



Wellington Transport Strategy Model

**Validation Report
Final**



SINCLAIR KNIGHT MERZ



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Validation Report

Final

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prepared for



**Greater Wellington – The
Regional Council**

By



Beca Carter Hollings & Ferner Ltd

And

SINCLAIR KNIGHT MERZ

Sinclair Knight Merz

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1. Introduction

Having estimated each sub-model independently, these sub-modules were linked together in a single model. This report describes the process of model error analysis used to de-bug the linked model in Section 2, and the consequent changes made to the specification.

The final model was then subjected to validation and sensitivity testing and the results are presented in Sections 3 and 4 respectively. Note that the results presented in Section 3 are prior to any matrix estimation that was undertaken as part of the final model tuning for specific use in project appraisal. The improved road assignment results from the matrix estimation are reported separately.

2. Preliminary Analysis of Model Error

2.1 Scope

In city strategic models the individual sub-models are separately estimated mainly on observed household survey data, but when these modules are linked their inputs are no longer taken from observations but from the outputs of the preceding sub-model in the sequence. Consequently errors and uncertainties can accumulate through the model system from sub-model to sub-model. One purpose of this analysis is to identify whether this is happening and make corrections.

A second reason is that the process of estimating the individual sub-models has occurred over a long period in which updates to a number of the data bases used have been made, potentially introducing inconsistencies between one sub-model and another. Finally, changes may have been made to the specifications of later sub-models which need to be reflected in the earlier sub-models, already calibrated.

The process is there to re-test each sub-model separately to determine how its error is affected by linking with other sub-models. This involves comparing the “fully synthetic” output of the sub-model with the outputs of the original calibration and with the observed data. Where it appears that the differences introduced by the fully synthetic model are significant, we have corrected them. The sub-models / data tested were:

- planning and household survey data consistency,
- car ownership model,
- family structure model,
- trip end model,
- networks (and associated cost skims),
- distribution and mode choice model,
- time period model, and
- assignment.

Each of these components is discussed in turn below.

2.2 Planning Data

The majority of the demand models have been calibrated primarily on the household survey data, which has been expanded to planning data household totals. As shown in Table 2-1, in the expanded total households for the Wellington Region shows the expected close fit to the planning data. However this table also illustrates the distribution by household types in the planning data as compared with the data in the household survey sample on which the model has been estimated, where there are some differences¹.

¹ The bias correction process used in the household survey expansion removed some but not all of the differences in population and household distributions between the survey sample and the census data.

The model development was based on the household surveys expanded and bias corrected to match the first estimate of demographic data from the census. Over the subsequent months there were two significant changes to the data:

- MERA re-processed the census data, and
- The definition of adults was modified after the preliminary analysis of the household data (from 15 years and over in the bias correction to 17 years and over for modelling purposes).

Both the car ownership and trip production models are disaggregate and their estimates for 2001 will correctly reflect the revised person and household distributions.

■ **Table 2-1 Planning Data Comparison - Households by Household Category**

Household Category	Planning Data	Household Data
1 Adult - Employed	25094	22614
1 Adult - Not Employed	25617	24499
2 Adults - Neither Employed	14685	15590
2 Adults - At Least 1 Employed	65636	66255
3+ Adults	26265	28435
Total	157297	157392

■ **Table 2-2 Planning Data Comparison - Population by TLA**

TLA	Planning Data	Household Data
Carterton District	6381	5084
Kapiti Coast District	42438	41643
Lower Hutt City	95502	93288
Masterton District	23100	23409
Porirua City	47373	44998
South Wairarapa District	8727	7527
Upper Hutt City	36375	34332
Wellington City	163881	159359
Total	423777	409640

2.3 Car Ownership Model

The car ownership has been calibrated such that in 2001, the level of car ownership in the census is reproduced for each zone and household category. Thus, with the exception of small differences due to rounding, there are no errors introduced through this model and no further adjustments to the model are required.

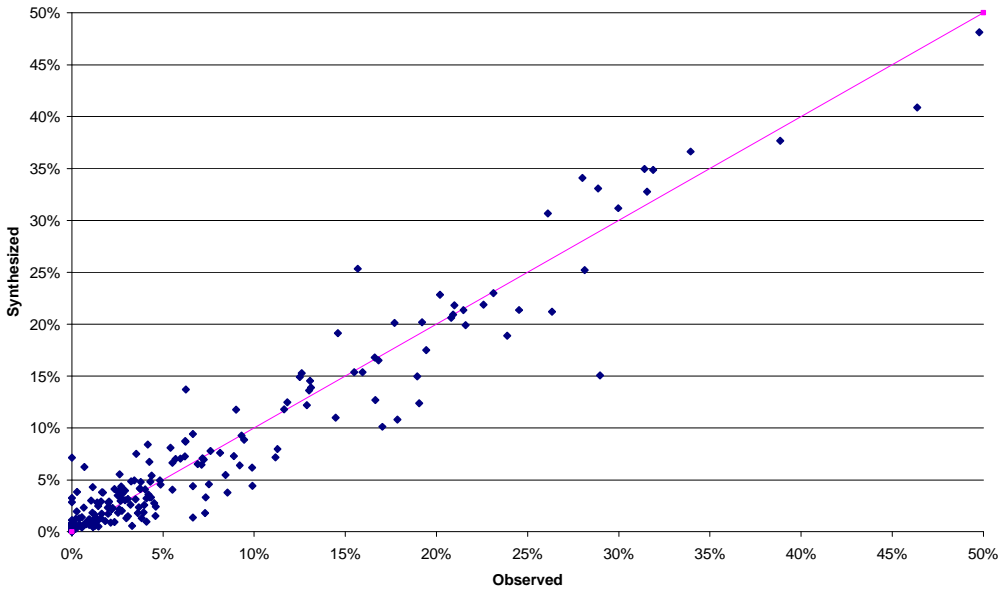
2.4 Family Structure Model

An input to the trip end model is the population of each zone classified by person type and expanded household category (where the household categories in Table 2-1 are expanded by the car ownership model to encompass car ownership levels of 0, 1 and 2 or more cars).

This sub-model takes as input the planning data estimates of zonal population classified by person type and the planning data/car ownership model estimates of the zonal number of households classified by expanded category. For each zone it then apportions the population of each type across these household categories. Aggregating zones to sectors (there are 15 such sectors) to give an adequate household survey sample size, the figure below evaluates the accuracy of this apportionment. These synthesised population proportions for each household category (for each person type) are plotted against the population proportions observed in the household survey..

Because the fit is both unbiased and close to the observed which is itself subject to sampling error, no changes to the model have been made.

■ **Figure 2-1 Family Structure - Synthesised v Observed Proportion of Persons in each Household Category by Sector**



2.5 Trip End Models

Trip Productions

The fully synthetic trip productions for each purpose have been compared to the observed trip ends. The table below illustrates the differences for each TLA. No explicit adjustments for TLA totals have been included in the production models.

The overall level of trips estimated by the disaggregate model is representative of the census estimate of population, the trip rates per person being applied to the correct population total. Overall, the 3% higher planning data population is reflected in a 1.5% greater number of synthesised trip productions.

Highlighted cells in the table indicate a significant difference at the 95% confidence level. Only two of the differences are significant at the 95% confidence level. As the total number of trips in the South Wairarapa is small, no change has been made to the HBW trip ends (the error is equivalent to just 1700 trips). Similarly the Porirua factor has not been implemented for HBO, but rather noted for further model analysis.

■ **Table 2-3 Trip Production - Observed by TLA by Purpose**

TLA	HBW	HBEd	HBSH	HBO	NHBO	BU	Total
Kapiti Coast District	19,208	10,303	37,446	44,017	43,310	8,383	162,668
Porirua City	25,728	10,723	27,805	35,475	35,043	6,747	141,521
Upper Hutt City	23,379	6,623	26,781	29,541	30,684	8,953	125,959
Lower Hutt City	52,294	20,597	61,355	77,384	86,466	32,213	330,310
Wellington City	112,596	35,145	117,797	144,892	236,507	83,236	730,173
Masterton District	15,010	5,573	20,652	23,189	38,338	8,823	111,584
Carterton District	3,400	1,080	3,318	5,929	5,569	1,653	20,950
South Wairarapa District	3,058	774	5,169	5,744	3,778	2,489	21,010
Total	254,671	90,817	300,323	366,170	479,695	152,498	1,644,173

■ **Table 2-4 Trip Production - Synthesised by TLA by Purpose**

TLA	HBW	HBEd	HBSH	HBO	NHBO	BU	Total
Kapiti Coast District	20,236	7,600	33,204	38,741	43,823	9,242	152,846
Porirua City	26,903	10,911	30,726	41,550	35,502	8,846	154,438
Upper Hutt City	21,856	7,726	24,814	32,205	31,070	9,879	127,550
Lower Hutt City	57,909	19,969	64,307	83,953	85,323	34,464	345,926
Wellington City	116,793	34,635	108,390	141,688	248,809	88,719	739,035
Masterton District	12,086	4,847	16,742	20,702	34,917	9,529	98,824
Carterton District	3,693	1,346	4,773	5,918	5,952	1,778	23,459
South Wairarapa District	4,826	1,520	6,098	7,569	4,213	2,460	26,686
Total	264,302	88,554	289,055	372,326	489,609	164,917	1,668,763

■ **Table 2-5 Trip Production - Synthesised v Observed by TLA by Purpose**

TLA	HBW	HBEd	HBSH	HBO	NHBO	BU	Total
Kapiti Coast District	5.4%	-26.2%	-11.3%	-11.3%	1.2%	10.2%	-6.0%
Porirua City	4.6%	1.8%	10.5%	17.1%	1.3%	31.1%	9.1%
Upper Hutt City	-6.5%	16.7%	-7.3%	9.0%	1.3%	10.4%	1.3%
Lower Hutt City	10.7%	-3.0%	4.8%	8.5%	-1.3%	7.0%	4.7%
Wellington City	3.7%	-1.4%	-8.0%	-2.2%	5.2%	6.6%	1.2%
Masterton District	-19.5%	-13.0%	-18.9%	-10.7%	-8.9%	8.0%	-11.4%
Carterton District	8.6%	24.6%	43.8%	-0.2%	6.9%	7.6%	12.0%
South Wairarapa District	57.8%	96.5%	18.0%	31.8%	11.5%	-1.2%	27.0%
Total	3.8%	-2.5%	-3.8%	1.7%	2.1%	8.1%	1.5%

A more detailed analysis indicated that, while overall the Wellington City trip productions for home based education are well within acceptable limits compared to observed, this is not the case for each sector in this TLA. In particular, sector 1 trip productions for this purpose are 29% lower than those observed. Subsequently, in the analysis of the assignment of passengers to buses, a significant underestimation of bus travel was noted in sector 1. Therefore, because education trips account for much bus travel, the sector 1 trip rates have been adjusted upwards accordingly.

Trip Attractions

In checking the trip attraction estimates, the statistical estimation procedure was discovered to have given erroneous values for the TLA-specific factors in the model. These factors have therefore been corrected as described below.

The fully synthetic trip attractions for each purpose, without TLA-specific factors, have been compared to the observed trip ends. The table below illustrates the differences for each TLA. As shown by the shading, for all purposes except business, one TLA showed a significant difference between the observed and synthesised trip attractions. For these purposes, therefore TLA factors have been implemented in the trip attraction models which correct for these differences from the observed trips.

■ **Table 2-6 Trip Attraction - Observed by TLA by Purpose**

TLA	HBW	HBE _d	HBS _h	HBO	NHBO	BU	Total
Kapiti Coast District	14,275	9,629	36,676	42,758	44,094	8,575	156,007
Porirua City	12,437	7,752	30,091	32,521	38,082	6,821	127,704
Upper Hutt City	16,938	5,433	25,283	29,860	31,275	8,445	117,235
Lower Hutt City	47,434	19,547	63,385	74,914	89,064	32,829	327,173
Wellington City	143,563	41,191	117,199	152,691	236,416	85,055	776,115
Masterton District	14,891	5,969	22,255	24,165	39,172	9,881	116,331
Carterton District	3,281	475	2,889	5,730	5,383	1,631	19,388
South Wairarapa District	2,206	639	3,846	5,027	4,238	2,563	18,520
Total	255,025	90,634	301,623	367,667	487,725	155,801	1,658,474

■ **Table 2-7 Trip Attraction - Synthesised by TLA by Purpose**

TLA	HBW	HBE _d	HBS _h	HBO	NHBO	BU	Total
Kapiti Coast District	14,724	7,735	33,335	43,318	44,018	8,681	151,809
Porirua City	14,020	6,717	27,847	32,585	40,550	8,481	130,202
Upper Hutt City	16,074	5,552	31,162	29,357	33,663	9,051	124,858
Lower Hutt City	50,961	18,721	58,147	76,533	92,274	33,715	330,350
Wellington City	145,915	36,555	125,772	157,385	240,117	83,703	789,447
Masterton District	15,093	5,853	21,212	24,080	39,328	9,672	115,237
Carterton District	2,539	348	2,364	5,629	5,512	1,459	17,850
South Wairarapa District	3,321	1,530	3,363	8,254	8,608	2,126	27,203
Total	262,647	83,012	303,201	377,141	504,069	156,887	1,686,957

■ **Table 2-8 Trip Attraction - Synthesised v Observed by TLA by Purpose**

TLA	HBW	HBE _d	HBS _h	HBO	NHBO	BU	Total
Kapiti Coast District	3.1%	-19.7%	-9.1%	1.3%	-0.2%	1.2%	-2.7%
Porirua City	12.7%	-13.3%	-7.5%	0.2%	6.5%	24.3%	2.0%
Upper Hutt City	-5.1%	2.2%	23.3%	-1.7%	7.6%	7.2%	6.5%
Lower Hutt City	7.4%	-4.2%	-8.3%	2.2%	3.6%	2.7%	1.0%
Wellington City	1.6%	-11.3%	7.3%	3.1%	1.5%	-1.6%	1.7%
Masterton District	1.4%	-1.9%	-4.7%	-0.3%	0.4%	-2.1%	-0.9%
Carterton District	-22.6%	-26.6%	-18.2%	-1.8%	2.4%	-10.6%	-7.9%
South Wairarapa District	50.5%	139.6%	-12.6%	64.2%	103.1%	-17.0%	46.9%
Total	3.0%	-8.4%	0.5%	2.6%	3.4%	0.7%	1.7%

Other Changes

A number of other adjustments have been made to the trip end models:

- the home based employers business trips have been recoded from production / attraction format to origin / destination format to be consistent with the non home based employers business trips with which they have been combined; the employers business attraction model was re-estimated;
- we have assumed the non home based other trip matrix to be symmetric and have revised the observed matrix so this is explicitly true, and consequently recalculated the attraction TLA correction factors.

2.6 Networks, Assignment and Generalised Costs

The validated road and public transport networks from the previous Wellington Region Model formed the basis of the updated model networks. In updating these networks sample checks were made of routings and distances and specific attention was given to improving key features.

Since the networks were originally developed and used in the calibration of the distribution and mode choice models, various updates have been introduced.

In particular, we have adjusted the public transport network by:

- modifying the bus travel time functions (as detailed in the bus function report), and
- updating the public transport fare matrices (from 1996 to 2001).

Analysis of fit of the public transport assignment led to the following changes to the assignment process:

- the rail connector links from two-way to one-way to reflect park-and-ride availability at only one end of each trip, the home end, and thus to increase the disutility of long egress trips from rail stations as compared with the local bus option,
- adjusting the boarding penalties for assignment (an additional 7.5 minutes for each rail node, and an additional 10 minutes for each bus node) - when calculating the generalised costs for public transport we remove the additional 10 minutes, hence overall reducing the boarding penalties for rail by 2.5 minutes; this was designed to improve the allocation between walk and bus access to the central rail station,
- modification of the rail travel time function (changing the 0.75 factor on INVT to 0.9); this was designed to optimise the rail assignment but we preferred not to include such a large differentiating factor without appropriate strong justification.

While the car network has had only minor adjustments in a few select areas, the car occupancy values used for the generalised cost calculations have been updated, resulting in new cost matrices for each car segment. These new values are documented in Appendix A of the distribution and mode choice report.

Some of the specific details of the auto network adjustments are discussed below.

Global Changes:

- Modified calculation of opposing flows at roundabouts to include the effect of exiting traffic,
- Modified global capacity and free speed values for arterial link types,
- Correction of a bug in the intersection capacity macro for single-lane roundabouts.

Specific Issues:

- Link type classification and hence speeds on SH58 calibrated to match survey,
- Link type classification and hence speeds on SH2 north of Upper Hutt also calibrated to match survey. Distances also altered to match surveyed distances as mapped distances inaccurate on such windy roads,
- Alteration of junction coding at a number of sites,
- Coding of a missing junction at one site,
- Alteration of link speeds and capacities at specific sites (such as sharp corners, tunnels, narrow bridges etc),
- Reduction in the effective number of lanes on SH1 Ngarauanga Gorge to replicate the effect of queuing (i.e. 3 lanes are available but vehicles queue in 2 lanes because of the lane drop at SH2),
- Testing and adoption of a lower distance weighting for routeing (ie for assignment only). A value of 0.075c/km was adopted.

While each of these changes was minor, the cumulative effects on the generalised costs used in model calibration were significant, mainly due to the change in the PT fare and car occupancies. Their implications were reviewed in the context of the distribution and mode choice models.

2.7 Distribution and Mode Choice Model

The distribution and mode choice models receive trip ends from the trip end models, generalised costs from the networks, and the demand/supply iterations then balance the highway speeds with travel demands on the network. We have analysed these effects in three steps:

- the first step was the first iteration of the distribution and mode choice models using the original network generalised costs originally used in model calibration and without highway demand:supply iterations; this checked the impacts of the fully synthetic trip ends;
- the second step was a repeat of the first but using the updated generalised costs referred to earlier;
- the final step was to analyse the matrices after the highway demand:supply iteration process has converged; this checked whether the iteration procedures caused the synthetic matrices to diverge from the first estimates (and the observed matrices) as highway speeds were optimised.

The primary checks in each of these steps involved comparisons of the modelled trip matrices and mode shares at a sector to sector level with those matrices output from the original calibration process.

Our conclusions were that the synthetic trips ends did not introduce significant errors or biases but that recalibration on the updated generalised costs was desirable for all purposes except Home Based Shopping and Employer's Business. In fact we chose to recalibrate the models for all purposes. The specification for all distribution models were retained as specified in the draft mode choice and distribution report, and new parameter values estimated. The one exception was the mode choice model specification for home based shopping where the captive mode choice cost parameters are now significant and have been calibrated (as opposed to using a fixed mode share by TLA as in the draft report).

A summary of these checks is provided in Appendix B. These tables illustrate for each purpose:

- the observed TLA level trip matrices,
- the calibration output TLA trip matrices (from the first calibration),
- the fully synthetic TLA trip matrix (from the first calibration), and
- the fully synthetic TLA trip matrix from the recalibration.

We illustrate the differences between the second and third matrices, as well as the third and fourth matrices in this list.

2.8 Time Period Model

Validation of the time period factors, by assessment of the time period matrices, indicated some outliers, but these were judged to be insignificant, and overall the time period model performed adequately in the validation and has not been changed.

Appendix C contains a series of plots that graphically illustrate the observed and final synthesised trip matrices for each time period. These plots compare the observed trips in each time period on a sector to sector level against the fully synthetic Emme/2 results.

The overall proportions of travel in the 3 time periods have not been changed when the fully synthesised matrices have been used. The outcome fit of the synthesised time period

matrices to the expanded survey data is summarised at matrix sector level in the figures in Appendix C. As the time period factors could not generally be statistically justified on a sector-sector basis, there is some spread in the fit, particularly for smaller flows.

The table below illustrates the good overall fit of the time period matrices. These numbers are the totals across each purpose and include both car and public transport trips, but not the slow mode trips.

■ **Table 2-9 Time Period Validation - Car and Public Transport Trips**

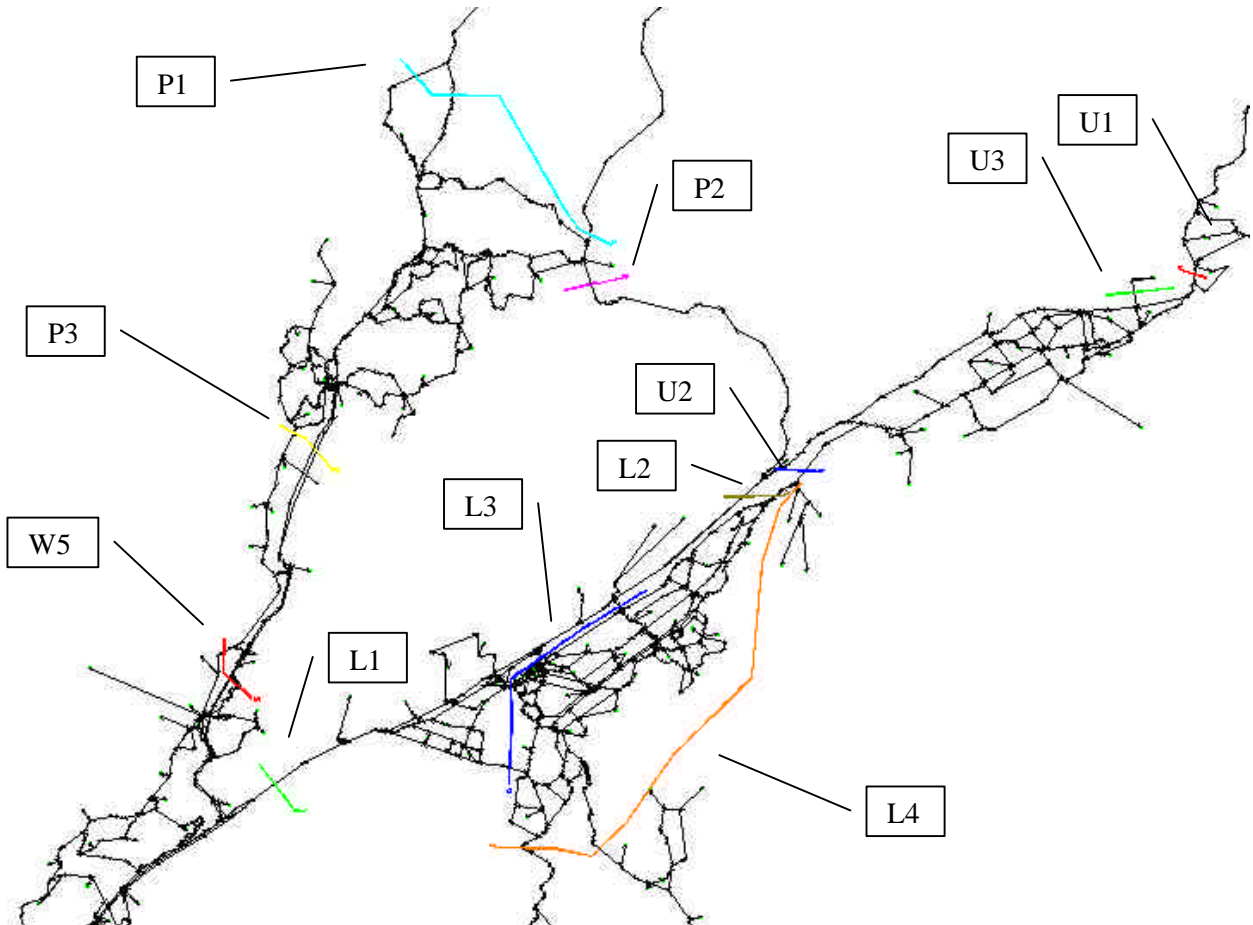
	24 hr Trips	AM	Interpeak	PM
Observed Trips	1,312,075	196,520	586,424	245,902
Observed Proportions		15.0%	44.7%	18.7%
Modelled Trips	1,362,340	207,451	606,505	254,304
Modelled Proportion		15.2%	44.5%	18.7%

3. Model Validation

3.1 Highway Assignment Validation

The independent counts which we have used for the validation are typically based on one week's data using tube counters and seasonal factors have been applied; the estimate of average annual flows is therefore subject to both measurement and sampling error. Presented below are screenline modelled flow results compared to counts for each of the AM, Inter Peak and PM periods-these screenline totals in effect act as sectorised matrix validation checks. Screenline GEH statistics are also presented. The nominal acceptance criteria for GEH statistics is 4, but for those screenlines with errors less than 500 vehicles greater GEH statistics have been accepted. Figure 3-1 and Figure 3-2 show the screenline locations.

■ Figure 3-1 Screenline Locations - Northern Region



■ Figure 3-2 Screenline Locations - Southern Region

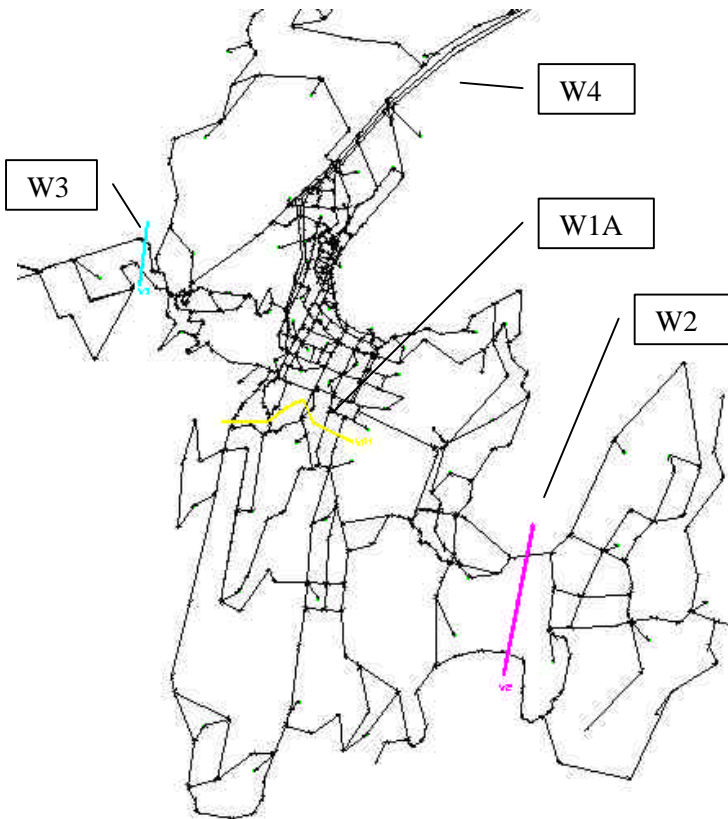


Table 3-2 – Table 3-4 summarise the performance of the model against screenline counts for the 3 time periods. In total, modelled traffic across all the screenlines is 5% over the traffic counts in the 3 periods. Most screenlines in the 3 time periods are within acceptable limits in terms of percentage error and GEH statistics.

Figure 3-3 – Figure 3-5 plot these statistics. The r-squared measures for the fit of the predicted to the observed screenline total counts are 0.973, 0.971 and 0.975 in the AM, interpeak and PM time periods respectively, substantially exceeding normal fit requirements. On an individual link basis these r-squared values are 0.907, 0.856 and 0.916 for the three time periods. The r-squared values have not been origin forced, with intercept values of 273, 333 and 291 for the am, ip and pm peak screenlines. In general the model fit pictures suggest a good fit, with most of the larger percentage errors being against the smaller screenline totals, as indicated by the GEH stats which take the size of the observed count into consideration.

Summary GEH statistics for all links across the screenlines are presented below in Table 3-1. The target performance for a roading project model is shown in the first column. The percentage of links meeting each criterion for each time period is shown in their respective columns. The performance of each time period is very similar, and while not quite meeting roading project targets, the model performs well for a strategic model; the uniformity across the time periods is particularly encouraging.

■ **Table 3-1 Summary GEH Statistics**

Target %	GEH	AM Proportion	IP Proportion	PM Proportion
60%	< 5	35%	44%	45%
95%	< 10	71%	67%	75%
100%	< 12	73%	78%	79%

■ **Table 3-2 AM Screenline Validation (2 hour volumes)**

Screenline	Direction	Count	Modelled	Difference	% Diff	GEH	Comment
W1	In	14571	15397	826	5.7%	4.8	ACCEPTABLE (1)
W1	Out	9385	9883	498	5.3%	3.6	ACCEPTABLE
W1A	North	5438	5836	398	7.3%	3.8	ACCEPTABLE
W1A	South	3523	3385	-138	-3.9%	1.7	ACCEPTABLE
W2	East	2477	2672	195	7.9%	2.7	ACCEPTABLE
W2	West	3843	3860	18	0.5%	0.2	ACCEPTABLE
W3	East	2000	2909	909	45.4%	13.0	
W3	West	1175	1609	434	36.9%	8.2	ACCEPTABLE
W4	North	6551	7136	585	8.9%	5.0	ACCEPTABLE
W4	South	15842	14970	-871	-5.5%	5.0	ACCEPTABLE
W5	North	3254	3439	185	5.7%	2.3	ACCEPTABLE
W5	South	6751	7215	464	6.9%	3.9	ACCEPTABLE
L1	North	5033	5517	484	9.6%	4.7	ACCEPTABLE
L1	South	7510	7895	385	5.1%	3.1	ACCEPTABLE
L2	North	4659	3245	-1413	-30.3%	15.9	
L2	South	5246	5467	221	4.2%	2.1	ACCEPTABLE
L3	In	7567	8337	770	10.2%	6.1	ACCEPTABLE
L3	Out	8270	9340	1070	12.9%	8.1	
L4	North	5562	5657	95	1.7%	0.9	ACCEPTABLE
L4	South	1589	2487	898	56.5%	14.1	
U1	North	613	1211	597	97.4%	14.0	
U1	South	1771	2081	309	17.5%	5.0	ACCEPTABLE
U2	North	4384	3609	-775	-17.7%	8.7	
U2	South	3712	4276	564	15.2%	6.3	ACCEPTABLE
U3	East	1156	757	-399	-34.5%	9.1	ACCEPTABLE
U3	West	266	322	56	21.0%	2.3	ACCEPTABLE
P1	North	1059	1437	378	35.7%	7.6	ACCEPTABLE
P1	South	2610	2306	-304	-11.6%	4.3	ACCEPTABLE
P2	East	1046	1739	693	66.3%	13.1	
P2	West	1537	1247	-291	-18.9%	5.5	ACCEPTABLE
P3	North	3635	2460	-1174	-32.3%	15.0	
P3	South	5148	5527	379	7.4%	3.7	ACCEPTABLE
External	North	959	1593	635	66.2%	12.6	(2)
External	South	942	2100	1158	122.9%	21.0	(2)

(1) W1 Screenline surrounds the Wellington CBD.

(2) This large difference may partly be explained by an unusual count profile, with the true peak not occurring until after 9am.

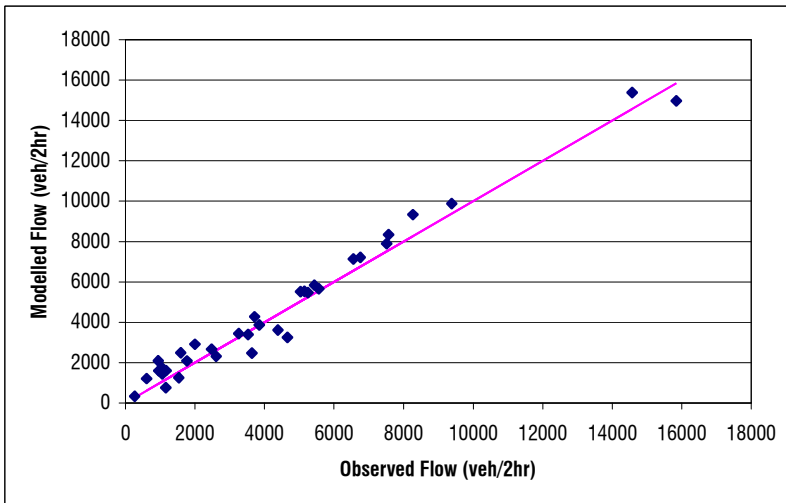
■ Table 3-3 Inter Peak Screenline Validation (2 hour volumes)

Screenline	Direction	Count	Modelled	Difference	% Diff	GEH	Comment
W1	In	9341	10262	921	9.9%	6.6	ACCEPTABLE
W1	Out	9544	9950	406	4.2%	2.9	ACCEPTABLE
W1A	North	3811	3696	-114	-3.0%	1.3	ACCEPTABLE
W1A	South	3977	3695	-282	-7.1%	3.2	ACCEPTABLE
W2	East	2643	2868	225	8.5%	3.0	ACCEPTABLE
W2	West	2717	2890	174	6.4%	2.3	ACCEPTABLE
W3	East	1166	1754	588	50.5%	10.9	
W3	West	1394	1705	311	22.3%	5.6	ACCEPTABLE
W4	North	7501	7350	-151	-2.0%	1.2	ACCEPTABLE
W4	South	8041	7727	-314	-3.9%	2.5	ACCEPTABLE
W5	North	3328	3296	-32	-1.0%	0.4	ACCEPTABLE
W5	South	3208	3451	243	7.6%	3.0	ACCEPTABLE
L1	North	4387	4675	288	6.6%	3.0	ACCEPTABLE
L1	South	4495	4844	349	7.8%	3.6	ACCEPTABLE
L2	North	2893	3276	383	13.2%	4.9	ACCEPTABLE
L2	South	2935	3332	396	13.5%	5.0	ACCEPTABLE
L3	In	7961	7118	-843	-10.6%	6.9	
L3	Out	8131	7204	-926	-11.4%	7.5	
L4	North	2296	3164	868	37.8%	11.8	
L4	South	2409	3108	699	29.0%	9.4	
U1	North	904	1437	533	59.0%	11.0	
U1	South	873	1436	563	64.5%	11.7	
U2	North	2531	3100	569	22.5%	7.6	
U2	South	2510	3158	647	25.8%	8.6	
U3	East	488	457	-31	-6.4%	1.0	ACCEPTABLE
U3	West	434	454	20	4.7%	0.7	ACCEPTABLE
P1	North	1476	1430	-47	-3.2%	0.9	ACCEPTABLE
P1	South	1389	1424	35	2.6%	0.7	ACCEPTABLE
P2	East	658	1057	399	60.7%	9.6	ACCEPTABLE
P2	West	628	1076	448	71.3%	10.9	ACCEPTABLE
P3	North	3291	2557	-735	-22.3%	9.6	
P3	South	3335	2709	-626	-18.8%	8.1	
External	North	1327	1443	116	8.8%	2.2	ACCEPTABLE
External	South	1251	1438	187	14.9%	3.6	ACCEPTABLE

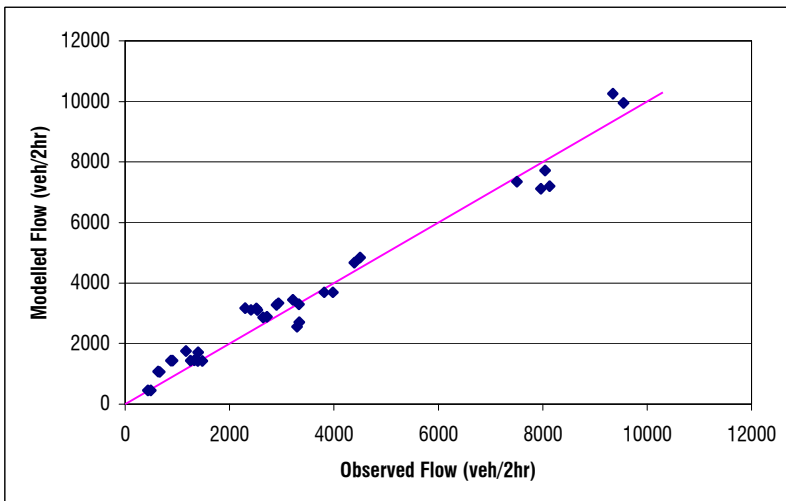
■ Table 3-4 PM Screenline Validation (2 hour volumes)

Screenline	Direction	Count	Modelled	Difference	% Diff	GEH	Comment
W1	In	11181	12341	1160	10.4%	7.6	
W1	Out	15025	15991	965	6.4%	5.5	
W1A	North	4207	4619	412	9.8%	4.4	ACCEPTABLE
W1A	South	5452	5572	120	2.2%	1.1	ACCEPTABLE
W2	East	3684	3978	294	8.0%	3.4	ACCEPTABLE
W2	West	2628	3245	617	23.5%	8.1	
W3	East	1203	2056	853	70.9%	14.9	
W3	West	2307	2906	599	26.0%	8.3	
W4	North	13868	14326	458	3.3%	2.7	ACCEPTABLE
W4	South	8551	9203	652	7.6%	4.9	ACCEPTABLE
W5	North	6384	7206	823	12.9%	7.1	
W5	South	3926	4486	560	14.3%	6.1	
L1	North	7484	7987	503	6.7%	4.0	ACCEPTABLE
L1	South	5713	6549	836	14.6%	7.5	
L2	North	5645	5382	-263	-4.7%	2.5	ACCEPTABLE
L2	South	4599	4047	-552	-12.0%	5.9	
L3	In	10991	10370	-621	-5.7%	4.2	ACCEPTABLE
L3	Out	10932	9483	-1449	-13.3%	10.1	
L4	North	2341	3402	1061	45.3%	14.0	
L4	South	5546	5768	223	4.0%	2.1	ACCEPTABLE
U1	North	1875	2295	420	22.4%	6.5	ACCEPTABLE
U1	South	1038	1590	551	53.1%	10.8	
U2	North	4271	4586	315	7.4%	3.3	ACCEPTABLE
U2	South	4148	4129	-18	-0.4%	0.2	ACCEPTABLE
U3	East	588	502	-86	-14.6%	2.6	ACCEPTABLE
U3	West	998	813	-185	-18.5%	4.3	ACCEPTABLE
P1	North	2873	2317	-555	-19.3%	7.7	
P1	South	1460	1797	337	23.1%	5.9	ACCEPTABLE
P2	East	1519	1612	93	6.2%	1.7	ACCEPTABLE
P2	West	981	1715	734	74.9%	14.1	
P3	North	5177	5335	158	3.0%	1.5	ACCEPTABLE
P3	South	4560	3234	-1326	-29.1%	15.0	
External	North	1537	2251	714	46.4%	11.6	
External	South	1543	1821	278	18.0%	4.8	ACCEPTABLE

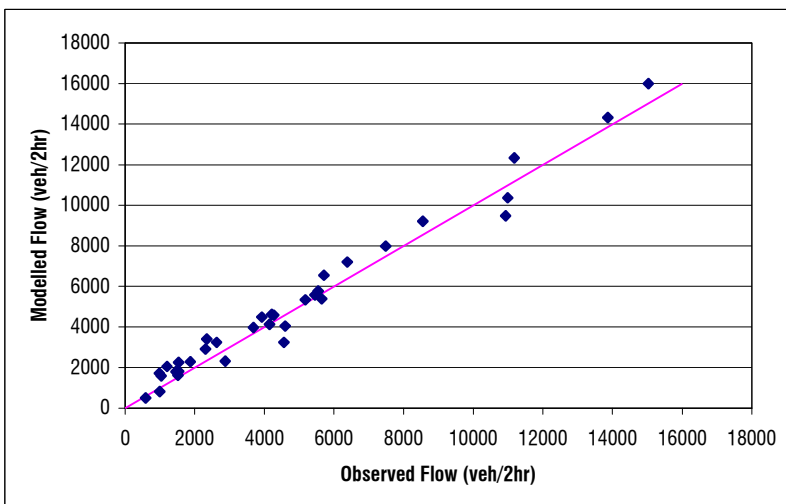
■ **Figure 3-3 AM Period Screenline Validation**



■ **Figure 3-4 Inter Peak Period Screenline Validation**



■ **Figure 3-5 PM Period Screenline Validation**



3.2 Highway Travel Time Validation

Travel times through the day have been collected in both directions on seven routes in April 2002, typically based on 10 runs per route per direction in each time period:

- Route 1 Waikanae Railway Station - Wellington Airport;
- Route 2 Upper Hutt Railway Station - Wellington Airport;
- Route 3 Porirua - Seaview;
- Route 4 Wellington Railway Station - Island Bay;
- Route 5 Featherstone - Upper Hutt Railway Station;
- Route 6 Wellington Railway Station - Karori West;
- Route 7 White Lines / Randwick Rd - Waterloo quay / Bunny St.

The full results are graphed in Appendix A. In general the model fit to these times results are satisfactory being close to the average for each route and within the range of variation of the observations (maximum and minimum time runs are given in the figures). There are a few localised exceptions which are judged to be insignificant in terms of model performance and vehicle routing.

3.3 Public Transport Assignment Validation

The public transport assignment has been validated on two sets of data:

- bus boarding counts (2 weeks in March 2002, based on ETM data provided by the operators, not seasonally adjusted);
- rail total boardings and alightings at Wellington Station and rail loadings by corridor taken from the WTSM rail surveys.

Our expectations of this validation are influenced by the following. In the previous Wellington model and the current Auckland model, an accurate validation of the public transport flows has been difficult to achieve in the regional model, which we attribute in part to a lack of specifically-collected public transport data. For the new WTSM, we were able to obtain rail survey information but it was not possible to enhance substantially the bus data. Because rail primarily caters for medium and longer distance movements whereas bus encompasses short distance journeys, which it would be difficult to represent accurately in a strategic model, the survey of rail passengers was judged to be the priority.

The consequence of this survey strategy is that we expect to achieve a much better fit to rail travel than to bus travel. There are a number of other reasons why we expect a less good bus travel validation:

- bus trips are very much shorter and many will be intrazonal; consequently some very short trips will be assigned to walk;
- we have preferred to exclude from the model primary school trips (mainly bus, car escort and walk) which our surveys showed were of very short distance (ca. 1.5kms);
- in general, it has not been possible to distinguish bus access to rail stations from access by other modes; this is because the zoning system is too coarse to accurately represent short access trips other than by centroid connectors and, in any case, access is primarily by car and walk and it would be inappropriate to load all of such trips onto the connecting bus services.

Rail Passengers

The table below details the boarding and alighting totals from the model and the surveys. The observed data is from the rail survey conducted in March 2002 and refers only to inbound boarding counts. We expect that in the AM period the inbound counts would

represent the vast majority of all boardings modelled, but this assumption is not true for the interpeak period. Alightings at Wellington station were compiled using the rail survey data rather than direct counts.

■ **Table 3-5 Rail Boarding / Alighting Validation**

Data	Inbound Count	Modelled (both directions)	Difference
AM - Region Boardings	10290 (1)	11233	9%
AM - Wellington Station Alightings	8851	9065	2%
IP - Region Boardings	1377(2)	1746	27%
IP - Wellington Station Alightings	827	1039	26%

- (1) The count is for the survey direction and excludes reverse direction boardings in the peak, so the model would be expected to give somewhat higher values.
- (2) Again these are boardings in one direction, and are therefore not compatible with modelled figures.

Given the limitations of the comparison, the modelled results are consistent with the counts. In particular the alightings at Wellington station show a good match to the AM rail survey data, and while the total boardings across the region is higher than the observed 'inbound only' counts, the overprediction of 9% appears consistent with the omission of outbound counts.

Figure 3-3 shows modelled inbound passenger loadings for each corridor showing the build up of patronage along the lines as the services approach Wellington CBD. The observed line in each plot has been synthesised using the rail survey data collected in March 2002.

With the exception of the Johnsonville line, the modelled loadings generally show a close fit to the observed loadings. The exceptions to this in the AM period are:

- on the Paraparaumu line, rail trips are assigned to a bus service that runs from Paraparaumu to Wellington CBD; the rail loadings are therefore low at the northern end of this corridor, but return to the correct levels by Porirua station;
- the loadings within the Lower Hutt area are high, as these short trips have switched from the corresponding bus services.

The level of modelled rail demand in the Johnsonville corridor is well below that observed. This is a small market where the bus and rail lines follow the same corridor competing all the way and most of the model error is in a handful of zones around Johnsonville station. Extensive analysis of the model discrepancies was undertaken, including analysis of:

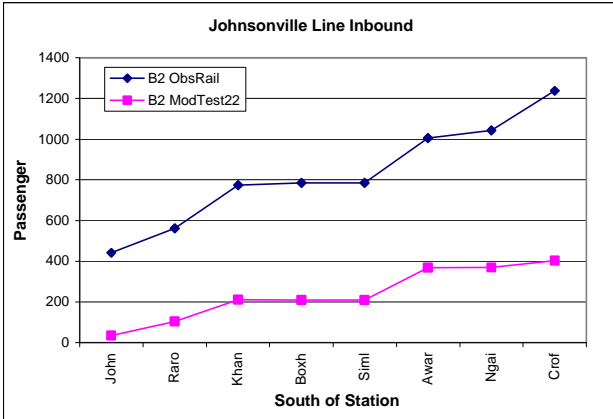
- observed and modelled rail trips by station
- observed and modelled bus trips in the corridor
- rail versus bus generalised costs for a variety of routes and origin destination pairs, and
- modelled bus speeds in and around Johnsonville and on the motorway.

The results of the analysis confirmed that the overall level of corridor public transport demand was correctly reproduced in the model (broadly an underestimate of rail travel of ca. 600 peak trips and a similar over-estimate of bus travel, see Table 3-5 for Johnsonville-Ngauranga). Our view is that a more detailed project model for this corridor would be an appropriate means of forecasting the precise split between rail and bus, . The decision was made not to bias WTSM by modifying it to fit 2 or 3 zones.

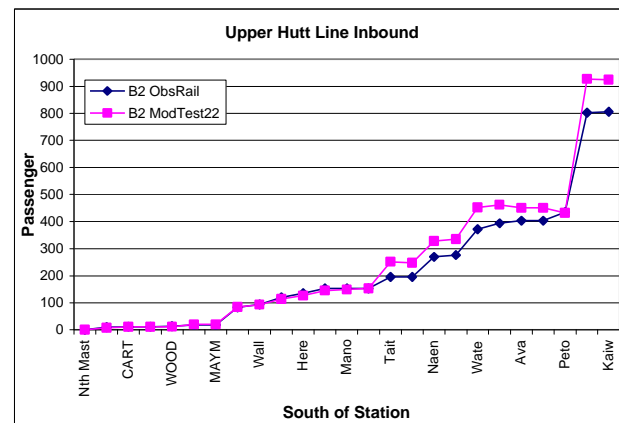
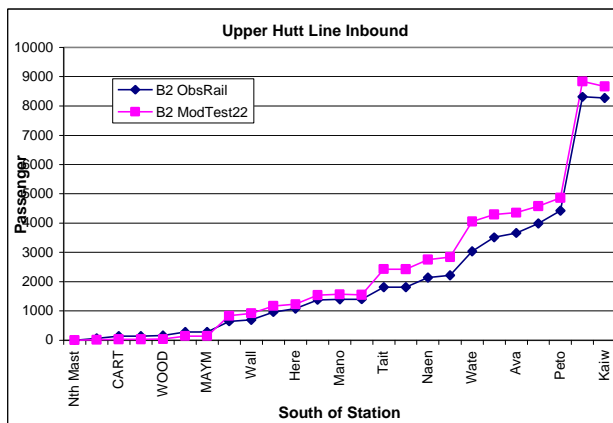
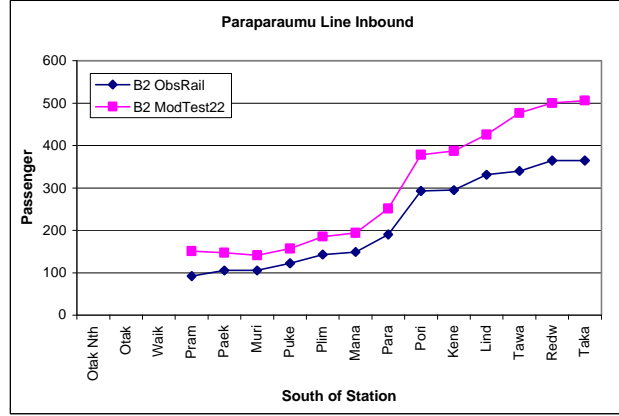
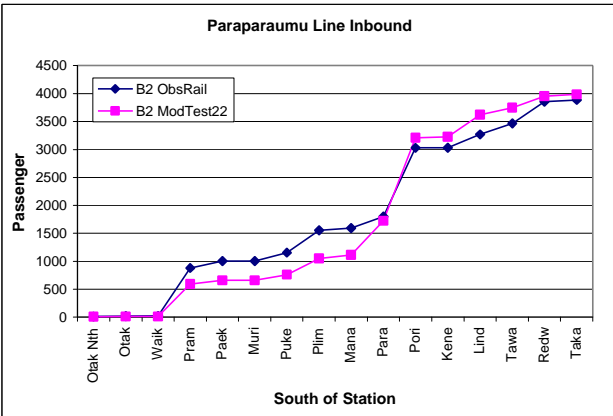
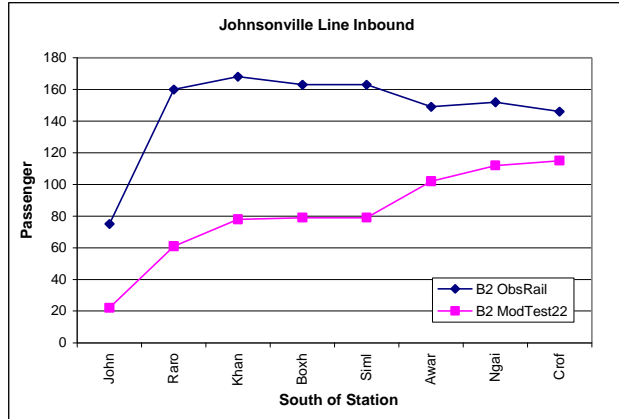
The interpeak fit for the Paraparaumu and Hutt lines are not as good as the AM fit, but the passenger numbers are very small.

■ Figure 3-3 Rail Passenger Loading Validation

AM



IP



Bus Passengers

Table 3-5 gives the fit to the boarding counts by area, and these are graphed in Figure 3-4 and Figure 3-5. Table 3-6, Figure 3-6 and Figure 3-7 provide comparisons for the same screenlines as the road traffic validation and for a set of other screenlines around each cbd in the region (eg Porirua, Lower Hutt etc); these data have been processed from the area counts and may be less reliable. Partly because of the small numbers of passengers involved but also because of the uncertainties in some of the count data, an unambiguous picture of the validation is difficult to obtain.

To seek to clarify the issues, we have also undertaken a validation of the modelled bus boarding against the modelled boardings from an assignment of the observed bus matrix, which is included in Table 3-5 as “Observed2”. This validation is much improved, confirming that our modelled public transport matrix is a reasonable reflection of the bus travel in the household and school surveys.

As explained earlier, we have omitted some short bus trips from the model by design. Consequently the validation table indicates that the overall level of modelled bus trips is slightly lower than the boarding counts. On a corridor basis, the differences are generally small (as are the observed counts in most areas) with the exception of the South East of Wellington where the modelled flows are significantly less than the observed boarding counts.

For the areas south and east of Wellington CBD which have the largest errors, where we have underpredicted bus boardings by some 4361 trips or 34% in the AM period, the modelled boardings are consistent with the WTSM observed data (this pattern is also repeated in the interpeak period). We have identified that we have removed approximately 1500 short primary school bus trips in this area of the network from the database and, additionally, a number of very short bus trips are assigned to walk; together these account for much but not all of this discrepancy .

■ **Table 3-5 Bus Boarding Count Validation**

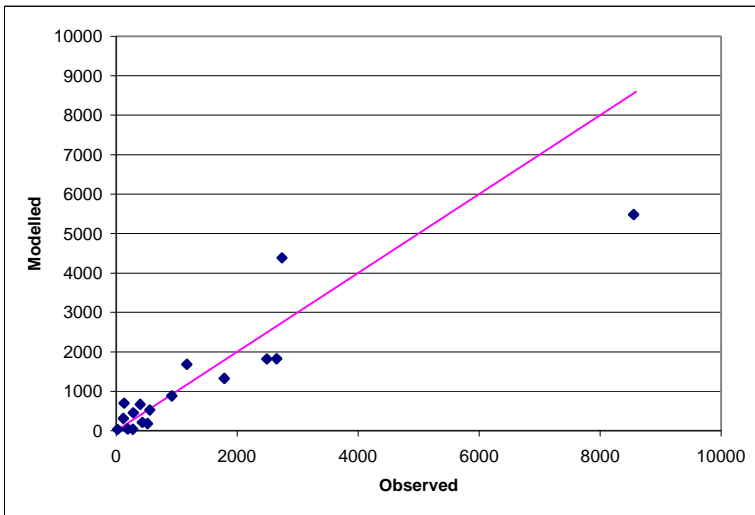
Description	AM Period					Interpeak Period				
	Observed	Observed 2	Modelled	Diff	%Diff	Observed	Observed 2	Modelled	Diff	%Diff
West and South of Paraparaumu CBD	191	44	49	-142	-74%	110	28	28	-82	-75%
Paraparaumu CBD	131	668	697	566	431%	76	263	263	187	245%
North west of Porirua CBD	274	43	42	-232	-85%	57	9	9	-48	-84%
East of Porirua CBD	518	186	181	-337	-65%	107	51	51	-56	-52%
South of Porirua CBD	22	35	35	13	60%	9	26	26	17	198%
Porirua CBD	282	465	454	172	61%	266	427	428	162	61%
South and east of Wgtn CBD	8556	5620	5482	-3074	-36%	2784	1497	1493	-1291	-46%
East of Wgtn	2654	1872	1826	-828	-31%	701	559	556	-145	-21%
Miramar Peninsular and Kilbirnie	1786	1366	1327	-459	-26%	331	277	275	-56	-17%
Karori	921	915	883	-38	-4%	216	264	264	48	22%
Johnsonville to Ngauranga	1169	1742	1686	517	44%	145	320	320	175	121%
Wellington CBD	2741	4555	4384	1643	60%	2256	2111	2099	-157	-7%
Lower Hutt	2492	1864	1819	-673	-27%	1353	1248	1241	-112	-8%
Upper Hutt	397	683	669	272	69%	225	304	304	79	35%
Total	19959	18828	18340	-1619	-8%	8403	7036	7012	-1391	-17%

Note: Observed2 refers to the boarding counts from assigning the observed bus matrix to the observed bus and walk only networks, ie excluding the rail network.

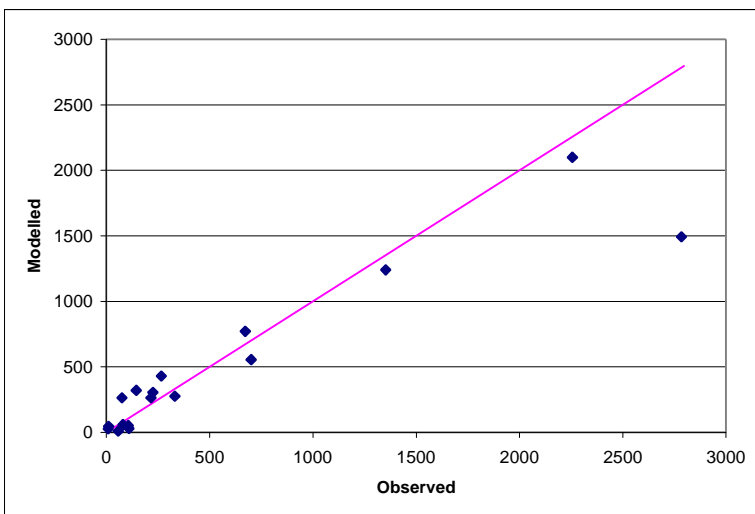
Whereas the model tends to under-estimate the area counts, this is not true of the screenlines (Table 3-6) where the reverse tendency is apparent in that the model over-predicts the screenline flows². This is the case for the area South and East of Wellington CBD: while the bus boardings for this area are 36% low in the am peak, the bus volumes on the screenline entering Wellington CBD are overestimated by 15%, and for the screenline south of Wellington (Wellington 1) they are overestimated by 7%.

Our overall view is that the reason for the discrepancies/under-estimation in the validation against the boarding counts, both in the south and east of Wellington and more generally, rests with very short distance bus trips, which are not accurately represented in the model (as should be expected), rather than the medium and long distance trips. This is offered some support by the screenline bus validation which does not indicate the same under-estimation. The close fit to the surveyed bus travel in our data base offers a further reason not to make changes to the bus travel patterns without more consistent evidence of error.

■ **Figure 3-4 AM Bus Boarding Comparison**



■ **Figure 3-5 Inter Peak Bus Boarding Comparison**

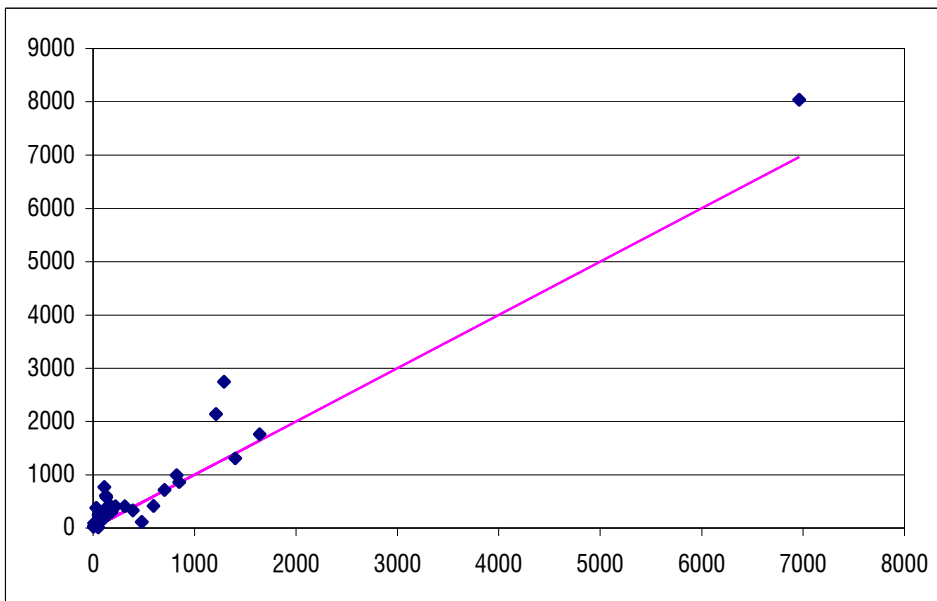


² Note that these observed volumes are generally very small and have a high degree of uncertainty as they are not derived from exact counts - rather they have been inferred by WRC from ticketing data.

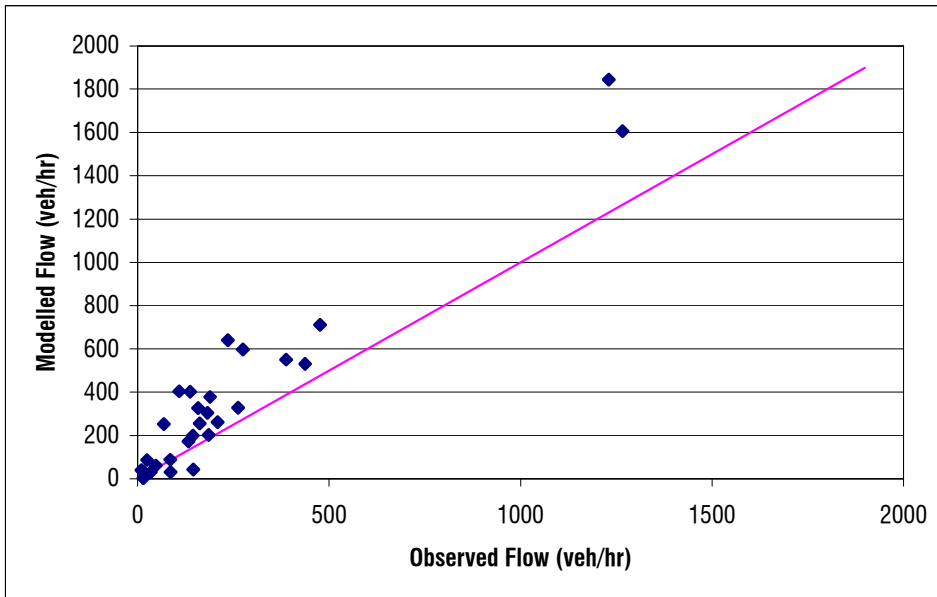
■ Table 3-6 Bus Screenline Comparison

Location	AM Period				Inter Peak Period			
	OBS	MOD	Diff	%Diff	OBS	MOD	Diff	%Diff
To Kapiti Coast_CBD	53	122	69	129%	86	30	-56	-65%
From Kapiti Coast_CBD	112	768	656	588%	68	252	184	270%
To Porirua_CBD	478	114	-364	-76%	146	42	-104	-71%
From Porirua CBD	143	247	104	73%	158	327	169	108%
To Lower Hutt_CBD	823	991	168	20%	275	597	322	117%
From Lower Hutt_CBD	222	409	187	85%	477	711	234	49%
To Wellington_CBD	6965	8042	1077	15%	1266	1606	340	27%
From Wellington_CBD	1288	2746	1458	113%	1230	1845	615	50%
Wellington1 - In	1644	1762	118	7%	438	530	92	21%
Wellington1 - Out	704	717	13	2%	388	550	162	42%
Wellington2 - In	1400	1308	-92	-7%	209	262	53	25%
Wellington2 - Out	183	303	120	66%	183	305	122	67%
Wellington3 - In	848	862	14	2%	162	255	93	57%
Wellington3 - Out	125	609	485	389%	144	199	55	38%
Wellington4 - In	1214	2137	923	76%	189	377	188	99%
Wellington4 - Out	131	573	442	336%	236	640	404	171%
Wellington5 - In	30	380	350	1164%	15	32	17	116%
Wellington5 - Out	8	93	85	1108%	10	40	30	290%
LowerHutt1 - In	392	332	-60	-15%	133	173	40	30%
LowerHutt1 - Out	114	345	231	204%	138	402	264	192%
Lower Hutt3 - In	314	407	93	30%	109	404	295	272%
Lower Hutt3 - Out	174	414	240	138%	185	202	17	9%
Lower Hutt4 - In	594	417	-177	-30%	86	88	2	3%
Lower Hutt4 - Out	55	243	188	344%	262	328	66	25%
Upper Hutt1 - In	50	13	-37	-74%	15	3	-12	-80%
Upper Hutt1 - Out	3	25	22	777%	25	86	61	249%
Upper Hutt2 - In	49	108	59	120%	48	61	13	27%
Upper Hutt2 - Out	109	180	71	65%	35	30	-5	-14%

■ Figure 3-6 AM Bus Screenline Comparison



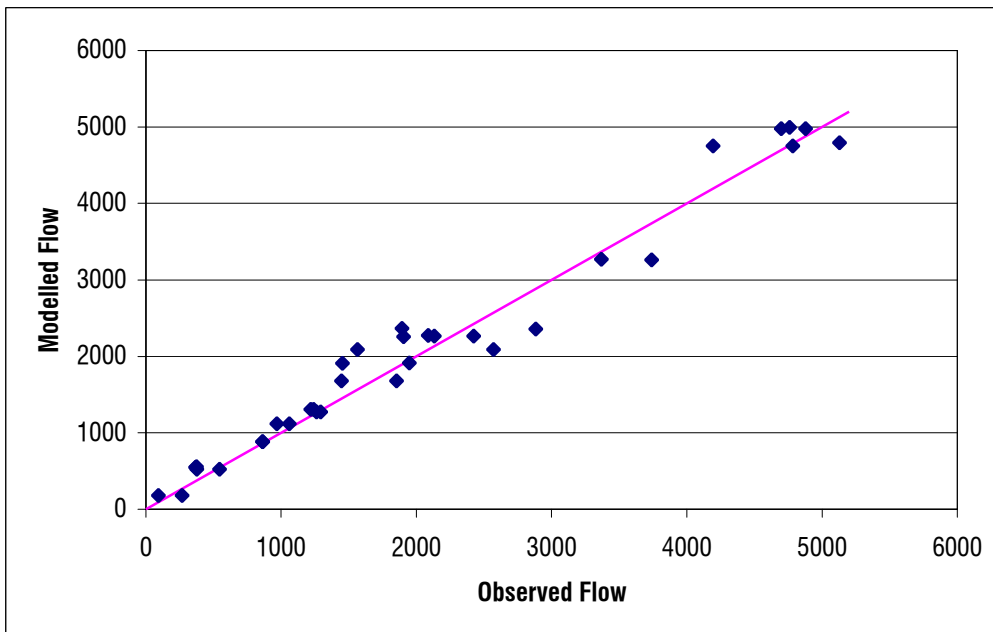
■ **Figure 3-7 Inter Peak Bus Screenline Comparison**



3.4 HCV Validation

The 24hr HCV matrix has been externally derived through a matrix estimation process utilising a number of data sources. The screenline validation results are presented in Table 3-7 and Figure 3-8 demonstrating a good fit for the majority of screenlines.

■ **Figure 3-8 HCV 24Hr Screenline Validation**



■ Table 3-7 HCV Screenline Validation (24 hour volumes)

Screenline	Direction	Count	Modelled	Difference	% Diff	GEH
W1	In	4759	4995	236	5.0%	2.4
W1	Out	5128	4795	-333	-6.5%	3.3
W1A	North	1893	2364	471	24.9%	7.2
W1A	South	2884	2356	-527	-18.3%	7.3
W2	East	1446	1681	235	16.2%	4.2
W2	West	1854	1681	-174	-9.4%	2.9
W3	East	377	521	144	38.2%	4.8
W3	West	543	521	-21	-3.9%	0.7
W4	North	4784	4752	-32	-0.7%	0.3
W4	South	4193	4752	559	13.3%	5.9
W5	North	2424	2265	-159	-6.6%	2.3
W5	South	1906	2259	352	18.5%	5.5
L1	North	3740	3264	-476	-12.7%	5.7
L1	South	3369	3271	-98	-2.9%	1.2
L2	North	2132	2267	135	6.3%	2.0
L2	South	2089	2273	184	8.8%	2.8
L3	In	4699	4980	281	6.0%	2.9
L3	Out	4879	4980	101	2.1%	1.0
L4	North	1241	1309	68	5.5%	1.4
L4	South	1219	1309	90	7.4%	1.8
U1	North	1260	1274	14	1.1%	0.3
U1	South	1291	1274	-17	-1.3%	0.3
U2	North	1565	2090	525	33.5%	8.7
U2	South	2572	2090	-482	-18.7%	7.1
U3	East	93	179	86	93.3%	5.2
U3	West	269	179	-90	-33.4%	4.2
P1	North	1059	1115	56	5.3%	1.2
P1	South	968	1115	147	15.2%	3.2
P2	East	374	558	184	49.2%	6.0
P2	West	369	552	183	49.6%	6.0
P3	North	1949	1917	-32	-1.7%	0.5
P3	South	1452	1910	458	31.6%	7.9
External	North	861	887	26	3.0%	0.6
External	South	863	887	23	2.7%	0.6

4. Sensitivity Testing

4.1 Introduction

Tests have been run to establish whether the overall sensitivity of the model to changes in network level-of-service are reasonable. These tests were:

- public transport fares: +20% changes in all PT fares, rail fares only and bus fares only;
- public transport in-vehicle times: +20% changes in PT times, rail times only and bus times only;
- public transport frequencies: +20% changes for all PT, rail only and bus only;
- car operating costs or fuel costs: +20%;
- car in-vehicle times: +20%.

For information we have also tested:

- CBD parking charges: 100% increase on average CBD charges;
- CBD pricing cordon: \$2 peak, \$1 off peak.

4.2 Results

Table 4-1 overleaf details the elasticity results/model responses for the above tests and comments on the results. For all sensitivity tests the results are in line with expectations drawn from local and international evidence. The results for the parking charge increase and cordon charges do not seem to be of an unreasonable magnitude.

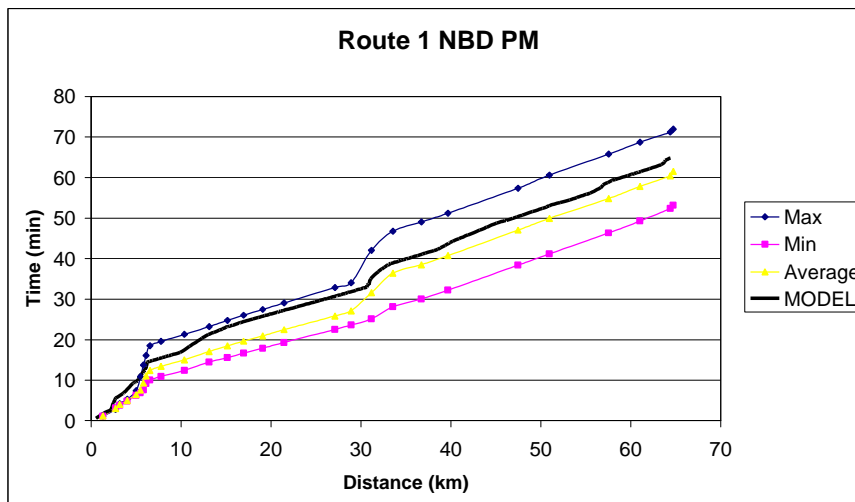
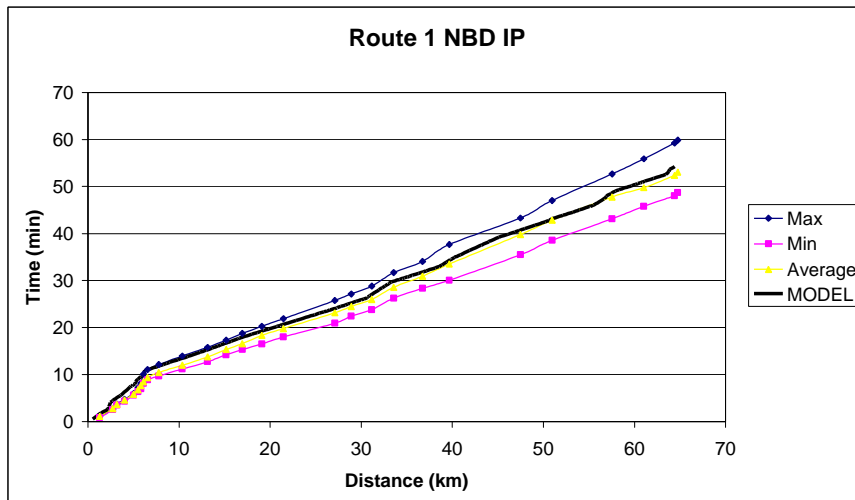
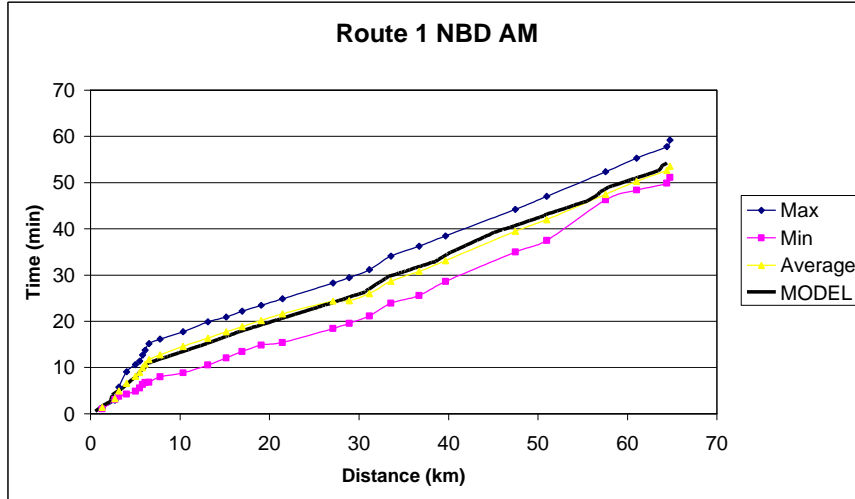
■ Table 4-1 Elasticity Results

Attribute	Response/Elasticity	Comparative Values	Commentary
Public transport fares	ϵ (trips) : -0.20 ϵ (pass kms) : -0.29	Original model: -0.22 (trips) International range: -0.1 to -0.6 (PDFH: short & medium distance urban rail: -0.3 to -0.6) Transfund patronage funding work: -0.2 to -0.45	Within the expected range. Because we expect that fares in NZ are lower than in some European countries from which fares elasticity evidence has been derived, we have checked the elasticity at twice the fare levels: Boardings/Pax kms fares elasticities increase to -0.35/-0.50
In-vehicle time: rail and bus rail only bus only	ϵ (trips) : -0.20 ϵ (pass kms) : -0.39 ϵ (trips) : -0.45 ϵ (pass kms) : -0.61 ϵ (trips) : -0.35 ϵ (pass kms) : -0.85	Original model - rail only: -0.46 (rail only trips) PDFH rail: -0.2 to -0.8 (inferred)	The passenger kilometres elasticity is within expected limits.
Service frequency: rail and bus rail only bus only	ϵ (trips) : +0.10 ϵ (pass kms) : +0.16 ϵ (trips) : +0.26 ϵ (pass kms) : +0.26 ϵ (trips) : +0.20 ϵ (pass kms) : +0.37	Original model: +0.085 (trips) Transfund patronage funding work: +0.2 to +0.7 PDFH rail: +0.15 to +0.6 (inferred)	These are within acceptable limits.
Car operating cost	ϵ (trips) : -0.05 ϵ (vkt) : -0.26	Original model: -0.1 (car driver trips) Typical international fuel price elasticities: -0.1 to -0.3	With urban trips being generally shorter there is an argument for lower fuel price elasticities. This argument also applies to the low fuel price context in NZ. The results therefore appear to be consistent with expectations. At twice the level for fuel prices: Trips/vkms elasticities increase to -0.30/-0.45.
Car journey time	ϵ (trips) : -0.07 ϵ (vkt) : +0.28	Transfund PEM: -0.2 to -0.25	The measure of traffic impact on the road is ϵ (vkt) and this is quite consistent with the Transfund value derived from UK experience
CBD parking charge	-0.6% in total car trips -4.0% in cbd car trips		The effective increase in the peak parking charge is \$1/trip broadly half of the cordon charge, showing the consistency of these results.
CBD cordon charge	-1.7% in total car trips -8.2% in cbd car trips		

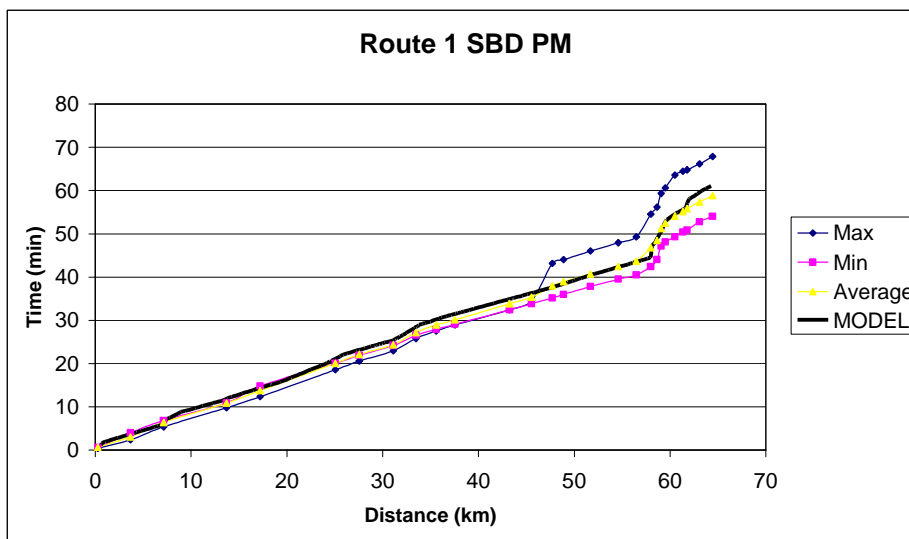
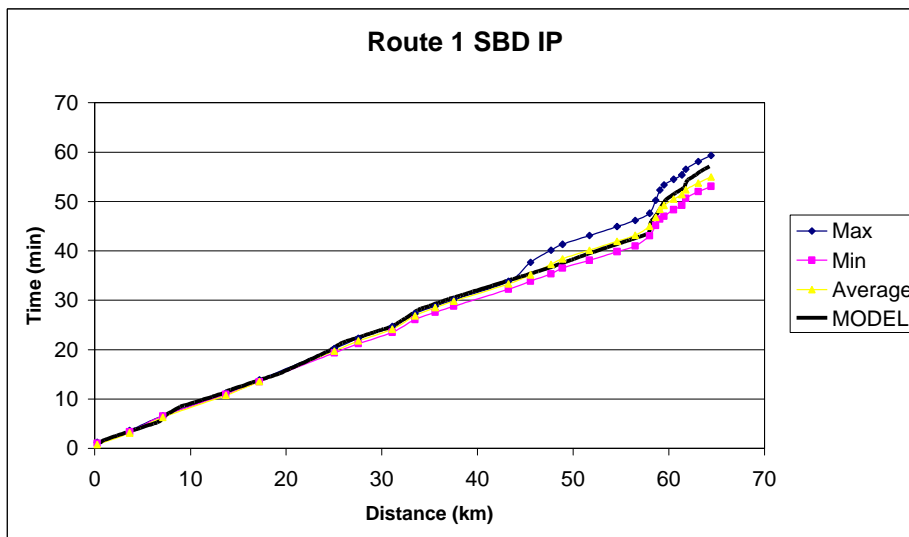
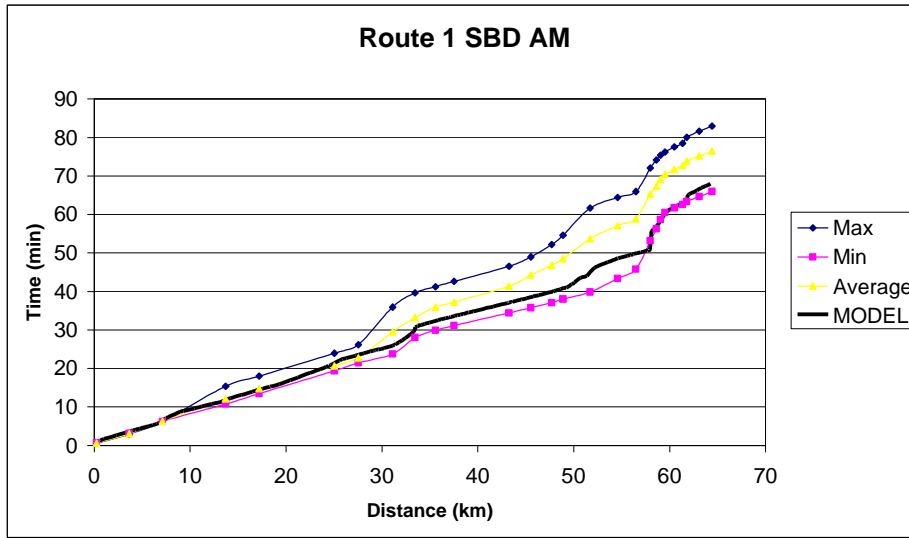
PDFH: British Rail Passenger Demand Forecasting Handbook

Appendix A Travel Time Validation

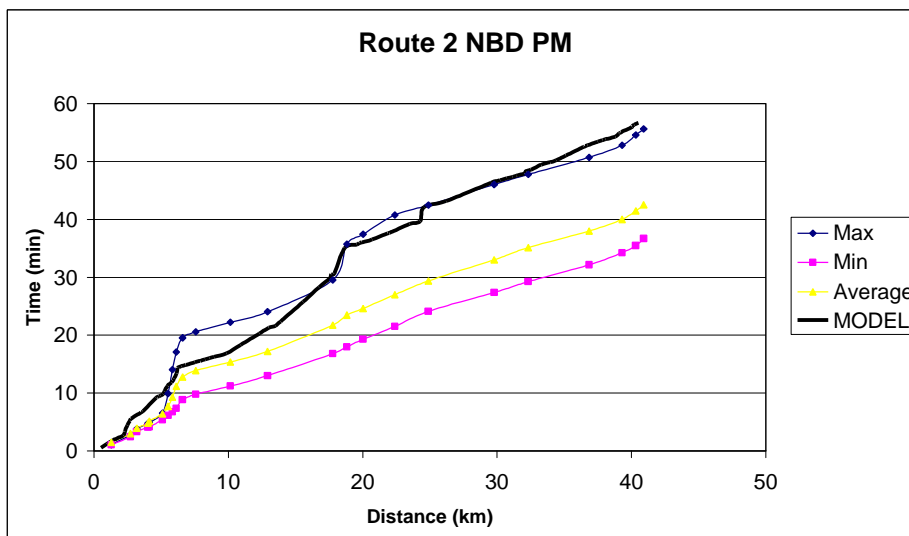
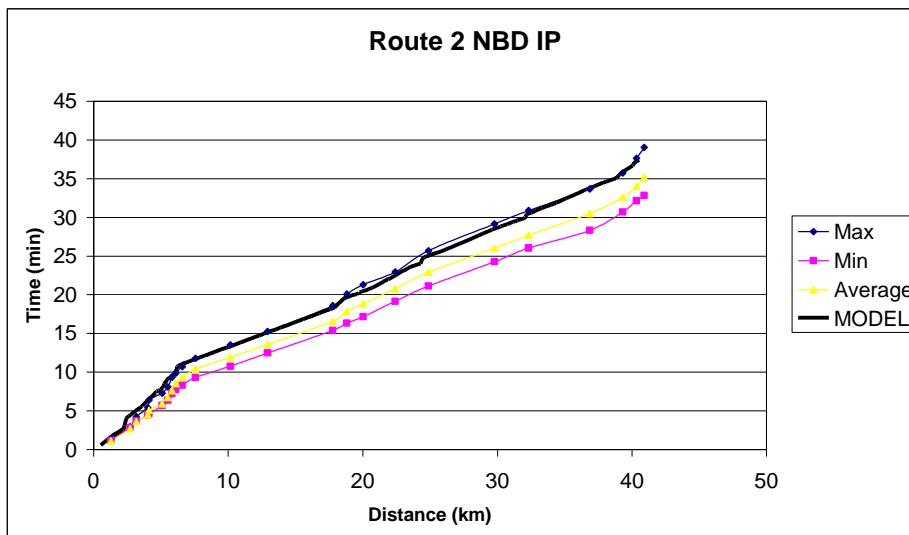
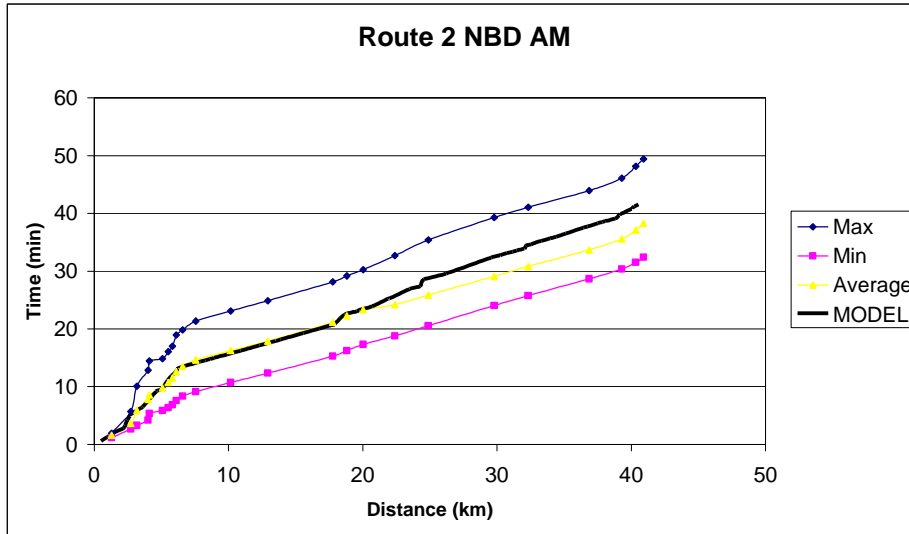
ROUTE 1 NORTHBOUND - Wellington Airport - Waikanae Railway Station



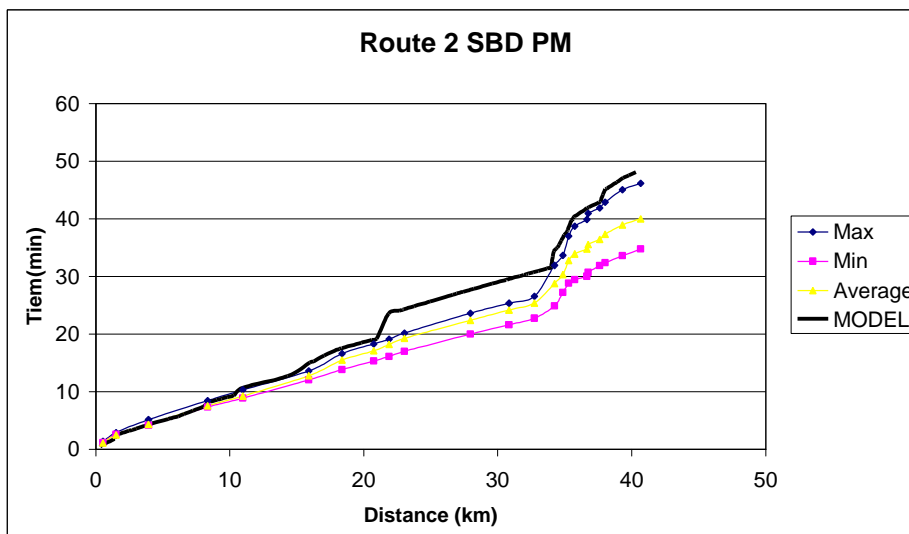
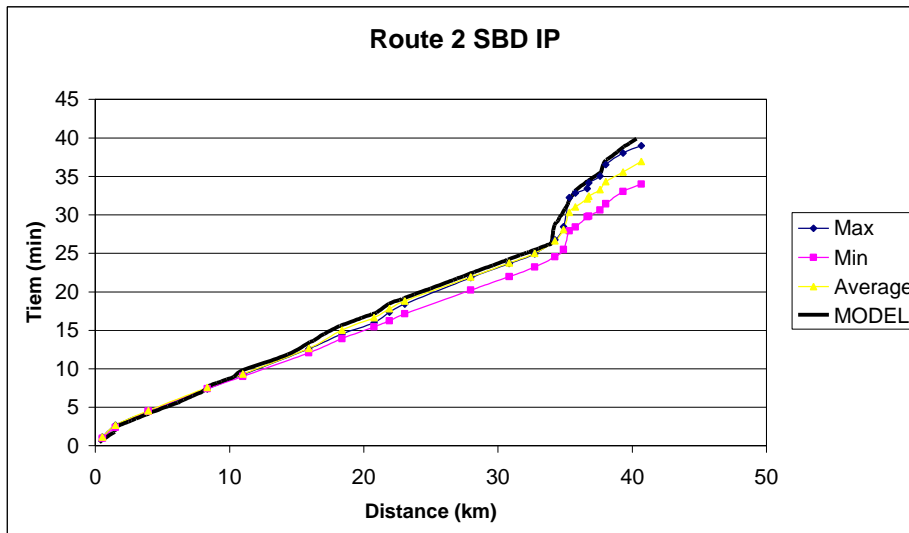
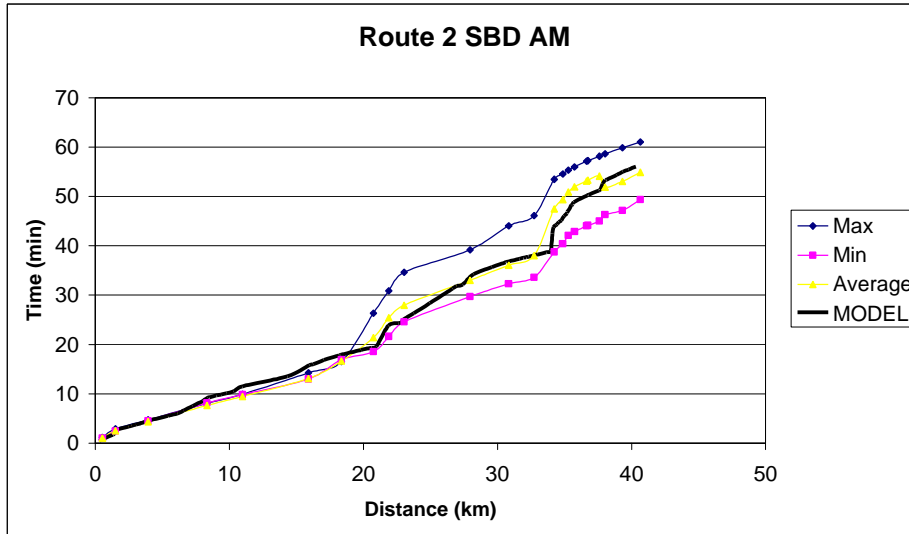
ROUTE 1 SOUTHBOUND - Waikanae Railway Station - Wellington Airport



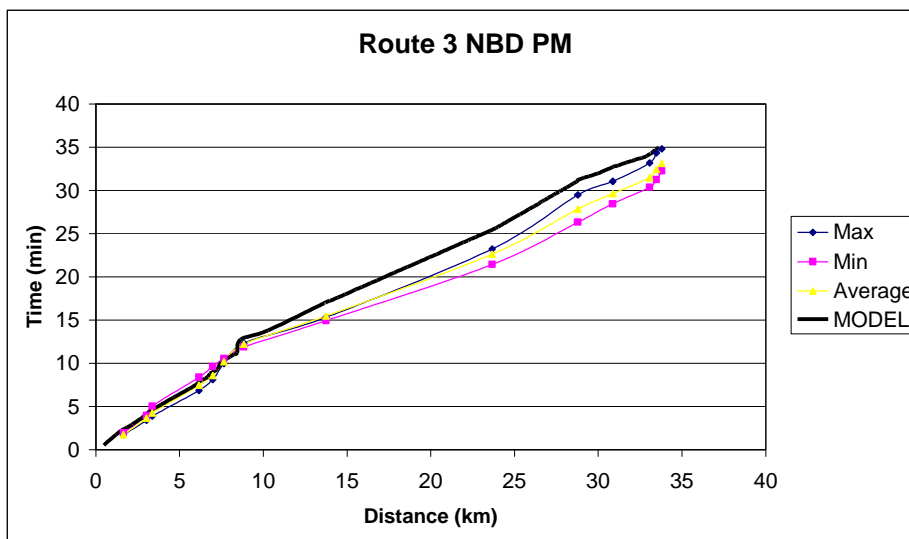
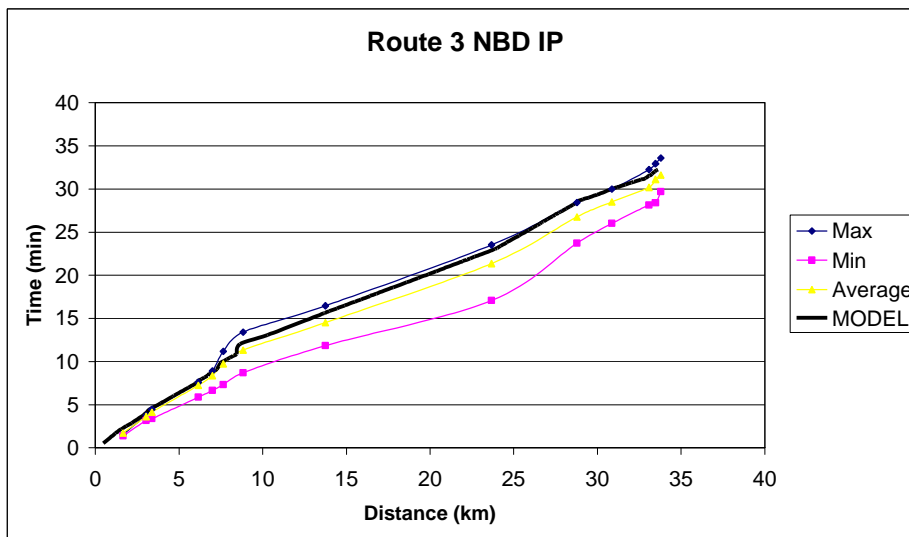
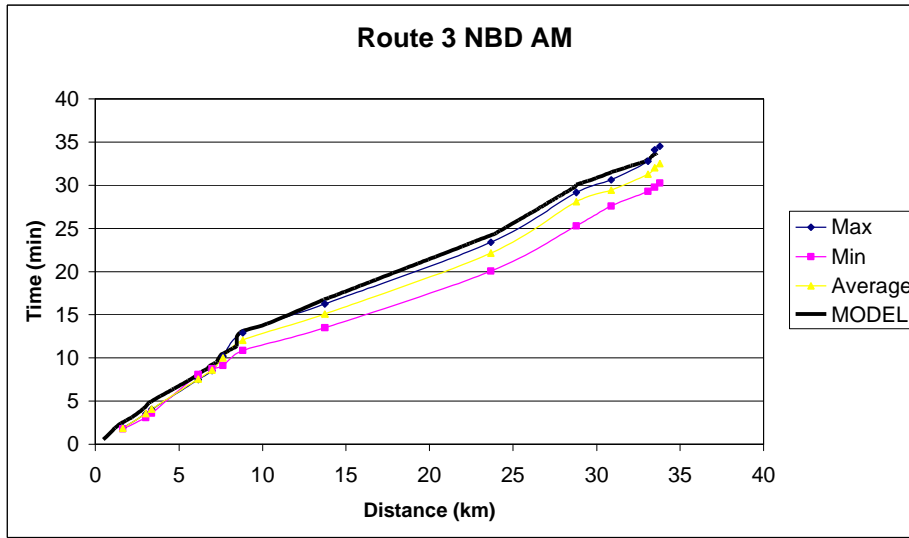
ROUTE 2 SOUTHBOUND - Wellington - AirportUpper Hutt Railway Station



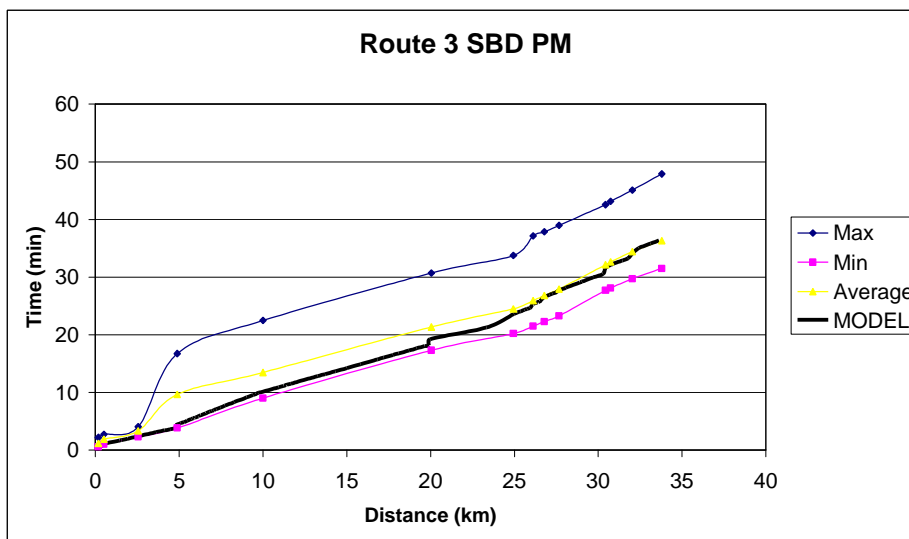
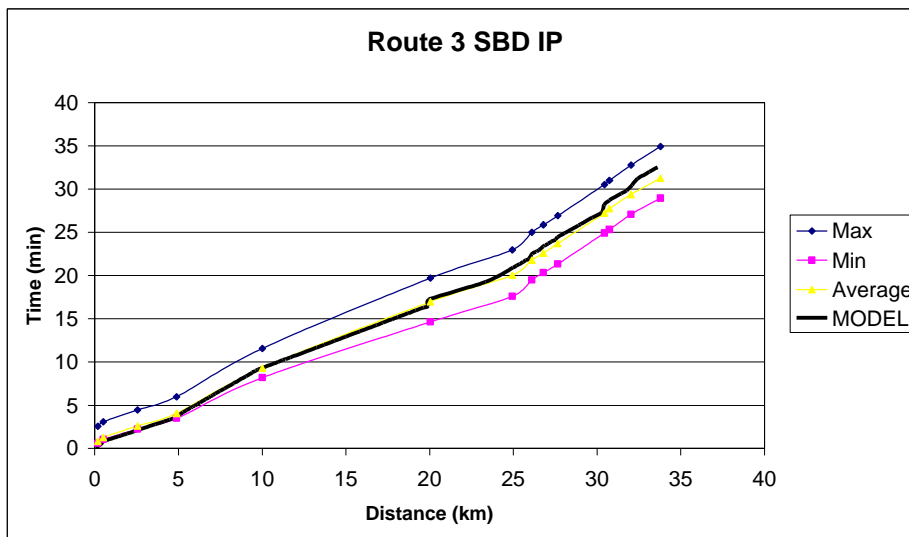
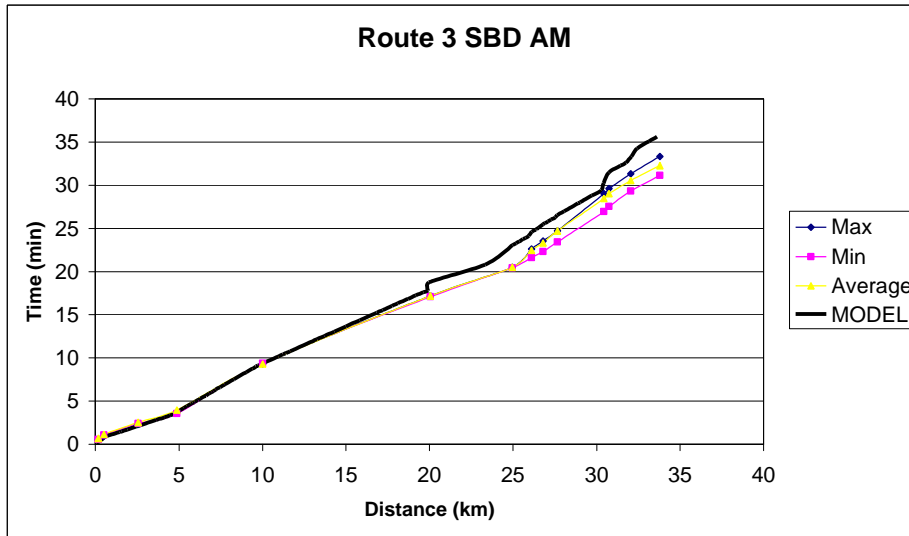
ROUTE 2 SOUTHBOUND - Upper Hutt Railway Station - Wellington Airport



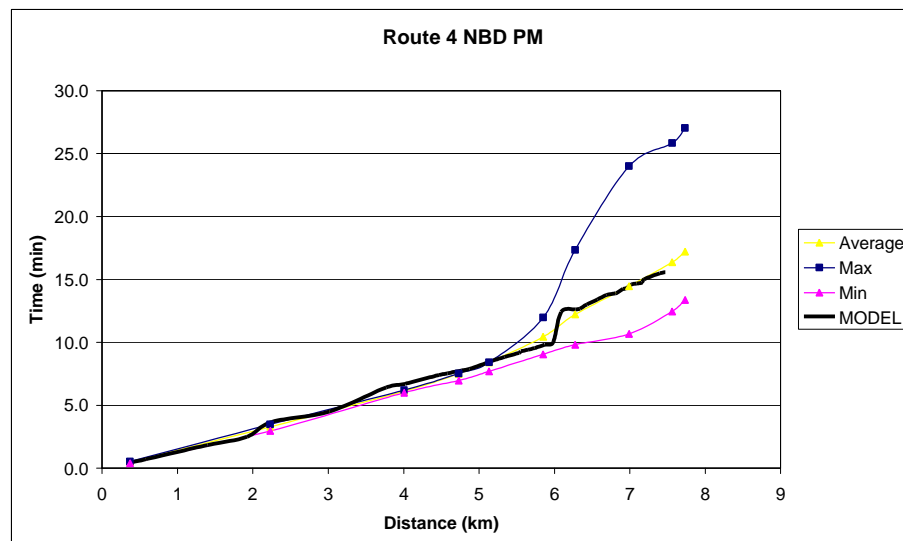
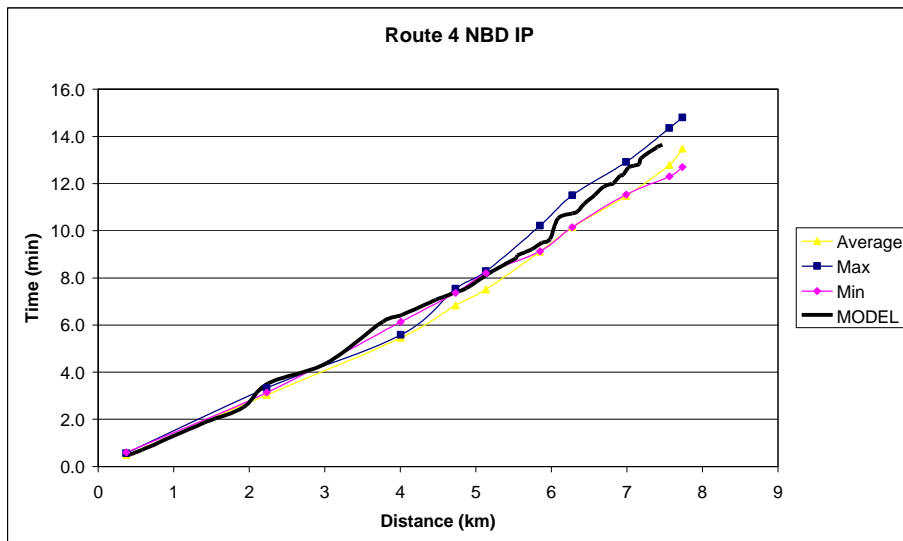
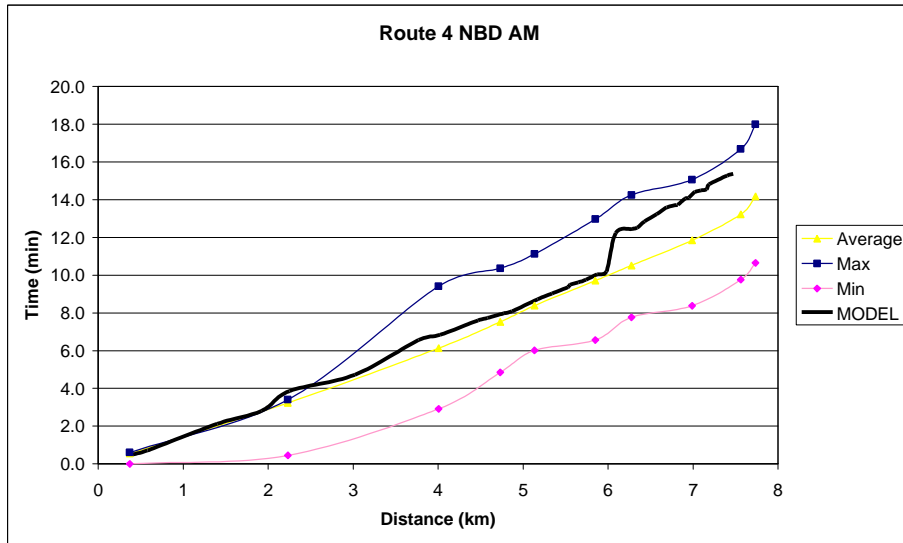
ROUTE 3 WESTBOUND - Seaview – Porirua



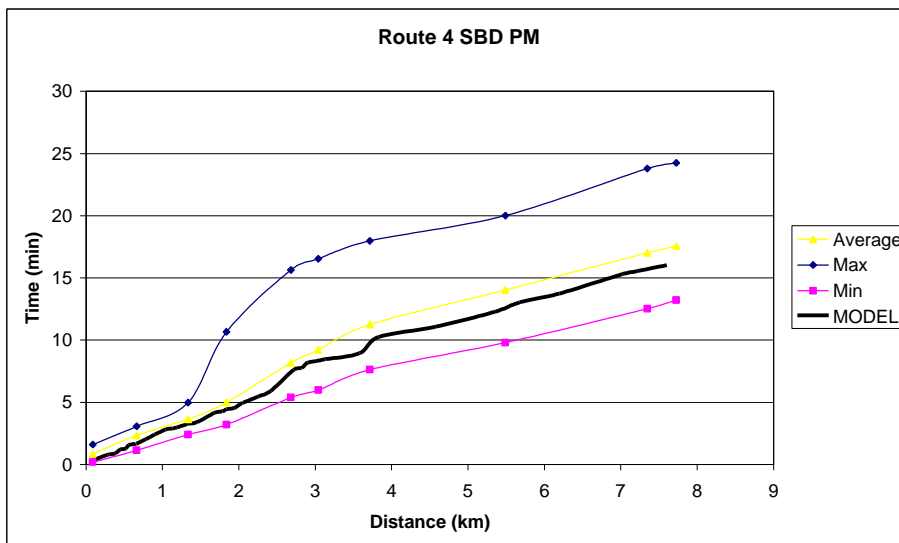
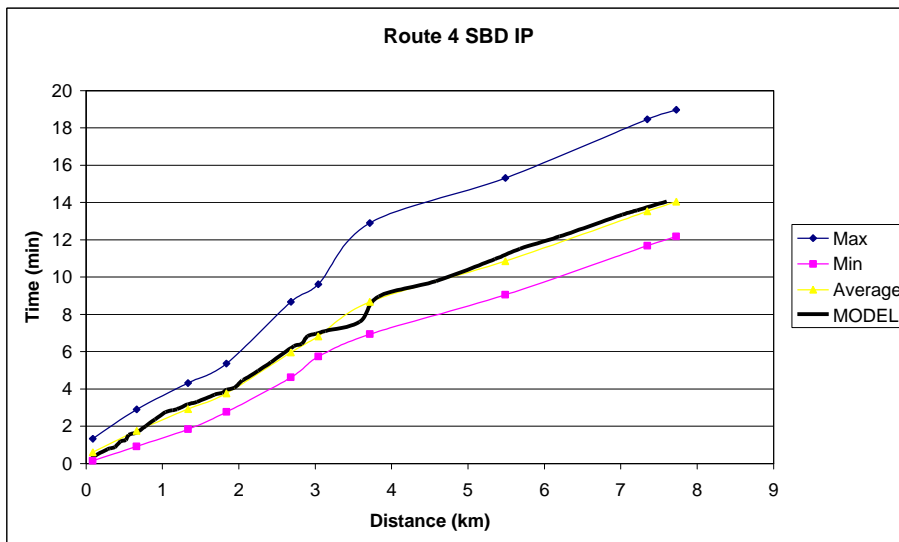
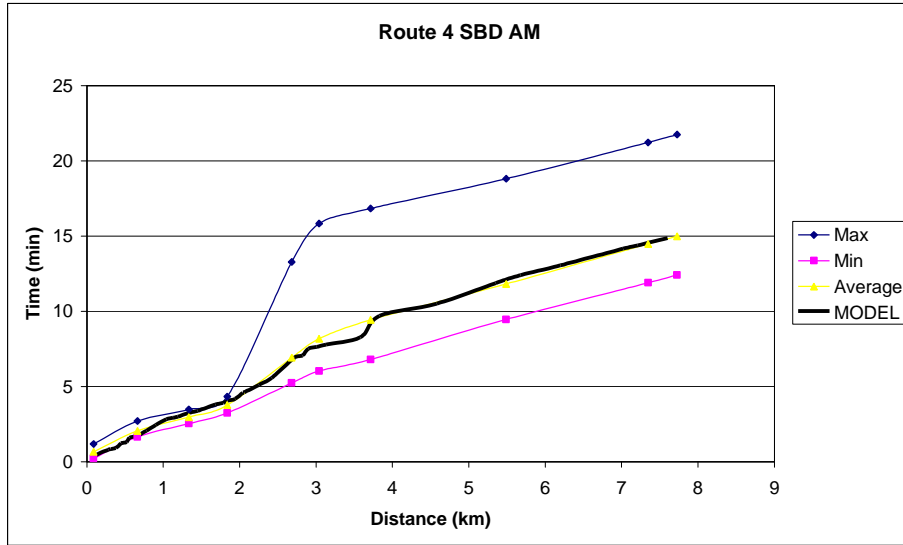
ROUTE 3 SOUTHBOUND - Porirua – Seaview



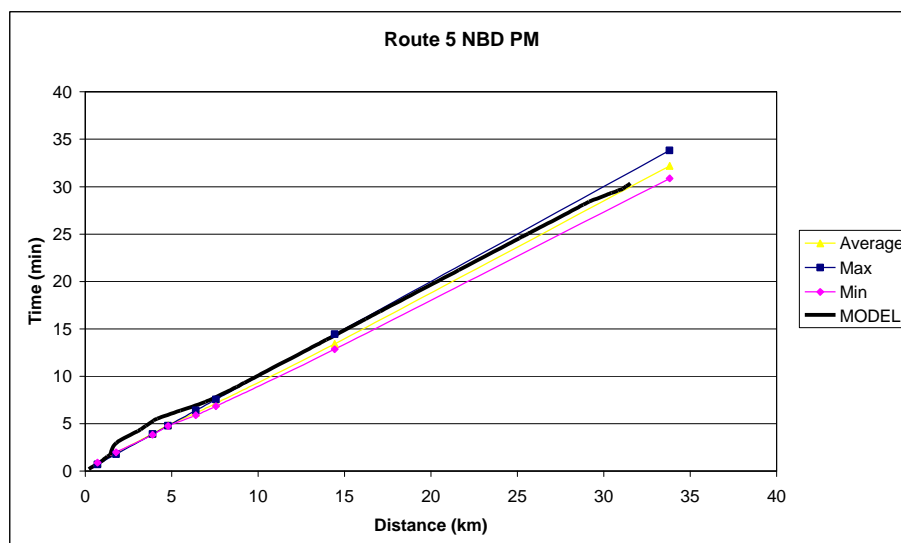
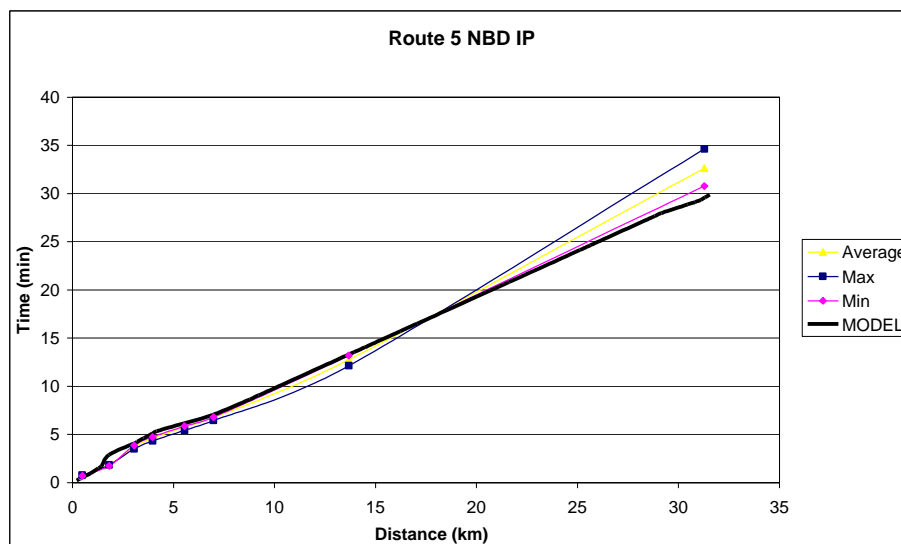
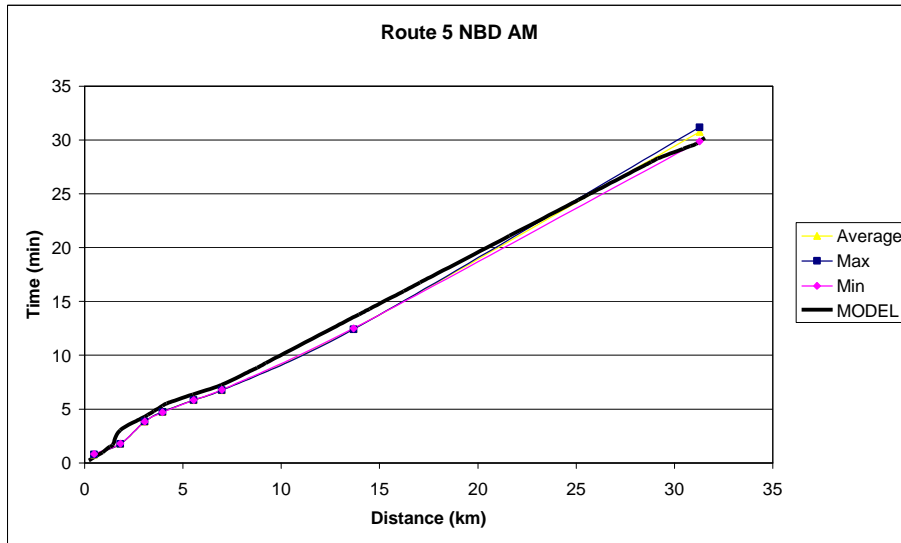
Route 4 - Island Bay - Wellington Railway Station – northbound



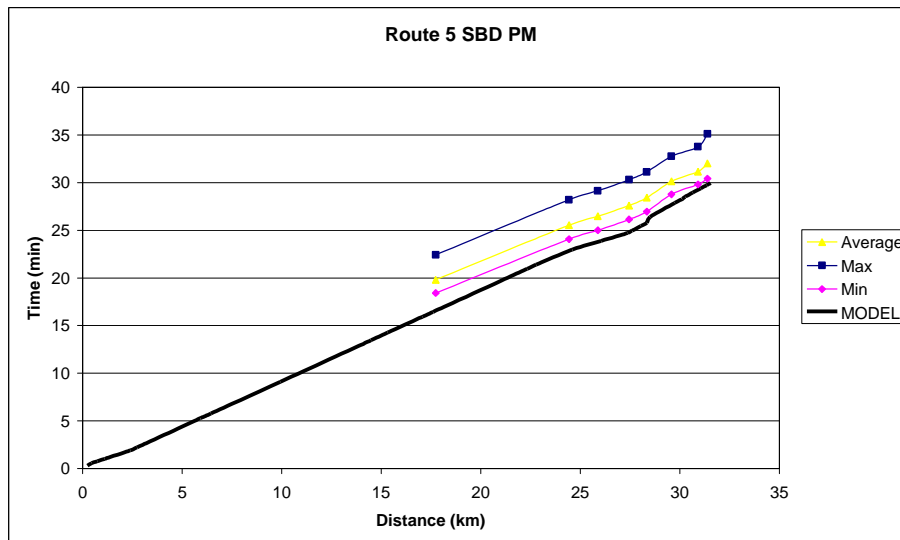
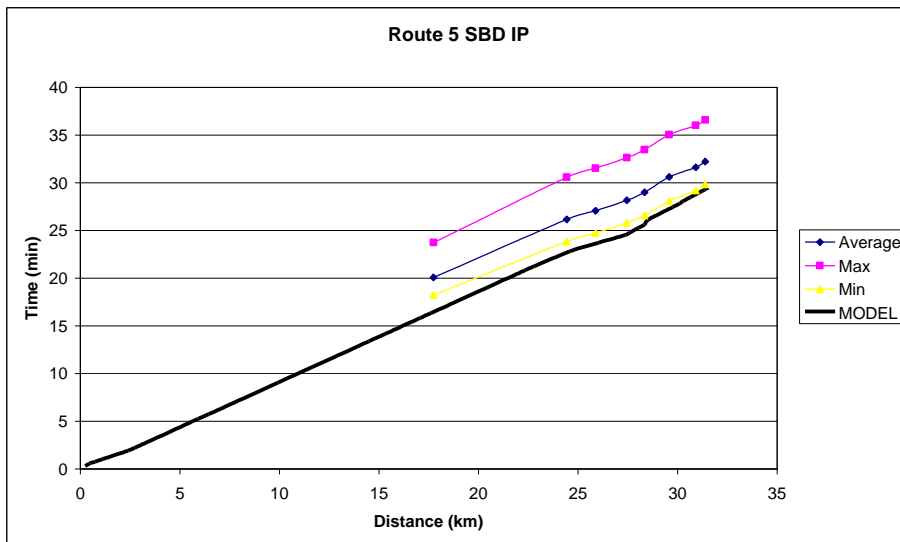
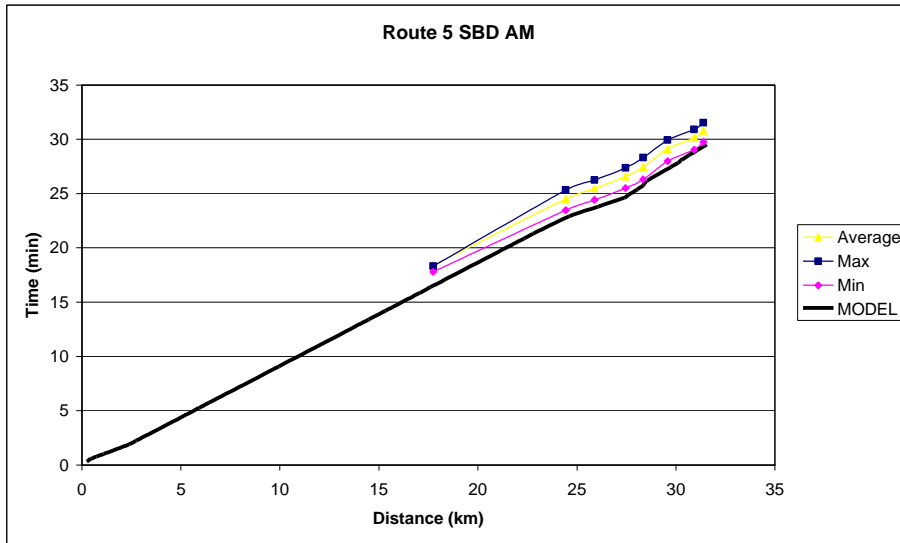
Route 4 - Wellington Railway Station - Island Bay – Southbound



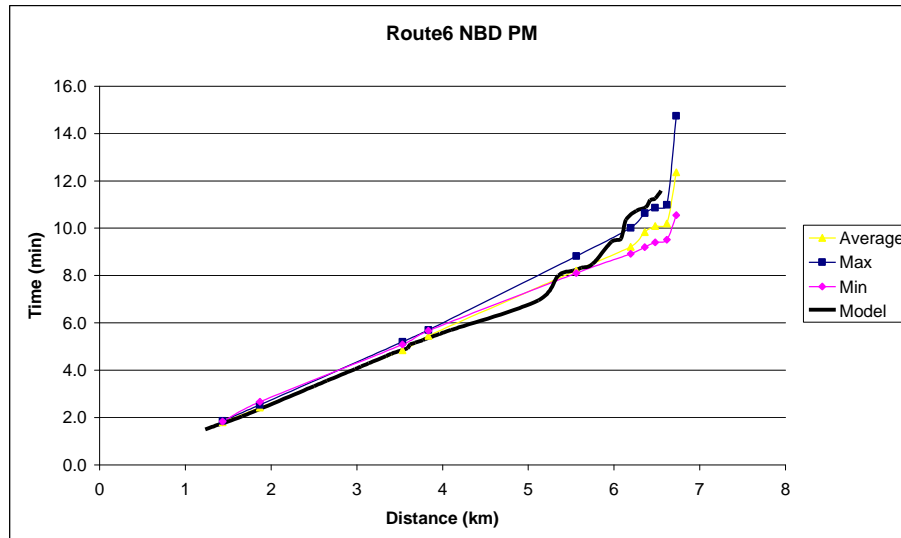
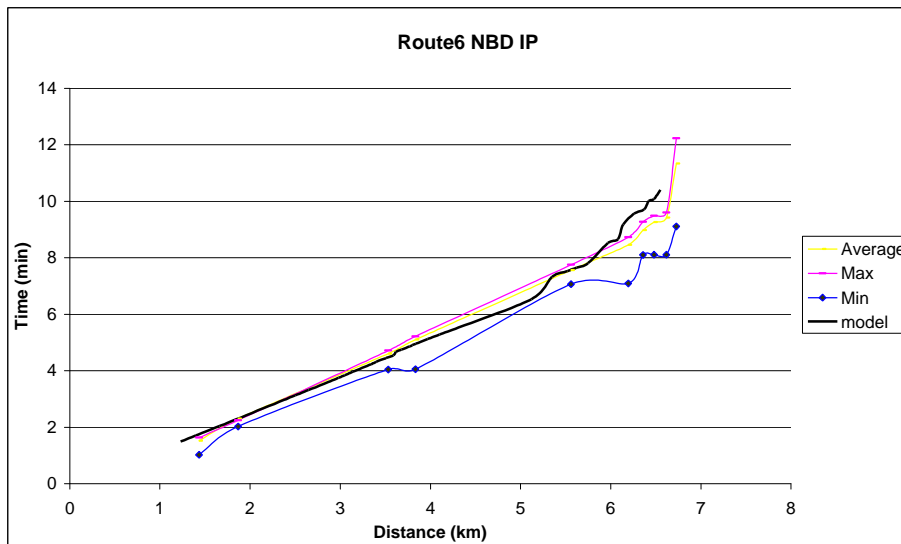
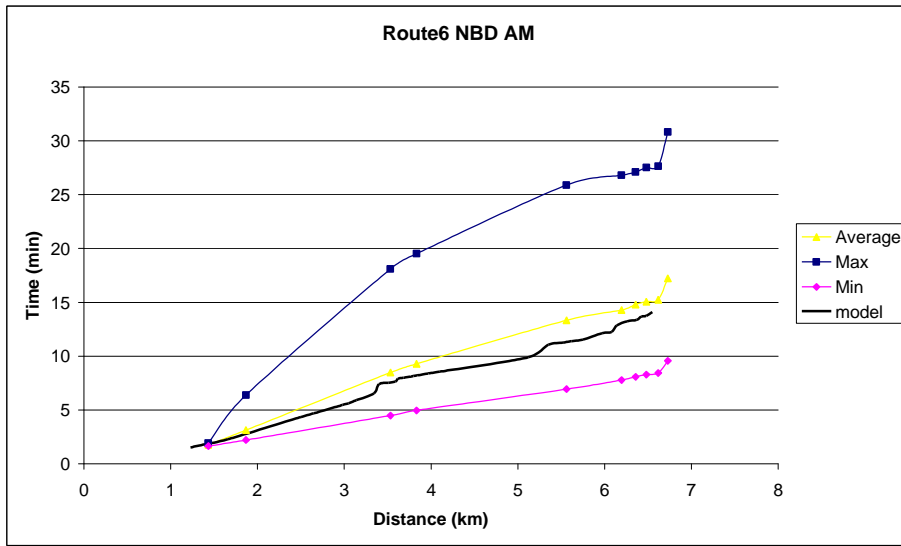
Route 5 - Upper Hutt Railway Station - Featherstone northbound



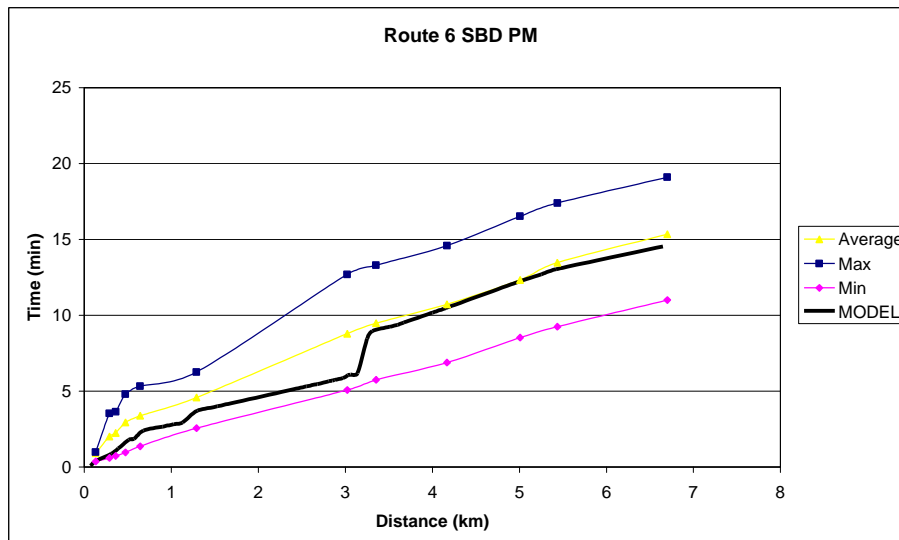
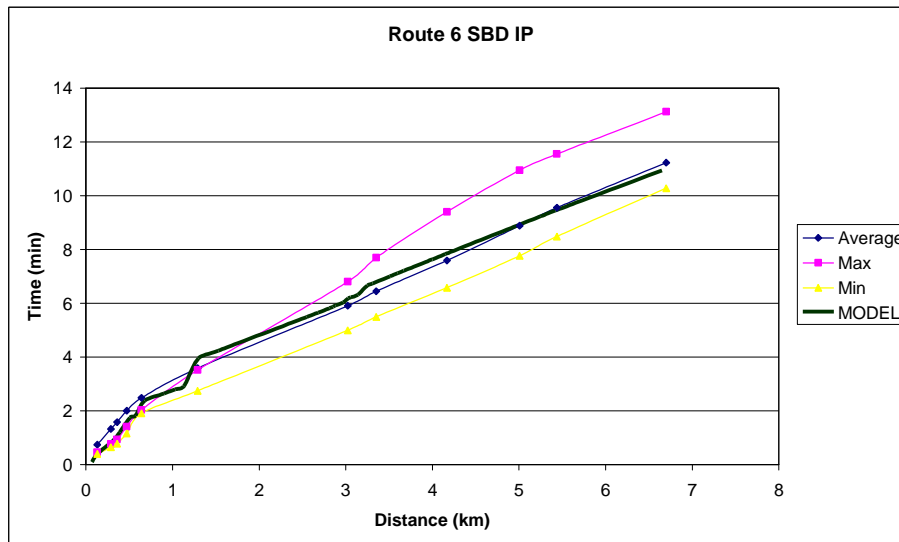
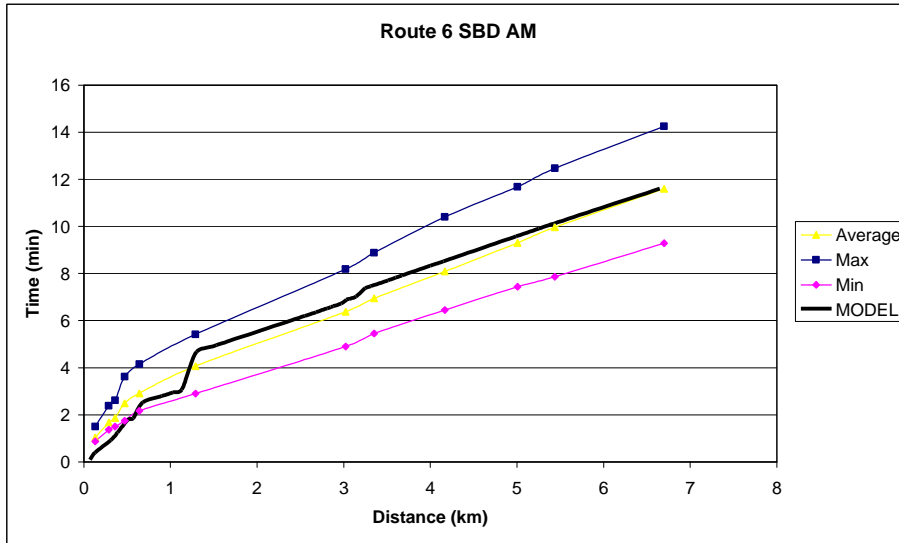
Route 5 Featherstone - Upper Hutt Railway Station – southbound



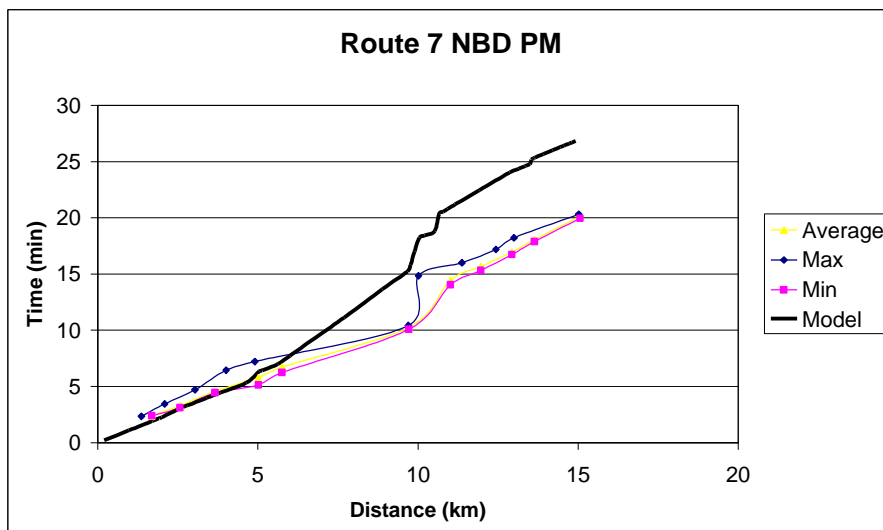
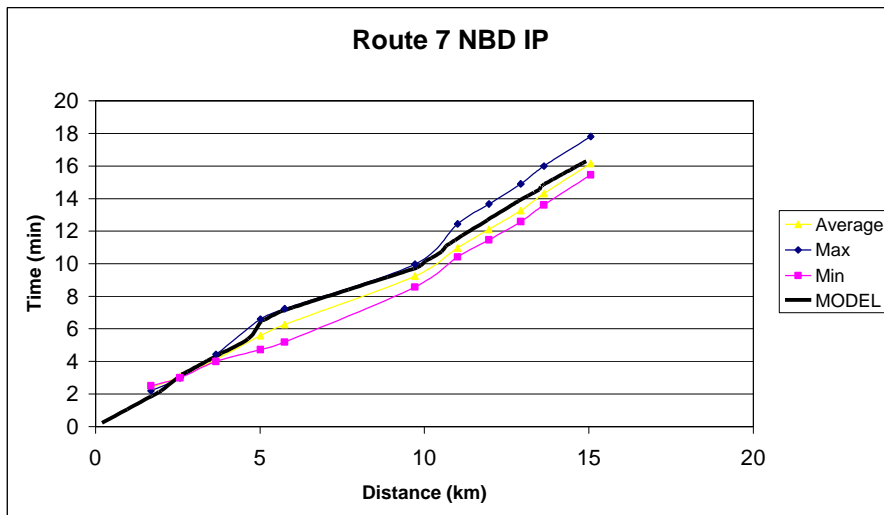
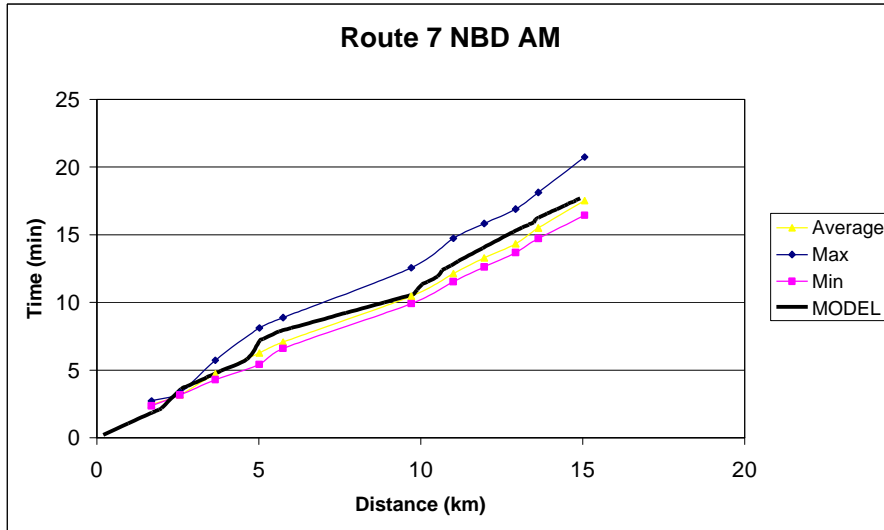
Route 6 Karori West - Wellington Railway Station



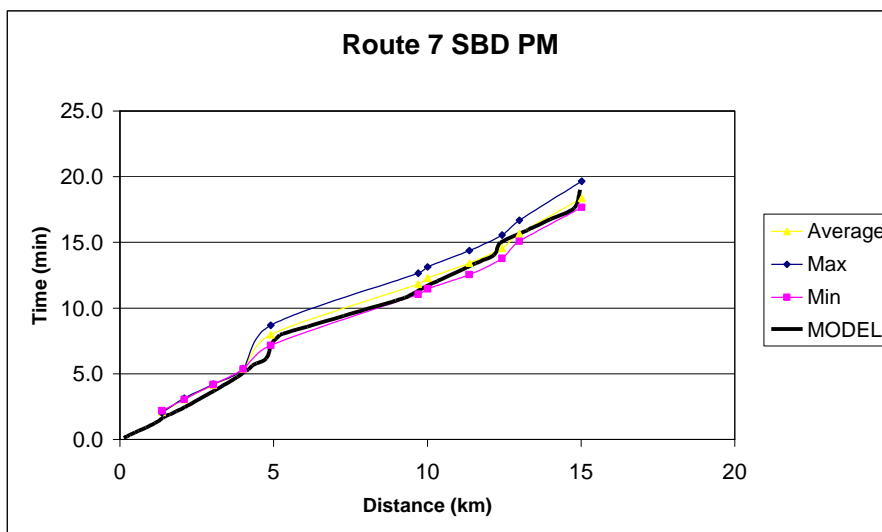
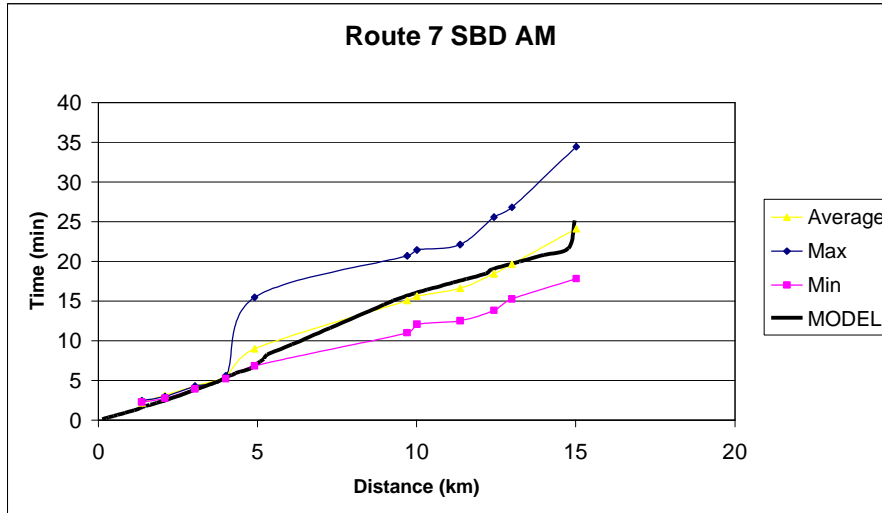
Route 6 Wellington Railway Station - Karori West



Route 7 Waterloo Quay / Bunny St to Whites Line / Randwick – northbound



Route 7 White Lines / Randwick Rd - Waterloo quay / Bunny St - Southbound



Appendix B Summary DMS Tables

B.1 Home Based Work

HBW Observed	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	101520	2500	722	1075	6311	0	227	241	112596
Porirua (Porirua)	13771	8253	479	410	2738	0	0	78	25728
Kapiti Coast (KC)	4133	989	11989	120	980	0	0	995	19208
Upper Hutt (UH)	5891	475	56	12094	4756	0	49	59	23379
Lower Hutt (LH)	16626	101	95	3109	32210	0	9	145	52294
Cart/Sth Wai (Car/SW)	866	27	0	44	173	3999	1318	32	6458
Masterton (Mast)	279	4	0	46	121	1449	12791	319	15010
External	462	89	934	40	145	40	497	0	2206
Total	143547	12438	14276	16937	47433	5487	14891	1868	256877

HBW Calibrated	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	101320	2176	229	811	8003	23	6	28	112596
Porirua (Porirua)	13266	8220	519	777	2850	24	6	66	25727
Kapiti Coast (KC)	4021	744	12055	261	746	8	2	1369	19208
Upper Hutt (UH)	6179	413	95	12485	3992	160	40	15	23378
Lower Hutt (LH)	17837	757	122	2131	31359	57	15	17	52294
Cart/Sth Wai (Car/SW)	496	36	9	369	327	4290	875	56	6458
Masterton (Mast)	175	6	2	64	59	832	13555	317	15010
External	240	83	1244	38	92	99	409	0	2205
Total	143533	12436	14274	16936	47429	5491	14908	1869	256876

HBW Synthesised Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	107335	1966	228	854	6522	39	38	25	117008
Porirua (Porirua)	13997	8667	521	858	2512	40	38	54	26686
Kapiti Coast (KC)	4128	719	13127	293	696	14	14	1244	20235
Upper Hutt (UH)	5139	354	86	12514	3290	233	218	22	21856
Lower Hutt (LH)	19874	746	141	2650	34262	109	105	21	57909
Cart/Sth Wai (Car/SW)	443	23	6	269	200	5283	2172	125	8520
Masterton (Mast)	28	1	0	7	6	379	11440	227	12088
External	310	96	1326	43	96	64	497	0	2432
Total	151255	12572	15434	17487	47583	6161	14522	1718	266733

HBW Synthesised New	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	106992	2052	233	933	6710	36	30	23	117008
Porirua (Porirua)	13913	8389	532	1035	2692	41	34	51	26686
Kapiti Coast (KC)	4043	746	13021	354	799	15	12	1245	20235
Upper Hutt (UH)	5324	443	107	12069	3492	220	179	21	21856
Lower Hutt (LH)	20289	831	171	2800	33615	99	82	21	57909
Cart/Sth Wai (Car/SW)	396	23	6	243	172	5209	2354	118	8520
Masterton (Mast)	25	1	0	7	5	475	11335	240	12087
External	273	88	1365	46	97	66	496	0	2432
Total	151255	12572	15434	17487	47583	6161	14522	1718	266733

Calibrated v Synth Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	6%	-10%	0%	5%	-19%	73%	563%	-12%	4%
Porirua (Porirua)	6%	5%	0%	10%	-12%	70%	540%	-18%	4%
Kapiti Coast (KC)	3%	-3%	9%	12%	-7%	75%	565%	-9%	5%
Upper Hutt (UH)	-17%	-14%	-9%	0%	-18%	46%	444%	46%	-7%
Lower Hutt (LH)	11%	-1%	16%	24%	9%	92%	611%	23%	11%
Cart/Sth Wai (Car/SW)	-11%	-37%	-36%	-27%	-39%	23%	148%	123%	32%
Masterton (Mast)	-84%	-90%	-90%	-89%	-90%	-54%	-16%	-28%	-19%
External	29%	15%	7%	12%	5%	-35%	21%	NA	10%
Total	5%	1%	8%	3%	0%	12%	-3%	-8%	4%

Synthesised New v Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	0%	4%	2%	9%	3%	-8%	-22%	-7%	0%
Porirua (Porirua)	-1%	-3%	2%	21%	7%	3%	-11%	-6%	0%
Kapiti Coast (KC)	-2%	4%	-1%	21%	15%	3%	-11%	0%	0%
Upper Hutt (UH)	4%	25%	25%	-4%	6%	-5%	-18%	-8%	0%
Lower Hutt (LH)	2%	11%	21%	6%	-2%	-10%	-22%	2%	0%
Cart/Sth Wai (Car/SW)	-11%	1%	0%	-10%	-14%	-1%	8%	-6%	0%
Masterton (Mast)	-10%	4%	2%	-5%	-7%	25%	-1%	6%	0%
External	-12%	-8%	3%	8%	1%	3%	0%	NA	0%
Total	0%	0%	0%	0%	0%	0%	0%	0%	0%

B.2 Home Based Education

HBE Observed	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	34301	511	1	0	326	0	0	25	35164
Porirua (Porirua)	2662	7012	302	222	504	0	0	1	10703
Kapiti Coast (KC)	406	262	9457	0	0	0	0	178	10303
Upper Hutt (UH)	990	0	0	4689	943	0	0	2	6623
Lower Hutt (LH)	2213	0	0	549	17818	0	0	17	20597
Cart/Sth Wai (Car/SW)	143	0	0	0	8	1138	554	11	1854
Masterton (Mast)	41	0	0	0	12	0	5383	137	5573
External	21	4	114	0	1	2	105	0	248
Total	40777	7789	9875	5460	19612	1140	6042	371	91065

HBE Calibrated	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	34085	246	36	66	726	0	2	2	35163
Porirua (Porirua)	2694	7247	162	88	495	0	3	10	10699
Kapiti Coast (KC)	367	113	9509	19	88	0	1	203	10299
Upper Hutt (UH)	743	47	13	4881	904	2	14	4	6608
Lower Hutt (LH)	2765	115	25	365	17313	1	8	4	20595
Cart/Sth Wai (Car/SW)	43	3	1	29	50	1131	418	70	1745
Masterton (Mast)	2	0	0	1	2	2	5473	79	5558
External	15	5	113	2	5	1	108	0	248
Total	40713	7776	9860	5451	19581	1137	6027	371	90915

HBE Synthesised Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	30820	157	166	17	339	0	2	1	31501
Porirua (Porirua)	2741	7052	787	25	246	0	4	7	10863
Kapiti Coast (KC)	90	22	7380	2	13	0	0	92	7600
Upper Hutt (UH)	1346	63	134	4859	1271	2	42	7	7725
Lower Hutt (LH)	2940	88	166	210	16546	1	14	4	19968
Cart/Sth Wai (Car/SW)	62	5	11	16	46	1156	1465	107	2867
Masterton (Mast)	1	0	0	0	0	1	4807	39	4848
External	8	2	127	0	2	0	109	0	249
Total	38009	7389	8771	5129	18462	1161	6443	258	85622

HBE Synthesised New	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	27838	148	133	25	369	0	2	2	28516
Porirua (Porirua)	1934	6047	536	40	258	0	4	7	8826
Kapiti Coast (KC)	91	24	6236	3	19	0	0	91	6465
Upper Hutt (UH)	959	74	130	3887	846	3	32	6	5937
Lower Hutt (LH)	2167	103	169	203	13800	1	12	4	16460
Cart/Sth Wai (Car/SW)	55	7	11	20	43	1082	1168	95	2480
Masterton (Mast)	1	0	0	0	1	2	4620	46	4670
External	8	3	126	1	2	0	109	0	249
Total	33053	6405	7341	4178	15337	1089	5947	251	73602

Calibrated v Synth Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	-10%	-36%	356%	-74%	-53%	-9%	-7%	-39%	-10%
Porirua (Porirua)	2%	-3%	385%	-71%	-50%	-40%	19%	-24%	2%
Kapiti Coast (KC)	-75%	-80%	-22%	-90%	-85%	-80%	-63%	-55%	-26%
Upper Hutt (UH)	81%	32%	955%	0%	41%	39%	201%	96%	17%
Lower Hutt (LH)	6%	-24%	562%	-42%	-4%	-9%	76%	10%	-3%
Cart/Sth Wai (Car/SW)	46%	52%	869%	-46%	-8%	2%	250%	54%	64%
Masterton (Mast)	-67%	-53%	NA	-88%	-79%	-53%	-12%	-51%	-13%
External	-44%	-57%	13%	-81%	-69%	-52%	1%	NA	1%
Total	-7%	-5%	-11%	-6%	-6%	2%	7%	-30%	-6%

Synthesised New v Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	-10%	-6%	-20%	46%	9%	70%	9%	15%	-9%
Porirua (Porirua)	-29%	-14%	-32%	57%	5%	55%	-5%	-4%	-19%
Kapiti Coast (KC)	1%	8%	-16%	86%	42%	72%	5%	-1%	-15%
Upper Hutt (UH)	-29%	19%	-3%	-20%	-33%	24%	-25%	-13%	-23%
Lower Hutt (LH)	-26%	17%	2%	-3%	-17%	38%	-15%	8%	-18%
Cart/Sth Wai (Car/SW)	-12%	31%	5%	25%	-6%	-6%	-20%	-12%	-13%
Masterton (Mast)	33%	79%	44%	78%	37%	100%	-4%	20%	-4%
External	-5%	23%	-1%	84%	39%	63%	0%	-99%	0%
Total	-13%	-13%	-16%	-19%	-17%	-6%	-8%	-3%	-14%

B.3 Home Based Shopping

HBSH Observed	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	109940	4627	91	46	2970	0	0	124	117797
Porirua (Porirua)	2697	24491	86	0	489	0	0	44	27805
Kapiti Coast (KC)	523	548	35584	0	54	0	0	738	37446
Upper Hutt (UH)	789	278	0	23690	1999	0	10	15	26781
Lower Hutt (LH)	2083	80	426	1176	57535	0	0	55	61355
Cart/Sth Wai (Car/SW)	0	0	0	93	144	6077	2162	10	8487
Masterton (Mast)	0	0	0	171	24	649	19527	282	20652
External	173	73	545	8	35	9	459	0	1302
Total	116205	30095	36732	25184	63249	6735	22158	1268	301625

HBSH Calibrated	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	110596	3159	172	329	3524	6	3	8	117797
Porirua (Porirua)	1352	25299	268	234	632	4	2	13	27805
Kapiti Coast (KC)	273	661	35390	81	169	2	1	871	37446
Upper Hutt (UH)	904	408	68	22893	2332	114	56	6	26780
Lower Hutt (LH)	3004	533	56	1278	56452	19	9	3	61354
Cart/Sth Wai (Car/SW)	48	23	4	359	124	6254	1602	73	8486
Masterton (Mast)	1	0	0	3	1	304	20048	295	20652
External	5	12	806	2	3	33	441	0	1302
Total	116183	30093	36764	25180	63237	6735	22161	1268	301622

HBSH Synthesised Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	104075	1863	664	155	1784	0	0	1	108543
Porirua (Porirua)	2788	24959	2030	215	576	0	0	4	30572
Kapiti Coast (KC)	77	93	32320	11	21	0	0	681	33204
Upper Hutt (UH)	1400	310	371	20807	1903	12	9	1	24814
Lower Hutt (LH)	6715	552	450	1788	54796	3	2	1	64307
Cart/Sth Wai (Car/SW)	156	36	43	781	211	6936	2682	27	10871
Masterton (Mast)	1	0	0	4	1	117	16564	57	16744
External	4	4	844	1	1	14	461	0	1329
Total	115215	27816	36722	23763	59294	7083	19719	772	290384

HBSH Synthesised New	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	104011	1769	653	227	1880	0	0	2	108543
Porirua (Porirua)	2867	24852	1832	331	682	1	0	6	30572
Kapiti Coast (KC)	86	94	32299	19	31	0	0	676	33204
Upper Hutt (UH)	1495	415	472	20500	1911	11	8	2	24814
Lower Hutt (LH)	6591	633	574	1923	54579	3	2	2	64307
Cart/Sth Wai (Car/SW)	161	47	53	754	208	6913	2708	27	10871
Masterton (Mast)	1	0	0	5	1	138	16540	57	16744
External	5	6	839	2	2	16	459	0	1329
Total	115215	27816	36722	23763	59294	7083	19719	772	290384

Calibrated v Synth Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	-6%	-41%	287%	-53%	-49%	-95%	-92%	-85%	-8%
Porirua (Porirua)	106%	-1%	657%	-8%	-9%	-90%	-85%	-69%	10%
Kapiti Coast (KC)	-72%	-86%	-9%	-86%	-87%	-99%	-98%	-22%	-11%
Upper Hutt (UH)	55%	-24%	443%	-9%	-18%	-89%	-83%	-86%	-7%
Lower Hutt (LH)	124%	4%	705%	40%	-3%	-84%	-76%	-70%	5%
Cart/Sth Wai (Car/SW)	223%	58%	1055%	117%	70%	11%	67%	-63%	28%
Masterton (Mast)	53%	-13%	NA	23%	3%	-62%	-17%	-81%	-19%
External	-29%	-65%	5%	-46%	-64%	-57%	5%	NA	2%
Total	-1%	-8%	0%	-6%	-6%	5%	-11%	-39%	-4%

Synthesised New v Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	0%	-5%	-2%	47%	5%	36%	33%	74%	0%
Porirua (Porirua)	3%	0%	-10%	54%	18%	43%	40%	58%	0%
Kapiti Coast (KC)	11%	1%	0%	71%	45%	59%	56%	-1%	0%
Upper Hutt (UH)	7%	34%	27%	-1%	0%	-9%	-11%	110%	0%
Lower Hutt (LH)	-2%	15%	28%	8%	0%	1%	-1%	121%	0%
Cart/Sth Wai (Car/SW)	3%	31%	24%	-3%	-2%	0%	1%	1%	0%
Masterton (Mast)	47%	87%	77%	37%	40%	18%	0%	0%	0%
External	44%	34%	-1%	81%	84%	14%	0%	NA	0%
Total	0%	0%	0%	0%	0%	0%	0%	0%	0%

B.4 Home Based Other

HBO Observed	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	136066	2571	558	467	4333	388	6	504	144892
Porirua (Porirua)	5322	28608	298	148	896	0	0	202	35475
Kapiti Coast (KC)	1341	540	40177	54	401	3	0	1501	44017
Upper Hutt (UH)	1081	552	127	24852	2716	0	108	105	29541
Lower Hutt (LH)	6193	6	561	3533	66216	156	0	720	77384
Cart/Sth Wai (Car/SW)	229	0	0	365	182	9346	1504	45	11673
Masterton (Mast)	0	0	0	171	66	679	22041	231	23189
External	651	143	958	75	113	49	236	2	2226
Total	150883	32420	42678	29665	74923	10621	23895	3311	368396

HBO Calibrated	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	136637	2022	578	1119	4152	137	77	171	144893
Porirua (Porirua)	4145	28033	747	766	1456	92	49	188	35475
Kapiti Coast (KC)	1099	729	39398	302	488	37	20	1945	44017
Upper Hutt (UH)	1641	444	187	24757	1865	373	185	89	29541
Lower Hutt (LH)	6869	975	347	2151	66542	249	132	120	77384
Cart/Sth Wai (Car/SW)	277	76	35	478	308	9149	1092	259	11673
Masterton (Mast)	16	5	2	30	18	510	22070	539	23188
External	205	141	1398	61	95	70	255	0	2226
Total	150889	32423	42691	29665	74925	10616	23878	3311	368396

HBO Synthesised Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	137831	1484	936	698	3047	64	62	93	144215
Porirua (Porirua)	6590	29714	1882	760	1608	64	56	189	40862
Kapiti Coast (KC)	530	238	37306	91	162	8	8	1027	39371
Upper Hutt (UH)	2379	408	418	26593	2082	279	226	57	32443
Lower Hutt (LH)	9810	870	739	2184	70444	177	151	82	84457
Cart/Sth Wai (Car/SW)	213	39	41	301	192	11119	1671	116	13693
Masterton (Mast)	8	1	2	10	7	294	20465	150	20936
External	107	52	1731	21	35	44	280	0	2270
Total	157468	32806	43055	30658	77579	12049	22920	1713	378247

HBO Synthesised New	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	135649	1390	905	804	2951	66	54	89	141908
Porirua (Porirua)	6894	29355	1929	1027	1794	80	60	189	41328
Kapiti Coast (KC)	548	231	36623	121	191	10	8	1008	38741
Upper Hutt (UH)	2681	505	535	25639	2248	310	222	65	32205
Lower Hutt (LH)	9863	919	871	2450	69432	185	139	92	83952
Cart/Sth Wai (Car/SW)	196	38	41	283	165	10836	1819	110	13488
Masterton (Mast)	9	2	2	10	7	397	20118	160	20705
External	102	47	1732	26	38	47	277	0	2270
Total	155942	32488	42638	30360	76826	11932	22697	1713	374596

Calibrated v Synth Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	1%	-27%	62%	-38%	-27%	-54%	-19%	-46%	0%
Porirua (Porirua)	59%	6%	152%	-1%	10%	-30%	15%	1%	15%
Kapiti Coast (KC)	-52%	-67%	-5%	-70%	-67%	-77%	-57%	-47%	-11%
Upper Hutt (UH)	45%	-8%	124%	7%	12%	-25%	22%	-36%	10%
Lower Hutt (LH)	43%	-11%	113%	2%	6%	-29%	14%	-32%	9%
Cart/Sth Wai (Car/SW)	-23%	-49%	20%	-37%	-38%	22%	53%	-55%	17%
Masterton (Mast)	-50%	-69%	4%	-68%	-63%	-42%	-7%	-72%	-10%
External	-48%	-63%	24%	-66%	-63%	-38%	10%	NA	2%
Total	4%	1%	1%	3%	4%	13%	-4%	-48%	3%

Synthesised New v Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	-2%	-6%	-3%	15%	-3%	4%	-12%	-5%	-2%
Porirua (Porirua)	5%	-1%	2%	35%	12%	24%	7%	0%	1%
Kapiti Coast (KC)	3%	-3%	-2%	33%	17%	21%	2%	-2%	-2%
Upper Hutt (UH)	13%	24%	28%	-4%	8%	11%	-2%	15%	-1%
Lower Hutt (LH)	1%	6%	18%	12%	-1%	5%	-8%	13%	-1%
Cart/Sth Wai (Car/SW)	-8%	-3%	0%	-6%	-14%	-3%	9%	-5%	-1%
Masterton (Mast)	10%	10%	4%	9%	1%	35%	-2%	7%	-1%
External	-4%	-9%	0%	23%	10%	8%	-1%	NA	0%
Total	-1%	-1%	-1%	-1%	-1%	-1%	-1%	0%	-1%

B.5 Non Home Based Other

NHBO Observed	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	219454	6800	1532	1115	7045	243	6	313	236507
Porirua (Porirua)	4742	28706	448	430	628	33	0	57	35043
Kapiti Coast (KC)	859	392	40682	32	689	0	0	656	43310
Upper Hutt (UH)	924	287	74	26159	2929	233	59	19	30684
Lower Hutt (LH)	7056	810	365	2099	75894	167	0	76	86466
Cart/Sth Wai (Car/SW)	160	0	0	0	109	7035	2029	14	9347
Masterton (Mast)	149	0	0	0	163	1721	36091	215	38338
External	381	30	235	71	44	12	201	111	1085
Total	233726	37023	43335	29905	87500	9442	38386	1461	480779

NHBO Calibrated	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	220302	4783	909	1786	8532	108	45	43	236507
Porirua (Porirua)	3313	29214	712	520	1203	34	14	33	35043
Kapiti Coast (KC)	811	762	40482	188	317	13	5	733	43310
Upper Hutt (UH)	1795	728	247	24672	2742	336	142	22	30684
Lower Hutt (LH)	7352	1462	360	2494	74560	152	64	21	86466
Cart/Sth Wai (Car/SW)	63	24	8	165	87	7740	1175	85	9347
Masterton (Mast)	33	10	3	67	35	1019	36648	523	38338
External	33	38	610	13	18	47	327	0	1084
Total	233702	37020	43330	29904	87492	9448	38421	1461	480779

NHBO Synthesised Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	232644	4224	655	1575	7809	39	11	22	246979
Porirua (Porirua)	4189	29774	712	567	1216	15	4	24	36501
Kapiti Coast (KC)	762	640	41483	151	231	4	1	595	43866
Upper Hutt (UH)	1546	603	179	25919	2660	158	46	8	31119
Lower Hutt (LH)	7714	1218	265	2717	73893	66	19	10	85903
Cart/Sth Wai (Car/SW)	50	15	4	140	61	8985	939	31	10225
Masterton (Mast)	34	4	1	40	17	926	33775	218	35016
External	17	19	563	6	8	30	215	0	858
Total	246957	36498	43862	31116	85894	10223	35011	907	490467

NHBO Synthesised New	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	233741	4317	770	1909	8152	59	14	24	248985
Porirua (Porirua)	4303	28025	781	777	1381	26	6	24	35324
Kapiti Coast (KC)	885	721	41042	239	339	8	2	587	43822
Upper Hutt (UH)	1879	818	276	24907	2917	213	49	10	31070
Lower Hutt (LH)	8031	1389	381	2986	72411	92	21	13	85323
Cart/Sth Wai (Car/SW)	71	25	8	197	86	8445	1296	37	10165
Masterton (Mast)	34	6	2	44	19	1285	33318	212	34919
External	19	19	557	8	10	36	209	0	858
Total	248962	35320	43818	31067	85315	10164	34914	907	490466

Calibrated v Synth Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	6%	-12%	-28%	-12%	-8%	-64%	-75%	-50%	4%
Porirua (Porirua)	26%	2%	0%	9%	1%	-56%	-69%	-28%	4%
Kapiti Coast (KC)	-6%	-16%	2%	-20%	-27%	-67%	-78%	-19%	1%
Upper Hutt (UH)	-14%	-17%	-28%	5%	-3%	-53%	-68%	-65%	1%
Lower Hutt (LH)	5%	-17%	-26%	9%	-1%	-56%	-70%	-54%	-1%
Cart/Sth Wai (Car/SW)	-21%	-39%	-47%	-15%	-29%	16%	-20%	-64%	9%
Masterton (Mast)	2%	-57%	-61%	-40%	-50%	-9%	-8%	-58%	-9%
External	-49%	-48%	-8%	-52%	-56%	-36%	-34%	NA	-21%
Total	6%	-1%	1%	4%	-2%	8%	-9%	-38%	2%

Synthesised New v Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	0%	2%	18%	21%	4%	52%	20%	10%	1%
Porirua (Porirua)	3%	-6%	10%	37%	14%	69%	34%	2%	-3%
Kapiti Coast (KC)	16%	13%	-1%	59%	47%	95%	54%	-1%	0%
Upper Hutt (UH)	22%	36%	55%	-4%	10%	35%	7%	33%	0%
Lower Hutt (LH)	4%	14%	44%	10%	-2%	38%	9%	30%	-1%
Cart/Sth Wai (Car/SW)	41%	72%	96%	40%	40%	-6%	38%	21%	-1%
Masterton (Mast)	-2%	35%	54%	11%	11%	39%	-1%	-3%	0%
External	9%	0%	-1%	32%	28%	21%	-3%	NA	0%
Total	1%	-3%	0%	0%	-1%	-1%	0%	0%	0%

B.6 Employers Business

EB Observed	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	73820	1987	515	1024	5495	0	85	313	83239
Porirua (Porirua)	1964	3995	115	124	494	0	0	53	6744
Kapiti Coast (KC)	501	103	7165	46	131	0	0	438	8383
Upper Hutt (UH)	1267	228	0	5577	1642	106	85	48	8953
Lower Hutt (LH)	5426	404	302	1292	24427	106	92	165	32213
Cart/Sth Wai (Car/SW)	111	0	0	0	0	3172	830	29	4142
Masterton (Mast)	63	0	0	85	92	786	7503	294	8823
External	341	64	442	37	107	25	295	5	1316
Total	83493	6782	8540	8184	32387	4194	8889	1345	153813

EB Calibrated	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	74537	1764	412	904	5422	90	27	83	83239
Porirua (Porirua)	1686	3794	256	231	698	23	7	50	6744
Kapiti Coast (KC)	358	225	6782	82	172	8	3	755	8383
Upper Hutt (UH)	1254	260	111	5357	1619	248	75	29	8953
Lower Hutt (LH)	5461	665	189	1387	24296	135	41	41	32213
Cart/Sth Wai (Car/SW)	85	18	7	158	108	3077	625	65	4142
Masterton (Mast)	23	5	2	43	29	560	7838	322	8823
External	84	52	780	23	42	55	281	0	1316
Total	83487	6781	8539	8183	32385	4197	8896	1345	153813

EB Synthesised Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	81489	2041	330	1111	5383	66	20	57	90496
Porirua (Porirua)	2187	5075	229	306	772	18	6	39	8632
Kapiti Coast (KC)	581	377	6867	138	245	8	3	820	9039
Upper Hutt (UH)	1127	301	81	6020	1627	159	49	18	9383
Lower Hutt (LH)	5395	722	141	1613	26016	94	29	26	34035
Cart/Sth Wai (Car/SW)	64	17	5	151	91	3023	576	55	3982
Masterton (Mast)	20	5	1	46	28	573	8376	301	9351
External	233	151	1446	60	100	66	352	0	2408
Total	91097	8689	9099	9445	34261	4007	9411	1315	167325

EB Synthesised New	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	79350	2102	372	1250	5568	66	20	59	88786
Porirua (Porirua)	2240	4924	256	410	879	22	6	40	8777
Kapiti Coast (KC)	608	392	6914	186	324	10	3	804	9242
Upper Hutt (UH)	1268	409	118	6098	1774	147	44	22	9879
Lower Hutt (LH)	5605	840	203	1750	25915	91	27	33	34464
Cart/Sth Wai (Car/SW)	64	20	6	139	87	3230	636	56	4238
Masterton (Mast)	19	6	2	41	26	632	8505	301	9531
External	222	143	1432	72	120	68	352	0	2408
Total	89376	8836	9303	9945	34693	4265	9592	1315	167325

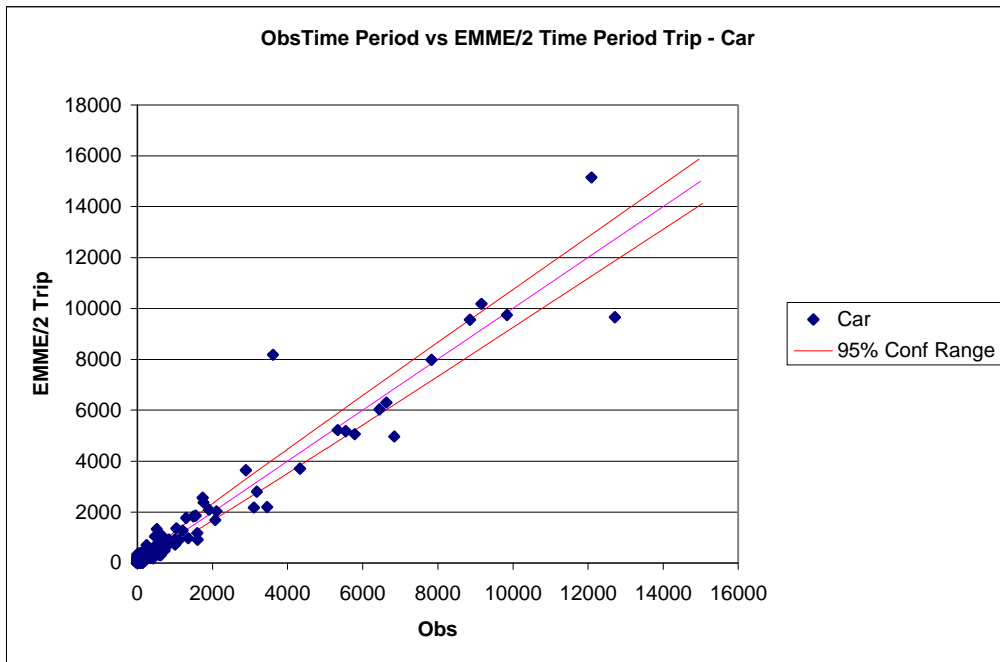
Calibrated v Synth Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	9%	16%	-20%	23%	-1%	-27%	-25%	-31%	9%
Porirua (Porirua)	30%	34%	-10%	33%	11%	-21%	-18%	-23%	28%
Kapiti Coast (KC)	63%	68%	1%	69%	43%	1%	2%	9%	8%
Upper Hutt (UH)	-10%	16%	-27%	12%	0%	-36%	-34%	-38%	5%
Lower Hutt (LH)	-1%	9%	-26%	16%	7%	-30%	-29%	-36%	6%
Cart/Sth Wai (Car/SW)	-24%	-2%	-38%	-4%	-16%	-2%	-8%	-16%	-4%
Masterton (Mast)	-14%	12%	-29%	8%	-5%	2%	7%	-7%	6%
External	179%	192%	86%	165%	139%	20%	25%	NA	83%
Total	9%	28%	7%	15%	6%	-5%	6%	-2%	9%

Synthesised New v Old	WC	Porirua	KC	UH	LH	Car/SW	Mast	External	Total
Wellington (WC)	-3%	3%	13%	13%	3%	0%	-4%	4%	-2%
Porirua (Porirua)	2%	-3%	12%	34%	14%	19%	14%	3%	2%
Kapiti Coast (KC)	5%	4%	1%	35%	32%	20%	15%	-2%	2%
Upper Hutt (UH)	12%	36%	46%	1%	9%	-8%	-11%	21%	5%
Lower Hutt (LH)	4%	16%	44%	8%	0%	-3%	-7%	28%	1%
Cart/Sth Wai (Car/SW)	-1%	19%	28%	-8%	-4%	7%	10%	2%	6%
Masterton (Mast)	-5%	14%	23%	-12%	-8%	10%	2%	0%	2%
External	-5%	-5%	-1%	19%	20%	2%	0%	NA	0%
Total	-2%	2%	2%	5%	1%	6%	2%	0%	0%

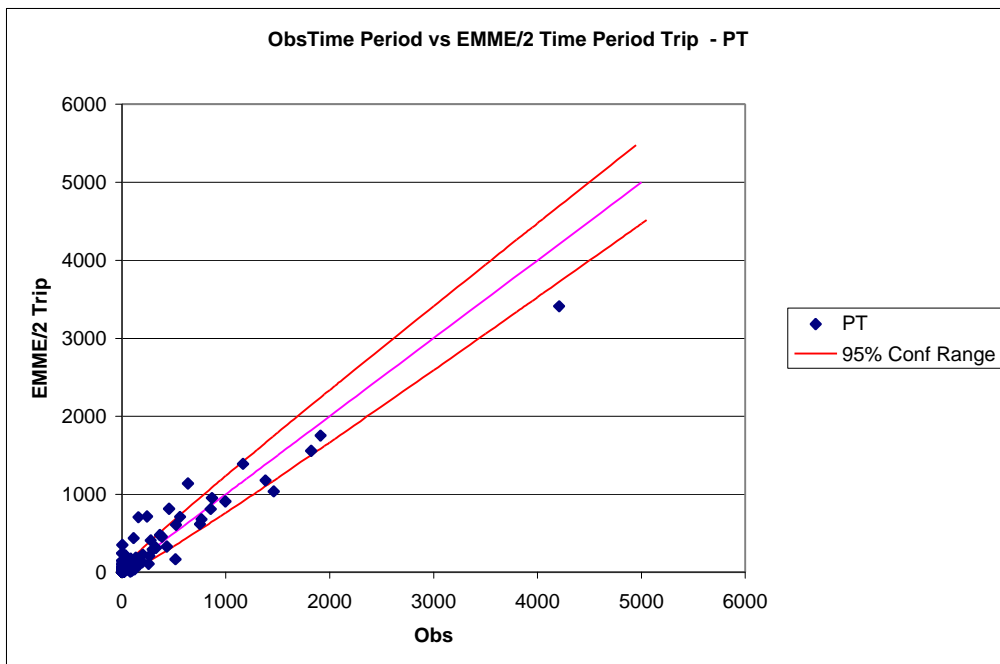
Appendix C Summary Time Period Plots

C.1 AM

■ **Figure C-1 AM Car Trip Matrix Comparison (Sector Level)**

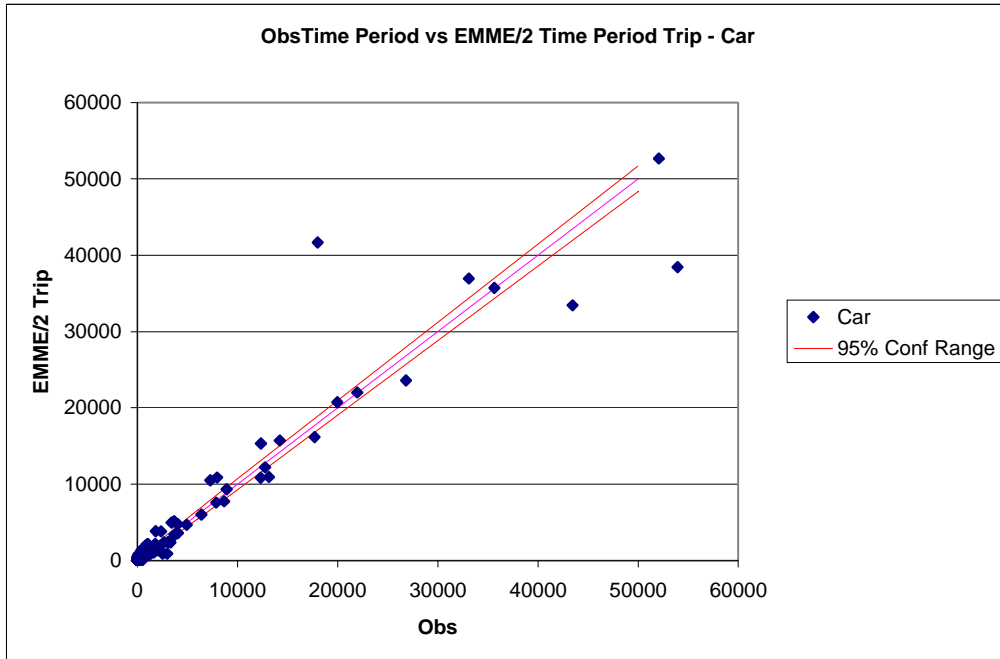


■ **Figure C-2 AM PT Trip Matrix Comparison (Sector Level)**

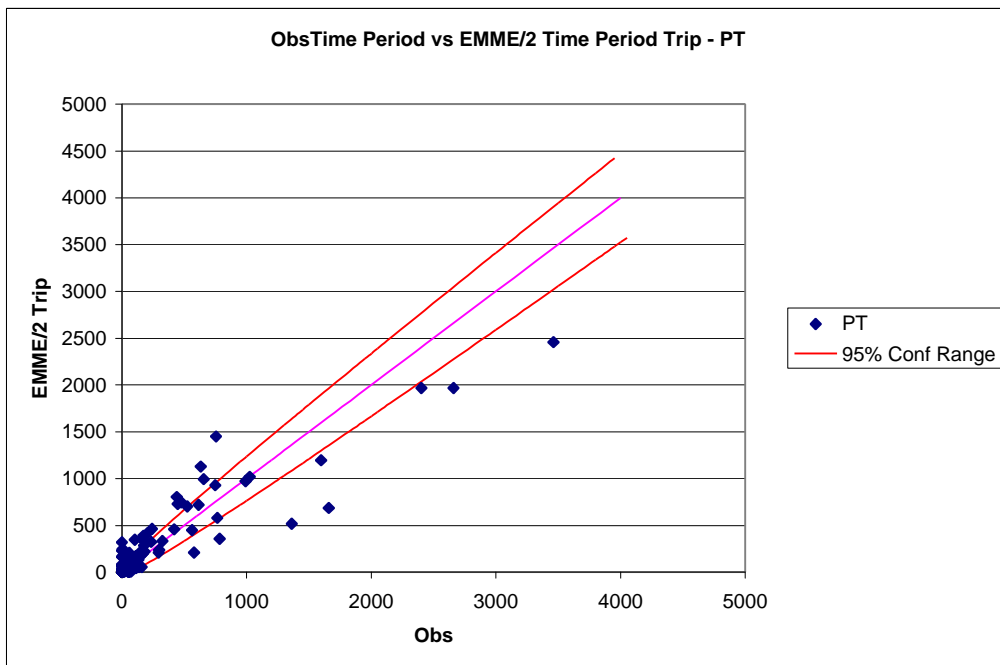


C.2 IP

■ Figure C-3 Interpeak Car Trip Matrix Comparison (Sector Level)

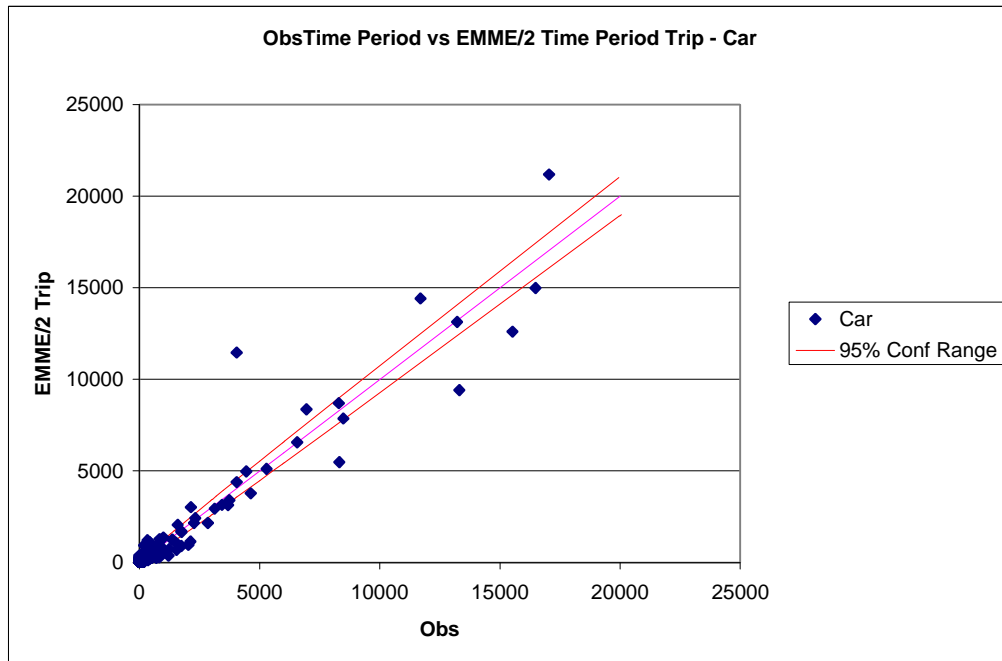


■ Figure C-4 Interpeak PT Trip Matrix Comparison (Sector Level)



C.3 PM

■ Figure C-5 PM Car Trip Matrix Comparison (Sector Level)



■ Figure C-6 PM PT Trip Matrix Comparison (Sector Level)

