REPORT

WELLINGTON TRANSPORT ANALYTICS UNIT

Hutt Aimsun Model: TN2 Demand Development

PREPARED FOR HUTT CITY COUNCIL

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1. Introduction

The Hutt Aimsun Model (HAM) has been updated by the Wellington Transport Analytics Unit (WTAU) to a new base year of 2024 for use on upcoming projects in the Lower Hutt area on behalf of Hutt City Council (HCC) and Waka Kotahi (NZTA).

The process of developing traffic demands for the HAM update is documented in this report. As part of the demand development process, the Wellington Transport Strategy Model (WTSM) has been updated to improve local calibration and reflect the recently released Census land use data released by Statistics NZ (Stats). The resulting WTSM demands are cordoned and disaggregated to the more refined HAM zone system.

This report outlines the demand development process for developing input base demand matrices for the HAM model which includes the following steps:

- WTSM Rebase and Recalibration
- Demand Disaggregation
- Screenline Factoring
- Demand Profiling
- Initial Matrix Estimation

2. WTSM Rebase and Local Recalibration

WTSM has a base year of 2018 and a range of forecast years including 2023. The current model has a range of future year forecasts including a 2023 forecast that was developed in 2022 based on population projections at that point in time.

The release of the 2023 Census TA level population projections by Stats NZ provided an opportunity to undertake a minor update to the 2023 'forecast' model to better represent the current population and travel patterns in the Hutt Valley

This section outlines the WTSM updates and localised calibration undertaken to produce a revised 2023 model and matrices for HAM. Model results were compared against observed count data across screenlines and localised calibration was undertaken.

It should be noted that these updates are considered interim with the purpose being to create a better starting point for the development of HAM. In late 2025, a more comprehensive update of WTSM to a 2023 base year will be undertaken.

2.1 Update Land use

Since the March 2023 Census was undertaken, Statistics NZ have been slowly releasing data from the survey. In September 2024 the 2023 Census population data was released at a Territorial Authority Level. The WTSM zone system is based on more detailed SA1 and SA2 level data so this population is not detailed enough to be used directly. Instead the approach was to keep the forecast 2023 land use distribution assumptions, which are based on Sense Partners projections, and simply scale the total population to match the new totals from Census.

Figure 1 shows the general process applied to scale the 2023 landuse to the released Census totals. The population totals provided from the Census represent the Usually Resident Population (URP)[1] whilst WTSM requires the Estimated Residential Population (EP)[2]. These are defined as footnotes, but the difference can be simply explained as a persons home address (URP) compared to how much of the population is actually staying at home on any given day (EP). People may travel for work, vacation or any other reason but their home address remains the same.

The growth of URP has been calculated between 2018 and 2023 (WTSM base year and forecast) and then applied to the 2018 EP total for each WTSM zone.

[1] Infometrics defines the URP as "This variable measures the number of people who usually reside in the focus area on the census night. It is based on the number people who filled out a Census form or were imputed using administrative data sources.".

[2] Stats NZ defines that EP as "This is an estimate of the number of people who usually live in New Zealand, at a given date. National population estimates give the best measure between census dates of the population that usually lives in New Zealand."

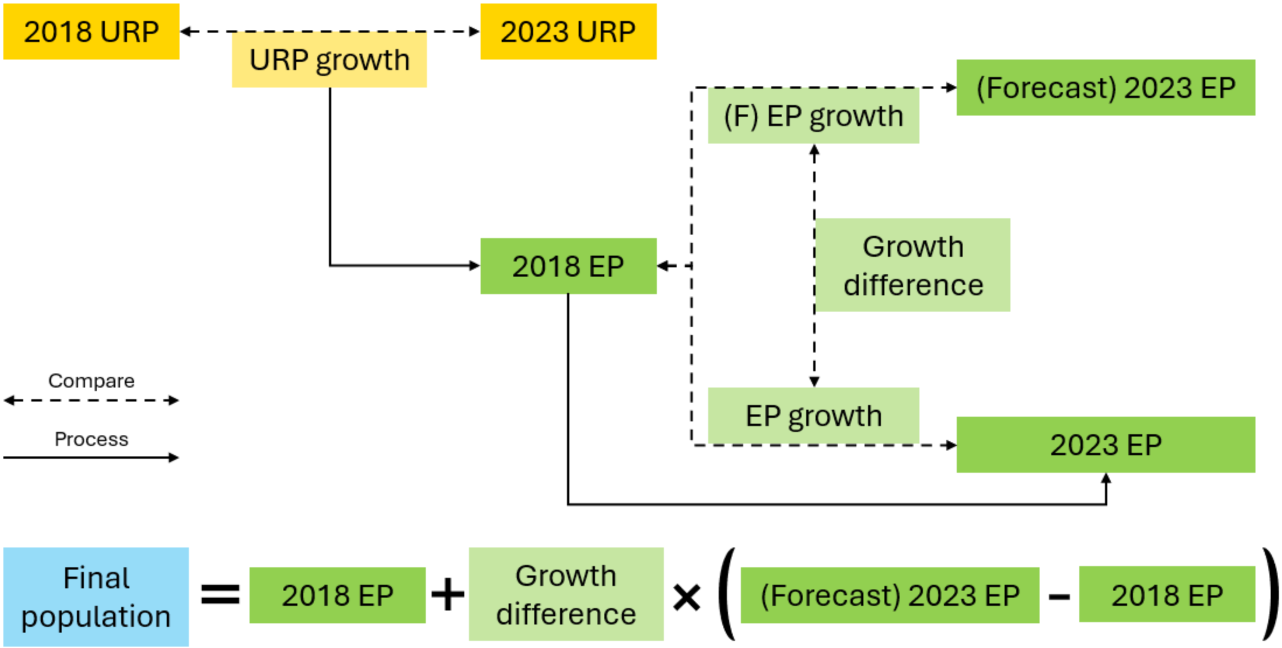

Figure 1: Demand creation process

Applying this growth process across the Wellington Region results in population changes as shown in Table 1. Focusing on Hutt City, the main location of interest, shows population growth from 2018 to 2023 was forecast as about 6% but only half of this actually occurred (3%).

Table 1: Population comparison for each TA

TA	2018 EP	Forecast 2023 EP	2023 EP	(F) EP Growth	EP Growth	Growth Difference
Wellington City	211,200	216,800	211,100	3%	0%	-0.02
Porirua City	108,500	114,600	111,700	6%	3%	0.52
Kapiti Coast District	45,400	48,700	47,200	7%	4%	0.55
Upper Hutt City	58,800	62,100	61,800	6%	5%	0.91
Hutt City	55,200	59,400	57,500	8%	4%	0.55
Masterton District	27,200	29,900	29,400	10%	8%	0.81
Carterton District	8,800	9,600	9,700	9%	10%	1.13
South Wairarapa District	10,900	11,900	12,100	9%	11%	1.20
Total	**526,000**	**553,000**	**540,500**	**5%**	**3%**	**0.54**

2.2 WTSM Screenlines

The updated 2023 landuse figures were then applied to the WTSM 2023 model. A range of screenlines were created to enable calibration of the model, as shown in Figure 2. These screenlines were formed prior to the collection of additional turning count data as documented in TN1, so instead made use of tube counts already collected by Hutt City Council and the NZ Transport Agency's Traffic Management System. Using the more current dataset would be ideal, but for the purposes of this update, slightly older data is sufficient. The data used is generally from 2023 which is arguably more appropriate for the WTSM 2023 model year.

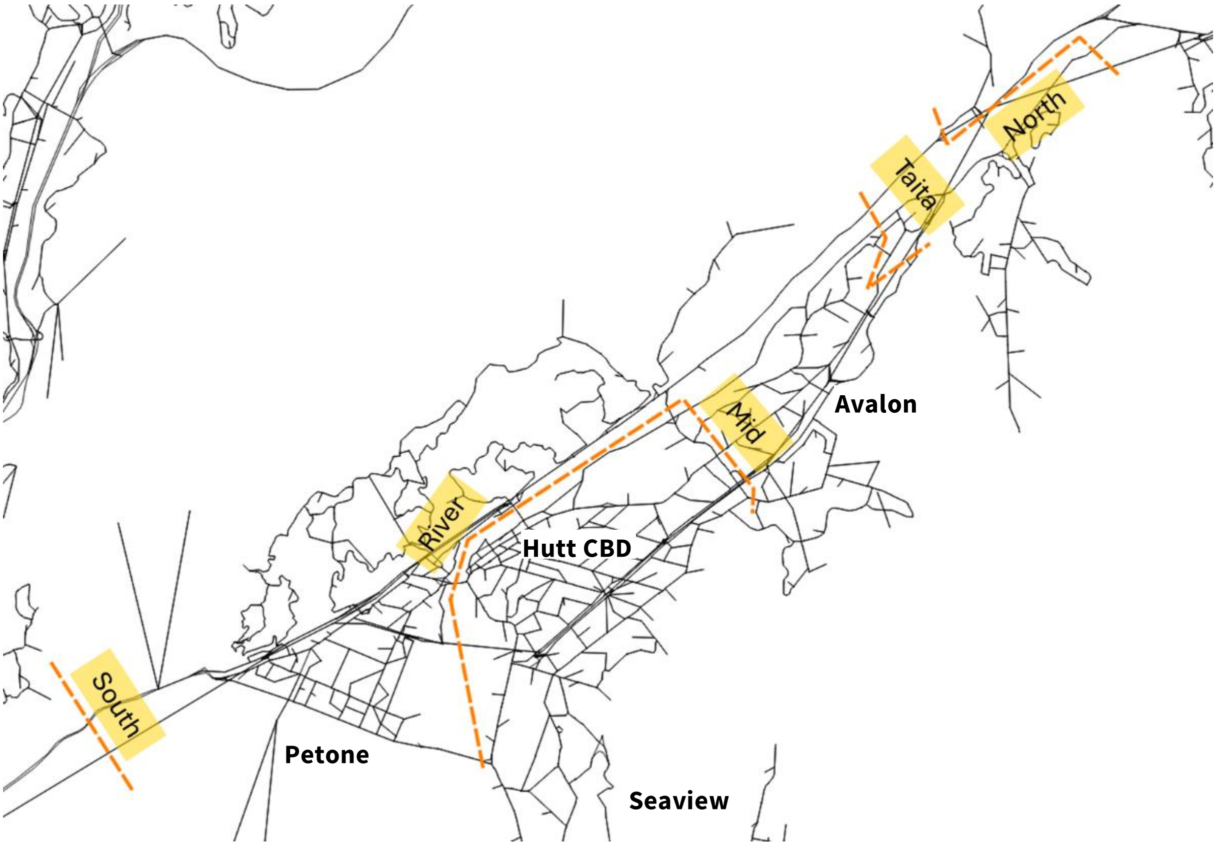

Figure 2: Screenline locations

2.3 Model Parameter changes

Throughout the calibration, some of the WTSM economic input parameters were adjusted to improve calibration. These factors were:

- Fuel Cost –implemented in WTSM as a global factor increase over the base 2018
- Public Transport (PT) Fare – Like the fuel cost, this is a factor increase over the 2018 base year
- Parking Costs – This is a dollar value by WTSM model sectors, representing a range of parking related costs
- Working from Home – This is a target reduction factor by mode and job type. Job type ratios have not been adjusted here.

The fuel cost has been adjusted based on the nominal value increase [3]in fuel prices as shown in Table 2. This shows a 25% increase in fuel costs.

Table 2: Nominal Average Fuel Cost Increase

Fuel Type	2018	2023	% Increase
Regular	$2.10	$2.63	25.2%
Premium	$2.25	$2.82	25.3%

Following the calibration and creation of HAM demands, it was noted that this doesn't include the impact of inflation and other economic factors which change the relative value of the currency over time. WTSM assumes costs are relative to the base year (2018). Table 3 shows the real fuel cost increase[4] in 2023 currency. This more modest 2.7-2.9% increase would have been a more appropriate value to use.

Table 3: Real Average Fuel Cost Increase

Fuel Type	2018	2023	% Increase
Regular	2.56	2.63	2.7%
Premium	2.74	2.82	2.9%

A similar issue occurred with the PT fare cost increase. Table 4 shows the 2018 and current fare cost for travel across one zone. This shows nominal costs have increased by 18% (increase ration 1.18).

Table 4: 2018 vs Current Fare Pricing

Fare	2018		Current		Increase Ratio
	Peak	Off-Peak	Peak	Off-Peak	
Zone 1	$1.71	$0.86	$2.02	$1.01	1.18

As fares are a mix of snapper card, cash and other discounts, the fare cost isn't directly used. Rather the mixture of fare types and a resulting average fare cost was calculated during the WTSM 2018 calibration for each model period. Table 5 shows the 2018 and 2023 PT fares by model period. The previous 2023 forecast assumed a 2% fare increase, while the new 2023 runs use the 18% nominal cost increase.

Table 5: Model PT Fares by Period

Period	2018 Model	2023 factor		Resulting Fare	
		Previous	Updated	Previous	Updated
AM	$1.53	1.02	1.18	$1.56	$1.81
IP	$1.10	1.02	1.18	$1.12	$1.30
PM	$1.61	1.02	1.18	$1.64	$1.90
ON	$1.54	1.02	1.18	$1.57	$1.82

The nominal values were kept due to the satisfactory calibration achieved. These are therefore taken to also represent other factors which influence the cost of travel which might also reduce travel across the screenlines.

[3] Nominal average prices of petrol in New Zealand - Figure.NZ

[4] Real average prices of petrol in New Zealand - Figure.NZ

The Wellington CBD Parking cost have also been adjusted. This is mostly targeted to reduce trips on SH2 to the south of the HAM area and improve calibration on this screenline. Parking cost data is difficult to source, particularly historic parking data. Some data was compiled for the 2018 WTSM calibration, but we were not able to source the equivalent 2023 data for this exercise.

The WTSM work from home module has been applied to the WTSM 2023 runs. This reflects the increased level of working from home noted by StatsNZ in a recent Census data release[5]. This Census data shows that working from home in the Wellington region has steadily increased over the last 10 years. 2013 had 6.4% working from home, which increased to 9% in 2018 and now 19% in 2023. This trend is also shown in Figure 3.

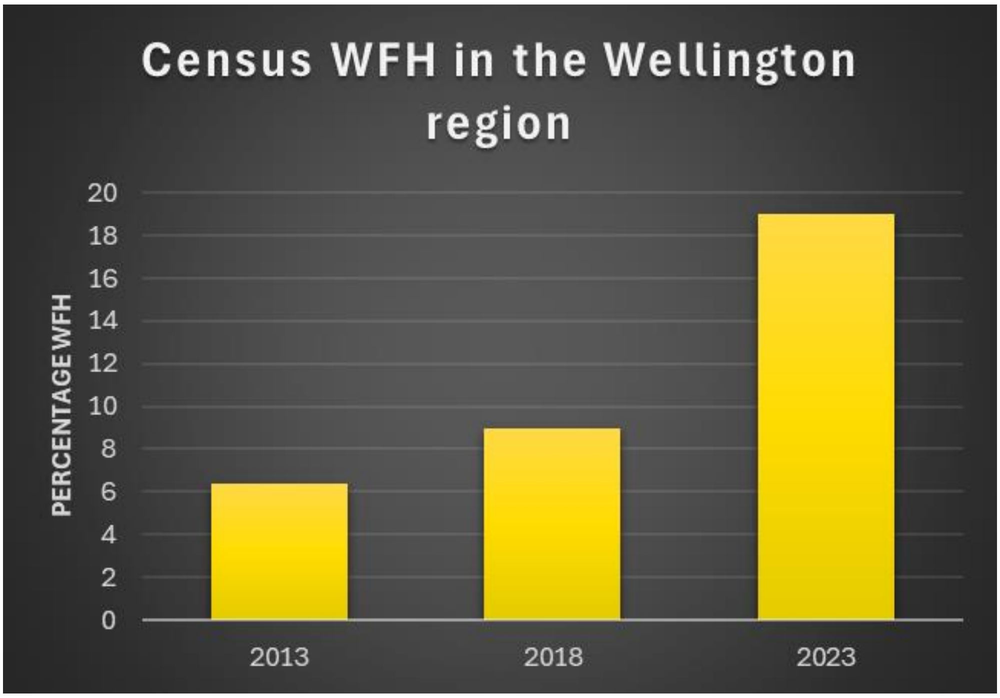

Figure 3: Working from Home Percentage 2013-2023

As the 19% value is from the Census, it is likely overstating the amount of Working from Home on a particular day, similar to the issue with the population URP values described earlier in this report. The Census survey asks what do you usually do, rather than what did you do on this day.

Through calibration test runs on WTSM, 9% WFH validated the best against the screenline counts and thus was adopted for the final runs.

[5] https://www.stats.govt.nz/information-releases/2023-census-population-dwelling-and-housing-highlights/

2.4 Calibration Results

With the updated landuse and revised model parameters run through the model, the results have been compared to the screenline counts. Comparisons are as per the Transport Model Development Guidelines and include:

- Total directional counts across screenlines,
- Hourly count band comparisons,
- observed vs modelled count comparison, and
- RMSE

Table 6 shows the resulting comparisons. The counts used for calibration are the hourly average counts for each period, consistent with how the original 2018 model comparisons were reported. WTSM is classified as a Type B model so the targets lists reflect this level of model.

Table 6: Screen line count comparison

AM	Light vehicles		TOTAL COUNT: 10	
GEH	Target	Model		Criteria met?
<5	75%	8	80%	Yes
<7.5	85%	10	100%	Yes
<10	95%	10	100%	Yes
RMSE	17.5%	8.79%		Yes
Count band				
<10	80%	7	70%	No
<15	90%	10	100%	Yes

AM	Heavy vehicles		TOTAL COUNT: 10	
GEH	Target	Model		Criteria met?
<5	75%	7	70%	No
<7.5	85%	9	90%	Yes
<10	95%	10	100%	Yes
RMSE	17.5%	35.80%		No
Count band				
<10	80%	2	20%	No
<15	90%	3	30%	No

IP	Light vehicles		TOTAL COUNT: 10	
GEH	Target	Model		Criteria met?
<5	75%	7	70%	No
<7.5	85%	7	70%	No
<10	95%	8	80%	No
RMSE	17.5%	17.37%		Yes
Count band				
<10	80%	7	70%	No
<15	90%	7	70%	No

IP	Heavy vehicles		TOTAL COUNT: 10	
GEH	Target	Model		Criteria met?
<5	75%	1	10%	No
<7.5	85%	3	30%	No
<10	95%	5	50%	No
RMSE	17.5%	100.58%		No
Count band				
<10	80%	0	0%	No
<15	90%	0	0%	No

PM	Light vehicles		TOTAL COUNT: 10	
GEH	Target	Model		Criteria met?
<5	75%	5	50%	No
<7.5	85%	10	100%	Yes
<10	95%	10	100%	Yes
RMSE	17.5%	10.22%		Yes
Count band				
<10	80%	5	50%	No
<15	90%	10	100%	Yes

PM	Heavy vehicles		TOTAL COUNT: 10	
GEH	Target	Model		Criteria met?
<5	75%	8	80%	Yes
<7.5	85%	10	100%	Yes
<10	95%	10	100%	Yes
RMSE	17.5%	34.30%		No
Count band				
<10	80%	3	30%	No
<15	90%	3	30%	No

In general, the AM and PM peak mostly meet the criteria – this is reassuring as these are the key periods which will be mainly focused on in through the development of HAM. The comparisons for light vehicles have also met most of the criteria. Whilst the inter-peak does note meet the target, the results are pretty close for light vehicles. Heavy vehicles have smaller sample size compared to the light vehicles, and only partially meet the targets.

In summary, this process has fulfilled its purpose, namely to provide an improved starting point for the development of HAM demand matrices from WTSM demand.

The input demand will be further refined through the HAM disaggregation and calibration process.

2.5 Cordon Demands

EMME, the software platform used by WTSM, includes a module for cordoning a sub-area of the model. Demands can then be directly extracted from the model, rather than need to account for a range of unrelated external trips. This same process has been used recently to create input demands for the Porirua Aimsun Model.

Figure 4 shows the resulting cordon area and zones for the WTSM Hutt cordon model. The demand matrices from this cordon model have been extracted for input into the HAM disaggregation process outlined in the next section.

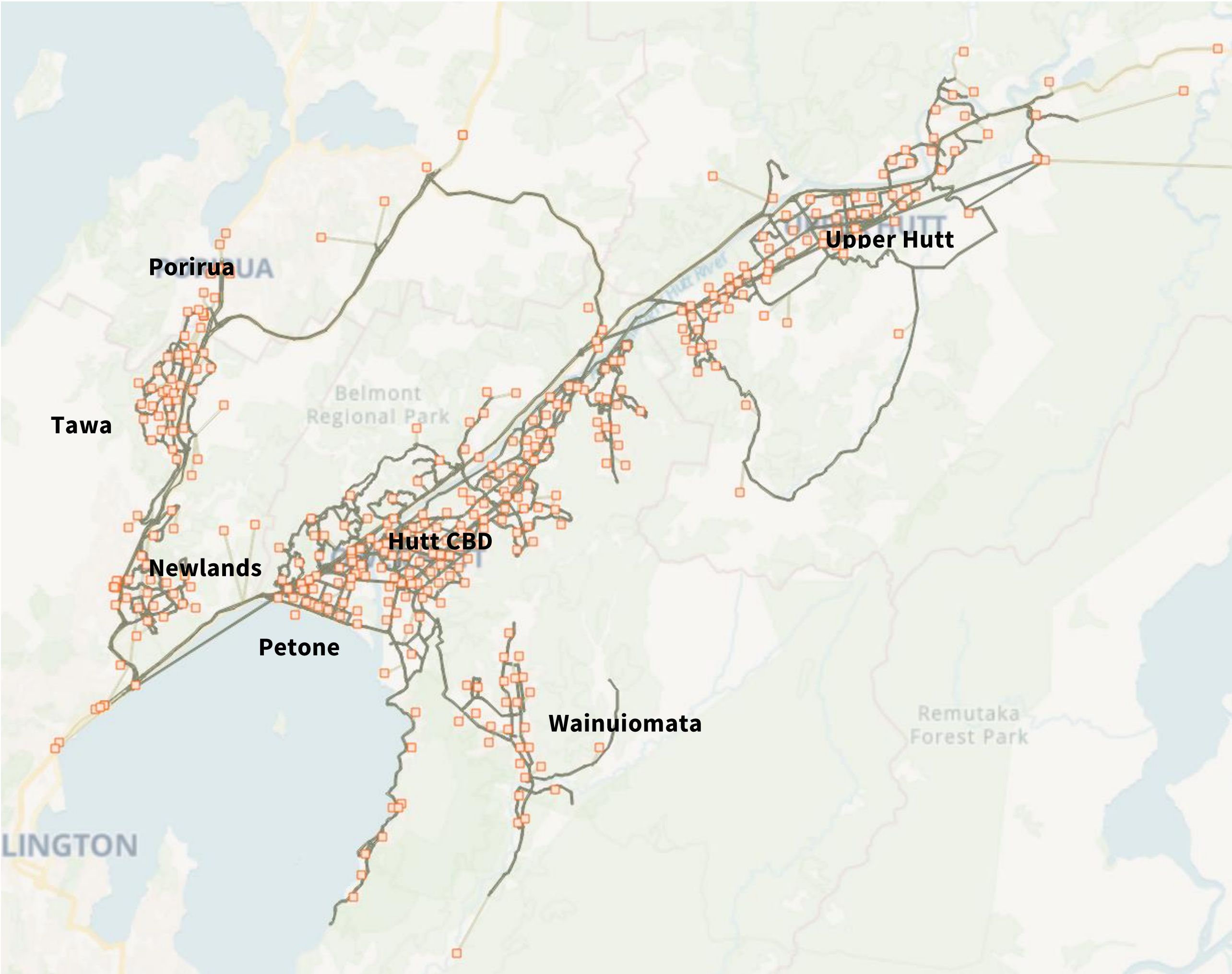

Figure 4: WTSM Cordon Area

3. HAM Demand Process

The HAM zone system has more zones than the WTSM system, reflecting the greater level of detail the Aimsun model simulated. This section outlines the disaggregation process and further refinement undertaken to create the HAM demand matrices. This includes additional factoring and demand profiling.

3.1 Disaggregation

Within the study area, WTSM has 316 internal zones, while HAM has 511. The WTSM trip matrices therefore need to be disaggregated. A linear regression modelling process has been developed for disaggregating demands in the Wellington region. This process was originally developed in 2010 for the Wellington Traffic Model which was built on Saturn modelling software. Most subsequent transport models developed in the region have also used this approach including the current Wellington and Porirua Aimsun models. The linear regression process is applied with the following formula:

$$G(mb) = (m_1 \times x_1) + (m_2 \times x_2) + (m_3 \times x_3) + (m_4 \times x_4)$$

Where G is the estimated trip generation of the sub-zone, either generated (O) or attracted (D). The proportion of the trips between the parent WTSM zones are then disaggregated to the sub HAM zones in proportion to their contribution to the total generated or attracted trips.

The x factors are population (residents) and employment (employees and labour force status) from the underlying meshblocks as described in Table 7.

Table 7: Meshblock Parameters

	Category	Description
x_1	Emp1	Retail and services employees
x_2	Emp2	Manufacture, TransCom, other employees and those who live and work in the same meshblock
x_3	Pop1	Employed population (either full time or part time)
x_4	Pop2	Unemployed Population

The m factors are linear regression factors as shown in Table 8 below.

Table 8: Linear Regression Factors

Class	Period	O/D	m_1	m_2	m_3	m_4
Light	AM	O	0.2673	0.0491	0.4193	0.1031
Light	AM	D	0.6428	0.2357	0.1056	0.0919
Light	IP	O	0.5402	0.0796	0.1796	0.1188
Light	IP	D	0.5400	0.0821	0.1734	0.1211
Light	PM	O	0.7998	0.1649	0.1916	0.1100
Light	PM	D	0.4728	0.0616	0.4033	0.1757
HCV	AM	O	0.0238	0.1485	0.0039	0.0010
HCV	AM	D	0.0236	0.1533	0.0055	-0.0008
HCV	IP	O	0.0252	0.1574	0.0041	0.0010
HCV	IP	D	0.0250	0.1625	0.0058	-0.0009
HCV	PM	O	0.0222	0.1384	0.0036	0.0009
HCv	PM	D	0.0220	0.1429	0.0051	-0.0008

The process calculates trips generated by each meshblock using linear regression factors (**Error! Reference source not found.**) developed initially by SKM based on Statistics NZ populate and employment information for the variables listed below in **Error! Reference source not found.**.

The meshblock trip productions / attractions are then aggregated to create productions / attractions for the parent zone system (WTSM) and lower tier zone system (HAM). The correspondence between WTSM zone and HAM zone is then used to disaggregate WTSM trips appropriately across the relevant HAM zones.

The output from this process is an initial disaggregated matrix.

3.2 Convert to Four Hours

WTSM and HAM have different time periods, so the WTSM demands need to be factored to match the HAM time periods.

WTSM time periods are:

- AM 06:00-09:00 (3 hours),
- IP 09:00-15:00 (6 hours),
- PM 15:00-18:00 (3 hours), and
- ON 18:00-0600 (12 hours)

Whereas the HAM time periods are:

- AM 06:00-10:00 (4 hours),
- IP 10:00-14:00 (4 hours), and
- PM 15:00-19:00 (4 hours)

The time conversion factors used to convert the WTSM demand totals to HAM are shown in Table 9. The AM and PM factors have been taken from the overall demand profiles which will be outlined in section 3.4, later in this report. The Interpeak factor is based on a flat division of the 6 hours in WTSM by the 4 hours in HAM. This flat IP assumption may be revisited later in the model calibration.

Table 9: Time Factors

Period	Factor
AM	1.25
IP	0.67
PM	1.34

Table 10 shows the demand totals before and after the time factoring application.

Table 10: Demand Totals

	WTSM	HAM
AM Cars	110,622	140,314
AM Trucks	5,185	6,459
IP Cars	210,990	135,095
IP Trucks	10,969	7,313
PM Cars	143,901	184,367
PM Trucks	4,719	6,343

3.3 Screenline Factoring

As part of the demand development process, the screenlines have been used to derive and apply simple factors to adjust the model demand. The screenlines used for this adjustment process differ from those used previously for the WTSM calibration as these screenlines utilise additional data collection. The screenline locations are shown in Figure 5.

Figure 5: HAM Screenline Locations

Following several iterations for factoring, the factors shown in Table 11 have been applied to the screenlines. Screenlines have been factored as a group, by direction, not accounting for the individual links that make up the screenlines. These individual links will be deal with by model route choice during the calibration.

Table 11: Screenline Factors

Screenline	Direction	Factors		
		AM	IP	PM
Eastern Hills	EB	1.01	0.64	0.68
	WB	0.56	0.64	0.86
Railway	NB	1.02	0.80	0.47
	SB	0.64	0.94	0.81
Riverbank	EB	0.66	0.62	0.57
	WB	0.65	0.55	0.33
Fairway/Daysh	NB	1.96	1.45	1.45
	SB	1.55	1.46	1.72
Wainuiomata	EB	0.85	0.74	0.86
	WB	0.91	0.73	0.74
SH2 South	NB	0.91	0.69	0.71
	SB	0.90	0.77	0.67
SH58	EB	1.47	0.83	1.00
	WB	1.00	1.00	0.79

3.4 Demand profiling

The demand profiling has been applied based on the sector systems. The boundary of the sectors aligns with the WTSM zones as well as the predominant landuse within. In total, 26 sectors have been identified, including 5 external sectors, 4 sub-external sectors and 17 internal sectors.

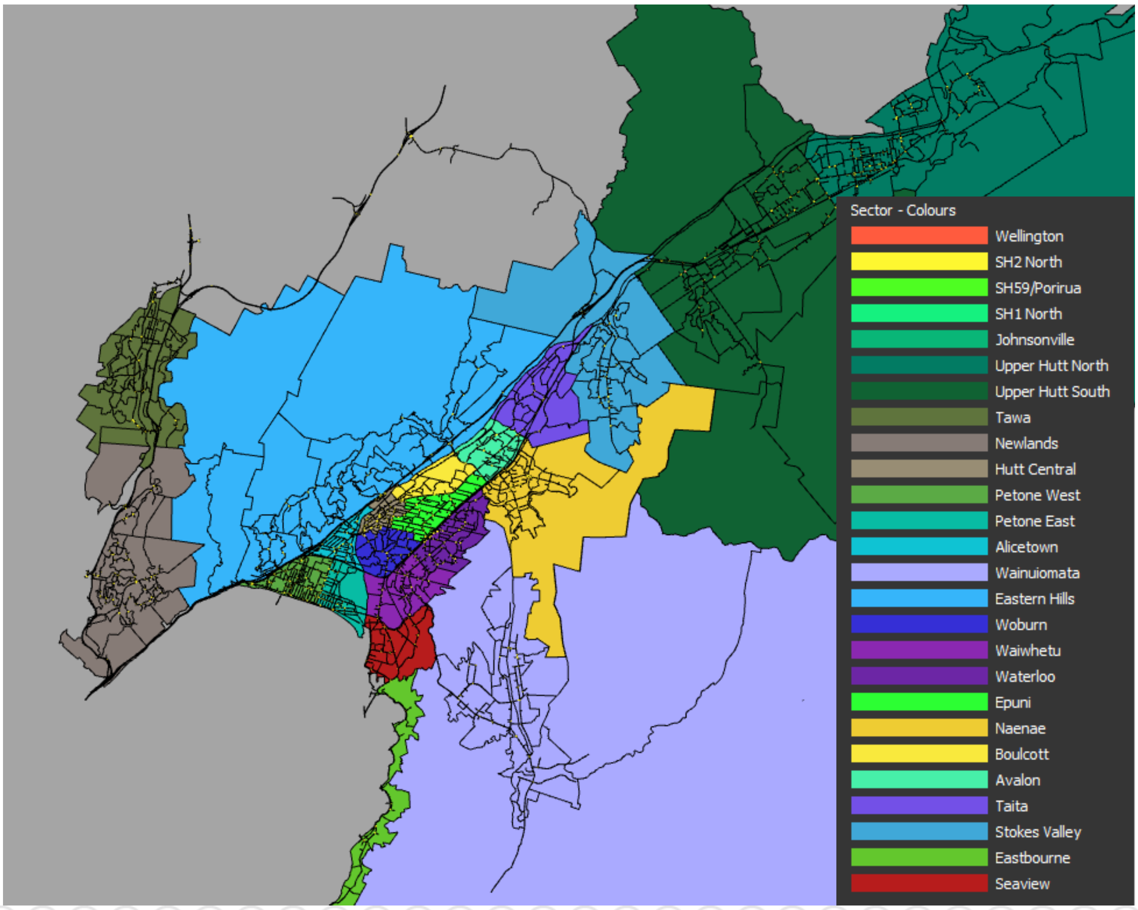

Figure 6: Profile Sector Map

Appropriate counts reflecting travel between these sectors have been selected and applied to the sector to sector movements. The overall profiles are shown in Figure 7, Figure 8 and Figure 9 for the AM, IP and PM peaks respectively.

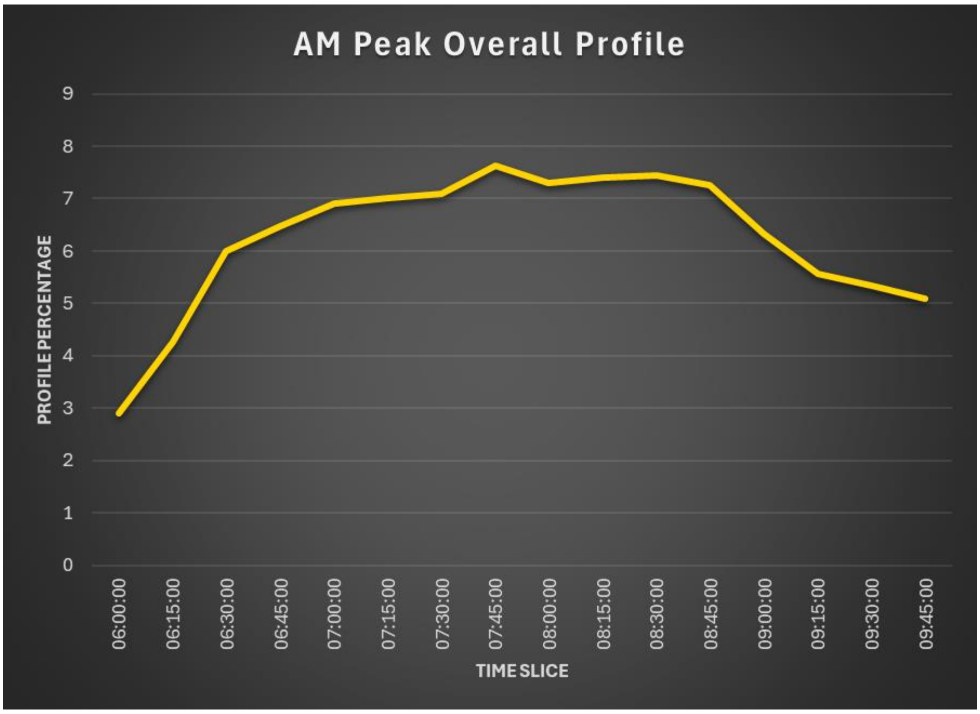

Figure 7: AM Peak Overall Demand Profile

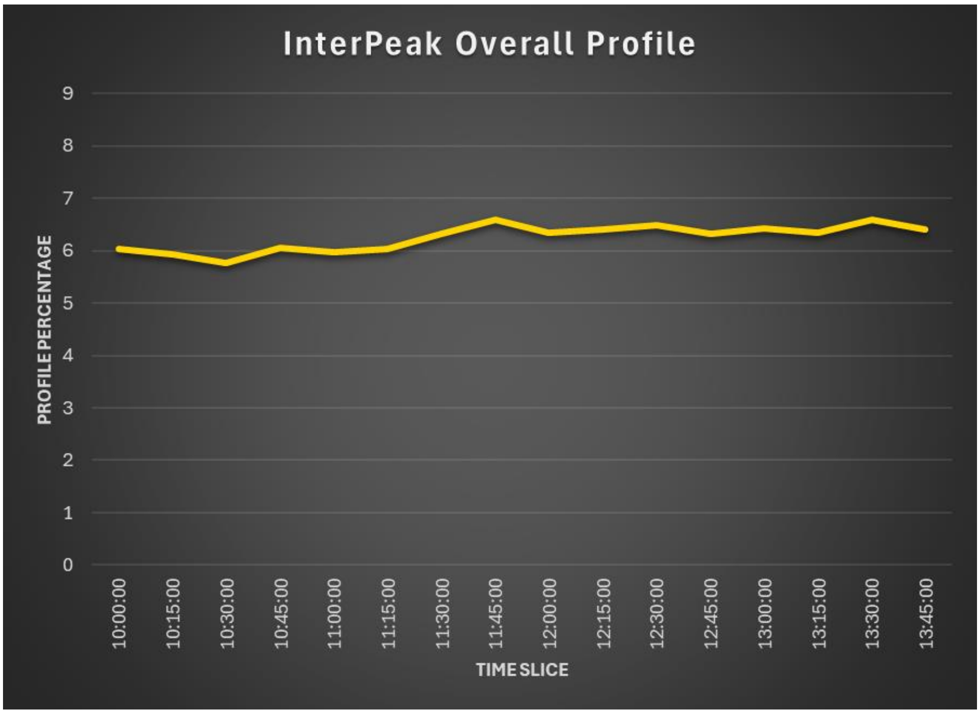

Figure 8: Interpeak Overall Demand Profile

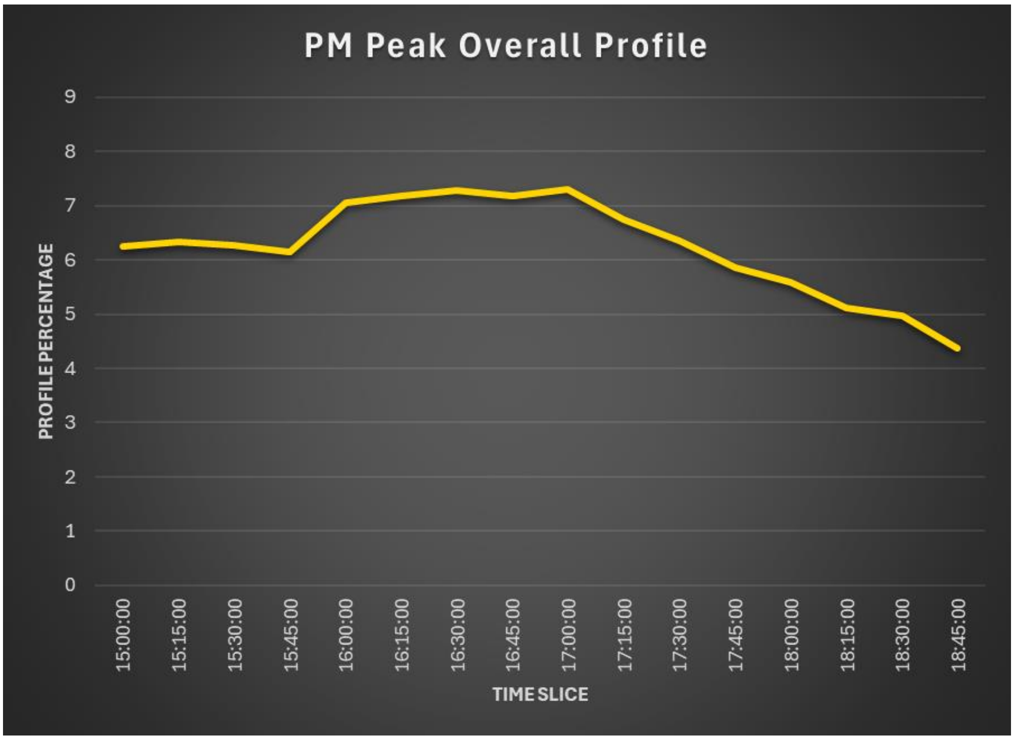

Figure 9: PM Peak Overall Demand Profile

Park n Ride zones have been dealt with separately to the sector-to-sector profiles. Their profiles instead coming from parking capacity survey results provided by Metlink.

This section has described the demand development and disaggregation process applied to convert the WTSM cordon matrices to the HAM zone system. The resulting matrices are applied to the HAM network as “prior” demand matrices.

The next section will describe the initial Matrix Estimation which takes these prior matrices and further refines them.

4. Matrix Adjustments

This section outlines the first stage of matrix estimation which has been applied using the same screenline counts as was used for the screenline factoring described in Section 3.3.

Matrix Estimation is an automated process to adjust the origin and destination cells of a demand matrix using observed count data. A constant debate in the transport modelling industry is the level of Matrix Estimation that should be applied to model demands. On the one hand, more data input into the process should result in a better demand matrix; but on the other hand, those same counts are then less useful of validating the base model results. Ideally, data collection would occur at the same locations over several days, allowing one full set of data for Matrix Estimation/Calibration and a second full set for Validation. Rarely is there budget available to cover this additional data collection so a compromise must be found.

The elasticity and other input parameters entered into the process should also be carefully applied so as not to overfit the demand matrices to the data. A common issue with automated Matrix Estimation is longer trips being removed and short trips added, changing the trip patterns in the demand matrix.

A range of Matrix Estimation parameters were tested before deciding on the most appropriate settings. A balance must be struck between improving the demand matrices whilst not overfitting the data and changing the trip distribution. An over adjusted model may result in a good base year calibration but a model which is unable to respond to forecast demands and/or network changes.

4.1 Matrix Estimation Parameters

Aimsun's implementation of the Matrix Estimation (Called Static OD Adjustment here) allows for the following parameters to be specified:

- Matrix Elasticity – This is an input value ranging from 0 (not elastic) to 1 (highly elastic) representing the ability of the total trips to change during the process,
- Distribution Elasticity – similar to Matrix Elasticity, this value ranges from 0 – 1 and represents the elasticity of trip length to change

A weighting function can be specified which can apply additional weighting to a particular model to observed comparison in the adjustment process. Groups of counts can also be adjusted together, such as across screenlines.

4.2 Applying Matrix Estimation Parameters to HAM

A range of tests have been run with various combinations of Matrix Estimation parameters as shown in Table 12. These tests can be broadly grouped in Tests 1-3 which input all available counts, Tests 4-7 which only input the screenline counts and Test 8-11 which input the screenlines counts with a grouping applied across each screenline.

Some of the tests apply a weighting function. The function applied here has been sourced from an Aimsun Tech Note[6] which compares the effect of various weighting functions. The function applied is function 3 from the Tech Note which is:

$$Weight = \left(\frac{1}{Observed\ Volume^{0.6}}\right) \times 300$$

Table 12: Matrix Estimation Test Parameters

Test	Counts	Grouping	Demand Elasticity	TLD Elasticity	Function
Test 1	All counts		1	0.5	
Test 2	All counts	SL Grouping	1	0.5	(1/vol^0.6)*300
Test 3	All counts	SL Grouping	0.5	0.2	(1/vol^0.6)*300
Test 4	Screenline Counts		1	0.5	
Test 5	Screenline Counts		1	0.5	(1/vol^0.6)*300
Test 6	Screenline Counts		1	0.8	(1/vol^0.6)*300
Test 7	Screenline Counts		0.5	0.2	(1/vol^0.6)*300
Test 8	Screenline Counts	SL Grouping	1	0.5	
Test 9	Screenline Counts	SL Grouping	1	0.5	(1/vol^0.6)*300
Test 10	Screenline Counts	SL Grouping	0.5	0.2	(1/vol^0.6)*300
Test 11	Screenline Counts	SL Grouping	1	1	(1/vol^0.6)*300

[6] https://www.aimsun.com/technical-notes/static-od-adjustment/

The various tests have been applied to the PM peak, as this period has the most demands and the poorest match to the observed data. The static model assignment results for each test are compared in Table 13 against the Transport Model Development Guidelines criteria which the model will later be validated against. This shows:

- Test 1 has the best results for individual counts, which reflects that all of the counts compared against have been input into the process.
- Tests 2 and 3 show similar results, much better results across the screenlines (reflecting the grouping applied), but slightly worse individual count results.
- Tests 4-7 show improved individual screenline link comparisons but worst individual count comparisons. These four tests show very similar results despite the elasticity and weight function differences.
- Tests 8-11 show almost identical results to each other. The total screenline results are improved from Tests 4-7 but the individual screenlines are worse than any other of the tests. Individual count comparisons show little improvement from the Prior Matrix results

Table 13: Test Results Against TMDG Criteria

	Cat C	GEH	Prior	Test1	Test2	Test3	Test4	Test5	Test6	Test7	Test8	Test9	Test10	Test11
Total Screenline	85%	5	86%	64%	71%	71%	57%	57%	57%	57%	71%	71%	71%	71%
	90%	7.5	93%	79%	86%	86%	79%	79%	79%	79%	86%	86%	86%	86%
	95%	10	93%	79%	100%	100%	100%	100%	100%	100%	93%	93%	93%	93%
Individual Link SL	85%	5	39%	50%	42%	41%	55%	56%	55%	55%	38%	38%	38%	38%
	90%	7.5	59%	70%	58%	57%	82%	83%	82%	82%	52%	52%	52%	52%
	95%	10	64%	82%	73%	71%	89%	91%	89%	89%	64%	64%	64%	64%
	100%	12	75%	89%	84%	82%	89%	91%	89%	89%	75%	75%	75%	75%
SL within 10%	85%	10%	86%	57%	71%	71%	79%	79%	79%	79%	79%	79%	79%	79%
SL within 20%	92.5%	20%	93%	100%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%
Individual Count	80%	5	28%	51%	39%	39%	33%	33%	33%	33%	29%	29%	29%	29%
	85%	7.5	47%	68%	58%	58%	53%	53%	53%	53%	45%	45%	45%	45%
	90%	10	61%	80%	69%	69%	67%	67%	67%	67%	62%	62%	62%	62%
		12	71%	88%	80%	80%	75%	75%	75%	75%	70%	70%	70%	70%

The matrix trip length distributions are shown for Tests 1-3 in Figure 10. This shows trips in the 17-23km length range reduce, while the shorter trips ranging from 1-5km show an increase.

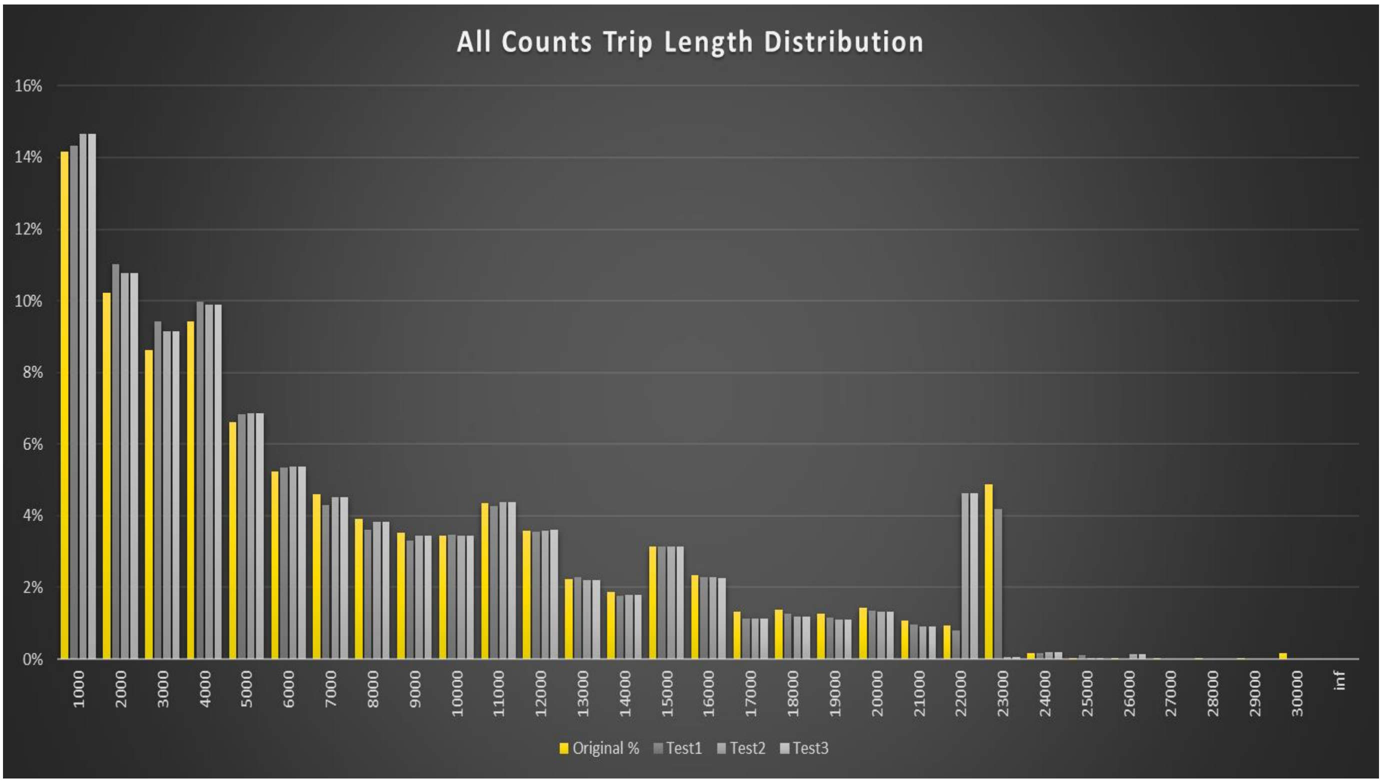

Figure 10: Trip Length Distribution Tests 1-3

The trip length distribution for Tests 4-7 is shown in Figure 11. This shows some minor trip length shortening, but much less than tests 1-3. The minimal difference between this range of tests is also shown here.

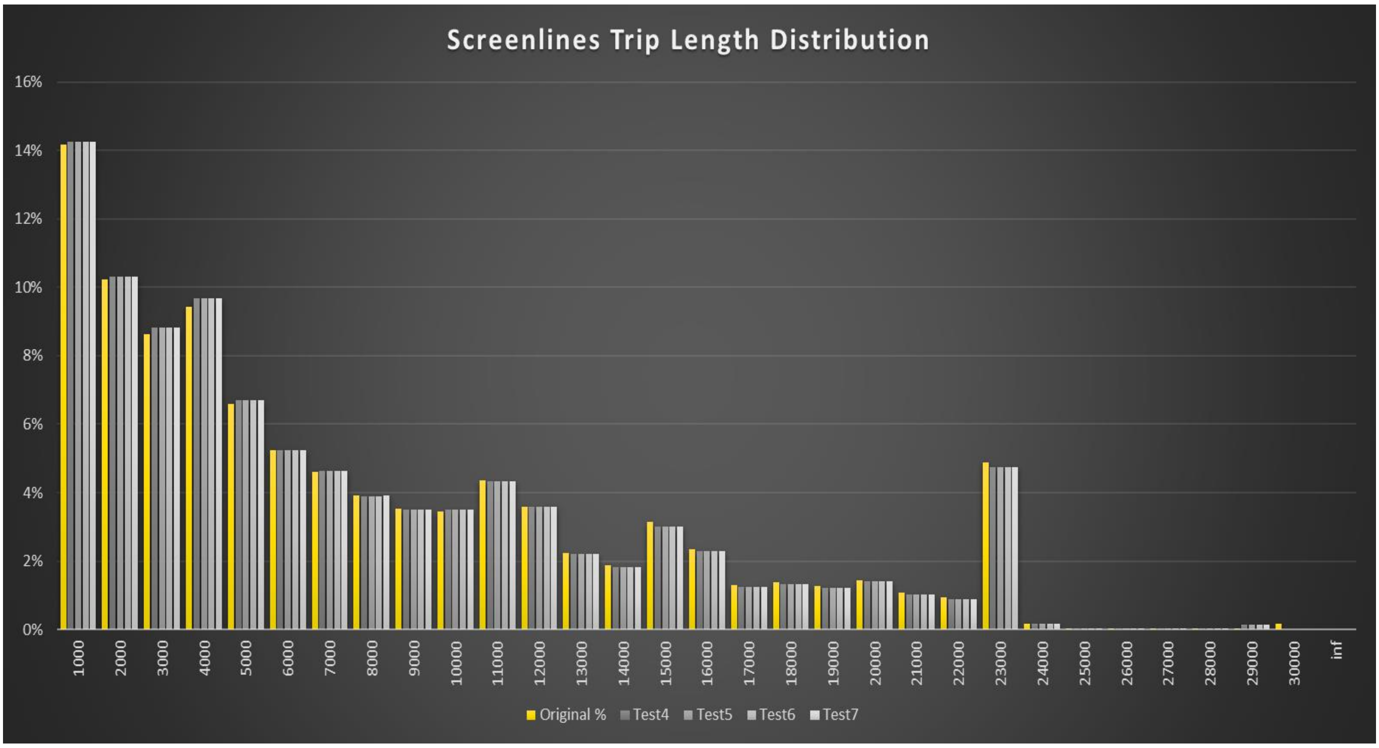

Figure 11: Trip Length Distribution Tests 4-7

The final trip length distribution comparison is shown in Figure 12. Here tests 8 – 11 show effectively no change from the prior matrix distribution.

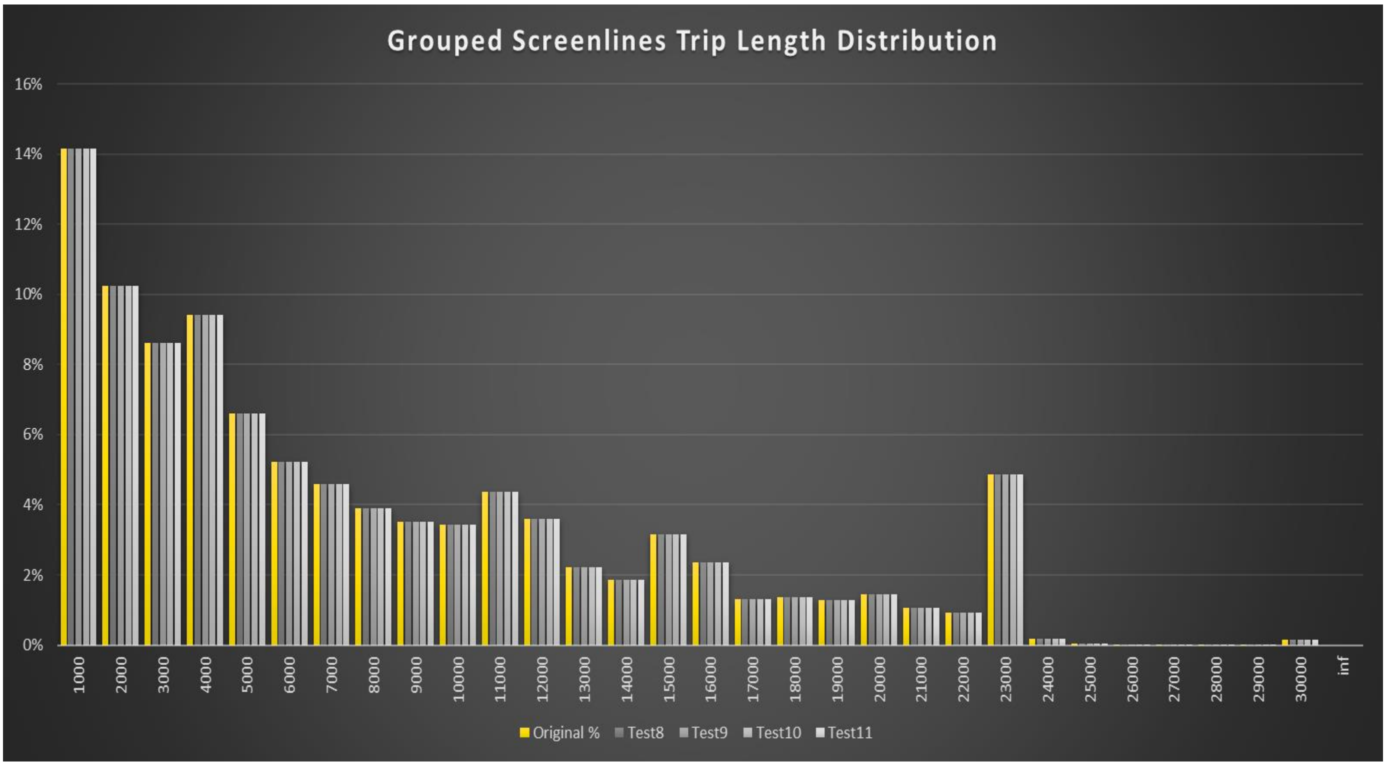

Figure 12: Trips Length Distribution Tests 8-11

Of the range of tests, the grouped screenline tests (8-11) show no notable differences from the prior matrix. The All count tests are at the other end of the spectrum, showing a large change from the prior matrix results, particularly the trip length distribution. Tests 4 – 7 strike a balance between improving the model and observed data match without over adjusting the demand matrices.

There is little variation between the range of tests 4 – 7. Test 4 has therefore been adopted as this test keeps the Aimsun default elasticity parameters and doesn't apply a weighting function.

4.3 Resulting Demands

With the Matrix Estimation process applied, the total demands show little difference from the prior totals. Table 14 compares these totals and shows no difference in the AM peak, a 0.9% increase of car trips in the IP and a small decrease of care trips in the PM. The PM does also show a 6.4% decrease in Truck demands, although this only represents 400 trips.

Table 14: Prior vs Estimation Totals

Demand	Prior	Matrix Estimated	Diff	% Diff
AM Cars	140,314	140,314	0	0.0%
AM Trucks	6,459	6,459	0	0.0%
IP Cars	135,095	136,378	1,283	0.9%
IP Trucks	7,313	7,276	-37	-0.5%
PM Cars	184,367	183,940	-427	-0.2%
PM Trucks	6,343	5,935	-408	-6.4%

Overall this shows the Matrix Estimation has resulted in appropriate adjustments without fundamentally changing the shape of the demand matrices. Further adjustments may be required during calibration to address specific issues. These shall be documented in the calibration/validation report.

5. Demand Checks

With the demands converted from WTSM to HAM zones, this section plots the resulting trips on GIS maps. This shall confirm reasonable demands have been developed and highlight any outliners that should be considered during the calibration. Through this section a consistent scale has been adopted to allow comparison between maps. Also note that these plots only include internal trips and also exclude park and ride trips. The plots include all of the adjustments covered in this report, including the initial Matrix Estimation.

AM peak trips are mapped in Figure 13 and Figure 14 by origins and destinations respectively. The destinations plot shows higher trips ends in the Petone shopping area, Upper Hutt CBD and around Ngauranga.

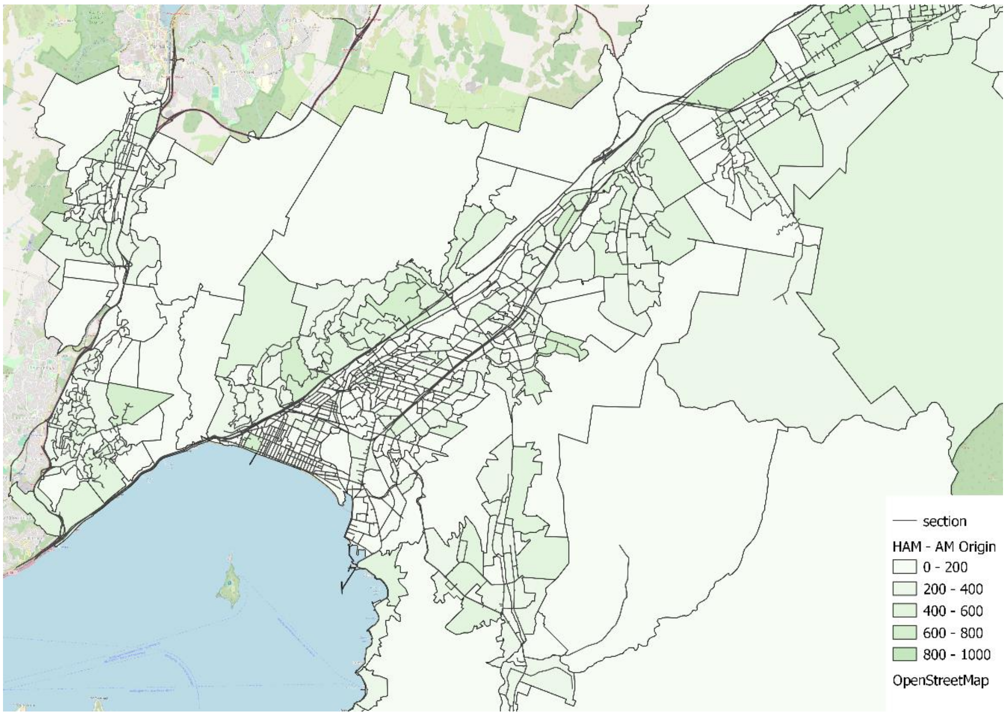

Figure 13: AM Trips by Origin

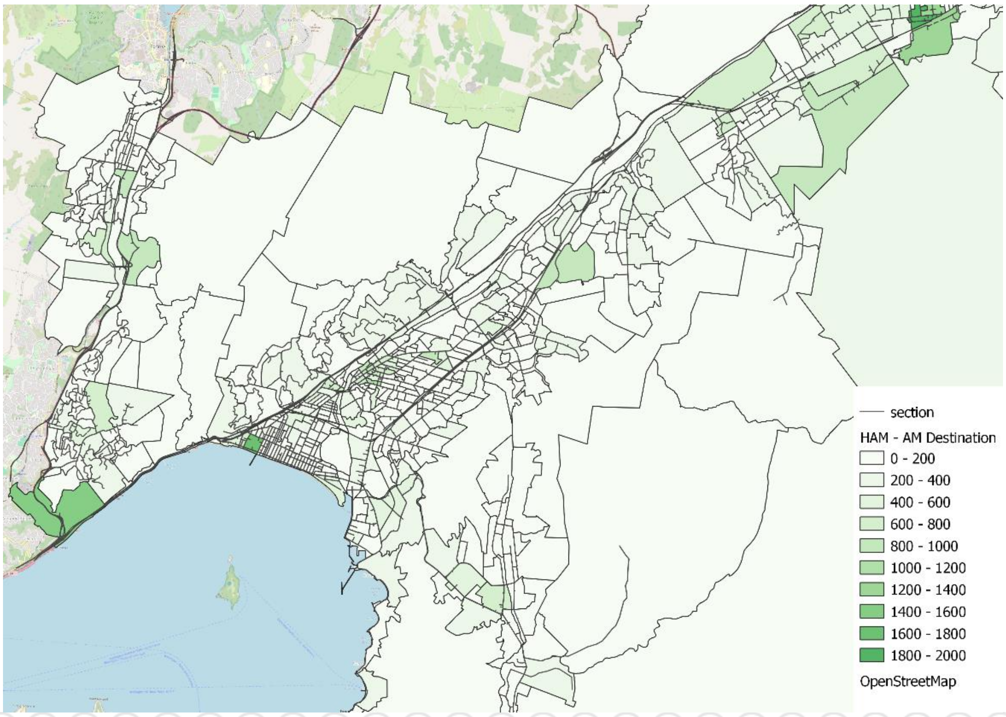

Figure 14: AM Trips by Destination

Figure 15 and Figure 16 show the origin and destination trip end plots for the IP. Here the hotspots for both directions are Upper Hutt CBD and the Petone shopping area.

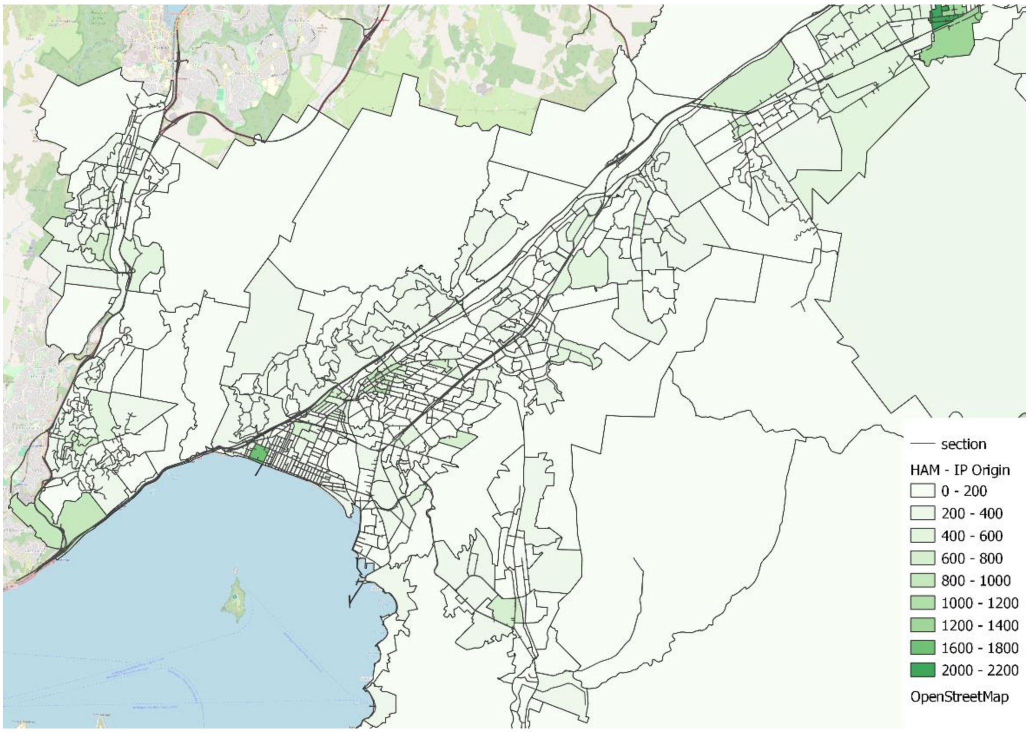

Figure 15: IP Trips by Origin

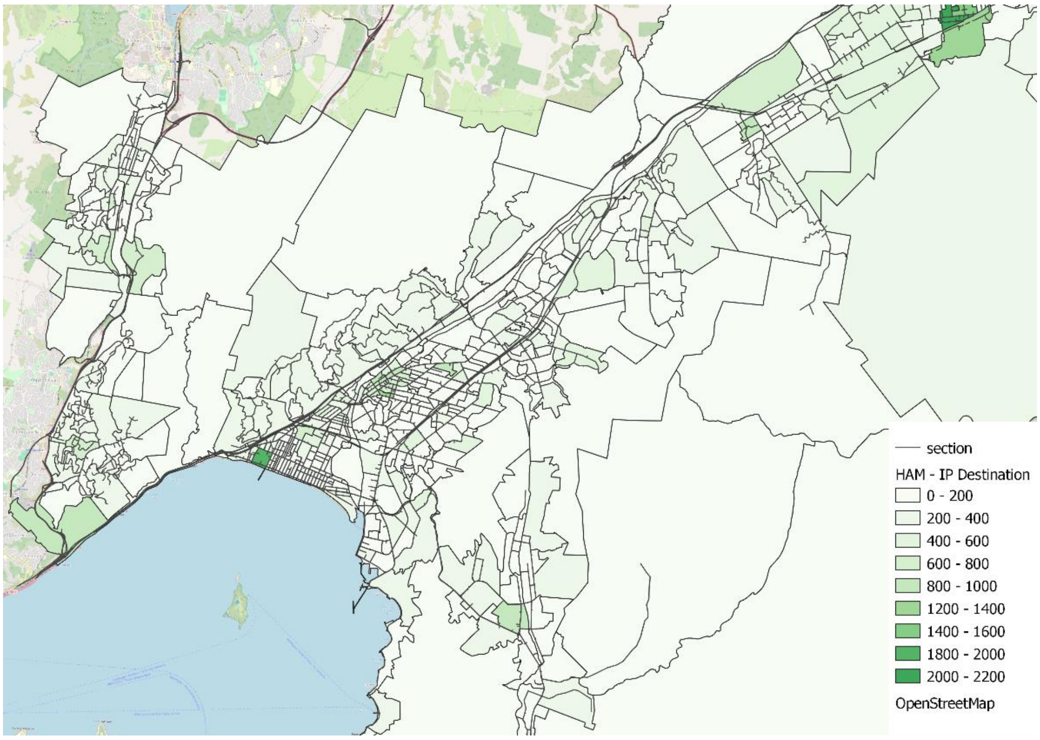

Figure 16: IP Trips by Destination

The same origin and destination plots are shown in Figure 17 and Figure 18 for the PM peak. This shows the same patterns as the other peaks. Upper Hutt CBD shows even higher trips here, compared to the other periods. The Petone shopping area stands out as it did in the other periods.

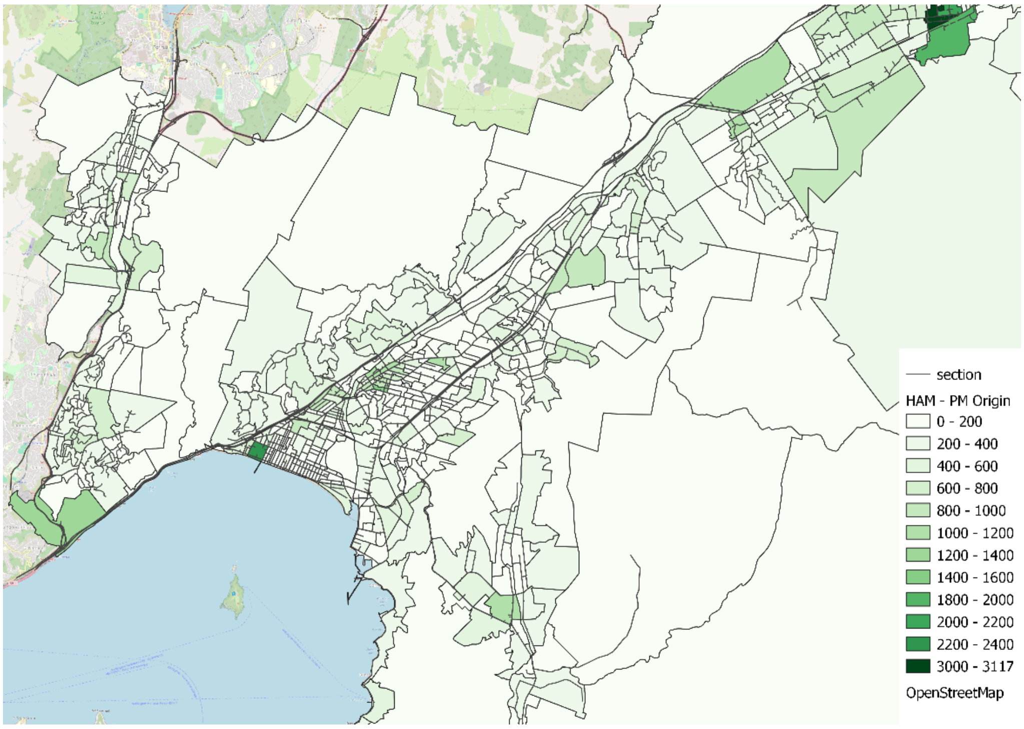

Figure 17: PM Trips by Origin

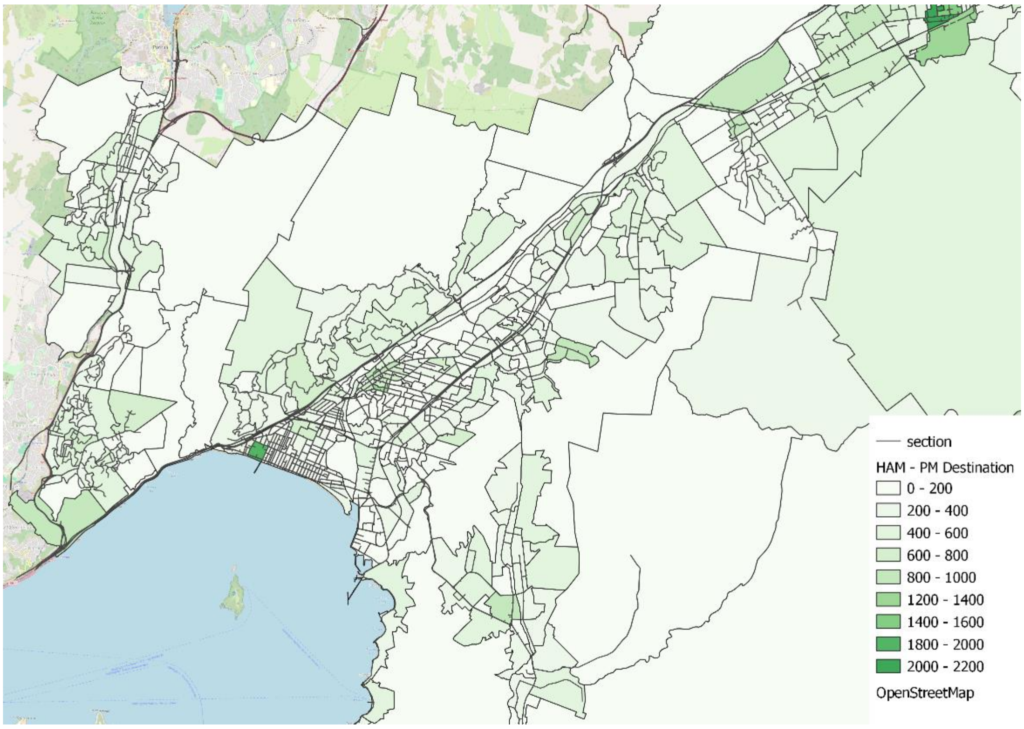

Figure 18: PM Trips by Destination

Looking closer at the Petone shopping area, this zone does stand out from the surrounding zones as shown in Figure 19. This does reflect the high concentration of shopping activities within this zone. There are also office activities which load onto the Esplanade. The area is contained in a single meshblock, so there is not a simple method to split the zone with the process already established. The area can be accessed from all sides of the zone anyway so it wouldn't be realistic to do so anyway, although the office block could potentially be separated. It is currently proposed to deal with this area with Aimsun's percentage loading functionality.

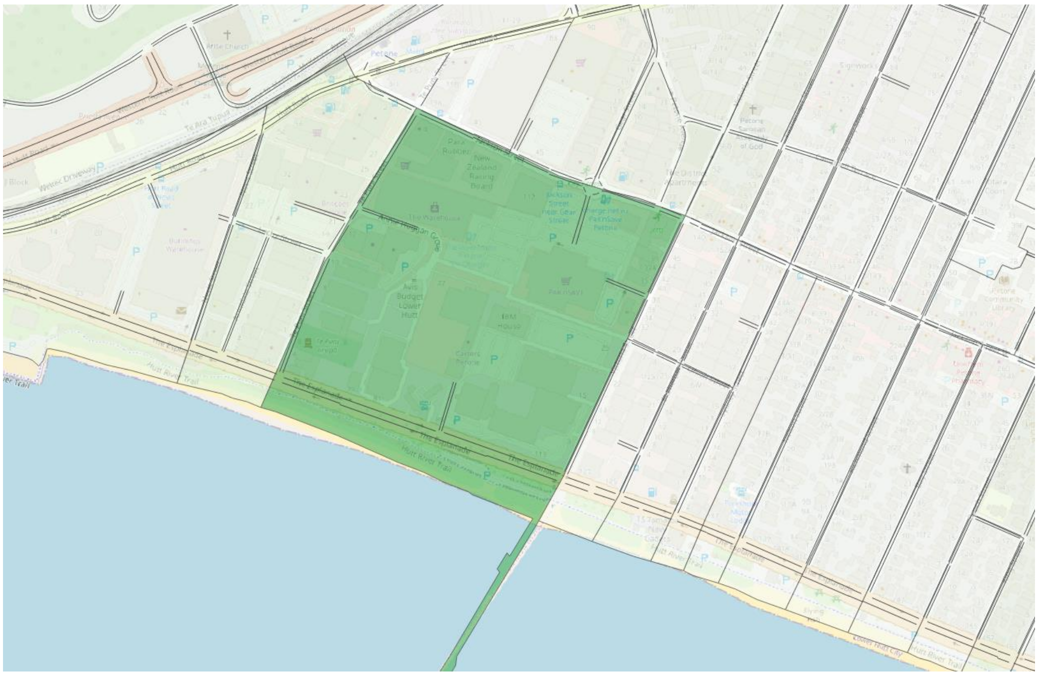

Figure 19: Petone High Generator

While the trips look reasonable, a further comparison to the landuse inputs has been made as shown in Figure 20. This shows the trips for each zone divided by the activity within that zone. Activity is in this case defined as:

$$Activity = Population + 2 \times Employment$$

HAM trips have been aggregated back up to WTSM zones for this comparison. This was simpler to do than disaggregating the landuse inputs to the HAM zones. This shows the zone near Haywards standing out as a high generator, relative to the landuse within this zone. This zone (zone 1541) however has very low trip generation and also very low activity. There are less than two trips generated in all periods and the population input is also less than one. This high activity zone can therefore be disregarded.

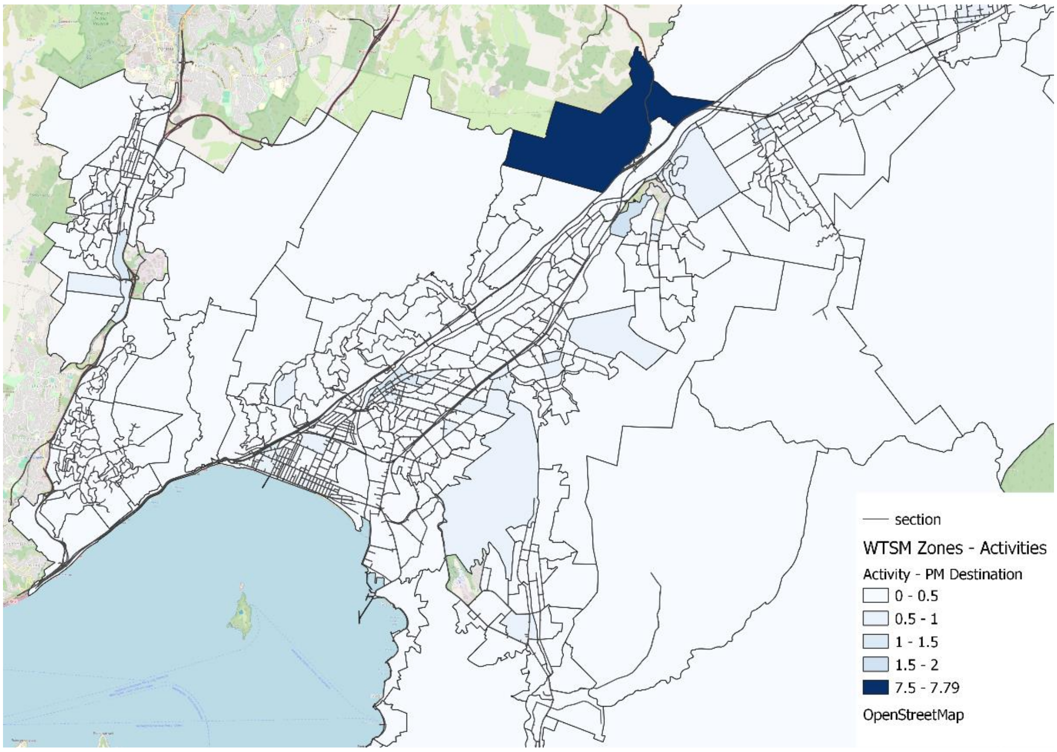

Figure 20: PM Peak Destination Trips/Activity Plot

5.1 Special Generators

Special generators are locations where demand growth occurring outside of the usual landuse based inputs which WTSM accounts for. An example of this is Hospital based trips, which fall outside the usual trip purpose categories such as home-based work, home-based shopping etc. No specific adjustments have been made at special generators in HAM, relying instead on WTSM's treatment of these locations. Special generators which could require adjustment during calibration are the Hutt Hospital and the Queensgate shopping mall. Table 15 below shows the current demands out of these zones.

Table 15: Hospital and Queensgate Generators

Location	AM		IP		PM	
	Origin	Destination	Origin	Destination	Origin	Destination
Hutt Hospital	450	1,000	800	800	1,100	800
Queensgate (South)	450	1,050	1,150	1,200	1,600	1,150
Queensgate (North)	250	600	650	700	900	650

Park and Ride has similarly used the WTSM demands to derive related demands. The WTSM station access numbers include drop offs, however a limitation of the current WTSM station access methodology is that it only generates trips in the peak direction. Generally, this is appropriate for a Strategic model, however the return journey of a drop off trip does not generate a trip.

Table 16 shows the resulting station related trips. HAM includes all of the Hutt Valley Line stations, as well as part of the Kapiti line between Takapu Road and Porirua. Mayborn Station is also included which is the next station after Upper Hutt on the Wairarapa Line.

Table 16: Station Access Trips

Rail Line	Location	AM (Destination)	IP (Destination)	PM (Origin)
Hutt Line	Petone	450	40	250
	Western Hutt	50	0	100
	Melling	300	0	100
	Ava	40	10	50
	Woburn	850	40	250
	Waterloo	850	20	650
	Epuni	0	0	20
	Naenae	0	10	40
	Wingate	10	0	20
	Taita	100	0	150
	Pomare	350	20	150
	Manor Park	10	0	10
	Silverstream	200	20	150
	Heretaunga	350	10	200
	Trentham	0	0	10
	Wallaceville	50	10	100
	Upper Hutt	500	20	300
	Maymorn	100	0	10
Kapiti Line	Takapu Road	450	30	300
	Redwood	100	0	100
	Tawa	200	10	200
	Linden	200	10	150
	Porirua	1150	100	250
	Porirua	0	0	900

6. Summary

This technical note has outlined the demand development process for the Hutt Aimsun Model (HAM). The process can be summarised as follows:

- The Wellington Transport Strategy Model (WTSM) has been locally recalibrated with the release of the 2023 census population totals.
- The resulting WTSM matrices have been cordoned to suit the HAM model extents.
- Disaggregation has been carried out on the WTSM cordon matrices using linear regression and the StatsNZ meshblock population and employment inputs.
- The HAM demands have been factored across the screenlines to improve calibration at these key locations of the model.
- Traffic release profiles have been developed and applied to the demands from the count data to represent travel between demand sectors over the model periods.
- Initial matrix estimation has been carried out on the demands using the screenline counts.

Further refinement of the demands will likely be required during the model calibration. This is likely to be additional matrix estimation to improve the model validation. Any additional demand refinement will be documented in the model calibration/validation report.