HALTON P.M. PEAK MODEL

Version 4.0

Documentation
&
Users' Guide

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Contents

1.0 Introduction

The name "Simplified GTA model" has been adopted to distinguish between this model and the "Full GTA model" developed at the University of Toronto. The model is "simplified" in terms of its ease of application. The level of detail, defined by the zone system and network information, is the same in both models. The simplified GTA model has been used in a number of sub-area studies that involve the splitting of GTA zones for more detailed site specific analysis.

The simplified approach is based on the extrapolation of existing (observed) travel behaviour patterns as opposed to using mathematical equations to synthesize those relationships. Assumptions as to future changes in trip rates, mode choice factors, average trip length and auto occupancy have to be explicitly stated as inputs to the modelling process.

The model uses a pre-distribution (trip end) mode split component that favours the incorporation of assumptions that reflect long term socio-economic trends, household decisions (such as car ownership) and general, area wide, levels of service rather than the details of individual route planning.

The trip distribution component is unique to the simplified model incorporating features of both the more traditional "gravity" and "Fratar" techniques. The results reflect both the existing O-D specific travel patterns at an aggregate level as well as the existing trip length distribution at a more detailed level. The latter feature enables the trip distribution process to be applied to areas of new development for which there is no existing travel information.

The trip generation, mode split and trip distribution components are based on a 3 hour peak period. The total auto person trip matrix is converted to a peak hour auto driver matrix prior to assignment. The transit assignment, if required as an output, is for the 3 hour peak period. The model, in its most basic form, does not use any network, or level of service information, to generate the trip matrices. Some of the supplementary features, discussed in Chapter 2, can be used to modify the trip distribution component to reflect anticipated changes in level of service.

The current release (version 4) has been calibrated using data from the 2001 Transportation Tomorrow Survey (TTS) and the 2001 Canada Census. To obtain complete coverage of the external areas the 2001 TTS was supplemented by data from the 1996 TTS, for the Region of Waterloo and County of Northumberland, and by 1991 Census Place of work – Place of residence data for the Region of Haldimand-Norfolk and the County of Brant. Model results have been validated using 2001 Cordon and transit ridership counts. In addition a number of operational improvements have been made relative to the earlier versions.

There are currently three versions of the simplified model:

1. An A.M. Peak period model for the entire GTA (Including Hamilton)
2. A P.M. Peak period model for the entire GTA (Including Hamilton)
3. A P.M. Peak period model developed specifically for the Regional Municipality of Halton.

This introduction is common to all 3 models.

The two GTA models are both based on the 1996 GTA zone system supplemented by 26 external zones. Some minor revisions, primarily re-calibration of the trip distribution component, will be necessary in order to adapt the model to the 2001 GTA zone system. A refinement in the current release is the ability to use the same emme2bank to run both the A.M. and P.M. models with little or no risk of "interference" between the two models or accidental loss of results.

The Halton model covers the same geographic area as the GTA models but uses a more detailed zone system within the region of Halton. The same 26 external zones are used and the GTA zones are retained in Peel Region and Parts of Hamilton. More aggregate zones are used in the rest of Hamilton, the City of

Toronto and in the Regions of Durham and York. The modelling procedures and the macros are identical to those used in the GTA P.M. model.

1.1 Summary Description

Table 1 provides a summary of the main features of the Halton P.M. peak period model. Table 2 provides a summary of the zone system used by the model. Figure 1 shows the flow of information through the Trip Generation, Mode Split and Trip Distribution components of the model. The modelling procedures are similar to those used in the GTA a.m. peak period model but the combinations of trip purposes and mode are different reflecting the greater diversity of trip making activity that occurs in the p.m. peak period

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

Time period	p.m. peak 3 hrs (3:30 - 6:29)
Geographic Scope	GTA, the City of Hamilton plus 10 adjacent Counties and Regional Municipalities
Zone system	GTA96 plus 26 external zones (1703 total)
Trip purpose categories	1. From Work (all modes) 2. Non-work origin (Auto & transit)
Modes	1. Auto (Driver & Passenger) 2. Transit (Excluding GO Rail access) 3. GO Rail 4. Other, primarily walk & cycle (Trips not distributed or assigned) 5. GO Rail Egress by auto

Table 2 - Halton zone system

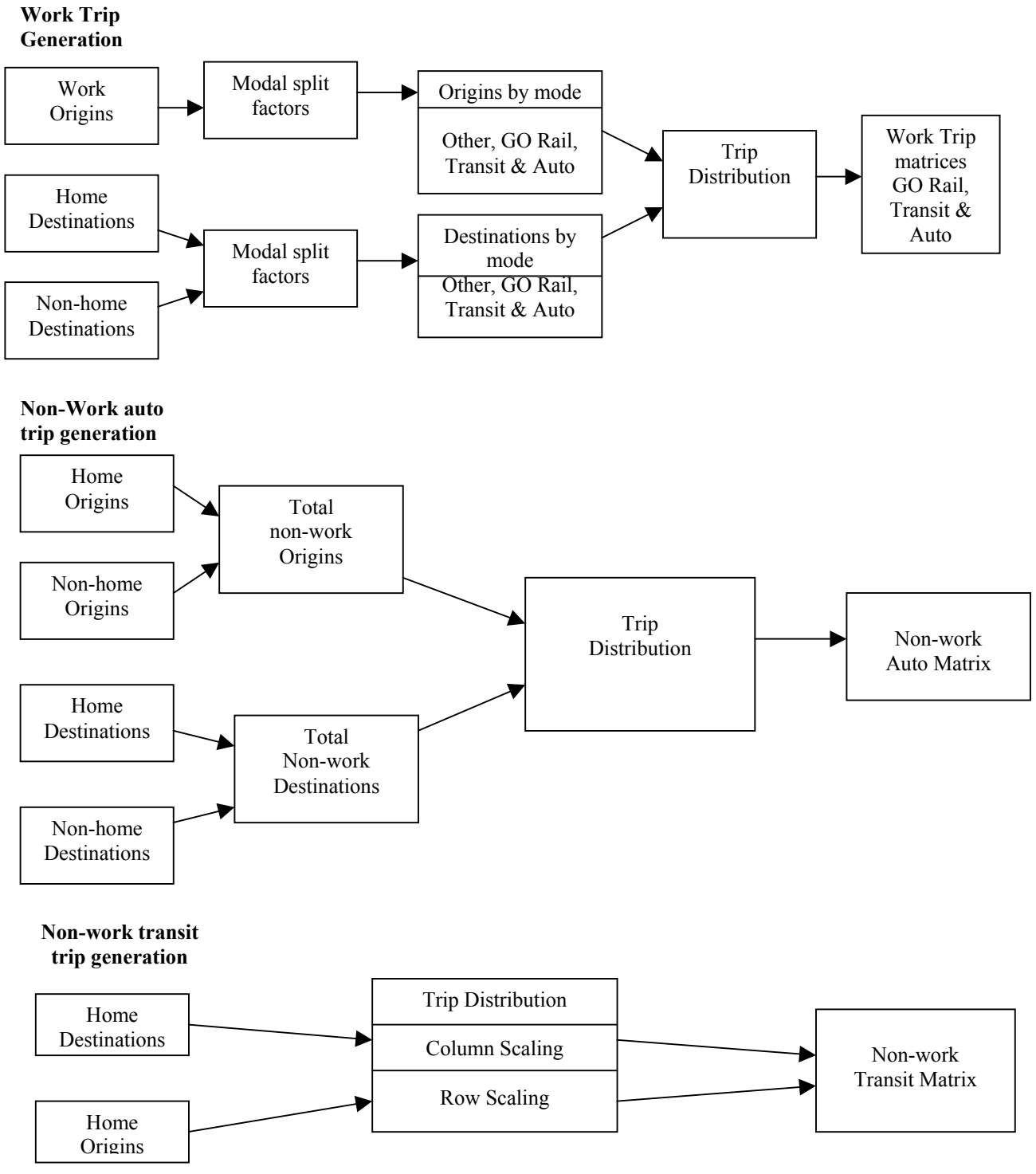
Regional Municipality	Number of zones	Definition	Numeric Range (1st & last zone numbers)	Number of GTA Zones	Range of GTA Zone Numbers
Halton	569	Sub-divisions of GTA zones	1 - 606	179	2001-2179
Peel	248	GTA zones	1501-1749	248	1501-1749
Hamilton	29	Custom aggregations	8502 - 8641	170	2501-2670
Toronto	16	Planning Districts	9001 - 9016	463	1-463
Durham	8	Municipalities	9017 - 9024	265	501-765
York	9	Municipalities	9025 - 9033	353	1001-1353
External	26	Same as GTA model	4001 - 4410	26	4001-4410
Total	905			1703	

School trips are not treated as a separate trip purpose because the trip generation and distribution procedures are the same as for other non-work related trips. Further stratification of trip purpose is unlikely to yield significantly different results unless the population forecasts can be stratified by age to reflect differences in ageing trends in different areas.

The modelling procedures include the options to perform network assignments of both auto driver and transit trips. At the time this documentation was prepared a transit network had not been coded to the Halton zone system. The trip matrices were therefore the final outputs of the GO Rail and local transit components.

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.

Figure 1 - Flow Diagram



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 smaller 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.

1.2 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 3 shows the categories of trip used in the trip generation component of the model. A user specified global weighting factor is applied to balance the total number of work trip origins and destinations to a common total value. The recommended default value of the origin weight for work trips is 0.0 and 0.5 for non-work trips. The destination weight is automatically calculated as 1 minus the origin weight.

Table 3 - Trip Generation Categories

		2001 TTS Trip Total
Employment Based Trip Rates		
	Work trip origins - all modes	1,650,477
Population Based Trip Rates		
	Work to home destinations - all modes	1,349,188
	Non work to home destinations -auto mode	756,800
	Non work to home destinations - transit mode	123,982
	Home origins – auto mode	585,324
	Home origins - transit mode	40,337
Composite Trip Rates (applied to employment plus 50% population)		
	Work to non-home destinations - all modes	335,117
	Non-home non-work origins - auto mode	1,005,768
	Non-home destinations with non-work origins - auto mode	649,085

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

1. GO Rail trips with a non work origin (7.4% of total p.m. peak GO Rail trips - TTS data)
2. Transit trips with a non-home destination and a non-home or work origin (4.4% of total p.m. peak transit trips - TTS data)

The model uses global adjustment factors, prior to trip assignment, to correct for the exclusion of these two modes.

The use of separate auto and transit trip generation rates in the non-work trip categories recognises the strong correlation between mode choice and trip purpose in those categories. 47% of transit trips are school related compared to just 8% of auto trips (TTS data).

Base case trip generation rates were obtained from the TTS data at an aggregated level. Within the external areas, the City of Hamilton and the regional municipalities of Halton and Peel the same zone aggregations are used as in the GTA models. The zone ensemble "gg", in the emme2bank, contains those zone aggregations. They are sub-divisions of Municipality with the first 2 digits being the number used to represent the municipality in the TTS database. For the City of Toronto and the Regional municipalities of Durham and York the trip generations are by municipality (Planning District in Toronto). The zone

ensemble “gp” contains the municipal (planning district) zone equivalence table. The total number of aggregations is 80.

The aggregations used in Halton & Peel (gg) are shown in Figure 2 and the Planning District aggregations (gp) in Figure 3. The zones that make up the aggregations within the Region of Halton are shown in Table 4. Although the Halton zones are basically sub-divisions of the GTA zones there have been minor revisions to those boundaries to more accurately reflect the development that has taken place subsequent to the definition of the 1996 GTA zone boundaries. As a result there is not an exact match between the GTA and Halton zone boundaries used to define Georgetown and the Milton urban area. Figure 3 is based on the GTA zone boundaries.

Table 4 - Halton zone aggregations

Aggregation number	Municipality	Halton zone numbers	GTA Zone numbers
1	Georgetown - Halton Hills	561-576 580-581	2157-2164
2	Halton Hills excl. Georgetown	550-560 577-579 582-606	2149-2156 2165-2179
3	Milton (Urban area)	444, 448 450-473	2122-2126 2145-2147
4	Milton (Rural)	430-443 445-447 449 474-534	2100-2121 2127-2144 2148
5	Oakville (South)	1-41	2001-2013
6	Oakville (East)	42-77	2014-2023
7	Oakville (North)	78-130 171-186	2024-2038 2048-2049
8	Oakville (West)	131-170	2039-2047
9	Burlington (West)	200-223 376-386	2050-2055 2091-2092
10	Burlington (South)	224-305	2056-2077
11	Burlington (Central)	306-404	2078-2090
12	Burlington (North)	405-419	2093-2099

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.

The trip generation rates have been adjusted globally to reflect the known under-reporting of non-work related trips in the TTS. Estimates of the amount of under-reporting were after the 1996 TTS through a comparison of non-respondent trip rates with those of respondents having the same demographic characteristics. Table 5 shows the estimated mean level of under-reporting, in the applicable trip categories, together with the observed change in trip rates, between 1996 and 2001, and the level of adjustment for under-reported that has been assumed for 2001. Reported trip rates in the 2001 TTS were generally higher than in the 1996 TTS. It is believed that some of that increase may have been due to better reporting in the 2001 TTS. The adjustments that need to be made to account for under-reporting are therefore assumed to be 2% to 3% lower in 2001 than they were in 1996. These adjustments are not included in the trip totals shown in Table 3.

Tables 6 and 7 shows the final trip generation rates used in the calibration of the model. These rates were calculated from the TTS data and adjusted to account for the known under reporting of non work or school related trips. The trip rates for areas outside the GTA shown in Table 7 are for trips to or from the GTA

only. The numbers shown in bold italics have been manually input or adjusted to reflect the absence or partial coverage of the TTS data. There is assumed to be no non-work related local transit trips to or from areas outside the GTA. The number of external transit trips recorded in the TTS database is too few to be meaningful.

Table 5 – Adjustment of Non-work Trip Generation Rates

Trip Category	Estimated mean level of under-reporting in 1996 (P.M. Peak Period)	Observed change in mean trip rate since 1996 (Unadjusted TTS)	Assumed factor to correct for under-reporting in 2001	Implied change in mean trip rate since 1996
Home origins – auto	17%	+7%	15%	+5%
Home origins – transit	17%	-4%	15%	-6%
Non-home non-work origins – auto.	20%	+5%	15%	0
Home destinations from non-work origins – auto	17%	+4%	15%	+2%
Home destinations from non-work origins – transit	9%	-13%	7%	-15%
Non-home destinations with non-work origins – auto	20%	+3%	15%	-2%

The trip rates used in the running of the model can be adjusted by applying a global factor or new rates can be defined using the same zone aggregations (gg or gp), any other zone grouping defined in the emme2bank, individual zones or any combination of the above.

Figure 2 – Halton & Peel Aggregations Used in Trip Generation & Mode Split

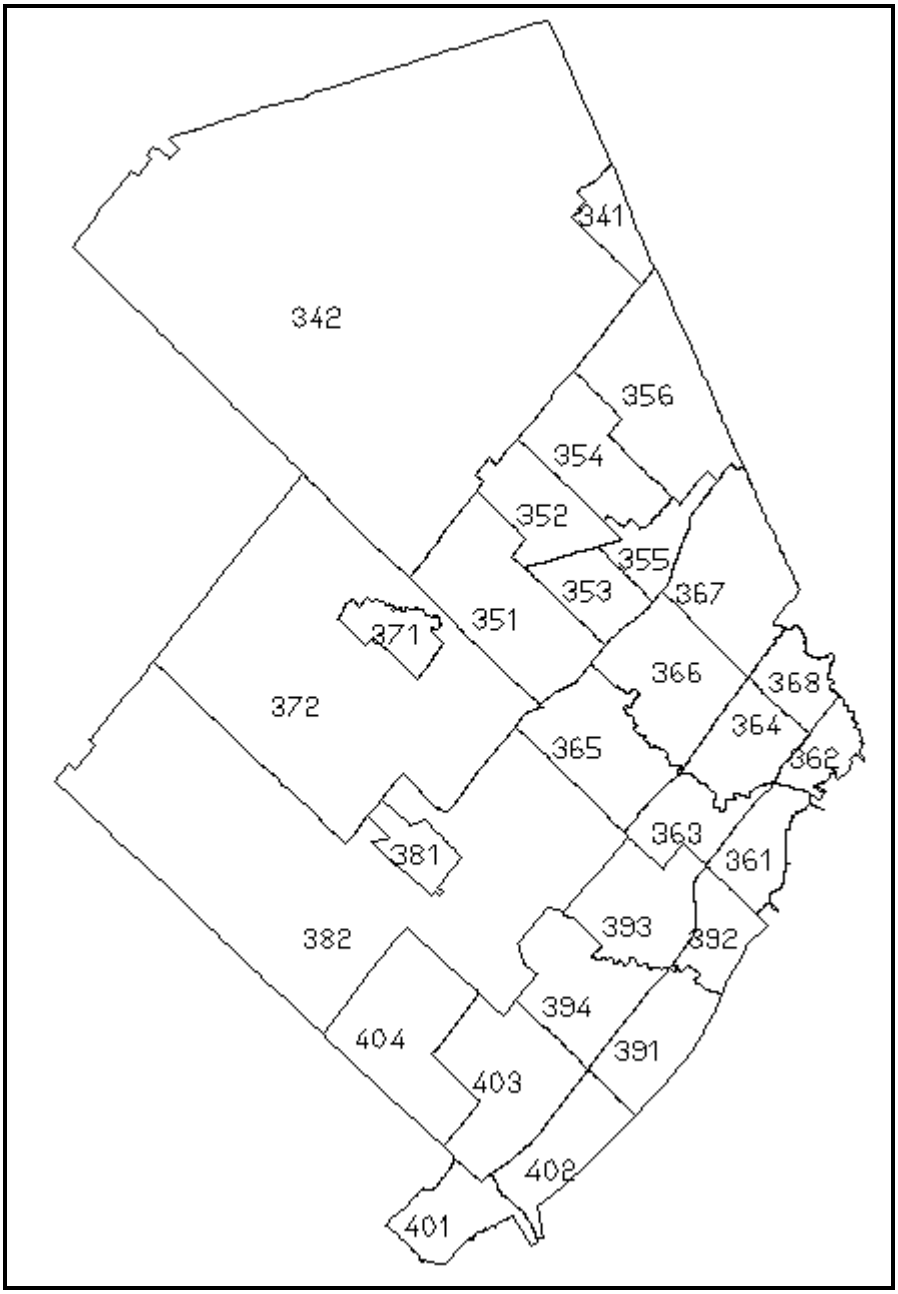


Figure 3 – Planning Districts

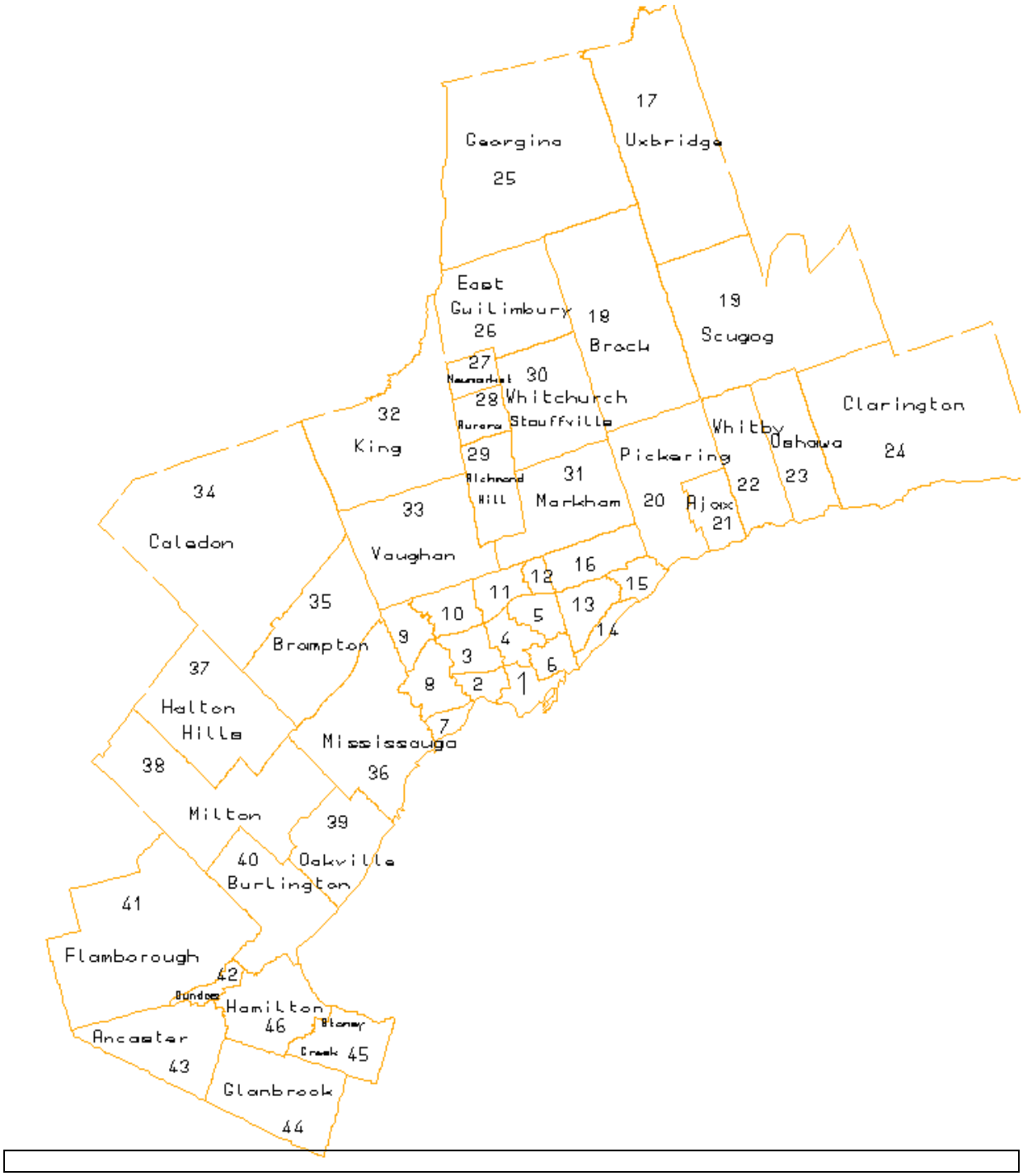


Table 6 – 2001 Trip Generation Rates

Emme2 matrix type and name		mo pm01	mo pm04	md pm06	md pm01	md pm04	md pm08	md pm03	md pm05	mo pm05
		Origins Per 1000 Emp.	Origins per 1000 population		Destinations per 1000 Population			Per 1000 (Emp. + Pop./2)		
								Destinations		Origins
From		Work	Home		Work	not work		Work	not work	not work or home
To		All	All		Home			not home	not home	All
Mode		All	Auto	Transit	All	Auto	Transit	All	Auto	
Halton Hills	gg371	496	120	1	242	127	0	Not applicable See Section 1.3 And Table 8		
"	gg372	508	72	0	216	117	4			
Milton	gg381	450	130	0	218	125	1			
"	gg382	554	105	0	224	157	0			
Oakville	gg391	562	105	2	195	169	7			
"	gg392	508	140	0	195	180	1			
"	gg393	510	113	1	222	150	2			
"	gg394	544	121	0	230	141	2			
Burlington	gg401	500	117	1	197	156	3			
"	gg402	506	105	1	219	152	6			
"	gg403	553	121	0	229	143	2			
"	gg404	533	85	0	140	154	0			
Caledon	gg341	519	87	0	241	90	1	64	120	129
"	gg342	448	90	0	224	117	0	64	109	141
Brampton	gg351	612	104	0	285	114	0	61	119	138
"	gg352	494	84	3	225	116	5	88	143	200
"	gg353	521	63	0	174	33	16	3	141	139
"	gg354	460	85	4	227	101	10	101	149	174
"	gg355	543	76	0	190	97	0	8	97	107
"	gg356	493	97	2	236	128	6	93	177	196
Mississauga	gg361	467	115	5	201	159	5	57	170	202
"	gg362	526	98	4	224	120	4	70	189	263
"	gg363	556	108	3	226	138	13	61	200	245
"	gg364	506	90	8	227	98	14	64	182	195
"	gg365	553	100	2	231	125	8	55	168	183
"	gg366	609	82	4	230	109	10	61	100	123
"	gg367	551	75	6	199	78	13	16	89	88
"	gg368	512	87	6	220	105	13	68	162	178
Toronto	gp1	599	33	27	230	40	53	12	60	67
"	gp2	430	52	22	220	62	45	60	103	120
"	gp3	529	55	22	206	73	50	62	110	138
"	gp4	531	74	14	222	108	40	32	135	180
"	gp5	548	74	15	200	123	43	39	112	155
"	gp6	416	58	20	215	70	52	60	98	123
"	gp7	499	85	9	230	89	37	66	91	104

Table 6(Cont.) – 2001 Trip Generation Rates

		Origins Per 1000 Emp.	Origins per 1000 population		Destinations per 1000 Population			Per 1000 (Emp. + Pop./2)		
								Destinations		Origins
From		Work	Home		Work	not work		Work	Not work	not work or home
To		All	All		Home			not home	Not home	All
Mode		All	Auto	Transit	All	Auto	Transit	All	Auto	
Toronto	gp8	541	84	10	200	119	32	48	176	219
"	gp9	549	83	10	198	88	33	50	133	155
"	gp10	586	54	10	207	73	39	50	96	155
"	gp11	543	74	12	206	112	44	40	139	193
"	gp12	576	68	12	207	105	49	37	128	173
"	gp13	529	67	15	186	88	41	55	156	202
"	gp14	454	77	8	188	112	30	71	136	170
"	gp15	465	83	7	222	121	33	84	146	193
"	gp16	529	73	10	207	104	39	48	126	161
Uxbridge	gp17	501	78	0	184	119	0	61	174	183
Brock	gp18	502	91	0	223	139	0	66	191	219
Scugog	gp19	440	85	0	192	134	0	64	190	241
Pickering	gp20	502	99	1	218	131	6	68	184	203
Ajax	gp21	479	102	1	224	120	6	75	194	223
Whitby	gp22	486	114	1	227	134	3	79	226	230
Oshawa	gp23	435	114	3	182	136	7	67	222	260
Clarington	gp24	426	123	1	173	121	1	76	170	174
Georgina	gp25	457	98	0	203	114	1	79	170	187
East garafraxa	gp26	373	89	0	236	117	0	81	93	84
Newmarket	gp27	496	98	2	220	143	8	54	246	283
Aurora	gp28	528	114	0	222	138	1	51	191	215
Richmond Hill	gp29	518	92	1	212	139	15	60	176	215
Whit.-Stouf.	gp30	540	91	0	240	123	1	77	159	194
Markham	gp31	584	87	3	221	144	15	40	148	192
King	gp32	514	103	0	185	129	0	41	122	238
Vaughan	gp33	573	88	2	245	121	10	50	118	139
Flamborough	gp41	416	112	0	211	127	1	75	166	149
Dundas	gp42	440	104	1	204	138	5	65	196	255
Ancaster	gp43	408	123	0	210	174	3	75	290	344
Glanbrook	gp44	418	105	0	190	138	0	79	92	113
Stoney Creek	gp45	510	117	3	198	127	4	82	162	156
Hamilton	gp46	479	99	7	176	112	18	57	186	213
Mean Values										
Toronto		551	76	15	209	103	43	43	110	142
Durham		465	125	1	203	149	4	71	197	221
York		555	106	2	225	153	10	51	150	185
Peel		537	105	4	226	131	9	58	140	162
Halton		521	131	1	218	170	3	55	202	236
Hamilton		474	119	5	185	138	13	62	181	205
Total		536	97	8	212	126	24	51	139	168

Table 7 – External Trip Generation Rates for Trips to/from the GTA

		Origins Per 1000 Emp.	Origins per 1000 population		Destinations per 1000 Population			Per 1000 (Emp. + Pop./2)		
								Destinations		Origins
From		Work	Home		Work	not work		Work	not work	not work or home
To		All	All		Home			not home	not home	All
Mode		All	Auto	Transit	All	Auto	Transit	All	Auto	
Northumberland	4001	***73***	***10***	***0***	***45***	***20***	***0***	***9***	***25***	***25***
City of Peterborough	4002	21	4	0	15	5	0	2	9	9
Peterborough County	4003	43	9	0	93	20	0	7	12	12
Kawartha Lakes South	4004	20	5	0	40	10	0	8	11	11
Kawartha Lakes North	4005	69	6	0	71	24	0	18	21	21
Simcoe South	4100	83	21	0	142	30	0	15	13	13
Simcoe West	4101	42	20	0	95	17	0	12	11	11
Barrie	4102	24	5	0	52	7	0	9	5	5
Simcoe North	4103	9	4	0	15	6	0	3	7	7
Orillia	4104	10	4	0	14	9	0	4	15	15
Orangeville	4201	54	17	0	108	15	0	17	36	36
Dufferin County	4202	***56***	***10***	***0***	***40***	***15***	***0***	***15***	***30***	***30***
Guelph	4301	41	6	0	30	5	0	5	9	9
Wellington South	4302	75	26	0	107	42	0	22	13	13
Wellington North	4303	38	10	0	36	10	0	5	9	9
Cambridge	4401	***70***	***11***	***0***	***32***	***6***	***0***	***5***	***3***	***3***
Kitchener-Waterloo	4402	***18***	***2***	***0***	***10***	***3***	***0***	***2***	***3***	***3***
Brant County	4403	***80***	***18***	***0***	***60***	***20***	***0***	***8***	***10***	***10***
Haldimand-Norfolk	4404	***20***	***5***	***0***	***20***	***8***	***0***	***2***	***2***	***2***
Grimsby	4405	80	19	0	76	25	0	8	13	13
St Catharines	4406	16	4	0	11	4	0	2	4	4
Niagara-Fort Erie	4407	18	3	0	7	3	0	1	1	1
West Lincoln	4408	30	13	0	35	9	0	4	8	8

1.3 Retail Intensive Zones

Staff at the Region of Halton have identified a number of traffic zones within the region that are considered to be "retail intensive". The 2001 TTS data shows that some of these zones have significantly higher non-work related trip generation rates than non retail zones. These zones have been grouped into categories for the application of category specific trip rates shown in Table 8. Table 9 lists the zones that make up the zone groups together with the descriptions supplied by the Region. It should be noted that the TTS data is based on a 5% sample and is not generally reliable at the individual zone level, particularly for those zones with a total employment of less than 1000 (50 observations). In addition the responses to the occupation question, on which the proportion of sales and service employment is based, relied heavily on the subjective judgement of the interviewers and respondent. Data from other sources, such as local employment surveys, should be more reliable and might provide more consistent information for the categorization of the zones. Adjacent zones that have same description, as provided by the Region, have been grouped together in the same category based on an approximation of the proportion of sales and service employment within the group.

The trip rates shown in Table 8 are calculated in the same manner as the corresponding trip rates shown in Table 6 except that they are based on the category of retail zone instead a purely geographic aggregation. The non-retail rate (category 6) is applied to all the Halton zones not included in any of the previous categories. The first number shown is the recommended (rounded) value for use as input to the model. The 2nd number, in brackets, is the actual value obtained from the TTS data. The zones in categories 1 & 2 were also observed to have a below average trip rate for work origins. It is recommended that the values shown be used for these zones but that the original values, based on geographic aggregation (Table 6), are used in the other categories including the non-retail zones. The TTS contains insufficient data to draw any conclusions about retail specific transit trip rates. The geographic based rates shown in Table 6 are retained. The zone groupings that define the retail categories are contained in a zone ensemble. These groupings may be changed for future forecasts to reflect expected changes in the retail characteristics of different zones. Similarly the trip rates applied to each category may be changed, new categories added or new rates can be entered on a zone specific basis.

Table 8 – Retail Intensive Trip Rates

Emme2 matrix I.D.			Mo pm01	Mo pm05	Md pm03	Md pm05
			Origins		Non-home Destinations	
Category	Description	Mean sales & service employment (TTS)	Work	Non-home non-work	With work origin	With non-work origin
			Recommended Trip Rate (TTS Actual)			
1	Zones with at least 1000 employment the majority in Sales and service.	63%	400 (398)	1000 (1011)	225 (223)	800 (807)
2	Other Malls & Box stores with a high level of S&S employment.	59%	425 (425)	800 (828)	170 (169)	700 (715)
3	Other zones with a high level of S&S employment	36%	N/C (487)	600 (592)	140 (143)	570 (569)
4	Other Malls & Big Box stores	26%	N/C (538)	350 (356)	130 (133)	350 (363)
5	Other zones with retail and industrial or residential mix	22%	N/C (548)	240 (241)	70 (67)	250 (256)
6	Non-retail	20%	N/C (526)	170 (170)	40 (40)	140 (141)
Halton mean		23%	521	206	50	175

Table 9 – Retail Intensive Zone Groupings

Category	Zones	Estimated Employment (TTS data)	Sales & service	Description	Location
1	103	1440	49%	Oakville Place	Oakville
	229	2059	69%	Mapleview Mall	Burlington
	255	1773	67%	Burlington Mall	Burlington
2	23	432	57%	Hopedale Mall	Oakville
	112	539	65%	Up-Town core	Oakville
	116	230	63%	Up-Town core	Oakville
	148	104	55%	Abby Plaza	Oakville
	213	207	57%	Ikea/Fortinos	Burlington
	297	365	67%	Appleby Mall	Burlington
	326	116	53%	New shopping Centre on Walkers Line	Burlington
	329	97	61%	New shopping centre – Appleby Line	Burlington
	348	164	37%	Super Centre & Burlington Heights Centre	Burlington
	349	115	50%	Super Centre & Burlington Heights Centre	Burlington
3	230	277	55%	Retail/Ind. Mix - Fairview St	Burlington
	268	945	50%	Retail/Ind. Mix - Fairview St	Burlington
	466	171	32%	Derry/Ontario retail area	Milton
	468	253	34%	Derry/Ontario retail area	Milton
	472	881	43%	Milton Mall, Loblaws & retail/ind. Mix on Main St	Milton
	473	84	19%	Milton Mall, Loblaws & retail/ind. Mix on Main St	Milton
	566	861	36%	Retail/Ind. Mix on Guelph St	Georgetown
	570	758	50%	Retail/Ind. Mix on Guelph St	Georgetown
	571	1153	18%	Retail/Ind. Mix on Guelph St	Georgetown
	572	1405	29%	Retail/Ind. Mix on Guelph St	Georgetown
4	42	897	28%	Traffalgar Village	Oakville
	79	3473	20%	Power Centre, Home Depot	Oakville
	146	946	35%	Town Centre	Oakville
	147	591	36%	Town Centre	Oakville
	320	113	0%	New shopping centre – Appleby Line	Burlington
	340	289	17%	Leons/Home Depot on Guelph line	Burlington
	351	358	41%	New shopping Centre on Walkers Line	Burlington
	353	94	17%	New shopping Centre on Walkers Line	Burlington
	362	469	39%	Costco & Power Centre	Burlington
	364	435	18%	Costco & Power Centre	Burlington
5	13	1122	9%	retail/ind. Mix - Speers Rd	Oakville
	14	421	9%	retail/ind. Mix - Speers Rd	Oakville
	28	1507	27%	retail/ind. Mix - Speers Rd	Oakville
	29	431	27%	retail/ind. Mix - Speers Rd	Oakville
	31	1995	23%	retail/ind. Mix - Speers Rd	Oakville
	37	358	23%	retail/ind. Mix - Speers Rd	Oakville
	233	344	22%	Retail/Ind. Mix - Fairview St	Burlington
	234	485	17%	Retail/Ind. Mix - Fairview St	Burlington
	251	678	20%	Retail/Ind. Mix - Fairview St	Burlington
	452	862	20%	Retail/Ind. Mix on Hwy 25/Hwy 401	Milton
	455	209	19%	Retail/Ind. Mix on Hwy 25/Hwy 401	Milton
	460	583	27%	Retail/Residential mix on Main St	Milton
	461	603	23%	Retail/Residential mix on Main St	Milton
	462	958	34%	Retail/Residential mix on Main St	Milton
	602	211	25%	Acton Town Centre	Acton

1.4 Mode Split

The zone aggregations used for trip generation, as shown in Figures 2 and 3, were also used in the calibration of the mode split component of the model. In the Halton model the same zone groups were used in the calibration of both trip generation and mode split but, in order to be compatible with the GTA model macros, the same groupings are stored as ensemble "gm" as well as ensemble "gg". The GTA model was calibrated using the same zone aggregations as for trip generation in the regions of Halton, Hamilton and Peel but smaller aggregations in the Region of York and the City of Toronto. A post trip distribution egress mode split is applied to trips made by GO Rail. Table 10 shows the base case modal split factors calculated from the 2001 TTS data. Table 11 shows the mode split factors for work trips made between the GTA and the external areas. Both the origin and destination factors for the other mode (walk and cycle) together with the origin factors for GO rail and local transit are assumed to be zero. Those areas not shown in Table 11 also have a zero destination mode split for both GO rail and local transit.

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 and 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 trips starting from work. The origins and destinations for each mode are factored to a common total, using a specified weighting factor, prior to calculation of the split for the next mode. The mode split factors applied in the running of the model may be based on the same aggregations as used in the calibration, a different set of aggregations or on individual zone values. The post-distribution GO rail egress mode split factors are used to calculate the proportion of GO Rail trips that use local transit as the egress mode at the destination end. The remaining GO Rail trips are assumed to use auto as their means of egress.

Table 10 - Work Trip Mode Split Factors (%)

Municipality	Zone Group	Origins			Destinations			GO Rail Transit Egress
		Other	GO Rail	Transit	Other	GO Rail	Transit	
Halton Hills	gm371	6.2	0.0	0.4	2.9	7.3	0.8	0.0
"	gm372	3.8	0.0	1.7	2.3	3.1	0.5	0.0
Milton	gm381	2.2	0.0	0.0	2.0	4.2	0.3	6.3
"	gm382	0.9	0.4	0.0	0.0	7.0	0.8	0.0
Oakville	gm391	2.0	1.4	2.4	2.7	10.2	1.9	25.4
"	gm392	0.6	0.9	0.6	0.3	17.2	0.6	12.8
"	gm393	2.6	0.0	1.5	2.1	15.4	2.0	29.7
"	gm394	2.1	0.5	0.9	0.7	18.0	1.1	8.7
Burlington	gm401	1.8	0.0	1.7	1.0	2.0	1.7	0.0
"	gm402	2.0	0.3	2.4	1.9	7.5	2.0	15.9
"	gm403	1.0	0.2	1.3	0.9	7.4	1.0	10.4
"	gm404	4.3	0.0	12.8	0.0	2.6	0.0	0.0
Caledon	gm341	2.2	0.0	0.0	1.4	2.4	0.7	0.0
"	gm342	1.5	0.0	0.7	1.1	2.2	0.9	12.5
Brampton	gm351	0.0	0.0	0.7	0.0	4.0	2.6	0.0
"	gm352	2.6	0.2	4.4	1.8	5.0	4.3	11.5
"	gm353	1.0	0.0	4.7	0.0	1.8	0.7	0.0
"	gm354	3.5	0.0	5.5	1.4	3.6	7.1	12.0
"	gm355	0.7	0.0	3.9	1.0	0.7	3.1	0.0
"	gm356	2.5	0.0	3.5	1.2	4.0	4.6	9.4
Mississauga	gm361	2.3	0.6	2.5	1.3	16.6	7.3	7.5
"	gm362	5.1	1.1	5.9	2.3	10.1	7.6	2.6
"	gm363	1.8	0.1	4.5	1.7	7.5	4.7	2.3
"	gm364	2.7	0.2	6.2	2.0	5.8	12.6	4.7
"	gm365	1.3	0.1	4.1	1.1	8.4	2.1	5.9
"	gm366	0.6	0.0	5.6	0.5	6.6	7.5	6.2
"	gm367	0.8	0.1	6.0	2.4	1.6	9.4	15.8
"	gm368	2.6	0.3	8.3	2.0	2.9	12.6	6.5
Toronto	gp1	9.4	19.4	55.0	30.1	0.4	45.9	100
"	gp2	10.1	0.8	27.6	9.2	0.1	42.8	100
"	gp3	5.1	0.3	21.1	4.8	0.5	33.9	7.6
"	gp4	7.2	2.4	34.7	7.2	0.1	36.9	100
"	gp5	2.2	0.4	15.8	2.5	0.3	25.2	0.0
"	gp6	11.2	0.6	27.5	6.5	0.1	41.5	100
"	gp7	4.2	0.9	10.7	4.5	5.0	19.6	1.9
"	gp8	2.2	0.3	14.8	1.9	0.8	21.0	3.3
"	gp9	1.7	0.2	9.1	2.3	1.3	15.9	13.0
"	gp10	2.3	0.1	15.4	3.1	0.3	24.0	37.6
"	gp11	3.5	0.5	23.0	4.0	0.3	32.5	21.5
"	gp12	1.6	0.0	10.9	1.6	2.0	26.9	0.0
"	gp13	2.5	0.2	15.7	2.3	1.5	28.7	5.9
"	gp14	5.2	0.3	11.8	2.8	5.1	26.3	0.0
"	gp15	2.5	0.0	10.9	0.7	8.4	14.4	6.0
"	gp16	1.6	0.2	11.1	1.6	2.1	21.6	7.4

Table 10 (Cont.) - Work Trip Mode Split Factors (%)

Municipality	Zone Group	Origins (%)			Destinations (%)			GO Rail Transit Egress
		Other	GO Rail	Transit	Other	GO Rail	Transit	
Uxbridge	gp17	6.0	0.0	0.0	3.5	0.0	0.0	0.0
Brock	gp18	3.4	0.0	1.6	1.9	2.4	0.7	0.0
Scugog	gp19	3.0	0.0	0.0	1.8	2.0	0.0	16.6
Pickering	gp20	1.3	1.2	1.6	1.1	10.7	2.3	25.4
Ajax	gp21	1.8	0.8	2.2	1.0	13.3	3.2	17.6
Whitby	gp22	1.9	0.4	1.1	1.1	11.4	2.0	17.7
Oshawa	gp23	3.0	0.3	2.5	2.3	4.8	2.8	13.0
Clarington	gp24	3.7	0.0	0.9	1.8	4.6	0.4	11.8
Georgina	gp25	4.2	0.0	0.0	1.6	0.7	0.7	0.0
East garafraxa	gp26	3.8	0.0	0.0	0.4	2.3	0.9	0.0
Newmarket	gp27	2.0	0.0	2.2	1.9	4.2	3.5	6.2
Aurora	gp28	3.6	0.0	1.4	2.3	3.1	2.6	21.5
Richmond Hill	gp29	1.1	0.1	4.5	0.6	6.0	8.0	15.6
Whit.-Stouf.	gp30	4.9	0.0	0.5	3.5	4.3	0.0	0.0
Markham	gp31	0.8	0.0	4.7	1.0	4.1	10.0	11.0
King	gp32	3.5	0.6	0.6	2.4	1.5	1.8	0.0
Vaughan	gp33	0.7	0.0	5.8	0.9	1.4	8.4	2.1
Flamborough	gp41	2.3	0.0	1.2	1.9	3.0	0.0	0.0
Dundas	gp42	7.2	0.0	3.6	4.5	1.4	1.5	0.0
Ancaster	gp43	1.5	0.0	0.9	0.8	0.6	0.9	0.0
Glanbrook	gp44	3.3	0.0	4.2	2.1	0.0	0.0	0.0
Stoney Creek	gp45	1.6	0.0	2.2	0.8	1.2	1.3	0.0
Hamilton	gp46	5.6	0.1	6.4	5.3	1.9	6.7	13.6
Mean values								
Toronto		5.8	7.0	29.1	6.9	1.2	30.9	12.1
Durham		2.4	0.5	1.7	1.6	8.2	2.1	18.3
York		1.2	0.0	4.5	1.2	3.4	7.1	10.4
Peel		1.5	0.1	5.2	1.4	5.7	6.7	6.7
Halton		2.0	0.4	1.5	1.6	9.7	1.3	15.7
Hamilton		4.9	0.1	5.4	4.0	1.7	4.6	9.8
GTA+Hamilton		4.0	3.6	16.3	4.1	3.6	16.5	12.1

Table 11 – External non-zero Mode Split Factors (%)

Municipality	Zone	From Work trip Destinations for trips originating in the GTA and Hamilton	
		GO Rail	Transit (Bus)
City of Peterborough	4002	0.0	2.6
Peterborough County	4003	1.2	0.0
Kawartha Lakes South	4004	2.0	0.0
Simcoe South	4100	2.1	1.9
Simcoe West	4101	0.9	1.0
Barrie	4102	1.5	3.5
Simcoe North	4103	0.0	5.1
Orillia	4104	0.0	6.2
Orangeville	4201	1.1	0.0
Guelph	4301	0.9	2.7
Wellington South	4302	2.1	0.0
Wellington North	4303	5.2	0.0
Kitchener-Waterloo	4402	0.0	0.8
Grimsby	4405	2.3	0.5
St Catharines	4406	1.1	1.6

1.5 Trip Distribution

Trips that start from work 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). Non-work auto trips are distributed in the same manner. The two non-work transit trip purposes are distributed by factoring each row or column of the applicable "base" matrix to the desired row or column totals. The rows are factored to the desired origin trip total for the from home transit trip matrix and the columns to the desired destinations for the to home matrix. 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 2001 TTS data, supplemented by 1996 TTS data for Waterloo and Northumberland and 1991 Census Place of Work – Place of Residence data for the Regional municipality of Haldimand-Norfolk and the County of Brant. These "probability" matrices have the following properties

a) When balanced to the TTS trip end totals they produce a trip pattern that is almost identical to the TTS at an aggregated level (e.g.: PD to PD) but which is more distributed at the individual zone level.
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 matrices can therefore be used to obtain trip distributions in newly developed areas for which there is no existing trip data. The resulting trip length distribution should be similar to that observed in other areas. The GO Rail and transit matrices do have some zero row and column totals. These are in areas where there is currently no ridership at all even at a very aggregate level (e.g. Planning District).

Table 12 compares the TTS, the "base" matrices and 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 820 thousand (905 x 905). 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 at all today, the number of trips is not likely to become significant in the foreseeable future.

Table 12 - Trip Distribution Matrices

Trip Category	No. of trips (2001 TTS)	Number of non zero cells	
		2001 TTS	Base matrix (Possible O-D pairs)
From work auto	1,314,573	17,028	744,430
From work GO Rail	49,439	458	80,201
From work local transit	218,431	1,506	144,017
Non work auto	1,582,968	12,455	660,316
Non work>home transit	138,339	4,803	196,408
From home transit	43,101	1,630	93,744

The calibration of the trip distribution matrices was performed and documented in the development of the GTA version of the model. The distribution matrices for the Halton model were then obtained by aggregating the appropriate cell values (probabilities) for areas outside the region Halton. Within the region of Halton the values were divided equally between the Halton zones that make up each of the GTA zones within the region. It is not necessary to weight by relative size since that is done in the first iteration of the balancing.

The base matrices used to distribute non-work transit trips were obtained in the same manner except that scaling factors were re-applied to ensure that the row totals in the matrix used to distribute trips from home, and the column totals in the matrix used to distribute to home trips, all have unit values.

1.6 Auto Assignment

Prior to assignment the matrices for the different trip purposes are aggregated. The auto egress component of the GO rail trips is included in that aggregation. Data from the 1997 and 1999 GO Rail surveys were combined with the data from the 2001 TTS to obtain the observed split between GO rail stations used by the residents of each zone. The three surveys were combined to increase the number of zones for which observations were available. Zones for which no data were available were assigned the average station distribution for the mode split aggregation (ref. figures 2 & 3) containing the zone. The observed station distribution is stored as a full matrix with each row normalized to sum to a total value of one. The number of GO rail egress trips added to the trip matrix is the total number of GO rail destinations to each zone, after the transit egress component has been subtracted, multiplied by the appropriate row of the observed distribution matrix.

An auto occupancy matrix is used to calculate the number of auto vehicles (auto drivers) and a peak hour factor is applied. The base case auto occupancy factors are shown in Tables 13 and 14. The factors are the number of auto drivers plus passengers divided by the number of auto drivers in the 2001 TTS data. Three different levels of aggregation have been used to calculate the factors with municipality (Planning district in Toronto) being the primary one. Table 13 shows the average auto occupancy factors for all trip movements between municipalities where the expanded TTS auto person trip total exceeds 1000 persons (approximately 50 observations). Municipal to municipal trip movements of less than one thousand auto persons have been aggregated together at the region to region level. These values, shown in Table 14, are used for all trip movements not shown in Table 13.

In the calibration of the GTA model intra-municipal trip movements within the Cities of Brampton and Mississauga were further sub-divided by the zone groups used for trip generation and mode split (See Figure 2). These values, also shown in Table 13, have been retained for consistency between the two models.

In general it can be seen that average auto occupancy is lower for medium length trips than it is for either short trips or very long trips. Intra-municipal trips (values shown in bold type) generally have the highest level of auto occupancy. The TTS data does not include trip information for people under the age of 11 nor are these included in the model. The average auto occupancy figures used in the model are therefore likely to be lower than the values one would expect to observe on the street.

Table 13 - Auto Occupancy Factors – By Municipality or Zone Group (gg)

From	To		From	To		From	To		From	To		From	To		From	To	
1	1	**1.23**	4	1	1.29	8	1	1.16	11	13	1.31	16	1	1.22	27	25	1.19
	2	1.27		2	1.16		2	1.17		16	1.25		4	1.10		26	1.15
	3	1.27		3	1.21		3	1.24		29	1.22		5	1.24		27	**1.27**
	4	1.17		4	**1.23**		4	1.17		31	1.24		6	1.14		28	1.14
	5	1.21		5	1.29		7	1.24		33	1.31		11	1.12	28	27	1.20
	6	1.24		6	1.25		8	**1.28**		36	1.09		12	1.33		28	**1.30**
	7	1.22		8	1.14		9	1.31	12	1	1.43		13	1.30		29	1.31
	8	1.20		10	1.18		10	1.17		4	1.15		14	1.22	29	11	1.31
	9	1.17		11	1.19		33	1.12		5	1.21		15	1.25		16	1.12
	10	1.23		12	1.26		35	1.08		6	1.11		16	**1.38**		27	1.12
	11	1.25		13	1.22		36	1.16		11	1.26		20	1.13		28	1.19
	12	1.21		16	1.26		39	1.21		12	**1.27**		21	1.11		29	**1.32**
	13	1.26		29	1.17	9	2	1.15		13	1.19		22	1.08		31	1.24
	14	1.27		31	1.19		3	1.21		16	1.26		29	1.14		33	1.19
	15	1.37		33	1.15		8	1.19		29	1.08		31	1.21	30	30	**1.19**
	16	1.27		36	1.18		9	**1.40**		31	1.23	17	17	**1.12**	31	1	1.25
	20	1.17	5	1	1.12		10	1.34	13	1	1.25	18	18	**1.26**		3	1.12
	29	1.20		3	1.15		33	1.13		4	1.22	19	19	**1.25**		4	1.10
	31	1.25		4	1.24		35	1.19		5	1.24	20	15	1.24		5	1.18
	33	1.15		5	**1.30**		36	1.14		6	1.26		20	**1.26**		6	1.10
	35	1.19		6	1.20	10	1	1.24		11	1.21		21	1.17		10	1.12
	36	1.19		11	1.15		2	1.13		12	1.25		22	1.13		11	1.20
	39	1.10		12	1.23		3	1.28		13	**1.31**		23	1.12		12	1.21
	40	1.26		13	1.26		4	1.12		14	1.33	21	20	1.32		13	1.19
2	1	1.22		15	1.10		5	1.07		15	1.19		21	**1.29**		15	1.12
	2	**1.30**		16	1.19		8	1.16		16	1.27		22	1.15		16	1.20
	3	1.32		20	1.19		9	1.30		20	1.15		23	1.26		20	1.09
	4	1.16		29	1.13		10	1.30		21	1.13	22	20	1.29		21	1.14
	6	1.21		31	1.17		11	1.19		22	1.05		21	1.31		22	1.07
	8	1.29		33	1.15		13	1.10		23	1.16		22	**1.28**		23	1.10
	36	1.16		36	1.17		16	1.18		29	1.10		23	1.21		25	1.13
3	1	1.24	6	1	1.26		29	1.18		31	1.20		24	1.11		27	1.09
	2	1.25		4	1.22		31	1.18		36	1.17	23	19	1.14		28	1.17
	3	**1.32**		5	1.30		33	1.17	14	6	1.22		21	1.10		29	1.20
	4	1.24		6	**1.26**		35	1.18		13	1.33		22	1.26		30	1.12
	5	1.22		13	1.35		36	1.09		14	**1.25**		23	**1.25**		31	**1.28**
	8	1.19		14	1.22	11	1	1.17		15	1.37		24	1.18		33	1.18
	9	1.29		16	1.35		3	1.27	15	13	1.30	24	22	1.36		36	1.03
	10	1.25	7	2	1.20		4	1.25		14	1.23		23	1.31	32	32	**1.15**
	11	1.22		7	**1.27**		5	1.27		15	**1.32**		24	**1.22**			
	33	1.18		8	1.29		10	1.30		16	1.23	25	25	**1.22**			
	35	1.10		36	1.18		11	**1.32**		20	1.32	26	26	**1.25**			
	36	1.16					12	1.27					27	1.19			

Bold text denotes intra-municipal values.
Trip movements of less than 1000 auto persons (~50 observations) not included.
Municipal codes are shown in Figure 3.

Table 13 (Cont.) - Auto Occupancy Factors by Municipality or Zone Group (gg)

From	To		From	To		From	To		From	To		From	To		From	To	
33	1	1.19	35	1	1.17	36	13	1.18	40	36	1.11	46	43	1.21	Peel sub-areas (gg)		
	2	1.18		3	1.28		16	1.07		39	1.18		44	1.24			
	3	1.28		8	1.10		29	1.07		40	**1.23**		45	1.22	368	364	1.37
	4	1.12		9	1.19		31	1.15		41	1.16		46	**1.26**		368	**1.24**
	5	1.17		10	1.12		33	1.11		42	1.08	Peel sub-areas (gg)			364	363	1.23
	8	1.11		33	1.14		34	1.08		43	1.16	352	352	**1.31**		364	**1.31**
	9	1.23		34	1.14		35	1.15		45	1.10		354	1.17		365	1.25
	10	1.30		35	**1.23**		36	**1.23**		46	1.14		356	1.32		366	1.19
	11	1.27		36	1.16		37	1.06	41	40	1.31	353	352	1.30		368	1.23
	13	1.09		37	1.08		38	1.15		41	**1.22**		354	1.21	365	363	1.24
	16	1.14		39	1.09		39	1.11		46	1.31		356	1.18		364	1.21
	27	1.10	36	1	1.21		40	1.08	42	42	**1.22**		352	1.35		365	**1.25**
	28	1.11		2	1.14		46	1.12		46	1.18		354	**1.30**		366	1.22
	29	1.20		3	1.20	37	37	**1.25**	43	43	**1.24**		356	1.29	366	364	1.23
	31	1.14		4	1.13	38	36	1.19		46	1.23	355	354	**1.29**		365	1.18
	33	**1.25**		5	1.09		37	1.18	44	46	**1.32**	356	352	1.25		366	**1.25**
	34	1.13		6	1.14		38	**1.20**	45	45	**1.26**		354	1.27	367	363	1.07
	35	1.11		7	1.14		40	1.16		46	1.24		356	**1.29**		364	1.15
	36	1.12		8	1.15	39	35	1.20	46	36	1.11	361	361	**1.26**		365	1.14
34	34	**1.18**		9	1.14		36	1.20		39	1.10	362	362	**1.21**		366	1.17
	35	1.27		10	1.18		39	**1.25**		40	1.16	363	363	**1.36**		367	**1.27**
				11	1.09		40	1.15		41	1.19		364	1.26		368	1.22
				12	1.19		46	1.16		42	1.20		365	1.30			

Bold text denotes intra municipal or zone group values.
Intra municipal values for Brampton (35) and Mississauga (36) exclude the records used to calculate the zone group to zone group values within those two municipalities.
Trip movements of less than 1000 auto persons (~50 observations) not included
Group and Municipal codes are shown in Figures 2 and 3 respectively.

Table 14 - Auto Occupancy Factors – By Region

From \ to	Toronto	Durham	York	Peel	Halton	Hamilton	External
Toronto	**1.18**	1.14	1.10	1.13	1.09	1.17	1.18
Durham	1.18	**1.20**	1.15	1.19	1.35	1.35	1.19
York	1.17	1.11	**1.18**	1.11	1.06	1.09	1.15
Peel	1.15	1.13	1.09	**1.18**	1.10	1.06	1.14
Halton	1.17	1.10	1.15	1.09	**1.16**	1.07	1.13
Hamilton	1.26	1.06	1.06	1.22	1.20	**1.21**	1.19
External	1.30	1.25	1.25	1.24	1.28	1.16	**1.23**

Values exclude those trip movements shown in Table 13

The factor applied to convert peak period to peak hour is based on the estimated travel time by road in 2001 between each zone pair. A conversion factor of 0.37 is applied to trips with a travel time of less than 20 minutes and 0.30 for trips greater than 50 minutes. Linear interpolation is used to determine the appropriate factor for trips with a travel time greater than 20 minutes but less than 50 minutes. These factors were obtained from the 2001 TTS data shown in Table 15. The factor for long trips has been reduced by almost 20% for 2 reasons. Firstly the TTS data is based on trip start time whereas the volume

assigned to a link in the network includes trips from many different origins requiring different amounts of time to reach that point. Across the network as a whole these delays are likely to produce a more uniform dispersal of trip times particularly for long trips. The peak hour factor for long trips is reduced further to take into account the accumulated effect of delays due to congestion on critical links in the network. If the resulting queues are not dissipated until after the peak period is over then the number of trips observed, based on trip start time, actually represents a longer period time than the 3 hours for which the data was extracted. The conversion factors, and the time ranges to which they apply, may be modified when applying the model to future scenarios.

The modelling procedures include the option to add in a "background traffic" matrix prior to assignment. In the Halton region model this matrix has been used to represent the auto egress component of GO Rail trips as reported in the 2001 TTS. The TTS gives the egress station and the GTA zone of destination. The trip destinations have been split between the Halton zones that make up the GTA zones in proportion to the population numbers supplied by the region. The Halton sub-zone containing the appropriate GO Rail station is assumed to be the trip origin. The TTS data is for P.M. peak period auto drivers. In the modelling procedure the peak hour factor is applied but no auto occupancy factor. The model has provision for factoring the supplementary matrix both globally and selectively by origin zone (station) to reflect projected growth in GO Rail ridership.

Table 15 – Peak Hour Factors

	3 hours	1 hour	Ratio
Trips (2001 TTS)	2,373,898	895,858	0.377
Minutes	38,992,580	15,511,540	0.398
trips < 20 mins	1,700,466	619,741	0.364
% of total & assumed value	72%	69%	**0.38**
trips > 50 mins	151,676	60,169	0.397
% of total & assumed value	6%	7%	**0.3**

1.7 Transit Assignment

The transit assignment may be performed as part of the same scenario as the road assignment, using an integrated road and transit network, or as a separate "transit only" scenario. The current model differs from previous versions in that it is a single assignment that includes both GO rail and local transit trips. In previous versions these two components were assigned separately.

The GO Rail trips that have a local transit egress component are included in the “total” transit matrix using the original origins and destinations. Matrix convolutions (emme2 module 3.23) are used to add the GO Rail component of GO rail trips to the matrix with the zone containing the egress station substituted as the destination. The change in modelling procedure eliminates the need for the auxiliary transit mode “z” used to represent GO rail auto egress in previous versions of the model.

The assignment procedure does not "force" trips designated as being GO Rail on to GO Rail if the network provides a more attractive alternative using local transit. Similarly GO rail trips with a local transit egress component will be assigned to the best transit route determined by the network, which may or may not include a GO rail component. The assigned GO Rail volumes may therefore differ slightly from those shown by the mode split calculations. GO Rail volumes can also be obtained by aggregating the trip matrix to observed catchment areas (ensemble gs). These volumes should match the mode-split calculations.

The transit network currently being used with the Halton model differs from the one used in the GTA model in that it does not include detailed bus route information. An auxiliary transit mode “a” has been added to all highway and arterial roads (vdf codes 11 through 49) within the Regions of Peel and Halton on the assumption that some minimum level of transit service would be provided on these roads in the future. The auxiliary transit mode “a” has also been added to all road links outside Peel and Halton to provide the necessary connectivity for transit trips external to those two regions. The auxiliary transit walk mode “w” is included on all centroid connectors and road links to ensure that all transit O-D pairs in a trip table can in fact be assigned to the network.

The geographic representation of the GO rail system has been copied from the GTA network using the same links and node numbers. The representation of GO rail service has been simplified to consist of a single route operating in both directions on each line using a headway of 20 minutes and an average operating speed of 80 kph. These attributes impose a waiting and boarding time penalty of 17 minutes for trips that use GO rail in addition to, or instead of the auxiliary transit mode “a”. As a result trips of less than 15 km are highly unlikely to be assigned to GO rail while trips over 20 km will be if the trip orientation is consistent with the GO rail network. GO rail stations are connected to the local road and auxiliary transit network by transfer links using the auxiliary transit mode “t”. Only those stations where a significant number of GO rail riders reported using local transit for egress in the most recent GO rail survey are connected in this way. The transfer connections do not affect auto assignment since that the auto egress component is assigned according to the traffic zone containing the station.

Table 16 provides a summary of the GO rail station, zone and node reference numbers and shows which stations have a transfer connection to the local transit network.

Table 16 - GO Rail Reference Numbers

Station	GO Rail Survey	TTS	Network Node	GTA96 Zone	Halton Zone	Local Transit
Hamilton	11	GS02	91044	2520	8515	Yes
Aldershot	10	GS50	91039	2052	210	No
Burlington	9	GS03	91038	2059	233	Yes
Appleby	8	GS04	91037	2077	302	Yes
Oakville West	7	GS05	91036	2003	11	No
Oakville	6	GS06	91035	2014	45	Yes
Clarkson	5	GS07	91034	1539	1539	Yes
Port Credit	4	GS08	91033	1547	1547	Yes
Long Branch	3	GS09	91200	1		Yes
Mimico	2	GS10	91032	10	9007	No
Exhibition	1	GS11	91027	11	9002	Yes
Union	0	SS38	91001	225	9001	Yes
Danforth (Main)	21	GS13	91004	369	9006	Yes
Scarborough	22	GS14	91006	402	9014	No
Eglinton	23	GS15	91007	405	9013	Yes
Guildwood	24	GS16	91008	458		No
Rouge Hill	25	GS17	91010	449	9015	Yes
Pickering	26	GS18	91011	541	9020	Yes
Ajax	27	GS19	91013	569	9021	Yes
Whitby	28	GS20	91015	616	9022	Yes
Oshawa	29	GS01	91017	664	9023	Yes
Milton	37	GS21	91084	2124	472	Yes
Meadowvale	36	GS22	91087	1512	1512	Yes
Streetsville	35	GS23	91088	1503	1503	Yes
Erindale	34	GS24	91090	1578	1578	Yes
Cooksville	33	GS25	91093	1566	1566	Yes
Dixie	32	GS26	91094	1560	1560	No
Kipling	31	SS01	91095	4	9008	Yes
Guelph	49					Yes
Acton	48					Yes
Georgetown	47	GS48	91141	2164	582	Yes
Brampton	46	GS47	91140	1649	1649	Yes
Bramalea	45	GS46	91139	1629	1629	Yes
Malton	44	GS45	91138	1611	1611	No
Etobicoke North	43	GS44	91134	124	9009	Yes
Weston	42	GS43	91124	61	9003	No
Bloor	41	SS09	91122	169	9002	Yes
Barrie	56					Yes
Bradford	55	GS32	91080	1310		Yes
Newmarket	54	GS31	91079	1254	9027	Yes
Aurora	53	GS30	91075	1239	9028	Yes
King City	52	GS29	91071	1286	9032	No
Maple	51	GS28	91069	1076		Yes
Rutherford			91067	1078	9033	Yes
York Univ.			91146	96		No
Richmond hill	64	GS33	91115	1122	9029	Yes
Langstaff	63	GS34	91113	1150		Yes
Old Cummer	62	GS35	91109	328	9012	Yes
Oriole	61	GS36	91106	324	9005	Yes
Stouffville	77	GS41	91061	1301	9030	Yes
Markham	76	GS40	91060	1206	9031	Yes
Unionville	75	GS39	91059	1185		Yes
Milliken	74	GS38	91057	1181		Yes
Agincourt	73	GS37	91056	380	9016	No

2.0 Supplementary Features

The following features are not part of the basic model but are either available, as supplementary macros, or can be easily incorporated. Some have already been built into current Halton Region model applications.

2.1 Trucking

The basic modelling and assignment procedures do not include trucks. In order to obtain link volumes that are more representative of total traffic, an extra attribute "@trucks" has been included in the emme2bank test scenarios. This attribute contains an estimate of the current proportion of trucks on each link in the network based on count information as it applies to different type roads. Total link volumes are obtained by adding these percentages to the assign volumes.

2.2 Trip Length Adjustment

Trip distribution in the basic model is an extrapolation of existing travel patterns without consideration of improvements in the network or other changes in level of service that might occur in the future. The trip length adjustment procedure allows such changes to be taken into account. The home to work auto trip distribution is modified to reflect projected changes in travel between zones based on the equilibrium assignment of the initial trip table produced by the model. The simulated travel times for single occupant vehicles from the initial trip distribution are compared with the base year (2001) 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 increase the number of trips between origins and destinations where there is a projected improvement in travel time and to decrease the number trips between zones where there is a projected increase in travel time. The sensitivity of the adjustment is controlled by a coefficient the default value of which (0.03) has been set based on experience with the a.m. Peak model. The default value will produce a trip length distribution that is approximately midway between one having the same mean trip length (km) and one having the same mean travel time as the observed 2001 trip distribution.

2.3 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 time savings. 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:

$P_2 = 0.85(1- x)$

$P_3 = 0.10(1 - x)$

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 2001 Cordon Count Information for the p.m. peak hour. The implied auto occupancy, calculated from the distribution, will be higher than that shown in Tables 13 and 14 since the calibration takes into

account persons under the age of 11 who are not included in other components of the model. The coefficients may be modified if desired and are different from the recommended values for use in the a.m. peak period.

A multiclass assignment is used to calculate 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 estimates the number of new HOVs that might be formed as a result of differences in travel time between the three categories. Two factors are used to calculate the diversion. The first is the proportion of the occupants of single person vehicles that will get together to form two person "car pools" for each minute of time saving that there is between one and two person vehicles. The second factor is the proportion of one and two person vehicle occupants that will combine to form three person "car pools" for each additional minute of time saving between two and three person vehicles. The procedure has been tested using values of 0.02 and 0.01 respectively for these two factors reflecting the observed experience when carpool lanes were first introduced on the Shirley highway in Washington D.C. The factors may be modified to reflect local experience. A second multiclass assignment completes is performed to complete the procedure.

2.4 Zone Splitting

Zone splitting can be used to increase the level of network detail and assignment results for a specific sub-area. The procedure to do that is to run the model using the existing zone system for which the model has been calibrated. The trips contained in the resulting auto driver trip table are then re-distributed between the sub-zones that make up each of the original zones on the basis of population and employment. A macro is available to perform the re-distribution using the weights shown in Table 17. These weights have been calculated on the basis of average trip generation rates and combination of trip purposes. The population and employment numbers assigned to the sub-zones are used to determine the proportion of trips to be assigned to each sub-zone. The total number of trips remains the same even if the total population or employment differs from the zone total used to run the model.

Table 17 - Population and Employment Weights for Zone Splitting

	Employment Weight		Population weight	
	Origins	Destinations	Origins	Destinations
a.m. model	0.05	0.9	0.95	0.1
p.m. model	0.8	0.35	0.2	0.65

The zone splitting procedure can be applied within the same emme2bank as was used to run the model providing that the following rules are followed in assigning numbers to the sub-zones.

1. The original zone numbers are retained, either as one of the sub-zone numbers or as dummy zones with zero population and employment.
2. Any new zone numbers that are assigned must have a zone number higher than that of any existing zone.

Failure to adhere to the above rules will cause corruption of the matrix data already contained in the emme2bank.

3.0 Validation

Validation of the model consists primarily of comparisons between a 2001 "Base Case" simulation, the 2001 TTS data and available cordon count information. The network used for calibration and validation of the GTA version of the model is Release 1 of the 2001 integrated network developed at the DMG. The road network used for the Halton model is the same network as used for the 1996 version of the model updated to 2001.

3.1 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 (ha2001) uses population and employment estimates provided by the 6 Regional Municipalities. Table 18 provides a comparison of the three sets of data. The total GTA population reported in the TTS is 3.3% 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. No adjustment has been made to the trip rates but a global adjustment factor of .97, applied to all the population based trip generation rates, is recommended when applying those rates to population estimates based on census data.

Table 18 - Population Data by Region

	2001 TTS	2001 Census	Base Case (ha2001)
Toronto	2,368,717	2,476,177	2,444,886
Durham	492,197	506,901	502,820
York	720,954	729,254	743,776
Peel	954,231	988,948	982,114
Halton	364,107	375,229	375,227
Hamilton	485,957	490,268	487,533
Total GTA	5,386,163	5,566,777	5,536,356

Employed Labour Force is not calculated or used directly in the model but is clearly a factor in determining trip generation rates. Table 19 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 19 - Employed Labour Force by Region

	2001 TTS	2001 Census	Difference	
Toronto	1,192,866	1,228,015	-35,149	-2.9%
Durham	253,498	247,395	6,103	2.5%
York	379,915	387,620	-7,705	-2.0%
Peel	507,829	535,330	-27,501	-5.1%
Halton	188,799	204,600	-15,801	-7.7%
Hamilton	230,543	232,240	-1,697	-0.7%
Total GTA	2,753,450	2,835,200	-81,750	-2.9%

Table 20 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 due to the close proximity of Brant County and Haldimand-Norfolk. The census and TTS employment totals for the GTA are almost identical. The base case total is 7.6% higher than either the TTS or census totals and there is considerable variation in the magnitude of the difference by region. If future employment estimates are derived from either the TTS or census data no adjustment of employment based trip rates should be necessary. If the current employment numbers from the regions continue are used as the base for future forecasts the employment based trip rates need to be adjusted by region to reflect the initial differences relative to the TTS and Census. Table 21 shows the adjustments used in the validation of the ha2001 base case scenario. Some of the difference, primarily in Halton and Hamilton, can be attributed to workers who commute from outside the TTS area.

Table 20 - Employment by Region

	2001 TTS	2001 Census	Base Case (ha2001)	Difference (TTS relative to ha2001)	
Toronto	1,339,544	1,327,610	1,453,539	-113,995	-7.8%
Durham	164,319	163,550	160,129	4,190	2.6%
York	353,380	350,165	415,815	-62,435	-15.0%
Peel	480,866	487,495	558,880	-78,014	-14.0%
Halton	163,067	173,940	176,900	-13,833	-7.8%
Hamilton	182,599	188,370	199,012	-16,413	-8.2%
Total GTA	2,683,775	2,691,130	2,904,475	-220,700	-7.6%

Table 21 – Base Case (ha2001) Trip Rate Adjustments

Region	Trip Rate Adjustment	
	Employment Based	Composite Rates
Toronto	.92	.96
York & Peel	.85	.925
Halton & Hamilton	.95	.975

3.2 Trip Generation, Mode Split and Trip Distribution

Table 22 compares the simulated trip total, mean travel time and standard deviation of travel time in each trip category with the observed 2001 TTS data. The trip times used to calculate the mean and standard deviation were obtained from an equilibrium assignment of the TTS data to the road network. The same travel time matrix is used for all trip categories, both simulated and observed. These comparisons are based on GTA version of the p.m. peak model using a different land use (2001aa) than for the Halton Region base case (ha2001). A similar comparison using the output of the Halton model would require that the TTS trip data be assigned to the Halton zone system. The trip totals from the Halton model are included in the table. The 2001aa land scenario is based on census population and TTS employment data with no adjustment of employment trip rates. Trips external to the GTA and Hamilton have been excluded for consistency with the TTS data. The simulated non-work trip totals are higher than in the TTS data due to the adjustment of trip rates that takes into account the estimated under-reporting of trips in those categories in the TTS data. In addition the simulated peak hour driver trip matrix includes the home end egress component of GO rail trips not included in the TTS trip matrix. In addition the TTS peak hour trip matrix has been extracted for a 1 hour time window of trip start times common to all areas. In the simulation the application of different peak hours based on trip length reduces the proportion of long trips occurring in the peak hour relative to the number of short trips. Both these factors contribute to the lower average trip time in the simulation (15 minutes) in the simulation relative to the TTS (16.7 minutes).

The comparison shows that the GTA version of the model reproduces both the number of observed (TTS) trips and the observed trip length distributions with a high degree of accuracy in all trip categories. The

Halton Region model uses basically the same trip rates, mode split factors and trip distribution patterns as input and should therefore produce similar results relative to the TTS data.

Table 22 - Trip Totals and Travel Times within the GTA and Hamilton

	2001 TTS data			Base Case Simulation (2001aa)			ha2001
Trip Category	Total trips within the GTA & Hamilton	Minutes by road		Total trips within the GTA & Hamilton	Minutes by road		Total trips within the GTA & Hamilton
		Mean	S.D		Mean	S.D	
From work Transit	215,897	18.4	12.0	214,889	19.1	12.0	212,151
From work Auto	1,068,433	20.5	15.5	1,083,945	21.1	15.9	1,069,352
Non-work Auto	1,217,173	10.4	11.1	1,400,029	10.7	11.2	1,369,421
Non-work Transit	172,097	12.2	10.3	187,652	13.1	10.6	170,614
Total auto person	2,285,888	15.1	14.3	2,483,974	15.2	14.4	2,438,773
Total GO Rail	52,623	53.0	15.7	53,965	53.1	15.9	52,477
Total local transit	387,994	15.6	11.7	402,541	16.3	11.8	398,076
Peak hour auto driver	704,969	16.7	14.5	766,195	15.0	13.9	760,865

Municipal self containment (the number of trips that have both the origin and destination within the same municipal expressed as a percentage of the total origins or destinations for that municipality) is one measure that reflects the characteristics of the trip distribution and the amount of travel (person or vehicle km) that are being generated in total. A high self containment factor is desirable from the point of view of minimising total travel demand.

Table 23 compares the base case simulated work trip self containment with the corresponding values obtained from the TTS data. The table is for the p.m. peak period and includes trips by all modes that have "work" as the origin trip purpose. Trips to work are excluded. Trips to and from areas outside the GTA and Hamilton are also excluded from the origin and destination totals throughout for consistency. The observed values from the 1986, 1996 and 2001 surveys are included in order to give an indication of the historical trend. The municipalities in the Regions of Durham and York and the Planning Districts in Toronto are each represented by a single zone in the Region of Halton. The values shown therefore represent the intra-zonal movement of a single zone in those areas.

Table 24 is similar to Table 23 but for peak period auto person and peak hour auto driver trips by destination (generally the home end) only. The higher proportion of non-work trips should produce a slightly higher level of self containment in the simulation relative to the TTS data since non-work trips are, on average, about half the length of work trips made by automobile. The simulated peak hour driver trip matrix also includes the GO rail auto egress, producing a further increase in peak hour self containment relative to the TTS.

The TTS data shows a downward trend in the degree of work trip self containment since 1986 in all 4 of the municipalities that make up the Region of Halton. The amount of self containment of all trips made by automobile has, however, remained relative constant with the exception of Halton Hills. The simulation produces levels of work trip and total auto person trip self containment that are within 2% of the 2001 observed values for all 4 municipalities with one exception – total auto person for Milton. The simulated are higher than the observed values in all 4 municipalities as expected for the reasons given in the previous paragraph.

Table 23 – Municipal Self Containment of p.m. Peak Period Work Trips

	% of Total Work Trip Origins				% of Total Work Trip Destinations			
	1986 TTS	1996 TTS	2001 TTS	**ha2001**	1986 TTS	1996 TTS	2001 TTS	**ha2001**
PD1-Toronto	14	15	15	**14**	56	58	58	**72**
PD2-Toronto	25	28	26	**31**	12	13	11	**13**
PD3-Toronto	28	27	26	**29**	21	18	17	**22**
PD4-Toronto	19	19	19	**20**	18	18	17	**20**
PD5-Toronto	13	10	12	**13**	16	13	14	**17**
PD6-Toronto	34	33	30	**37**	14	13	12	**12**
PD7-Toronto	21	15	15	**18**	21	13	11	**16**
PD8-Toronto	22	21	18	**19**	17	20	17	**19**
PD9-Toronto	15	14	12	**13**	24	21	18	**21**
PD10-Toronto	24	18	17	**19**	30	28	24	**28**
PD11-Toronto	18	16	15	**16**	14	15	16	**15**
PD12-Toronto	11	9	8	**9**	8	10	8	**9**
PD13-Toronto	26	22	23	**23**	27	20	21	**26**
PD14-Toronto	18	20	18	**19**	5	5	6	**5**
PD15-Toronto	26	20	22	**27**	8	7	7	**7**
PD16-Toronto	22	19	21	**25**	14	16	19	**17**
Brock	81	69	75	**72**	50	31	30	**24**
Uxbridge	52	51	51	**45**	27	29	27	**23**
Scugog	72	65	67	**62**	37	29	34	**26**
Pickering	23	24	22	**18**	15	15	15	**10**
Ajax	30	29	31	**29**	22	16	17	**13**
Whitby	35	34	35	**30**	27	23	21	**16**
Oshawa	63	55	56	**57**	57	42	41	**40**
Clarington	49	57	61	**56**	38	26	27	**19**
Georgina	79	73	74	**67**	32	28	26	**24**
East Gwillimbury	27	25	35	**34**	5	6	9	**8**
Newmarket	46	42	43	**40**	32	28	33	**30**
Aurora	33	31	31	**29**	23	20	20	**19**
Richmond Hill	27	25	24	**24**	20	19	15	**18**
Whit.-Stouff.	31	27	24	**23**	22	18	16	**13**
Markham	19	22	23	**23**	21	27	29	**27**
King	35	21	28	**22**	12	10	14	**12**
Vaughan	12	20	25	**24**	18	27	28	**28**
Caledon	44	47	46	**41**	16	23	21	**19**
Brampton	55	52	52	**55**	41	34	35	**35**
Mississauga	45	45	45	**47**	44	47	51	**51**
Halton Hills	76	62	53	**54**	37	30	26	**25**
Milton	57	45	33	**34**	38	36	34	**38**
Oakville	44	38	34	**34**	38	34	32	**32**
Burlington	53	51	43	**45**	41	40	38	**39**
Flamborough	40	43	28	**29**	21	23	13	**10**
Dundas	45	31	39	**43**	22	19	18	**21**
Ancaster	33	25	26	**25**	18	12	14	**10**
Glanbrook	17	39	22	**24**	7	13	10	**9**
Stoney Creek	32	33	30	**29**	22	21	19	**18**
Hamilton	71	67	66	**68**	76	68	63	**67**

Table 24 – Municipal Self Containment of Auto Trips by Destination

	Peak Period Auto Person				Peak Hour Auto Driver			
	1986 TTS	1996 TTS	2001 TTS	**ha2001**	1986 TTS	1996 TTS	2001 TTS	**ha2001**
PD1-Toronto	32	29	27	**37**	33	28	25	**38**
PD2-Toronto	22	27	28	**32**	18	25	23	**30**
PD3-Toronto	28	28	29	**35**	28	22	23	**34**
PD4-Toronto	34	35	36	**40**	27	30	31	**39**
PD5-Toronto	24	24	26	**31**	22	22	22	**30**
PD6-Toronto	30	31	29	**34**	26	23	22	**33**
PD7-Toronto	29	24	23	**28**	25	19	19	**29**
PD8-Toronto	35	43	41	**45**	30	37	33	**44**
PD9-Toronto	35	33	33	**37**	32	27	28	**34**
PD10-Toronto	36	37	30	**37**	37	34	27	**36**
PD11-Toronto	29	30	31	**34**	27	27	26	**32**
PD12-Toronto	18	23	19	**22**	15	17	14	**22**
PD13-Toronto	39	37	36	**41**	38	33	32	**40**
PD14-Toronto	21	22	23	**20**	17	21	19	**22**
PD15-Toronto	25	25	26	**28**	22	19	17	**29**
PD16-Toronto	29	32	35	**37**	22	26	28	**35**
Brock	59	45	40	**31**	56	44	33	**33**
Uxbridge	43	51	45	**39**	41	42	38	**37**
Scugog	47	47	50	**41**	43	41	41	**40**
Pickering	31	38	40	**34**	23	32	35	**35**
Ajax	37	40	42	**37**	34	29	35	**38**
Whitby	42	45	43	**36**	36	42	41	**37**
Oshawa	68	60	59	**59**	64	58	56	**59**
Clarington	52	46	48	**38**	51	35	40	**37**
Georgina	45	41	48	**43**	40	35	40	**44**
East Gwillimbury	17	16	16	**13**	16	12	12	**12**
Newmarket	52	50	53	**51**	44	41	48	**49**
Aurora	35	40	41	**39**	25	29	34	**37**
Richmond Hill	34	37	39	**41**	26	33	32	**40**
Whit.-Stouff.	25	37	32	**29**	22	25	29	**30**
Markham	36	43	46	**44**	29	38	41	**43**
King	25	21	21	**15**	17	24	18	**16**
Vaughan	25	38	43	**42**	22	35	39	**41**
Caledon	35	36	36	**32**	29	33	34	**32**
Brampton	58	54	55	**58**	51	48	48	**57**
Mississauga	58	62	66	**68**	56	59	63	**69**
Halton Hills	57	53	51	**53**	50	40	42	**53**
Milton	58	56	53	**58**	53	51	52	**59**
Oakville	60	58	60	**59**	53	50	51	**60**
Burlington	61	61	61	**64**	54	54	58	**65**
Flamborough	31	32	30	**26**	29	29	26	**26**
Dundas	33	36	34	**40**	30	29	26	**40**
Ancaster	32	29	37	**36**	27	24	29	**35**
Glanbrook	11	15	15	**15**	13	13	12	**15**
Stoney Creek	34	32	32	**30**	34	28	31	**29**
Hamilton	79	76	72	**76**	76	71	71	**76**

3.3 Assignment Results

Tables 25 and 26 give comparisons between the simulated volumes, both auto and transit, from the base case (ha2001) assignment and cordon count data across a number of screen lines in the Region. The cordon count data were collected in the spring and summer of 2001 whereas the TTS data used to calibrate the model were collected in the fall. Neither the counts nor the simulation include commercial vehicles.

The model over simulates the observed total auto driver volumes by an average of 1% across all screen lines. The over simulation can be attributed to the peak direction of the QEW corridor which is known to be heavily congested. In some locations the counts are substantially less than the theoretically capacity of the highway and less than the observed counts taken in 1998. This might suggest that the flow of traffic when the counts were taken might have been reduced by "stop and go" traffic that generally reduces the capacity to les than the theoretical maximum. If that was the case the model may well provide a better estimate of the actual demand in that corridor than is provided by the count data.

The GEH statistic is included as a measure of the *overall quality of the calibration* used in economic assessment of road transport schemes in the UK (and now being adopted in other modelling exercises worldwide). Its use stems from the fact that neither the absolute difference nor the relative difference takes into account the importance of both the volume of the flow and the size of the difference. Basically, the GEH statistic is a form of the Chi-squared statistic that incorporates both relative and absolute errors for individual links or groups of links.

The formula used to calculate the GEH statistic is:

$$\mathrm{GEH} = \sqrt{\frac{(\mathrm{observed} - \mathrm{modelled})^2}{\left(\frac{\mathrm{observed} + \mathrm{modelled}}{2}\right)}}$$

In the UK standards individual links having a GEH value of less than 5 are considered good. A value greater than 10 is considered unacceptable. Screen line totals are expected to have a value of less than 4.

The GEH statistic may be useful in comparing the results of different models but it is not clear whether or not the UK standards are appropriate for modelling in the GTA. A prerequisite is that the count information be accurate and reliable. The cordon count data, on which the comparisons are based, were collected at a different time of year from the TTS data and are mostly based on a single day's observation, not an average over an extended period of time. Over simulation of the QEW volumes is the primary factor that produces most of the GEH values that exceed 10.

The model under-simulates the observed transit volumes across all screen lines by an average of 29% due, primarily to under-representation of bus volumes on the QEW and Highway 401. The cordon count data shows that these observed volumes are made up almost entirely of inter-city bus passengers. It is not known how well inter-city bus travel is represented in the TTS data used to calibrate the model. Trips made by non-residents of the survey area are not included. More than two thirds of all the bus riders recorded in the Halton cordon count data are attributed to inter-city buses. There is no evidence of significant over or under representation of total GO rail or local bus riders. Ridership on the GO Rail service to Hamilton is over-represented with a corresponding under-representation of the number of bus riders using the QEW. This difference in assignment results can be attributed to the simplified way in which those two services have been representing. Bus trips to/from the City of Guelph are assigned to Hwy 7 instead of Hwy401 leading to over-simulation of transit ridership across the Georgetown and Acton cordons and under-simulation on the 401 through Milton and at the Wellington boundary.

Table 25 – Screen Line Summary – Peak Direction

Screen Line	Cap.	Peak Direction									
	1 way	Dir	Autos - 1 hour					Transit - 3 hours			
	vph		Count	ha2001	Ratio	GEH stat	sim v/c	Count	Sim	Ratio	m/s %
Skyway	8050	S	4821	4898	1.02	1.1	0.61	122	85	0.70	0.7
(Skyway & lift bridge)											
West boundary South	7300	W	6077	6345	1.04	3.4	0.87	1715	1428	0.83	8.9
(Plains Rd & 403)											
Indian Creek	12250	W	8298	9190	1.11	9.5	0.75	750	1881	2.51	8.2
(Plains Rd to Hwy 5)											
Bronte Creek	9400	W	7294	7760	1.06	5.4	0.83	6271	5330	0.85	23.0
(Lakeshore Dr to Hwy 5)											
Oakville Creek	14300	W	11112	11285	1.02	1.6	0.79	7028	6768	0.96	20.7
(Rebecca St to Hwy 5)											
Mississauga boundary	17850	W	9806	10704	1.09	8.9	0.60	11071	10814	0.98	30.5
(Lakeshore Dr to Hwy 403)											
CNR Burlington	11800	S	7700	6814	0.88	10.4	0.58	342	460	1.35	2.9
(Waterdown Rd to Burloak Dr)											
CNR Oakville	13700	S	5738	5972	1.04	3.1	0.44	683	549	0.80	3.8
(Bronte Rd to Winston Churchill Blvd)											
South of Dundas in Burlington	8600	S	4028	3396	0.84	10.4	0.39	885	152	0.17	1.9
(Kerns Rd to Orchard Dr)											
South of Dundas in Oakville	14450	S	6241	5909	0.95	4.3	0.41	1361	298	0.22	2.1
(Hwy 25 to 9th line)											
Wellington Boundary (401)	8450	W	4508	4158	0.92	5.3	0.49	675	6	0.01	0.1
(Killbride to RR 34)											
Brampton Boundary	13950	W	10081	9131	0.91	9.7	0.65	1816	1033	0.57	4.7
(Brittania Rd to Hwy 7)											
North of 401	7250	N	2404	2255	0.94	3.1	0.31	14	13	0.89	0.2
(Trafalgar Rd to Guelph Line)											
South of 401	8000	S	2902	2429	0.84	9.2	0.30	15	30	1.97	0.5
(9th Line to Guelph Line)											
Georgetown	11100	In	4496	4671	1.04	2.6	0.42	630	1075	1.71	9.1
Milton	22850	In	10718	9532	0.89	11.8	0.42	2667	528	0.20	2.4
Acton	5300	In	1434	1755	1.22	8.0	0.33	71	28	0.39	0.7
Sub-Total	**194600**		**107658**	**106205**	**0.99**	**4.4**	**0.55**	**36116**	**30475**	**0.84**	**11.1**
2 Directions combined	389200		191680	192649	1.01		0.49	48662	34764	0.71	7.3

Table 26 – Screen Line Summary – Reverse Direction

Screen Line	Cap.	Reverse Direction									
	1 way	Dir	Autos - 1 hour					Transit - 3 hours			
	Vph		Count	ha2001	Ratio	GEH stat	sim v/c	count	ha2001	Ratio	m/s %
Skyway	8050	N	3378	3089	0.91	5.1	0.38	213	146	0.69	2.0
(Skyway & lift bridge)											
West boundary South	7300	E	5211	5022	0.96	2.6	0.69	1347	323	0.24	2.7
(Plains Rd & 403)											
Indian Creek	12250	E	5802	6847	1.18	13.1	0.56	0	377		2.3
(Plains Rd to Hwy 5)											
Bronte Creek	9400	E	5564	5602	1.01	0.5	0.60	908	348	0.38	2.6
(Lakeshore Dr to Hwy 5)											
Oakville Creek	14300	E	8495	8395	0.99	1.1	0.59	524	671	1.28	3.4
(Rebecca St to Hwy 5)											
Mississauga boundary	17850	E	8575	9038	1.05	4.9	0.51	1326	731	0.55	3.4
(Lakeshore Dr to Hwy 403)											
CNR Burlington	11800	N	5122	5362	1.05	3.3	0.45	448	238	0.53	1.9
(Waterdown Rd to Burloak Dr)											
CNR Oakville	13700	N	5780	6434	1.11	8.4	0.47	567	504	0.89	3.3
(Bronte Rd to Winston Churchill Blvd)											
South of Dundas in Burlington	8600	N	2810	2960	1.05	2.8	0.34	908	120	0.13	1.7
(Kerns Rd to Orchard Dr)											
South of Dundas in Oakville	14450	N	6683	6878	1.03	2.4	0.48	3133	501	0.16	3.1
(Hwy 25 to 9th line)											
Wellington Boundary (401)	8450	E	2338	2328	1.00	0.2	0.28	0	21		0.4
(Killbride to RR 34)											
Brampton Boundary	13950	E	4099	4665	1.14	8.6	0.33	1221	108	0.09	1.0
(Brittania Rd to Hwy 7)											
North of 401	7250	S	1332	1713	1.29	9.8	0.24	0	13		0.3
(Trafalgar Rd to Guelph Line)											
South of 401	8000	N	2560	2823	1.10	5.1	0.35	24	15	0.63	0.2
(9th Line to Guelph Line)											
Georgetown	11100	out	3029	3755	1.24	12.5	0.34	10	89	8.85	1.0
Milton	22850	out	11934	10038	0.84	18.1	0.44	1875	47	0.03	0.2
Acton	5300	out	1310	1494	1.14	4.9	0.28	42	38	0.90	1.1
Sub-Total	**194600**		**84022**	**86445**	**1.03**	**8.3**	**0.44**	**12546**	**4289**	**0.34**	**2.1**
2 Directions combined	389200		191680	192649	1.01		0.49	48662	34764	0.71	7.3

The transit assignment in the Halton Region model differs from the full GTA version of the model with respect to the manner in which the current transit network has been coded. In the GTA model the 2001 transit network for the entire GTA has been coded with a detailed representation of the actual routes (itineraries, headways and segment speeds) that operate in the A.M. peak period. Table 27 shows a comparison of the results obtained from a simulation run using the GTA A.M. model with an assignment of the 2001 TTS data. The validation of the TTS data showed that the number of a.m. peak period transit trips reported was within 2% of actual TTC ridership counts. Total reported GO Rail ridership was within 3% of the actual count. Peak period counts were not available for other transit operators. Reported daily ridership differed from the available counts from -20% for Mississauga to +65% for Richmond Hill with the TTS numbers generally higher than the counts provided by the transit operators.

Table 27 – A.M. Peak Period Transit (GTA model – GO Rail included)

Screen line	Peak direction					Reverse direction				
	Dir	# of routes	TTS	2001aa	Ratio	Dir	# of routes	TTS	2001aa	Ratio
Toronto										
North Toronto Boundary	S	45	23237	24443	1.05	N	33	5032	5968	1.19
East Toronto Boundary	W	8	11513	12822	1.11	E	4	436	389	0.89
West Toronto Boundary	E	64	38910	43002	1.11	W	42	3458	3159	0.91
Humber River	E	53	55503	58270	1.05	W	37	12608	12506	0.99
South of Hwy 401	S	76	67733	68161	1.01	N	48	23014	22809	0.99
Bala Sub-division		32	20391	22648	1.11	E	31	6488	7024	1.08
Sub-total		246	196895	206698	1.05		164	44548	44831	1.01
Peel										
Mississauga/Halton	E	21	16718	19933	1.19	W	13	904	500	0.55
Credit River	E	38	20786	22850	1.10	W	25	2924	2454	0.84
E of Hwy 10	E	80	38812	39914	1.03	W	68	9855	6572	0.67
N of the QEW in Mississauga	N	12	1225	1242	1.01	S	16	9328	3865	0.41
S of Hwy 401 in Mississauga	S	16	1300	1098	0.84	N	20	3137	2937	0.94
Brampton/Mississauga	S	14	3092	2699	0.87	N	19	1444	1094	0.76
Peel/York	E	4	447	304	0.68	W	2	38	45	1.20
Sub-total		185	82380	88040	1.07		163	27631	17467	0.63
York										
South York	S	15	3228	3149	0.98	N	7	134	500	3.73
East of Hwy 400	E	5	1277	884	0.69	W	7	2010	1622	0.81
West of Hwy 404	E	8	740	1398	1.89	W	10	3066	2805	0.91
Sub-total		28	5245	5431	1.04		24	5210	4926	0.95
Durham										
South of Hwy 401	N	76	67733	68161	1.01	S	48	23014	22809	0.99
Total		535	352254	368330	1.05		399	100404	90033	0.90
Bi-direction total		934	452658	458363	1.01					

4.0 Model Operation

4.1 Emme2bank

The emme2bank and the macros used to run the model are located in the directory "/halton/internal/model2001".

Matrices

The matrices used in the running of the model are identified by name, not number. The matrix numbers may vary as each matrix is assigned to the first available number when first initiated. Matrix names generally consist of 4 characters, the first 2 of which are always the letters "pm" and the remaining the number that was used in the previous version of the model. An exception to the previous naming convention is the scalars used to store the results of the transit assignment. These values result from network calculations the output of which has to be stored in a scalar matrix identified by I.D., not name. Appendix A contains a listing of the current matrix directory. Table 28 provides a summary of the current allocation by primary function.

Table 28 - Matrix Allocation Table

Matrix name	Status	Description
mspm		
1-26, 36-40	User Defined	Input parameters
27-35, 41-60	Calculated	Performance Indicators
61-68	Calculated	Validation check totals
99	Reserved	Internal use
ms (Matrix I.D.)		
121-132	Calculated	Transit assignment performance indicators
mopm or mdpm		
1-13	User Defined	Trip rates and mode split factors
18	User Defined	Population/Employment
20-43	Calculated	Trip end totals
45-51	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
Mfpm		
1-14	Protected	Base case trip distribution & other input matrices
15-16	User Defined	Auto occupancy & extra vehicle matrices
17-38	Calculated	Simulated trip and travel time matrices
43-60	Protected	TTS and calibration data

The matrices used as input to the trip distribution component of the model have been pre-loaded along with the base matrices containing the 2001 travel times and the distribution of GO rail egress stations for each destination zone. For most applications of the model these matrices do not change and should therefore be protected against accidental modification. The matrices are listed in Table 29.

Table 29 – Base Matrices

mfpm01	Work trip Auto
mfpm02	Work trip GO Rail
mfpm03	Work trip local transit
mfpm04	Non-work auto
mfpm05	Non-work to home transit
mfpm06	From home transit
mfpm07	2001 travel times
mfpm08	GO Rail egress station distribution

Zone Ensembles

A number of zone ensembles have been pre-defined or allocated for specific purposes as shown in Table 30. Ensembles gj, gk and gl are used in the matrix convolutions applied to GO rail trips. These ensembles are generated by the macro "pmod5" and do not need to be pre-defined. Any previous data stored in those ensembles will be over-written.

Table 30 – Zone Ensembles

Letter	Description and/or use
A	Calibration of trip distribution
G	Calibration & Input of trip generation Rates
H	GTA zone equivalence
J	Matrix convolution - Non-zero rows
K	Matrix convolution - Non-zero columns
L	Matrix convolution – Intermediate nodes
M	Calibration & Input of mode split factors
P	Planning district
R	Regions
S	Retail (sales & service) intensive zones
Q	Output of performance indicators

Volume Delay Functions

The 2001-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 in applying peak hour factors and in calculating a number of performance indicators.

The application of tolls can be taken into account in the auto assignment by adding the time equivalent of the toll to the appropriate volume delay function. This is done by appending " + X * length" to the end of the function. The appropriate value of X is determined from an assumed value of travel time and the toll rate using the expression:

$$X = \text{Toll rate (\$ per km)} * 60 / \text{value of travel time (\$ per hr)}$$

The emme2bank for the Halton Regional model was created with volume delay functions representing three different values of travel time, based on a toll rate of 10c per km, as shown in the following table.

Function	Value of X	Value of travel time
Fd14	0.5	$12 per hour
Fd15	0.4	$15 per hour
Fd16	0.33	$20 per hour

Subsequent testing of volume delay functions applicable to the existing section of Highway 407 has shown that a higher value of travel time is needed to produce assigned travel volumes that match observed volumes. A value of $24 per hour (X = 0.25) was found to produce the best results.

Network Scenarios

It is recommended that a new scenario be created for each model run. The current base road network was developed prior to the 2001 re-calibration of the model. Many of the node numbers are not consistent with the 2001 Integrated GTA network developed by the DMG.

Extra Attribute Data

Table 31 lists the extra attributes that have to be defined prior to any application that requires their use.

Table 31 - Extra Attributes

Attribute	Type	Required for	Description
@board	Line	Transit assignment	Passenger boardings
@trvol	Link	Transit assignment	Transit link volumes (Aux. + Route)
@truck	Link	User calculations	User defined - % truck traffic
@lkagg	Link	Performance Indicators	User defined

It is recommended that user field ul1 be used to identify cordon count stations for the output of screen line data. The recommended procedure is described in section 4.10.

4.3 Macros

The macros that run the model have been developed as independent modules. A master macro "pmod.mac" is call the modules in the proper sequence. Table 32 shows the current list of macros including those used in the supplementary features (Trip length adjustment and HOV assignment).

Table 32 - Macros

Macro name	Function
Pmod.mac	Calls the other macros in the required order
Pmod0	Sets run ID and calling arguments used by subsequent macros
Pmod1	Updates matrix input data using an external file
Pmod2	Work trip generation, mode split and distribution
Pmod4	Non work trip generation and distribution. Matrix aggregation
Pmod5	Transit assignment
Pmod6	Road assignment
Pmod7	Performance Indicator and trip end summary report
Pmod8	Modal split and auto performance report
Pmod9	Link aggregation performance report
Pmod10	Trip length adjustment
Pmod11	Road assignment with HOV lanes
Pmod12	Generation of new HOVs

The master macro "pmod.mac" can be edited to include only those macros that are required for a given run. The macros need to be run in the correct sequence 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 "pmac0" must be repeated as the first macro in each stage. If any performance reports have already been generated the output file should be copied, or renamed, prior to running the next stage otherwise the information in it will be lost.

The macro "pmod0" requires three calling arguments defined in the master macro (pmod.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 for the road assignments
- Arg3 The emme/2 scenario number for the transit assignments (may be the same as Arg2)

The macros "pmod7", "pmod8" and "pmod9" generate the reports that summarize the results of the model run. These reports are written to the file "Arg1_pm.rep". Any previous file of that name is deleted at the start of "pmod7". **The link summaries generated by "pmod9" are computer intensive and time consuming to produce. It is recommended that "pmod9" be skipped if a fast turn around is required. The report can be generated later.**

The macro “pmod10” performs the trip length adjustment described in section 2.2. The macro also re-calculates the total auto person and peak hour auto driver trip matrices. Macros “pmod7” through “pmod9” must be repeated in order to obtain the revised assignment results and performance indicators.

The macros “pmod11” and “pmod12” are used to perform the HOV assignment procedures described in section 2.4. “pmod11” stratifies the auto driver matrix into 1, 2 and 3+ occupants and performs the initial multiclass assignment. “pmod12” estimates the number of new HOV that might be forms as a result of the difference in travel time, and then performs a new multiclass assignment using the revised trip matrices.

The recommended way to disable one or more of the sub-macros is to insert a "/" as the 2nd character of the call line thus making it into a comment line. The following is an example of the master macro file “pmod.mac” modified to run (or re-run) just the auto assignment and performance indicator summaries.

```
username
        ~<pmod0 ha2001 2001 2001
        ~/<pmod1
        ~/<pmod2
        ~/<pmod3
        ~/<pmod4
        ~/<pmod5
        ~<pmod6
        ~<pmod7
        ~<pmod8
        ~<pmod9
        q
```

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

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

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

4.4 Input Data

The macro "pmod1" reads matrix input data contained in the file "x_pm", where "x" is the first argument used to call "pmod0". This file may be used to selectively modify the simulation parameters (mspm01 through mspm26 and mspm36 through mspm40), enter population and employment data and to redefine the trip generation rates and/or mode split factors as desired. It is recommended that matrices requiring change be deleted and re-created rather than modifying the values in the existing matrix. The macro will then still run even if the there is no existing matrix of that name whereas attempting to modify a non-existing matrix will cause a fatal area. If modifying an existing matrix it is important to remember that only the cells that are specified get changed. It is therefore essential to include zero values in the list.

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 as origin matrix mopm18 and the employment data as destination matrix mdpm18. The population and employment data is usually imported in the "x_pm" file at the start of the model run.

Table 33 provides a list of the other input parameters that can be modified, together with recommended values for the years 2001, 2006, 2011, 2016 and 2021. The 2021 values are also recommended for subsequent years. The recommended method of modification is to include specification of the desired scalar matrices and values in the "x_pm" file for each model run. Any scalars not included will retain the values from the previous run.

It is recommended that a new "x_pm" file be created for each model run using an appropriate name to identify the year and development scenario. The file should be saved, along with the output summary report, in order to provide a complete record of the input data for that model run. Every "x_pm" file should include specification of values for all of the scalars listed in Table 33 as well as any origin or destination vectors that may be selectively modified for different years or simulation scenarios. The inclusion of all

the scalar values in the appropriate "x_pm" file helps to prevent the accidental use of the wrong values from a previous run.

Table 33 - Recommended "Base Case" Input Parameter Values

mspm	Description	2001	2006	2011	2016	2021
01	Work to home origin factor	1	1	1	1	1
02	Work to home destination factor	0.97	0.95	0.92	0.89	0.85
03	Work to non home destination factor	1	1	0.99	0.99	0.99
04	Auto non-work origin factor	0.98	0.99	1	1.02	1.05
06	Transit from home factor	0.97	0.98	0.99	1.02	1.04
08	Transit non-work to home factor	0.97	0.97	0.97	0.97	0.97
09	Work trip generation origin weight	0	0	0	0	0
11	Work trip other m/s factor	1	1	1	1	1
12	Work trip GO Rail m/s factor	1	1	1	1	1
13	Work trip transit m/s factor	1	1	1	1	1
17	M/s origin weight - other mode	0.5	0.5	0.5	0.5	0.5
18	M/s origin weight – GO Rail	0.7	0.7	0.7	0.7	0.7
19	M/s origin weight - Local Transit	0.5	0.5	0.5	0.5	0.5
20	GO Rail non work factor	1.07	1.08	1.08	1.08	1.08
21	Local transit excluded factor	1.04	1.05	1.05	1.05	1.05
22	Auto occupancy adjustment factor	1	1	1	1	1
23	Trip length adjustment coefficient	0.03	0.03	0.03	0.03	0.03
24	2 person hov coefficient	0.85	0.85	0.85	0.85	0.85
25	3 person hov coefficient	0.10	0.10	0.10	0.10	0.10
26	3 person Hov conversion factor	0.01	0.01	0.01	0.01	0.01
36	Background traffic factor	1	1	1	1	1
37	Peak hour factor for short trips	0.38	0.38	0.38	0.38	0.38
38	Peak hour factor for long trips	0.3	0.3	0.3	0.3	0.3
39	Upper bound for short trips (mins.)	20	20	20	20	20
40	Lower bound for long trips (mins.)	50	50	50	50	50

4.5 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. Changing the appropriate global adjustment factor(s). (See table 33)
2. Performing matrix calculations to adjust the base case data. Zone groupings may be used to perform selective calculations.
3. Importing new rates or factors to the required matrices. The required matrices may be included in the "x_pm" file at the start of each model run.

An example where the modification of trip rates may be appropriate is with respect to retail intensive zones identified in Halton Region (See section 3.4)

4.6 Trip Distribution

The trip distribution can be modified by the creation of a new base matrix for the desired mode and trip purpose combination(s) (mf01 through mf08). It is recommended that a protected copy of the original matrix be made prior to removing the protection from the matrix to be modified. Applying a factor greater than 1 to the desired cells in the original base matrix will increase the number of simulated trips between those O-D pairs. A factor of less than 1 will reduce the number of the trips. The magnitude of the change, however, is likely to be somewhat less than the factor due to the moderating effect of the trip end balancing procedure.

4.7 Auto Occupancy

The auto occupancy matrix (mfpm14) may be modified by:

1. Applying the appropriate global adjustment factor (mspm22).
2. Performing matrix calculations on the base case matrix (mfpm14) as input
3. Importing a new matrix (mfpm14).

4.8 Background Traffic

In the current applications of the model the background traffic matrix (mfpm12) is set to zero values throughout. This matrix may be used to add auto driver trips that are not included in the basic simulation model.

4.9 Other Adjustment Factors

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

1. The weight assigned to the work trip origin total relative to the work trip 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. Local transit excluded factor.

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

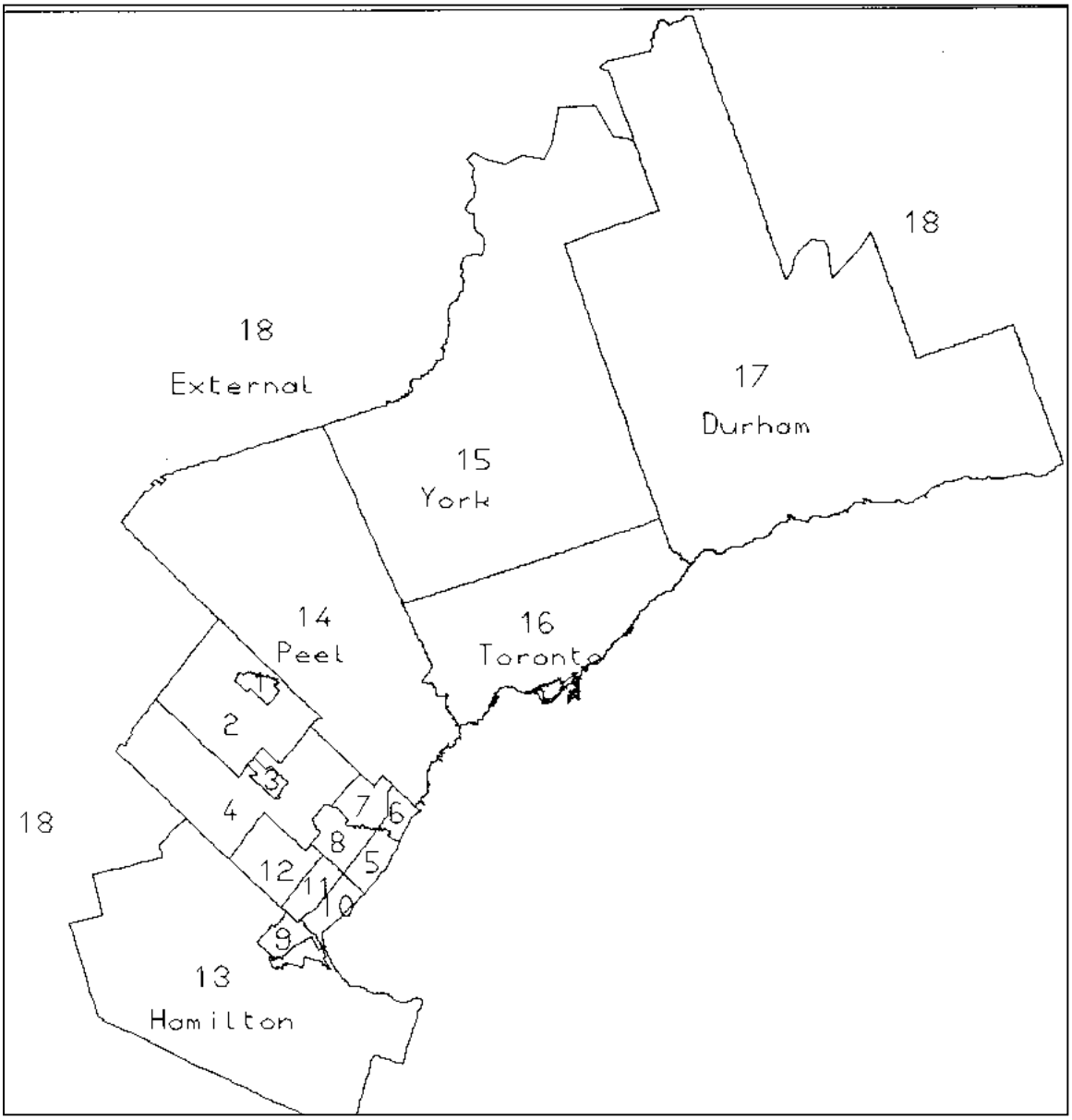
4.10 Model Outputs

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.

The macro “pmod7” produces 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 macros “pmod7” and “pmod8” produce reports that summarise trip data by the zone groups contained in zone ensemble “gq”. Figure 4 shows the groupings as they are currently defined in the emme2bank.

Figure 4 – Aggregations Used for Output Summaries



The macro "pmod7" produces two reports containing the following information

Report 1

- Population.
- Employment
- From work trip origins
- From home trip origins
- To home trip destinations
- Non home base non work trip origins

Report 2

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

Calculated performance indicators contained in the report produced by "pmod8"

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

Aggregated trip matrices (O-D) contained in the report produced by "pmod8"

- Peak hour auto driver trips
- Peak period auto person trips
- Peak period GO Rail trips
- Peak period local transit trips

This part of the output report may be imported to a spreadsheet for the purpose of calculating O-D specific mode splits. The number of zone groups defined in zone ensemble "gq" and the printer device option will determine the size of the output report and the number of pages required to print the aggregated trip matrices. The maximum number of aggregations that can be printed on a single page at 15 cpi (Device option set for HP Laserjet) is 9. The maximum for 2 pages per trip matrix is 19.

The macro "pmod9" calculates totals and averages for link aggregations defined by non-zero values of the extra link attribute "@lkagg". The report that is produced contains the following for each category of link.

- Number of links in the aggregation
- Total assigned vehicle km
- Total assigned vehicle hours
- Mean speed (kph)
- 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 is used to weight the result. Capacity utilisation is the appropriate measure to use as the average for a geographic area.

The link categories may be used to define screen lines, geographic areas, categories of road, or any combinations of these attributes. The current link categorization is a three digit number (xyz) where:

- x is the municipality
  1. Halton Hills
  2. Milton
  3. Oakville

  4 or 5 Burlington
- y is the type of link (typical lane capacity per the DMG coding standards)
  0. Freeway (1,800)
  1. Freeway ramp (1,400)
  2. Controlled access or rural highway (1,200)
  3. Rural highway or arterial road (1,500)

4. High capacity urban arterial (900)
5. Medium capacity urban arterial (700)
6. CBD arterial (500)
7. Collectors and local streets (400)
8. Centroid connectors (9999)

- z is the jurisdiction
  1. Federal
  2. Provincial
  3. Regional
  4. Local (Area municipality)
  5. Private (toll)

The allocation of links to the appropriate category requires that the DMG network coding standards be adhered to when coding and making modifications to the network. The macro "xxxxx" may be used to calculate the appropriate values of the extra link attribute "@lkagg" in a new scenario or to re-calculate the values after the network has been modified. The attribute must be created prior to running the macro.

The output 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 un-weighted average that does not take into account the different sizes of the aggregations.
- Origin and destination vectors are used to store the results of the calculations for each link aggregation. The zone numbers shown are the reference numbers for each link aggregations used in these vectors. There is no relationship to actual zones or zone system other than that a zone numbers must be defined as centroids in the network in order for them to be used as valid reference numbers.

Other matrix and link attribute data may be exported for external analysis using modules 3.14 and 2.41.

Appendix A - Emme/2 Matrix Directory

Matrix Directory
---

ms01: pm01	03-05-15 22:38	Work trip origin factor	.97
ms02: pm02	03-05-15 22:38	Work to home destination factor	.97
ms03: pm03	03-05-15 22:38	Work to non-home destination factor	.97
ms04: pm04	03-05-15 22:38	Non-work origin auto factor	.97
ms05: pm05	03-05-15 21:56	Auto non-home or work factor (1)	1
ms06: pm06	03-05-15 22:38	Transit home origin factor	.97
ms07: pm08	03-05-15 22:38	Transit non work to home dest. factor	.97
ms08: pm09	03-05-15 22:38	Trip generation origin weight (0)	0
ms09: pm11	03-05-15 22:38	Work trip other m/s adjustment (1)	1
ms10: pm10	03-05-15 21:56	Peak hour adjustment factor (1)	1
ms11: pm12	03-05-15 22:38	Work trip GO Rail m/s adjustment (1)	1
ms12: pm13	03-05-15 22:38	Work trip transit m/s adjustment (1)	1
ms13: pm17	03-05-15 22:38	m/s origin weight - other mode (0.5)	.5
ms14: pm18	03-05-15 22:38	m/s origin weight - GO Rail (0.7)	.7
ms15: pm16	03-05-05 17:25	m/s origin weight - other mode (0.5)	.5
ms16: pm19	03-05-15 22:38	m/s origin weight - local transit (0.5)	.5
ms17: pm20	03-05-15 22:38	GO Rail non work factor (1.08)	1.07
ms18: pm21	03-05-15 22:38	Local transit excluded factor (1.04)	1.04
ms19: pm22	03-05-15 22:38	Auto occupancy adjustment	1
ms20: pm23	03-05-15 22:38	Trip length adjustment coefficient (.03)	.03
ms21: pm24	03-05-15 22:38	2 person HOV coefficient (1.01)	.85
ms22: pm25	03-05-15 22:38	3+ person HOV coefficient (.16)	.1
ms23: pm26	03-05-15 22:38	new HOV coefficient (.01)	.01
ms24: pm36	03-05-15 22:38	Background traffic factor (1)	1
ms25: pm27	03-05-16 10:48	ha2001 Total population	7543946
ms26: pm28	03-05-16 10:48	ha2001 Total employment	3689634.5
ms27: pm29	03-05-16 10:48	ha2001 Employment per 1000 population	489
ms28: pm30	03-05-16 10:51	ha2001 peak hour auto driver trips	861410
ms29: pm31	03-05-16 10:47	ha2001 From work total trips	1489934
ms30: pm32	03-05-16 10:47	ha2001 From Work other trips	53970
ms31: pm33	03-05-16 10:47	ha2001 From Work GO Rail trips	50052
ms32: pm34	03-05-16 10:48	ha2001 From Work transit trips	215030
ms33: pm35	03-05-16 10:48	ha2001 From work auto trips	1170882
ms34: pm37	03-05-15 22:38	Peak hour factor for short trips (.38)	.38
ms35: pm38	03-05-15 22:38	Peak hour factor for long trips (.3)	.3
ms36: pm39	03-05-15 22:38	Upper limit for short trips (20 minutes)	20
ms37: pm40	03-05-15 22:38	Lower limit for long trips (50 minutes)	50
ms39: pm41	03-05-16 10:49	ha2001 non work origin auto trips	1494560
ms40: pm42	03-05-16 10:49	ha2001 non work to home transit trips	126637
ms41: pm43	03-05-15 21:56	GO Rail auto egress adjustment (1)	1
ms42: pm44	03-05-16 10:50	ha2001 from home transit trips	44124
ms43: pm46	03-05-16 10:50	ha2001 total auto person trips	2665442
ms44: pm47	03-05-16 10:51	ha2001 total GO Rail trips	53535
ms45: pm48	03-05-16 10:52	ha2001 total transit trips	400351
ms46: pm59	03-05-16 10:49	ha2001 Unadj. Non work auto origins	1540873600
ms47: pm60	03-05-16 10:49	ha2001 unadj non-work auto destinations	1540692480
ms48: pm61	03-05-16 10:47	Unadj. From work origin total	1539640832
ms49: pm62	03-05-16 10:47	Unadj. From work Dest total	1489934208
ms50: pm63	03-05-16 10:47	unadj. from work other origins	5731649.5
ms51: pm64	03-05-16 10:47	unadj. From work other dest.	5062433.5
ms52: pm65	03-05-16 10:47	unadj. From work GO Rail origins	4970074.5
ms53: pm66	03-05-16 10:47	unadj. From work GO Rail dest.	5087286.5
ms54: pm67	03-05-16 10:48	unadj. From work transit origins	21987482
ms55: pm68	03-05-16 10:48	unadj. From work transit dest.	21018614
ms56: pm99	03-05-15 21:56	initialized	0
ms121:pm49	03-05-16 10:53	ha2001 pm subway boardings	0
ms122:pm50	03-05-16 10:53	ha2001 pm subway passenger km	0
ms123:pm51	03-05-16 10:53	ha2001 pm streetcar boardings	0
ms124:pm52	03-05-16 10:53	ha2001 pm streetcar passenger km	0
ms125:pm53	03-05-16 10:53	ha2001 pm TTC bus boardings	0
ms126:pm54	03-05-16 10:53	ha2001 pm TTC bus passenger km	0
ms127:pm55	03-05-16 10:53	ha2001 pm GO Rail boardings	83024
ms128:pm56	03-05-16 10:53	ha2001 pm GO Rail passenger km	2406603
ms129:pm57	03-05-16 10:53	ha2001 pm GO Bus boardings	0
ms130:pm58	03-05-16 10:53	ha2001 pm GO Bus passenger km	0
ms131:pm70	03-05-16 10:53	ha2001 pm other bus boardings	0
ms132:pm71	03-05-16 10:53	ha2001 pm other bus passenger km	0

```
mo01: pm01             03-05-15 21:56  2001TTS Work trip origin rate
mo02: pm04             03-05-15 21:56  TTS non-work auto home origin *1.15
mo03: pm05             03-05-15 21:56  TTS non-work non-home auto origins*1.17
mo04: pm06             03-05-15 21:56  2001TTS transit home origin rate * 1.15
mo05: pm18             03-05-15 22:38  2001ha Population
mo06: pm11             03-05-15 21:56  2001TTS work trip origin other ms
mo07: pm12             03-05-15 21:56  2001TTS Work origin GO Rail ms
mo08: pm13             03-05-15 21:56  2001TTS work origin transit ms
mo09: pm20             03-05-16 10:49  ha2001 non-work pre-bal auto origins
mo10: pm21             03-05-16 10:49  ha2001 non work origin auto origins
mo11: pm23             03-05-16 10:49  ha2001 non work to home transit origins
mo12: pm25             03-05-16 10:50  ha2001 from home transit origins
mo13: pm27             03-05-16 10:50  ha2001 total auto person origins
mo14: pm28             03-05-16 10:51  ha2001 total GO Rail origins
mo15: pm29             03-05-16 10:52  ha2001 Total transit origins
mo16: pm31             03-05-16 10:47  ha2001 From work total origins
mo17: pm32             03-05-16 10:47  ha2001 From Work other origins
mo18: pm33             03-05-16 10:47  From Work GO Rail origins
mo19: pm34             03-05-16 10:48  ha2001 From Work transit origins
mo20: pm35             03-05-16 10:48  ha2001 From Work auto origins
mo21: pm41             03-05-15 21:56  initialized
mo22: pm42             03-05-16 10:55  ha2001 total home origins
mo23: pm43             03-05-16 10:50  ha2001 peak hour auto driver origins
mo24: pm45             03-05-16 10:56  ha2001 origin transit m/s (%)
mo25: pm46             03-05-15 21:56  initialized
mo26: pm47             03-05-16 10:56  ha2001 employment per 1000 population
mo27: pm48             03-05-16 11:15  ha2001 assigned vehicle hours (links)
mo28: pm50             03-05-16 11:16  ha2001 capacity utilization (%)
mo29: pm51             03-05-16 11:16  ha2001 total link volume (veh)
mo30: pm98             03-05-16 10:56  temp2 - transit (agg)
mo31: pm99             03-05-16 10:56  temp -auto + GO + transit (agg)
mo33: temp             03-05-15 22:34  temp
mo38: pm89             03-01-23 10:04  2001ha population by GTA zone
mo39: pm10     /r      03-01-23 10:08  Base year (ha2001) population
mo97: nozone           03-02-05 07:04  number of zones in split

md01: pm02             03-05-15 21:56  2001TTS work to home dest. Rate
md02: pm03             03-05-15 21:56  2001TTS work to non-home dest. Rate
md03: pm04             03-05-15 21:56  TTS non-work to home auto des. Rate*1.15
md04: pm05             03-05-15 21:56  TTS non-work to non-home auto dest *1.18
md05: pm08             03-05-15 21:56  TTS transit non-work to home dest.*1.07
md06: pm10             03-05-15 21:56  2001TTS GO Egress transit m/s
md07: pm11             03-05-15 21:56  2001TTS work dest. Other ms
md08: pm12             03-05-15 21:56  2001TTS work dest GO Rail ms
md09: pm13             03-05-15 21:56  2001TTS work destination transit ms
md10: pm15             03-05-16 10:50  ha2001 GO Rail auto egress destinations
md11: pm20             03-05-16 10:49  ha2001 non-work pre-bal auto dest
md12: pm21             03-05-16 10:49  ha2001 non work origin auto dest.
md13: pm23             03-05-16 10:49  ha2001 non work to home transit dest.
md14: pm25             03-05-16 10:50  ha2001 from home transit dest.
md15: pm27             03-05-16 10:50  ha2001 total auto person dest.
md16: pm28             03-05-16 10:51  ha2001 total GO Rail dest.
md17: pm29             03-05-16 10:52  ha2001 Total transit dest.
md18: pm31             03-05-16 10:47  %t!% From work total destinations
md19: pm32             03-05-16 10:47  ha2001 From Work other destinations
md20: pm33             03-05-16 10:47  From Work GO Rail destinations
md21: pm34             03-05-16 10:48  ha2001 From Work transit destinations
md22: pm35             03-05-16 10:48  ha2001 From Work auto destinations
md23: pm41             03-05-16 11:15  ha2001 number of links
md24: pm42             03-05-16 10:55  ha2001 total home destinations
md25: pm43             03-05-16 10:50  ha2001 peak hour auto driver dest.
md26: pm44             03-05-16 10:57  ha2001 self containment (% of dest.)
md27: pm45             03-05-16 10:57  ha2001 destination transit m/s (%)
md28: pm47             03-05-16 10:57  ha2001 mean auto person time (equi.)
md29: pm48             03-05-16 11:15  ha2001 assigned vehicle km (links)
md30: pm49             03-05-16 11:15  ha2001 mean link speed (kph)
md31: pm51             03-05-16 11:16  ha2001 volume/capacity ratio (link)
md32: pm97             03-05-16 10:57  temp - aggregated auto time (equil.)
md33: pm98             03-05-16 10:57  temp - auto drivers excl. extras
md34: pm99             03-05-16 10:57  temp - aggregated auto persons
md35: temp             03-05-15 22:33  temp
md37: pm18             03-05-15 22:38  2001ha Employment
md39: pm89             03-01-23 10:04  2001ha employment by GTA zone
md40: pm10xx   /r      03-05-06 07:12  Base year (ha2001) employment
md41: pm46             03-05-16 10:57  ha2001 mean auto person time (2001LOS)
```

```
mf01: pm14              03-05-15 21:56  2001 TTS pm peak Auto occupancy
mf02: pm15              03-05-16 10:51  GO Rail with auto egress
mf03: pm17              03-05-16 10:52  ha2001 Total transit (incl. GO Rail)
mf04: pm18              03-05-16 10:48  ha2001 From work transit
mf05: pm08     /r       03-05-05 16:53  GO Egress station distrib.
mf08: pm19              03-05-16 10:49  ha2001 From work auto
mf09: pm23              03-05-16 10:49  ha2001 non work origin auto
mf10: pm24              03-05-16 10:49  ha2001 non work to home transit
mf11: pm25              03-05-16 10:52  ha2001 GO Rail to egress station
mf12: pm26              03-05-16 10:49  ha2001 from home transit
mf13: pm28              03-05-16 10:50  ha2001 total auto person
mf14: pm29              03-05-16 10:48  ha2001 Total GO Rail trips
mf15: pm30              03-05-16 10:52  ha2001 Total local transit
mf16: pm31              03-05-16 10:49  temp non work origin auto
mf18: pm32              03-05-16 10:55  ha2001 auto travel times
mf20: local             03-01-25 07:02  mfpm38ha split to Halton zones
mf21: local             03-02-05 07:05  mfaa2001 split to Halton zones
mf22: pm38              03-05-16 10:50  ha2001 peak hour auto driver trips
mf35: pm07     /r       03-01-23 08:07  2001 pm travel times
mf37: pm01     /r       03-05-16 10:44  From work auto base
mf38: pm02     /r       03-05-15 21:58  From work GO Rail base
mf39: pm03     /r       03-05-15 21:59  From work transit base
mf40: pm04     /r       03-05-16 10:45  Non-work origin auto base
mf41: pm05     /r       03-05-15 22:00  Non-work to home transit base
mf42: pm06     /r       03-05-15 22:01  From home transit base
mf45: pm12              03-02-03 12:29  Add. auto driver trips (transit egress)
```

Appendix B - Sample Printout of Performance Indicators

```
EMME/2 Module:  3.14       Date: 03-06-30 06:26       User: E145/DMG.UTYU..eh?           Page:18656
 Project:        Model B Transportation Projects 2001-2003
 ---------------------------------------------------------------------------------------------------


 MATRICES BY ZONE GROUPS
 ***********************


 Data matrices:         mo05: pm18      2001ha Population                        (03-06-30 06:18)
                        md35: pm18      2001ha Employment                        (03-06-30 06:18)
                        mo16: pm31      hx2001 From work total origins           (03-06-30 06:18)
                        mo22: pm42      hx2001 total home origins                (03-06-30 06:26)
                        md24: pm42      hx2001 total home destinations           (03-06-30 06:26)
                        mo10: pm21      hx2001 non work origin auto origins      (03-06-30 06:21)

 Constraint matrix:     none

 Ensemble:              gq:                                                      (03-04-03 13:35)
 Aggregation:           sum

 Submatrix:             all zones


   zone      mo05      md35      mo16      mo22      md24      mo10
  group      pm18      pm18      pm31      pm42      pm42      pm21

   gq01     27549      9354      4284     10040     17354     10040
   gq02     20635      5946      2790      4429      9915      4429
   gq03     23410     15334      6373      9434     15068      9434
   gq04      8059      6566      3357      2724      5009      2724
   gq05     37884     23611     12144     12729     23521     12655
   gq06     23478     18836      8836      8909     14890      8909
   gq07     47620     19867      9050     16179     29265     16133
   gq08     35756      6986      3403      9809     19124      9809
   gq09     15642      6771      3092      4806      8655      4791
   gq10     64160     39292     17859     25480     43771     25418
   gq11     67501     22728     11444     20156     38071     20156
   gq12      3046      1305       642       760      1459       760
   gq13    487535    199011     87203    153334    264999    150905
   gq14    982114    558880    276799    267330    551492    263592
   gq15    743776    415815    212306    220610    437007    219735
   gq16   2444886   1453539    740057    583110   1245147    546941

   gq17    502820    160129     68467    153394    283171    152675
   gq18   2007868    785166     24072     36575    106586     36575

    sum   7543739   3749136   1492178   1539808   3114504   1495681
    avg    419097    208285     82899     85545    173028     83093
    min      3046      1305       642       760      1459       760
    max   2444886   1453539    740057    583110   1245147    546941
```

```
EMME/2 Module:  3.14       Date: 03-06-30 06:27       User: E145/DMG.UTYU..eh?           Page:18657
 Project:        Model B Transportation Projects 2001-2003
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 MATRICES BY ZONE GROUPS
 ***********************


 Data matrices:          mo14: pm28      hx2001 total GO Rail origins             (03-06-30 06:22)
                         mo15: pm29      hx2001 Total transit origins             (03-06-30 06:24)
                         mo13: pm27      hx2001 total auto person origins         (03-06-30 06:21)
                         mo23: pm43      hx2001 peak hour auto driver origins     (03-06-30 06:22)
                         md16: pm28      hx2001 total GO Rail dest.               (03-06-30 06:22)
                         md17: pm29      hx2001 Total transit dest.               (03-06-30 06:24)
                         md15: pm27      hx2001 total auto person dest.           (03-06-30 06:21)
                         md25: pm43      hx2001 peak hour auto driver dest.       (03-06-30 06:22)

 Constraint matrix:      none

 Ensemble:               gq:                                                      (03-04-03 13:35)
 Aggregation:            sum

 Submatrix:              all zones


   zone      mo14      mo15      mo13      mo23      md16      md17      md15      md25
  group      pm28      pm29      pm27      pm43      pm28      pm29      pm27      pm43

   gq01         0        62     14052      4580       582        17     16521      5276
   gq02         0        24      7070      2159       154        45      9610      2976
   gq03         0        45     15780      5089       275        32     14625      4649
   gq04        15        23      6093      1895       158         0      4841      1527
   gq05       181       365     24491      7763       946       477     22127      6926
   gq06        85        97     17729      6341      1014       135     13823      4566
   gq07         0       372     24998      7600      1987       586     26773      8670
   gq08        18       229     13203      4036      1701        32     17282      5723
   gq09         0       133      7977      2618        72        95      8416      2597
   gq10        57       732     43589     14611      1355       875     41579     13097
   gq11        24       447     32006      9957      1347       275     36199     11439
   gq12         0        12      1331       413        15        84      1444       461
   gq13        44     14047    237845     72348      1963     13679    247033     75757
   gq14       327     30394    520510    164394     16073     25027    506241    159651
   gq15        52     22757    417803    130768      6962     14493    406891    127803
   gq16     51824    323804   1009234    307004      7195    338965    925614    281921
   gq17       360      5586    219042     69295     10496      4148    266584     83997
   gq18         0         0     57976     15145       692       164    105126     28980

    sum     52987    399129   2670729    826016     52987    399129   2670729    826016
    avg      2944     22174    148374     45890      2944     22174    148374     45890
    min         0         0      1331       413        15         0      1444       461
    max     51824    323804   1009234    307004     16073    338965    925614    281921
```

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?           Page:18681
 Project:        Model B Transportation Projects 2001-2003
 ---------------------------------------------------------------------------------------------------


 MATRICES BY ZONE GROUPS
 ***********************


 Data matrices:          mo26: pm47      hx2001 employment per 1000 population    (03-06-30 06:27)
                         mo24: pm45      hx2001 origin transit m/s (%)            (03-06-30 06:28)
                         md27: pm45      hx2001 destination transit m/s (%)       (03-06-30 06:28)
                         md26: pm44      hx2001 self containment (% of dest.)     (03-06-30 06:28)
                         md41: pm46      hx2001 mean auto person time (2001LOS)   (03-06-30 06:28)
                         md28: pm47      hx2001 mean auto person time (equi.)     (03-06-30 06:28)
                         md30: pm49      hx2001 mean dest. auto occupancy         (03-06-30 06:29)

 Constraint matrix:      none

 Ensemble:               gq:                                                      (03-04-03 13:35)
 Aggregation:            maximum

 Submatrix:              all zones


   zone      mo26      mo24      md27      md26      md41      md28      md30
  group      pm47      pm45      pm45      pm44      pm46      pm47      pm49

   gq01    339.00       .44       .10     60.73     16.95     16.60      1.19
   gq02    288.00       .34       .46     51.45     23.94     24.06      1.17
   gq03    655.00       .28       .21     68.00     14.82     14.70      1.18
   gq04    814.00       .38       .00     57.75     22.44     22.45      1.18
   gq05    623.00      1.46      2.03     69.02     17.16     15.67      1.21
   gq06    802.00       .54       .90     54.74     17.22     15.74      1.19
   gq07    417.00      1.47      2.00     53.98     18.14     15.95      1.19
   gq08    195.00      1.70       .17     64.18     17.26     15.83      1.20
   gq09    432.00      1.64      1.11     69.15     18.38     16.48      1.20
   gq10    612.00      1.65      2.00     70.43     15.52     13.67      1.20
   gq11    336.00      1.38       .73     67.64     17.40     14.83      1.20
   gq12    428.00       .89      5.44     62.73     21.77     19.37      1.20
   gq13    408.00      5.58      5.21     81.64     10.83     11.96      1.22
   gq14    569.00      5.51      4.57     72.94     15.45     14.11      1.21
   gq15    559.00      5.16      3.38     64.72      7.42     11.58      1.21
   gq16    594.00     23.38     26.65     83.55      6.41     10.01      1.25
   gq17    318.00      2.48      1.47     67.82     12.02     14.71      1.21
   gq18    391.00       .00       .15       .00     59.90     50.09      1.16

    sum   8780.00     54.28     56.59   1120.48    333.06    317.81     21.56
    avg    487.78      3.02      3.14     62.25     18.50     17.66      1.20
    min    195.00       .00       .00       .00      6.41     10.01      1.16
    max    814.00     23.38     26.65     83.55     59.90     50.09      1.25
```

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?           Page:18682
Project:        Model B Transportation Projects 2001-2003
Matrix   mf22:  pm38      hx2001 peak hour auto driver trips
-------------------------------------------------------------------------------------------------
```

Matrix mf22: pm38 (hx2001 peak hour auto driver trips)

Ensemble: gq: 03-04-03 13:35
Aggregation: sum

origin groups \ destination groups	gq01	gq02	gq03	gq04	gq05	gq06	gq07	gq08	gq09	gq10
gq01	2358	613	114	65	4	13	25	3	3	12
gq02	492	602	84	36	3	9	16	5	1	7
gq03	205	166	2272	450	82	37	72	61	30	130
gq04	104	77	461	231	38	21	35	32	14	70
gq05	38	28	81	40	2141	555	918	1004	107	513
gq06	35	18	32	19	798	888	1014	742	60	278
gq07	31	27	28	19	846	530	1936	754	70	305
gq08	22	8	41	21	594	325	718	1125	41	212
gq09	4	3	20	10	60	20	40	49	338	616
gq10	28	18	96	45	337	103	193	228	702	5177
gq11	30	16	60	25	175	77	144	133	451	2357
gq12	1	0	3	2	5	7	5	9	22	97
gq13	11	8	99	44	124	114	223	87	365	1561
gq14	1215	850	773	306	1013	1357	2267	886	163	754
gq15	103	77	43	17	88	50	109	77	12	57
gq16	303	218	210	81	459	349	736	408	91	400
gq17	10	7	5	3	2	0	2	1	1	5
gq18	286	240	227	113	157	111	217	119	126	546
sum	5276	2976	4649	1527	6926	4566	8670	5723	2597	13097

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?           Page:18683
Project:        Model B Transportation Projects 2001-2003
Matrix   mf22:  pm38      hx2001 peak hour auto driver trips
-----------------------------------------------------------------------------------------------
```

origin groups	destination groups gq11	gq12	gq13	gq14	gq15	gq16	gq17	gq18	sum
gq01	19	0	45	598	54	108	14	532	4580
gq02	15	1	32	389	39	74	11	343	2159
gq03	115	6	252	559	59	205	29	359	5089
gq04	62	0	137	276	35	107	11	184	1895
gq05	429	19	686	646	60	288	14	196	7763
gq06	208	8	324	1300	60	341	13	203	6341
gq07	236	19	355	1673	71	438	12	250	7600
gq08	170	6	223	288	23	140	4	75	4036
gq09	449	22	710	80	3	33	3	158	2618
gq10	2953	110	3187	401	13	163	18	839	14611
gq11	3439	93	1905	346	39	143	33	491	9957
gq12	87	14	101	22	2	9	3	24	413
gq13	1210	66	61450	644	108	511	58	5665	72348
gq14	1054	52	1613	120552	5708	18958	1280	5593	164394
gq15	82	3	187	5613	84871	27867	6591	4921	130768
gq16	539	23	863	23725	33505	226320	13763	5011	307004
gq17	6	0	14	312	1481	3616	59694	4136	69295
gq18	366	19	3673	2227	1672	2600	2446	0	15145
sum	11439	461	75757	159651	127803	281921	83997	28980	826016

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?           Page:18684
Project:        Model B Transportation Projects 2001-2003
Matrix   mf13:  pm28      hx2001 total auto person
-------------------------------------------------------------------------------------------------

Matrix  mf13: pm28   (hx2001 total auto person                )
---------------------------------------------------------------
Ensemble:             gq:                                        03-04-03 13:35
Aggregation:         sum
```

origin groups	destination groups gq01	gq02	gq03	gq04	gq05	gq06	gq07	gq08	gq09	gq10
gq01	7238	1890	349	183	14	41	80	11	8	35
gq02	1608	1993	253	120	9	25	60	10	5	28
gq03	617	490	6935	1343	243	118	221	190	92	419
gq04	314	249	1468	705	124	61	109	99	51	214
gq05	129	92	265	127	6764	1822	2977	2764	322	1563
gq06	102	76	90	36	2217	2602	2146	1453	194	839
gq07	114	90	100	53	2805	1747	6373	2481	208	982
gq08	56	33	125	70	1950	1058	2353	3715	131	639
gq09	16	10	60	28	197	73	123	150	1078	1985
gq10	107	58	291	136	1051	305	614	702	2225	15671
gq11	92	65	181	77	542	240	448	402	1456	7601
gq12	4	1	11	3	25	15	22	27	66	314
gq13	31	25	328	170	377	357	704	265	1137	4930
gq14	3555	2597	2402	994	3197	3516	6692	2780	585	2525
gq15	339	247	147	60	306	170	373	271	44	203
gq16	1046	765	705	288	1662	1203	2566	1470	340	1497
gq17	41	36	23	10	6	3	7	7	4	24
gq18	1112	893	892	438	638	467	905	485	470	2110
sum	16521	9610	14625	4841	22127	13823	26773	17282	8416	41579

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?           Page:18685
Project:        Model B Transportation Projects 2001-2003
Matrix   mf13:  pm28      hx2001 total auto person
-----------------------------------------------------------------------------------------------
```

origin groups \ destination groups	gq11	gq12	gq13	gq14	gq15	gq16	gq17	gq18	sum
gq01	68	2	156	1677	191	391	42	1676	14052
gq02	44	2	112	1171	139	269	36	1186	7070
gq03	360	17	766	1700	226	721	95	1227	15780
gq04	205	6	423	879	120	379	45	642	6093
gq05	1297	56	2211	2087	224	1001	55	735	24491
gq06	608	28	1095	4081	221	1133	44	764	17729
gq07	737	46	1218	5332	261	1481	42	928	24998
gq08	517	24	731	938	85	486	14	278	13203
gq09	1461	76	1784	247	6	119	8	556	7977
gq10	8405	348	8909	1243	42	586	47	2849	43589
gq11	11178	304	5833	1096	138	537	101	1715	32006
gq12	289	47	313	61	6	28	8	91	1331
gq13	3814	207	201164	2338	377	2100	207	19314	237845
gq14	3460	126	5698	379499	17762	59731	4578	20813	520510
gq15	284	10	683	17363	271136	88210	19913	18044	417803
gq16	2024	79	3367	76358	104999	745513	45648	19704	1009234
gq17	24	0	62	1231	4617	11687	186656	14604	219042
gq18	1424	66	12508	8940	6341	11242	9045	0	57976
sum	36199	1444	247033	506241	406891	925614	266584	105126	2670729

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?           Page:18686
Project:        Model B Transportation Projects 2001-2003
Matrix   mf14:  pm29      hx2001 Total GO Rail trips
-------------------------------------------------------------------------------------------------

Matrix  mf14: pm29   (hx2001 Total GO Rail trips              )
-----------------------------------------------------------------
Ensemble:             gq:                                        03-04-03 13:35
Aggregation:         sum
```

origin groups \ destination groups	gq01	gq02	gq03	gq04	gq05	gq06	gq07	gq08	gq09	gq10
gq01	0	0	0	0	0	0	0	0	0	0
gq02	0	0	0	0	0	0	0	0	0	0
gq03	0	0	0	0	0	0	0	0	0	0
gq04	0	0	0	0	0	0	0	0	0	0
gq05	0	0	0	0	0	0	0	0	0	19
gq06	0	0	0	0	0	0	0	0	2	15
gq07	0	0	0	0	0	0	0	0	0	0
gq08	0	0	0	0	0	0	0	0	0	1
gq09	0	0	0	0	0	0	0	0	0	0
gq10	0	0	0	0	11	6	12	16	0	0
gq11	0	0	0	0	0	2	10	0	0	0
gq12	0	0	0	0	0	0	0	0	0	0
gq13	0	0	0	0	4	0	0	5	0	0
gq14	26	8	11	6	9	0	0	15	5	121
gq15	0	0	0	0	7	0	0	12	0	0
gq16	556	146	264	152	915	1006	1965	1653	65	1199
gq17	0	0	0	0	0	0	0	0	0	0
gq18	0	0	0	0	0	0	0	0	0	0
sum	582	154	275	158	946	1014	1987	1701	72	1355

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?           Page:18687
Project:        Model B Transportation Projects 2001-2003
Matrix   mf14:  pm29      hx2001 Total GO Rail trips
-----------------------------------------------------------------------------------------------
```

origin groups \ destination groups	gq11	gq12	gq13	gq14	gq15	gq16	gq17	gq18	sum
gq01	0	0	0	0	0	0	0	0	0
gq02	0	0	0	0	0	0	0	0	0
gq03	0	0	0	0	0	0	0	0	0
gq04	0	0	0	0	0	15	0	0	15
gq05	24	0	0	78	0	60	0	0	181
gq06	0	0	0	0	0	40	28	0	85
gq07	0	0	0	0	0	0	0	0	0
gq08	2	0	0	12	0	3	0	0	18
gq09	0	0	0	0	0	0	0	0	0
gq10	0	0	0	0	0	12	0	0	57
gq11	0	0	0	0	0	12	0	0	24
gq12	0	0	0	0	0	0	0	0	0
gq13	0	0	0	9	0	17	9	0	44
gq14	0	0	0	27	0	83	0	16	327
gq15	0	0	0	33	0	0	0	0	52
gq16	1321	15	1963	15868	6962	6780	10318	676	51824
gq17	0	0	0	46	0	173	141	0	360
gq18	0	0	0	0	0	0	0	0	0
sum	1347	15	1963	16073	6962	7195	10496	692	52987

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?          Page:18688
Project:        Model B Transportation Projects 2001-2003
Matrix   mf15:  pm30      hx2001 Total local transit
-------------------------------------------------------------------------------------------------

Matrix  mf15: pm30   (hx2001 Total local transit              )
-------------------------------------------------------------
Ensemble:             gq:                                        03-04-03 13:35
Aggregation:         sum
```

origin groups \ destination groups	gq01	gq02	gq03	gq04	gq05	gq06	gq07	gq08	gq09	gq10
gq01	0	0	0	0	0	0	0	0	0	0
gq02	0	0	0	0	0	0	0	0	0	0
gq03	0	0	26	6	0	0	0	0	0	0
gq04	0	0	0	0	0	0	0	0	0	0
gq05	0	0	0	0	143	37	153	73	9	43
gq06	0	0	0	0	30	8	29	22	0	0
gq07	0	0	0	0	125	33	99	84	0	0
gq08	0	0	0	0	5	2	13	4	1	6
gq09	0	0	0	0	0	0	0	0	7	43
gq10	0	0	0	0	0	0	0	0	62	360
gq11	0	0	0	0	0	0	0	0	15	58
gq12	0	0	0	0	0	0	0	0	3	19
gq13	0	0	6	5	0	0	0	0	29	160
gq14	0	0	0	0	16	15	64	15	0	0
gq15	0	0	0	0	0	0	0	0	0	0
gq16	62	24	13	12	46	2	14	31	7	43
gq17	0	0	0	0	0	0	0	0	0	0
gq18	0	0	0	0	0	0	0	0	0	0
sum	62	24	45	23	365	97	372	229	133	732

```
EMME/2 Module:  3.14       Date: 03-06-30 06:29       User: E145/DMG.UTYU..eh?           Page:18689
Project:        Model B Transportation Projects 2001-2003
Matrix   mf15:  pm30      hx2001 Total local transit
-----------------------------------------------------------------------------------------------
```

origin groups \ destination groups	gq11	gq12	gq13	gq14	gq15	gq16	gq17	gq18	sum
gq01	0	0	0	0	0	17	0	0	17
gq02	0	0	0	0	0	45	0	0	45
gq03	0	0	0	0	0	0	0	0	32
gq04	0	0	0	0	0	0	0	0	0
gq05	0	0	19	0	0	0	0	0	477
gq06	0	0	4	35	0	7	0	0	135
gq07	0	0	16	215	0	14	0	0	586
gq08	0	0	1	0	0	0	0	0	32
gq09	19	0	23	0	0	3	0	0	95
gq10	245	10	174	0	0	24	0	0	875
gq11	109	2	91	0	0	0	0	0	275
gq12	14	0	48	0	0	0	0	0	84
gq13	60	0	13287	0	0	132	0	0	13679
gq14	0	0	42	19717	104	5054	0	0	25027
gq15	0	0	0	402	6074	7996	21	0	14493
gq16	0	0	307	10025	16476	310271	1632	0	338965
gq17	0	0	0	0	16	199	3933	0	4148
gq18	0	0	35	0	87	42	0	0	164
sum	447	12	14047	30394	22757	323804	5586	0	399129

```
EMME/2 Module:  3.14       Date: 03-07-05 09:21       User: E145/DMG.UTYU..eh?          Page:19425
Project:        Model B Transportation Projects 2001-2003
-------------------------------------------------------------------------------------------------


MATRICES BY ZONES
*****************


Data matrices:          md23: pm41      hx2001 number of links                  (03-07-05 09:20)
                        md29: pm48      hx2001 assigned vehicle km (links)      (03-07-05 09:20)
                        mo27: pm48      hx2001 assigned vehicle hours (links)   (03-07-05 09:20)
                        md30: pm49      hx2001 mean link speed (kph)            (03-07-05 09:20)
                        mo28: pm50      hx2001 capacity utilization (%)         (03-07-05 09:20)
                        mo29: pm51      hx2001 total link volume (veh)          (03-07-05 09:21)
                        md31: pm51      hx2001 volume/capacity ratio (link)     (03-07-05 09:21)

Constraint matrix:      md29: pm48      hx2001 assigned vehicle km (links)      (03-07-05 09:20)
Constraint interval:          0          0      exclude

Submatrix:              all zones
```

zone	md23 pm41	md29 pm48	mo27 pm48	md30 pm49	mo28 pm50	mo29 pm51	md31 pm51
102	4	64464	814	79	72	15570	72
122	34	14744	209	71	38	16533	42
123	84	30405	428	71	40	30578	41
124	12	812	13	62	9	766	10
132	34	11136	214	52	51	24860	52
133	70	14573	211	69	25	12118	25
143	68	8385	155	54	33	20902	32
144	154	11152	171	65	12	12601	15
154	192	8741	208	42	14	13430	16
180	144	6806	170	40	0	14193	0
202	24	87099	973	90	59	76076	59
206	8	6987	98	71	11	3381	12
222	2	228	3	76	16	381	16
223	70	34128	460	74	36	31629	42
233	166	39579	574	69	29	47265	29
234	22	4711	96	49	32	11672	31
243	30	1224	18	68	7	1652	8
244	120	11479	214	54	13	20793	23
254	314	12835	215	60	11	20908	14
280	288	6407	160	40	0	12670	0
302	38	160970	2327	69	81	140579	74
306	12	66293	976	68	42	24145	39
312	6	1657	18	92	32	3712	33
323	76	50186	765	66	54	79947	55
333	64	22857	424	54	48	58526	47
334	100	37443	682	55	53	87145	54
343	18	2019	29	70	23	5439	28
344	492	77710	1470	53	33	180130	36
354	452	18096	481	38	20	49487	23
380	476	13873	347	40	0	50467	1
402	74	189592	2595	73	72	214348	66
406	14	44003	631	70	40	28799	38
412	5	1446	19	76	49	3573	40
433	41	12464	260	48	48	40296	58
434	236	68454	1248	55	40	182866	41
443	10	292	5	58	18	2612	35
444	474	68191	1131	60	28	145402	31
454	646	14792	354	42	18	53138	19
480	556	5407	135	40	0	54053	0
481	4	3695	46	80	61	3976	61
522	8	6501	94	69	31	7439	52
523	62	30800	487	63	44	48696	46
524	4	29	0	*********	2	72	2
sum	5708	1272665	19928	*********	1347	1852825	1418
avg	133	29597	463	*********	31	43089	33
min	2	29	0	38	0	72	0
max	646	189592	2595	*********	81	214348	74