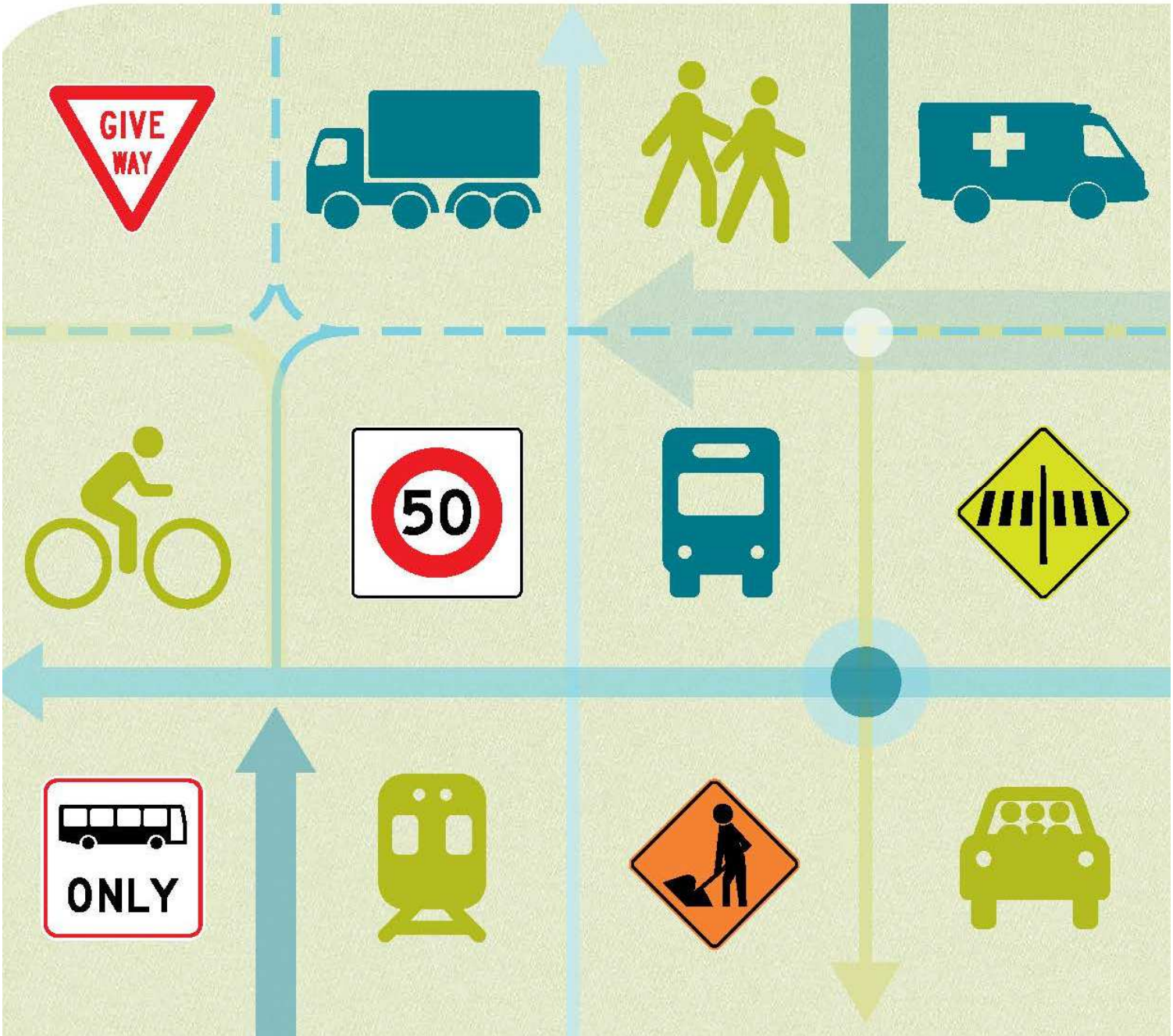
WELLINGTON REGIONAL LAND TRANSPORT PLAN 2015

Working Paper 3

Transport Modelling Approach

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao



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REGIONAL COUNCIL
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Wellington's Regional Land Transport Plan

Working Paper 3 – Transport Modelling Approach

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1. Introduction

1.1 Policy context for RLTP working papers

The Regional Land Transport Programme represents the Wellington region's bid for funding from the National Land Transport Fund (NLTF) which is administered by the New Zealand Transport Agency (NZTA).[1] The current Regional Land Transport Programme, covering the period 2012 to 2015, reflects both the national direction provided in the Government Policy Statement on Land Transport Funding 2012/13-2021/22 (GPS) – which includes a focus on economic growth and productivity, value for money and road safety – and the Wellington region's priorities and outcomes in the Regional Land Transport Strategy (RLTS).

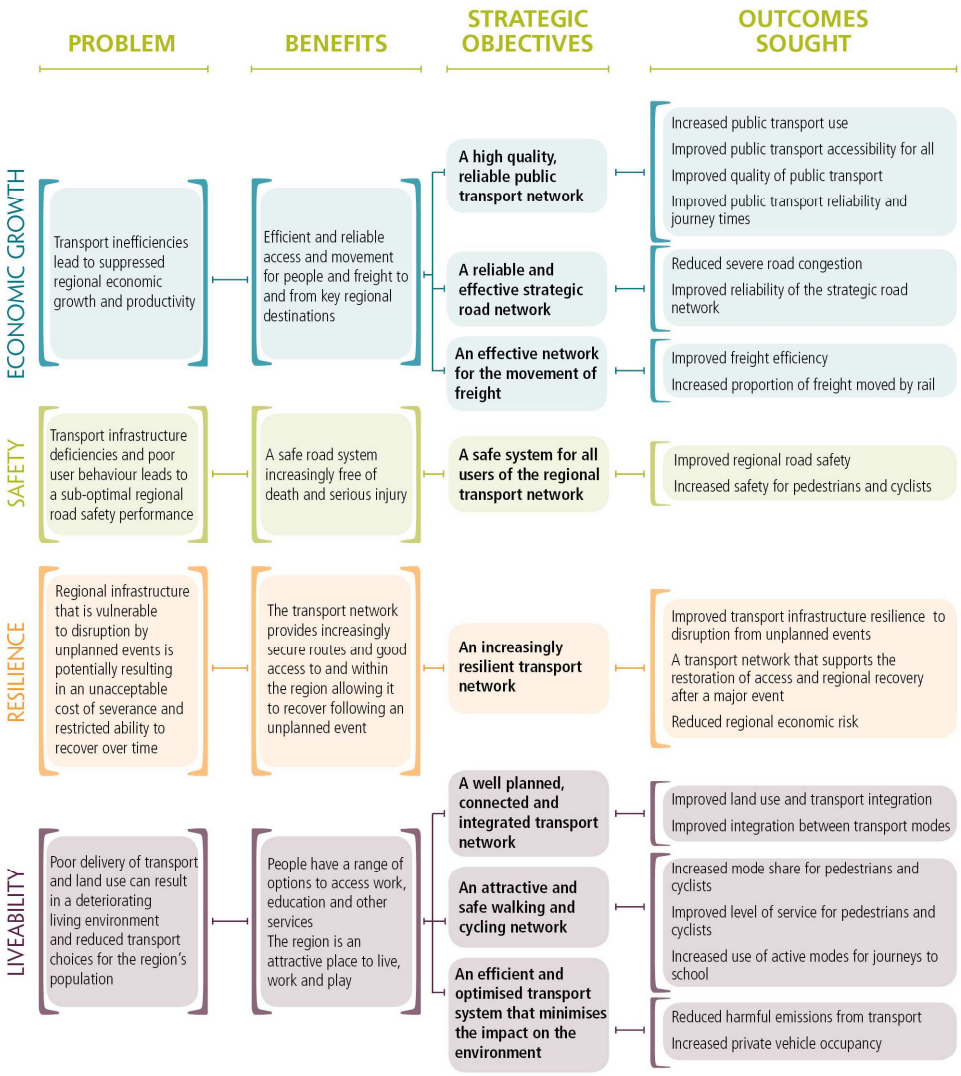
From 1 July 2015, the Land Transport Management Act (2013) requires that the RLTS and Regional Land Transport Programme be consolidated into a new planning document called the Regional Land Transport Plan (RLTP). The Wellington Regional Transport Committee[2] is developing the new RLTP to be adopted in April 2015. The RLTP will set out the region's land transport objectives, policies, measures and targets for at least 10 years, i.e. for the period 2015 to 2025 (with a view to the strategic approach for development of the land transport network over the longer term, of up to 30 years). The RLTP will identify the transport activities for funding in the short term (up to six years) and the regional priority to be given to these projects.

As shown in Figure 1, the RLTP will address the challenges facing the region in terms of its transport network, relating to four key areas – economic growth, safety, resilience and liveability.[3] The figure shows the benefits associated with addressing the challenges, then these feed into a list of eight key objectives and associated outcomes. How these outcomes are measured, and the targets relating to the objectives, are the focus of this set of RLTP working papers.

The new RLTP needs to reflect changes to the purpose and decision-making criteria in the Land Transport Management Act (LTMA) with a new focus on aiming for an 'effective, efficient, and safe' transport network and to reset targets out to 2025 (the targets are out to 2020 for the existing RLTS). It is therefore timely to review the region's outcomes and targets to ensure that they are relevant and measurable.

[1] Note that funding is not guaranteed for all projects included in the RLTP. Final decisions regarding funding are taken by the NZTA.
[2] The Regional Transport Committee comprises Greater Wellington Regional Council (GWRC), the city and district councils in the Wellington region, and NZTA.
[3] Definitions of these terms may be found at GWRC (2015): *Regional Land Transport Plan 2015 (for consultation)*, p.141.

Figure 1 RLTP problems, benefits, strategic objectives and outcomes sought



1.2 Overview of RLTP working papers

In order to inform the RLTP policy framework, a series of five working papers have been developed. There is a set of measures and targets associated with the RLTS for 2010-2040. The RLTP for 2015 will also contain a comparable set of measures and targets, but with changing circumstances and patterns of behaviour, and developments in the region since the last set were established, some revision is appropriate.

The five working papers start with a review of the current situation for the Wellington regional transport network, look at trends and influences in recent years; pressures and issues relating to the region's transport network; and arrive at a revised set of targets and measures for the RLTP, informed by modelling and by actual trends.

The five working papers, of which this is the third, are as follows:

Working Paper 1: Review of Wellington Region Land Transport Strategy 2010-2040 Targets

This paper begins the process of transition from RLTS to RLTP by reviewing the region's land transport outcomes and associated targets which are determined by the strategic objectives for the region. The paper focuses on whether the targets are relevant, measurable and achievable, and the extent to which the work carried out by the Greater Wellington Regional Council can influence progress towards achieving these targets. The purpose of this paper is to provide information to guide the development of SMART targets – specific, measurable, achievable, realistic and time-bound – for the 2015 RLTP, which will cover the period 2015 to 2025.

Working Paper 2: Background Trends and Issues

This paper summarises demographic and transport-related trends over the last 10 to 20 years, suggests how these trends might develop in the short to medium term and the implications that this might have for future travel demand and the transport system. It arrives at a summary of trends and issues affecting the region's transport network and identifies areas where future travel demand growth may occur. The purpose of this paper is to provide an evidence base for the development of an 'expected future' scenario that will be used to inform the development of RLTP targets.

Working Paper 3: Transport Modelling Approach

Drawing upon information presented in Working paper 2, this paper outlines the infrastructure, land use and economic assumptions that form the basis for the development and modelling of a number of future scenarios in the Wellington Transport Strategy Model (WTSM). This paper provides a description of the scenarios that are modelled in the WTSM. The modelling produces an 'expected future' for the Wellington region's transport network, and a range of alternative scenarios as key assumptions are varied. The scenario results are analysed in Working paper 4.

Working Paper 4: Development of Future Scenarios

This paper presents the results from the WTSM scenarios modelling in Working paper 3 and outlines how the different future scenarios that are modelled result in different travel patterns. The modelled impacts of the scenarios are compared according to key performance indicators. The results of 'revised future' modelling are presented with revisions to two central expected future assumptions based on 2014 policy decisions. Drawing upon the modelling and information presented in the background paper, the 'expected future' scenario is developed further, and this is the expected future that forms the basis for the development of the RLTP targets.

Working Paper 5: Targets Development

This final working paper brings together the analysis from the first four working papers to produce a revised set of targets and measures for the RLTP. The purpose of this paper is to outline and provide rationale behind a set of targets that are considered challenging, yet achievable, and will help the region make progress towards a range of strategic objectives and outcomes.

A glossary of terms for the five working papers is provided as a separate document.

1.1 Outline of this working paper

This working paper, WP3, is structured as follows.

Section 2 provides an overview of the Wellington Transport Strategy Model (WTSM), outlining the model structure, key data sources, key processes and key outputs, together with the four main components of the model: trip generation, trip distribution, mode split and assignment components of the WTSM.

Section 3 presents the modelling assumptions that form the basis of the 'expected future', relating to infrastructure, economic variables, land use (population and employment) and 'lifestyle changes'. Proposed sensitivity tests, designed to determine the extent to which outcomes might vary if some of the input assumptions are modified, are also outlined.

Section 4 outlines the idea of an 'alternative future', where the projects that are assumed and modelled are not currently committed or included in the 2015 RLTP. Such assumptions include additional public transport infrastructure and travel demand management measures – parking management, a congestion charge and tolling certain strategic roads.

Section 5 summarises the packages that are to be modelled – the expected future packages, four sensitivity tests based upon the expected future and four alternative future packages.

2. Wellington Transport Strategy Model

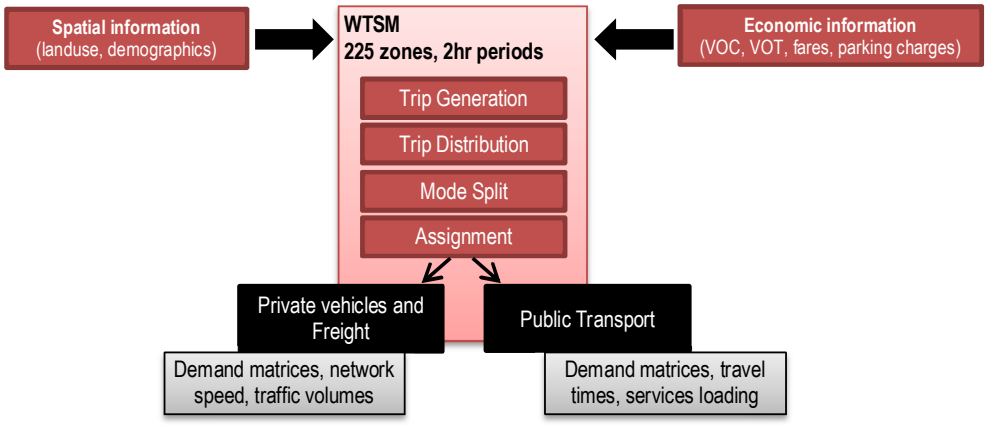
The Wellington Transport Strategy Model (WTSM) is a four-stage transportation model that uses population projections, employment projections, economic assumptions and infrastructure assumptions to develop a range of forecasts relating to transport demand and the resulting use of the regional transport network. The terminology used in the model is defined in section 2.3.[4]

These forecasts are used to look at how traffic volumes, public transport patronage, delays and congestion across the network might change through time in response to changes to model inputs and assumptions.

2.1 Model structure

This section summarises the key terminology, time coverage and base model year, key inputs, processes and outputs of the model. The structure of the model is shown in **Figure 2** below.

Figure 2 WTSM model structure



2.1.1 Model terminology

This section presents key terminology used in the WTSM and it also explains key terms that are used both in this working paper (WP3) and WP4.

- Current year/base year – since the model was updated using 2011 data, the 'current' year or base year is 2011.
- Trip generation, trip distribution, mode split and assignment are the intermediate processes internal to the model. See section 2.1.4 for more detail.
- Highways – the regional roading network including state highways and local roads.
- Public transport – bus, rail, ferry and cable car travel modes.

[4] Full information about the WTSM can be found on the GWRC website.

- Vehicle operating cost – the monetary cost of operating a vehicle, which is a function of the fuel price, vehicle efficiency and travel distance. One component of the cost of travelling by car.

- Parking cost – The cost of parking in Wellington City CBD. One component of the cost of travelling by car.

- Public transport fare – The monetary cost to the passenger of travelling by public transport. One component of the cost of travelling by public transport.

- Highway travel time – The time it takes to travel from an origin to a destination via the roading network, taking into account congestion. One component of the cost of travelling by car.

- Public transport travel time – The time it takes to travel from an origin (e.g. home) to destination (e.g. work), including time spent walking, waiting and travelling on public transport. The walking and waiting times are 'weighted'[5] to convert into perceived time, to reflect the fact that people tend to find waiting and/or walking more onerous than travelling on a public transport vehicle.

- Value of time – This measure represents the monetary value that transport users place on their time. It is used to convert other components of cost (including public transport fares, vehicle operating costs, for example) in a time-based measure, specific to the time periods during the day (see section 2.1.2). This enables all cost components to be aggregated and compared across modes on a like-for-like basis.

- Highway generalised cost – This term represents the cost of travelling by car, and includes travel time, vehicle operating costs and parking costs.

- Public transport generalised cost – This term represents the cost of travelling by public transport and comprises origin to destination travel times (walking, waiting and in-vehicle) in addition to public transport fare costs.

The model uses Gross Domestic Product (GDP) and the Consumers Price Index (CPI) obtained from New Zealand Treasury. Forecasts of these variables are used as a basis for modelling trends in parking costs, values of time and public transport fares into the future.

Other key assumptions that are represented in the model relate to trends in population, car ownership, and the fuel efficiency of vehicles, as follows:

- The areas where future population growth is projected to occur will generate new trips. The location of any new residential developments

[5] http://www.gw.govt.nz/assets/Transport/Transport-models/TN16-WPTM-and-WTSM-PT-Assignment-Comparison-FINAL.pdf

will to some extent determine whether the development will favour active modes, public transport or the private car.

- Changes in car ownership levels reflect car availability (the access of people in a household to a car) and the ability to drive (whether a person has a driver's licence). This in turn affects whether a person chooses to travel by private car, public transport or active modes.

- Vehicle efficiency (for both light and heavy vehicles) is assumed to increase in the future, where the efficiency relates to the vehicle's use of fuel per kilometre travelled. Improvements in vehicle fuel efficiency will have the effect of dampening the fuel cost component of vehicle operating cost increases in the future as people are able to drive the same journeys using less fuel (and thus costing less).

2.1.2 Model base year and time periods

The WTSM was first created and calibrated using 2001 observed data. The current (2011 base year) version of the model was updated using 2011 observed data.

The WTSM covers three time periods during the day:

- AM peak – 7am to 9am
- Inter-peak – an average two hour period between 9am and 3pm
- PM peak – 4pm to 6pm

The model is run separately for each time period.

2.1.3 Key inputs

The key inputs to WTSM can be split into two categories:

- observed data that are used to create, calibrate and validate the current (2011 base year) version of the model
- forecast data and projections that are used to create future scenarios (2021, 2031, 2041)

The observed data used to create, calibrate and validate the 2011 base year model are as follows:

- Household travel survey data (from 2001) from which household travel patterns, trip characteristics and car ownership is obtained. From this data, the trip rates and equations that underpin the function of the model were formulated. These equations and relationships are taken forwards and used when forecasting scenarios
- a representation of the current roading network within the region, consisting of all strategic and major roads, most local roads and some minor roads

- the existing public transport network, including bus/rail services
- public transport fares, vehicle operating costs, parking costs, GDP and values of time
- population and employment estimates for the base year 2011, based upon 2006 New Zealand Census and more recent Statistics NZ data
- observed traffic volumes (numbers of vehicles) and travel times for a selection of roads across the region, by time period
- observed public transport boardings, volumes (numbers of passengers) and travel times for selected routes across the region

For the purpose of the modelling of the RLTP forecast scenarios, a 2031[6] future year is used, with the following changes made between the 2011 base year and 2031 future year scenarios:

- the base roading and public transport networks were changed to reflect future infrastructure projects (roading and public transport) and changes to public transport services
- car ownership rates forecasts were adjusted according to recent MoT and 2013 census data
- standard WTSM demographic and employment projections were used, including Wellington City Council recent population forecasts.
- future public transport fares, vehicle operating costs, parking costs, GDP and values of time were estimated based upon a combination of recent trends and projections from a number of sources[7]
- equations and relationships underpinning the model remain unchanged between the base year and forecast versions of the model

2.1.4 Processes and intermediate outputs

The inputs listed in section 2.1.3 are used in the four stages of the WTSM that are outlined in this section.

In order to understand how the model works, it is important to understand the principles of the zonal system under which input and output data are grouped and processes undertaken.

Land use varies from one area to the next and, with it, so does the pattern of trip productions and attractions. For example, a primarily residential area will generate many commuter trips in the morning peak whilst an area of employment will largely attract trips in the morning peak. Educational establishments, leisure facilities and shopping centres also generate and/or

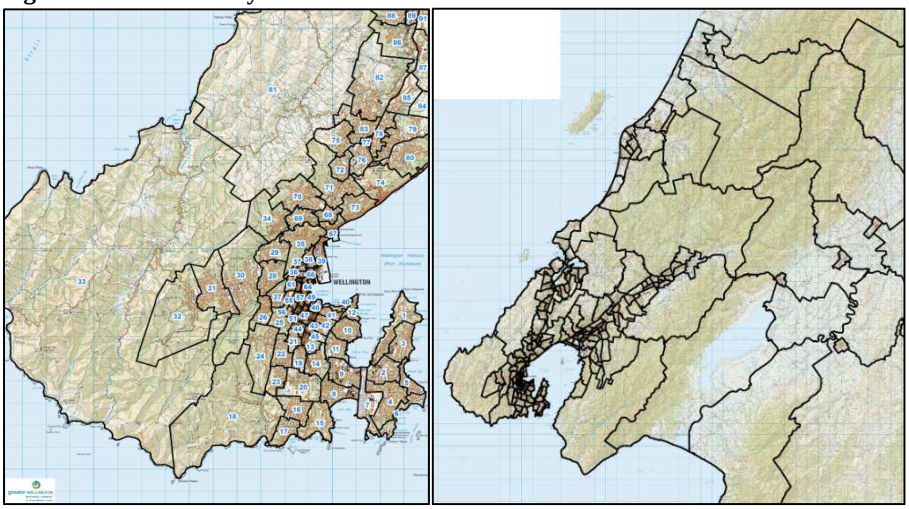
[6] 2021, 2031 and 2041 forecast versions of the model are available. For the purpose of modelling the RLTP scenarios only a 2031 year is considered.
[7] NZ Treasury (value of time and parking costs), MBIE (fuel prices), GWRC (public transport fares)

attract trips at certain times of the day. It is the relationship between population and land use (employment, education, leisure, shopping, etc.) that largely dictates travel patterns.

The WTSM consists of 225 geographical zones, each of which has different underlying land use characteristics.

Figure 3 shows the WTSM zone system, focusing on Wellington City (left) and the whole region (right).

Figure 3 WTSM zone system



In the model, zones are connected to the public transport and roading networks. The model **generates** and **distributes** trips between pairs of zones, allocates these trips to certain **modes** and then **assigns** the trips to routes depending on the relative difference in cost between the various options.

The four-stage process that is modelled and used to produce forecasts, as illustrated in Figure 2, are trip generation, trip distribution, mode split and assignment. These are discussed in turn in terms of what the model uses as inputs, the process involved and the outputs produced.

1 - Trip generation

- inputs are trip rate and land use data, which generate numbers for trip production (i.e. where the trip started and why – for example if a person starts from home) and trip attraction (where the trip ended and why, e.g. it is where a person works), by purpose (commuter, education, leisure trips), for each zone within the region

- the output from this process is the number of trip ends generated and attracted by purpose (i.e. work, education, etc.) for each zone within the model

2 - Trip distribution

- the trip ends that are generated in the preceding process are distributed between pairs of zones, creating full trips between an origin and a destination. The characteristics of these trips, such as the average distance travelled, will differ depending on the trip purpose.

- patterns of trips to be expected are as follows: the majority of commuter trips between residential areas and employment areas; the majority of education trips between residential areas and educational establishments; and in most cases shopping trips in the inter-peak are largely between residential and shopping/leisure areas

3 - Mode split

- the mode split module looks at trips between each origin–destination pair and splits them between car, public transport and active modes depending on the relative attractiveness of travelling by each mode.

- the output from the trip distribution and mode split process is a series of matrices covering all origins and destinations within the model, providing a distribution of trips, by purpose, mode and time period, across the region

4 - Assignment

- this final process takes the car and public transport matrices of travel patterns produced by the preceding stage and assigns them to routes on the relevant networks, depending upon the relative difference in costs between competing routes

- Active modes are not included in this stage, which only applies to motorized transport (private vehicle and public transport)

The process of calculating travel costs for each mode is discussed in section 2.2.

2.1.5 Key outputs

The key outputs produced from the assignment stage are as follows:

- traffic volumes (numbers of vehicles) for all roads

- road travel times, including congestion

- public transport volumes (numbers of passengers) by line, service and route

- public transport boardings by stop or station

- public transport travel times

When validating the 2011 base model, these outputs are compared against observed data for the 2011 base model to assess how accurately the model is representing reality. This is an iterative process, with model parameters and

assumptions adjusted until there is a satisfactory match between observed data and modelled outputs.

When future year versions of the model are run, these outputs are used to show the extent to which infrastructure, service and land use changes affect travel patterns and travel times.

2.2 Modal choice and route choice

As mentioned in the previous section, the modal split[8] between a particular origin–destination pair is dependent on the relative difference in the cost of travelling by car, public transport and active modes.

Similarly, once trips have been allocated to 'car' or 'public transport', the distribution of trips between alternative routes (i.e. bus or rail) is also dependent upon the relative difference in cost between options.

The costs of travel are expressed in common units of generalised time, with values of time (in dollar units) used to convert monetary values to time-based equivalent values.

Actives modes are handled in a different way from other modes in WTSM, with their share calculated as a function of the distance travelled and then subtracted from total demand. They are then not processed any further as part of a model run and are therefore not discussed here.

This section presents the cost components for car and public transport travel and suggests key changes that might affect those costs in future.

2.2.1 Costs of travelling by car and public transport

The cost components of travelling by car and public transport are as follows:

Car

- vehicle operating costs – a function of travel distance, fuel price, and vehicle efficiency
- vehicle travel time – travel time from an origin zone to a destination zone on the roading network, including time spent in congestion
- parking cost (if applicable) – costs of parking in Wellington City CBD only

Public transport

- public transport fare
- walking time[9] from initial origin to boarding stop/station
- time spent[10] waiting for a bus/train

[8] Split between car, public transport, walking and cycling over a 24 hour period.

[9] Perceived rather than actual time is used, to reflect the fact that people perceive walking to be more onerous than time spent on a public transport vehicle or in a private car. For more details please visit http://www.gw.govt.nz/assets/Transport/Transport-models/TN16-WPTM-and-WTSM-PT-Assignment-Comparison-FINAL.pdf.

- time spent on board[11] a bus/train – a function of timetabled time (rail) or road travel times plus travel time adjustment factors (bus)

- walking time from alighting stop/station to final destination

The relative costs of travel between modes (car vs public transport), within the public transport modes (bus vs rail) and between different routes (for example, a longer but faster car route vs a shorter but slower car route) dictate the modal split and route choices.

In simple terms, the cost of travelling by different mode and route is calculated, from which a probability of someone choosing a certain option (mode and/or route) is calculated. The greater the probability, the greater the percentage of trips allocated to that particular choice (mode/route).

2.2.2 Future interventions

New or improved public transport services, and new or improved infrastructure affecting public transport and/or car travel will change the relative cost of travelling by public transport and/or car and will change the resulting modal split. For example, if public transport becomes more attractive due to infrastructure enhancements, the public transport mode share might increase. Conversely, if travelling by car becomes more attractive, the public transport mode share might decrease.

Future changes in travel patterns and modal choice are likely to arise for three main reasons:

- Road, public transport or multi-modal schemes infrastructure projects affecting the cost of travelling by car or public transport

- land use changes favouring public transport (or active modes) over the private car; for example, continued residential development in the Wellington City CBD is likely to result in more people living closer to work and to good public transport links, thereby favouring public transport (and active modes) over the private car

- changes to vehicle operating costs, public transport fares and parking costs

[10] As above, perceived rather than actual time is used, to reflect the fact that people perceive waiting to be more onerous than time spent on a public transport vehicle.
[11] As with walking time and waiting time, perceived rather actual time is used in order to reflect the fact that people perceive certain modes to be more attractive than others. Details may be found at: http://www.gw.govt.nz/assets/Transport/Transport-models/TN16-WPTM-and-WTSM-PT-Assignment-Comparison-FINAL.pdf.

3. Expected future modelling assumptions

This section outlines the series of assumptions that form the basis for the 'expected future' packages to be modelled in the WTSM, the results of which are used to develop an expected future scenario that will inform the development of the RLTP targets.

The 'expected future' is essentially a 'most likely view of the future', using a set of assumptions that are based upon current knowledge, recent observations and future projections.

The assumptions cover the period between:

- 2011 – WTSM base year and
- 2031 – the forecast scenario that is used for the RLTP modelling

This section outlines:

- expected future infrastructure assumptions
- economic assumptions
- land use assumptions
- proposed sensitivity tests around the expected future
- lifestyle changes and how they are accounted for in the modelling system

3.1 Expected future – infrastructure

Infrastructure projects that are included in the expected future scenario are defined as those that are included in the regional programme and are expected to be delivered during the lifetime of the 2015 RLTP (2015 to 2025). They include projects that are aimed at improving roading infrastructure and public transport infrastructure (both bus and rail).

Regarding the road infrastructure, most of the expected projects are part of the SH1 Wellington Northern Corridor[12], one of the Roads of National Significance (RoNS) identified by the Government as essential state highways requiring upgrading. The road infrastructure projects assumed to be completed by 2025 are as follows:

- Airport to Mt Victoria Tunnel (part of the RoNS): widening of Wellington Road and Ruahine Street and duplication of Mt Victoria tunnel
- Basin reserve bridge (part of the RoNS): bridge for SH1 westbound from Patterson Street to Buckle Street, separating north-south traffic to east-west traffic.

[12] http://www.nzta.govt.nz/network/projects/wellington-northern-corridor/

- Inner city bypass improvements (part of the RoNS): upgrade to key intersections to increase capacity along the bypass
- Terrace tunnel duplication (part of the RoNS): additional lane for southbound traffic
- Ngauranga to Aotea Quay (part of the RoNS): 4-lanes on SH1 between the SH1 / SH2 Ngauranga interchange and the Aotea Quay interchange, in both directions
- Transmission Gully (part of the RoNS): new 4-lane motorway between MacKays and Linden, with interchanges at SH58, eastern Porirua and Kenepuru
- MacKays to Peka Peka (part of the RoNS): new 4-lane expressway between MacKays and Peka Peka, through Paraparaumu and Waikanae
- Peka Peka to Otaki (part of the RoNS): new 4-lane expressway between Peka Peka and Otaki, including a bypass of Otaki
- Petone to Grenada[13]: new east-west link between the Hutt Valley at Petone and Tawa/Porirua at Grenada North.
- SH58 / SH2 grade-separation: Grade-separated interchange between SH58 and SH2

The public transport infrastructure projects assumed to be completed by 2025 are as follows:

- A bus rapid transit (BRT) corridor from Wellington Railway station to Kent/Cambridge along the Golden Mile, with branches to Newtown through Adelaide Road and to Kilbirnie through the duplicated Mt Victoria tunnel. This BRT, resulting from the Public Transport Spine Study (PTSS)[14] and ratified by the Regional Transport Committee (RTC) in May 2014, will include dedicated public transport lanes and priority measures, as well as higher capacity and superior quality vehicles. It will result in increased capacity and faster travel times for public transport between Wellington's eastern and southern suburbs and Wellington City CBD.
- The implementation of an updated and revised bus network in Wellington City, as outlined in the Regional Public Transport Plan (RPTP)[15] providing a simplified network that is designed around the principle of core, secondary, targeted and commuter routes.
- Minor bus priority measures in Wellington City CBD (e.g. bus lanes, signal pre-emption) and the selective rationalisation of bus stops along key corridors, aimed at improving bus travel times and travel time reliability.

[13] http://www.nzta.govt.nz/projects/petone-grenada-link-road/index.html?r=1
[14] http://www.gw.govt.nz/assets/Transport/Regional-transport/PT-Spine-Study/PTSS-Final-Reports-2013/FINAL-PDF-Public-Transport-Spine-Study-Compilation-Report.PDF
[15] http://www.gw.govt.nz/assets/Transport/Regional-transport/RPTP/WGNDOCS-1386111-v1-FinalRPTPdocWEBversion.PDF, page 41

- The Regional Rail Plan RS1 scenario, as outlined in the 2014 RPTP[16]. Components of this scenario include rolling stock renewal, improved service frequencies, infrastructure improvements, additional rolling stock capacity at peak times and improved reliability. No appreciable improvement in line speed is expected to be delivered through RS1.

- An integrated public transport ticketing system, as outlined in the RPTP.[17]

3.2 Expected future – economic assumptions

This section outlines how a range of economic variables are forecast to change between 2011 and 2031. Further detail is provided in WP2 ('Background trends and issues') and the WTSM technical reports that are available on the GWRC website.

3.2.1 Fuel prices

The price of fuel is forecast to increase at an annual rate greater than the rate of inflation. This information is derived from the MBIE forecasts, with a 'high' fuel price trajectory considered a 'most likely' future.[18]

3.2.2 Vehicle fuel efficiency

Vehicle fuel efficiency is forecast to increase by around 15% to 20% between 2013 and 2031.[19] Given that the fuel efficiency of the vehicle fleet and the price of fuel are key components of vehicle operating costs, the net result is likely to be a future where the impact of rising fuel prices will be softened somewhat by improved vehicle efficiency (i.e. vehicles can travel further on a given amount of fuel).

3.2.3 Parking costs

The cost of parking in Wellington City CBD is forecast to increase in real terms at a rate greater than the rate of inflation.[20] This is based upon recent trends and an assumption that parking supply in Wellington City CBD will remain largely unchanged between 2015 and 2025. The market response is likely to be to increase the price of parking at a higher rate than inflation.

It is also assumed that the cost of all-day commuter parking will rise at a faster rate than the cost of inter-peak parking.

3.2.4 Public transport fares

Public transport fares are forecast to increase by 0.45% per annum in real terms.[21] This is based upon the long-term relationship between public transport fares and GDP and an assumption that this trend will continue in the period to 2031.

[16] http://www.gw.govt.nz/assets/Transport/Regional-transport/RPTP/WGNDOCS-1386111-v1-FinalRPTPdocWEBversion.PDF, p. 50
[17] http://www.gw.govt.nz/assets/Transport/Regional-transport/RPTP/WGNDOCS-1386111-v1-FinalRPTPdocWEBversion.PDF,
[18] http://www.gw.govt.nz/assets/Transport/Transport-models/TN15-Input-Parameters-FINAL.pdf , p. 14
[19] http://www.gw.govt.nz/assets/Transport/Transport-models/TN15-Input-Parameters-FINAL.pdf, p. 14
[20] http://www.gw.govt.nz/assets/Transport/Transport-models/TN15-Input-Parameters-FINAL.pdf, p. 20
[21] http://www.gw.govt.nz/assets/Transport/Transport-models/TN15-Input-Parameters-FINAL.pdf, p. 29

3.2.5 Value of time

The value of time is forecast to increase in line with real GDP per capita growth.[22]

3.3 Expected future – land use assumptions

Where people live and work are two of the main factors that influence travel patterns.

There was a substantial increase in the number of people living in Wellington City CBD between 2001 and 2013.[23] Typical CBD residents are also likely to work in the CBD, with a relatively high proportion of residents choosing to walk or cycle to work and/or local amenities and placing relatively little reliance upon public transport. Also, Wellington City CBD residents have been shown to generally have lower car ownership rates compared to the rest of the region's population.

Wellington's northern suburbs (particularly Johnsonville, Churton Park and Grenada) and Kapiti are other main areas to have experienced rapid residential growth between 2001 and 2013.

Due to regional and local council policies, these trends are expected to continue out to 2025, with population growth likely to be concentrated in Wellington City CBD, along key transport corridors within Wellington City, in Wellington's northern suburbs and Kapiti. Employment growth is also likely to be concentrated in Wellington City CBD.

The land use assumptions for the expected future scenario are based upon Statistics NZ 'medium' population and employment projections. These projections are for population growth of 9%[24] and employment growth of around 12%[25] between 2013 and 2031.

Population growth is not expected to be evenly spread and is forecast to be concentrated in areas such as Kapiti, Wellington City CBD, Wellington's northern suburbs and along the Wellington City 'growth spine'[26], the latter reflecting Wellington City Council's aspirations for growth in this area.

3.4 Expected future – sensitivity tests

The assumptions that have been outlined in this section form one view of the future. A number of sensitivity tests were developed to assess the extent to which changing some of these assumptions might change the expected future outcomes. The sensitivity tests are as follows:

- a land use sensitivity test, with growth focused in areas other than the Wellington City CBD, northern suburbs and Kapiti

[22] http://www.gw.govt.nz/assets/Transport/Transport-models/TN15-Input-Parameters-FINAL.pdf, p. 7
[23] WP2 – Background issues and trends – section 2.
[24] WP2 – Background pressures and issues, section 2.
[25] WP2 – Background pressures and issues, section 3.
[26] Wellington City Council's 'growth spine' aims to develop the spine from Wellington City CBD along Adelaide Road to Newtown and Kilbirnie, combining high-density residential and employment developments.

- a public transport fare sensitivity test, with no real increase in the cost of public transport fares, as opposed to the expected future where public transport fares increase by 0.45% per annum in real terms
- a 25% inter-peak public transport fare discount
- delaying several RoNS schemes – Petone to Grenada, Ngauranga to Aotea Quay and Terrace Tunnel – until after 2031

3.5 Lifestyle changes

Evidence presented in the background working paper (WP2) highlighted a number of emerging lifestyle trends:

- the percentage of the region's population aged over 65 rose from 11.1% (2001) to 13.2% (2013) and is forecast to rise further in the future
- the percentage of the national labour force aged over 65 rose from 2.7% (2006) to 5.2% (2013) and is forecast to increase at a faster rate in the future
- young people (those aged under 20) are driving less and are less likely to hold a driver's licence, although there is uncertainty surrounding the extent to which this trend might continue in the future
- since the early 2000s, the number of total per capita trips remained broadly flat or in some areas declined slightly
- Whilst per capita active mode and public transport trips within the region increased between 2001 and 2013, road trips per capita decreased

Section 2 of WP2 demonstrated the fact that New Zealand has an ageing population. For the Wellington region, this may result in an increase in inter-peak travel demand, particularly for public transport. However, the percentage of the overall population categorised as being in the labour force is assumed to remain constant through time. If this is the case, more people may be expected to work later into life, into their late 60s and 70s, a trend that has already been observed.[27]

Another emerging lifestyle trend is people taking advantage of technological improvements in communications – including internet, mobile phones and cloud computing – to work remotely, thereby reducing the need to travel. The 2013 Census shows a small increase in the number of people working from home (compared with 2006), a trend that is likely to continue into the future.

The WTSM takes account of these lifestyle changes as outlined below.

3.5.1 Travel demand management measures

The WTSM assumes that soft travel demand management (TDM) measures - people working from home, working remotely and adopting flexible working

[27] Statistics NZ Labour Force Survey - Across the whole of New Zealand, the percentage of the labour force aged over 65 increased from 2.9% (2006) to 5.4% (2013).

practices in terms of location and hours of work, will result in approximately 3% fewer commuter car trips to Wellington City CBD in 2031 compared with the 'business as usual' scenario.

3.5.2 Composition of population by age group

Between 2011 and 2031, WTSM forecasts are based on the assumption that the age composition (based on WTSM categories of population) of the regional population will change as follows:

Table 1 WTSM - population by WTSM age group

	Children (under 17)	Young adult (17 to 25)	Adult (26 to 65)	Older adult (65+)
2011	23%	13%	53%	11%
2031	20%	11%	50%	18%

Table 1 demonstrates that the WTSM applies to a future where persons aged over 65 will account for a larger percentage of the population in 2031 than in 2011.

3.5.3 Economic activity of persons aged over 65

The WTSM assumes that a specific number of persons aged over 65 are economically active, employed either on a full-time or part-time basis. According to the WTSM inputs, between 2011 and 2031 the number of over 65s assumed to be economically active is forecast to increase by around 400%, compared with an 87% increase in the total number of older adults between 2011 and 2031.

Table 2 WTSM - economic activity of older adults

	Older adults (aged 65+)			
	Economically active (full-time)	Economically active (part-time)	Economically inactive	Total
2011	3,200	3,700	43,600	50,500
2031	14,900	19,800	59,800	94,500

Table 2, together with **Table 1**, shows that the WTSM accounts for the future impacts of emerging demographic trends, namely:

- the proportion of the population aged over 65 increasing
- of those aged over 65, an increasing percentage will remain in employment

4. Alternative future

Section 3 outlines the expected future scenario and this section outlines the development of the 'alternative future' scenario based upon assumptions about transport infrastructure and TDM measures, which are not committed or part of the 2015 RLTP programme of activities. The assumptions cover the period between the 2011 WTSM base year and the 2031 WTSM forecasts.

This section outlines:

- an enhanced public transport (PT) future
- three travel demand management (TDM) measures
- how these two scenarios might combine to form an 'alternative future'

4.1 Enhanced PT future

The enhanced public transport future scenario is referred to as the enhanced PT future. Whilst the Regional Rail Plan (RS1), integrated ticketing and BRT will deliver improvements to the public transport network as part of the expected future in section 3, the level of investment in these public transport projects is less than the level of investment to be delivered through the RoNS schemes.

Outlined below is a package of public transport investment in addition to that which is committed and budgeted for in the RLTP. Together this package of measures can be said to constitute an 'enhanced PT future', with the differences between the expected future and the enhanced PT future as follows:

- Additional rail improvements, along the lines of those envisaged as part of the 'Rail Scenario 2 (RS2)' scenario documented in the 2010–2035 Regional Rail Plan.[28] RS2 includes increases in capacity and service frequency, plus travel time improvements achieved through increasing line speeds at certain locations.
- More extensive bus priority measures that reallocate road space from general traffic to public transport. Such interventions would reduce road capacity available to general traffic, improve public transport capacity and travel times, and increase the public transport mode share.
- Cashless fare payment at peak times, to speed up bus boarding and alighting, with new buses with multiple entry/exit doors on all key corridors. This should result in shorter bus stop dwell times, improved public transport travel times and improved public transport travel time reliability.
- A 20% increase in bus service frequencies along core routes.

In combination, these measures would be expected to provide a further 'step change' in the public transport level of service, resulting in a notable increase in public transport mode share.

[28] http://www.gw.govt.nz/assets/Transport/Public-transport/Train-docs/WellingtonRegionalRailPlan2010-2035.pdf, p. 56

4.2 Additional TDM measures

Management of the roading network targeted at improving the efficiency of the road network, over and above what is forecast to be delivered by the RoNS and P2G under the expected future, relate to the management of the current network rather than any additional large infrastructure projects.

Three key TDM measures are as follows (the first two relating to peak periods, the third acting as an all-day measure):

- parking management – introducing a CBD parking levy at peak times, targeting commuter trips
- congestion charge – imposing a charge for all vehicles crossing a cordon around the CBD at peak times
- tolling of the Transmission Gully (TG) and the Petone to Grenada link road (P2G) once completed under the expected future

The aim of the TDM measures would be to:

- apply a degree of management to the number of vehicle trips on the roading network, particularly at peak times, particularly those heading to Wellington City CBD, which would preserve or improve levels of service and travel times for all vehicles on the network
- enable 'high value' network users, defined as those users whose value of travel time is relatively high due to the opportunity cost of their time (who tend to be mainly business people and freight companies as opposed to private users) – to experience journeys, especially at peak times, that are as fast and reliable as the network can accommodate
- apply a degree of management to the number of vehicle trips using the local road network by time of day, thereby enhancing opportunities to deliver improved priority measures for public transport

Details of the three proposed TDM measures are provided below.

4.2.1 Parking levy

The cost and availability of parking is one factor that affects whether someone drives or takes public transport in order to access a place of work within the Wellington City CBD.

The managed parking scenario in the WTSM envisages a targeted council rates increase that would be levied on land currently being used for parking (workplace, residential and other private uses), primarily in and around Wellington City CBD. It is assumed that this cost would be passed from car park operators to the consumer, with policy tools to ensure that additional costs would only be borne by peak time commuters and/or business users and not by inter-peak users.

Such a proposal is consistent with the proposals in the alternative funding study[29] that accompanied the Wellington Public Transport Spine Study (PTSS)[30] investigations. The PTSS proposals are discussed in section 7.7.1 of WP2.

4.2.2 Congestion charging

A congestion charge would work by charging a fee to all vehicles crossing a pre-defined cordon. Based on experience overseas, a higher charge might be levied at peak times and/or in specific directions.

The additional costs borne by vehicles crossing the cordon will influence their behaviour and result in a degree of modal shift from private car to public transport, thus reducing congestion and improving travel times for remaining road users.

The proposed cordon crossing points listed below are based on the 2008 study undertaken by SKM on behalf of GWRC and are identical to what was assumed when congestion charging was evaluated in 2013 as a potential funding mechanism for the PTSS.[31]

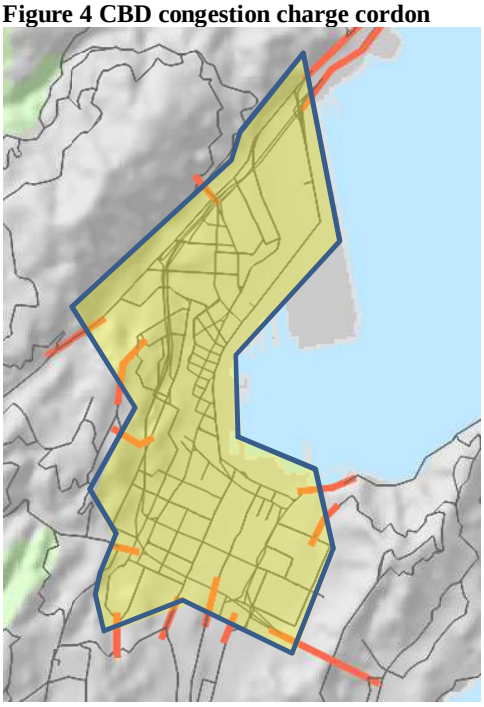
The cordon crossing points are as follows:

- Oriental Parade
- SH1 (Mount Victoria)
- Adelaide Road (north of Basin Reserve)
- Wallace Street (north of Karo Drive)
- Aro Street
- Salamanca Street
- Bowen Street
- Tinakori Road
- Murphy Street
- Thorndon Quay
- Aotea Quay
- SH1 (Aotea Quay)

The resulting cordon is shown in Figure 4.

[29] http://www.gw.govt.nz/assets/Transport/Regional-transport/PT-Spine-Study/AlternativeFundingStudyFinal.pdf
[30] http://www.gw.govt.nz/assets/Transport/Regional-transport/PT-Spine-Study/PTSS-Final-Reports-2013/FINAL-PDF-Public-Transport-Spine-Study-Compilation-Report.PDF
[31] http://www.gw.govt.nz/assets/Transport/Regional-transport/PT-Spine-Study/AlternativeFundingStudyFinal.pdf

Figure 4 CBD congestion charge cordon



4.2.3 Tolling

For this option, a toll would be applied in both directions along Transmission Gully and the Petone to Grenada link road.

Similar to a congestion charge, the purpose of a toll would be to change travel behaviour and generate a level of modal shift from private car to public transport, thus reducing congestion and improving travel times for remaining road users.

4.3 Alternative future scenarios

The alternative future scenario combines the expected future with the changes envisaged in the enhanced PT future.

In the case of the alternative future, it is assumed that there would be some reallocation of road space from general traffic to public transport, which would result in increased congestion and increased travel times for general traffic if no behavioural change were to occur or if roading demand was not managed through other means.

The additional TDM measures are modelled in turn with the alternative future to create three scenarios incorporating behavioural change in terms of generating modal shift from private vehicles (mainly cars) to public transport that results in reduced congestion and improved travel times for remaining road users. These scenarios implicitly assume that viable public transport alternatives are available for most affected users.

Such a ‘carrot and stick’ approach has been effectively employed in places such as London, where a congestion charge is used to manage demand for road use and the proceeds reinvested in public transport.

5. Packages to be modelled

The scenarios detailed in sections 3 and 4 have been combined into a series of packages to be modelled in the WTSM. These packages and associated terminology and definitions are summarised below, and shown in **Table 3** with the associated measures shaded for each scenario. A range of sensitivity tests were also run, numbered 1, 2, 3, and 4a to 4c. With these tests, in each case a key change is made to the scenario as stated.

- **Expected future** – scenario including all expected infrastructure projects
- **Alternative future** – the expected future plus all measures in the enhanced PT future
- **Alternative future + parking levy** – the alternative future plus a Wellington City CBD parking levy
- **Alternative future + congestion charge** – the alternative future plus a Wellington City CBD congestion charge
- **Alternative future + tolling** – the alternative future plus the tolling of Transmission Gully and the Petone to Grenada link road
- **Sensitivity 1** – the expected future with a 0% p.a. public transport fare increase in real terms (as opposed to 0.45% p.a. increase in real terms assumed as part of the expected future)
- **Sensitivity 2** – the expected future with a 25% inter-peak public transport fare discount for all modes
- **Sensitivity 3** – the expected future minus three of the RoNS schemes – P2G, N2AQ and TT
- **Sensitivity 4a, 4b, 4c** – the expected future with an alternative land use scenario that assumes higher regional population focused in turn on a) Wellington City Council; b) Kapiti Coast District Council and Porirua City Council; and c) Hutt City Council, Upper Hutt City Council and the Wairarapa (see section 3.11 in WP4 for details)

In addition, two scenarios were created to account for the decision made by the Environmental Protection Agency board of inquiry to decline the resource consent application for the Basin Reserve Bridge project, and its impact on the proposed infrastructure within Wellington city:

- **Revised future A** – expected future minus all Wellington inner-city RoNS schemes[32] and minus the proposed BRT
- **Revised future B** – expected future minus all Wellington inner-city RoNS schemes and minus the proposed BRT but with bus priority measures along the proposed BRT corridors

[32] Basin Bridge, Mount Victoria to Cobham Drive, Terrace Tunnel Duplication, Ngauranga to Aotea Quay (southbound)

The results from the modelling of these packages, together with the conclusions that can be drawn, are presented in WP4 – 'Development of future scenarios'.

Table 3 Packages modelled for RLTP 2015 to 2025

	Expected future	Alternative future	Alternative future + parking levy	Alternative future + congestion charge	Alternative future + tolling	Sensitivity 1	Sensitivity 2	Sensitivity 3	Sensitivity 4a,4b,4c	Revised Future A	Revised Future B
Wellington inner-city RoNS	■	■	■	■	■	■	■	■	■		
Other Regional RoNS	■	■	■	■	■	■	■	■	■	■	■
Bus Rapid Transit	■	■	■	■	■	■	■	■	■		
Bus Priority											■
Fuel price	■	■	■	■	■	■	■	■	■	■	■
Parking	■	■	■	■	■	■	■	■	■	■	■
Vehicle fleet efficiency	■	■	■	■	■	■	■	■	■	■	■
Value of time	■	■	■	■	■	■	■	■	■	■	■
PT fare increase	■	■	■	■	■	■	■	■	■	■	■
Additional PT infrastructure		■	■	■	■						
Parking levy			■								
Congestion charge				■							
Selected roads tolled					■						
Lifestyle changes	■	■	■	■	■	■	■	■	■	■	■
Expected future land use scenario	■	■	■	■	■	■	■	■		■	■
Alternative land use scenario									■		
0% PT fare increase in real terms						■					
25% inter-peak PT fare discounts							■				
Delayed RoNS – TG, P2G, N2AQ								■			