Strategic Options Assessment

September 2009

1. Goal

To develop a robust methodology that effectively tests the overall direction of the next Wellington Regional Land Transport Strategy (RLTS) issues and policies; and assists the evaluation of the RLTS impact assessments.

2. Objectives

The purpose of this paper is to assess the robustness of the current 2007–16 RLTS issues and policies by creating strategic options that promote varying RLTS policy packages. It also examines the overall conclusions of the impact assessments to determine if they are still valid. To accomplish this, the assessment has the following objectives:

1. Create futures scenarios with trends and pressures that are relevant to the Wellington region
2. Identify land transport strategic options for 2040
3. Develop a methodology for assessing the strategic options within the futures scenarios that is unbiased towards any particular strategic option
4. Determine if the broad conclusions of the current RLTS impact assessments relevant for the 2010 to 2040 time period.

3. Background

This paper is being produced in the context of the review of the current 2007–16 RLTS for the Wellington region. Section 74 of the amended Land Transport Management Act 2003 (LTMA) mandates each regional council to produce a RLTS for that region. The current Wellington RLTS is in force until July 2010 when the new strategy will have to be adopted (Land Transport Act 1998, s. 176). The next RLTS is required to have a policy outlook of at least 30 years (LTMA, s. 74(1)(a)).

The assessment is based in a futures thinking concept. Futures thinking provides a means for discussion around what the future may hold and how to approach it. Futures thinking is not about 'predicting' the future, but more a means of identifying key variables that will shape the context in which proposed policies will be implemented as well as potential barriers in implementation.

Futures thinking is about constructing various scenarios that help guide the policy making process. It strengthens and enhances strategic decision making by bringing awareness of key variables and barriers.

Wherever possible, this assessment builds on available work. The figures used are derived from the regional council's Wellington Transport Strategic Model (WTSM), as well as from other governmental sources (e.g. Statistics New Zealand, Ministry of Transport, New Zealand Transport Agency, and Ministry of Economic Development).

The components of the transport network forms identified in this assessment are different combinations of projects and other activities listed in various planning documents including:

- RLTS Implementation Plans
- RLTS Corridor Plans
- Regional Land Transport Programme 2009-12 (RLTP)
- Regional Rail Plan 2008
- other potential projects to 2040

The Implementation and Corridor plans sit underneath the RLTS and identify short, medium and long term measures to progress the RLTS objectives and outcomes. The RLTP sets out funding and activity priorities for the next three years and identifies likely projects out to 10 years.

The overall direction of public transport activities in the Wellington region is set out in the Passenger Transport Plan 2007. The Regional Rail Plan sets out options for strategic investment on the rail network out to 2035.

4. Limits and Assumptions

The scope of this assessment paper is focused on the land transport system of the Wellington region. Future global trends, such as climate change, are considered from a regional perspective. Trends in population and economic growth are also specific to the Wellington region.

The analysis focuses on the high and low spectrum ranges of future possibility at the expense of more moderate projections. It is assumed that the assessment of these more peripheral projections will provide adequate insight on how various land transport network forms will fare in more moderate conditions. Only one moderate future projection was conducted.

The objectives of the RLTS are largely determined by the LTMA 2003. RLTS targets are influenced by guidance from national policy direction and observed trends. The primary national level documents that affect the RLTS targets are the New Zealand Transport Strategy 2008 (NZTS) and the Government Policy Statement on land transport funding (GPS). RLTS objectives and targets are not assessed in this paper.

Some low probability, high consequence changes (like a pandemic, natural disaster[1] or transfer of the seat of Government) are considered to be outside the scope of this analysis. The effects of such radical changes on government priorities and regional travel demand would be extreme and unpredictable. Attempting to plan for such occurrences in the context of an RLTS would not be useful as any strategies or programmes would have to be dramatically rewritten.

A large degree of international and national political stability is assumed in order to isolate the identified key variables to long-term average use of Wellington's land transport infrastructure.

[1] For a detailed analysis of risk from natural hazards on infrastructure lifelines see NZTA Research Report 355A + B: Engineering Lifelines and Transport – should New Zealand be doing better? August, 2008. http://www.landtransport.govt.nz/research/reports/index.html.

It is also assumed that various projections into the future are underlined by cultural changes that would make them possible; and the priorities and activities of the various network forms will be supported by both Central government and the local Territorial Authorities.

5. Wellington Transport Strategy Model

The Wellington Transport Strategy Model (WTSM) is a multimodal model designed to assess the strategic land transport network of the Wellington region and is the primary tool used in the strategic options analysis. It has the ability to examine a number of different projections rather than a single forecast. The model can be used to assess impacts of future land use assumptions, changes in demography, GDP, assumptions around transport costs, and impacts of transport infrastructure and service changes.

The model performance is quite robust in terms of car and freight road trips and medium to longer public transport trips (although less suitable for separating park and ride and bus feeder access legs of medium and long trips). Due to the coarse nature of strategic models, WTSM is limited in its ability to assess short active mode and public transport trips.

WTSM outputs in this assessment consist of the following indicators:

- Total public transport boardings (split by peak and off-peak)
- Home to Work public transport modeshare
- AM peak congestion
- Annualised CO_2 emissions.

6. Methodology

Objective 3 is to develop an assessment methodology that is unbiased towards any strategic option.

There were no existing concepts for Wellington's transport network in 2040. It was decided at the outset not to create a preferred transport package of activities to start with, but instead to assess how different strategic options for land transport infrastructure will fare under a range of travel demand levels.

External trends and pressures (e.g. population and GDP growth) that are largely unaffected by the RLTS, but affect travel demand levels, were used to start planning the future scenario projections. Strategic options were developed to detail different land transport network forms.

The futures scenarios provide a set of travel demand levels within which the various strategic options will be modelled. Each strategic option will be assessed on how well it manages the level of travel demand in each future scenario.

The preferred strategic option will provide the best results across the widest range of futures. This assessment will help determine which network form package has the most potential to yield the best results – affecting the policies of the 2010-2040 RLTS.

The process was divided into two phases. The first phase used a minimum investment strategic option to test the sensitivity of the variables in the futures scenarios. This was done to ensure the results provided by WTSM were measurable and useful. The second phase tested the various network form strategic options that reflect various potential RLTS policies.

6.1 Phase 1: Creating the Futures Scenarios

The futures scenarios are meant to capture the range of potential travel demand on the strategic land transport network of the Wellington region, subject to the limits and assumptions described above.

A workshop was conducted to brainstorm the trends and pressures on the transport network that will occur regardless of what the network looks like. Five key themes emerged from this workshop: population, economy, transport costs, environment and innovation.

The likely impact of each theme on the level of travel demand in the Wellington region was then assessed. This analysis led to the isolation of key variables that would be built into the model. Utilising the 2007-16 RLTS background technical documents, as well as other sources, the potential range (high, medium and low values) of each key variable was set.

Another round of workshops determined the key variables that would be used to construct the futures scenarios. It was decided to construct the scenarios around the high and low values to capture the widest range of possibility. Another scenario composed of the medium range values was developed for comparison.

All the futures scenarios were then run in WTSM with the base network (do minimum) strategic option. The model outputs were analysed to determine if any adjustments were required.

6.2 Phase 2: Developing the Strategic Options

The strategic options were designed to highlight a range of how land transport network forms in the Wellington region may change out to 2040. Each strategic option consists of a list of activities that can be represented in WTSM.

Strategic options were developed with the idea that they could realistically be implemented by 2040 – subject to funding availability. It was also important that the strategic options be diverse enough that a full range of different policy options could be tested.

A ‘base network’ strategic option was developed first as a minimum investment option where only confirmed and highly likely projects are implemented. From this baseline, other mode-specific strategic options were developed:

- Public Transport Priority,
- Roading Priority, and
- Road Pricing.

The relative merits of the projects in each were then determined through model runs. The results factored into the development of the Mixed Investment and Mixed plus Road Pricing strategic options.

The current RLTS policies favour a mixed investment approach with various pricing mechanisms signalled as useful in the long term to close funding gaps. The inclusion of the Mixed Investment and Mixed + Road Pricing strategic options is the primary means of testing the robustness of the current policies out to 2040.

7. Futures Scenarios

Objective 1 is to create futures scenarios for the Wellington region.

The following sections detail the scenarios built into WTSM. The future trend and pressure variables were assessed to determine their likely impact on peak period land transport. From that assessment, a set of key variables were chosen for inclusion in the model.

It is important for the key variables to be represented in a manner that is relevant to how the WTSM model functions.

Transport costs, while acknowledged as an important determinant in travel demand and behaviour, can be influenced by government policies. Therefore, most were considered with the transport strategic options. Car running costs were retained in the Economic theme because government policy has limited influence on the base costs of petrol and diesel.

7.1 Trend and Pressure Variables

The following table presents the identified variables and indicates their likely impact on travel demand during peak periods. It also shows the likely impacts on the various modes of travel: car, PT, and active modes.

The indicators and comments assume each variable is increasing.

The '+' sign indicates a growth in travel demand and modal choice. The '–' sign indicates a reduction in travel demand. A '0' represents a neutral or insignificant effect.

Variable	Likely Impact on Peak Demand	Likely Impact on Modal Choice			Comment
		Car	PT	Active	
Population					
Number	+	+	+	+	As the total number of people increases, the total demand increases proportionally.

Variable	Likely Impact on Peak Demand	Likely Impact on Modal Choice			Comment
		Car	PT	Active	
Density	-	-	+	+	As density increases, the amount of time needed to travel reduces, PT and active modes become more economic as more people live along routes and closer to their destinations.
Household Structure	-	-	+	+	Larger households tend to have fewer cars per person, encouraging trip chaining and the use of alternative modes. Smaller households tend to have more cars per person and make more trips.
Ageing Population	-	-	-	-	As people age and retire they tend to not travel as much during the peak hours and, on balance, move into denser communities.
Economic					
Employment Rate/Job Numbers	+	+	+	+	As the employment rate and number of jobs increases, more people will be making journey-to-work peak period trips.
GDP	+	+	+	+	As productivity increases more people and freight will be using the transport network.
Job Types/ Knowledge Economy	-	-	-	-	Different types of jobs have different travel patterns. Jobs in a services oriented economy tend to have an overall lower level of travel demand. The more people work from home, the lower peak time travel demand.
Household Income	+	+	+	+	As income increases more people will be making shopping and other recreational trips. Car ownership rates also increase.
Rail/Sea Freight Share	0	0	0	0	By moving freight onto rail and sea lines, the capacity for private vehicles and buses on the road-space increases. However, the amount of freight that could reasonably be carried by rail and sea modes in Wellington is minimal.
Car Running Costs per km	-	-	+	+	Increased car running costs reduce private vehicle travel demand and makes PT more competitive. Overall travel demand reduces as fewer discretionary trips (which are primarily taken with private vehicles) tend to be made.

Variable	Likely Impact on Peak Demand	Likely Impact on Modal Choice			Comment
		Car	PT	Active	
Environmental					
Road/Rail Maintenance Costs	-	-	-	+	Increased maintenance costs due to climate change are passed onto users of roads and rail in some way. Rail lines are closer to the coast along most vulnerable sections so it is expected that rail services will be exposed to reliability issues before the motorways.
Stormy Weather	-	-	-	-	Creates reliability issues of road and PT modes (landslips, storm surges, etc) and discourages active modes. Remedial maintenance is expected to be manageable.
Coastal Erosion	0	0	0	0	Most areas of the strategic network that are at threat to coastal erosion are armoured with a variety of coastal protection measures. The areas at the most long term risk are portions of Colburn Drive and the Centennial Motorway.
Loss of low-laying land	0	0	0	0	Areas of potential permanent flooding are not expected to be at risk out to 2040 due to coastal armouring and flood protection works.
Innovation					
New Technology	+	+	+	+	Newer and greener vehicle (private and public) technology is likely to increase use. Increased prevalence of iPods, GPS and an online journey planner makes active modes more attractive.
Vehicle Fleet Make-up	0	+	-	-	As the average age of the vehicle fleet grows younger, perceived day-to-day operating costs become cheaper.
Alternative Fuels	0	+	-	-	Removes a possibly powerful incentive to use PT and other alternative modes.
Vehicle Safety Technology	0	+	-	-	The safer private vehicles become, people will use them more often than PT or active modes.
Tele-working/Advanced Communications	-	-	-	-	Reduces personal travel demand across all modes. Perhaps will increase door-to-door delivery services.

Table 1: Trend and pressure variable analysis

7.2 Projected Ranges of Key Variables

Utilising the likely impact analysis above, key variables for the Wellington region were identified. The criteria for this selection took into account the strength of the likely impact and the model data input parameters. The selection process is described in detail for each theme.

The range of each key variable growth values (low, medium and high) used in the construction of the futures scenarios is also provided. Demographic data is based on 2031 Statistics NZ projections and then extrapolated out to 2041 (the closest census year to the end of the RLTS outlook).

7.2.1 Population

The population number is a key variable to the level of land transport demand. This variable is based on the high, medium and low usually resident population figures in the WTSM 2006 *Baseline Forecasting Report*.

Land use density is another key variable. Lower, central-case and higher densities were modelled to show the effects of low density "sprawl" to high density nodes and corridors. The figures are based off WTSM medium projections which are then extrapolated out to 2041.

Household structure and changing population demographics were captured in the model as part of the household categories input. The central-case trends in WTSM track a change to smaller households and an older population in the Wellington region out to 2031. These trends were then extrapolated out to 2041.

Current trends in the distribution of growth across the Territorial Authorities (TAs) of the region are kept the same out to 2041. It is assumed that Wellington City will continue to be the main population centre, sharing a higher growth rate with Kapiti Coast relative to the rest of the region. Kapiti Coast's high rate of growth is expected to be primarily driven by retirees.

Key Variable	**Data Source**	**Projected Value Range**		
		Low	**Medium**	**High**
Population				
Number	Stats NZ, WTSM projections (low, med, high) of usually resident population to 2041 (2006 pop = 450,000)	447,900	523,000	595,200
Density	WTSM medium projections, central case, 2 scenarios (less dense, more dense)	Sprawl	Central-case	Infill, denser urban development

Table 2: Population variable breakdown

7.2.2 Economic

Economic variables are considered alongside population. It was decided not to model futures where the two are mismatched as it was assumed one would negate the other (i.e. high population growth but low economic growth would cause people to emigrate out of the region).

WTSM captures employment rates with population household categories that differentiate full-time and part-time employment as well as households of varying sizes where at least one adult is employed. Since employment is the primary generator of trips during the peak times and is captured alongside population in the model, it is considered to be a key variable.

The growth in employment is expected to be quite evenly distributed across the TAs of the region, with Hutt, Kapiti Coast, and Wellington having the highest growth rates. These rates are extrapolated out to 2041 from data contained in the WTSM 2006 *Baseline Forecasting Report*.

Gross Domestic Product (GDP), as a measure of economic productivity, is a key variable to transport demand. Statistics NZ has information on GDP trends per capita in historic growth and these were assumed to continue. Low and high growth values were assumed to be +/- 0.5% around the central value. GDP is factored into WTSM calculations when determining employment forecasts, car ownership and growth in Heavy Commercial Vehicle demands.

Employment trends are captured by five WTSM categories: manufacturing, retail, transport and communications, services, and other. Each category has its own level of travel demand. The growth of a knowledge economy in the Wellington region would be captured in WTSM by these job type trends as well. The fastest growing job types are services and retail, which is in line with a knowledge economy. Extrapolating trends used in the *Baseline Forecasting Report* is assumed to accommodate changing job types and a knowledge economy.

Fuel costs are a key variable in overall transport costs. Background information was initially provided by the Auckland Regional Council's commissioned report: *Price Forecasts for Transport Fuels and other Delivered Energy Forms* and Ministry of Transport fleet makeup and fuel efficiency data. It is difficult to determine the impact of fuel prices, or peak oil particularly, in the future given an expectation that a significant proportion of the fleet may use little (or no) fuel.

However, for these new vehicles, some form of road usage charge will be required. Also, higher fuel prices may well stimulate a larger uptake of new technology. Rather than focusing specifically on fuel cost, ranges were developed around increases in car running costs which were asserted in the model.

Key Variable	Data Source	Projected Value Range		
		Low	Medium	High
Economic				
Employment Rate	Low, med, high WTSM projections, extrapolated out to 2041	250,400 jobs	296,800 jobs	335,100 jobs
GDP	Low, med, high WTSM projections, extrapolated out to 2041, MED, Treasury	+1.5% pa real/capita	+ 1.8% pa real/capita	+2.1% pa real/capita
Car Running Costs per km	Asserted	+ 0%	+ 35%	+ 70%

Table 3: Economic variable breakdown

7.2.3 Environmental

The identified environmental variables were climate change induced road and rail maintenance costs, stormy weather, coastal erosion and loss of low-laying land to sea level rise and storm-induced erosion. These variables are consistent with research commissioned by the NZTA.[2] Each of these variables was assessed on their potential impacts to Wellington's land transport network and then investigated to determine the likely range of their severity.

Greater Wellington has recently put together a discussion document on the region's *Climate Change Response*. While it has a timeframe out to 2100, the discussion document is still valid for this strategic options assessment. The information in this section is based on that document. *Wellington Regional Climate Change Response* is also useful for keeping in mind that the worst potential effects from climate change will likely occur after 2040.

The mid-range potential temperature increase for the Wellington region by 2040 is predicted to be about 1 C, although the increase can be over 2 C. This can have an impact by heat warping the rail tracks and weakening road seals which would reduce the reliability of the strategic transport network and increase travel times and maintenance costs. However, this effect is expected to be minor in the long term. Since WTSM does not model periodic short-term disruptions to the network from such incidents, this type of increased maintenance cost is not included in this assessment.

The strategic transport network is mostly vulnerable to inundation from sea level rise and storm-induced land slips. The sections of the network that are particularly vulnerable to these likely environmental effects are State Highway (SH) 1 and 2 as well as the North Island Main Trunk (NIMT) rail line between Wellington and Petone, SH 1 and NIMT along Porirua Harbour to Mana, and the stretch of SH 1 known as the Centennial Motorway where it travels along the coast. SH2 and the Wairarapa Rail line are also vulnerable to storm induced land slips.

[2] NZTA (2009). Research Report 378A + B: *Climate Change Effects on the Land Transport Network*.

The science around sea level rise is still fairly uncertain. However, by 2100 it is reasonable to plan for a rise in sea level around the coast to be between 0.8-1.0 metres. Therefore, this futures assessment assumes a sea level rise of about 0.4-0.5 metres out to 2040. It is not expected that this amount of sea level rise would undermine the strategic transport network.

Sea level rise can be reflected in WTSM only by removing certain vulnerable routes. The route most at risk is the Centennial Motorway where it runs along the coast. A half metre rise in sea level is not expected to seriously undermine the integrity of Centennial Motorway as it is about 3 to 4 metres above the mean high water mark. Although the costs in maintaining the route would be expected to increase, the long-term level of service is not expected to be seriously affected out to 2040. Based on this analysis, sea level rise has been determined to not be significant in the context of this assessment.

Climate models predict increased rainfall on the western half of the region, and a decreasing annual rainfall trend for Wairarapa. With rising sea temperatures, storms are also predicted to become more energetic as well. Presently, storms surges of up to 1 metre are common in the Wellington region. Compounded with rising sea levels, storm surges are likely to have a greater affect on the strategic network out to 2040. This will also increase the rate of coastal erosion along much of the regional shoreline.

As with rising sea levels, increased storminess is likely to have a negative effect on the reliability of both road and rail networks. Waves washing up on the network and land slips are predicted temporarily close the routes mentioned above more often. However, it is not expected that these temporary closures will accumulate sufficiently into a long-term loss of service that would justify removal of those routes in WTSM. Along the majority of the vulnerable routes, the shoreline is already armoured against wave action and coastal erosion. It is worth noting that, except along the coastal stretch of Centennial Motorway, the rail lines are closer to the shore and will therefore likely be affected the most and more often.

These results indicated that the environmental variables would not have a severe enough level of impact out to 2040 that WTSM can examine. No environmental variables, then, were included in the construction of the futures scenarios.

7.2.4 Innovation

Innovation and future technologies cannot be an input into WTSM as a variable. Therefore, none of the innovation variables were considered key.

The model can provide an indication of the effects of innovation and new technology by altering the ratios of vehicle types in the regional fleet and the formula whereby carbon dioxide emissions of each type of vehicle are calculated. The effects of tele-working and other advanced communications technology can be asserted into the model by altering the trip numbers associated with certain types of employment categories, but cannot be examined as a variable in-and-of itself.

The Ministry of Transport has research on the fuel efficiency and makeup of the New Zealand vehicle fleet for Light Passenger Vehicles (LPV) and Light Commercial Vehicles (LCV). WTSM calculates emissions based on formulas from the Economic Evaluation Manual provided by NZTA. The percentages in the table below are based on 2008 emissions per kilometre.

MoT has also put together projections on vehicle fleet makeup and the uptake of alternative fuels by 2040. The categories for the different types of vehicles are petrol, diesel, hybrid, plug in hybrid (P.I.H) and electric vehicles.

The extent to which these new technologies will be incorporated into the vehicle fleet is largely dependent on the price of fuel and the timing of peak oil in the future. In the absence of projections on how peak oil or significantly higher fuel prices will affect the regional fleet make-up, only the central-case projections were used.

WTSM does not examine the safety of various types of vehicles, so the effects of an uptake of new vehicle safety technology has also not been included.

Key Variable	**Data Source**	**Projected Value Range**		
		Low	**Medium**	**High**
Innovation				
New Tech	MoT VFEM guidelines of the average CO_2 production, compared to 2008 values		LPV: 60% of 2008 emissions LCV: 56% of 2008 emissions	
Vehicle Fleet Make-up / Alternative Fuels	MoT guidelines around future fleet compositions on new LPVs and LCVs entering fleet for 2041		Petrol LPV 38%, Petrol LCV 7% Diesel LPV 30%, Diesel LCV 61% Hybrid LPV 7% Hybrid LCV 7% P.I.H LPV: 14% P.I.H LCV: 14% Elec LPV: 11%, Elec LCV: 11%	

Table 4: Innovation variable breakdown

7.3 Constructing Futures Scenarios

Key variables carried forward to create the range of futures were growth (population, GDP and employment), transport costs, and land use density.

Transport costs include both car travel costs and public transport fares. Public transport fares are assumed to increase only at the rate of inflation across all scenarios. For land use density, the total population numbers for each TA are kept the same but growth areas are changed proportionally to reflect low, medium or high density land use.

These three key variables were chosen because they can be set independent of each other. The futures scenarios focus on the low and high ranges of each key variable. A single medium case scenario provides a "central" case for comparison.

The result was nine futures as demonstrated in the table below. 'L' represents a low or negative level of increase; 'H' represents a high amount of increase and 'M' stands for a moderate amount of increase.

Future	Growth	Cost	Land Use	Expectation
1	L	L	L	Potential lower PT demand
2	L	L	H	
3	L	H	L	
4	L	H	H	Potential lower road demand
5	M	M	M	Central-case
6	H	L	L	Potential higher road demand
7	H	L	H	
8	H	H	L	
9	H	H	H	Potential higher PT demand

Table 5: Futures Scenarios key variable settings

8. Strategic Options

Objective 2 is to identify strategic options for the Wellington region.

The following sections describe the six strategic options for land transport network form. Each option has been built around projects identified in various planning documents for the Wellington region as well as other potential projects.

The six strategic options are:

1. Base Network
2. Roading Priority
3. Public Transport Priority
4. Road Pricing
5. Mixed Investment
6. Mixed Investment plus Road Pricing

These strategic options map out different configurations of the land transport network. They have been designed to reflect the range of possibility in how the Wellington region may invest in its land transport infrastructure.

The strategic options represent the different types of transport networks that the RLTS policies can encourage to meet the strategy's objectives and outcomes.

8.1 Base Network

This strategic option is meant to set a baseline as a 'do-minimum' investment option.

Beyond this operational and maintenance work, only the currently committed and high third priority projects listed in the 2009 – 2012 Regional Land Transport Programme are implemented. The high priority large capital projects were included because they are very likely to happen by 2040 even with low levels of available funding.

8.2 Roading Priority

This strategic option places priority investment in identified roading projects.

It includes possible road projects highlighted in previous studies as well as others identified as potentially being needed by 2040. Public transport investment is limited to the 'do minimum' Base Network projects.

8.3 Public Transport Priority

In this strategic option, investment in public transport is given top priority at the expense of all other modes.

Only the 'do minimum' road projects are carried forward. This strategic option includes the full Regional Rail Plan along with real time information, integrated ticketing, and light rail from Johnsonville, through the Wellington CBD and to the airport, along with the Melling Loop.

8.4 Road Pricing

This strategic option contains the 'do minimum' infrastructure investment programme, but with hard travel demand management measures of the RLTS funding policy 8.6(b) implemented.

It involves a peak period, peak direction road pricing scheme as described in the 2005 *Road Pricing Study*. Other pricing options identified in the Travel Demand Management Plan 2009 (including parking, vehicle registration and carbon charges) can only be included in the model as proxies factored with the peak period, peak direction road pricing.

Road pricing is a surcharge system for motorists as a traffic management tool for travel behaviours that have a negative contribution to the RLTS objectives. Road pricing is simulated in this strategic option during the peak period, in the peak direction, focusing on trips to (AM) and from (PM) the Wellington CBD.

Road pricing locations and set prices are as follows:

- SH1 S of Tawa interchange including adjacent roads $1.00
- SH2 S of SH58 interchange including adjacent roads $1.00
- SH2 S of Petone toward CBD only $2.00
- SH1 S of Ngauranga interchange including adjacent roads $1.50
- Mt Victoria screenline including Mt Vic Tunnel, Oriental Parade, Constable St, Manchester St including adjacent roads $3.00

Parallel routes are included in road pricing to prevent 'rat-running' to avoid road pricing. It is expected that the level of road pricing in the future would be determined on a case by case basis to reduce severe congestion on selected routes to manageable levels with the potential to reduce the need for capital investment. However, prices are not optimised to fit these requirements in the modelling.

8.5 Mixed Investment

This strategic option is built around an investment strategy where the current 2007-16 RLTS polices remain in place.

It sets out a programme of roading and PT investments that support growing travel demand and encourage mode shift to PT.

The Mixed Investment strategic option was developed after the Public Transport and Roading options in order to incorporate information from the WTSM runs to determine which projects would be included. Public transport and roading projects with marginal benefits were excluded from the Mixed Investment strategic option.

8.6 Mixed Investment + Road Pricing

This strategic option is an amended Mixed Investment programme where four capital projects are deferred with a road pricing mechanism.

The deferred projects are widening Ruahine Street and Wellington Road to 2 lanes in each direction, duplicating the Mt. Victoria and Terrace Tunnels and the removal of 1 lane each way along the waterfront route.

This strategic option most closely matches the current RLTS policies which favour a mixed approach to infrastructure investment and advocacy for various road pricing tools as a long-term option (Policy 8.6(b)).

8.7 Project List

The six strategic options were built into WTSM for testing against the background travel demand created in the futures scenarios. The projects listed for each strategic option reflect the activities that can be incorporated into the model, and are not meant to be exclusionary.

Table 6 lists the projects and activities used in WTSM for each of the strategic options.

Project Name	**1: Base**	**2: Road**	**3: PT**	**4: Rd Price**	**5: Mixed**	**6: Mixed + RP**
Regional Travel Behaviour Change Programme	✓	✓	✓	✓	✓	✓
Rail Infrastructure – Electrify & Double Track MacKays to Waikanae	✓	✓	✓	✓	✓	✓
Real Time Passenger Information System	✓	✓	✓	✓	✓	✓
Bus Priority Scheme	✓	✓	✓	✓	✓	✓
Bus Service Improvements	✓	✓	✓	✓	✓	✓
Rail Scenario 1	✓	✓	✓	✓	✓	✓
Paraparaumu and Waikanae Station Upgrades	✓	✓	✓	✓	✓	✓
Adelaide Road capacity improvements	✓	✓	✓	✓	✓	✓
SH1 Basin Reserve upgrade	✓	✓	✓	✓	✓	✓
Dowse to Petone Interchange	✓	✓	✓	✓	✓	✓
Melling Interchange	✓	✓	✓	✓	✓	✓
SH2/58 (Haywards) Interchange	✓	✓	✓	✓	✓	✓
Western Link Road Stage 1	✓	✓	✓	✓	✓	✓
Western Link Road Ihakara Extension	✓	✓	✓	✓	✓	✓
Western Link Road Stage 3	✓	✓	✓	✓	✓	✓
Western Link Southern Connection	✓	✓	✓	✓	✓	✓
Integrated Ticketing			✓		✓	✓
Rail Electronic Ticketing			✓		✓	✓

Rail Scenario 2			✓		✓	✓
Rail Scenario A			✓		✓	✓
Rail Scenario B			✓			
Light rail Wgtn Station to Hospital			✓		✓	✓
Light rail Johnsonville to Airport			✓		✓	✓
Light rail Melling Loop (WTRL-MELL-WGTN)			✓		✓	✓
4 lane Ruahine St and Wellington Rd		✓			✓	
Mt. Victoria Tunnel duplication		✓			✓	
Inner City Bypass Upgrade		✓				
Terrace Tunnel duplication		✓			✓	
Remove 1 lane ea way at waterfront route		✓			✓	
Waterloo Quay capacity improvements		✓			✓	✓
SH1 Ngauranga-Aotea peak period tidal flow lanes and Hutt Road bus lanes package		✓			✓	✓
Ngauranga Gorge Upgrade		✓				
Karori Tunnel Duplication		✓				
Johnsonville Road capacity improvements		✓			✓	✓
3 lane each way SH2 – Petone to Ngauranga		✓				
SH2 Kennedy Good Interchange		✓			✓	✓
SH2 Upper Hutt bypass upgrade – 2 lane each way River Road		✓				
SH2 Rimutaka Hill Rd ongoing upgrades		✓			✓	✓
2 lane each way upgrade to SH58		✓				
Grenada-Gracefield Western		✓			✓	✓
Grenada-Gracefield Eastern		✓				
Akatarawa Road upgrade		✓				
3 lane each way SH1 from Tawa to Gorge		✓				
SH1/Whitford Brown Interchange		✓				
SH1 Waikanae Grade Separation		✓			✓	✓
SH1 Pukerua Bay Bypass		✓				

SH1 Otaihanga interchange		✓				
SH1 Kapiti Expressway Project		✓			✓	✓
Transmission Gully		✓			✓	✓
Western Link Road Stage 2		✓			✓	✓
Targeted congestion and road pricing				✓		✓

Table 6: Project list for each Strategic Option

9. Strategic Option Assessment

This section details the WTSM results on how each strategic option interacted with each futures scenario.

The assessment measures percent change in the model output indicators from 2006 levels. This was done because there are no regional targets to be met out in 2040. The NZTS 2040 targets are at a national level and have not been 'regionalised' to specify the expected contribution of the Wellington region.

The best performing strategic option is the one which provides the best results over the widest range of futures scenarios.

The following sections provide brief commentary on the results.

9.1 Introduction

The network form strategic options were applied in model runs within the context of the futures scenarios described above. The level of service of each strategic option across each futures scenario is measured as percentage increase or decrease from 2006 levels.

The results from the model runs relate to three of the 2007-2016 RLTS Objectives. These are:

- Economic and regional development,
- Improve access, mobility and reliability,
- Environmental sustainability.

Detailed results from the model runs are described in a separate background technical document: *RLTS Modelling Report*. Table 7 summarises the results produced from WTSM:

✓✓✓ Very significant improvement
✓✓ Significant improvement
✓ Minor improvement
0 Neutral -no significant improvement over current outcome
× Minor negative contribution
×× Significant negative contribution
××× Very significant negative contribution

Note: Tolerances are symmetric, so 50% increase tolerance same as 50% decrease.

Future Key:
yearxyz
x=Growth (Low, Medium, High)
y=Road Cost (Low 0%, Medium 35%, High 75%)
z=Density (Lower - more rural, Medium, Higher - more urban)

Performance Indicators	Tolerances (above percentage value)			
	Neutral	Minor	Significant	Very Significant
PT Boardings	0%	13%	25%	50%
HBW Modeshare	0%	5%	10%	20%
AM Congestion	0%	19%	38%	75%
CO2	0%	19%	38%	75%
	○	✓	✓✓	✓✓✓
	Neutral	Minor	Significant	Very Significant

			Future							
Indicator	Network	2006MMM	2041LLL	2041LLH	2041LHL	2041LHH	2041MMM	2041HHH	2041HHL	2041HLH	2041HLL
Total PT Boardings	Base	○	○	○	✓	○	✓✓	✓✓	✓✓✓	✓✓	✓✓✓
	Roads	○	○	×	✓	○	✓	✓✓	✓✓✓	✓	✓✓
	PT	○	✓	○	✓✓	✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓
	Road Pricing	○	✓✓	○	✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
	Mixed	○	○	○	✓✓	✓	✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓
	Mixed +Rd Pricing	○	✓✓	✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
HBW PT Modeshare	Base	○	○	××	✓✓	✓	✓	✓✓	✓✓✓	○	✓✓
	Roads	○	×	××	✓✓	○	○	✓	✓✓	×	○
	PT	○	○	×	✓✓	✓	✓✓	✓✓	✓✓✓	○	✓✓✓
	Road Pricing	○	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
	Mixed	○	○	××	✓✓	✓	○	✓✓	✓✓✓	○	✓✓
	Mixed +Rd Pricing	○	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
AM Congestion	Base	○	××	○	○	✓	××	××	×××	×××	×××
	Roads	○	○	✓✓	✓✓	✓✓	○	○	×	×	×××
	PT	○	××	○	○	✓	××	××	×××	×××	×××
	Road Pricing	○	✓	✓	✓✓	✓✓	✓	✓	○	○	××
	Mixed	○	○	✓	✓	✓✓	○	○	××	××	×××
	Mixed +Rd Pricing	○	✓✓	✓✓	✓✓	✓✓	✓	✓	○	○	○
Annual CO2	Base	○	○	○	○	○	×	××	××	××	×××
	Roads	○	○	○	○	○	×	××	××	××	×××
	PT	○	○	○	○	○	×	××	××	××	×××
	Road Pricing	○	○	○	○	✓	○	×	××	××	××
	Mixed	○	○	○	○	○	×	××	××	××	××
	Mixed +Rd Pricing	○	○	○	○	✓	○	×	×	×	××

Table 7: Results from WTSM runs for all the Strategic Options against all the Futures Scenarios

9.2 Base Network

Since it was a 'do minimum' strategic option, the Base Network did not consider means to encourage economic and regional growth.

The Base Network does little to increase the access, mobility and reliability of the transport network. Public transport trip increases appear to result from the very significantly worsening of the road network. Under low growth scenarios the Base Network results average out to a neutral effect. However at medium and high growth futures scenarios the Base Network cannot accommodate the increased demand.

CO_2 emissions in the low growth futures scenarios remain close to 2006 levels, but increase significantly in medium and high growth scenarios.

9.3 Roading Priority

Freight efficiency is increased in the low and medium growth futures scenarios due to a focus on roading projects. However, worsening congestion in the high growth scenarios negates some of this efficiency.

Public transport use and mode share increases is relatively neutral, increasing when car travel costs increase.

Under the low growth futures scenarios, this strategic option significantly improves congestion. Medium growth sees congestion remain at 2006 levels while in high growth scenarios some trips seem to move to an unimproved public transport system contrary to the intention of the strategic option.

CO_2 emissions growth remains steady in the low growth futures scenarios, mostly due to improved travel times from less congestion. Emissions become significantly worse in the medium growth scenario to very significantly worse in the high growth futures scenarios.

9.4 Public Transport Priority

The Public Transport Priority strategic option increases public transport mode share across many of the futures scenarios, but the economic benefit to freight efficiency is tempered by increased congestion across several scenarios.

Under low growth futures scenarios improved public transport patronage and mode share is muted by the flat population growth. Mode shift in the medium and high growth futures scenarios are positive, but less strong than what might be expected.

The unimproved road network results in congestion being very significantly worse under high growth scenarios, which in turn encourages mode shifting.

CO_2 emissions are largely neutral in the low growth futures scenarios, but become significantly worse in the medium and high growth scenarios. This is largely due to the increased congestion.

9.5 Road Pricing

Freight efficiency is increased in the Road Pricing strategic option while operating on a ‘do minimum’ road network with a peak period, peak direction road pricing scheme. HCV’s may not be sensitive to road pricing as any extra costs (over and above the time savings due to reduced congestion) would be passed on to their customers.

Public transport mode share is significantly increased across all futures scenarios as the increased car travel costs close the gap between car and public transport based travel. The pressure exerted on

the public transport network due to this mode shift will require further investment in public transport infrastructure and rolling stock than this strategic option contains.

Congestion shows minor to significant improvement in the low growth futures scenarios. Congestion in the medium and high growth scenarios shows largely neutral growth due to road pricing targeting the most congested parts of the network.

The Road Pricing strategic option has a mostly neutral growth rate in CO_2 emissions. In the high growth futures scenarios, the very significant worsening of CO_2 emissions is the result of heavy commercial vehicles – due mostly to the lack of increased fuel efficiency assumed in the model.

9.6 Mixed Investment

The Mixed Investment strategic option delivered increased public transport mode share, decreased or had a neutral effect on congestion levels while largely accommodating economic growth. The congestion results were poorer in high growth futures scenarios particularly when low transport costs were coupled with low density land use.

The Mixed Investment option had positive to neutral results for journey to work public transport mode share and neutral or reduced congestion for low and medium growth futures scenarios. In high growth scenarios the road network was unable to meet increased travel demand.

The CO_2 emissions are neutral in the low growth scenarios, but this strategic option does not have acceptable emission results for medium and high growth futures scenarios.

9.7 Mixed Investment plus Road Pricing

The Mixed Investment plus Road Pricing strategic option accommodated for economic growth by increasing mode shift to public transport and reducing or maintaining congestion levels with the subsequent increase in freight efficiency across all futures scenarios.

Mode shift to public transport was strongly positive across all futures scenarios. Congestion results ranged from significantly positive to neutral across all scenarios.

Growth in CO_2 emissions remained largely neutral across low and medium growth futures scenarios, while significant increases occurred is several high growth scenarios.

10. Summary and Analysis Impact Assessments

Objective 4 of this assessment is to determine if the previous impact assessments require updating.

The following sections summarise the impact assessments that were conducted during the development of the 2007 – 16 RLTS.

10.1 Economic Impact Assessment

The economic impact assessment was produced in September 2006 by consultants GHD and looked at how the RLTS would affect economic and regional development as well as affordability issues.

The Wellington region has no real manufacturing base, and there is no significant pastoral hinterland in comparison to other parts of New Zealand. The main business is the public sector and the associated supporting services and businesses.

However, when compared with the other cities and regions that Wellington is in direct competition with, the Economic Impact Assessment concluded that there has been a significant under-investment in transport infrastructure, leading to a 15 year backlog of projects. This has resulted, generally, to a poor safety record in the region; and specifically in high levels of congestion in Wellington City, a lack of local arterial routes in Kapiti, and poor connections between Wairarapa and the rest of the region.

The main lesson is that this lack of access coupled with a relatively small population base impedes Wellington's competitiveness. The public transport system in Wellington is a big selling point, and a well managed PT network can attract new businesses and keep business in the region. The affordability of reducing the backlog of capital projects is the largest concern. The Economic Impact Assessments recommends a combination of rates increases, user charges and public-private partnerships to make up the funding gap.

10.2 Environmental Impact Assessment

The Environmental Performance Review for the Draft RLTS 2007 – 2016 was completed in August 2006 by Environmental Management Services Ltd. It focuses on the effects of climate change and the potential environmental repercussions of specific projects on natural systems.

The impact assessment identifies more extreme weather patterns and sea level rise as the main consequences due to climate change for the Wellington region. The main risks to the land transport network from these events are land slips and flooding, which could affect a considerable amount of the strategic network.

The impact assessment concluded that comprehensive pricing systems and other hard TDM measures are the most effective means to reduce carbon dioxide emissions. Improved emissions technology is the other significant means of improving air quality and reducing CO_2 emissions, so long as those technologies are widely incorporated into the vehicle fleet.

Transmission Gully motorway offers benefits as a second route in cases of extreme events. However, in an extreme event it is probable that both TG and SH1 would be out of commission for an extended period of time. It is also important for public transport and TDM measures to be in place along the Western Corridor before Transmission Gully opens in order to lock in the environmental benefits possible with the project.

The impact assessment also recommends that mechanisms for improving the integration of land use development and regional infrastructure be strengthened. It identifies Battle Hill Regional Park, Belmont Regional Park and the Pauatahanui Inlet as the areas primarily vulnerable to pollution effects from regional development.

10.3 Health Impact Assessment

The Health Impact Assessment was completed in September 2006 by Quigley and Watts Ltd. It focussed on five determinants of health: physical activity, accessibility to services and the community, accident rates and changes in injuries and fatalities, community effects and severance as a result of traffic, and stress and anxiety.

The main conclusions are:

- Increasing modal share for public transport use and walking and cycling, and reducing private motor vehicle modal share are the best ways for transport to promote health, and the draft RLTS is not predicted to achieve these changes. If the RLTS is to meet its objective of protecting and promoting public health it must shift its focus to increasing public transport use and TDM.
- Individual investments in the RLTS that promote public transport infrastructure and services, and access for people with disabilities are applauded. However, on balance their positive public health impact is likely to be overshadowed by the impact of the new roading.
- Assumptions that increased allocation of funds to public transport are likely to increase congestion and negatively impact on economic and regional development must be strongly challenged.

The major recommendations of the HIA approach are:

- Incorporate social equity and affordability into the RLTS objectives and outcomes
- Investigate changes in fare pricing structures and fare boundaries to improve equity and affordability
- Increase the proportion of funding for public transport, walking and cycling, and reduce the proportion of funding for new roading, as new roading is not likely to promote health, while other modes of transport are.
- Initiate HIA in projects that flow out of this RLTS, and initiate HIA earlier in future RLTS planning processes.
- Strengthen the aims of the RLTS towards increased mode share for public transport and active modes and reduced dependence on private motor vehicles.

10.4 Analysis of Impact Assessments

The Health Impact Assessment is difficult to assess using this strategic options assessment. However, most of the recommendations in the HIA have benefits in other areas (namely access, mobility and reliability as well as environmental sustainability) making an assessment possible.

There were no areas touched upon by the impact assessments that are not still relevant to the Wellington region. Publications since the finalisation of the impact assessments, primarily by NZTA,[3] do not highlight any significant issues not addressed.

[3] See a full list of the research reports published by the NZTA at: http://www.nzta.govt.nz/resources/results.html?catid=16.

The results of the WTSM runs do not seem to contradict the impact assessments. Significant investment in Greater Wellington's land transport network is needed to improve access and make the region more competitive. Improvements in roading capacity when not coupled with increased public transport usage and mode share do not attain the economic benefits of improved access, reduced congestion and greater freight efficiency. The affordability, and beneficial results, of the strategic options can be increased when coupled with road pricing schemes if the revenue generated is spent on transport infrastructure improvements.

Extreme weather and sea level rise continues to be a primary concern to the land transport network of the Wellington region. Since the most severe of these effects are projected to occur after 2040, no routes were removed from network in the model based on these risks. Road capacity improvements alone do not reduce congestion across all the futures and are thus an insufficient means of reducing CO_2 emissions.

Improved access and mobility have follow-on health effects. This strategic options analysis concurs that investments in public transport is very beneficial to access and mobility (and thus health), but in-and-of-itself not the best response. Statistics collected by the Ministry of Transport and Greater Wellington through the Annual Monitoring Report process indicate that public transport is one of the safest transport modes.[4] This futures assessment also confirms that investment in public transport does not have a detrimental effect on access and mobility, and thus economic activity. However, this is only when coupled with some increase in road capacity.

11. Conclusions

This analysis tests the issues and policies of the 2007-16 RLTS as well as the robustness of the impact assessments. The WTSM modelling did not highlight any significant issues that were not addressed, nor do any recent publications contradict the impact assessments. The Economic, Environmental, and Health Impact Assessments are therefore robust enough not to require updating for this RLTS review.

The futures scenarios and strategic options were developed independent of each other as a means to not preference any one strategic option. The options that focused on individual modal solutions were developed and modelled before a mixed approach. This process lead to 54 model runs across 9 futures scenarios and 6 strategic options. The process was therefore reasonably fair and unbiased towards any particular strategic option.

The Mixed Investment plus Road Pricing strategic option lead to the best results over the widest range of futures scenarios, followed by the Road Pricing strategic option at second best. The Mixed Investment plus Road Pricing strategic option:

- had the most significantly positive results across all WTSM outputs for the low growth futures scenarios,
- kept congestion from significantly worsening across all the high growth scenarios,
- and was the most successful at reducing the growth rate of CO_2 emissions.

[4] The latest 2008/2009 Annual Monitoring Report on the Regional Land Transport Strategy is available at GW's website at: http://www.gw.govt.nz/amr/.

The model indicates that road pricing is the most powerful tool for addressing congestion, CO_2 emissions, and for encouraging mode shift to public transport. Road pricing should continue to be advocated for in the RLTS.

As the RLTS is primarily a document for guiding infrastructure investment, a mixed approach in improving public transport and roading capacity in conjunction with each other is the best approach to future investment.

The strategic option that best fit the current 2007-16 RLTS policies was the Mixed Investment plus Road Pricing, followed by the Mixed Investment strategic option. Therefore, **the identified issues and policies of the 2007-2016 RLTS are robust enough to carry forward over the 2010 to 2040 time frame**.

However, the impacts from climate change and natural disasters are the variables most likely to affect the robustness of the RLTS polices in the future.

The Road Pricing strategic option had similarly excellent results across all futures scenarios. However, it was less successful at reducing CO_2 emissions in the high growth futures scenarios – indicating that investment in transport infrastructure above a 'do minimum' amount is desirable.

The Base Network strategic option was insufficient to adequately cope with medium and high growth futures scenarios. The Roading Priority strategic option scored poorly with congestion and CO_2 emissions. The Public Transport Priority strategic option did not provide adequate results in the low growth futures scenarios across the outputs, nor did it adequately handle congestion and CO_2 emissions in the medium and high growth scenarios. The Mixed Investment strategic option had little improvement across most of the outputs in the low growth futures scenarios and inadequate results for congestion and CO_2 emissions in the high growth scenarios.