Wellington Transport Models – List of Technical Reports

Technical Report Number	Title	Comment
0	Model Investigation Report - NOV 2011	Available
1	Network Preparation	Available
2	Survey Sampling Methodology	Confidential
3	Electronic Ticket Machine Data Cleaning and Analysis	Confidential
5a	Bus Intercept Survey Analysis	Confidential Public version available
5b	Rail Intercept Survey Analysis	Available
6	WPTM Specification	Available
7	Public Transport Matrix Development	Confidential
8	Airport Survey Methodology	Confidential
9	Airport Model WTSM	Not Available Draft 04-09-2012
13	Base Model Car Ownership	Available
15	Input Parameters	Available
16	WTSM and WPTM Public Transport Assignment Comparison	Available
17	Validation Guidelines and Criteria - WTSM and WPTM	Available
18	WTSM Calibration and Validation	Available
19	WPTM Calibration and Validation	Available
20	WPTM Forecasting	Available
21	WTSM-WPTM Interface (& User Guide)	Not Available Draft 26-06-2012
22	WPTM Sensitivity Testing	Available
23	Future Year Base Networks and Services	Available
24	Baseline Forecasting Report	Available
29	Demographic Inputs to WTSM	Available
00	Model Development Report - DEC 2012	Available

WTSM – Wellington Transport Strategy Model

WPTM – Wellington Public Transport Model

Summary of Technical Report 24 – Baseline Forecasting

Person Trips

This summary looks at changes in person trips by purpose, mode and TA area between 2011 and each of the three forecast years to paint of picture of how patterns of travel are forecast to change through time.

Daily Person Trips by Purpose

Table 1 below shows the number of daily person trips by purpose for 2011 and each forecast year, together with the percentage increase relative to 2011. The employment and population growth rates are also appended to the bottom of the table for comparative purposes.

Table 1 Daily Person Trips by Purpose

	2011	2021		2031		2041	
Purpose	**Trips**	**Trips**	**% Diff***	**Trips**	**% Diff***	**Trips**	**% Diff***
Home to Work and vv. (HBW)	280,763	317,904	13%	334,267	19%	340,940	21%
Home to Education and vv. (HBEd)	98,993	97,489	-2%	95,068	-4%	96,755	-2%
Home to Shopping and vv. (HBS)	329,525	352,986	7%	379,734	15%	386,185	17%
Home to other and vv. (HBO) eg Hosp/ Church/ Sport	424,620	448,319	6%	470,429	11%	481,158	13%
Non-Home Based Other (NHBO)	549,549	587,722	7%	615,294	12%	629,115	14%
Employers Business (EB)	179,817	204,185	14%	213,808	19%	219,753	22%
Total	**1,863,266**	**2,008,604**	**8%**	**2,108,600**	**13%**	**2,153,905**	**16%**
Population Growth Rate			**5%**		**10%**		**12%**
Employment Growth Rate			**7%**		**12%**		**15%**

*Diff = relative differences between 2011 and forecast year

It shows that the region-wide increase in daily person trips correlates very well with the increase in employment across all forecast years.

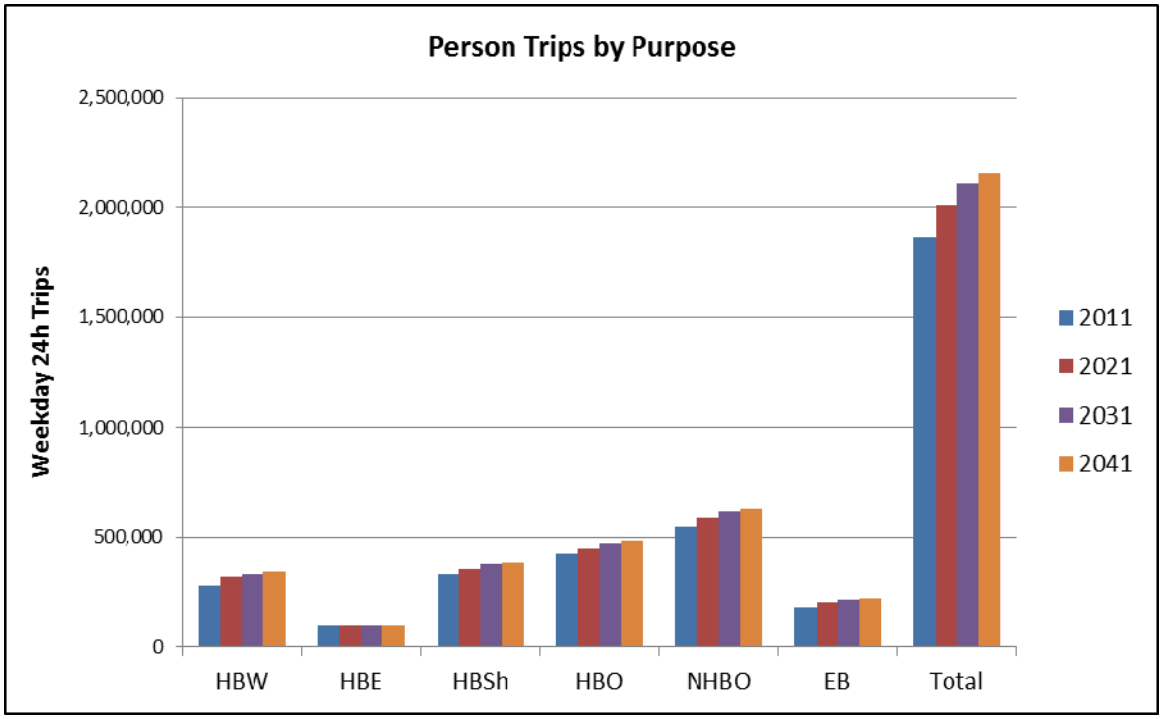
There is around a 3 percentage point difference between the population and employment/ person trip growth rates. This is because we expect the current unemployment rate of ~6.5% to fall between 2011 and 2021 before levelling out at around 4-5%. Therefore a proportion of the growth in trips between 2011 and 2021 will be due to people who are currently unemployed taking up employment

and thus making more trips, with the remainder of the employment growth reflective of an increasing population.

Growth is greatest for work related (Home-based Work and Employers Business) journey purposes whilst it is lowest for Home-based Education trips as an aging population and reducing household sizes meaning fewer school-aged children.

Figure 1 below shows daily person trips by purpose

Figure 1 Daily Person Trips by Purpose



From this analysis of daily trips by purpose it can be seen that the increase in person trips is linked to increased population and employment.

Commute Trips

The transport network is under greatest stress during the AM peak and PM peak commuting periods - highway travel times are slowest during these periods and public transport services are at their most crowded.

Table 2 below shows the number of daily commute trips in 2011 by mode – car, public transport, active modes - together with the number of additional commute trips added (by mode) by ten year increment e.g. 2011/21, 2021/31, 2031/41. The additional trips added during each ten-year increment are expressed in both absolute terms and as a percentage value relative to the number of trips at the start of each respective period.

Table 2 Daily AM Peak Commute Trips and AM Peak Mode Share

Mode	2011	Growth 2011 - 2021		Growth 2021 - 2031		Growth 2031 - 2041	
	Trips	Trips Added	% of 2011 Trips	Trips Added	% of 2011 Trips	Trips Added	% of 2011 Trips
Car	209,146	24,849	12%	18,335	9%	8,932	4%
PT	46,976	10,629	23%	-1,478	-3%	-1,558	-3%
Active	25,903	1,908	7%	-361	-1%	-599	-2%
Total	**282,025**	**37,386**	**13%**	**16,496**	**6%**	**6,775**	**2%**

The table shows that between 2011 and 2021, over 10,000 additional public transport commute trips are added together with 25,000 additional car commute trips. Expressed relative to 2011 trips, the public transport growth rate (23%) exceeds the car growth rate (12%) This difference occurs because car costs rise at a faster rate than the public transport fares and the highway network becomes more congested, making public transport more attractive relative to car travel for many journeys.

Between 2021 and 2031, the public transport growth rate is actually negative, with around 1,500 fewer PT trips in 2031 compared with 2021. By comparison, 18,000 additional car trips are added during this period. The main reason for this trend is that the NZTA RoNS schemes are all planned to be completed between 2021/31, improving highway network travel times and capacities throughout the State Highway network and reducing the cost of travelling by car. As public transport travel times and the associated cost of travelling by public transport remains largely unchanged between 2021 and 2031, most additional commute trips generated during the period 2021 and 2031 are car trips. Some existing public transport users switch to car due to improved highway travel times.

Between 2031 and 2041 the same trend is apparent – an increase in car trips and a slight decrease in public transport trips – although the number of additional car trips (about 9,000) is forecast to be lower than in the preceding 10 year period (about 18,000).

The number of active mode commute trips in the AM peak increases by 7% between 2011 and 2021 (relative to the number of trips in 2011) and then falls slightly between 2021/31and 2031/41.

Table 3 below shows the resulting change in mode share between 2011 and 2041.

It shows that the car mode share initially falls to 73% in 2021 (from 74%) before rising in 2031 (75%) and 2041 (76%). The public transport mode share increases to 18% in 2021 (from 17%) before falling back in 2031 (17%) and 2041 (16%).

Table 3 Change in Mode Share Between 2011 and 2041

Mode	2011	2021		2031		2041	
	Mode Share	Mode Share	Change (from 2011)	Mode Share	Change (from 2011)	Mode Share	Change (from 2011)
Car	74%	73%	-1	75%	+1	76%	+2
PT	17%	18%	+1	17%	0	16%	-1
Active	9%	9%	0	8%	-1	8%	-1

Commute Trips to Wellington City CBD

The previous section highlighted how the number of public transport commute trips (and mode share) increases from 2011 to 2021 and then falls between 2021 and 2041. Car commute trips, by comparison, increase steadily between 2011 and 2041. The resulting public transport mode share in 2041 (16%) is slightly lower than the current public transport mode share (17%).

In order to understand and explain why the apparent trends are occurring it is necessary to look at AM commute trips to Wellington CBD in more detail. **Table 4** below shows the following information, by mode and origin TA area:

- 2011 commute trips to Wellington CBD.
- Additional commute trips to Wellington City CBD by 10 year increment (2011/21, 2021/31, 2031/41), expressed in absolute terms and as a percentage of commute trips at the start of each 10 year period.

The colour coding of the cells relates to the magnitude of the growth:

- Growth in commute trips of between 0% and 10%
- Growth in commute trips of greater than 10%
- A decline in commute trips of between 0% and 10%
- A decline in commute trips of greater than 10%

Table 4 AM Peak Commute Trips to Wellington City CBD by Mode and Area

Area	Mode	2011	Growth - 2011 to 2021		Growth - 2021 to 2031		Growth - 2031 to 2041	
		Trips	Added Trips: 2011 to 2021	% Change (relative to 2011 trips)	Added Trips: 2021 to 2031	% Change (relative to 2021 trips)	Added Trips: 2031 to 2041	% Change (relative to 2031 trips)
Wellington	Car	21,088	1,608	8%	1,930	9%	2,476	12%
	PT	9,255	2,727	29%	270	3%	-200	-2%
Porirua	Car	1,481	-50	-3%	17	1%	53	4%
	PT	1,741	352	20%	-174	-10%	-84	-5%
Kapiti	Car	424	-23	-5%	125	29%	71	17%
	PT	1,002	437	44%	-255	-25%	72	7%
Lower Hutt	Car	2,847	-167	-6%	270	9%	74	3%
	PT	3,237	503	16%	-199	-6%	-186	-6%
Upper Hutt	Car	682	-116	-17%	35	5%	17	2%
	PT	906	97	11%	-87	-10%	-39	-4%
Region	**Car**	**26,548**	**1,244**	**5%**	**2,372**	**9%**	**2,690**	**10%**
	PT	**16,168**	**4,108**	**25%**	**-451**	**-3%**	**-437**	**-3%**

Table 4 shows that, between 2011 and 2021, the increase in public transport commute trips to Wellington City CBD from all areas exceeds 10%, with the greatest increases apparent for trips originating in Kapiti and Wellington City. Car commute trips to Wellington City CBD actually fall between 2011 and 2021 across all areas with the exception of Wellington City. This is driven by the current roading network operating at or near capacity in the AM peak, with significant bottlenecks along SH1 and SH2 regulating any increase in car trips between regional TA areas and Wellington City CBD. Around 75% (4,100) of the 5,250 additional commute trips to Wellington CBD generated between 2011 and 2021 are expected to use public transport.

The Wellington RoNS schemes are all planned to be completed by 2031, providing increased highway capacity, faster travel times and alleviating bottlenecks on the network. The result is an increase in car commute trips from all TA areas to Wellington City CBD between 2021 and 2031.

The greatest increase, in percentage terms, occurs for trips from Kapiti to Wellington City CBD. This is plausible as people living on the SH1 corridor stand to gain the greatest benefits (in terms of travel time savings) from the entire package of RoNS schemes – M2PP, TG, N2AQ and also P2G[1]. In absolute terms the greatest increase in car trips to Wellington City CBD is associated with Wellington

[1] M2PP – Mackays to Peka Peka, N2AQ – Nauranga to Aotea Quay, P2G – Petone to Granada, TG – Transmission Gully

City itself, suggesting that many of these additional car trips come from catchments that are also served by public transport.

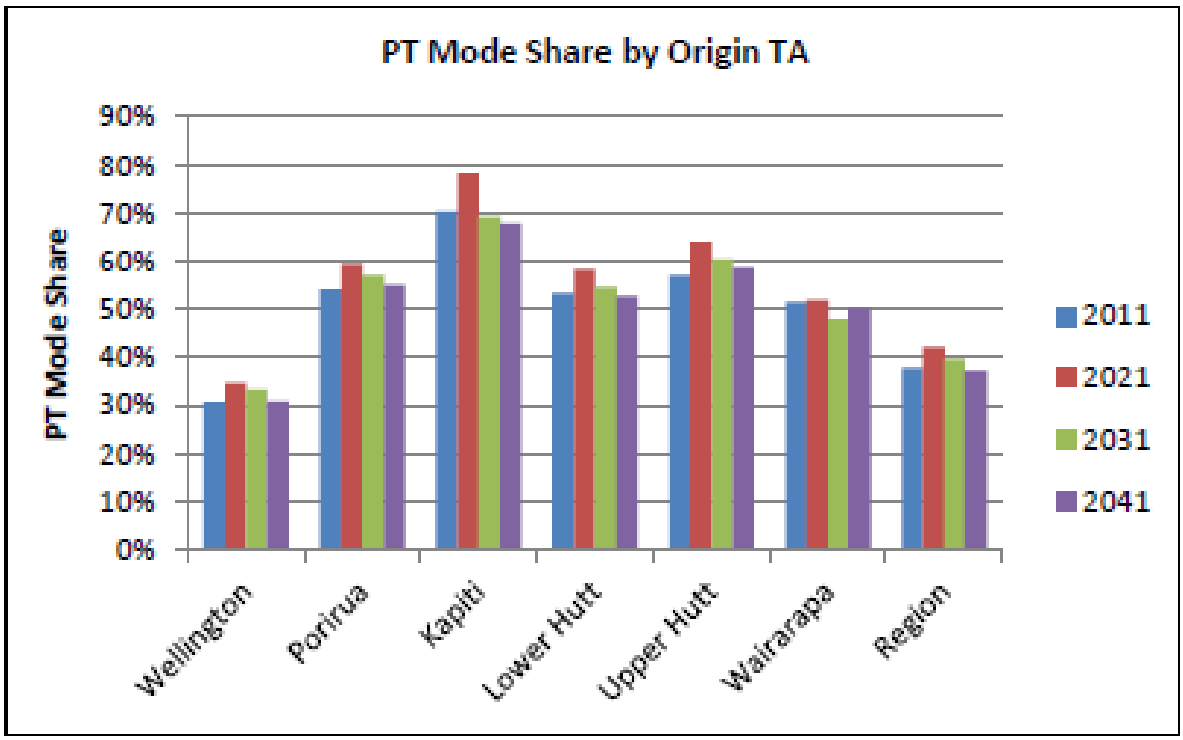
The number of public transport commute trips to Wellington City CBD declines slightly between 2021 and 2031 – an increase in public transport trips from Wellington City to Wellington City CBD is balanced by a decrease in public transport trips between other TA areas and Wellington City CBD. Any decline in public transport trips will be due to improved car travel times resulting in a small public transport -car mode shift.

The pattern between 2031 and 2041 is similar to the preceding 10 year period, with further small declines in public transport commute trips and an increase in car commute trips largely driven by increased demand from within Wellington City.

Public Transport Mode Share

Figure 2 below shows the resulting change in public transport mode share by origin TA area for commute trips to Wellington City CBD.

Figure 2 PT Mode Share by Origin



The PT mode share peaks in 2021 before declining in 2031 and further still in 2041. Interestingly, Wellington City has the lowest public transport mode share (~30%) when looking solely at commute trips to Wellington City CBD in the AM peak, highlighting that there is potential for increasing the PT mode share here (notwithstanding the existing higher mode share for walking and cycling in Wellington City).

Whilst Kapiti shows the greatest decrease in mode share, this should be placed in the context of a very high (~ 70%) current public transport mode share for trips to Wellington City CBD. It is also interesting to note that public transport mode share will be affected in both the SH1 and SH2 corridors; this is attributed to the P2G project providing decongestion benefits and removing the

current bottleneck at Ngauranga interchange, as a result improving travel times along both SH1 and SH2.

Highway Network Statistics

The RoNS schemes deliver a step-change in highway network performance, providing additional capacity and improving travel times.

Table 5 below shows the average network travel speeds, by time period, for the three forecast years. The percentage increase in car trips, relative to 2011, is also provided.

Table 5 AM Peak Commute Vehicle Trips to Wellington City CBD by Mode and Area

Mode	2011	2021		2031		2041	
	Average Network Speed	Avg Network Speed	% Growth in Trips (relative to 2011)	Avg Network Speed	% Growth in Trips (relative to 2011)	Avg Network Speed	% Growth in Trips (relative to 2011)
AM Peak	47.9	47.5	9%	48.5	17%	46.2	22%
Inter-peak	53.4	53.0	8%	52.9	17%	52.1	20%
PM Peak	47.5	47.1	9%	47.0	17%	45.6	20%

Average vehicle speeds vary slightly between 2011 and 2021, despite the fact that there is 9% growth in vehicle trips during that period and reflects infrastructure projects completed by then. Between 2021 and 2031 there is a further 8% growth in vehicle trips across all time periods, yet average highway network speeds remain constant (Inter-peak and PM peak) or , in the case of the AM peak, improve slightly. This demonstrates that the additional capacity provided by the RoNS schemes creates a network that can sustain reasonable travel speeds whilst catering for increased demand (Attachment 4 below shows which projects are planned to be completed when).

Table 6 below shows predicted southbound AM peak travel times between Waikanae, Upper Hutt and Wellington City CBD for 2011 and the three forecast years. The volume/ capacity ratio, a measure of how much spare capacity exists on the highway network, is also provided for three 'bottlenecks' across the network.

Table 6 AM Peak Commute Trips to Wellington City CBD by Mode and Area

Route	AM Peak Travel Time (Minutes)			
	2011	**2021**	**2031**	**2041**
Waikanae - Wellington	64	64	58	60
Upper Hutt - Wellington	39	37	34	35
Location	**AM Peak – Volume / Capacity Ratio**			
Mt Victoria Tunnel	1.0	1.2	0.9	0.9
Terrace Tunnel	1.0	1.0	0.7	0.7
SH1 (Ngauranga)	1.0	0.8	0.9	0.9
SH2 (Petone)	0.7	0.7	0.9	0.9

The travel time comparisons show that the RoNS schemes result in improved travel times between Waikanae / Upper Hutt and Wellington City in 2021 and 2031. Whilst travel times worsen a little between 2031 and 2041, they are still superior to 2011 travel times despite expected increases in traffic volumes over this period.

The volume / capacity ratios improve markedly at the four bottlenecks between 2021 and 2031 with the construction of the RoNS schemes. Using a traffic light scoring system, the 'red' bottlenecks in 2011 are now all 'amber / green' in 2031 and 2041 showing that traffic conditions are likely to improve.

Caution when interpreting Highway Network Statistics from WTSM

Caution should be exercised when interpreting travel speeds from a strategic model such as WTSM whose primary purpose is to model how trip making patterns change through time as a response to changes in land use and infrastructure.

- whilst strategic routes will be fairly accurately modelled in WTSM, local routes are not as well represented, their function being to feed trips onto the main highway network rather than accurately represent trip making patterns and highway network conditions in local areas.

- looking at an average speed across the whole network masks regional and local variations, such as certain areas / corridors where network speeds markedly increase or decrease.

- strategic models like WTSM have limitations relating to the modelling of delays at complex signalised intersections. Other models are more accurate and reliable for gauging changes in travel times and speed.

- NZTA has developed project models covering areas within the region – Wellington City, North Wellington and Kapiti Coast. – that use different transport modelling software to appraise schemes such as the RoNs in more detail.

Summary of Technical Report 15 – Input Parameters

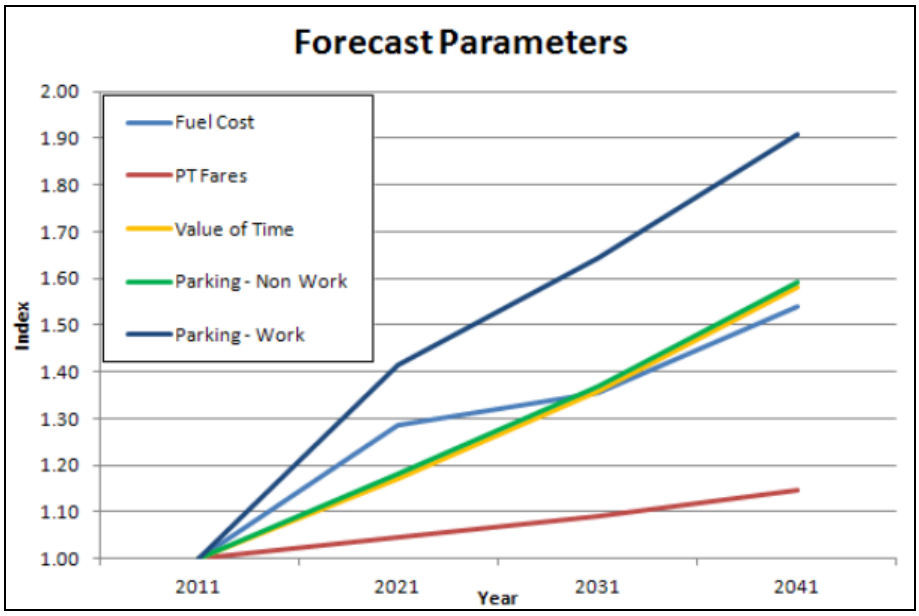
This attachment summarises how the input parameters to the model change through time.

The relative differences in the costs of highway and public transport travel influence a person's choice of mode, the input assumptions relating to changes in costs through time will also affect such choices – for example, if fuel prices increase twice as fast as public transport fares then, all things being equal, this should result in increased public transport usage.

Figure 1 below shows the changes in the main parameters over time relative to 2011:

- fuel costs – increase each year reflecting a combination of higher prices and increasing fuel efficiency;
- public transport fares – increase each year with respect to GDP/ capita growth (1.8% pa) with an elasticity of 0.25. This means that public transport fares increase more slowly than income rises;
- values of time – increase with respect to GDP/ capita growth of 1.8% pa. This figure is the average long run economic growth in New Zealand;
- parking costs - increase with respect to GDP/ capita growth (1.8% pa) with an elasticity of 1.2 (Work) and 1.0 (non-work), meaning they rise faster than income rises.

Figure 1 WTSM Forecast Parameters



It can be seen that the increase in public transport fares is less than the increase in fuel costs which, in turn, are lower than the increase in parking costs. On its own this would make public transport travel more favourable relative to car travel in the long run. The approach of linking changes in GDP to changes in public transport fares and other costs, is similar to that which has been used in Auckland during recent model development processes. This approach was developed in tandem with NZTA and is considered 'best practice' within New Zealand.

Summary of Technical Report 23 – Future Year Base Networks and Services

People's travel decisions are governed by the quality of the transport network and the choices available to them. For example, a person would choose between public transport and a private vehicle based upon a number of factors including public transport travel times, public transport costs, highway travel times and parking costs. Any changes to these factors may result in people re-evaluating their choices.

Committed public transport and highway schemes have been taken from a number of sources (NZTA, WCC, GWRC-RLTP) and included in the future year transport networks to reflect the change in travel choices in the future.

Table 1 below tabulates the major[2] schemes that have been included in the future year networks and their assumed completion date. This information is correct as of June 2012.

Table 1 Major Committed Infrastructure Projects in the Wellington Region, 2011-2041

Scheme	Promoter	Primary Mode	2021	2031	2041
Mt Vic Tunnel / Ruahine Street	NZTA	Car	N	Y	Y
Nauranga to Aotea Quay	NZTA	Car	Y	Y	Y
Basin Reserve	NZTA	Car & Bus	Y	Y	Y
Mackays to Peka Peak	NZTA	Car	Y	Y	Y
Transmission Gully	NZTA	Car	N	Y	Y
SH1 Grenada to Petone	NZTA	Car	N	Y	Y
Terrace Tunnels	NZTA	Car	N	Y	Y
Peka Peka to Otaki	NZTA	Car	Y	Y	Y
Regional Rail Plan	GWRC	Rail	Y	Y	Y
Bus Priority Phase 2	WCC	Bus	Y	Y	Y

N = not complete or fully operational in year indicated
Y = project complete and fully operational in year indicated

The information shows that:

- The majority of committed schemes are highway schemes – excluding the Basin Reserve, only two public transport schemes were assumed for the baseline forecasting exercise.

[2] A 'major' scheme is defined as one that is a) over $5m in Capex and b) would have a significant impact on highway and / or public transport travel costs

- Around half of schemes are forecast to be completed by 2021 with the remainder being completed by 2031.

- The four schemes that are not assumed to be completed until 2031 are critical to relieving known bottlenecks on the highway network. The highway network will not be fully optimized and the full benefits of the RoNs schemes will not be realized until these four schemes are completed. . This is evident from TN24 and the analysis that is documented in this report.

Summary of Technical Report 29 – Demographic Inputs to WTSM

Three key demographic variables are input to WTSM in both the base year and for any future forecast years:

- Population
- Households
- Employment.

These demographic inputs are used as the basis for generating and distributing trips in WTSM.

The land use scenarios used for the 2011 model are based on 2006 forecasts that were produced by Monitoring and Evaluation Research Associates (MERA) using Statistics NZ local authority projections and 2006 Census results. This process is fully documented in Appendix A of TN29

The base and future forecast assumptions for the 2011 model update were developed based on a demographic review undertaken by Russel Jones of Prisim Consulting (Appendix B of TN29). This review used, amongst other data, Statistics NZ 2011 projections and data gathered from councils.

In summary, the forecast are produced by demographers and use the most up to date information including Statistics NZ forecasts.

Population Forecasts

An increase in the region's population and an associated increase in employment opportunities will result in increased trip making. The difference between highway and public transport travel times for a certain trip, governed by the infrastructure and network conditions, will determine which mode a person uses for their particular trip.

Table 1 below shows the population in 2011 and each of the three forecast years (2021, 2031 and 2041) together with the % increase in population relative to the 2011 figure.

Table 1 Population (000s) by Area and Year

	2011	2021		2031		2041	
Area	**Population '000**	**Population '000**	**Growth (relative to 2011)**	**Population '000**	**Growth (relative to 2011)**	**Population '000**	**Growth (relative to 2011)**
Wellington	191	209	9%	225	18%	238	24%
Porirua	51	52	2%	53	3%	52	1%
Kapiti	49	54	10%	59	20%	63	28%
Hutt Valley	140	142	1%	141	1%	137	-2%
Wairarapa	39	40	0%	39	-1%	36	-8%
Region	**471**	**496**	**5%**	**517**	**10%**	**526**	**12%**

The table shows that, as a region, the population is estimated to increase by 55,000 (12%) between 2011 and 2041. This growth is not split evenly throughout the region – higher growth rates are experienced in Wellington City (24%) and Kapiti (28%), reflecting a high level of development is planned for both Kapiti and Wellington City relative to the rest of the region.

The absolute increase in population between 2011 and 2021 (25,000) and between 2021 and 2031 (31,000) is broadly the same. Between 2031 and 2041, however, the population only grows by 9,000, due to lower growth rates in Wellington City and Kapiti and a reduction in population in the Hutt Valley and Wairarapa (the result of the ageing population and fewer children).

Employment Forecasts

Table 2 below shows the number of jobs (FTEs)[3] in 2011 and each of the three forecast years (2021, 2031 and 2041) together with the % increase in jobs relative to the 2011 figures

Table 2 Employment (000s) by Area and Year

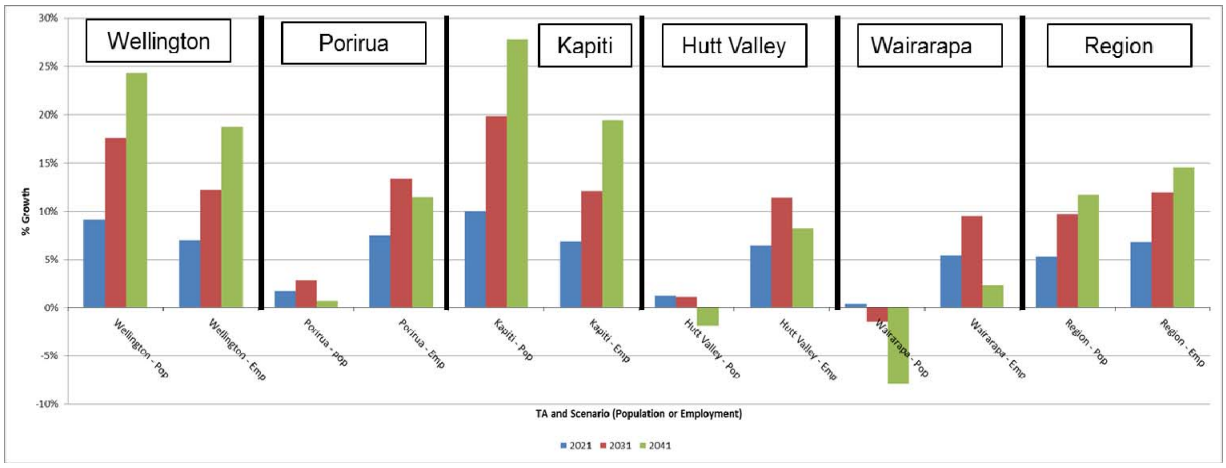
	2011	2021		2031		2041	
Area	**Jobs (FTE)**	**Jobs (FTE)**	**Growth (relative to 2011)**	**Jobs (FTE)**	**Growth (relative to 2011)**	**Jobs (FTE)**	**Growth (relative to 2011)**
Wellington	134	143	7%	150	12%	159	19%
Porirua	17	18	8%	19	13%	19	11%
Kapiti	15	16	7%	17	12%	18	19%
Hutt Valley	56	60	6%	62	11%	61	8%
Wairarapa	18	19	5%	20	9%	19	2%
Region	**240**	**257**	**7%**	**269**	**12%**	**276**	**15%**

As a region, 36,000 jobs are added between 2011 and 2041. Initially the percentage growth in employment appears to be fairly evenly distributed across the region, ultimately 25,000 (out of 36,000) additional jobs are located in Wellington City. Accessibility to Wellington City from the rest of the region, coupled with the current high concentration of jobs in the Wellington CBD, future intensification strategies and infrastructure projects that will improve access to Wellington City CBD, means that it is unsurprising that most new jobs are forecast to be located within Wellington City.

Figure 1 below shows, for each area, the % increase in population and employment between 2011 and each of the forecast years.

[3] FTE – Full Time Equivalents

Figure 1 Comparison of Population and Employment Growth Rates by Area – 2011 to 2041



The figure shows that population and employment growth rates across the five areas are unlikely to be equal. Some areas (such as Wellington City and Kapiti) have higher population growth rates, meaning that people will have to commute out of the area in order to take up employment. Other areas, such as Hutt Valley and Porirua, have higher employment growth rates, meaning that more people will commute to these areas to take up employment than is currently the case.

The main point to take from this analysis is that the spatial distribution of population and employment growth will lead to increased travel between areas within the region (e.g. Porirua to Hutt Valley). Wellington City currently has about 40% of the population and about 60% of the employment located there. Any increase in longer distance trips as a result of future population/ employment forecasts should be placed within this context.