Wellington Transport Strategy Model (WTSM) Update 2006

BASELINE FORECASTING REPORT

- Final
- February 2008

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Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
Draft A	21/12/07	AWB	TBI	21/12/07	Draft including original demographic forecasts
Draft B	28/1/08	AWB	TBI	28/1/08	Draft including updated demographic forecasts
Final	18/2/08	AWB	TBI	18/2/08	Final

Distribution of copies

Revision	Copy no	Quantity	Issued to
Draft A	electronic		
Draft B	electronic		GWRC (Tim Kelly)
Final	electronic		GWRC (Tim Kelly)

Printed:	11 July 2011
Last saved:	25 February 2008 07:53 AM
File name:	Y:\06 Development\Wellington Transport Models\12_Update and Validation of WTSM\99_2001and 2006 Reports\2006\WTSM Update Baseline Forecasting Report
Author:	David Young
Project manager:	Andrew Bell
Name of organisation:	Greater Wellington Regional Council
Name of project:	WTSM Update
Name of document:	WTSM Update Baseline Forecasting Report
Document version:	Final
Project number:	an00832

1. Introduction

1.1 Background

Greater Wellington Regional Council (GWRC) commissioned Sinclair Knight Merz Ltd to update the Wellington Transport Strategy Model (WTSM) to a 2006 base year and to review, investigate and advise on a number of specific model aspects.

The reviews and investigations related to the base year have been undertaken, documented in a series of technical notes and the WTSM Update Specification Report. A Validation Report detailing the update of WTSM to a 2006 base year and setting out the 2006 validation was produced in December 2007.

This report documents the future year demographic and transport forecasting undertaken. Demographic forecasts were produced by MERA for 2011, 2016, 2021, 2026 and a longer range forecast was produced for 2051. In each year three projections were produced: low, medium and high.

Transport networks and forecasts were produced for 2016 and 2026 for a Do Minimum scenario and for a scenario including transport improvements envisaged in the GWRC Regional Land Transport Strategy 2007 – 2016 which form part of the Regional Transport Plan (RTP). The medium demographic projections were used for these forecasts.

1.2 Project Brief

The project brief was set out as a series of tasks specific to updating the demographic inputs and the model, and possible enhancements to the model. Project outputs are listed as:

- an updated model,
- updates to documentation as required,
- a new baseline and forecast report, (this report) and
- presentations to the Regional Land Transport Committee, external stakeholders, and Greater Wellington officers.

Further details of the project brief are given in Appendix A.

1.3 Purpose and Structure of Report

The purpose of this report is to describe the background to the demographic forecasts and the WTSM forecasts, including key factors affecting travel demand, to present the results of the forecasting, and implications for the region.

The remainder of the report is structured as follows:

- Chapter 2: Demographic Forecasts
- Chapter 3: Factors Affecting Transport Demand
- Chapter 4: Trends and Implications
- Chapter 5: Conclusions

2. Demographic Forecasts

2.1 Introduction

This chapter gives a summary of the demographic forecasts developed as part of this project. The overall forecast population and employment totals are presented and discussed, followed by a summary of the location of growth within the region. The detail of these forecasts is set out in the separate report:

2006 Base Run, Demographic / Development Model Summary Report, MERA, January 2008.

2.2 Population Forecasts

Table 1 gives historical regional population and the low, medium and high forecasts arising from the new projections. The figures have been rounded so do not exactly match those in Table 2. The new projections are higher than previous forecasts due to new Statistics New Zealand projections based on the 2006 Census.

As noted above the medium level projections have been used in the 2016 and 2026 transport modelling forecasts.

- **Table 1: Historical and Projected Usually Resident Regional Population**

Projection Assumption	1991	1996	2001	2006	2011	2016	2021	2026	2006 to 2026 growth
Low	400,400	413,900	423,600	451,200	457,100	461,000	463,400	464,700	4%
Medium					467,100	480,700	493,100	504,400	12%
High					477,100	500,800	523,300	545,100	21%

Table 2 gives the 2006, 2016 and 2026 regional totals for population and households in the categories used by the WTSM trip generation model, including the differences between the forecasts and 2006.

Persons are by age groupings and employment status, and households are categorised by the number of adults and their employment status.

The population overall increases by 7% and 12% to 2016 and 2026 respectively, while households have higher growth (12% and 23%) implying a continuation of the current trend for smaller-sized households.

The population mix shows change over time, with a slight decline in children and very large growth in older working adults. The largest person category, full-time working adults, increase at about the same rate as the overall average.

For households, those with non-working adults increase at a much higher rate than households with working adults.

- **Table 2: Regional Population and Households by WTSM Categories**

Data	2006	2016	Diff	% Diff	2026	Diff	% Diff
Infants	30,516	30,499	-17	0%	29,983	-533	-2%
Children 5-10 yrs	37,099	37,050	-48	0%	34,783	-2,316	-6%
Children 11-16 yrs	38,753	35,699	-3,054	-8%	35,924	-2,828	-7%
Young Adult Full-Time Employed	24,609	27,715	3,106	13%	26,135	1,526	6%
Young Adult Part-Time Employed	11,962	12,763	801	7%	12,634	672	6%
Young Adult Other	22,971	21,187	-1,785	-8%	20,032	-2,939	-13%
Adult Full-Time Employed	149,258	161,846	12,587	8%	166,076	16,818	11%
Adult Part-Time Employed	30,712	34,434	3,722	12%	36,430	5,718	19%
Adult Other	57,375	54,793	-2,582	-5%	55,639	-1,736	-3%
Older Adult Full-Time Employed	3,208	11,580	8,372	261%	17,267	14,059	438%
Older Adult Part-Time Employed	3,731	12,151	8,421	226%	20,084	16,353	438%
Older Adult Other	41,524	41,006	-518	-1%	49,432	7,908	19%
Population Total	**451,204**	**480,723**	**29,519**	**7%**	**504,421**	**53,217**	**12%**
1 Adult Employed	28,813	32,802	3,988	14%	36,125	7,311	25%
1 Adult Non-Employed	24,558	30,965	6,406	26%	39,878	15,319	62%
2 Adults (Min of 1 Employed)	71,037	75,348	4,311	6%	77,514	6,477	9%
2 Adults Neither Employed	13,992	17,120	3,128	22%	21,060	7,068	51%
3+ Adults	28,455	30,663	2,208	8%	30,837	2,382	8%
Household Total	**166,899**	**186,898**	**19,999**	**12%**	**205,414**	**38,515**	**23%**

2.3 Employment Forecasts

Projections of the number of employed residents in the region are derived directly from the population projections by applying age and gender specific employment rates to population estimates by age and sex. The projected labour force demand is based on the BERL "business as usual" June 2007 employment projection scenario customised down from 1.4% per annum growth in FTE down to 1.14% over the 2006 to 2021 period. The rate of change is calibrated to fit the projection intercensal changes in labour force supply at a regional level.

Table 3 gives the 2006 and forecast regional employment totals by employment category used in the transport model. Employment is forecast to grow by 15% to 2016 and 21% by 2026; this trend corresponds with the increases in working adults shown in Table 2.

The growth is fairly evenly spread between the categories ("Other" excepted), with Services having the highest and Transport/Communications the lowest.

- **Table 3: Regional Employment by WTSM Categories**

Data	2006	2016	Diff	% Diff	2026	Diff	% Diff
Manufacturing	34,284	39,372	5,088	15%	40,736	6,452	19%
Retail	49,265	55,993	6,728	14%	58,905	9,641	20%
Transport / Communications	11,204	12,510	1,306	12%	13,017	1,812	16%
Services	133,840	156,352	22,511	17%	165,679	31,838	24%
Other	4,971	4,998	26	1%	4,897	-74	-1%
Employment Total	**233,565**	**269,224**	**35,659**	**15%**	**283,233**	**49,669**	**21%**

2.4 Educational Roll Forecasts

Table 4 gives the 2006 and forecast education rolls by category used in the transport model.

Primary and secondary rolls are forecast to decline by 6-7% by 2016 and grow only slightly between then and 2026. These trends are similar to those in the numbers of children in the person forecasts (refer to Table 2).

Tertiary rolls have a small increase to 2016 and then remain at this level in 2026.

- **Table 4: Regional Education Rolls by WTSM Categories**

Data	2006	2016	Diff	% Diff	2026	Diff	% Diff
Primary	37,024	34,886	-2,138	-6%	35,382	-1,642	-4%
Secondary	42,757	39,882	-2,875	-7%	40,547	-2,210	-5%
Tertiary	47,521	48,938	1,417	3%	47,778	257	1%
Education Rolls Total	**127,302**	**123,706**	**-3,596**	**-3%**	**123,707**	**-3,595**	**-3%**

2.5 Location of Growth

The location of growth is shown in terms of population and employment by WTSM zone in Appendix B and by TA in Table 5.

The data indicates varying population growth rates between TA areas. Kapiti and Wellington have much higher growth than the rest; around 20% increase by 2026 over 2006, compared with 1-5% for the other TA's (the regional average to 2026 is 12% - Table 2).

The growth in employment is much more evenly distributed between TA's, varying between 14 and 22%. The highest growth areas are Hutt, Kapiti, and Wellington, and the lowest are the three Wairarapa TA's.

Table 5: Population and Employment by TA

	Population				
TA	**2006**	**2016**	**% Diff**	**2026**	**% Diff**
Carterton	6943	7150	3%	7169	3%
Hutt	38727	39830	3%	39909	3%
Kapiti	46329	52043	12%	57139	23%
Hutt City	98132	100614	3%	101318	3%
Masterton	23268	23610	1%	23396	1%
Porirua	49202	50842	3%	51666	5%
South Wairarapa	8630	8840	2%	8736	1%
Wellington	177966	195641	10%	212799	20%
Total	451,204	480,723	7%	504,421	12%
	Employment				
TA	**2006**	**2016**	**% Diff**	**2026**	**% Diff**
Carterton	3261	3607	11%	3714	14%
Hutt	12099	14003	16%	14761	22%
Kapiti	14539	16781	15%	17672	22%
Hutt City	44068	50486	15%	52899	20%
Masterton	11113	12663	14%	13244	19%
Porirua	15281	17830	17%	18887	24%
South Wairarapa	3865	4299	11%	4445	15%
Wellington	128965	149121	16%	157152	22%
Total	233,565	269,224	15%	283,233	21%

3. Factors Affecting Transport Demand

3.1 Introduction

This chapter gives the values of model inputs and discusses some of the key factors that affect the level of travel demand.

Aspects of the modelling discussed in Sections 3.3 to 3.7 below are:

- The demographic forecasts
- Trip rates
- Car ownership levels
- The cost of travel, including the value of time, operating costs, fares, and parking charges
- The transport networks

3.2 Modelling Input Values

The values of inputs to the modelling that have an impact on demand are set out below.

Values of Time

The values of time used in the model, which vary by purpose and car availability, are given in Table 6. These values were developed from values in the Economic Evaluation Manual and scaled to 2006, and have remained constant in forecasting.

- **Table 6 2006 Values of Time**

Purpose	Car Availability	VOT ($/min)
HBW	Captive	0.096
HBW	Competition and Choice	0.130
HBEd	Captive	0.063
HBEd	Competition and Choice	0.097
EB	All	0.435
Other	Captive	0.083
Other	Competition and Choice	0.116

Note: HBW = Home-Based Work, HBEd = Home-Based Education, EB = Employers Business

Vehicle Operating Costs

The vehicle operating costs used are given in Table 7. For EB purpose and trucks this includes the separate fuel and non-fuel costs. Note that the HCV costs do not affect HCV demand in the model, but they do have an impact on routeing. The 2006 costs have remained constant in the forecasting reported here.

- **Table 7 Vehicle Operating Costs**

Vehicle Class	2002 Cost (c/Km)	2006 Cost (c/Km)
Car – EB total	20.0	26.6
Car-EB fuel	7.6	12.5
Car-EB non-fuel	12.4	14.1
Car - Other (Inc GST)	8.6	14.1
HCV total	79.3	108.5
HCV fuel	36.7	60.2
HCV non-fuel	42.7	48.4

Note: EB = Employers Business

Parking Costs

The parking charges applied in the model to car trips are given for each purpose in Table 8. These represent the average costs paid, taking into account the proportions of trips that pay no costs. These costs have remained constant in the forecasting.

- **Table 8 Parking Costs**

Parking Costs ($/trip)	2006
HBW Lower Wellington	2.805
HBW Upper Wellington	4.538
EB Lower Wellington	0.995
EB Upper Wellington	1.768
Other Lower Wellington	0.816
Other Upper Wellington	1.632

Note: HBW = Home-Based Work, EB = Employers Business

PT Fares

PT fares are represented in the model as a cost between each zone. These costs were developed for the original 2001 model, and for the current base year 2006 model rail fares are 10% higher than in 2001 and the same for bus. The 2006 fares have remained constant in the forecasting.

Gross Domestic Product

Growth in Gross Domestic Product per capita is assumed to be 1.8% p.a. based on historical time series data and affects three aspects of the modelling: the employment forecasts, the level of car ownership, and the growth in HCV demands.

3.3 Demographic Forecasts

The amount of travel that occurs is directly related to the size of the population, and then to a lesser extent on the makeup of the population, such as population age, household size/composition, and employment. This transport demand is considered in terms of person trips and is seen on the ground as the volume of traffic, the patronage on Passenger Transport (PT), and amount of walking and cycling occurring.

The WTSM model generates person trips from the demographic forecast information described in Chapter 2. This showed increases in population from 2006 to 2016 of 7%, and from 2006 to 2026 of 12%, which will be reflected in the growth in person trips in the model.

3.4 Trip Rates

The rate at which trips are made also directly affects the transport demand generated, the higher the rate the greater the demand.

One of the specific tasks for this project was to review whether the trip rates used in the model should be revised given that they were developed from 2001 survey data. Our review included collation of available information from other surveys and contexts within New Zealand and a review of international research and best practise.

The summary and conclusion from this review was as follows[1]:

> It is international practice to assume the temporal stability of all-mode trip rates. While this is supported by some research, we would not take this as being conclusive. Much of the research is old and behaviour may have since changed, certainly model specifications have advanced and are different from the early models evaluated in some of these studies.
>
> The lack of knowledge about the 1988 Wellington Household Travel Survey (HTS) and thus inconsistencies of methodology and degrees of underreporting make it impossible to draw confident conclusions on the very simplistic trip rate comparisons that have been offered.
>
> Collation of information from Auckland, Christchurch and the MoT did not provide any evidence of increasing person trip rates over time that could be applied with any confidence to WTSM.
>
> Thus, while we cannot rule out the possibility of trip rates changing through time, the balance of evidence and practice is to take them as temporally constant and comparisons between the 1988

[1] For full technical note refer to WTSM Update Specification Report, May 2007, Appendix D

and 2001 HTSs do not have sufficient reliability for us to wish to advise going against international practice.

3.5 Car Ownership

The level of car ownership has an effect on the level of car travel and as such WTSM includes a car ownership module which represents current (2006) and forecast car ownership levels.

Table 9 gives the proportion of households by car ownership levels for the 2001 and 2006 Census' for Wellington and New Zealand. This shows that household car ownership levels have increased between 2001 and 2006. The proportion of households without a car has declined from 13% to 11% and those with 2 or more cars increased from 44% to 47%. As in 2001, the 2006 car ownership for Wellington is lower than the national average.

- **Table 9 Census Car Ownership**

Car Ownership Level	2001 Census		2006 Census	
	Wellington	NZ	Wellington	NZ
0 cars	13%	10%	11%	8%
1 car	43%	39%	42%	36%
2+ cars	44%	51%	47%	56%

Figure 1 illustrates historical and projected car ownership as cars per person for Wellington, and Table 10 gives the 2006 and future values.

The projections are an update of the 2001-based WTSM car ownership model using recent actual data and a revised forecasting model of car ownership which includes a saturation effect. The saturation level in this model is set at 0.8 cars per person, which is not reached until well beyond the intended forecasting horizon.

The projections indicate car ownership increasing between 2006 and 2026 by 18% to from 0.57 cars per person to 0.68, while GDP is assumed to increase at 1.8% p.a., a 41% increase over the same period. Combined with a decrease in household size, this is expected to lead to a situation where a larger proportion of households have one or more vehicles available, and hence a greater propensity for trips by car over other modes.

- **Table 10 2006 and Future Car Ownership Levels**

Year	Cars/ Person
2006	0.5694
2016	0.6273

2026	0.6743

- **Figure 1 Historical and Projected Car Ownership for the Wellington Region**

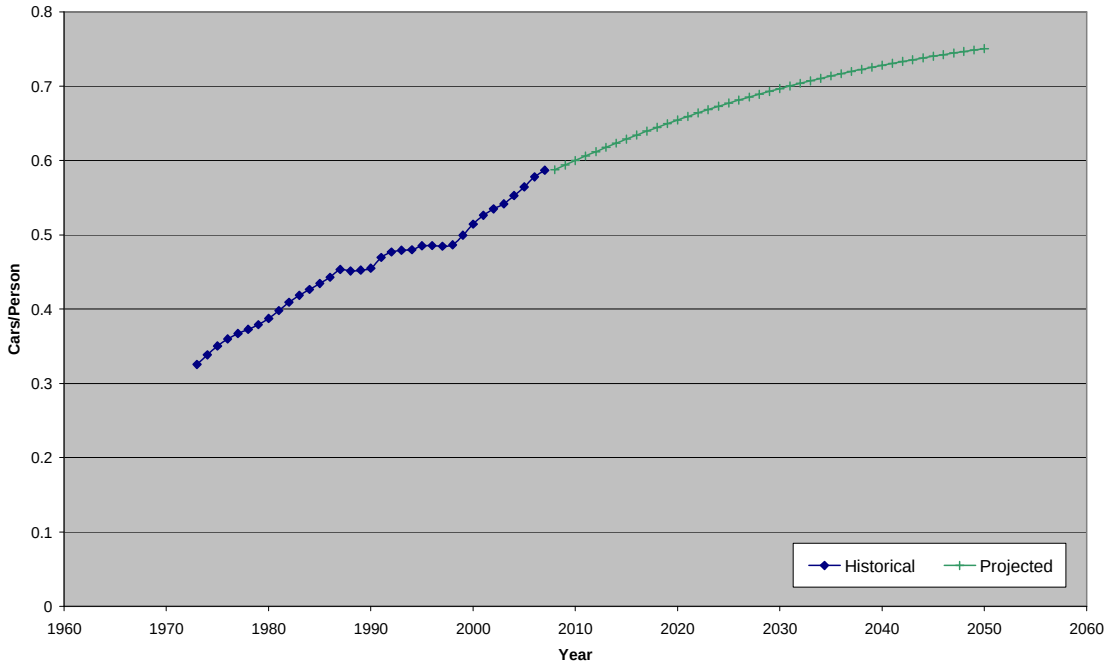


Table 11 gives the modelled 2006 and forecast car ownership levels by TA as the proportion of households by car ownership levels. This shows declining proportions of zero car households and increasing proportions of 1 and 2+ car households. The latter is the case generally, but for some TAs the proportion of 2+ car households declines slightly, which will be related to reducing household sizes.

- **Table 11 Modelled Car Ownership by TA**

Level	Carterton	Hutt	Kapiti	Hutt City	Masterton	Porirua	South Wairarapa	Wellington	Total
2006									
0 cars	8%	10%	9%	11%	10%	13%	7%	14%	12%
1 car	39%	41%	47%	42%	43%	40%	44%	45%	43%
2+ cars	53%	49%	44%	46%	47%	48%	49%	42%	45%
2016									
0 cars	7%	9%	7%	9%	9%	10%	6%	11%	10%
1 car	43%	42%	47%	41%	44%	38%	49%	43%	43%
2+ cars	51%	49%	46%	50%	47%	52%	45%	46%	48%
2026									
0 cars	5%	7%	5%	7%	7%	8%	5%	9%	8%
1 car	48%	44%	47%	41%	47%	38%	56%	42%	43%
2+ cars	47%	49%	48%	51%	46%	54%	38%	49%	49%

The full technical note on car ownership forecasting is given in Appendix C.

3.6 The Cost of Travel

The costs of travel influences choices people make about their trip making, such as where they travel to (that is how far from home), how long it takes, mode of travel, and time of day. Monetary travel costs include the costs of running a vehicle, parking costs and PT fares.

The costs of running a vehicle include fuel and the costs of owning and maintaining a vehicle. Both of these are included in WTSM and have an affect on the modelled travel demands. The vehicle running costs are represented as perceived costs, that is, those that are considered at the time of making the choice about travel, and are a proportion of the total resource costs. The cost of buying and maintaining a car are effectively considered as sunk costs and don't affect whether the car is used or not. The cost of fuel is taken as the perceived cost in WTSM for all but employers business trips; for the latter all operating costs are considered perceived costs.

Parking costs are also included for trips into the Wellington CBD, the 2006 levels based on estimated increases over the original 2001 levels and proportions of trips that do pay.

For the forecasts undertaken and reported here, the 2006 costs and values of time have been retained[2] and not increased, though all can be increased as necessary and the model is now set up to be able to easily test the impact of an increase in fuel price for instance.

3.7 Transport System (Network)

The transport system or network or transport supply also has an effect on travel costs in the general sense. In forecasting, the networks assumed will impact on the growth in trips by mode and time of day, but not the overall all-day person travel.

Three networks have been modelled:

- a Do Minimum network, made up of the 2006 network plus committed projects, including:
  - Inner City Bypass
  - Dowse to Petone Interchange
  - Kapiti Link Road
  - Various rural passing lanes
  - Extension of Paraparaumu rail services to Waikanae
  - Improved rail rolling stock
  - Investment in non-pricing TDM (this is modelled as a 5% reduction in commuting trips to the Wellington CBD in the AM peak, and the reverse in the PM peak, with 90% of the reduction being allocated to PT)
- a 2016 RTP network, with main projects including:
  - Terrace Tunnel tidal flow
  - SH2/58 Grade Separation
  - Ngauranga – Aotea capacity improvements
  - Grenada to Petone link
  - Transmission Gully Motorway
  - Increased rail services on the Hutt, Western and Johnsonville lines
  - Integrated ticketing and fares, and real time information systems
  - Buslanes in Wellington CBD
- a 2026 RTP network, which includes 2016 RTP projects as well as:
  - Petone to Gracefield link
  - Kennedy Good Bridge grade separation

[2] For details refer to the WTSM Update Model Validation Report

- Further increased rail services on the Hutt, Western and Johnsonville lines
- Extensions of the CBD buslanes

Appendix D lists in more detail the new transport infrastructure and other improvements included in these networks.

4. Trends and Implications

4.1 Introduction

This section presents a summary of statistics from WTSM in the base year (2006) and the forecast years (2016, 2026) to provide a picture of the forecast trends in travel demands and patterns. As noted previously the forecasts, and the following results, are based on the medium growth demographic projections (refer to Chapter 2).

4.2 Summary

Person Trips:

- Person trips show a steady increase between 2006 and 2026 of 15% (for both the Do Minimum and RTP networks), compared with 12% growth in the population over the same period;
- The growth in person trips varies by purpose due to changing makeup of the population and households.

Mode Shares:

- Daily car vs PT mode shares (83:17 in the AM peak) do not change significantly in forecasting and the RTP has little effect on these.

Trips from/to TAs:

- There is continued growth in trips from/to all TAs, but the magnitude of the growth does vary by TA. There is lower growth from Upper Hutt, Hutt, and Porirua, and to a lesser extent Wairarapa, than from Wellington City and Kapiti. This is primarily driven by the forecast growth in population.
- PT trips from Kapiti show a very high growth rate, though the numbers are quite low in absolute terms.
- The effect of the RTP is generally small changes to AM peak private vehicle and PT trips from each TA, the larger changes include the growth in car trips from Hutt, which coincide with improvements to State Highway links into the Wellington CBD.

Commuting Trips:

- Commuting by car increases more than PT in both absolute and percentage terms (52,000, 25% for car vs 8,000, 16% for PT to 2026). This will be related to all the key drivers of travel, but particularly increasing car ownership over time and to how the relative costs of travel by car and PT change.
- Active mode commuting trips increase at a lower rate than car or PT, which reflects increasing car ownership, and the wider spread of population and employment growth resulting in longer trips being made.

- The effects of the RTP on overall commuting trips by mode are small; the change in car trips is insignificant, while PT trips increase slightly and active mode trips decrease by a similar amount.

Trips to Wellington CBD:

- AM peak trips to the Wellington CBD by both car and PT generally increase from all TAs, the largest increase in trips being from within Wellington City, and the most significant percentage increase is in trips from Kapiti. These reflect the continued growth in CBD employment and in Wellington City population.
- The increases are greater for PT than car, which is a reflection of the rail improvements that are included in the Do Minimum and the increased road congestion in accessing the CBD.
- The RTP has only a small effect on the number of trips to the Wellington CBD, the largest being those from Hutt (2006 to 2026) where the car trips increase by some 325. This will be related to the improved roading accessibility arising from improvements to SH1 and SH2.

HCV Trips:

- HCV trips increase uniformly from 2006 to 2026 to be 85% higher by 2026. In contrast person trips and private vehicle (car) trips are forecast to increase by 15% and around 18% respectively over the same time. The growth in HCV trips is generated not only by demographic growth, particularly employment, but also but growth in the economy.
- Employment is forecast to grow by 21% between 2006 and 2026, while growth in the economy is measured in terms of the Gross Domestic Product (GDP) per capita which is assumed to increase at 1.8% per annum (refer to Section 3.2).
- The growth in HCV trips is fairly evenly spread reflecting the even spread in employment growth generally (refer to Section 2.3) and in the type of employment.

Road Network Performance:

- Network travel (vkt) and travel time (veh-min) increase in all periods between 2006 and the 2016 and 2026 Do Minimum, with a greater increase in travel time than vkt in the peak periods, which is reflected in lower average speeds than in 2006, and an indication of increasing peak period congestion.
- The effect of the RTP is a reduction in network travel time and an increase in average speed, to a greater extent in the peaks than the Interpeak. With the RPT the average speeds in 2016 are similar to those in 2006, but this is not maintained in 2026 in the peak periods.
- The RTP also causes some increase in the amount of private vehicle (car) travel, which arises from increases in both trips and the average distance travelled.

- Travel times on SH1 and SH2 southbound are increased in the 2016 and 2026 Do Minimum; the RTP has a marked effect on reducing these times to below 2006 levels.
- The RTP improves some key congestion points (Terrace Tunnel, SH1 in the vicinity of Mana) - due to the road network improvements in the RTP - but not others (eg Mt Victoria Tunnel).

RLTS Objectives and Measures:

- The measures used for this report indicate that implementing the RTP improves the performance of the transport system in terms of Economic and Regional Development, and Access and Mobility resulting from improved network performance.
- The objectives Protect and Promote Public Health and Ensuring Environmental Sustainability show improvement over 2006, due to assumptions about emissions and fuel usage rates; there is little effect due to the RTP.
- A high level economic assessment indicates that there are benefits with the RTP over the Do Minimum.
- It needs to be emphasised that this assessment is based only on the measures reported in here, which are largely global in nature and do not necessarily capture all the effects of the RTP.

4.3 Person Trips

Table 12 tabulates the modelled regional daily weekday person trips (excluding HCVs) in total and by purpose for 2006, 2016 and 2026, and

Figure 1 presents the statistics graphically. Only one set of forecast figures is given as person trips are not dependent on the transport network. Note that Home-Based refers to a trip to home or from home.

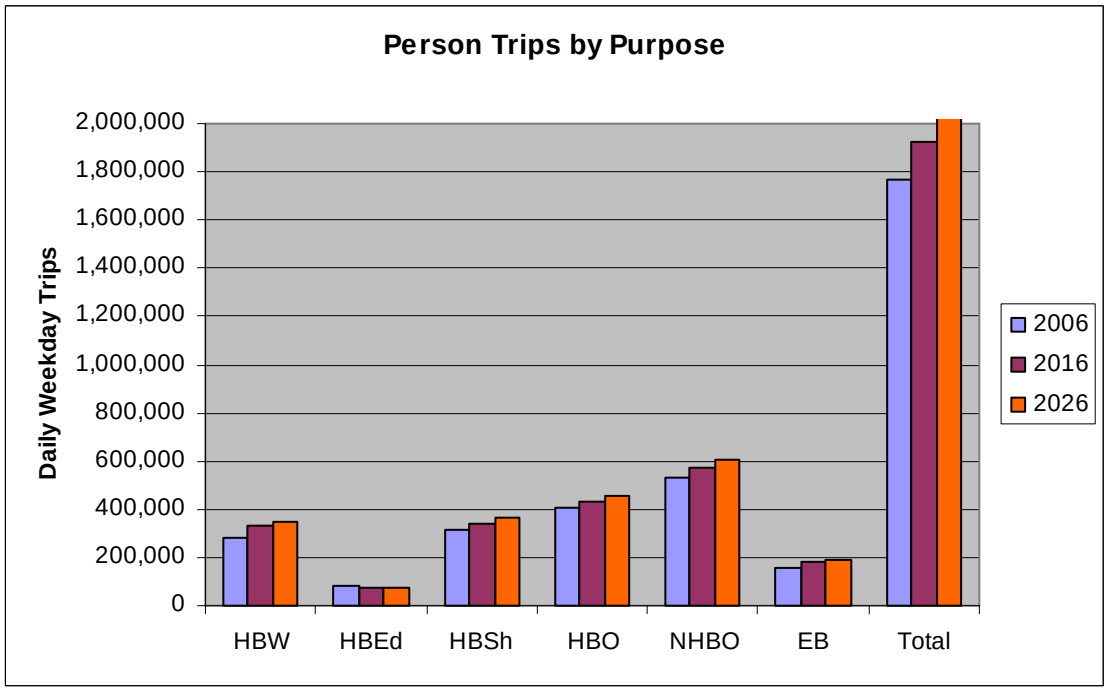
The results show a steady increase in person trips between 2006 and 2026 of 15%; by way of comparison the population growth over the same period is 12%. Education trips show a small decline which is due to an aging population and reducing household sizes meaning less school-aged children.

Shopping and other non-work-related trips increase 6-8% between 2006 and 2026, whereas employers business and commuting trips increase by some 20% between 2006 and 2026. The different growth rates are due to higher growth over the same period in working adults than non-working adults.

- **Table 12 Person Trips in Total and by Purpose**

	2006	2016			2026		
Purpose	**Trips**	**Trips**	**Diff**	**% Diff**	**Trips**	**Diff**	**% Diff**
Home-Based Work	285,632	328,197	42,565	15%	347,321	61,689	22%
Home-Based Education	79,011	74,653	-4,358	-6%	75,515	-3,496	-4%
Home-Based Shopping	313,281	337,976	24,695	8%	367,246	53,966	17%
Home-Based Other	404,067	429,182	25,115	6%	455,487	51,420	13%
Non- Home-Based Other	528,383	571,843	43,460	8%	604,066	75,683	14%
Employers Business	157,288	180,333	23,045	15%	190,234	32,946	21%
Total	1,767,662	1,922,184	154,522	9%	2,039,869	272,206	15%

- **Figure 1 Person Trips in Total and by Purpose**



4.4 Trips by Mode and Mode Shares

Trips by mode and mode shares are examined in this section.

4.4.1 Private Vehicle and PT Trips by Mode and Mode Shares

The private vehicle and PT regional trips and mode shares in 2006, 2016 and 2026 are presented as follows:

- Trips and the differences by period between the forecast and 2006, the forecasts being for the Do Minimum network case (Table 13);
- Trips and the differences by period for the two forecast years and the Do Minimum and RTP networks (Table 14);
- Private vehicle and PT mode shares by period (Table 15);
- AM peak PT mode shares Figure 2.

Table 13 shows that, as expected, the largest absolute increases occur with private vehicle (car) trips where the 2006 base is around 5 times greater for private vehicle than PT in the AM peak. There are reasonably uniform increases in trips to 2016 and then 2026. In 2016 there are lower percentage increases in private vehicle trips than PT in the peak periods, but by 2026 these are similar.

These trends will be related to the relative costs of travel by the two modes, and particularly by road travel times, which affect both car and bus travel costs, as well as the rail rolling stock improvements and the extension of services to Waikanae.

- **Table 13 Private Vehicle and PT Trips – Comparison with 2006**

		2006	2016 Do Min			2026 Do Min		
Period	**Mode**	**Trips**	**Trips**	**Diff**	**% Diff**	**Trips**	**Diff**	**% Diff**
AM	Car	153,770	170,310	16,539	11%	181,288	27,517	18%
	PT	30,411	33,993	3,582	12%	34,777	4,367	14%
IP	Car	142,565	157,068	14,503	10%	168,659	26,093	18%
	PT	9,619	10,443	824	9%	10,493	874	9%
PM	Car	183,801	201,751	17,950	10%	214,972	31,171	17%
	PT	24,577	27,913	3,336	14%	28,823	4,246	17%

Table 14 shows that the RTP networks have small effects on overall trips compared with the changes from 2006. In the peak periods, car and PT trips increase slightly with the RTP networks in both 2016 and 2026, while there are numerically smaller changes in the Interpeak period. The fact that trips by both car and PT increase trips in the peaks suggests that the RTP improvements result in a small number of vehicle trips retiming back into these periods compared with the Do Minimum.

- **Table 14 Private Vehicle and PT Trips – Effect of RTP**

		2016				2026			
Period	**Mode**	**Do Min Trips**	**RTP Trips**	**Diff**	**% Diff**	**Do Min Trips**	**RTP Trips**	**Diff**	**% Diff**
AM	Car	170,310	171,398	1,088	1%	181,288	182,835	1,547	1%
	PT	33,993	34,507	514	2%	34,777	35,744	967	3%
IP	Car	157,068	156,884	-184	0%	168,659	168,329	-330	0%
	PT	10,443	10,570	126	1%	10,493	10,722	229	2%
PM	Car	201,751	203,587	1,835	1%	214,972	217,202	2,230	1%
	PT	27,913	28,273	360	1%	28,823	29,599	776	3%

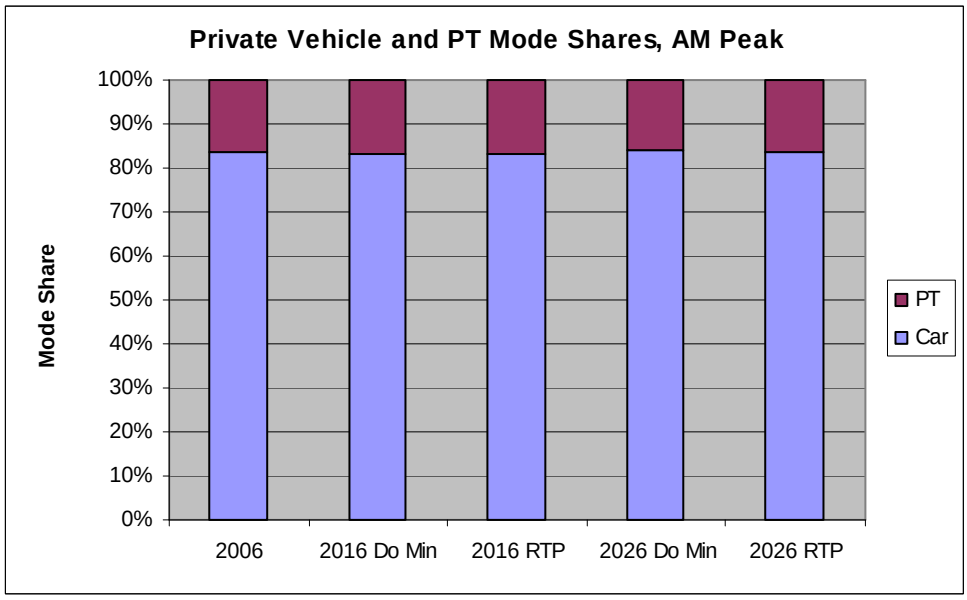
The mode shares as given in Table 15 and Figure 2 are between private vehicle (car) trips and PT trips, and do not include active modes or car passengers. The data show that any changes to the mode shares between years and the Do Minimum and RTP networks are 1% at most.

These results suggest that the RTP road and PT improvements have opposite and about equal effects in terms of mode share changes.

- **Table 15 Private Vehicle and PT Mode Shares**

Period	**Mode**	**2006**	**2016 Do Min**	**2016 RTP**	**2026 Do Min**	**2026 RTP**
AM	Car	83%	83%	83%	84%	84%
	PT	17%	17%	17%	16%	16%
IP	Car	94%	94%	94%	94%	94%
	PT	6%	6%	6%	6%	6%
PM	Car	88%	88%	88%	88%	88%
	PT	12%	12%	12%	12%	12%

- **Figure 2 AM Peak Private Vehicle and PT Mode Shares**



4.4.2 AM Peak Private Vehicle and PT Trips and Mode Shares by TA

The AM peak private vehicle and PT trips TA of origin and destination by mode and mode shares in 2006, 2016 and 2026 are presented as follows (note that the three Wairarapa TAs have been combined in this analysis):

- AM peak trips and the differences between the forecast and 2006, the forecasts being for the Do Minimum network case (Table 16 and Table 17);
- AM peak trips and the differences for the two forecast years and the Do Minimum and RTP networks (Table 18 and Table 19);
- AM peak private vehicle and PT mode shares (Table 20 and Table 21)
- AM peak PT mode shares (Figure 3 and Figure 4)
- AM peak % of intra-TA trips by origin TA by mode (Table 22)

Table 16 shows continued growth in trips from all TAs, but that the magnitude of the growth varies by TA. There is lower growth in trips from Upper Hutt, Hutt, and Porirua, and to a lesser extent Wairarapa, than from Wellington City and Kapiti. This is primarily driven by the forecast growth in population. Note that this data does not include trips from outside the region so the sum of the TA figures does not match those in Table 13 and Table 14.

PT trips from Kapiti show a very high growth rate, though the numbers are quite low in absolute terms. This is due to both the population growth in Kapiti and improvements in the rail services and infrastructure.

For destinations, Table 17, the major influence on increases in AM peak trips to each TA over 2006 will be growth in employment, and differences by mode will be associated with relative improvements to each. The low growth in PT trips to Hutt, Upper Hutt and Porirua is the most noticeable feature, though the numbers of trips are low.

- **Table 16 AM Peak Private Vehicle and PT Trips by TA Origin – Comparison with 2006**

		2006	2016 Do Min			2026 Do Min		
TA	Mode	Trips	Trips	Diff	% Diff	Trips	Diff	% Diff
Wairarapa	Car	13,598	14,908	1,310	10%	15,390	1,792	13%
	PT	618	675	57	9%	650	32	5%
Kapiti	Car	13,735	15,469	1,734	13%	16,754	3,020	22%
	PT	1,792	2,437	645	36%	2,760	968	54%
Hutt	Car	32,306	34,656	2,350	7%	36,068	3,762	12%
	PT	6,763	7,099	336	5%	6,800	37	1%
Porirua	Car	14,633	15,870	1,237	8%	16,498	1,865	13%
	PT	3,350	3,578	227	7%	3,557	207	6%
Upper Hutt	Car	12,163	13,135	971	8%	13,586	1,423	12%
	PT	2,437	2,624	187	8%	2,452	15	1%
Wellington	Car	65,769	74,530	8,761	13%	81,151	15,382	23%
	PT	15,390	17,496	2,106	14%	18,456	3,066	20%
Total	Car	152,203	168,567	16,364	11%	179,447	27,245	18%
	PT	30,350	33,908	3,558	12%	34,676	4,326	14%

- **Table 17 AM Peak Private Vehicle and PT Trips by TA Destination – Comparison with 2006**

		2006	2016 Do Min			2026 Do Min		
TA	Mode	Trips	Trips	Diff	% Diff	Trips	Diff	% Diff
Wairarapa	Car	14,039	15,477	1,438	10%	16,328	2,289	16%
	PT	407	441	34	8%	515	108	26%
Kapiti	Car	12,732	14,316	1,584	12%	15,445	2,713	21%
	PT	1,038	1,136	98	9%	1,167	129	12%
Hutt	Car	30,978	34,101	3,123	10%	35,954	4,977	16%
	PT	2,963	2,993	31	1%	2,994	31	1%
Porirua	Car	13,118	14,452	1,334	10%	15,341	2,223	17%
	PT	1,277	1,302	26	2%	1,281	4	0%
Upper Hutt	Car	10,748	11,907	1,158	11%	12,614	1,866	17%
	PT	1,095	1,123	28	3%	1,134	39	4%
Wellington	Car	70,852	78,593	7,741	11%	84,048	13,196	19%
	PT	23,626	26,992	3,366	14%	27,680	4,054	17%
Total	Car	152,466	168,845	16,379	11%	179,730	27,264	18%
	PT	30,406	33,987	3,582	12%	34,771	4,365	14%

Table 18 shows that the effect of the RTP is generally small changes to AM peak private vehicle and PT trips from each TA. The changes will be related to mode switching or to changes in the time of travel (into or out of the TAs during the AM peak period).

The larger changes include the growth in car trips from Hutt, which coincide with improvements to State Highway links into the Wellington CBD.

Trips to the TAs (Table 19) show similarly small changes.

- **Table 18 AM peak Private Vehicle and PT Trips by TA Origin - Effect of RTP**

		2016				2026			
TA	Mode	Do Min Trips	RTP Trips	Diff	% Diff	Do Min Trips	RTP Trips	Diff	% Diff
Wairarapa	Car	14,908	14,939	31	0%	15,390	15,374	-16	0%
	PT	675	658	-17	-3%	650	724	73	11%
Kapiti	Car	15,469	15,685	216	1%	16,754	16,977	223	1%
	PT	2,437	2,422	-15	-1%	2,760	2,850	89	3%
Hutt	Car	34,656	35,214	558	2%	36,068	36,592	524	1%
	PT	7,099	7,147	48	1%	6,800	6,992	192	3%
Porirua	Car	15,870	15,967	97	1%	16,498	16,686	188	1%
	PT	3,578	3,763	185	5%	3,557	3,757	199	6%
Upper Hutt	Car	13,135	13,192	57	0%	13,586	13,553	-33	0%
	PT	2,624	2,709	84	3%	2,452	2,686	234	10%
Wellington	Car	74,530	74,623	93	0%	81,151	81,767	616	1%
	PT	17,496	17,742	246	1%	18,456	18,661	205	1%
Total	Car	168,567	169,619	1,052	1%	179,447	180,949	1,502	1%
	PT	33,908	34,440	531	2%	34,676	35,669	993	3%

- **Table 19 AM peak Private Vehicle and PT Trips by TA Destination - Effect of RTP**

		2016				2026			
TA	Mode	Do Min Trips	RTP Trips	Diff	% Diff	Do Min Trips	RTP Trips	Diff	% Diff
Wairarapa	Car	15,477	15,492	15	0%	16,328	16,255	-73	0%
	PT	441	437	-4	-1%	515	679	164	32%
Kapiti	Car	14,316	14,281	-35	0%	15,445	15,382	-63	0%
	PT	1,136	1,203	67	6%	1,167	1,277	110	9%
Hutt	Car	34,101	34,125	24	0%	35,954	36,212	258	1%
	PT	2,993	3,116	123	4%	2,994	3,144	151	5%
Porirua	Car	14,452	14,624	172	1%	15,341	15,523	182	1%
	PT	1,302	1,373	70	5%	1,281	1,387	106	8%
Upper Hutt	Car	11,907	11,907	0	0%	12,614	12,655	41	0%
	PT	1,123	1,158	35	3%	1,134	1,189	55	5%
Wellington	Car	78,593	79,506	913	1%	84,048	85,251	1,203	1%
	PT	26,992	27,215	223	1%	27,680	28,062	382	1%
Total	Car	168,845	169,934	1,089	1%	179,730	181,279	1,548	1%
	PT	33,987	34,501	514	2%	34,771	35,738	967	3%

The changes in AM peak mode shares are small for trips both from TAs (Table 20, Figure 3), and to TAs (Table 21, Figure 4). As noted previously for regional results, this suggests that regionally the RTP road and PT improvements have opposite and about equal effects in terms of mode share changes.

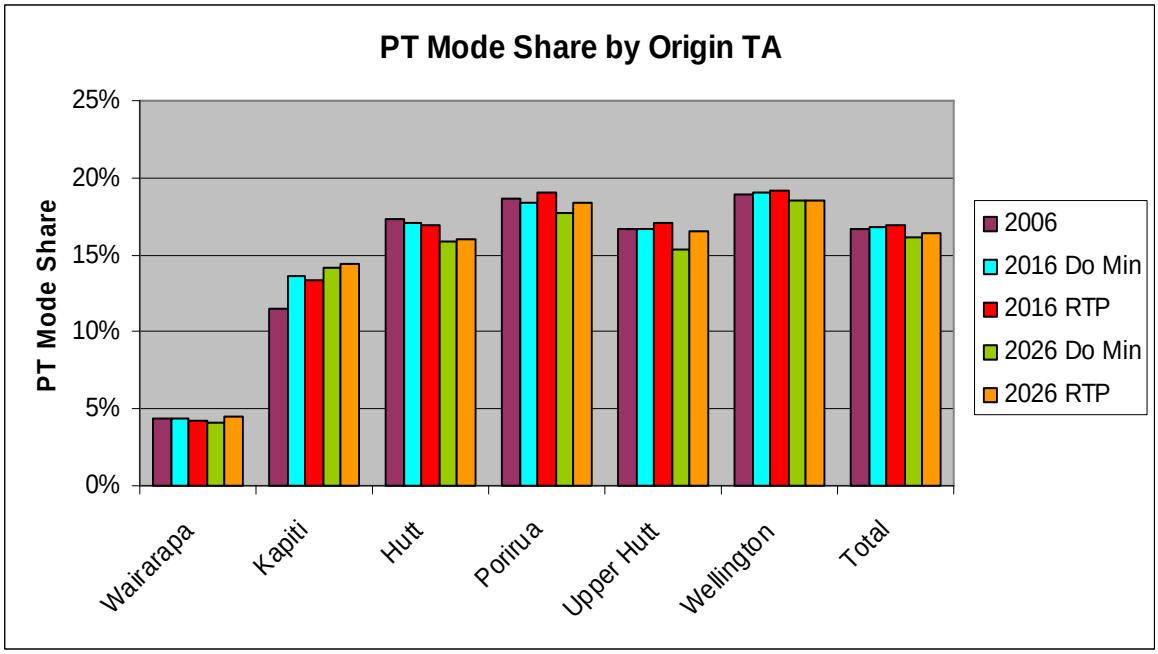
- **Table 20 AM Peak Private Vehicle and PT Mode Shares by TA Origin**

TA	Mode	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Wairarapa	Car	96%	96%	96%	96%	96%
	PT	4%	4%	4%	4%	4%
Kapiti	Car	88%	86%	87%	86%	86%
	PT	12%	14%	13%	14%	14%
Hutt	Car	83%	83%	83%	84%	84%
	PT	17%	17%	17%	16%	16%
Porirua	Car	81%	82%	81%	82%	82%
	PT	19%	18%	19%	18%	18%
Upper Hutt	Car	83%	83%	83%	85%	83%
	PT	17%	17%	17%	15%	17%
Wellington	Car	81%	81%	81%	81%	81%
	PT	19%	19%	19%	19%	19%
Total	Car	83%	83%	83%	84%	84%
	PT	17%	17%	17%	16%	16%

- **Table 21 AM Peak Private Vehicle and PT Mode Shares by TA Destination**

TA	Mode	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Wairarapa	Car	97%	97%	97%	97%	96%
	PT	3%	3%	3%	3%	4%
Kapiti	Car	92%	93%	92%	93%	92%
	PT	8%	7%	8%	7%	8%
Hutt	Car	91%	92%	92%	92%	92%
	PT	9%	8%	8%	8%	8%
Porirua	Car	91%	92%	91%	92%	92%
	PT	9%	8%	9%	8%	8%
Upper Hutt	Car	91%	91%	91%	92%	91%
	PT	9%	9%	9%	8%	9%
Wellington	Car	75%	74%	74%	75%	75%
	PT	25%	26%	26%	25%	25%
Total	Car	83%	83%	83%	84%	84%
	PT	17%	17%	17%	16%	16%

- **Figure 3 AM Peak Private Vehicle and PT Mode Shares by Origin TA**



- **Figure 4 AM Peak Private Vehicle and PT Mode Shares by Destination TA**

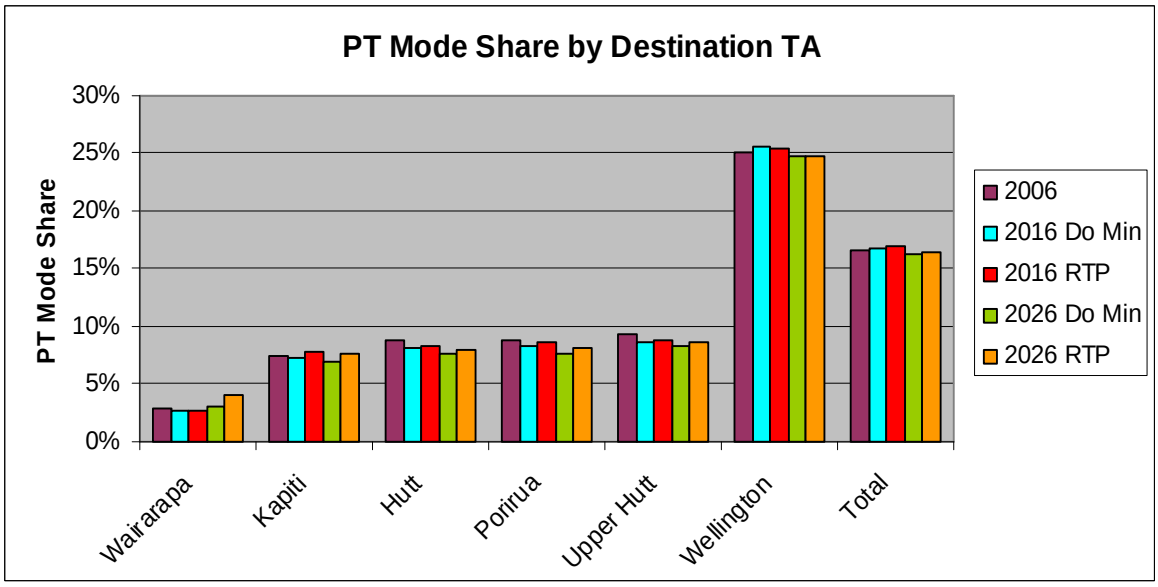


Table 22 gives the percentage of AM peak trips that remain within each TA as a proportion of the total trips from each. Generally the car proportions are higher than for PT, the exception being Wellington City. This is not unexpected given that it is for the AM peak where PT usage is dominated by commuting trips and relatively high rail usage for longer trips. The proportion of PT trips within Kapiti reduces from 2006 to 2016 due to improvements to the rail services and rolling stock. To a lesser extent this also occurs for PT trips from Wairarapa Hutt, and Porirua.

- **Table 22 Percentage of AM Peak Private Vehicle and PT Intra-TA Trips by TA Origin**

TA	Mode	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Wairarapa	Car	80%	80%	80%	81%	81%
	PT	34%	29%	27%	29%	25%
Kapiti	Car	78%	79%	76%	79%	77%
	PT	42%	32%	34%	29%	30%
Hutt	Car	74%	74%	71%	75%	72%
	PT	26%	24%	24%	25%	23%
Porirua	Car	62%	62%	61%	63%	61%
	PT	27%	24%	22%	23%	21%
Upper Hutt	Car	66%	66%	65%	67%	66%
	PT	5%	5%	4%	4%	4%
Wellington	Car	38%	39%	43%	40%	39%
	PT	48%	49%	48%	50%	48%
Total	Car	79%	79%	78%	80%	78%
	PT	64%	62%	61%	63%	61%

4.4.3 Commuting Trips by Mode and Mode Shares

The daily commuting trips by mode for 2006, 2016 and 2026 are presented as follows:

- trips and the differences between the forecast and 2006, the forecasts being for the Do Minimum network case (Table 23);
- trips and the differences for the two forecast years and the Do Minimum and RTP networks, with the differences between the two networks (Table 24);
- trips for each year and both networks (Figure 5);
- commuting mode shares (Table 25 and Figure 6).

Table 23 shows that commuting by car increases more than PT in both absolute and percentage terms, though the percentage increases are quite similar. This will be related to all the key drivers of travel, but particularly increasing car ownership over time and to how the relative costs of travel by car and PT change.

Active mode commuting trips increase at a lower rate than car or PT, which reflects increasing car ownership, and the wider spread of population and employment growth resulting in longer trips being made.

- **Table 23 Daily Commuting Trips by Mode – Comparison with 2006**

	2006	2016 Do Min			2026 Do Min		
Mode	Trips	Trips	Diff	% Diff	Trips	Diff	% Diff
Car	209,939	244,647	34,707	17%	262,305	52,365	25%
PT	48,679	54,326	5,647	12%	56,543	7,864	16%
Active	27,014	29,225	2,211	8%	28,474	1,459	5%
Total	285,632	328,197	42,565	15%	347,321	61,689	22%

Table 24 and Figure 5 show that the effects of the RTP on overall commuting trips by mode are small. The change in car trips is insignificant percentage wise, while PT trips increase slightly and active mode trips decrease similarly. As noted above the location of population and employment growth results in a trend of some longer commuting trips and slightly less commuting by active modes.

- **Table 24 Daily Commuting Trips by Mode – Effect of RTP**

	2016				2026			
Mode	Do Min Trips	RTP Trips	Diff	% Diff	Do Min Trips	RTP Trips	Diff	% Diff
Car	244,647	244,491	-156	0%	262,305	261,232	-1,073	0%
PT	54,326	55,021	695	1%	56,543	58,215	1,672	3%

Active	29,225	28,683	-541	-2%	28,474	27,861	-613	-2%

- **Figure 5 Daily Commuting Trips by Mode**

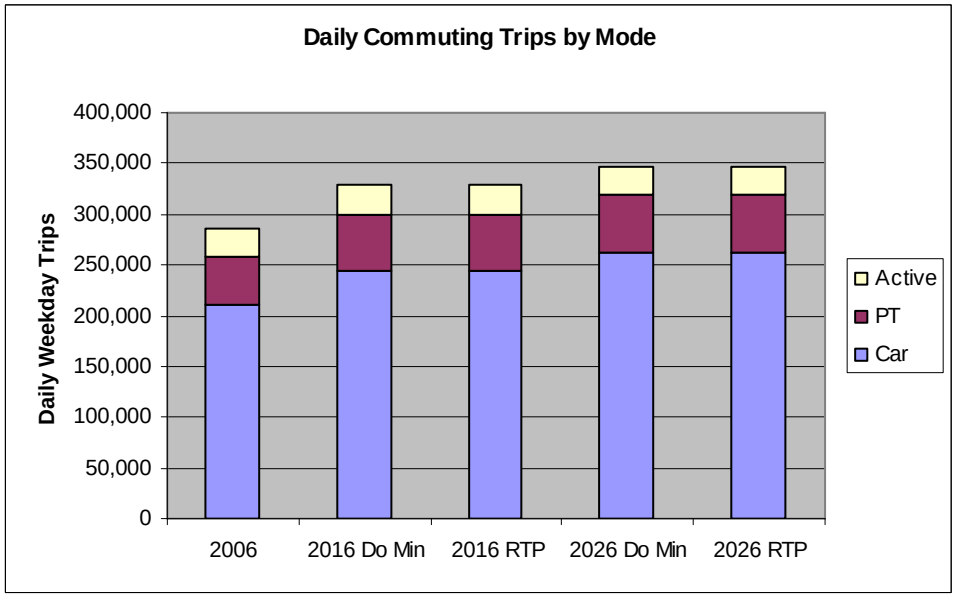
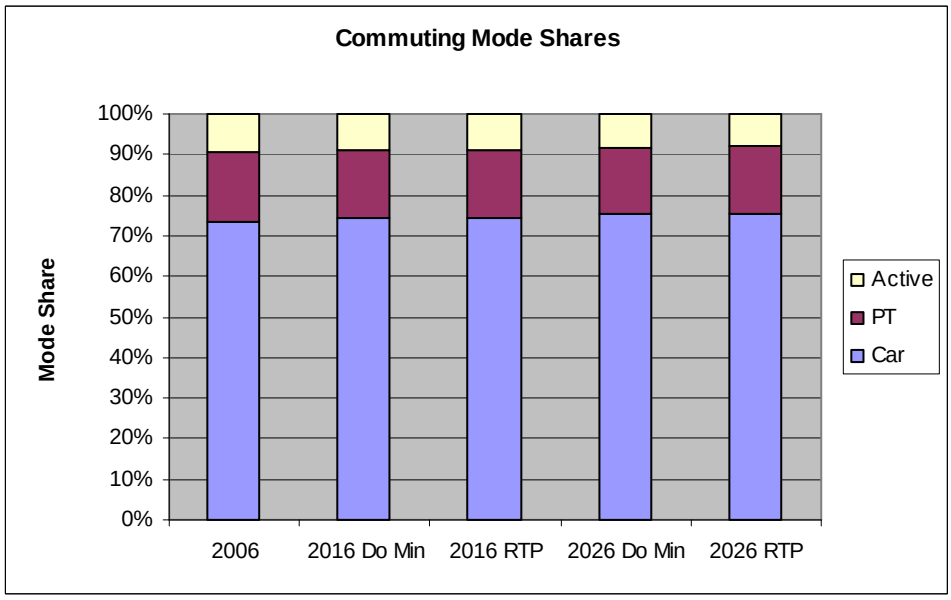


Table 25 and Figure 6 show that, similar to the above results, there are small changes in mode shares for commuting trips between 2006 and the forecasts. Note that these are rounded so may not sum to 100% in the table. The RTP results in little change in PT mode share, which suggests that the network improvements in the RTP have similarly counteracting effects for car and PT. The active mode share declines slightly which corresponds with the small reduction in active mode trips noted above.

- **Table 25 Daily Commuting Mode Shares**

Mode	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Car	73%	75%	74%	76%	75%
PT	17%	17%	17%	16%	17%
Active	9%	9%	9%	8%	8%

- **Figure 6 Daily Commuting Mode Shares**



4.4.4 AM Peak Trips to the CBD by Mode and Mode Shares

The AM peak private vehicle and PT trips to the Wellington CBD from each TA by mode and mode shares are presented as follows:

- Trips and the differences between the forecast and 2006, the forecasts being for the Do Minimum network case (Table 26);
- Trips and the differences for the two forecast years and the Do Minimum and RTP networks, with the differences between the two networks (Table 27);
- Private vehicle and PT mode shares (Table 28);
- PT mode shares (Figure 7).

Table 26 shows that AM peak trips to the Wellington CBD generally increase by both car and PT, which is a reflection of ongoing growth in CBD employment (though this is at the same rate as the region as a whole). The largest absolute increases are from within Wellington City, which is a reflection of continued growth within the City, including a higher rate within the CBD itself (though the absolute numbers are low).

The increases are greater for PT than car, which is a reflection of the rail improvements that are included in the Do Minimum and the increased road congestion in accessing the CBD. Some of the

PT increases are high percentage-wise – with Kapiti the most notable - but involve low trip numbers.

- **Table 26 AM Peak Private Vehicle and PT Trips to Wellington CBD by TA Origin – Comparison with 2006**

		2006	2016 Do Min			2026 Do Min		
Period	**Mode**	**Trips**	**Trips**	**Diff**	**% Diff**	**Trips**	**Diff**	**% Diff**
Wairarapa	Car	25	27	2	7%	19	-7	-26%
	PT	59	89	29	50%	53	-6	-11%
Kapiti	Car	453	458	4	1%	449	-5	-1%
	PT	853	1,351	498	58%	1,593	740	87%
Hutt	Car	2,804	2,845	41	1%	2,769	-36	-1%
	PT	3,148	3,462	313	10%	3,293	145	5%
Porirua	Car	1,556	1,635	79	5%	1,593	37	2%
	PT	1,638	1,904	266	16%	1,959	321	20%
Upper Hutt	Car	702	698	-4	-1%	627	-75	-11%
	PT	969	1,133	164	17%	1,007	38	4%
Wellington	Car	20,653	23,313	2,660	13%	25,011	4,358	21%
	PT	8,593	10,002	1,409	16%	10,829	2,236	26%
Total	Car	26,194	28,975	2,781	11%	30,467	4,273	16%
	PT	15,260	17,940	2,680	18%	18,734	3,474	23%

Table 27 shows changes in trips to the CBD of up to 16% as a result of the RTP, but the trip numbers in these cases are low. This, as with other results, is a reflection of improvements in both roading and PT, which have opposite effects in terms of trips by each mode.

The largest change in trip numbers occurs with those from Hutt (2006 to 2026) where car trips increase by some 325. This will be related to the improved roading accessibility arising from improvements to SH1 and SH2.

- **Table 27 AM Private Vehicle & PT Trips to Wellington CBD by TA Origin – Effect of RTP**

		2016				2026			
TA	Mode	Do Min Trips	RTP Trips	Diff	% Diff	Do Min Trips	RTP Trips	Diff	% Diff
Wairarapa	Car	27	30	3	12%	19	22	3	16%
	PT	89	85	-4	-4%	53	58	5	10%
Kapiti	Car	458	513	55	12%	449	518	69	15%
	PT	1,351	1,255	-96	-7%	1,593	1,555	-38	-2%
Hutt	Car	2,845	3,180	335	12%	2,769	3,094	325	12%
	PT	3,462	3,474	13	0%	3,293	3,402	108	3%
Porirua	Car	1,635	1,662	27	2%	1,593	1,639	46	3%
	PT	1,904	2,009	105	6%	1,959	2,058	99	5%
Upper Hutt	Car	698	785	87	12%	627	720	93	15%
	PT	1,133	1,197	64	6%	1,007	1,152	144	14%
Wellington	Car	23,313	23,272	-41	0%	25,011	25,058	47	0%
	PT	10,002	9,877	-125	-1%	10,829	10,591	-238	-2%
Total	Car	28,975	29,442	466	2%	30,467	31,050	583	2%
	PT	17,940	17,897	-43	0%	18,734	18,816	81	0%

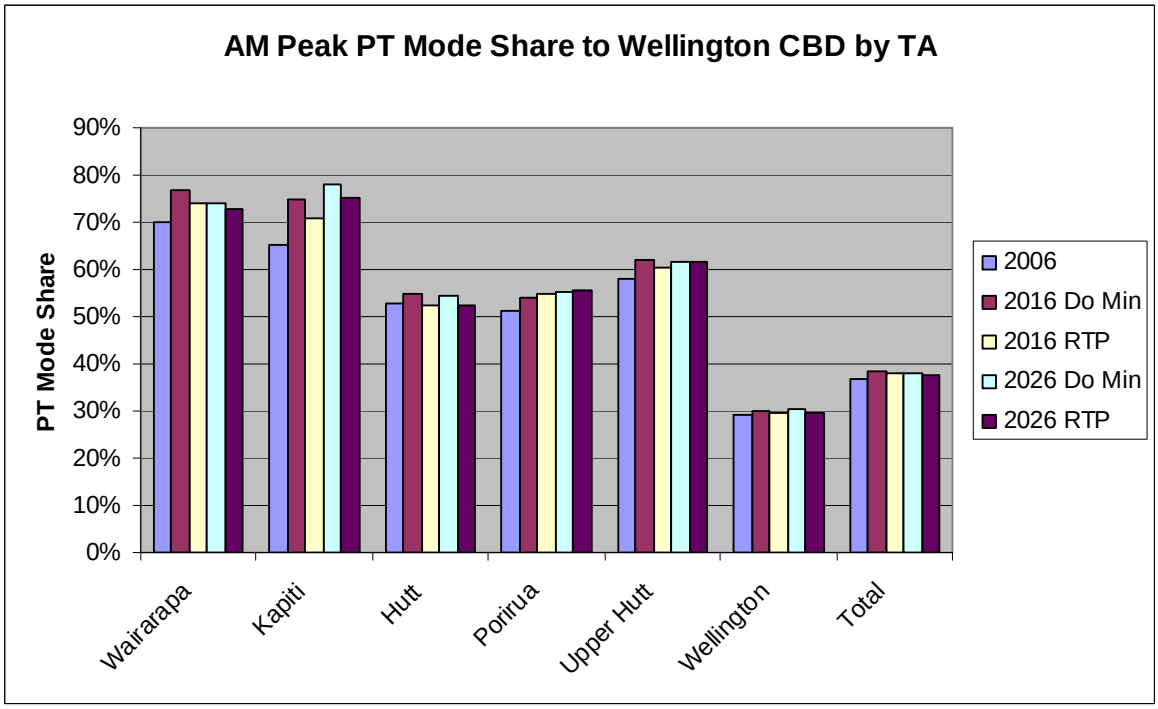
Table 28 and Figure 7 show that there are generally only small changes in car and PT mode shares from the TAs closer to the CBD (Hutt, Porirua, Wellington), and more significant changes from the outlying TAs particularly Wairarapa and Kapiti. In these cases the PT mode shares increase in the forecasts, but not with the RTP network compared to the Do Minimum.

PT mode shares for trips from Hutt and Upper Hutt generally decrease by 1-3% between the Do Minimum and the RTP networks, which will be related to the road network improvements on SH1 and SH2.

- **Table 28 AM Peak Private Vehicle and PT Mode Shares to Wellington CBD by TA Origin**

Period	Mode	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Wairarapa	Car	30%	23%	26%	26%	27%
	PT	70%	77%	74%	74%	73%
Kapiti	Car	35%	25%	29%	22%	25%
	PT	65%	75%	71%	78%	75%
Hutt	Car	47%	45%	48%	46%	48%
	PT	53%	55%	52%	54%	52%
Porirua	Car	49%	46%	45%	45%	44%
	PT	51%	54%	55%	55%	56%
Upper Hutt	Car	42%	38%	40%	38%	38%
	PT	58%	62%	60%	62%	62%
Wellington	Car	71%	70%	70%	70%	70%
	PT	29%	30%	30%	30%	30%
Total	Car	63%	62%	62%	62%	62%
	PT	37%	38%	38%	38%	38%

- **Figure 7 AM Peak Private Vehicle and PT Mode Shares to Wellington CBD by TA**



4.5 HCV Trips

This section presents data on HCV trips; in doing so it is important to understand that these trips are modelled as a fixed demand matrix in a particular year, that is, they do not vary with changes to the transport system, such as the Do Minimum and RTP networks.

4.5.1 HCV Trips by Period

Table 29 gives total HCV trips by period in 2006 and the two forecast years and Figure 8 shows the Interpeak 2-hour average HCV trips graphically.

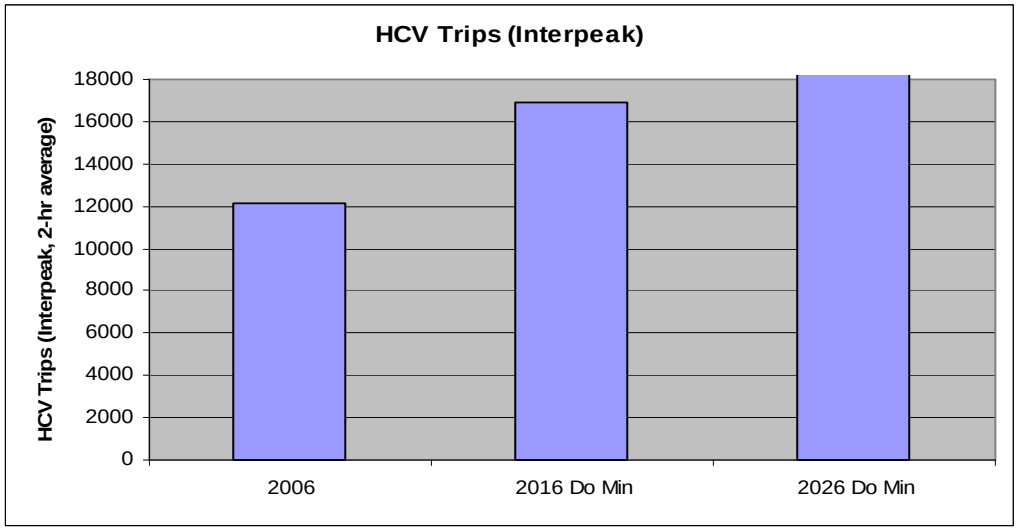
These show that HCV trips increase uniformly from 2006 to 2026 in all three modelled periods to be 85% higher by 2026. In contrast person trips and private vehicle (car) trips are forecast to increase by 15% and around 18% respectively over the same time. The growth in HCV trips is generated not only by demographic growth, particularly employment, but also but growth in the economy.

Employment is forecast to grow by 21% between 2006 and 2026, while growth in the economy is measured in terms of the Gross Domestic Product (GDP) per capita which is assumed to increase at 1.8% per annum (refer to Section 3.2).

- **Table 29 HCV Trips by Period – Comparison with 2006**

	2006	2016 Do Min		2026 Do Min	
Period	Trips	Trips	% Diff	Trips	% Diff
AM	12,108	16,918	40%	22,353	85%
IP	12,155	16,980	40%	22,438	85%
PM	10,516	14,710	40%	19,448	85%

- **Figure 8 HCV Trips, Interpeak 2-hour Average**



4.5.2 HCV Trips by TA

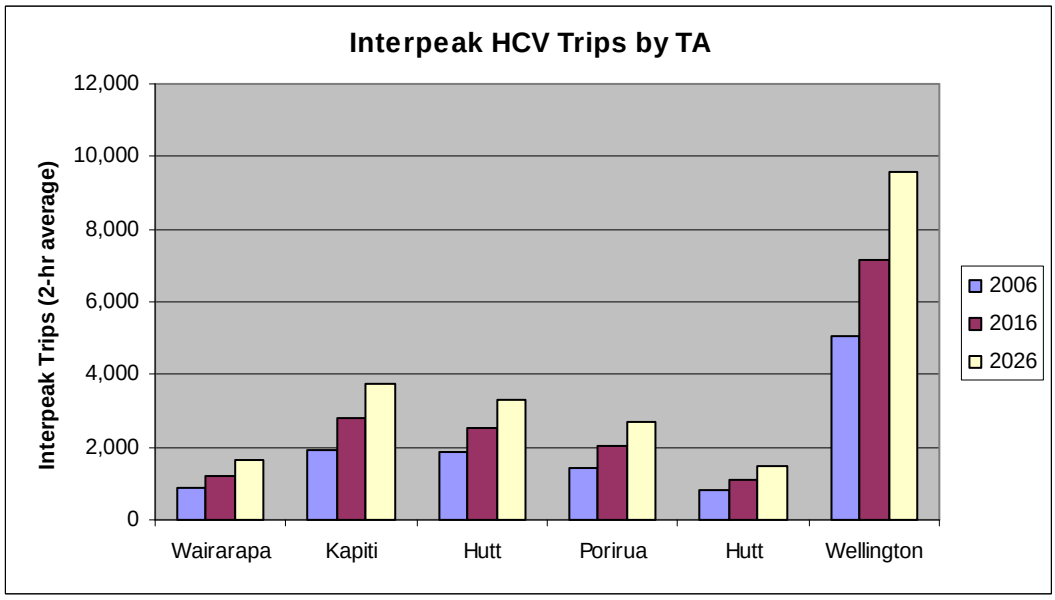
Table 30 gives the Interpeak HCV trips by TA of origin in 2006 and the two forecast years and Figure 9 shows this graphically.

The growth in HCV trips is fairly evenly spread reflecting the even spread in employment growth generally (refer to Section 2.3) and in the type of employment. Kapiti has a slightly higher growth rate (91% by 2026) and Hutt a lower rate (78%).

- **Table 30 Interpeak HCV Trips by TA Origin – Comparison with 2006**

	2006	2016 Do Min		2026 Do Min	
TA	Trips	Trips	% Diff	Trips	% Diff
Wairarapa	883	1,217	38%	1,626	84%
Kapiti	1,950	2,781	43%	3,723	91%
Hutt	1,862	2,541	37%	3,311	78%
Porirua	1,458	2,039	40%	2,692	85%
Upper Hutt	806	1,090	35%	1,483	84%
Wellington	5,067	7,134	41%	9,604	90%

- **Figure 9 HCV Trips by TA Origin, Interpeak 2-hour Average**



4.6 Road Network Statistics

4.6.1 Network Statistics

Road network statistics for 2006, 2016 and 2026 are given as:

- Private vehicle trips, that is all trips by light vehicle (excluding HCVs),
- The amount of vehicle travel on the network, vehicle-kilometres (vkt),
- The network travel time, vehicle-minutes (veh-min),
- Average travel distance, time, and speed.

They are presented as follows:

- Statistics for each year and the differences between the forecast and 2006, the forecasts being for the Do Minimum network case (Table 31);
- Statistics for the two forecast years and the Do Minimum and RTP networks, with the differences between the two networks (Table 32);
- In graphical form for each year and both networks; AM peak vehicle-km, vehicle-min, and average speed (Figure 10).

Table 31 shows that network travel (vkt) and travel time (veh-min) by private vehicle (car) increase in all modelled time periods between 2006 and 2016 and 2026. There is a greater increase in travel time than vkt in the peak periods, which is reflected in lower average speeds, and suggests increasing peak period congestion.

This also occurs in the Interpeak period but to a lesser extent; the Interpeak average speed declines by 2% by 2026 compared with 14% and 11% in the two peak periods.

The average trip distances change only slightly in all cases

- **Table 31 Road Network Statistics – Comparison with 2006**

	2006	2016 Do Min			2026 Do Min		
Statistics	**Value**	**Value**	**Diff**	**% Diff**	**Value**	**Diff**	**% Diff**
AM							
Car Trips	153,770	170,310	16,539	11%	181,288	27,517	18%
Veh-min	1,780,159	2,121,504	341,344	19%	2,418,496	638,337	36%
Veh-km	1,402,603	1,542,847	140,244	10%	1,645,911	243,308	17%
Av Time (min)	11.6	12.5	0.9	8%	13.3	1.8	15%
Av Distance (km)	9.1	9.1	-0.1	-1%	9.1	0.0	0%
Av Speed (kph)	47.3	43.6	-3.6	-8%	40.8	-6.4	-14%
IP							
Car Trips	142,565	157,068	14,503	10%	168,659	26,093	18%
Veh-min	1,140,417	1,286,353	145,937	13%	1,425,268	284,852	25%
Veh-km	1,023,242	1,140,352	117,110	11%	1,247,456	224,214	22%
Av Time (min)	8.0	8.2	0.2	2%	8.5	0.5	6%
Av Distance (km)	7.2	7.3	0.1	1%	7.4	0.2	3%
Av Speed (kph)	53.8	53.2	-0.6	-1%	52.5	-1.3	-2%

PM							
Car Trips	183,801	201,751	17,950	10%	214,972	31,171	17%
Veh-min	1,918,033	2,209,432	291,400	15%	2,529,926	611,893	32%
Veh-km	1,522,713	1,672,317	149,604	10%	1,787,302	264,589	17%
Av Time (min)	11.6	12.5	0.9	8%	13.3	1.8	15%
Av Distance (km)	8.3	8.3	0.0	0%	8.3	0.0	0%
Av Speed (kph)	47.6	45.4	-2.2	-5%	42.4	-5.2	-11%

Table 32 shows that the effect of the RTP (that is the network improvements) is a reduction in network travel time and an increase in average speed in both 2016 and 2026. As expected, this occurs to a greater extent in the peaks than the Interpeak.

With the RPT the average speeds in 2016 are similar to those in 2006, but this is not maintained in 2026 in the peak periods. By then the average peak period speeds are 1-2 kph lower than in 2006. The average differences will be seen as large increases in some locations and little change in others

The RTP also causes some increase in the amount of private vehicle (car) travel, which arises from increases in both trips and the average distance travelled.

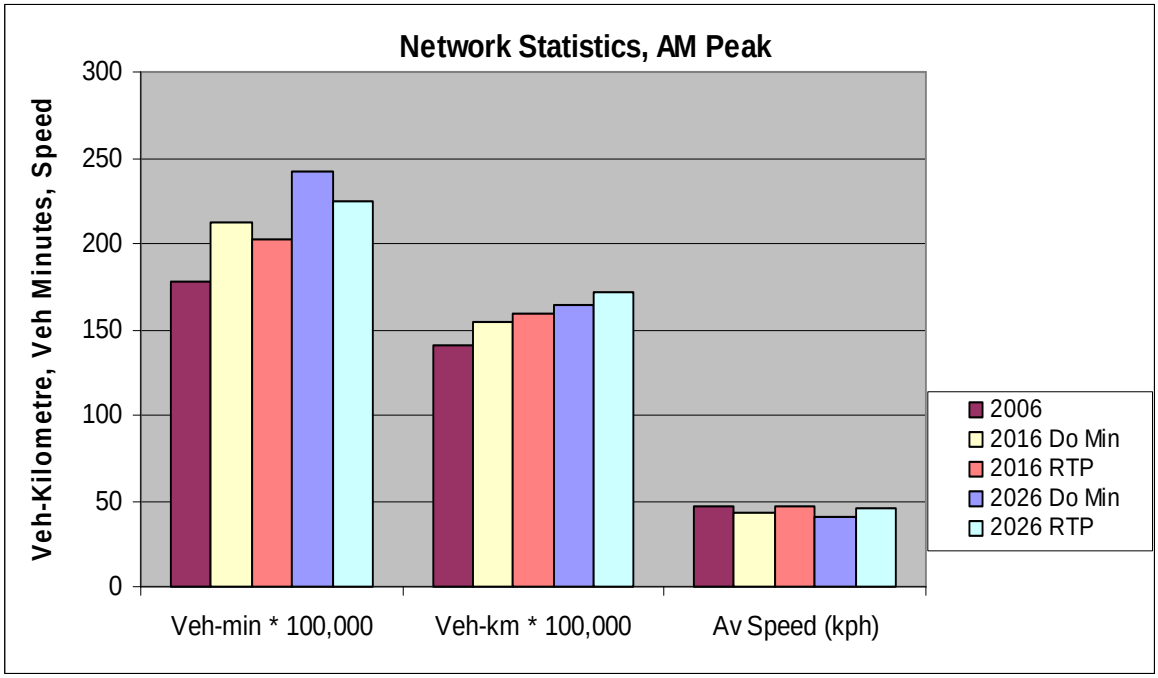
- **Table 32 Network Statistics – Effect of RTP**

	2016				2026			
Statistics	**Do Min**	**RTP**	**Diff**	**% Diff**	**Do Min**	**RTP**	**Diff**	**% Diff**
AM								
Car Trips	170,310	171,398	1,088	1%	181,288	182,835	1,547	1%
Veh-min	2,121,504	2,025,969	-95,534	-5%	2,418,496	2,245,459	-173,037	-7%
Veh-km	1,542,847	1,598,503	55,656	4%	1,645,911	1,713,523	67,612	4%
Av Time (min)	12.5	11.8	-0.6	-5%	13.3	12.3	-1.1	-8%
Av Distance (km)	9.1	9.3	0.3	3%	9.1	9.4	0.3	3%
Av Speed (kph)	43.6	47.3	3.7	8%	40.8	45.8	5.0	12%
IP								
Car Trips	157,068	156,884	-184	0%	168,659	168,329	-330	0%
Veh-min	1,286,353	1,286,711	358	0%	1,425,268	1,425,945	676	0%
Veh-km	1,140,352	1,153,590	13,238	1%	1,247,456	1,262,486	15,030	1%
Av Time (min)	8.2	8.2	0.0	0%	8.5	8.5	0.0	0%
Av Distance (km)	7.3	7.4	0.1	1%	7.4	7.5	0.1	1%
Av Speed (kph)	53.2	53.8	0.6	1%	52.5	53.1	0.6	1%
PM								

Car Trips	201,751	203,587	1,835	1%	214,972	217,202	2,230	1%
Veh-min	2,209,432	2,137,314	-72,118	-3%	2,529,926	2,418,011	-111,916	-4%
Veh-km	1,672,317	1,746,112	73,795	4%	1,787,302	1,876,618	89,316	5%
Av Time (min)	12.5	11.8	-0.6	-5%	13.3	12.3	-1.1	-8%
Av Distance (km)	8.3	8.6	0.3	3%	8.3	8.6	0.3	4%
Av Speed (kph)	45.4	49.0	3.6	8%	42.4	46.6	4.2	10%

Figure 10 shows graphically the changes in AM peak private vehicle network travel (veh-km), travel time (veh-min) and average speed between 2006 and the forecast years and networks. The reduction in travel time and increase in average speed due to the RTP is evident, as is the small increase in the amount of travel (veh-km).

- **Figure 10 Network Statistics, AM Peak**



4.6.2 Traffic Volumes Across Screenlines

Traffic volumes across the screenlines used in model validation have been extracted from the models and compared.

Figure 11 shows the location of the screenlines and Appendix E lists:

- those for 2006 and the 2016 and 2026 forecasts with the Do Minimum network, and
- shows the effect of the RTP.

The first table in Appendix E shows that, in forecasting, the traffic volumes increase across all screenlines in all three modelled time periods. The magnitude and rate of growth varies; some of the largest increases occur across the Wellington CBD screenline (W1) in all three modelled periods. The growth across most screenlines is around 20-30% in 2026, but some have markedly lower increases.

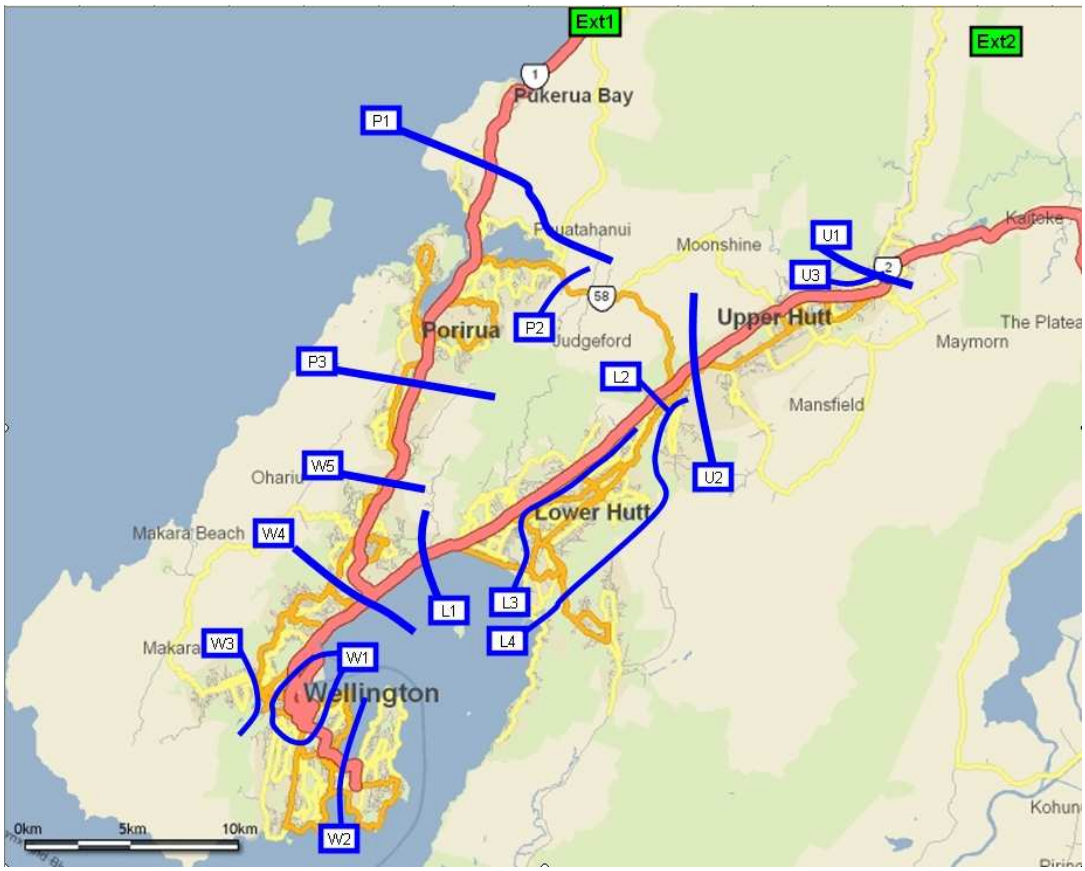
W4 (south of Ngauranga) and L1 (SH2 north of Ngauranga) have low growth in the peak directions, for example 3-5% in the AM peak southbound in 2026. The other Hutt corridor screenlines (L2, L3, L4, and U2) also have lower growth in the peak directions, though not noticeably so.

The lowest growth in the western corridor in on screenline P1 (north of Plimmerton) with less than 20% growth by 2026.

As shown by results in the second table in Appendix E, the effects of the RTP networks on screenline traffic flows are, in most cases, small in either absolute or relative terms. The most significant changes are:

- Increased flows across W4 (south of Ngauranga) in the peak direction – which will be related to the additional capacity provided in this corridor,
- Decreased flows across L1 (SH2 north of Ngauranga) and W5 (SH1 north of Ngauranga) – which will be related to the Petone-Grenada-Gracefield links taking trips off the existing motorways via Ngauranga,
- Increased flows across P1 (north of Plimmerton) which is due to the additional demands generated by Transmission Gully.

- **Figure 11 Screenlines**



4.6.3 Travel Times

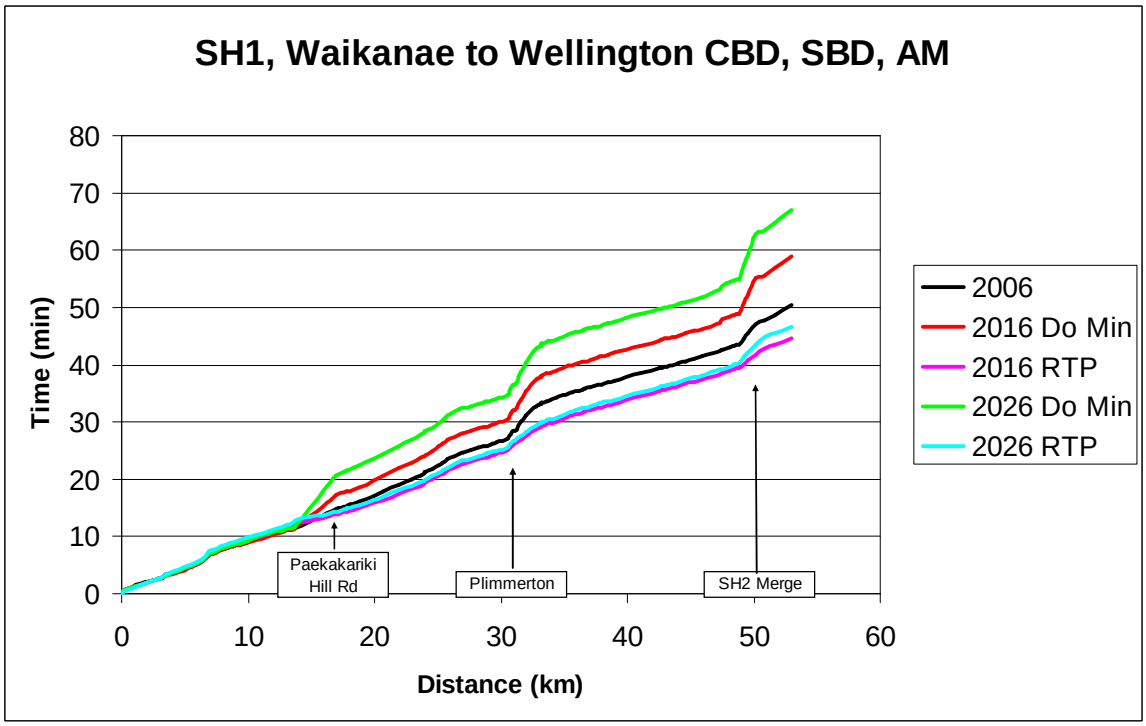
The cumulative travel times on SH1 (Waikanae to Wellington CBD) and SH2 (Upper Hutt to Wellington CBD) southbound in the AM peak for 2006 and the forecast years (Do Minimum and RTP) are shown in Figure 12 and Figure 13 respectively.

On the existing SH1:

- All forecasts show similar travel time to 2006 until about 15 km (just north Paekakariki Hill Road), at which point the Do Minimum networks, and in 2026 particularly, have higher times than in 2006 and the RTP networks.
- The forecast Do Minimum travel times are then higher than 2006 for the rest of the route, so that by the Terrace Tunnel the 2016 time is 8 minutes higher and the 2026 time is 16 minutes higher.
- With the RTP forecasts, on the other hand, the travel times from 15 km to the end of the route are lower than in 2006; 7 minutes in 2016 and 5 minutes in 2026. This is not due to

improved time at specific points only, but is a result of continuously improved times along the route including the effects of Transmission Gully and the Petone-Grenada link.

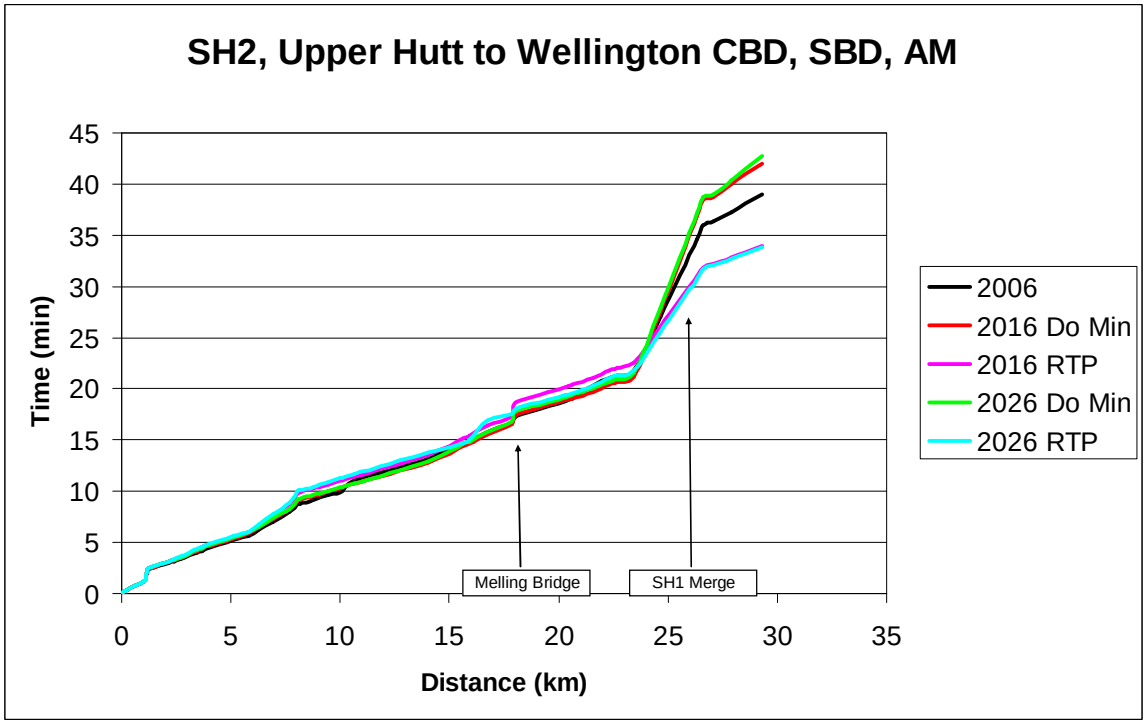
- **Figure 12 Travel Time, SH1, Waikanae to Wellington , Southbound, AM Peak**



On SH2:

- The travel times between the start of the route at Upper Hutt to about 24km, between Petone and Ngauranga, are similar with the cumulative forecast times within a minute of that in 2006;
- At this point the forecast Do Minimum travel times become slightly higher than for 2006, so that at the Ngauranga merge there is between 2 and 3 minutes difference in cumulative time between the 2016 and 2026 Do Minimum and 2006;
- The forecast RTP cases in 2016 and 2026 are lower than that in 2006, so that at the Ngauranga merge they are around 4 minutes better than in 2006. This will be the impact of capacity improvements on SH1 through Ngauranga and the Petone Grenada link.

- **Figure 13 Travel Time, SH2, Upper Hutt to Wellington , Southbound, AM Peak**



4.7 Congestion Points

Information on congestion points in the network are given in two ways:

- Volume-to-capacity ratios at identified key congestion points
- Plots of level of service (LOS).

Key congestion points have been identified in the 2006 network measured in terms of volume to capacity ratio. In some cases these show up in the model as extending over some distance, and the location presented below is representative of the wider congestion point.

The volume-to-capacity ratio at these sites has also been determined for each of the forecasts as given in Table 33 and shown in Figure 14.

These show that the RTP results in a marked improvement:

- at the Terrace Tunnel - due to tidal flow arrangement, and
- on SH1 in the vicinity of Mana – which will be due to the traffic taken off SH1 by Transmission Gully

In other locations there is little or no improvement in congestion level:

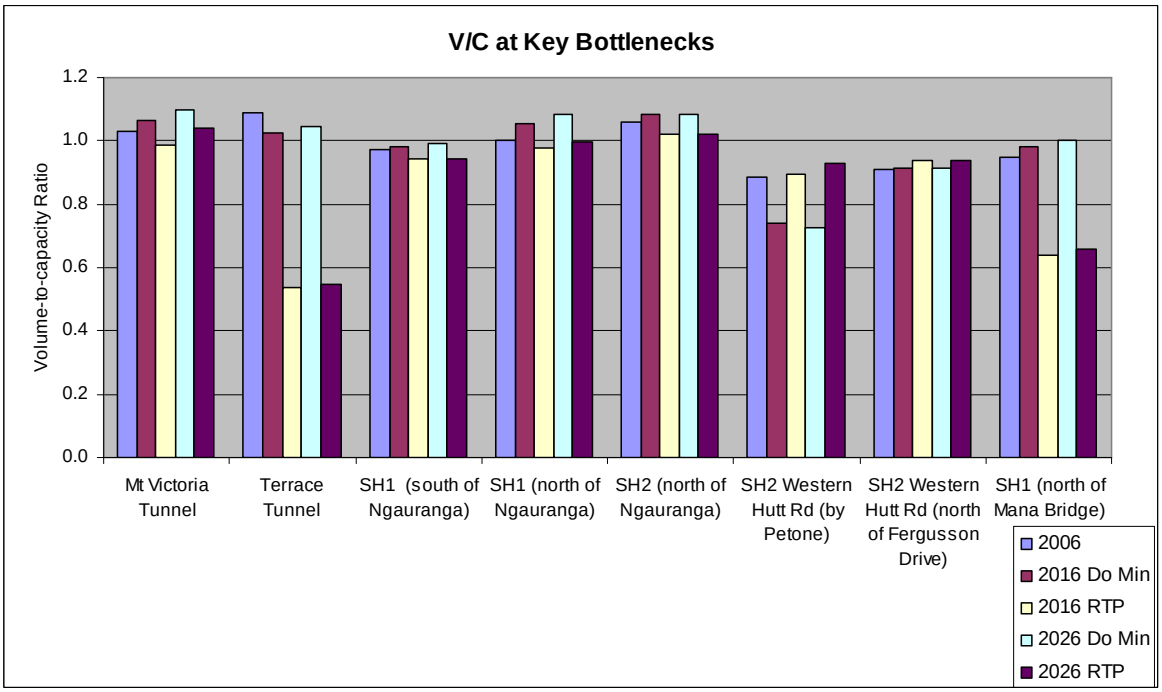
- the effect of the additional lane on SH1 south of Ngauranga is small as the extra capacity gives rise to higher traffic volumes (refer to Appendix E), and
- there is little change on Mt Victoria Tunnel as the RTP does not include any roading schemes to address this congestion point.

SH2 by Petone becomes worse with the RTP due to increased volumes as a result of improvements in the corridor.

Table 33 Volume-to-capacity Ratios at Key Bottlenecks, AM Peak

	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Mt Victoria Tunnel	1.0	1.1	1.0	1.1	1.0
Terrace Tunnel	1.1	1.0	0.5	1.0	0.5
SH1 (south of Ngauranga)	1.0	1.0	0.9	1.0	0.9
SH1 (north of Ngauranga)	1.0	1.1	1.0	1.1	1.0
SH2 (north of Ngauranga)	1.1	1.1	1.0	1.1	1.0
SH2 Western Hutt Rd (by Petone)	0.9	0.7	0.9	0.7	0.9
SH2 Western Hutt Rd (north of Fergusson Drive)	0.9	0.9	0.9	0.9	0.9
SH1 (north of Mana Bridge)	0.9	1.0	0.6	1.0	0.7

- **Figure 14 Volume-to-capacity Ratios at Key Bottlenecks, AM Peak**



The level of service (LOS) has been determined for each link in the network, and then grouped into three categories:

- LOS A or B (free flow conditions, corresponding to volume-to-capacity ratio of < 0.40)
- LOS C or D (interrupted conditions corresponding to volume-to-capacity ratio between 0.40 and 0.80)
- LOS E or F (congested conditions corresponding to volume-to-capacity ratio of >0.80)

Plots of the network showing these three categories are given in Appendix E. Three plots are given for each year/network showing the CBD and surrounds, the Ngauranga-Petone area, and Porirua-Kapiti-Hutt.

4.8 PT Boardings

Table 34 gives total bus boardings, rail boardings by line, and rail alightings at Wellington Station in 2006 and the Do Minimum forecasts, and Table 35 gives the forecasts and shows the effect of the RTP.

- **Table 34 PT Boardings - Difference with 2006**

	2006	2016 Do Min	% Diff	2026 Do Min	% Diff
Bus Boardings					
AM	19,719	20,758	5%	20,466	4%
IP	6,229	6,385	2%	6,207	0%
PM	13,871	14,724	6%	14,540	5%
Rail Boardings					
AM					
Johnsonville	1,710	2,533	48%	3,155	85%
Hutt	5,843	6,831	17%	6,698	15%
Western	4,952	6,522	32%	7,065	43%
Total	12,505	15,886	27%	16,918	35%
IP					
Johnsonville	411	525	28%	561	36%
Hutt	832	1,029	24%	1,053	27%
Western	1,178	1,417	20%	1,444	23%
Total	2,421	2,971	23%	3,058	26%
PM					
Johnsonville	1,258	1,681	34%	1,912	52%
Hutt	3,933	5,348	36%	5,541	41%
Western	4,168	5,397	29%	5,864	41%
Total	9,359	12,426	33%	13,317	42%
Rail Alightings at Wellington Station					
AM	10,292	13,269	29%	13,940	35%
IP	884	1,173	33%	1,221	38%
PM	1,316	1,875	42%	2,166	65%

Bus boardings show modest increases over 2006, which will in part be due to the same bus services being modelled in all years. Rail boardings, however, increase much more, and more so on the Johnsonville and Western Lines and to a lesser extent on the Hutt Line. This growth is a combination of organic growth (increasing population and hence trip making), improvements to the rail network, plus secondary effects of roading improvements in the corridors. The effect on traffic volumes of the improvements in the SH1/SH2 corridor between Hutt and Wellington CBD has been noted previously and hence on the Hutt boardings seen here.

The effect of the RTP on bus boardings is relatively small increases in 2016, and no or slight increases in 2026. Rail boardings generally increase moderately to 2016, though the Western line has higher increases than the others. In 2026 there are significant increases over the Do Minimum, except for the Johnsonville line which has a small reduction in the AM peak. The increases on the other lines in the peaks are 16-21%, and higher than this (28%) on the Hutt line in the Interpeak.

These patterns will be related to the relative improvements to in the roading network versus rail; to 2016 there are significant roading and some rail improvements (notably the extension to Waikanae on the Western line), but to 2026 there are further rail improvements and limited roading improvements.

- **Table 35 PT Boardings – Effect of RTP**

	2016 Do Min	2016 RTP	% Diff	2026 Do Min	2026 RTP	% Diff
Bus Boardings						
AM	20,758	21,855	5%	20,466	20,499	0%
IP	6,385	6,835	7%	6,207	6,327	2%
PM	14,724	15,765	7%	14,540	14,766	2%
Rail Boardings						
AM						
Johnsonville	2,533	2,400	-5%	3,155	3,042	-4%
Hutt	6,831	7,291	7%	6,698	8,013	20%
Western	6,522	7,341	13%	7,065	8,554	21%
Total	15,886	17,032	7%	16,918	19,609	16%
IP						
Johnsonville	525	541	3%	561	666	19%
Hutt	1,029	1,047	2%	1,053	1,404	33%
Western	1,417	1,645	16%	1,444	1,758	22%
Total	2,971	3,233	9%	3,058	3,828	25%
PM						
Johnsonville	1,681	1,757	5%	1,912	2,140	12%
Hutt	5,348	5,400	1%	5,541	6,423	16%
Western	5,397	5,954	10%	5,864	6,910	18%
Total	12,426	13,111	6%	13,317	15,473	16%
Rail Alightings at Wellington Station						
AM	13,269	13,281	0%	13,940	14,350	3%
IP	1,173	1,368	17%	1,221	1,609	32%
PM	1,875	2,284	22%	2,166	2,733	26%

A coarse assessment of the ability of the rail services to cater for the projected demand has been undertaken and is given in Table 36. The model does not include any effects of crowding that might affect travellers choice, such as increased delay boarding or alighting, or increased waiting time due to trains been fully loaded.

For this assessment the patronage alighting at Wellington station in the 2-hour AM peak is compared with estimates of the numbers of seats available. It has been assumed that each train has two 3-car sets and each 2-car set seats 148 persons.

As the current AM peak loadings are very peaked within the 2-hour period, it would be expected that the maximum loadings on individual trains would be higher than the 2-hour averages given in the table. Hence the data is best considered relative to 2006.

In 2006 the average loading is 68%, which increases to 88% and 92% in the Do Minimum forecasts (which have the same capacity as in 2006). Given the current level of crowding, the increases suggest significantly increased issues with crowding in the future without additional capacity being provided or a marked change in the 2-hour loading profile. The additional capacity in the RTP reduces the average loading compared with 2006, particularly in 2026, suggesting an improvement over the current level of crowding.

- **Table 36 Rail Patronage and Capacity**

	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Trains per hour	17	17	26	17	43
2-car Sets per hour	51	51	78	51	129
Seats per 2hour AM peak	15,096	15,096	23,088	15,096	38,184
AM Alightings as Well Station	10,292	13,269	13,281	13,940	14,350
Average 2-hour Load	68%	88%	58%	92%	38%

4.9 RLTS Measures

This section presents, in turn, selected modelled outputs as measures related to RLTS objectives and comments on the change from 2006, and the effect of RTP networks on each measure. The Safety and Personal Security objective has not been considered here as this requires crash rates to be allocated to every link in every network modelled, including changes in rates resulting from safety improvements. The Efficiency objective has been considered in terms of network benefits of the RTP networks over the Do Minimum.

4.9.1 Assist Economic and Regional Development

The average cost of travel per kilometre and per trip are the measures used for Economic and Regional Development on the basis that lower cost/km or /trip are positive effects. These have been considered by mode (private vehicle, PT and HCV) and modelled period. Cost has been defined as the generalised cost, so includes time and operating costs, parking costs, fares, and inconvenience costs (eg PT transfers).

Table 37 and Table 38 give the costs per kilometre and per trip respectively for 2006 and each forecast and Figure 15 and Figure 16 present the data graphically. These statistics are weighted by the trips made in each case.

PT costs per km and per trip are significantly higher (~4.5 times in the peaks and ~ 8 times in the Interpeak) than car costs, some of which will be due to the high weighting placed on walking to and from PT, waiting for PT and transferring between services.

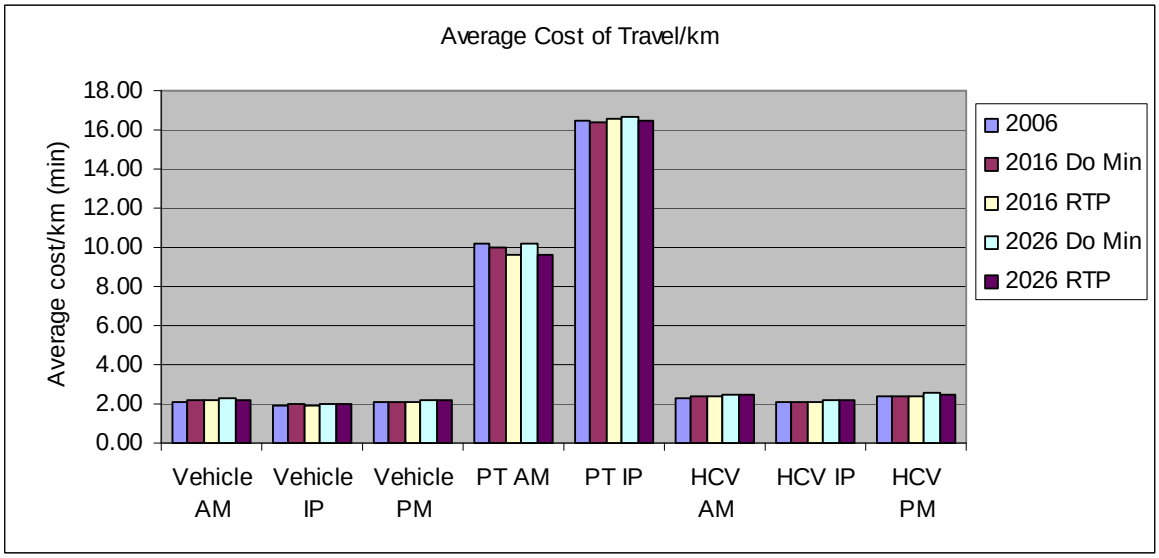
There are small reductions in the peak period car costs per km and per trip due to the RTP compared with the increase from 2006 to 2016 and 2026. There is also some reduction in AM peak PT costs in the 2016 and 2026 RTP compared with the Do Minimum. Some of this will be due to integrated fares and ticketing and the effects of real time information.

HCV costs increase slightly in forecasting, and the RTP has little effect.

- **Table 37 Travel Cost per Kilometre (generalised minutes/km)**

	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Vehicle AM	2.11	2.21	2.17	2.32	2.23
Vehicle IP	1.94	1.95	1.95	1.97	1.97
Vehicle PM	2.09	2.13	2.09	2.22	2.17
PT AM	10.20	10.02	9.65	10.23	9.57
PT IP	16.46	16.41	16.53	16.64	16.50
HCV AM	2.26	2.37	2.36	2.50	2.44
HCV IP	2.10	2.14	2.13	2.17	2.17
HCV PM	2.35	2.41	2.39	2.54	2.50

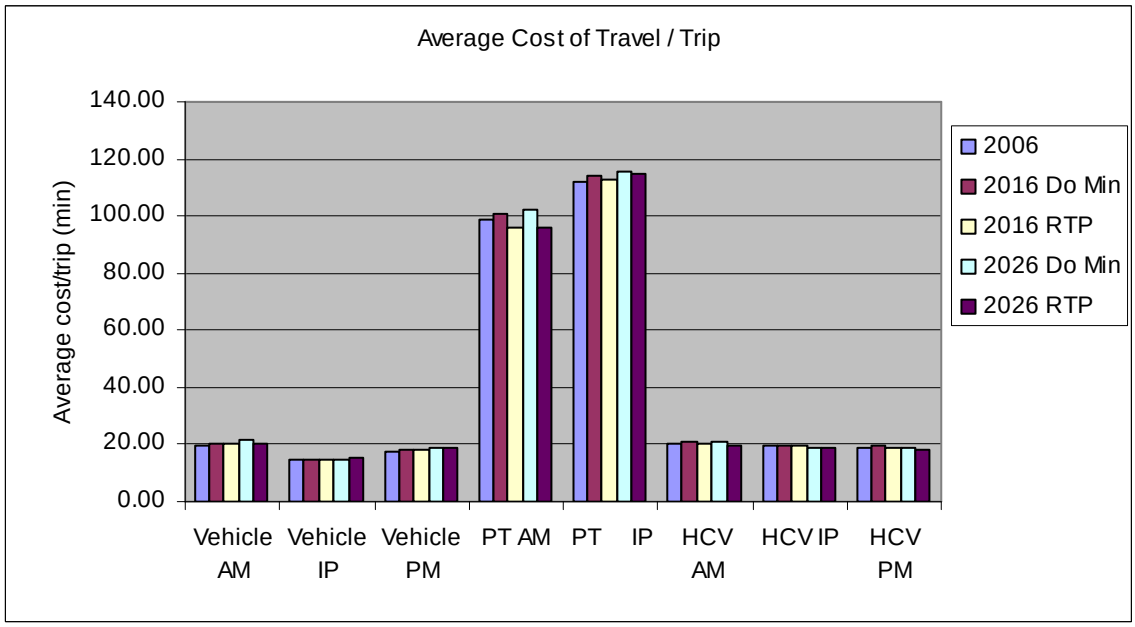
- **Figure 15 Travel Cost per Kilometre (generalised minutes/km)**



- **Table 38 Travel Cost per Trip (generalised minutes/trip)**

	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Vehicle AM	19.90	20.47	20.30	21.29	20.61
Vehicle IP	14.60	14.85	14.96	15.22	15.13
Vehicle PM	17.99	18.36	18.28	19.19	18.85
PT AM	98.83	101.14	96.13	102.39	95.83
PT IP	111.87	113.94	112.78	115.32	114.69
HCV AM	20.70	21.35	20.74	21.97	19.71
HCV IP	20.03	20.09	19.85	20.21	18.59
HCV PM	19.36	20.19	19.59	20.94	18.42

- **Figure 16 Travel Cost per Trip (generalised minutes/trip)**



4.9.2 Improve Access, Mobility and Reliability

The Access, Mobility and Reliability objective has been measured in two ways:

- Average speed by mode and time period, and
- Vehicle-kilometres of travel below level of service (LOS) D, where LOS D reflects the level at which congestion can significantly impact on travel time reliability

Table 39 and Figure 17 show the average speeds for 2006 and the forecasts. Note that "car"means persons travelling by car, including passengers; hence the car speeds presented here will have some small differences from those given in 4.6.1 which were for vehicles and not persons in vehicles.

This shows lower forecast Do Minimum car and HCV speeds than in 2006, whereas the RTP speeds are higher than the Do Minimum, and in the case of 2016 similar to 2006. In 2026, however, the RTP average speed is about 2 kph lower than in 2006.

The HCV speeds are higher than those for car as HCVs generally use a higher proportion of the strategic network which has higher speed levels.

The average PT speeds are based on journey time including access and egress time (walking to and from PT), waiting time and time on the bus, train or ferry. These components of journey time have a significant effect and account for much of the difference between private vehicle and PT speeds. The average PT speeds increase in the RTP forecasts over 2006, whereas those in the Do Minimum

forecasts are lower. This will be due to the lower car speeds in the Do Minimum, to which the bus speeds are related.

- **Table 39 Average Speed by Mode and Period**

Mode / Period	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Car					
AM	48.2	44.5	48.2	41.6	46.6
IP	55.3	54.6	55.2	53.9	54.5
PM	49.3	47.2	50.9	44.2	48.4
PT					
AM	15.0	14.5	15.5	14.2	15.2
IP	13.4	13.2	13.6	12.9	13.3
HCV					
AM	52.1	48.8	51.6	45.1	49.0
IP	58.6	57.5	58.1	56.0	56.7
PM	50.3	47.9	50.7	44.2	47.3

- **Figure 17 Average Speed by Mode and Period**

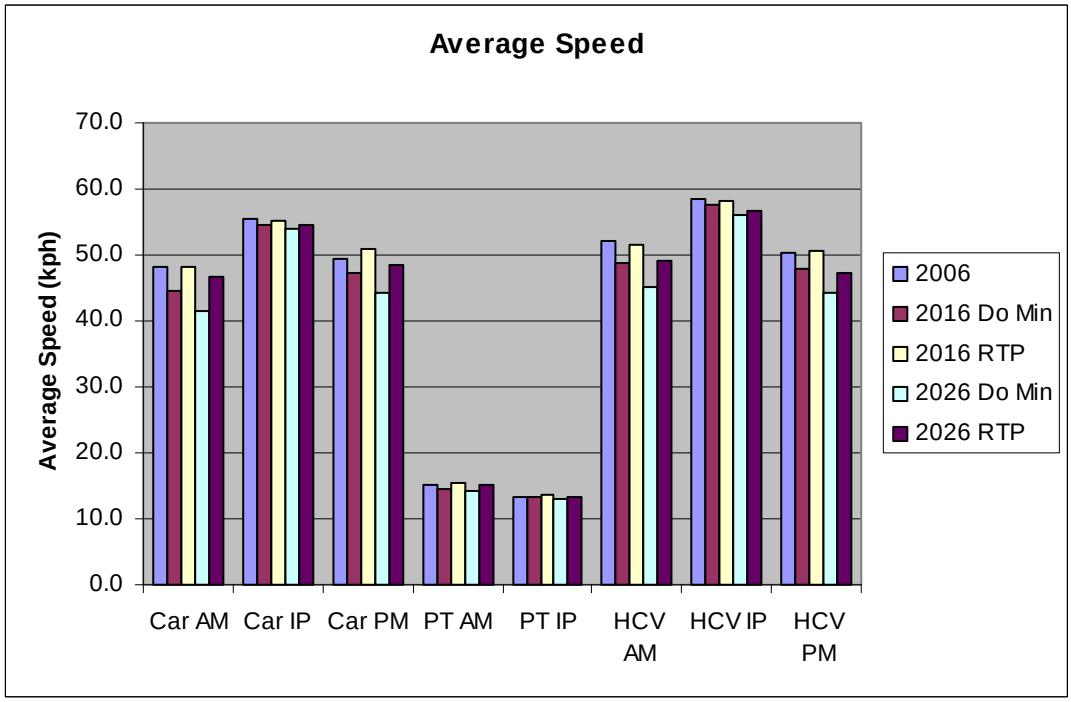


Table 40 gives the amount of travel (measured as vkt) occurring in congested conditions (ie worse than LOS D) by TA and in total in 2006 and the forecasts for each of the modelled periods. Figure 18 and Figure 19 show this graphically; respectively for the region by each modelled period, and in the AM peak for each TA.

They show that the amount of regional congested travel increases in the forecasts compared with 2006, and that the RTP networks result in a reduction over the Do Minimum network. This is the case in all three modelled periods.

This is not the case for all TAs; for all the level of congested vkt increases in the Do Minimum forecasts over 2006, but the effect of the RTP networks varies. In Wellington, Porirua, Kapiti (2026) and Hutt (2026) the RTP gives lower levels than the Do Minimum which can be related to RTP projects such as Transmission Gully, Petone-Grenada, and the SH1 and SH2 improvements. In Wairarapa and Upper Hutt the Do Minimum and RTP levels are much the same, and in these areas there are fewer roading improvements aimed at addressing congestion points.

The model network in Wairarapa is mainly just the state highways so there are limited paths that the modelled traffic can take, and the figures here need to be considered in this light.

- **Table 40 Amount of Travel (VKT) in Congested Conditions (<LOS D)**

TA	Period	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Wairarapa	AM	24,065	67,172	66,953	98,209	95,290
	IP	0	0	0	33,602	33,327
	PM	24,444	67,993	67,867	96,700	96,019
Kapiti	AM	22,506	46,302	34,366	50,428	51,898
	IP	0	6,514	7,336	8,297	16,677
	PM	32,501	52,796	35,087	58,460	51,337
Hutt	AM	86,841	115,359	123,312	127,393	106,062
	IP	4,537	24,377	15,987	29,124	18,001
	PM	84,671	101,490	118,778	122,462	101,881
Porirua	AM	55,443	72,618	28,807	75,938	20,990
	IP	2,757	5,060	222	9,345	613
	PM	54,615	74,045	29,387	80,587	26,388
Upper Hutt	AM	18,065	36,220	38,193	63,612	64,730
	IP	6,056	19,153	19,781	30,228	30,880
	PM	31,020	51,777	53,538	73,771	76,660
Wellington	AM	277,575	345,886	327,121	405,114	358,790
	IP	35,801	90,979	49,702	109,911	99,363
	PM	284,405	375,203	339,550	425,289	431,933
Total	AM	484,495	683,557	618,752	820,693	698,886
	IP	49,151	146,083	93,028	220,506	198,594
	PM	511,657	723,303	644,208	857,269	797,373

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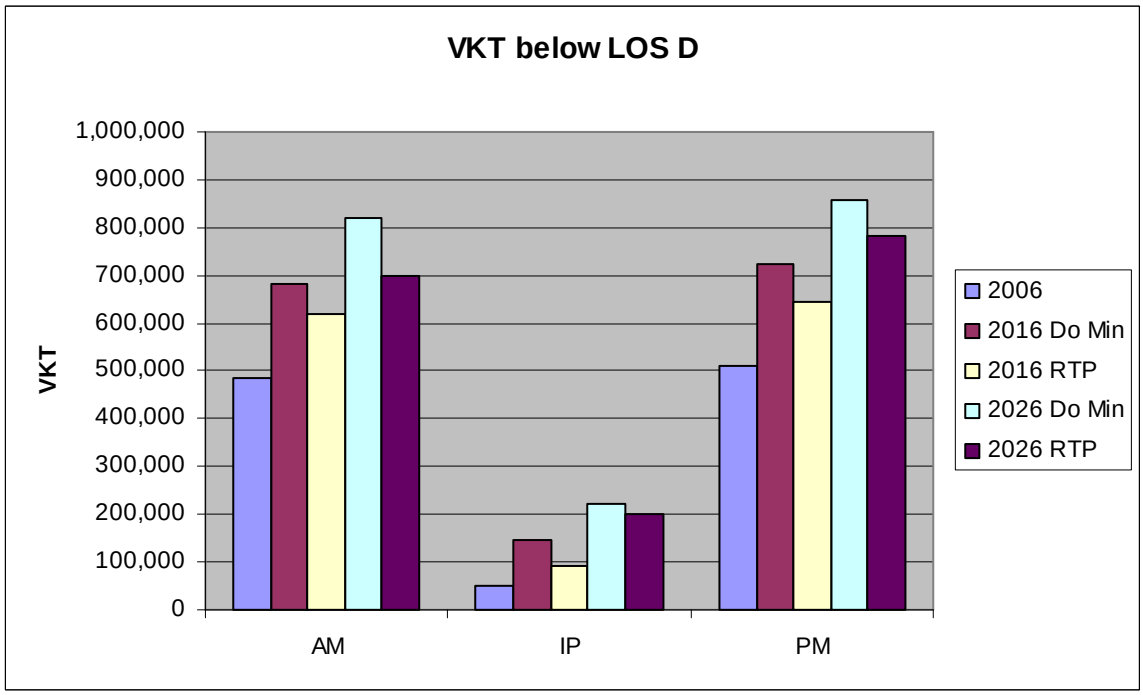
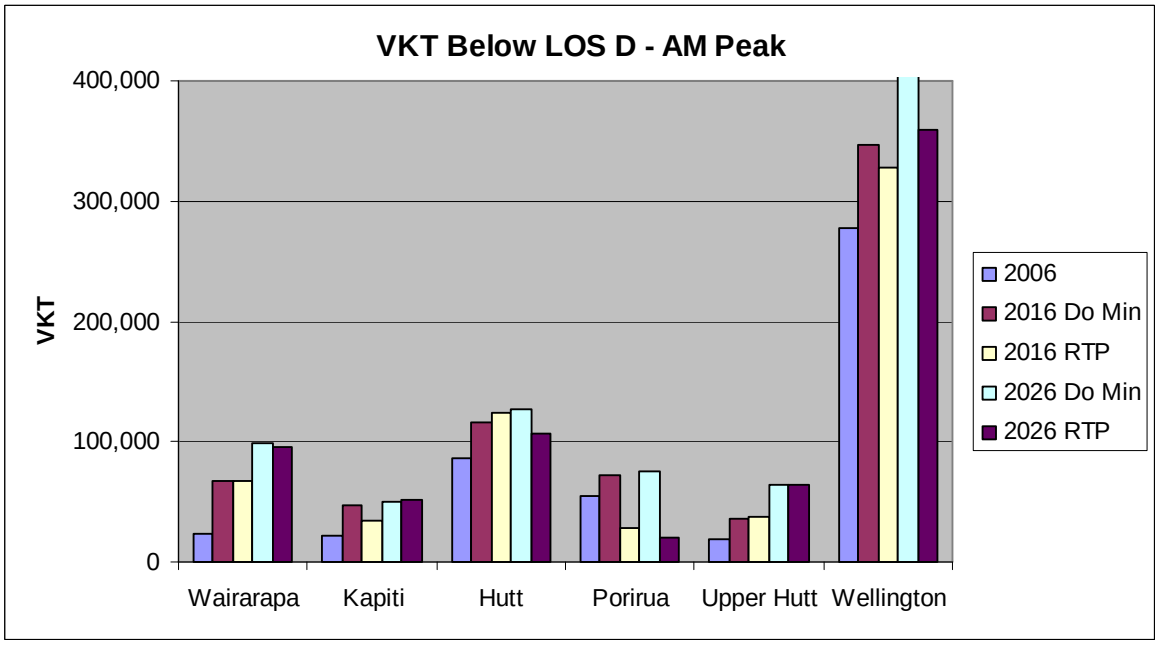
- **Figure 18 Amount of Travel (VKT) in Congested Conditions (<LOS D)**



- **Figure 19 Amount of Travel (VKT) in Congested Conditions (<LOS D) – by TA, AM Peak**



4.9.3 Protect and Promote Public Health

Estimated emissions from private vehicles have been used as the measure for this objective. The estimated emissions are nitrous oxides (NOx), patrticulates, and volatile organic compounds (VOC). These have been estimated at the regional level using the emissions factors and processes previously provided by GWRC.

The estimates are based on rates given in the EEM for light vehicles. The rates have been used for 2006 and the reduction factors given in Table 41 provided by GWRC applied for the forecast years. These reductions account for assumed improvements in vehicle technology and emissions requirements. It is important to note that they have been developed from information that is now dated and are to be revised.

- **Table 41 Assumed Reductions in Emissions Rates**

	2016	2026
CO car	-67%	-74%
CO hcv	4%	-15%
NOx car	-64%	-69%
NOx hcv	-3%	-26%
PM10 car	-63%	-77%
PM10 hcv	2%	-25%
VOC car	-62%	-68%
VOC hcv	4%	-13%

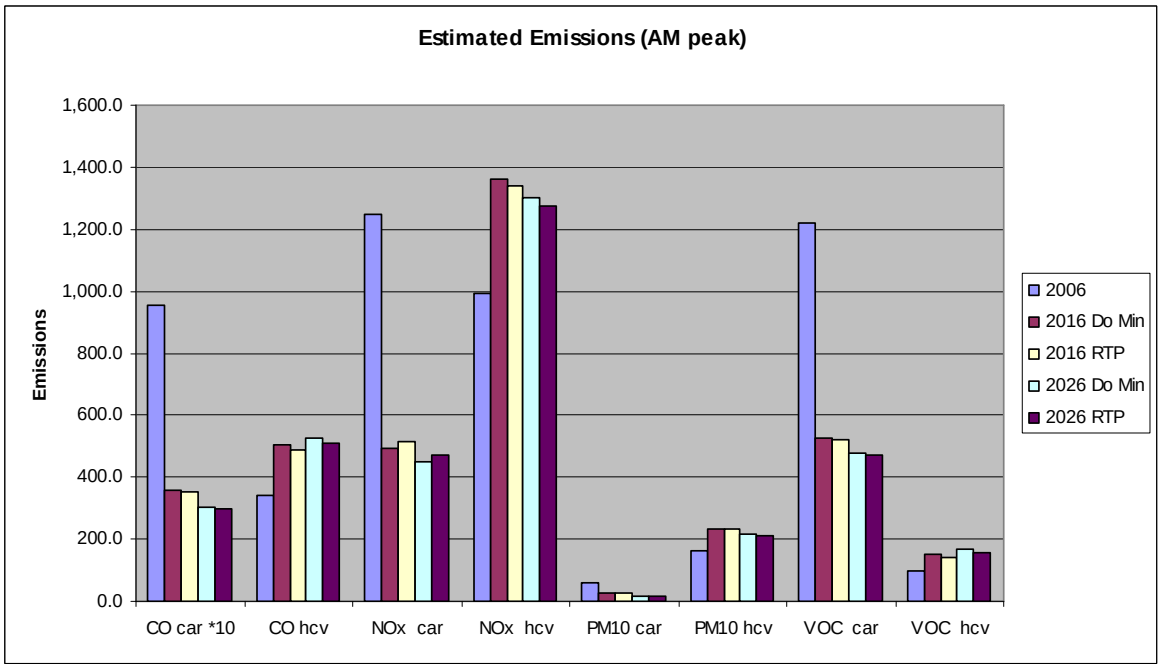
Table 42 gives the estimated quantity of AM peak emissions of each type for car and HCV in each modelled period and Figure 20 shows these graphically. Note that the CO car emissions have been divided by 10 for presentational purposes.

As can be seen all the car estimated emissions reduce markedly from 2006 to 2016 and 2026, whereas HCV emissions increase markedly to 2016 and then show some change (both increase and decrease) to 2026. These effects are due to the assumed reductions in emissions rates; without them the estimates would increase in all cases. As expected, the RTP has little effect on reducing emissions at this broad regional level.

- **Table 42 Estimated Emissions (AM Peak) - kg**

	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
CO car	9526	3586	3553	3042	2990
CO hcv	341	504	490	528	508
NOx car	1,247	496	516	448	471
NOx hcv	993	1,359	1,338	1,300	1,274
PM10 car	62	26	26	17	17
PM10 hcv	165	236	234	216	214
VOC car	1,221	525	519	479	471
VOC hcv	99	149	142	166	155

- **Figure 20 Estimated Emissions (AM Peak) - kg**



4.9.4 Ensure Environmental Sustainability

Environmental Sustainability has been measured in terms of estimated fuel usage and carbon dioxide (CO_2) emissions. Fuel usage has been estimated using rates given in the EEM for car, HCV and bus and for different driving conditions – base, congested, bottlenecks and changes in speed. CO_2 in tonnes is estimated from fuel use (litres) as 2.7/1000.

As for emissions assumed reductions in fuel usage rates are applied to the forecasts, in this case as shown in Table 43. As for the other emissions these factors are in need o updating.

- **Table 43 Assumed Reductions in Fuel Usage Rates**

	2016	2026
Car	-21%	-25%
HCV	1%	2%
Bus	-2%	-3%

Table 44 and Table 45 give estimated AM peak fuel use and CO_2 emissions respectively and Figure 21 and Figure 22 show these graphically. Fuel usage is given for each of the above vehicle types and driving conditions, except that the figure excludes buses for presentational purposes.

Forecast fuel use is less than in 2006 for cars, and buses show little change. Fuel use for HCVs increases fuel usage rate. The RTP results in slightly increases so that by 2026 it is double the 2006 level. This is consistent with the increase in HCV trips and slightly longer trips.

The RTP has no apparent effect on car fuel use overall. This is due to increased vehicle travel over time, which outweigh any improved congestion conditions brought about by the RTP. The separate components of the fuel estimates confirm this; for example the increase in 2026 car base fuel use between the Do Minimum and the RTP is similar to the reduction in congested and bottleneck fuel use.

HCV fuel use does reduce slightly in 2016 as a result of the RTP network; this will be due to a reduction in the congested fuel use for HCVs as is seen with cars.

- **Table 44 Estimated Fuel Usage (AM Peak) (litres)**

	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
Car base	108,090	93,364	97,058	94,995	99,252
Car congested	11,302	12,874	12,010	17,376	14,817
Car bottlenecks	3,888	4,703	2,903	5,774	3,318
Car speed change	4,076	3,549	3,626	3,578	3,614
Car total	127,355	114,490	115,596	121,723	121,001
HCV base	36,241	51,169	50,624	64,763	64,120
HCV congested	18,716	35,539	29,228	53,755	45,451
HCV bottlenecks	285	618	382	1,089	609
HCV speed change	5,403	7,686	7,640	9,810	9,686
HCV total	60,645	95,013	87,874	129,418	119,865
Bus base	1,534	1,508	1,523	1,494	1,496
Bus congested	151	197	190	231	219

Bus bottlenecks	19	30	28	43	34
Bus speed change	229	226	230	225	225
Bus total	1,933	1,961	1,970	1,994	1,974

- **Figure 21 Estimated Fuel Usage (AM Peak) (litres)**

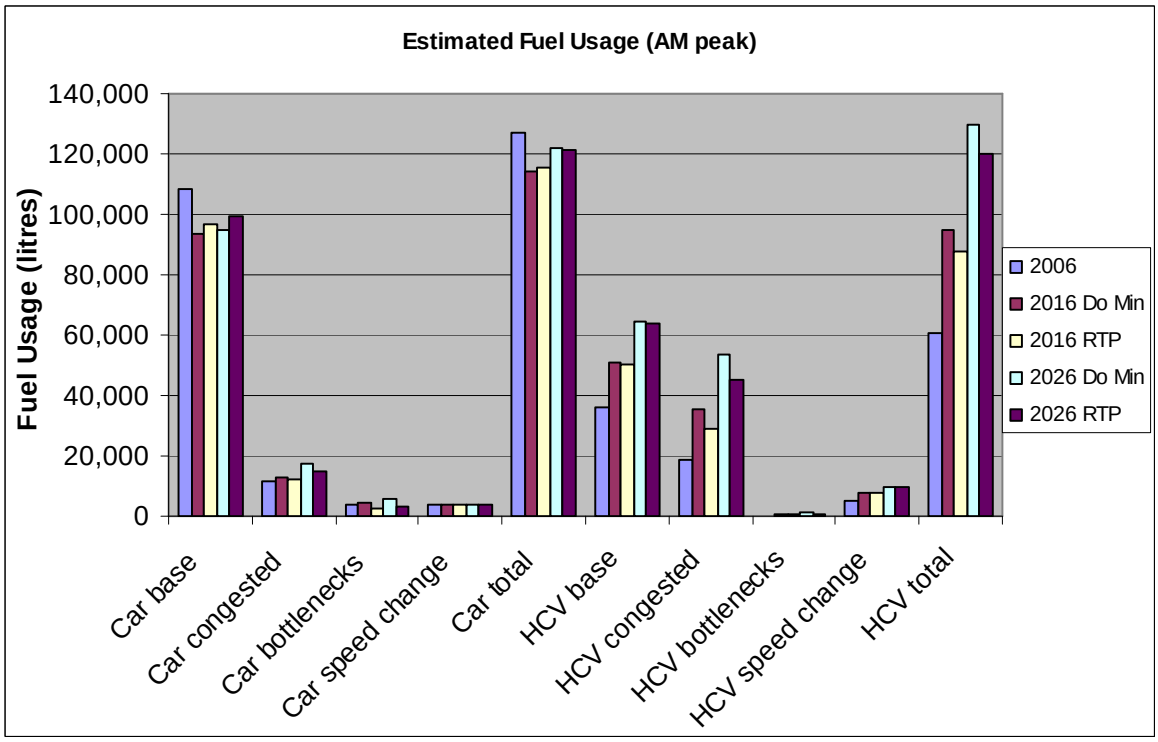


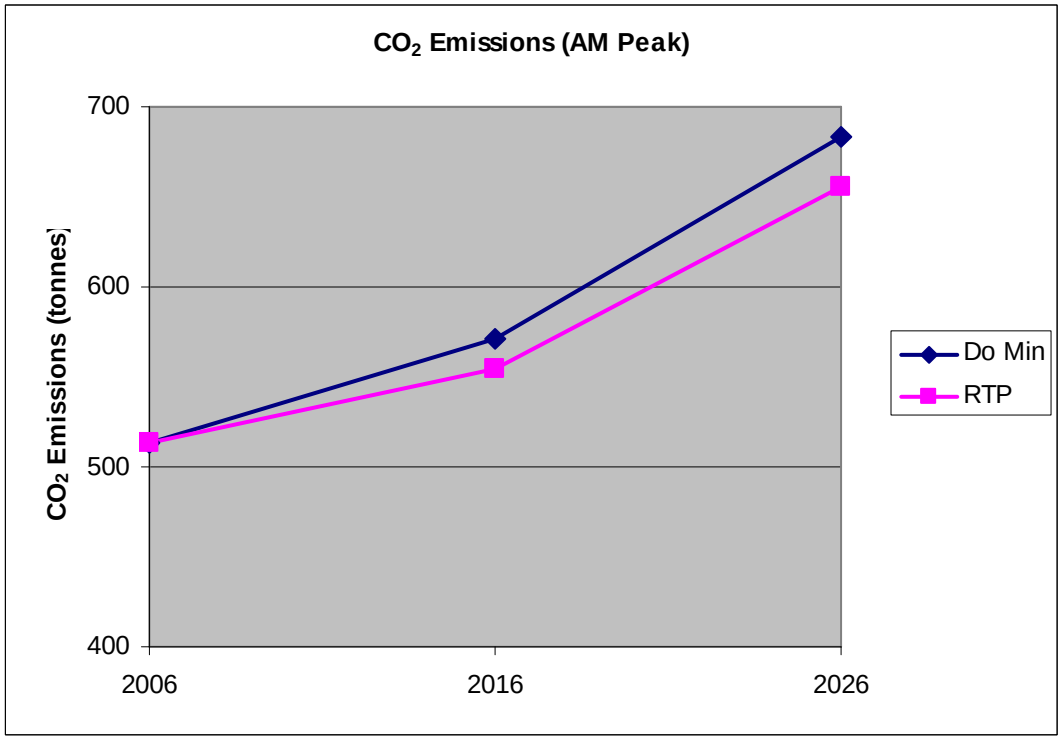
Table 45 and Figure 22 give the estimated CO_2 emissions; note the scale in the figure does not start at zero.

Carbon dioxide emissions in 2016 are predicted to be around 10% higher than in 2006, and 30% higher by 2026. The RTP does have some effect; 3-4% reductions over the Do Minimum.

- **Table 45 Estimated AM Peak CO_2 Emissions (Tonnes)**

	2006	2016 Do Min	2016 RTP	2026 Do Min	2026 RTP
CO_2	513	571	555	683	656

- **Figure 22 Estimated AM peak CO2 Emissions (Tonnes)**



4.9.5 Efficiency

For the purposes of this report the Efficiency objective has been measured in terms of estimated benefits of the RTP networks over the Do Minimum. These have been calculated using the rule-of-a-half, that is:

Benefits = 0.5 x (Do Minimum Demand + RTP Demand) x (Do Minimum Costs - RTP Costs)

These have been calculated at a matrix level for private vehicle, HCV and PT separately. For private vehicle and HCV the "costs" are travel times and distances to which values of time and operating costs are applied, and for PT the "costs" are the generalised costs generated in the model.

Input values to this were developed by scaling 2002 values to 2006 using the growth in GDP (11%) for time and the increase in operating costs of 30%. An occupancy factor of 30% has been used for private vehicles.

- Private vehicle:
  - values of time: peak periods $10.61 /hr, Interpeak and off-peak periods $9.61 /hr
  - operating costs: $0.200/km
- HCV:
  - value of time: $22.31 /hr
  - operating cost: $0.657/kn
- PT:
  - value of time: $6.66 /hr
- Days per year:
  - Peaks: 245
  - Other times: 1959

Table 46 gives the benefits in $ by mode, component and period and in total for 2016 and 2026. The figures have been rounded to the nearest $1000. No discounting effects have been included.

This shows positive travel time benefits for private vehicles and HCVs, but negative benefits in terms of operating costs. The latter is due to slightly longer distances travelled in the RTP cases. The PT benefits are positive and include the benefits of integrated fares and ticketing and real time information, as well as those associated with travel time and frequency improvements.

The total benefits in 2016 are in the order of $48 million and $67 million in 2026.

Table 46 Estimated Benefits ($)

Mode	Benefit Component	Periods	2016 Benefits ($)	2026 Benefits ($)
Private Vehicle	Time	Peaks	15,547,000	23,207,000
		Other Times	5,963,000	6,779,000
		Total	21,509,000	29,987,000
	Operating	Peaks	1,616,000	2,027,000
		Other Times	4,681,000	5,182,000
		Total	6,297,000	7,208,000
HCV	Time	Peaks	2,006,000	3,593,000
		Other Times	2,299,000	3,421,000
		Total	4,305,000	7,014,000
	Operating	Peaks	218,000	275,000
		Other Times	1,848,000	2,230,000
		Total	2,067,000	2,505,000
PT		Peaks	5,909,000	8,917,000
		Other Times	8,286,000	10,970,000
		Total	14,195,000	19,887,000

Total			48,373,000	66,602,000

5. Conclusions

GWRC to insert draft for SKM review

Appendix A Project Background

The project was defined as a series of tasks, categorised into those that were to be implemented (Primary Tasks) and those that a decision would be made on following the investigation phase (Secondary Tasks). The tasks were:

Primary Tasks

- Task 5.2.1 Update Input Rates
- Task 5.2.2 Update networks
- Task 5.2.3 Enhance road network detail
- Task 5.2.4 Validate auto assignment
- Task 5.2.5 Validate PT assignment
- Task 5.2.6 Commercial Vehicle Model
- Task 5.2.7 Changing 2001 HTS trip rates
- Task 5.2.8 Actually vs usually resident population
- Task 5.2.9 Higher PCE factor for CVs
- Task 5.2.10 Update to 2005 Vehicle Fleet Emissions Factors
- Task 5.2.11 Demographic projections
- Task 5.2.12 Car ownership
- Task 5.2.13 Traffic data and screenline review
- Tasks 5.2.14/15 PT data and screenline review

Secondary Tasks

- Task 5.3.1 Intersection delays and merges
- Task 5.3.2 Park & ride sub mode choice model
- Task 5.3.3 Passenger capacity constraint for rail and bus services
- Task 5.3.4 Multi-class assignment
- Task 5.3.5 CV route choice function
- Task 5.3.6 Adjust flight related airport trips
- Task 5.3.7 Including interisland traffic

The outputs for the project are listed as:

- An updated WTSM, validated to a 2006 base and signed off by Greater Wellington's peer reviewer
- Updates to the *as delivered* technical notes as appropriate

- A new baseline and forecast report for:
  - 2006 base
  - 2016 do minimum
  - 2016 Regional Land Transport Strategy
  - 2026 do minimum
  - 2026 Regional Land Transport Strategy

- Presentations to:
  - The Regional Land Transport Committee
  - An invited technical audience of mainly external stakeholders
  - Greater Wellington officers.

Appendix B Location of Population and Employment Growth

	Polulation					Employment				
Zone	2006	2016	% Diff	2026	% Diff	2006	2016	% Diff	2026	% Diff
1	2007	2152	7%	2289	14%	373	435	16%	460	23%
2	4164	4488	8%	4765	14%	1216	1385	14%	1445	19%
3	3534	3803	8%	4038	14%	1120	1284	15%	1350	21%
4	5895	6333	7%	6733	14%	878	1017	16%	1070	22%
5	1714	1834	7%	1947	14%	390	460	18%	489	26%
6	868	929	7%	987	14%	140	165	18%	176	26%
7	28	30	8%	32	15%	614	718	17%	760	24%
8	4090	4407	8%	4688	15%	1187	1391	17%	1473	24%
9	4781	5155	8%	5475	15%	2895	3277	13%	3433	19%
10	3849	4147	8%	4416	15%	633	739	17%	783	24%
11	2386	2562	7%	2726	14%	319	373	17%	395	24%
12	1481	1602	8%	1710	15%	175	202	16%	213	22%
13	1480	1742	18%	2016	36%	3679	4534	23%	4901	33%
14	5456	5871	8%	6234	14%	1954	2295	17%	2433	25%
15	2544	2729	7%	2903	14%	286	338	18%	360	26%
16	3615	3876	7%	4120	14%	708	830	17%	881	24%
17	2936	3150	7%	3348	14%	332	388	17%	412	24%
18	1648	1760	7%	1874	14%	313	371	18%	397	27%
19	2279	2456	8%	2589	14%	771	919	19%	981	27%
20	3532	3797	8%	4022	14%	563	670	19%	715	27%
21	1917	2406	26%	2920	52%	182	211	16%	223	23%
22	3409	3888	14%	4450	31%	593	697	18%	741	25%
23	2268	2430	7%	2579	14%	175	204	17%	216	24%
24	3343	3998	20%	4756	42%	321	372	16%	393	22%
25	3300	3560	8%	3745	13%	426	496	16%	526	23%
26	1812	1915	6%	2028	12%	183	214	17%	228	24%
27	2381	2565	8%	2719	14%	725	846	17%	897	24%
28	3563	3798	7%	4032	13%	500	585	17%	620	24%
29	2111	2260	7%	2402	14%	229	270	18%	287	25%
30	6024	6460	7%	6865	14%	1621	1908	18%	2031	25%
31	5960	6379	7%	6777	14%	716	841	17%	893	25%
32	2175	2333	7%	2479	14%	229	265	16%	281	23%
33	435	467	7%	495	14%	140	154	10%	163	16%
34	1425	1523	7%	1618	14%	460	545	19%	581	26%
35	3276	3505	7%	3719	14%	519	607	17%	644	24%
36	1646	2046	24%	2485	51%	442	523	18%	556	26%
37	190	236	24%	286	51%	1601	1892	18%	2011	26%
38	1270	1580	24%	1918	51%	2842	3359	18%	3570	26%
39	99	123	24%	149	51%	2377	2809	18%	2986	26%
40	1281	1375	7%	1465	14%	336	386	15%	407	21%
41	1681	2089	24%	2521	50%	608	701	15%	740	22%
42	1921	2386	24%	2880	50%	871	1005	15%	1060	22%
43	1615	2006	24%	2422	50%	434	500	15%	528	22%
44	1725	2164	25%	2624	52%	1409	1638	16%	1731	23%
45	578	697	21%	821	42%	666	787	18%	838	26%
46	628	787	25%	942	50%	1333	1534	15%	1615	21%
47	824	1032	25%	1235	50%	4426	5092	15%	5363	21%
48	372	467	25%	558	50%	2981	3430	15%	3612	21%
49	0	0	#DIV/0!	0	#DIV/0!	6223	7102	14%	7443	20%
50	856	1073	25%	1284	50%	3494	4020	15%	4234	21%
51	614	770	25%	921	50%	2124	2444	15%	2574	21%
52	507	636	25%	760	50%	4197	4830	15%	5086	21%
53	638	799	25%	956	50%	2842	3271	15%	3444	21%
54	1270	1598	26%	1945	53%	1053	1198	14%	1254	19%
55	352	387	10%	416	18%	1606	1874	17%	1985	24%
56	1240	1483	20%	1730	40%	192	221	15%	233	21%
57	1147	1443	26%	1756	53%	6908	7865	14%	8231	19%
58	70	88	26%	107	53%	2840	3234	14%	3384	19%
59	21	27	26%	33	53%	6508	7410	14%	7755	19%
60	675	850	26%	1034	53%	7697	8763	14%	9170	19%

	Polulation					Employment				
Zone	2006	2016	% Diff	2026	% Diff	2006	2016	% Diff	2026	% Diff
61	797	944	18%	1095	37%	430	502	17%	532	24%
62	123	155	26%	189	53%	5013	5708	14%	5973	19%
63	0	0	#DIV/0!	0	#DIV/0!	4817	5484	14%	5739	19%
64	155	196	26%	238	53%	2191	2494	14%	2610	19%
65	144	180	25%	219	52%	4848	5623	16%	5932	22%
66	487	605	24%	735	51%	5084	6009	18%	6387	26%
67	0	0	#DIV/0!	0	#DIV/0!	1030	1175	14%	1225	19%
68	1431	1541	8%	1640	15%	170	198	17%	210	24%
69	1690	1815	7%	1932	14%	218	259	19%	277	27%
70	4704	5002	6%	5305	13%	672	796	18%	848	26%
71	3269	3509	7%	3732	14%	813	951	17%	1008	24%
72	1881	2019	7%	2145	14%	160	183	14%	191	19%
73	2102	2255	7%	2399	14%	624	734	18%	779	25%
74	0	0	#DIV/0!	0	#DIV/0!	1825	2098	15%	2194	20%
75	2880	3086	7%	3280	14%	234	262	12%	270	16%
76	2091	2239	7%	2379	14%	1298	1450	12%	1495	15%
77	23	24	7%	26	14%	1437	1637	14%	1719	20%
78	2644	2831	7%	3011	14%	350	416	19%	444	27%
79	4493	4834	8%	5135	14%	593	702	18%	747	26%
80	4137	4438	7%	4705	14%	558	646	16%	683	22%
81	314	337	7%	357	14%	609	670	10%	708	16%
82	5431	5830	7%	6187	14%	598	783	31%	838	40%
83	3555	3803	7%	4041	14%	805	936	16%	991	23%
84	211	220	4%	230	9%	29	44	54%	48	67%
85	993	1061	7%	1125	13%	29	34	20%	37	29%
86	3624	3894	7%	4139	14%	899	1045	16%	1105	23%
87	535	561	5%	588	10%	1068	1190	11%	1236	16%
88	3243	3500	8%	3722	15%	457	532	16%	564	23%
89	1044	1127	8%	1199	15%	906	1055	16%	1118	23%
90	3822	4008	5%	4184	9%	420	497	18%	529	26%
91	1552	1665	7%	1765	14%	192	212	11%	218	14%
92	324	317	-2%	326	1%	2142	2482	16%	2619	22%
93	474	476	0%	484	2%	2800	3248	16%	3427	22%
94	1800	1807	0%	1841	2%	239	277	16%	293	22%
95	3273	3170	-3%	3089	-6%	429	512	20%	547	28%
96	4314	4166	-3%	4074	-6%	370	443	20%	474	28%
97	0	0	#DIV/0!	0	#DIV/0!	2665	3090	16%	3260	22%
98	2105	2138	2%	2219	5%	233	276	18%	293	26%
99	1350	1316	-3%	1272	-6%	109	134	23%	145	33%
100	4886	4880	0%	4955	1%	391	465	19%	497	27%
101	3785	3671	-3%	3624	-4%	254	302	19%	323	27%
102	4834	4652	-4%	4570	-5%	431	500	16%	529	23%
103	2736	2684	-2%	2707	-1%	118	141	20%	151	28%
104	1263	2461	95%	3048	141%	896	1074	20%	1150	28%
105	2680	3743	40%	4248	58%	404	481	19%	514	27%
106	4306	4161	-3%	4029	-6%	725	856	18%	911	26%
107	3468	3802	10%	3911	13%	344	396	15%	416	21%
108	1038	1007	-3%	974	-6%	477	551	16%	580	22%
109	1788	1744	-2%	1722	-4%	419	490	17%	519	24%
110	695	678	-2%	670	-4%	544	629	16%	664	22%
111	1876	1817	-3%	1788	-5%	380	447	18%	474	25%
112	1749	1674	-4%	1616	-8%	224	265	18%	282	26%
113	144	140	-3%	142	-1%	80	99	24%	107	34%
114	207	213	3%	228	10%	97	109	12%	113	16%
115	1623	1783	10%	1988	22%	310	359	16%	379	22%
116	3564	6099	71%	6570	84%	520	618	19%	659	27%
117	4407	4523	3%	4859	10%	1051	1228	17%	1302	24%
118	2152	2222	3%	2387	11%	604	693	15%	728	21%
119	618	638	3%	686	11%	2574	2947	15%	3095	20%
120	4966	5127	3%	5509	11%	1699	1945	15%	2043	20%

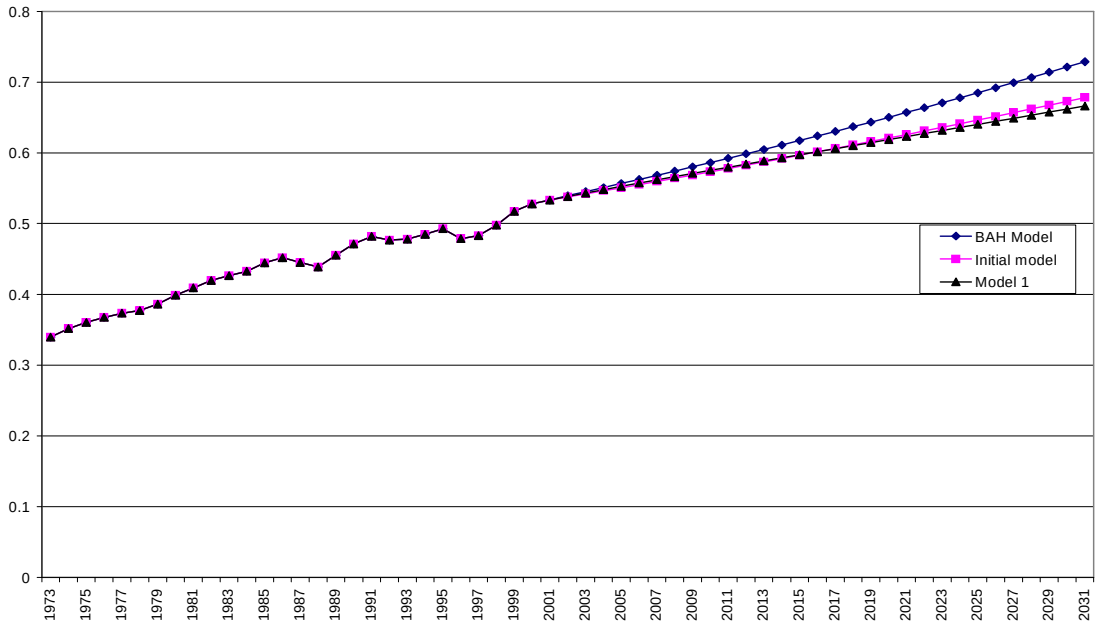
	Polulation					Employment				
Zone	2006	2016	% Diff	2026	% Diff	2006	2016	% Diff	2026	% Diff
121	4748	4899	3%	5265	11%	1071	1255	17%	1332	24%
122	3695	3796	3%	4079	10%	674	800	19%	852	26%
123	1632	1679	3%	1805	11%	341	392	15%	411	20%
124	2895	3003	4%	3309	14%	413	480	16%	508	23%
125	5619	7010	25%	8791	56%	1788	2082	16%	2203	23%
126	1816	1857	2%	1995	10%	348	413	19%	440	26%
127	527	540	3%	573	9%	134	149	11%	154	15%
128	991	1022	3%	1073	8%	374	411	10%	422	13%
129	5500	6201	13%	6490	18%	1986	2283	15%	2396	21%
130	927	969	4%	1037	12%	413	457	11%	472	14%
131	442	462	4%	495	12%	142	157	11%	162	14%
132	360	372	3%	380	6%	75	85	13%	89	19%
133	636	639	0%	653	3%	55	65	18%	69	26%
134	1083	1102	2%	1072	-1%	128	152	18%	161	26%
135	2562	2614	2%	2556	0%	162	194	20%	207	28%
136	2745	2810	2%	2770	1%	248	293	18%	312	26%
137	2874	3022	5%	3092	8%	213	248	16%	262	23%
138	2031	2102	4%	2117	4%	638	695	9%	705	10%
139	456	449	-2%	450	-1%	1411	1607	14%	1686	20%
140	329	334	2%	348	6%	2197	2512	14%	2643	20%
141	2160	2206	2%	2228	3%	250	295	18%	314	25%
142	3201	3321	4%	3345	4%	681	795	17%	842	24%
143	2173	2234	3%	2229	3%	318	373	17%	396	25%
144	1491	1500	1%	1457	-2%	288	333	16%	351	22%
145	1171	1206	3%	1226	5%	1721	2003	16%	2101	22%
146	2772	2863	3%	2885	4%	881	1046	19%	1114	26%
147	2232	2390	7%	2476	11%	696	805	16%	848	22%
148	2121	2151	1%	2134	1%	328	392	19%	419	28%
149	903	885	-2%	857	-5%	91	106	17%	112	24%
150	2236	2303	3%	2316	4%	595	709	19%	758	27%
151	1565	1611	3%	1617	3%	224	265	18%	282	26%
152	1688	1731	3%	1727	2%	736	846	15%	893	21%
153	1938	1984	2%	1974	2%	163	186	14%	196	20%
154	396	406	3%	426	8%	205	254	24%	274	34%
155	3239	3261	1%	3200	-1%	334	394	18%	419	25%
156	1991	2121	7%	2209	11%	426	501	18%	533	25%
157	2794	2790	0%	2734	-2%	321	376	17%	399	24%
158	251	251	0%	246	-2%	245	286	17%	304	24%
159	3000	3096	3%	3154	5%	413	468	13%	485	17%
160	3044	3067	1%	3012	-1%	1449	1584	9%	1608	11%
161	2382	2514	6%	2587	9%	114	138	21%	149	30%
162	1656	1660	0%	1647	-1%	125	150	20%	161	29%
163	2567	2587	1%	2542	-1%	345	403	17%	428	24%
164	2194	2211	1%	2173	-1%	326	381	17%	404	24%
165	1037	1056	2%	1061	2%	1158	1304	13%	1348	16%
166	2514	2559	2%	2571	2%	77	87	13%	90	16%
167	2307	2328	1%	2310	0%	578	675	17%	716	24%
168	3259	3309	2%	3305	1%	668	765	14%	817	22%
169	3384	3381	0%	3344	-1%	463	543	17%	574	24%
170	3009	3049	1%	3037	1%	2378	2950	24%	3187	34%
171	2093	2115	1%	2094	0%	400	500	25%	543	36%
172	2994	3013	1%	2967	-1%	325	384	18%	407	25%
173	3651	3711	2%	3723	2%	202	242	20%	259	28%
174	2475	2588	5%	2655	7%	92	109	19%	117	28%
175	4219	4257	1%	4222	0%	959	1155	20%	1235	29%
176	1813	1832	1%	1825	1%	374	430	15%	458	22%
177	1468	1486	1%	1488	1%	394	454	15%	478	21%
178	159	161	1%	161	1%	2037	2345	15%	2470	21%
179	0	0	#DIV/0!	0	#DIV/0!	665	766	15%	807	21%
180	0	0	#DIV/0!	0	#DIV/0!	487	561	15%	591	21%

	Polulation					Employment				
Zone	2006	2016	% Diff	2026	% Diff	2006	2016	% Diff	2026	% Diff
181	0	0	#DIV/0!	0	#DIV/0!	1818	2093	15%	2204	21%
182	43	43	1%	43	1%	2022	2328	15%	2452	21%
183	49	50	1%	50	1%	357	411	15%	433	21%
184	996	1013	2%	1017	2%	1494	1683	13%	1751	17%
185	1506	1606	7%	1681	12%	819	929	13%	971	19%
186	722	731	1%	731	1%	1241	1430	15%	1506	21%
187	1771	1774	0%	1769	0%	226	267	18%	282	25%
188	3972	4068	2%	4023	1%	1193	1349	13%	1400	17%
189	1620	1770	9%	1871	15%	524	526	0%	491	-6%
190	2222	2266	2%	2285	3%	307	362	18%	384	25%
191	2056	2217	8%	2375	16%	4055	4612	14%	4818	19%
192	2157	2156	0%	2122	-2%	270	319	18%	340	26%
193	3570	3598	1%	3535	-1%	327	384	18%	407	25%
194	1295	1297	0%	1279	-1%	507	577	14%	600	18%
195	1313	1553	18%	1783	36%	4299	4841	13%	5035	17%
196	1045	1236	18%	1419	36%	997	1135	14%	1191	19%
197	0	0	#DIV/0!	0	#DIV/0!	5106	5623	10%	5771	13%
198	2628	2718	3%	2754	5%	422	487	15%	514	22%
199	396	410	3%	415	5%	653	754	15%	796	22%
200	2586	2615	1%	2618	1%	624	729	17%	771	24%
201	2145	2170	1%	2172	1%	392	457	17%	484	24%
202	1968	2097	7%	2178	11%	189	216	14%	227	20%
203	2487	2614	5%	2681	8%	197	230	17%	245	24%
204	3499	3605	3%	3630	4%	357	413	16%	435	22%
205	191	196	3%	193	1%	109	124	13%	129	19%
206	1321	1354	2%	1350	2%	806	906	12%	941	17%
207	2343	2393	2%	2342	0%	548	633	15%	667	22%
208	2064	2118	3%	2099	2%	1107	1296	17%	1374	24%
209	4122	4187	2%	4095	-1%	1404	1622	15%	1707	22%
210	3885	3966	2%	3927	1%	1187	1418	19%	1507	27%
211	7343	7365	0%	7226	-2%	4940	5680	15%	5970	21%
212	6469	6541	1%	6429	-1%	2689	3095	15%	3260	21%
213	591	599	1%	602	2%	368	379	3%	374	2%
214	1647	1780	8%	1886	15%	668	699	5%	698	4%
215	791	851	8%	890	13%	539	568	5%	571	6%
216	2651	2610	-2%	2532	-4%	865	964	11%	997	15%
217	1217	1218	0%	1221	0%	867	945	9%	966	12%
218	721	742	3%	731	1%	255	268	5%	269	5%
219	334	343	3%	338	1%	200	210	5%	210	5%
220	483	497	3%	506	5%	225	239	6%	241	7%
221	619	637	3%	628	1%	251	263	5%	264	5%
222	753	792	5%	817	8%	454	478	5%	480	6%
223	637	654	3%	647	1%	330	345	5%	345	5%
224	252	272	8%	283	12%	148	154	4%	154	4%
225	598	681	14%	753	26%	389	407	5%	406	4%

Appendix C Car Ownership Forecasting

Current Model

The following graph from the WTSM car ownership report presents historic car ownership levels to 2001 and forecasts beyond that to 2031. Model 1 was the adopted model. The actual data associated with this graph has not been located so the values from it have been interpreted.



To determine the average cars/person from running the implemented car ownership model, the average household car ownership for 2+ cars needs to be asserted.

This has been done by using the car ownership model forecasts for 2006 and asserting averages for each of the three relevant household types until the car/person matches the forecast on the above graph (0.55 cars /person).

The averages are:

- 2 adults, neither working: 2.2 cars/household,
- 2 adults, 1 or both working: 2.4 cars/household, and
- 3+ adults: 2.7 cars/household.

These averages were then applied to the model with zonal lambda adjusted so that the 2006 census data of households by car ownership level: 0, 1, 2+ was matched. This gave 0.57 cars/person, and was used as the starting point for applying the proposed new forecasting (temporal) model.

Proposed New Model

The proposed new forecasting model – the model developed and now adopted for Auckland – is of the form:

$$C = S/(1+\exp(h)), \text{ where } h = -\ln Y = \text{constant} + \alpha.GDP + \beta.P + \gamma.t$$

Where:

C is cars/person

GP is GDP/person

P is car price

t is the number of years from the start of the period

S is the input saturation level

α and β are elasticities

γ is the factor in the time trend formulation

The adopted model, which does not include the car price term, is:

$$C = 0.8/(1+\exp(h)), \text{ where } h = -\ln Y = -8.436 + 0.899.GDP + 0.025.t$$

Note that this model, unlike the current model includes a saturation effect, the level being 0.8 cars/person.

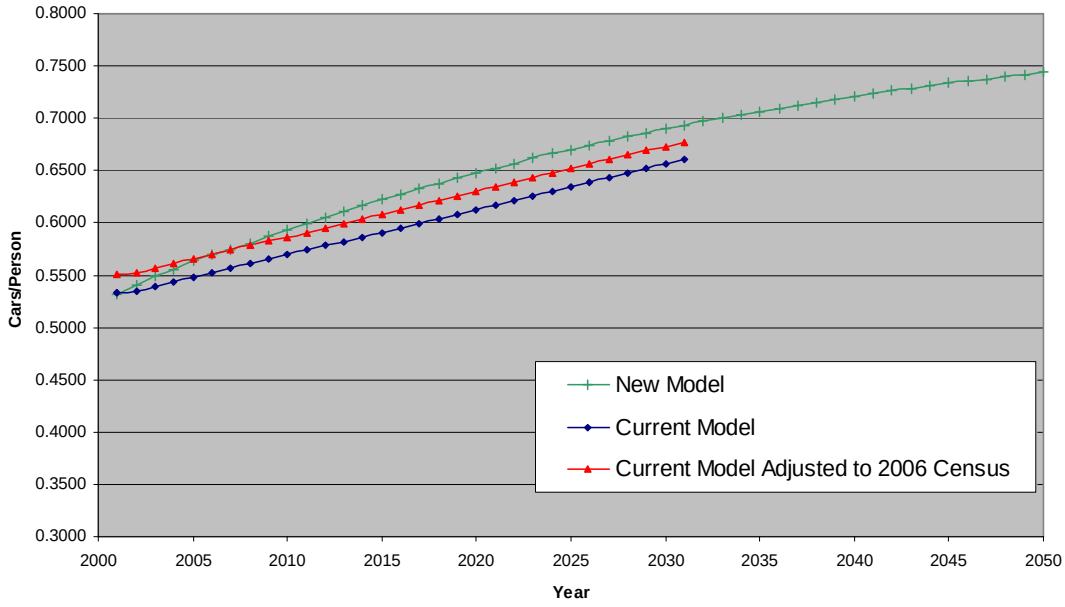
The GDP growth assumed is 1.8% p.a.

This model was developed for the new Auckland model (ART3) with input from David Ashley, reviewed by John Bates as part of the project team, and then peer reviewed by Pilo Willumson (the ARC's peer reviewer). The ART3 car ownership model report sets out the development of this.

The graph below shows:

- the current model forecasts from 2001,
- the current model forecasts from 2001, but adjusted to match the 2006 Census level, and
- the proposed new model forecasts from 2001, set to match the 2006 Census level.

The table following gives the 2001, 2006, 2016 and 2026 values in each case.



	Current Model	Current Model Adjusted to Match 2006 Census	New Model
2001	0.5334	0.5508	0.5318
2006	0.5519	0.5694	0.5694
2016	0.5952	0.6126	0.6273
2026	0.6384	0.6558	0.6743

Implementing the Proposed New Model

The proposed new model would be implemented for 2016 and 2026 as follows:

- the car ownership model would be run (ie the cross-sectional model), with the zonal lambda adjustments, and the average car ownership for 2+ cars given above used to calculate the average cars/person.

This would be compared with the temporal model forecast for each year and a global adjustment for each determined by trial and error so that the new forecasts were matched. These adjustments would replace the current temporal adjustments.

Appendix D Transport Networks

The following tables list the projects and investments included in the Do Minimum and RTP networks; the first covers all but the rail improvements which are given in the second table.

Projects	2006	2016	2026	DoMin Network	Description	Model Changes
MacKays Crossing Overbridge	Y	Y	Y	Y	Grade separation of SH1 and the rail crossing and local roads at MacKays crossing. Refer to Appendix A1 for layout. Construction now complete.	Grade separation implemented as no intersection delay
Inner City bypass	N	Y	Y	Y	New road layout including new signals between the Terrace Tunnel and the Basin Reserve. Refer to Appendix A2 for layout. Construction now complete.	Implemented
Waiohine Bridge	N	Y	Y	Y	Bridge replacement	No changes implemented as no change in capacity
Centennial Highway Median Barrier - Stage 1	Y	Y	Y	Y	Median barrier installation on SH1	No changes implemented as no change in capacity
Centennial Highway Median Barrier - Stage 2	N	Y	Y	Y	Median barrier installation on SH2	No changes implemented as no change in capacity
Dowse to Petone Interchange	N	Y	Y	Y	Currently under construction	Implemented
Basin Reserve Improvements	N	Y	Y	N	Grade separation in accordance with MWH option F. Refer to Appendix A3 for layout.	Implemented
Kapiti Western Link Road - Stage 1	N	Y	Y	Y	Construction of the WLR Stage 1	Implemented
Kapiti Western Link Road - Stage 2	N	Y	Y	Y	Construction of the WLR Stage 2	Implemented
Kapiti Western Link Road - Stage 3	N	Y	Y	Y	Construction of the WLR Stage 3	Implemented
Melling Interchange	N	N	Y	N	Grade separation of SH2 and Melling bridge. Refer to Appendix A5 for layout.	Implemented
Kennedy Good Bridge Grade	N	N	Y	N	Grade separation of SH2 and Kennedy Good bridge.	Implemented

Separation					Refer to Appendix A6 for layout.	
Rimutaka Corner Easing (Muldoon's)	N	Y	Y	N	Geometric improvements on SH2 Rimutaka Hill Road	No changes implemented as no change in capacity
SH2/58 Grade Separation	N	Y	Y	N	Grade separation of SH2 and SH58. Refer to Appendix A7 for layout	Implemented
Rugby St/Adelaide Rd Intersection	N	Y	Y	Y	Rugby St / Adelaide Rd Intersection signalisation and amendments to lane markings. Refer to Appendix A10 for layout. Construction completed.	Implemented
Ngauranga to Terrace Tunnel ATMS	N	Y	Y	Y	New ATMS infrastructure (VMS signage, cameras etc.) on SH1 between Ngauranga and the Terrace Tunnel.	No changes implemented
Petone to Ngauranga ATMS	N	Y	Y	Y	New ATMS infrastructure (VMS signage, cameras etc.) on SH2 between Petone and Ngauranga.	No changes implemented
Otaki Roundabout	N	Y	Y	Y	Additional circulating lanes installed on the Otaki Roundabout	Implemented
Old Hautere Road Safety Improvements	N	Y	Y	Y	Intersection safety improvements	No changes implemented
Paekakariki Improvements	N	Y	Y	Y	New seagull layout at the SH1 / Paekakariki Hill Road / Beach Road. Refer to Appendix A8 for layout.	Implemented
Pukerua Bay Improvements	N	Y	Y	Y	Safety improvements at intersections.	No changes implemented as no impact on capacity
Otaki to Waikanae Sth Bd PL	N	Y	Y	Y	SH1 Otaki to Waikanae southbound passing lane - location is from RP 1012/0.47 to RP 1012/2.25 approx	Not coded in model
Featherston to Greytown Nth Bd PL	N	Y	Y	Y	Northbound passing lane located between Featherston and Greytown	Not coded in model
Greytown to Featherston Sth Bd PL	N	Y	Y	Y	Northbound passing lane located between Featherston and Greytown	Not coded in model
Carterton to Masterton Nth Bd PL	N	Y	Y	Y	Northbound passing lane located between Carterton to Masterton	Not coded in model
Masterton to	N	Y	Y	Y	Southbound passing lane	Not coded in model

Carterton Sth Bd PL					located between Masterton to Carterton	
Judgeford Passing Lane	N	Y	Y	Y	Unknown - check with Transit	Not coded in model
Petone - Horokiwi Cycling Facility						No changes implemented as no impact on capacity
Teihana Road Pedestrian Facilities						No changes implemented as no impact on capacity
Wellington State Highway Strategy						No changes implemented as no impact on capacity
SH2 Petone to Hayward Safety Review						No changes implemented as no impact on capacity
Wellington Cycle Strategic Audit						No changes implemented as no impact on capacity
TDM Impacts	N	Y	Y	Y	Impacts of TDM strategy - the RLTS assumes 5% reduction in trips to the CBD.	Revised approach implemented
Lindale Grade Separation	Y	Y	Y	Y	Already constructed.	No connections in model to modify
Mana-Plimerton Upgrade	Y	Y	Y	Y	Already constructed.	Implemented in 2006 base
Waterloo Quay Rail Grade Separation	N	Y	Y	N	Grade separation of Aotea Quay and the rail line to the port.	Not to be included in the model
Terrace Tunnel Tidal flow	N	Y	Y	N	Installation of two vs one lane tidal flow in the peak periods through the Terrace Tunnel	Implemented
Ngauranga – Aotea Capacity Improvement	N	Y	Y	N	8-laning of SH1 between Ngauranga and Aotea Quay offramp.	Implemented
Grenada - Gracefield Stage 1 to Petone	N	Y	Y	N	New link between SH1 (Grenada North) and SH2 (Petone).	Implemented
Grenada - Gracefield Stage 2 CVL	N	N	Y	N	New link between SH2 (Petone) and Gracefield.	Implemented
SH58 SH2-summit 4 laning	N	N	N	N	4-laning from SH2 to the summit	
Petone - Ngauranga incl cyclelane	N	Y	Y	N		No changes implemented as no impact on capacity
Akatarawa	N	N	N	N		

Upgrade						
TDM, Western Corridor ATMS+HOV	N	N	N	N		
Transmission Gully Motorway Construction	N	Y	Y	N	Transmission Gully Motorway constructed between MacKays crossing and Linden with all connections as per the Beca Costed viaduct option. Refer to Appendix A9 for layout. Capacity across Mana Bridge reduced to one lane in each direction.	Implemented
SH58 upgrade TGM to SH2	N	N	Y	N	Roundabouts at 7 locations & 70 km/h treatment: ▪ Roundabout at Bradey Road ▪ Roundabout at Sawmill ▪ Roundabout at Belmont Road ▪ Roundabout at Murphys Rd / Flightys Rd ▪ Roundabout at Mulhern Rd ▪ Roundabout at Judgeford Golf Club entrance ▪ Roundabout at Moonshine Road ▪ 70 km/h speed limit from Pauatahanui to Moonshine Road Existing alignment with 100 km/h speed limit from Moonshine Road to SH2	Not implemented in the model
Otaihanga Interchange (2 lane)	N	Y	Y	N	Grade separation of SH1 and Otaihanga Road	Implemented
Waikanae Upgrade	N	N	Y	N	Grade separation of SH1 and Te Moana and Elizabeth Street in Waikanae	Implemented
Rail Station Maintenance and Upgrade	N	Y	Y	Y		No changes implemented in model
Park & ride Carparks	N	Y	Y	Y		No changes implemented in model

Porirua Interchange	N	N	N	N		
Kaiwharawhara Throat Improvements	N	Y	Y	Y	Additional capacity at the Kaiwharawhara throat. Improved reliability.	Not implemented in the model
Integrated Ticketing	N	Y	Y	N	Reduced boarding time as a result of improved ticketing	Reduction in boarding penalty of 0.5 minute
Integrated Fares	N	Y	Y	N	Passengers can pay for whole journey independent of operator	No boarding fare for 2nd/3rd boardings in assignment
Real Time Information Systems	N	Y	Y	N	New automated passenger information signs	1 minute reduction in boarding times based on 5% fare and VoT $6/h
Buslanes	N	Y	Y	N		Implemented
Road Pricing	N	N	N	N		Not implemented in the model

Scenario		Do Minimum 2016 and 2026	RTP 2016 - 15-Minute Scenario	RTP 2026 - 10-Minute Scenario
Service Spec - Peak	Hutt	As existing	4 tph Upper Hutt <-> Wellington (all stops to Taita, then non-stop Waterloo, then non-stop Wellington)	6 tph Upper Hutt <-> Wellington (all stops to Taita, then non-stop Waterloo, then non-stop Wellington)
			4 tph Taita <->Wellington (all stops Wellington)	6 tph Taita <->Wellington (all stops Wellington)
			4 tph Melling <->Wellington (all stops Wellington)	4 tph Melling <->Wellington (all stops Wellington)
	Western	As existing but …	4 tph Waikanae <-> Wellington (all stops to Porirua, then non-stop Wellington)	6 tph Waikanae <-> Wellington (all stops to Plimmerton, then non-stop Wellington)
		Paraparaumu <-> Wellington services extended to Waikanae (non stop Porirua to Wellington)	4 tph Plimmerton <-> Wellington (all stops to Wellington)	6 tph Plimmerton <-> Wellington (all stops to Porirua, non-stop Wellington)
				6 tph Porirua <-> Wellington (all stops to

				Wellington)
	Johnsonville	As existing	4 tph Johnsonville <-> Wellington (all stops to Wellington)	6 tph Johnsonville <-> Wellington (all stops to Wellington)
	Wairarapa	As existing	As existing	2 tph Wairarapa <-> Wellington (existing stopping pattern)
Service Spec - Offpeak	Hutt	As existing	2 tph Upper Hutt <-> Wellington (all stops to Wellington)	3 tph Upper Hutt <-> Wellington (all stops to Wellington)
			No Melling	2 tph Melling <-> Wellington (all stops)
	Western	As existing but … Paraparaumu <-> Wellington services extended to Waikanae (non stop Porirua to Wellington)	2 tph Waikanae <-> Wellington (all stops to Wellington)	3 tph Waikanae <-> Wellington (all stops to Wellington)
	Johnsonville	As existing	2 tph Johnsonville <-> Wellington (all stops to Wellington)	3 tph Johnsonville <-> Wellington (all stops to Wellington)
	Wairarapa	As existing	As existing	As existing
New Rolling Stock - Better Quality	Johnsonville/ Wairarapa	replacement of English Electric and older stock	As DM	As DM
	Capital Connection	same stock	As DM	As DM
	Rest	replacement of Ganz	As DM	As DM
New Rolling Stock - Faster Speeds	All lines	10% faster services apart from north of Waikanae	As DM	As DM
Stations	Lindale	No	Yes	Yes
	Raumati	No	No	Yes
	Electrification to Maymorn (all UH services running to Maymorn)	No	No	Yes
	Timberlea	No	No	Yes
	Cruickshank	No	No	Yes
	Kaiwharawhara	Closed	Closed	Closed

Appendix E Traffic Volumes Across Screenlines

Traffic Volumes Across Screenlines - Difference with 2006

		2006	2016 Do Min			2026 Do Min		
SL	Dir	Value	Value	Diff	% Diff	Value	Diff	% Diff
AM								
W1	In	29,109	33,440	4,331	15%	35,553	6,444	22%
W1	Out	15,954	19,151	3,197	20%	21,081	5,127	32%
W2	East	2,889	3,265	377	13%	3,598	709	25%
W2	West	4,178	4,800	622	15%	5,328	1,149	28%
W3	East	3,069	3,444	375	12%	3,688	619	20%
W3	West	1,675	1,877	202	12%	1,990	315	19%
W4	North	6,182	7,374	1,192	19%	8,247	2,065	33%
W4	South	13,608	14,142	534	4%	14,256	647	5%
W5	North	3,889	4,476	588	15%	5,028	1,140	29%
W5	South	7,167	7,993	826	12%	8,238	1,072	15%
L1	North	5,468	6,482	1,015	19%	7,228	1,760	32%
L1	South	8,012	8,240	228	3%	8,235	223	3%
L2	North	3,286	3,843	558	17%	4,236	951	29%
L2	South	5,666	6,299	633	11%	6,389	723	13%
L3	In	9,852	10,666	815	8%	11,088	1,236	13%
L3	Out	8,327	9,565	1,238	15%	10,289	1,962	24%
L4	North	6,085	6,589	504	8%	6,871	787	13%
L4	South	2,467	2,775	308	12%	2,954	487	20%
U1	North	1,466	1,716	249	17%	2,101	635	43%
U1	South	2,121	2,439	318	15%	2,526	404	19%
U2	North	3,413	3,985	573	17%	4,487	1,074	31%
U2	South	4,508	4,862	354	8%	4,844	336	7%
U3	East	811	876	65	8%	923	111	14%
U3	West	378	432	54	14%	475	97	26%
P1	North	1,404	1,567	164	12%	1,645	241	17%
P1	South	2,627	2,996	368	14%	3,114	486	19%
P2	East	1,549	1,884	335	22%	2,050	501	32%
P2	West	1,438	1,567	129	9%	1,524	87	6%
P3	North	2,899	3,462	563	19%	3,943	1,044	36%
P3	South	5,519	6,013	494	9%	6,095	576	10%
IP								
W1	In	15,455	19,085	3,630	23%	21,032	5,577	36%
W1	Out	15,595	18,670	3,076	20%	20,658	5,063	32%
W2	East	2,954	3,344	390	13%	3,742	787	27%
W2	West	2,953	3,334	382	13%	3,724	771	26%
W3	East	1,784	1,995	212	12%	2,150	366	21%
W3	West	1,736	1,945	209	12%	2,094	358	21%

		2006	2016 Do Min			2026 Do Min		
SL	Dir	Value	Value	Diff	% Diff	Value	Diff	% Diff
W4	North	5,754	6,806	1,052	18%	7,474	1,720	30%
W4	South	5,991	6,974	983	16%	7,569	1,579	26%
W5	North	3,136	3,674	537	17%	4,057	921	29%
W5	South	3,301	3,873	572	17%	4,273	972	29%
L1	North	4,414	5,259	845	19%	5,875	1,461	33%
L1	South	4,490	5,206	716	16%	5,709	1,219	27%
L2	North	3,088	3,521	433	14%	3,872	784	25%
L2	South	3,102	3,487	385	12%	3,783	681	22%
L3	In	7,129	8,020	891	12%	8,629	1,500	21%
L3	Out	6,998	7,919	921	13%	8,542	1,544	22%
L4	North	3,143	3,480	336	11%	3,705	561	18%
L4	South	3,066	3,412	345	11%	3,645	578	19%
U1	North	1,469	1,757	288	20%	2,079	610	42%
U1	South	1,475	1,757	282	19%	2,053	578	39%
U2	North	2,912	3,351	440	15%	3,744	832	29%
U2	South	2,962	3,380	418	14%	3,732	770	26%
U3	East	481	535	54	11%	576	95	20%
U3	West	511	579	68	13%	638	128	25%
P1	North	1,436	1,619	184	13%	1,715	279	19%
P1	South	1,385	1,524	139	10%	1,595	210	15%
P2	East	954	1,026	71	7%	1,097	143	15%
P2	West	977	1,063	86	9%	1,127	150	15%
P3	North	2,620	3,106	486	19%	3,454	834	32%
P3	South	2,715	3,200	484	18%	3,527	812	30%
PM								
W1	In	18,574	22,283	3,709	20%	24,209	5,635	30%
W1	Out	27,681	31,659	3,978	14%	33,865	6,184	22%
W2	East	4,363	4,940	577	13%	5,458	1,095	25%
W2	West	3,464	3,879	415	12%	4,285	822	24%
W3	East	2,110	2,321	211	10%	2,461	351	17%
W3	West	2,956	3,299	344	12%	3,549	593	20%
W4	North	12,606	13,722	1,116	9%	14,083	1,476	12%
W4	South	7,587	8,915	1,328	17%	9,622	2,035	27%
W5	North	6,742	7,802	1,061	16%	8,200	1,458	22%
W5	South	4,463	5,141	678	15%	5,702	1,239	28%
L1	North	7,845	8,117	273	3%	8,195	350	4%
L1	South	6,263	7,327	1,064	17%	7,727	1,465	23%
L2	North	5,337	5,795	457	9%	6,039	702	13%
L2	South	3,852	4,445	593	15%	4,771	919	24%
L3	In	9,292	10,550	1,258	14%	11,181	1,889	20%
L3	Out	10,485	11,379	894	9%	11,819	1,335	13%
L4	North	3,303	3,661	358	11%	3,836	533	16%
L4	South	5,868	6,364	496	8%	6,631	763	13%

		2006	2016 Do Min			2026 Do Min		
SL	Dir	Value	Value	Diff	% Diff	Value	Diff	% Diff
U1	North	2,160	2,493	333	15%	2,696	535	25%
U1	South	1,752	2,111	359	21%	2,482	730	42%
U2	North	4,465	4,837	372	8%	4,961	496	11%
U2	South	3,850	4,454	603	16%	4,880	1,030	27%
U3	East	517	571	54	10%	606	89	17%
U3	West	853	931	78	9%	989	136	16%
P1	North	2,471	2,677	206	8%	2,743	272	11%
P1	South	1,692	1,762	71	4%	1,772	81	5%
P2	East	1,508	1,704	196	13%	1,740	232	15%
P2	West	1,509	1,741	231	15%	1,960	451	30%
P3	North	5,173	5,840	667	13%	6,001	829	16%
P3	South	3,527	4,048	521	15%	4,476	950	27%

Traffic Volumes Across Screenlines – Effect of RTP

		2016				2026			
SL	Dir	Do Min Trips	RTP Trips	Diff	% Diff	Do Min Trips	RTP Trips	Diff	% Diff
AM									
W1	In	33,440	33,689	248	1%	35,553	36,134	581	2%
W1	Out	19,151	18,894	-257	-1%	21,081	21,049	-32	0%
W2	East	3,265	3,277	12	0%	3,598	3,606	8	0%
W2	West	4,800	4,776	-24	-1%	5,328	5,317	-10	0%
W3	East	3,444	3,443	-1	0%	3,688	3,733	44	1%
W3	West	1,877	1,892	15	1%	1,990	2,026	36	2%
W4	North	7,374	7,526	152	2%	8,247	8,611	364	4%
W4	South	14,142	15,794	1,652	12%	14,256	16,100	1,844	13%
W5	North	4,476	4,014	-463	-10%	5,028	4,601	-427	-8%
W5	South	7,993	7,138	-855	-11%	8,238	7,372	-866	-11%
L1	North	6,482	4,739	-1,743	-27%	7,228	5,412	-1,816	-25%
L1	South	8,240	7,744	-496	-6%	8,235	7,774	-461	-6%
L2	North	3,843	3,647	-196	-5%	4,236	4,243	7	0%
L2	South	6,299	6,344	46	1%	6,389	6,390	2	0%
L3	In	10,666	11,307	640	6%	11,088	10,264	-824	-7%
L3	Out	9,565	9,888	323	3%	10,289	10,341	53	1%
L4	North	6,589	6,747	158	2%	6,871	7,035	164	2%
L4	South	2,775	2,819	44	2%	2,954	3,031	77	3%
U1	North	1,716	1,736	21	1%	2,101	2,124	23	1%

		2016				2026			
SL	Dir	Do Min Trips	RTP Trips	Diff	% Diff	Do Min Trips	RTP Trips	Diff	% Diff
U1	South	2,439	2,435	-4	0%	2,526	2,466	-60	-2%
U2	North	3,985	4,265	280	7%	4,487	4,881	394	9%
U2	South	4,862	5,164	302	6%	4,844	5,118	274	6%
U3	East	876	881	5	1%	923	909	-13	-1%
U3	West	432	432	0	0%	475	476	1	0%
P1	North	1,567	1,821	254	16%	1,645	1,904	259	16%
P1	South	2,996	1,216	3,603	120%	3,114	3,825	711	23%
P2	East	1,884	1,963	79	4%	2,050	1,959	-91	-4%
P2	West	1,567	1,449	-118	-8%	1,524	1,334	-191	-13%
P3	North	3,462	3,963	501	14%	3,943	4,437	494	13%
P3	South	6,013	6,587	573	10%	6,095	6,934	839	14%
IP									
W1	In	19,085	19,045	-40	0%	21,032	21,075	43	0%
W1	Out	18,670	18,633	-37	0%	20,658	20,716	58	0%
W2	East	3,344	3,339	-4	0%	3,742	3,721	-20	-1%
W2	West	3,334	3,328	-6	0%	3,724	3,701	-22	-1%
W3	East	1,995	1,990	-6	0%	2,150	2,154	4	0%
W3	West	1,945	1,941	-4	0%	2,094	2,099	5	0%
W4	North	6,806	6,843	37	1%	7,474	7,607	133	2%
W4	South	6,974	7,078	104	1%	7,569	7,743	173	2%
W5	North	3,674	2,952	-722	-20%	4,057	3,264	-793	-20%
W5	South	3,873	3,148	-725	-19%	4,273	3,454	-819	-19%
L1	North	5,259	4,121	-1,138	-22%	5,875	4,605	-1,270	-22%
L1	South	5,206	4,242	-964	-19%	5,709	4,654	-1,054	-18%
L2	North	3,521	3,536	15	0%	3,872	3,974	102	3%
L2	South	3,487	3,539	51	1%	3,783	3,895	112	3%
L3	In	8,020	8,166	146	2%	8,629	8,228	-401	-5%
L3	Out	7,919	8,026	107	1%	8,542	8,138	-404	-5%
L4	North	3,480	3,498	19	1%	3,705	3,729	24	1%
L4	South	3,412	3,415	3	0%	3,645	3,653	8	0%
U1	North	1,757	1,748	-9	0%	2,079	2,063	-17	-1%
U1	South	1,757	1,751	-5	0%	2,053	2,036	-17	-1%
U2	North	3,351	3,511	160	5%	3,744	3,901	157	4%
U2	South	3,380	3,562	181	5%	3,732	3,908	176	5%
U3	East	535	534	-1	0%	576	573	-3	0%
U3	West	579	577	-2	0%	638	635	-3	-1%
P1	North	1,619	1,801	182	11%	1,715	1,899	185	11%
P1	South	1,524	1,713	189	12%	1,595	1,794	199	12%
P2	East	1,026	1,234	209	20%	1,097	1,207	110	10%
P2	West	1,063	1,261	198	19%	1,127	1,249	121	11%

		2016				2026			
SL	Dir	Do Min Trips	RTP Trips	Diff	% Diff	Do Min Trips	RTP Trips	Diff	% Diff
P3	North	3,106	3,228	122	4%	3,454	3,573	119	3%
P3	South	3,200	3,303	104	3%	3,527	3,651	124	4%
PM									
W1	In	22,283	22,629	345	2%	24,209	24,935	726	3%
W1	Out	31,659	32,620	961	3%	33,865	35,184	1,318	4%
W2	East	4,940	4,947	7	0%	5,458	5,471	13	0%
W2	West	3,879	3,910	31	1%	4,285	4,313	27	1%
W3	East	2,321	2,364	43	2%	2,461	2,521	60	2%
W3	West	3,299	3,306	6	0%	3,549	3,589	40	1%
W4	North	13,722	15,047	1,325	10%	14,083	15,659	1,577	11%
W4	South	8,915	9,223	309	3%	9,622	10,293	671	7%
W5	North	7,802	6,718	-1,084	-14%	8,200	7,611	-589	-7%
W5	South	5,141	4,584	-557	-11%	5,702	5,129	-573	-10%
L1	North	8,117	7,595	-522	-6%	8,195	7,720	-475	-6%
L1	South	7,327	5,750	-1,577	-22%	7,727	6,847	-880	-11%
L2	North	5,795	6,109	314	5%	6,039	6,436	397	7%
L2	South	4,445	4,270	-174	-4%	4,771	4,743	-28	-1%
L3	In	10,550	10,892	342	3%	11,181	11,100	-81	-1%
L3	Out	11,379	12,178	799	7%	11,819	11,163	-656	-6%
L4	North	3,661	3,731	70	2%	3,836	3,959	123	3%
L4	South	6,364	6,606	242	4%	6,631	6,911	280	4%
U1	North	2,493	2,510	16	1%	2,696	2,699	4	0%
U1	South	2,111	2,121	10	0%	2,482	2,519	38	2%
U2	North	4,837	5,285	449	9%	4,961	5,409	449	9%
U2	South	4,454	4,769	315	7%	4,880	5,280	400	8%
U3	East	571	572	1	0%	606	609	3	0%
U3	West	931	939	8	1%	989	988	-2	0%
P1	North	2,677	3,329	652	24%	2,743	3,489	746	27%
P1	South	1,762	2,083	321	18%	1,772	2,112	340	19%
P2	East	1,704	1,578	-126	-7%	1,740	1,424	-316	-18%
P2	West	1,741	1,929	188	11%	1,960	1,989	29	1%
P3	North	5,840	6,271	431	7%	6,001	6,586	584	10%
P3	South	4,048	4,622	574	14%	4,476	5,114	637	14%

Appendix F LOS Plots

AM peak LOS plots for 2006 and the forecasts are shown in the following figures. Links are coloured as follows:

- Green: LOS A or B
- Blue: LOS C or D
- Red: LOS E or F

Figure 1 AM Peak LOS, 2006, CBD

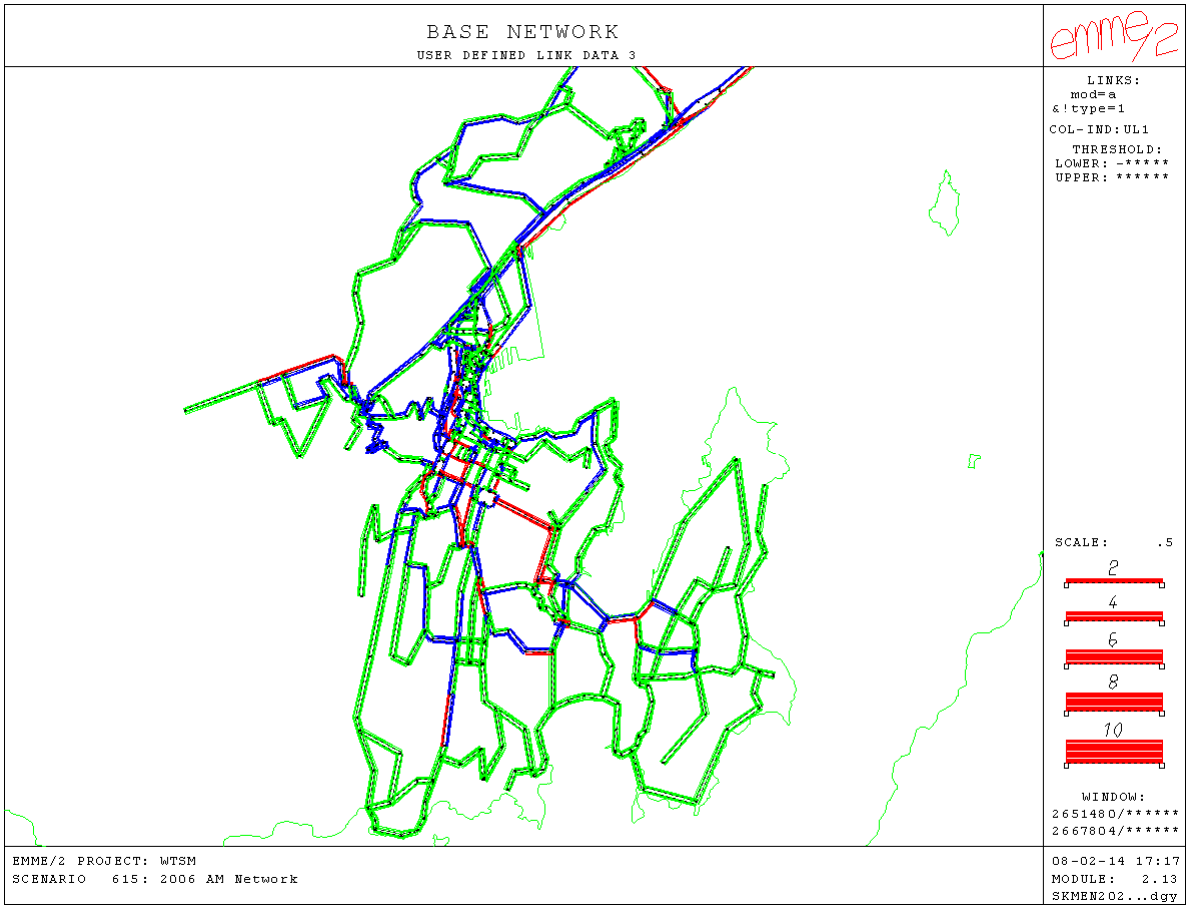
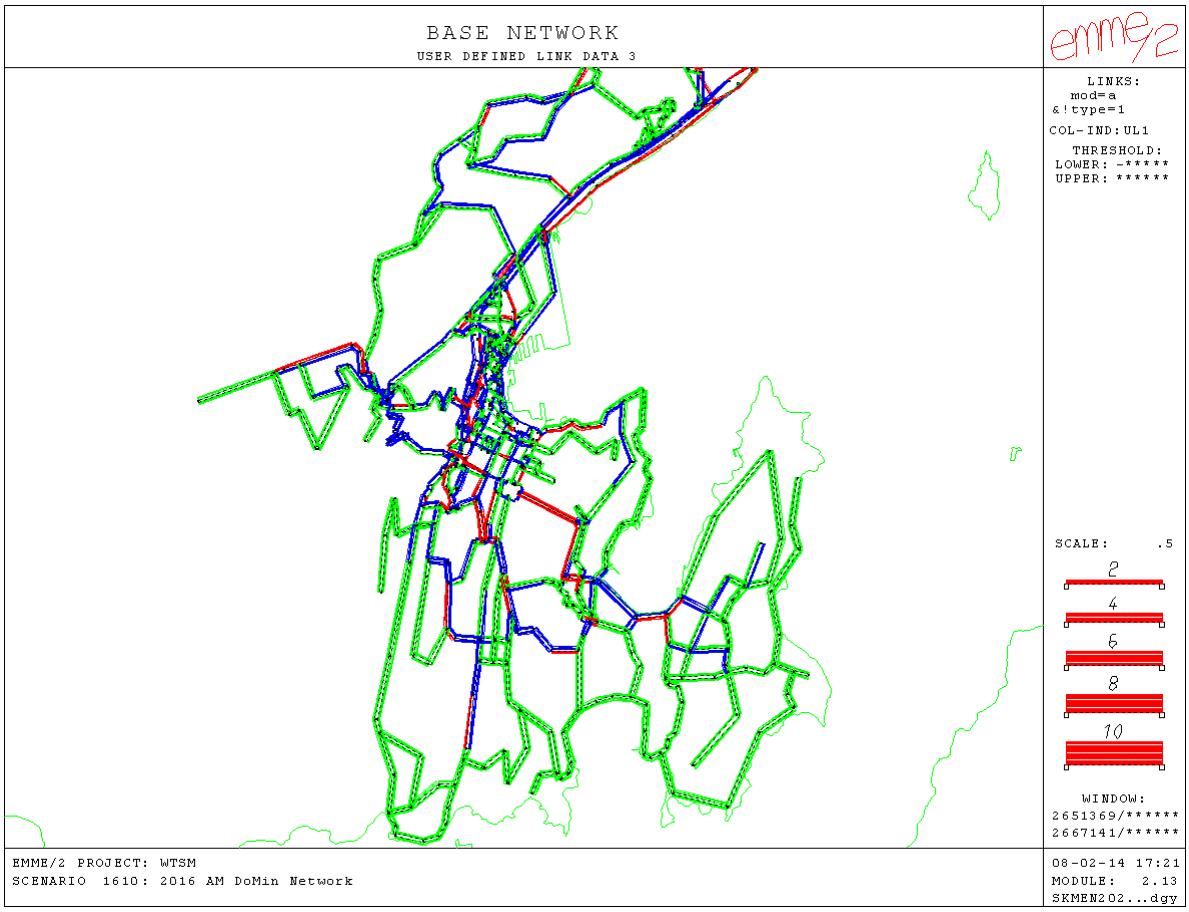


Figure 2 AM Peak LOS, 2016 Do Minimum, CBD



- **Figure 3 AM Peak LOS, 2016 RTP, CBD**

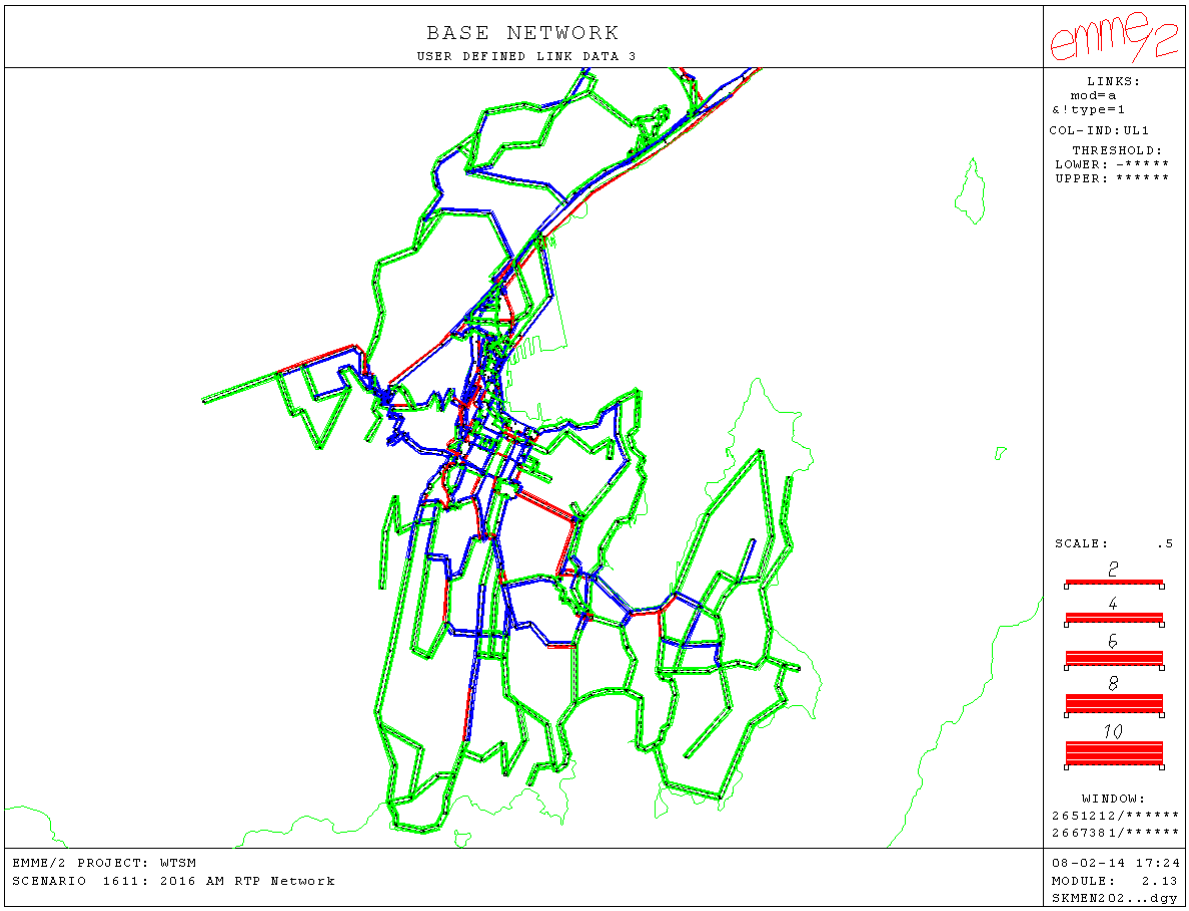
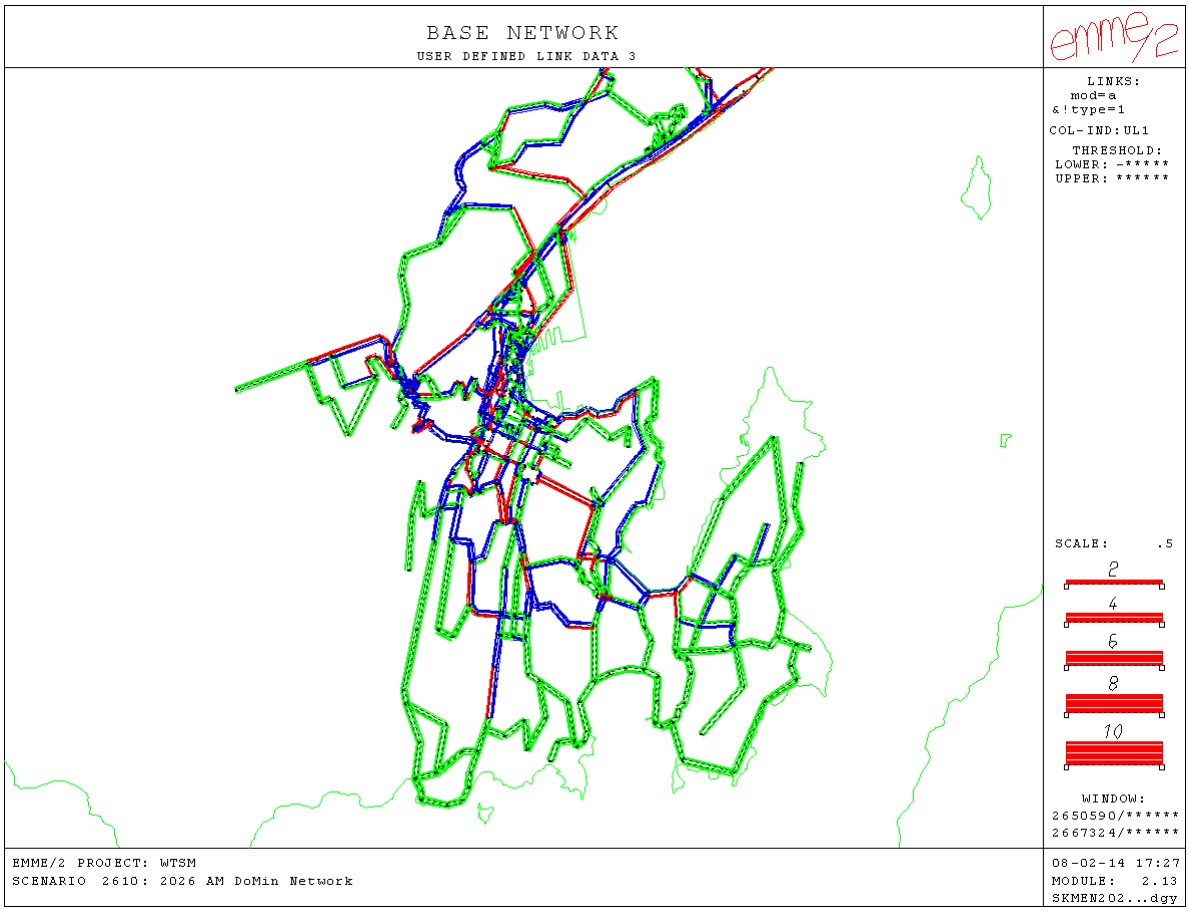


Figure 4 AM Peak LOS, 2026 Do Minimum, CBD



- **Figure 5 AM Peak LOS, 2026 RTP, CBD**

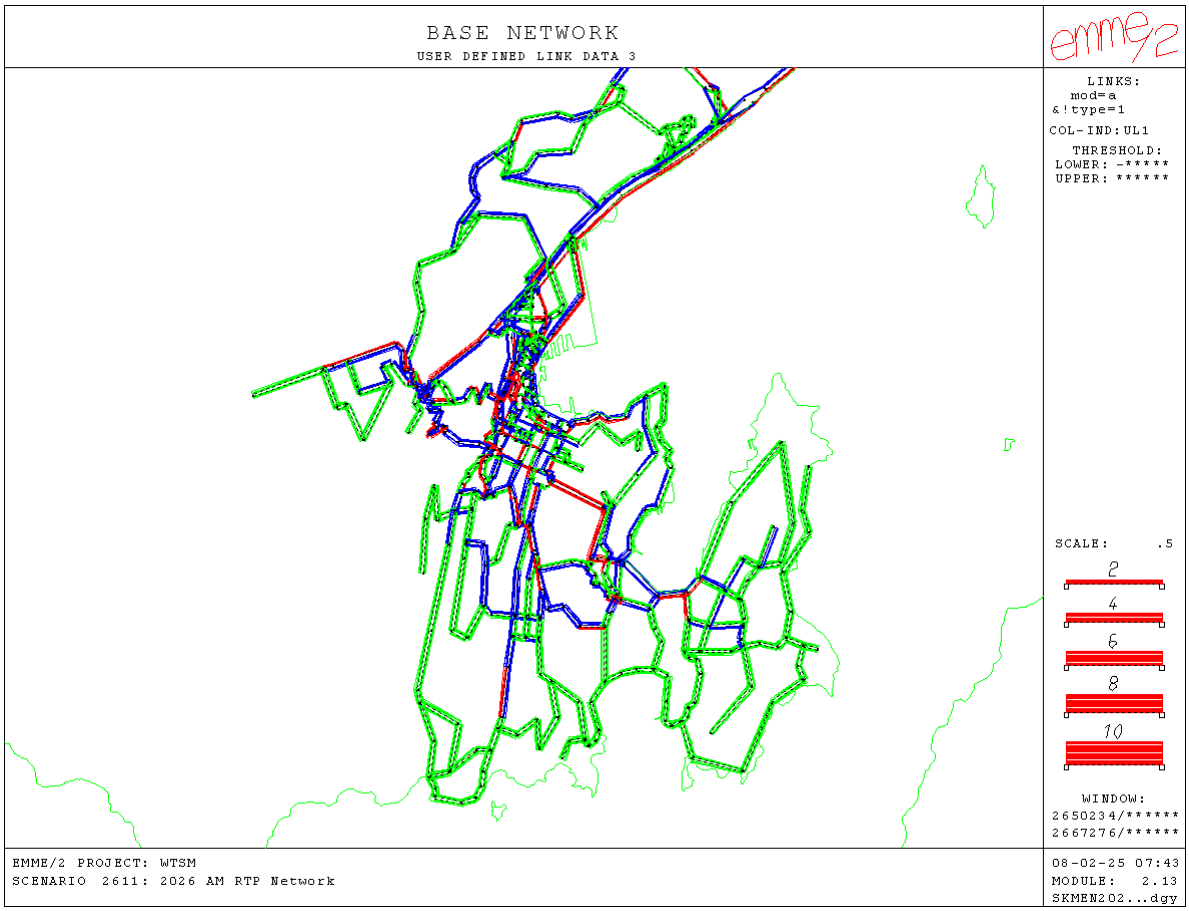
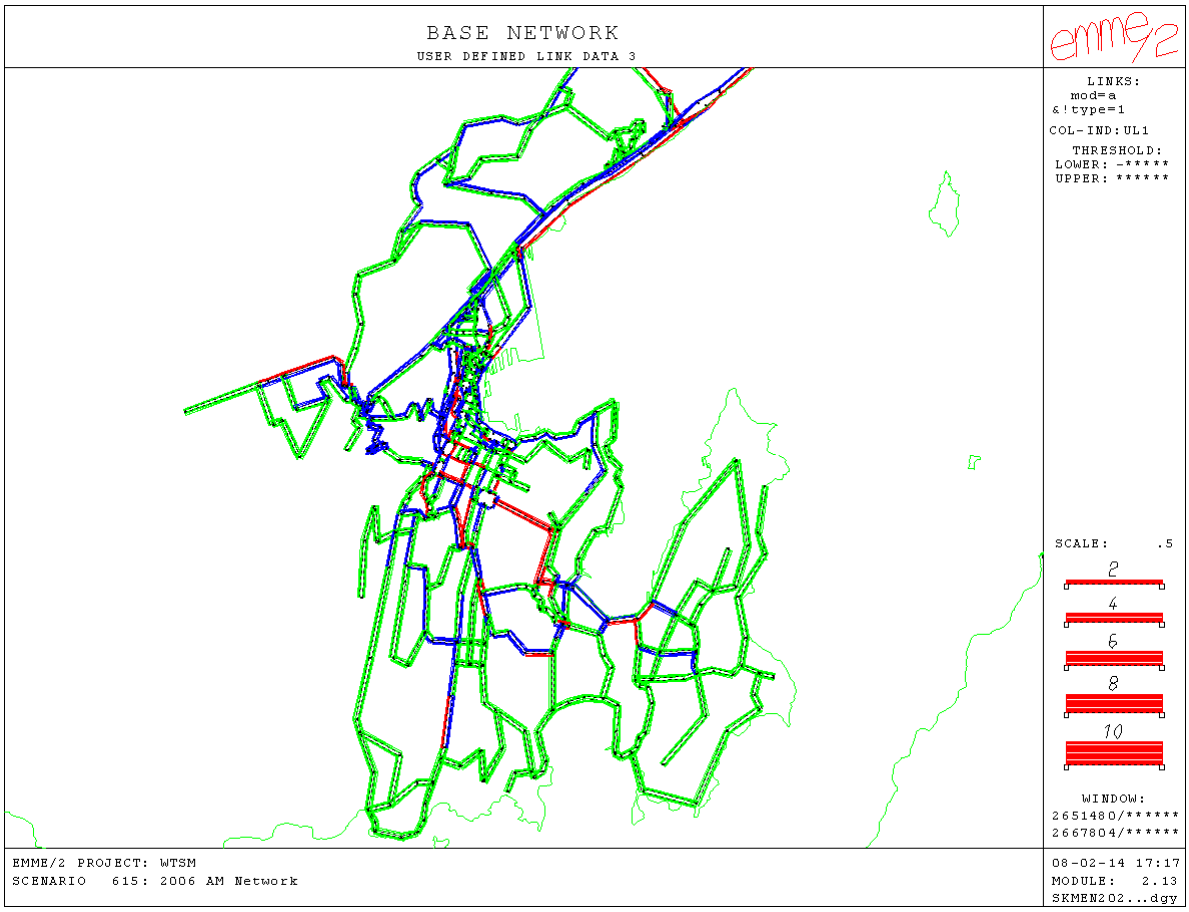
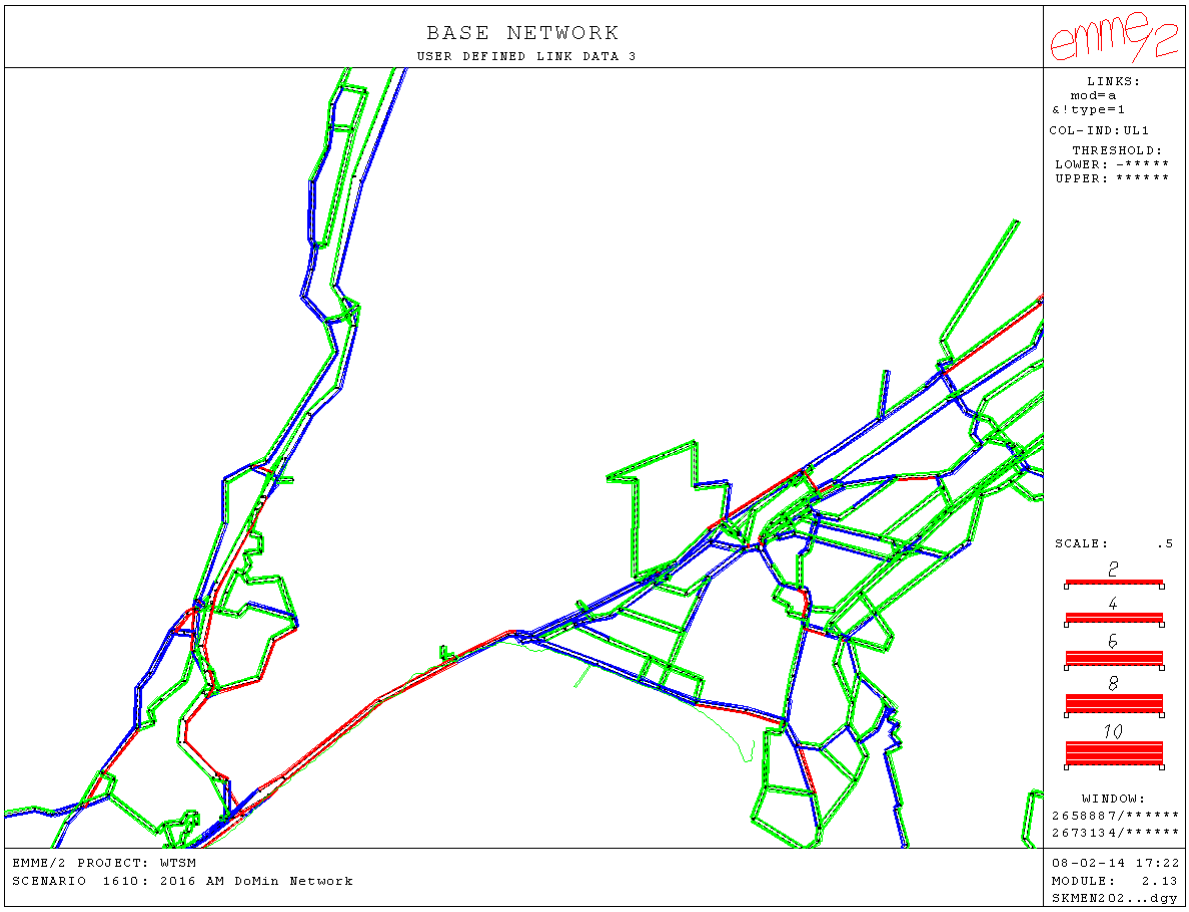


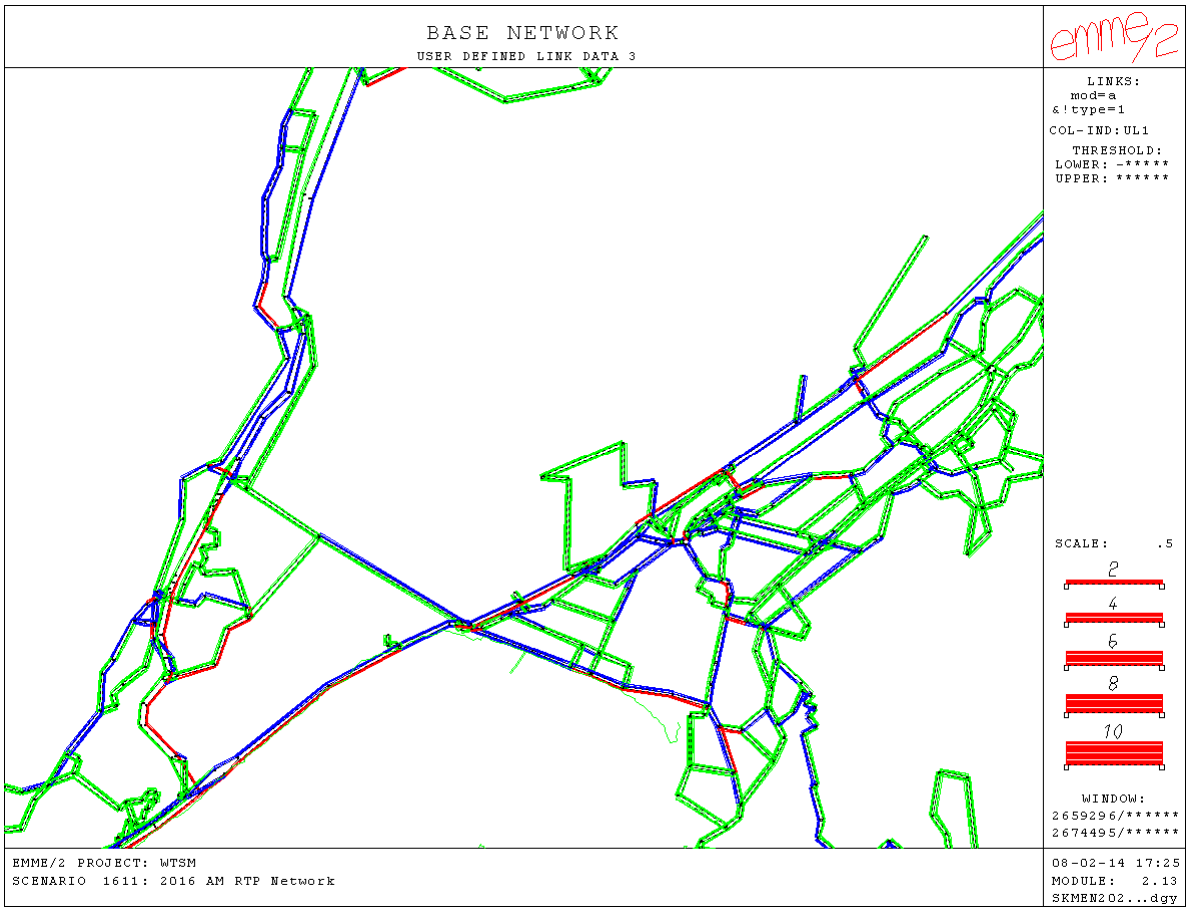
Figure 6 AM Peak LOS, 2006, Ngauranga-Petone



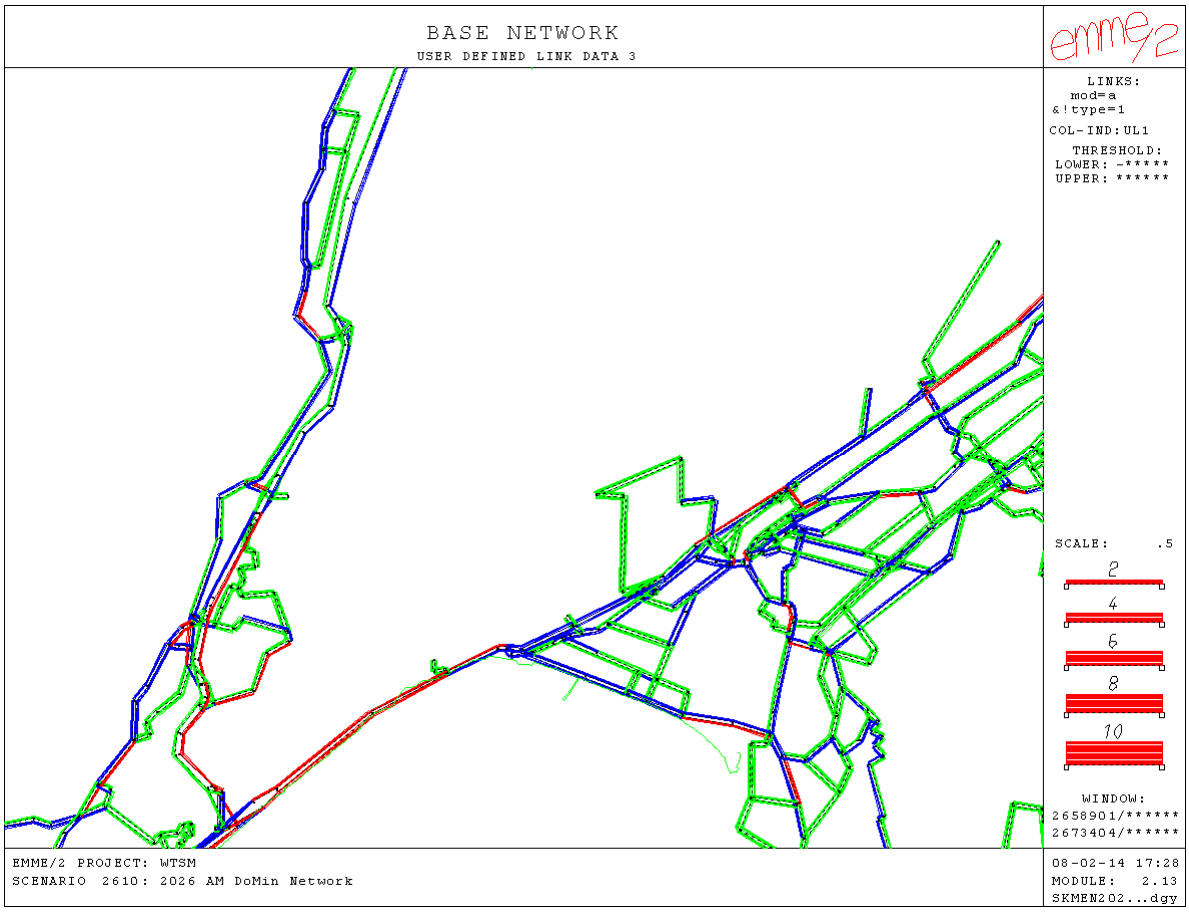
- **Figure 7 AM Peak LOS, 2016 Do Minimum, Ngauranga-Petone**



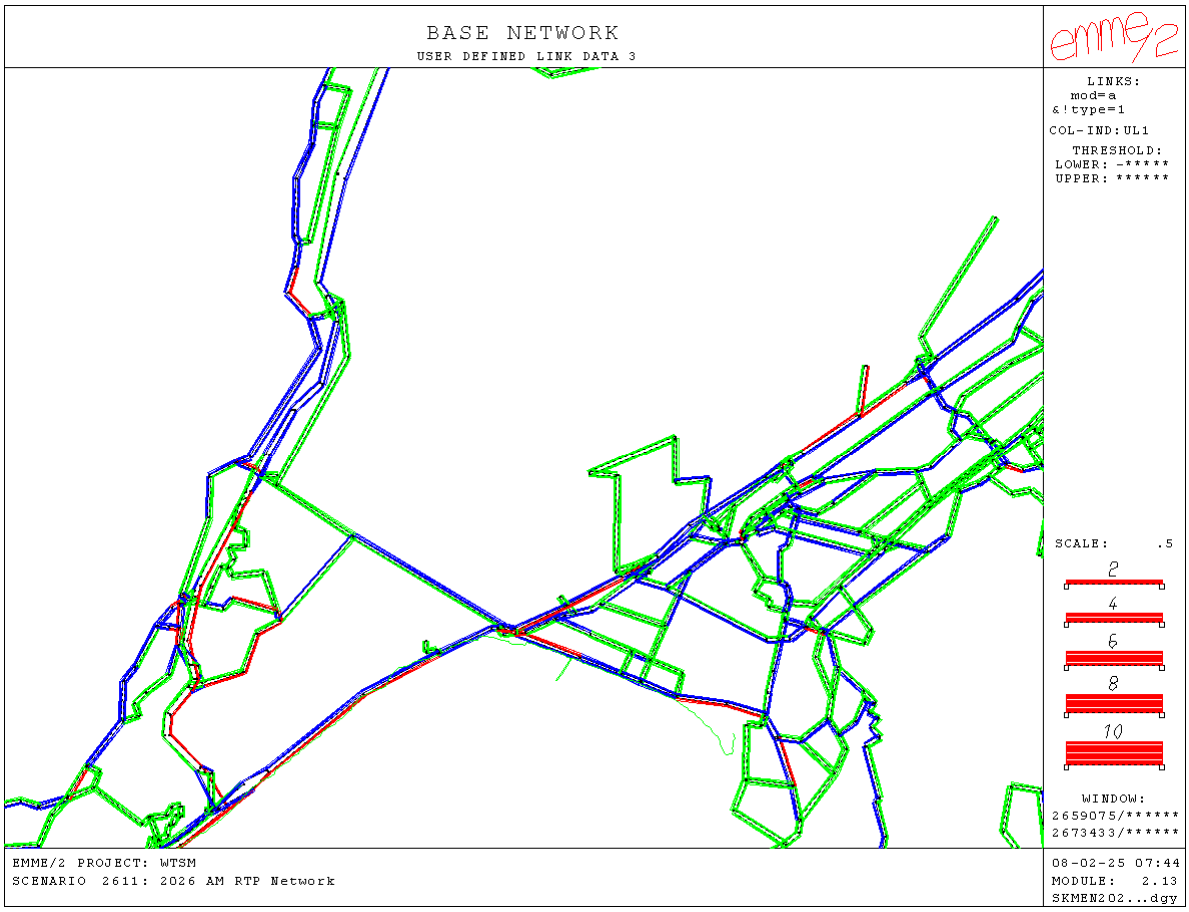
- **Figure 8 AM Peak LOS, 2016 RTP, Ngauranga-Petone**



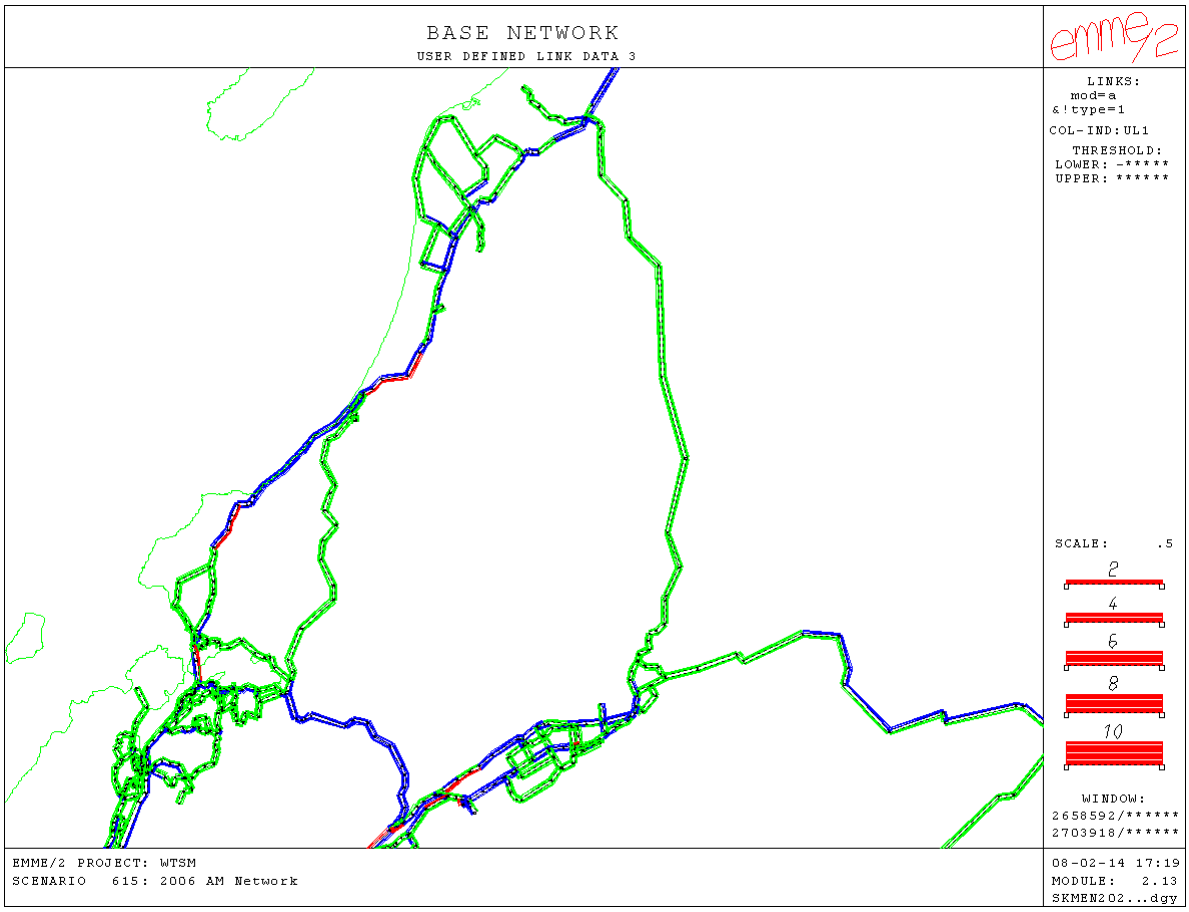
- **Figure 9 AM Peak LOS, 2026 Do Minimum, Ngauranga-Petone**



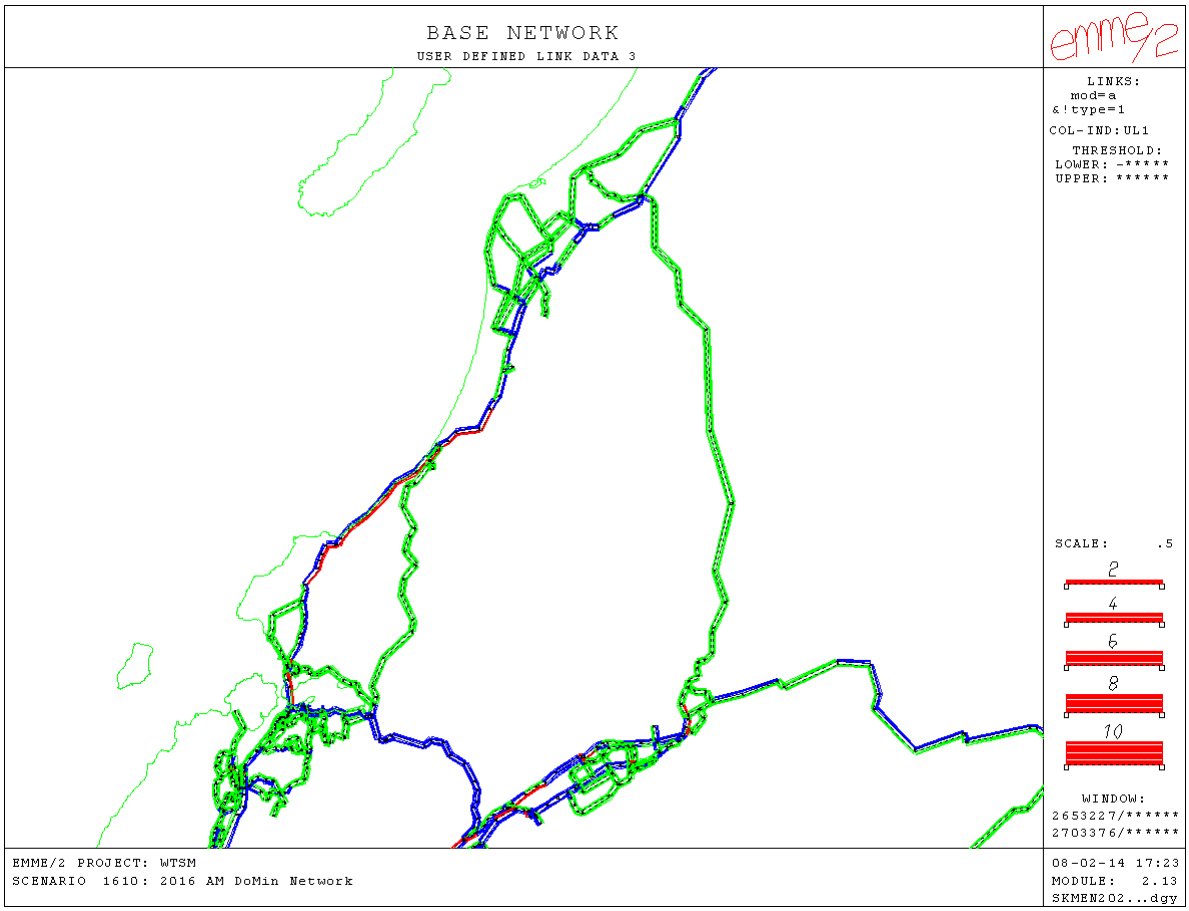
- **Figure 10 AM Peak LOS, 2026 RTP, Ngauranga-Petone**



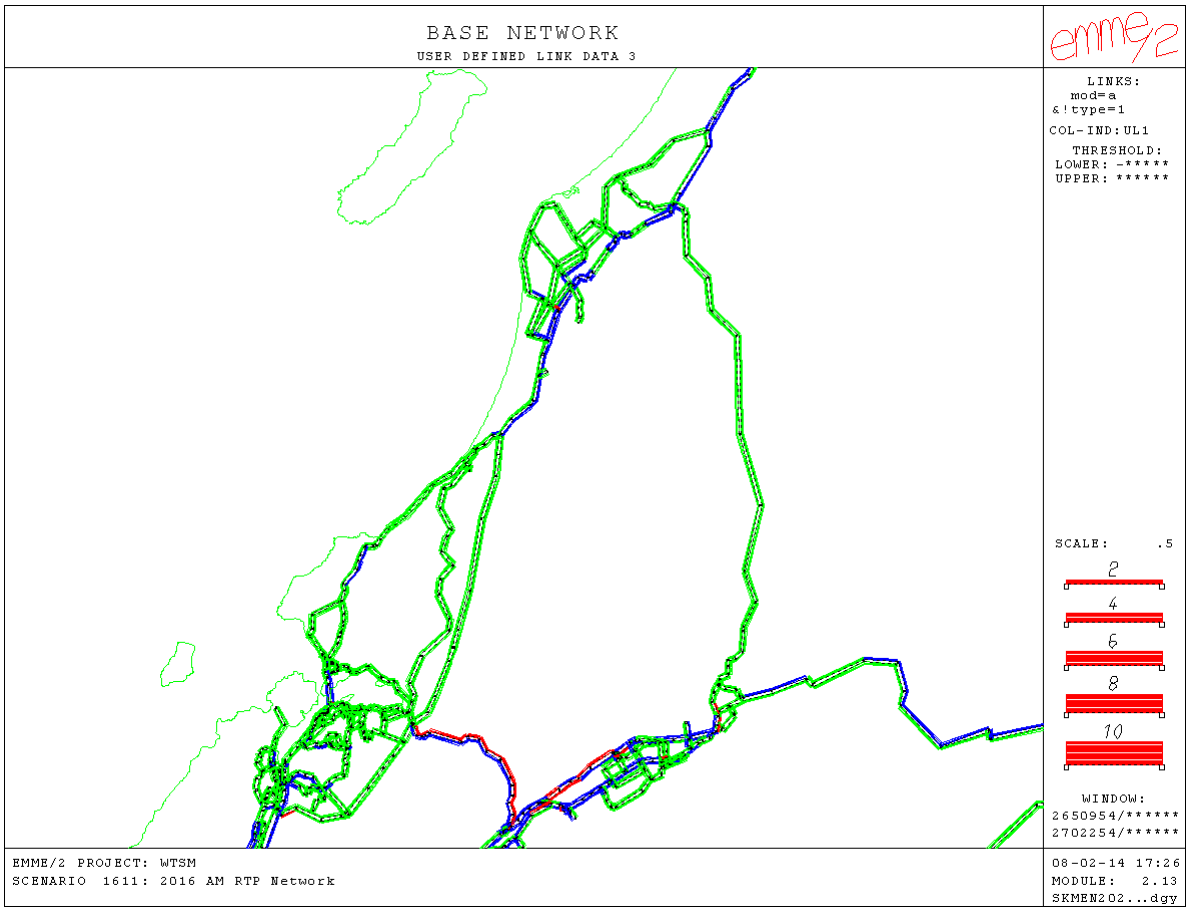
- **Figure 11 AM Peak LOS, 2006, Porirua-Kapiti-Upper Hutt**



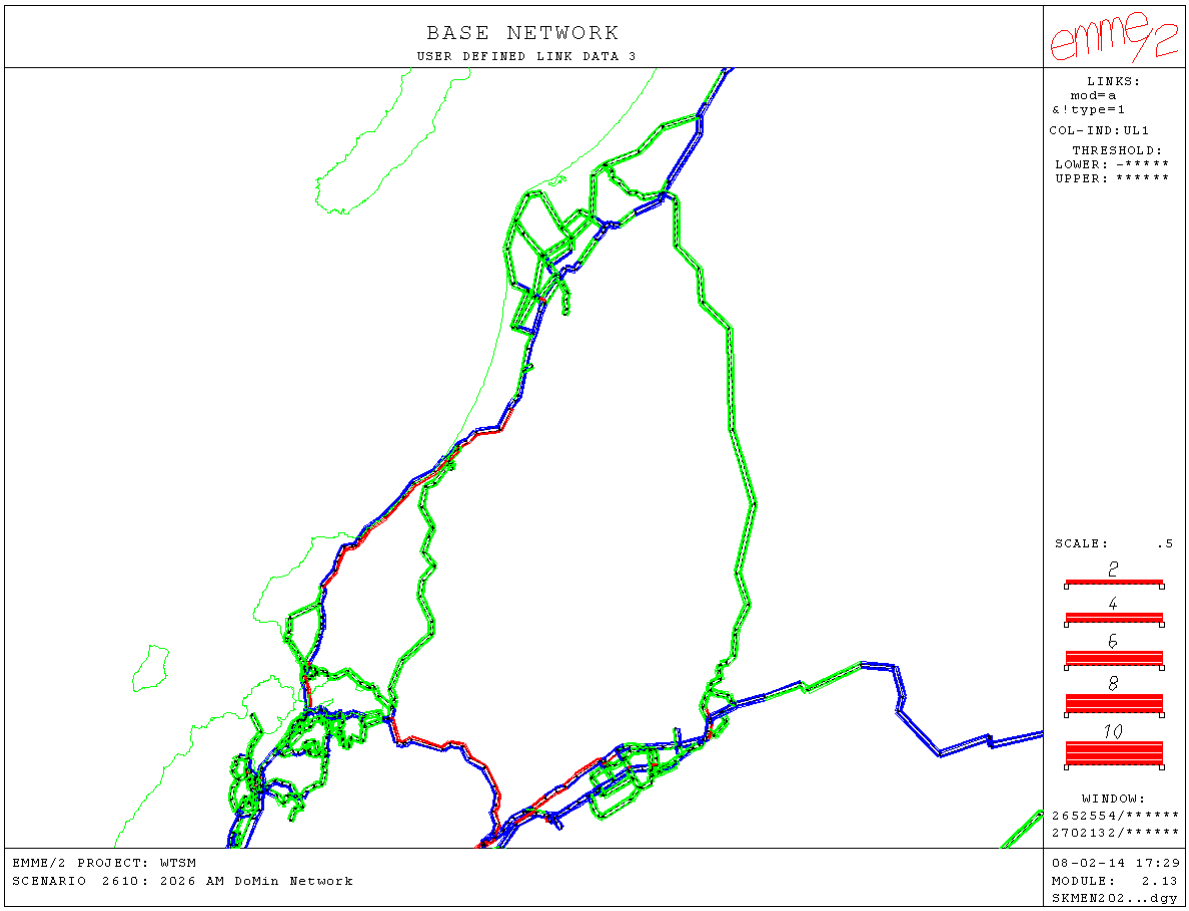
- **Figure 12 AM Peak LOS, 2016 Do Minimum, Porirua-Kapiti-Upper Hutt**



- **Figure 13 AM Peak LOS, 2016 RTP, Porirua-Kapiti-Upper Hutt**



- **Figure 14 AM Peak LOS, 2026 Do Minimum, Porirua-Kapiti-Upper Hutt**



- **Figure 15 AM Peak LOS, 2026 RTP, Porirua-Kapiti-Upper Hutt**