-04-15 21:05)

Constraint matrix:     none

Ensemble:              gq: Mississauga Aggregations                             (01-02-16 12:46)
Aggregation:           sum

Submatrix:             all zones
```

zone group	mo28 totgoo	mo29 tottro	mo27 aut_po	mo43 auto_o	md28 totgod	md29 tottrd	md27 aut_pd	md43 auto_d
gq01	1620	862	15453	5781	55	504	11778	5254
gq02	675	776	12098	4457	24	1412	10418	4114
gq03	1862	2025	23841	8951	23	1374	17663	6338
gq04	2656	10450	69781	26054	73	4234	51931	19286
gq05	1884	1735	37256	13676	25	1201	30520	11139
gq06	1266	2064	31105	11407	0	1150	24051	8663
gq07	96	1346	16763	6302	28	3729	76828	27607
gq08	2605	6378	101890	37295	0	4249	80027	28806
gq09	47	215	16145	5982	0	208	11274	4218
gq11	82	22658	24387	9039	35387	124583	119060	38715
gq12	1683	28454	98737	36097	268	22416	119324	43946
gq13	5263	233310	514939	185997	2294	152673	496794	178681
gq14	5031	1435	49905	18983	361	1462	50886	19315
gq15	2854	1238	82308	30888	26	1063	74292	28510
gq16	3417	16988	205910	73864	21	11352	212514	75931
gq17	7104	8587	158053	56895	263	7268	124527	46818
gq18	761	12141	138381	50410	58	11730	138531	50110
gq19	0	0	75984	22565	0	54	22518	7192
sum	38906	350662	1672936	604643	38906	350662	1672936	604643
avg	2161	19481	92941	33591	2161	19481	92941	33591
min	0	0	12098	4457	0	54	10418	4114
max	7104	233310	514939	185997	35387	152673	496794	178681

Appendix B - Sample Printout of Performance Indicators

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EMME/2 Module:  3.14       Date: 01-04-15 22:01       User: E145/DMG.UTYU..pmd          Page: 4149
Project:        City of Mississauga
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MATRICES BY ZONE GROUPS
**********************

Data matrices:         mo42: actrat    1996cn employment per 1000 population    (01-04-15 21:58)
                       mo45: trorms    1996cn origin transit m/s (%)            (01-04-15 21:59)
                       md45: trdems    1996cn destination transit m/s (%)       (01-04-15 21:59)
                       mo44: selfco    1996cn self containment (% of orig.)     (01-04-15 21:59)
                       mo46: mt96      1996cn mean auto person time (96LOS)     (01-04-15 22:00)
                       mo47: mtequ     1996cn mean auto person time (equi.)     (01-04-15 22:00)
                       mo49: autocc    1996cn mean dest. auto occupancy         (01-04-15 22:00)

Constraint matrix:     none

Ensemble:              gq: Mississauga Aggregations                             (01-02-16 12:46)
Aggregation:           maximum

Submatrix:             all zones


  zone      mo42      mo45      md45      mo44      mo46      mo47      mo49
 group    actrat    trorms    trdems    selfco      mt96     mtequ    autocc

  gq01    307.00      4.81      4.09     24.89     17.72     17.59      1.22
  gq02    265.00      5.73     11.91     23.63     14.41     14.71      1.22
  gq03    289.00      7.30      7.21     26.13     18.09     18.01      1.22
  gq04    324.00     12.61      7.53     26.74     14.11     14.37      1.22
  gq05    358.00      4.24      3.78     25.23     17.63     18.07      1.22
  gq06    342.00      5.99      4.56     23.15     17.05     17.23      1.21
  gq07   3043.00      7.39      4.63     21.02     13.46     13.53      1.19
  gq08    361.00      5.75      5.04     28.68     14.46     14.94      1.22
  gq09    338.00      1.31      1.81     24.37     28.30     29.22      1.09
  gq11   2419.00     48.08     44.65     62.37     11.50       .00      1.19
  gq12    484.00     22.08     15.79     42.39     12.72     12.77      1.24
  gq13    361.00     30.96     23.42     49.80     13.94       .00      1.24
  gq14    446.00      2.55      2.77     22.51     18.79     18.36      1.19
  gq15    436.00      1.43      1.41     24.20     19.98     19.66      1.14
  gq16    476.00      7.51      5.07     21.33     20.18       .00      1.21
  gq17    326.00      4.94      5.50     27.58     22.72       .00      1.18
  gq18    397.00      8.03      7.80     33.77     16.25       .00      1.19
  gq19    390.00       .00       .24       .00     64.09       .00      1.08

   sum  11362.00    180.71    157.22    507.77    355.39    208.46     21.48
   avg    631.22     10.04      8.73     28.21     19.74     11.58      1.19
   min    265.00       .00       .24       .00     11.50       .00      1.08
   max   3043.00     48.08     44.65     62.37     64.09     29.22      1.24
```

Appendix B - Sample Printout of Performance Indicators

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EMME/2 Module:  3.14       Date: 01-04-15 22:10       User: E145/DMG.UTYU..pmd          Page: 4307
Project:        City of Mississauga
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MATRICES BY ZONES
*****************

Data matrices:         md41: nolink    1996cn number of links                  (01-04-15 22:10)
                       md48: vehkm     1996cn assigned vehicle km (links)      (01-04-15 22:10)
                       mo48: vehhr     1996cn assigned vehicle hours           (01-04-15 22:10)
                       md49: mspeed    1996cn mean link speed (kph)            (01-04-15 22:10)
                       mo50: caput     1996cn capacity utilization (%)         (01-04-15 22:10)
                       mo51: lkvol     1996cn total link volume (veh)          (01-04-15 22:10)
                       md51: vcrat     1996cn volume/capacity ratio            (01-04-15 22:10)

Constraint matrix:     md48: vehkm     1996cn assigned vehicle km (links)      (01-04-15 22:10)
Constraint interval:         0           0      exclude

Submatrix:             all zones
```

zone	md41 nolink	md48 vehkm	mo48 vehhr	md49 mspeed	mo50 caput	mo51 lkvol	md51 vcrat
1	17	70449	1118	63	75	38815	69
2	15	46544	508	92	51	24778	47
12	149	443362	6489	68	65	512817	56
22	215	16253	384	42	34	129931	23
25	28	4208	52	81	18	12007	18
33	392	179416	3191	56	34	350048	38
43	812	258447	5178	50	31	497757	35
53	631	74450	1680	44	17	155188	20
64	178	10102	275	37	19	21423	21
90	552	82953	2074	40	1	150770	1
sum	2989	1186184	20949	573	345	1893534	328
avg	299	118618	2095	57	35	189353	33
min	15	4208	52	37	1	12007	1
max	812	443362	6489	92	75	512817	69

Appendix C - Rationale for Recommended Input Values

Appendix C - Rationale for Recommended Input Values

The following table shows the values that were recommended for input to the original version of the a.m. peak model. The speadsheets that were used for the trip generation and mode split components had each trip generation component broken down into sub-factors that could be modified individual. In the current formulation only the combined factors for each component are used as input to emme/2. The original spreadsheets may still be used to calculate the appropriate factors from the sub-components.

The suggested forecasts are of the global, or average, net change relative to 1996.

Recommended Assumptions

	Annual rate of change between 1986 and 1996	Factors	2001 Forecast	2011 Forecast	2021 Forecast (& Beyond)
Population	+ 1.95%	Natural Growth. Migration.	Hemson (see rationale)	Hemson (see rationale)	Hemson (see rationale)
Trip Generation Rates					
ELF Participation Rate	- 1.1%	Aging of the population. Female participation. Economic activity Early retirement. Higher education.	+8%	+ 8%	+ 3%
Work outside the home	- 0.2%	Technology. Outside contracting.	-2%	- 5%	- 8%
Daily work trip rate	+ 0.6%	Absenteeism. Nature of part time work.	No change	No change	No change
Peak period factor	- 0.8%	Flexible work hours. Part time work. Congestion.	-2%	- 5%	- 5%
Net trip rate (Sum of last 4 factors)	- 1.5%		+3%	- 2%	- 9%
External commuting rate	> 5%	Job opportunities in the outskirts of the GTA. Tele-commuting. Semi-retirement.	+10%	+ 20%	+ 25%
Employment	N/A	Economic activity Labour force	Interpolate Hemson forecast of growth to match population based trip forecast		
Non work auto peak period trip generation rate.	+ 3.1%	Age distribution. Socio-economic trends.	+3%	+ 15%	+ 20%
a.m. peak transit school trip rate.	No change	School busing policies. Security for young females.	No change	No change	No change

Appendix C - Rationale for Recommended Input Values

Modal Split Factors					
Other work origins	No change.	(Small local increase in downtown Toronto)	No change	No change	No change
Other work dest.	No change.	(Small local increase in downtown Toronto)	No change	No change	No change
GO Rail origins 4 Regions	+ 1.5%	Growth in population relative to downtown employment.	No change *	No change *	No change *
GO Rail dest. PD 1	+ 5.0%	Growth in population relative to downtown employment.	No change *	No change *	No change *
Transit origins Metro 4 Regions Ham-Wen.	 - 1.1% - 0.3% - 6.1%	Socio-economic trends. (Females & youths) Level of service. Environmental concerns. Financial constraints.	No change	No change	No change
Transit dest. Metro 4 Regions Ham-Wen.	 - 1.6% - 0.4% - 6.3%	Socio-economic trends. Level of service. Environmental concerns. Financial constraints.	No change	No change	No change
Auto occupancy	No change	Auto availability Driver's licensing Cost of driving Environmental Policies	No change	No change	No change
GO Rail non work factor	-0.1%		No change	No change	No change
Background Traffic Factor	N/A	Growth in GO Rail & subway ridership. Access mode split	+15%	+45%	+75%

* See discussion regarding GO Rail mode split and balancing factors.

Rationale

The following discussion focuses primarily on the forecasts for 2011 and 2021. It is recommended that the assumed trip generation rates and mode split factors should remain constant beyond the year 2021 because of the high degree of uncertainty involved in all aspects of forecasting beyond a 25 year time horizon. The recommendations for 2001 have been included as an aid to addressing immediate, short term planning issues, and as a potential validation point against which future trends can be monitored and compared.

- Population

  Population growth rates have declined substantially since the 1960s, when the annual growth rate for the GTA as a whole was more than 3%. Most of that decline can be attributed to lower fertility rates. Fertility rates currently remain well below long term mortality replacement rates but due to the age distribution of the population there will continue to be a small amount of natural growth in population for the next 10 to 15 years. Unless there is a sudden increase in fertility rates population growth beyond the year 2011 will be entirely dependent on in migration.

  The reduction in population growth rates since 1991 has reduced the likelihood of the Hemson Scenario 2 forecasts being achieved within the time frame for which they were projected. Scenario 2 was used as the base in the application of the simplified model for the GTA Transportation Plan

Study. Rather than make changes to these forecasts it is suggested that the fact that it may take longer to achieve them be recognized i.e.: that the forecast for 2011 may be applicable to 2014 and the forecast for 2021 may not be reached until 2025 or later.

- Labour Force Participation Rates

  Labour force participation rates reached an all time high shortly after the 1986 TTS. Age distribution, all of the baby boomers were of working age, and increased female participation in the labour force were significant factors in reaching those high levels of participation. The proportion of the population that is of working age will remain constant until the year 2011 and will then decline as the baby boomers reach retirement age. Female participation rates, in the middle and older age categories, have remained constant or declined only slightly since the start of the economic recession. Participation rates for women remain below those for men in all but the youngest (15 to 24) age category. Future increases are therefore possible.

  The recent (since 1989) decline in labour force participation rates must be attributed, at least in part, to the economic recession and the resulting shortage of employment opportunity. It is not clear as to the extent to which these changes represent permanent re-structuring of the economy as opposed to being part of a prolonged economic cycle.

  The recent drop in labour force participation rates has been most noticeable in the 15 to 24 age range, where the 1996 rate was approximately half the 1986 rate for both sexes. In the 55 to 64 age category for men there was a 25% drop. In the same time period the proportion of the total population in the 20 to 24 age range that were full time students increased by 50%. The TTS data on its own does not permit any quantitative conclusions to be drawn as to the extent that these changes reflect personal aspirations and life style choices as opposed to being driven by the state of the economy and lack of available jobs. There is clearly potential for a reversal of these trends that could lead to the employed labour force expanding more rapidly than the population, should more jobs become available.

  The recommended future values are based on the assumption that there will be continued economic recovery leading to an increase in labour force participation rates by 2001 of half the amount lost since 1986. In the longer term it is assumed that the changing age distribution of the population will become the dominant factor resulting in a decline in labour force participation rates after the year 2011.

- Work at Home

  Although there has been much talk about the increased potential for people to work at home, and a significant percentage increase in the number of people who do, the effect on total trip making has been minimal to date. It is suggested that the trend will continue and may increase slightly in pace.

- Daily work trip rate.

  The increase in daily work trip rate between 1986 and 1996 was due primarily to an increase in trip frequency for people who are employed part time. It could be that there are more people working 3 or 4 days a week or that a number of people have more than one part time job. The TTS data does not identify people with more than one job. In either case there is limited potential for further increase or there could be a reversal of the previous trend as the economy recovers.

Appendix C - Rationale for Recommended Input Values

- Peak period factor

  There has been a consistent trend towards a slight spreading of the peak period for work trips in all regions. The 1991 TTS data generally lies mid-way between the 1986 and 1996 data. It is suggested that the trend will continue in the short term before leveling off at a constant value.

- Net work trip rate

  The effect of applying the suggested values in combination produces over all peak period work trip rates for 2011 and 2021 that are about 10% lower than the base case rates assumed in using the simplified model for in the GTA Transportation Plan Study and 18% to 25% below the 1986 levels used in the previous calibration of the full GTA model (Need to confirm the latter with Eric M).

- External commuting

  The suggested future values for external, population based, generation rates for work trips to the GTA are similar in magnitude to those used for the GTA Transportation Plan Study. The 1996 TTS values are consistent with previous values derived from 1991 Census POW and traffic count data.

- Employment

  A substantial reduction is needed in the previously forecast totals in order for the employed based forecast numbers to be consistent with the above population based assumptions. The previous totals (Hemson scenario 1) need to be reduced by 20% for 2011 and about 30% for 2021. In the previous application of the simplified GTA model the discrepancy between the population and employment forecasts was resolved by using the population based work trip generation as the control total to calculate a uniform reduction factor applied to the employment based trip calculations. **An important question is whether it is more accurate to factor total employment to obtain a balance, or the projected growth in employment. There is likely be significant differences in the resulting travel patterns depending on which approach is adopted.** An alternative approach (used in the application of the full GTA model - check with Eric), is to factor to the mid-point of the calculated population and employment based trip totals.

  The recommended alternative avoids the need to generate new employment forecasts. In it the current forecasts (Hemson) are used to determine the distribution of future employment growth but the rate at which the growth is assumed to occur is adjusted so that the overall GTA job and work trip totals are consistent with the population based forecasts. It is suggested that the employment forecast for a given year be obtained by interpolating between the appropriate two years of the Hemson forecasts, to give a total GTA employment estimate that agrees with the population and labour force participation rate assumptions. The work trip movements are balanced to the origin total as a final adjustment.

- Non work auto trip generation

  The suggested adjustments to the rates for 2011 and 2021 are 15% higher than those used in the GTA Transportation Plan Study. The observed increase between 1991 and 1996 has been greater than the increase that was previously assumed for the entire period from 1991 to 2011. The assumed growth rate in work trip rates prior to 2001 is assumed to reduce the rate of growth in non work related travel in the immediate future.

Appendix C - Rationale for Recommended Input Values

- School trips by local transit

  Continued no change in the over all trip rate was the assumption used in the GTA Transportation Plan Study. Further changes in school busing policy could affect future rates but such changes are hard to predict and are likely to be localized.

- "Other" mode split factors

  The "other" mode split factor has been highly consistent, both spatially and over time.

- GO Rail mode split factors

  The GO Rail mode share for work trip destinations to the downtown increased significantly between 1986 and 1989 and has remained constant since 1989. Origin mode shares have declined since 1989 as the population and employed labour force in the GO service area have increased at faster rates than downtown employment. Using the same mode split factors with adjustment factors to balance to an over all trip total that is between the origin and destination totals reflects a continuation of existing long term trends. The use of 0.3 origin and 0.7 destination balancing factors reflects the significant dependence that continued growth in GO Rail ridership is likely to have on downtown employment. These assumptions are the same as were used in the GTA Transportation Plan Study and in the formulation of the GO Rail ridership model.

- Local transit mode split factors

  It was assumed in the GTA Transportation Plan Study that transit mode splits would increase from 1991 levels part way back to 1986 levels by 2011 and then remain constant. The trend between 1991 and 1996, however, has continued downwards. In addition the elimination of provincial subsidies and the current financial constraints that could lead to further fare increases and cuts in service suggest that any significant increase in transit mode splits in the near future is unlikely. Future changes in the age distribution of the population could have a minor beneficial effect. The increase in auto use and availability among younger women is likely to have a continued negative effect for at least the next twenty years as these women replace the women in the older age groups who were more transit dependent in their youth. Further declines in transit ridership are therefore possible, and likely, if current service levels cannot be maintained or improved. The assumption that transit mode splits can be maintained at 1996 levels implies some degree of renewed commitment to maintain public transit levels of service.

- Background traffic

  It is assumed that the background traffic matrix will be used to represent auto access to GO Rail and the subway. The recommended growth factors are the average growth in the total population in the regions of Halton, Peel, York and Durham as projected in the forecasts released by the Greater Toronto Coordinating Committee in May 2000.

Appendix C - Rationale for Recommended Input Values

Modification of Trip Generation Factors

The workbook "gen_inp.xls" contains 1 page for each of the sub-factors listed in the previous table. These pages have a common format

Column A	Shows the zone aggregation (ggnnn)
Columns B-D	Observed values from the 1986, 1991 and 1996 TTS.
Column E	Currently selected values. The selection is made by putting the appropriate ID in row 2.
Coumn F	Base case values (default)
Column G-Z	Available to calculate and store alternative values. Each column represents one set of values identified by a unique ID code in row 2. The column can be selected by entering the same code into cell E2. Any cells set to zero or left blank will default to the values shown in column F.

At the front of the workbook are 4 additional pages (ampkwk_rt, ampkde_rt, ampknwau_rt, and ampktrsc_rt) that show the combined values of the trip generation factors currently selected on the other pages. These are the values that need to be imported into emme/2. The page "emme2" contains the 4 sets of values formatted for input to emme/2. To make the transfer copy the entire page to the appropriate "set" file using the edit, paste special and values commands. Save the "set" file as text.

Modification of Mode Split Factors

The workbook "ms_inp.xls" contains 1 page for each of the mod-split factors. These pages have a common format.

Column A	Shows the zone aggregation (gmnnn).
Column B	Used to group aggregations where there is insufficinet data
Columns C-F	Observed values from the 1986, 1991 and 1996 TTS. Two values are shown for the 1996 TTS, the 1st based on aggregations of the 1991 GTA zone system and the 2nd on aggregations of the 1996 GTA zone system. There are minor differences in the aggregated zone boundaries mainly in Toronto.
Column G	Currently selected values. The selection is made by putting the appropriate ID code into cell G2.
Column H	Base case values (default)
Columns I-Z	Available to calculate and store alternative sets of values. Each column represents one set of values idetified by a unique ID code in row 2. The coilumn may be selected by entering the same code into cell G2. Any cells set to zero or left blank will default to the value shown in column H.

The page "emme2" cotains all of the currently selected values formatted for input to emme2. To make the transfer copy the entire page to the appropriate "set" file using the edit, paste specialand values commands. Save the "set" file as text.