Technical Report 34

Traffic Modelling Report

NZ TRANSPORT AGENCY
WAKA KOTAHI

MacKays to Peka Peka Expressway

Revision History

Revision Nº	Prepared By	Description	Date
A	Andy Ford, Reena Solanki	Draft for Planning Review	22nd August 2011
B	Graham Bell, Reena Solanki	Draft for Planning Review	7 December 2011
C	Graham Bell	Draft for review following NZTA and Chapman Tripp Comments	20 January 2012
D	Graham Bell	Draft for review following EPA Completeness Check	17 February 2012

Document Acceptance

Action	Name	Signed	Date
Prepared by	Graham Bell		23 March 2012
Reviewed by	Andrew Murray		23 March 2012
Approved by	Andrew Murray		23 March 2012
on behalf of	Beca Infrastructure Ltd		

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Executive Summary

The NZ Transport Agency ('the NZTA') is lodging a Notice of Requirement (NOR) and resource consent applications (RCAs) to construct, operate and maintain an Expressway between MacKays Crossing and Peka Peka ('the Project') on the Kāpiti Coast.

The proposed MacKays to Peka Peka Expressway route has been identified as one of eight sections within the Wellington Northern Corridor (State Highway 1 from Levin to the Wellington Airport) which is an identified "Road of National Significance" (RoNS) introduced in the 2009 Government Policy Statement (and reconfirmed in GPS2012). The upgrading of the Wellington Northern Corridor and the other six RoNS across the country is to be substantially progressed in the next 10 years.

This report details the future year traffic modelling undertaken for both the Project assignment model and the operational traffic model which were both developed for the assessment of the Project.

These models form a hierarchy of models used for the Project, listed below in order of increasing level of detail:

- Wellington Transport Strategy Model (WTSM) – a four stage regional multi-modal demand model covering the Greater Wellington Region (operated by Greater Wellington Regional Council), used to model the change in travel demand through time in response to changes in land use and infrastructure improvements, global changes to travel cost assumptions (e.g. public transport fares, fuel prices) and policy interventions (such as travel demand management measures);
- Kāpiti District Transport Model (KTM2) – a Project traffic assignment model that represents the study area in more detail. It is used to model the impact of changes in traffic volumes in the future, as a result of growth between the base year and forecast years and changes in traffic volumes and delays between the Do Minimum and Option scenarios; and
- Kāpiti Road Operational Model - a detailed micro-simulation model focussing on the Kāpiti Road Interchange, designed to inform intersection design along this busy corridor. This package models the queuing and interaction between closely spaced intersections to a greater level of precision than both the regional and Project models.

The report is a technical reference document describing the inputs and outputs of the traffic modelling undertaken. The detailed assessment of effects on the transport system is based on these modelling results but reported separately.

This report provides an overview of the modelling process and extensive model outputs. Key outcomes of the modelling include the following forecasts (the interpretation and explanation of these forecasts is contained in the *Assessment of Transport Effects*, Technical Report 32, Volume 3):

- With the proposed Expressway in place, daily two-way traffic volumes along the existing SH1 between Peka Peka and MacKays Crossing are reduced by approximately 50%;
- In 2026 over 20,000 vehicles per day are predicted to use the proposed Expressway between Kāpiti Road and Te Moana Road;
- 50% of journeys that use one or more section of the proposed Expressway originate or terminate outside of the study area. The remainder are local trips between Waikanae and Paraparaumu;
- The proposed Expressway leads to substantial improvements in travel times across a wide range of routes within the Kāpiti Coast District;
- The proposed Expressway is predicted to significantly improve travel times for through traffic between MacKays Crossing and Peka Peka, reducing the travel time in 2026 by seven minutes in the weekday morning peak (southbound) and over ten minutes in the weekday evening peak (northbound);
- Delays experienced by traffic turning onto the existing SH1 from side roads such as Raumati Road, Rimu Road and Otaihanga Road are substantially reduced as the proposed Expressway draws traffic off the existing state highway, reducing traffic congestion along this route;
- Of the traffic using the proposed Expressway 88% is existing traffic that has migrated to the proposed Expressway whilst 12% is ‘induced’ traffic (new travel) forecast as a result of the Project;
- Although not directly forecast by the models (which predict average travel times), it is known that travel time variability increases as traffic levels approach the capacity of the network, as expected in this corridor. Therefore the significant increase in capacity provided as part of this Project is also expected to significantly improve travel time reliability;
- A VISSIM model was developed to assess the Kāpiti Road interchange area with and without the Project in place. The results of the VISSIM model indicated that the Kāpiti Road interchange will operate at LOS C during peak times in 2026;
- Sensitivity testing was undertaken of a “Full Growth” scenario. The KTM2 did not converge for the Do-Minimum network due to the traffic demands significantly exceeding the capacity of the network, and hence a stable model result was not found. Convergence was however found with the Project in place. This indicates that substantial transport network improvements would be required to accommodate the demands predicted under the “Full Growth” scenario; and
- The VISSIM modelling for the “Full Growth” scenario indicated that the Kāpiti Road interchange will operate within capacity however the LOS will reduce to D with a number of movements operating at LOS E.

1 Introduction

1.1 Background

The NZ Transport Agency ('the NZTA') is lodging a Notice of Requirement (NOR) and resource consent applications (RCAs) to construct, operate and maintain an Expressway between MacKays Crossing and Peka Peka ('the Project') on the Kāpiti Coast.

The MacKays to Peka Peka Expressway Project (Project) has been identified as one of eight sections within the Wellington Northern Corridor (State Highway 1 from Levin to the Wellington Airport) which is an identified "Road of National Significance" (RoNS) in terms of the 2009 Government Policy Statement[1]. The upgrading of the Wellington Northern Corridor and the other six RoNS across the country is to be substantially progressed in the next 10 years.

The MacKays to Peka Peka Alliance (the Alliance) has been commissioned by the NZTA to undertake a Transport Assessment to assess the potential effects of the works to be undertaken for the Project. This will inform the Assessment of Environmental Effects (AEE) for the Project and any transport evidence presented at a Board of Inquiry.

1.2 Report Purpose

The Project team[2] has undertaken traffic modelling to forecast the effect of the proposed Expressway during construction and operation, and to inform other aspects of the assessment of environmental effects being undertaken such as air quality and noise.

The purpose of this report is to detail the findings of the forecast year traffic modelling undertaken to assess the effects of the Project. The report details the assumptions and inputs to the modelling that has been undertaken at a regional, Project assignment and operational level.

1.3 Other Reports

The main transport assessment is documented in the *Assessment of Transport Effects* (Technical Report 32, Volume 3).

There are a number of technical reports which support and inform the transport assessments. These reports will be provided separately as part of the AEE. The other transport reports include:

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[1] Government Policy Statement on Land Transport Funding 2009/2010-2018/2019, and GPS2012

[2] This Technical Report refers to the Project team as carrying out works on behalf of and as contracted by the NZTA. The NZTA is the requiring authority and the consent holder.

The Assessment of Transport Effects (Techncial Report 32, Volume 3)*;*

The Assessment of Temporary Traffic Effects (Technical Report 33, Volume 3)*; and*

The Construction Traffic Management Plan (CEMP Appendix O, Volume 4)*.*

This report forms the Traffic Modelling Report. Its intended purpose is as a technical model reference report, with the interpretation and analysis being included in Technical Report 32, Volume 3.

1.4 Report Structure

The remainder of this report is structured as follows:

Chapter 2: Discusses the structure of the modelling system used to undertake the assessments;

Chapter 3: Contains a brief description of the Project as assessed here;

Chapter 4: Details the assumptions used in the modelling;

Chapter 5: Details the predicted demands used and processes for the creation of these demands;

Chapter 6: Contains an assessment of the wider network results;

Chapter 7: Contains an operational assessment of the traffic performance of specific intersections;

Chapter 8: Describes the sensitivity testing of four significant growth areas in Kāpiti; and

Chapter 9: Provides a summary of this report.

2 Model Structure

This chapter summarises the structure of the traffic models used for the assessment of environmental effects of the Project. The development, calibration and validation of each of these models are described in detail in the following separate validation reports:

- Strategic Demand Model (WTSM) – Wellington Transport Strategy Model (WTSM), Greater Wellington Regional Council / SKM, 2008;
- Project Assignment Model (KTM2) – MacKays to Peka Peka SATURN Model Validation Report, Beca/Alliance July 2011; and
- Operational Model – MacKays to Peka Peka VISSIM Model Validation Report, Beca/Alliance August 2011.

2.1 Model Structure

The MacKays to Peka Peka Project follows a hierarchical modelling system used successfully on other major Project across both the Auckland and Wellington regions, including the Transmission Gully and the Waterview Connection Projects. This modelling system involves the following three components as shown in Figure 2.1 overleaf:

- A strategic multi-modal demand model that relates land use (such as population and employment), to person travel patterns at a strategic, region-wide level;
- A Project assignment model, which is smaller in area than the demand model but has a more refined network in the Project area. This model loads the vehicle trip patterns predicted by the demand model onto the road network to test various options and investigate the traffic effects at a more detailed level; and
- An operational model, which uses micro-simulation to look at specific intersections and connections in even greater detail.

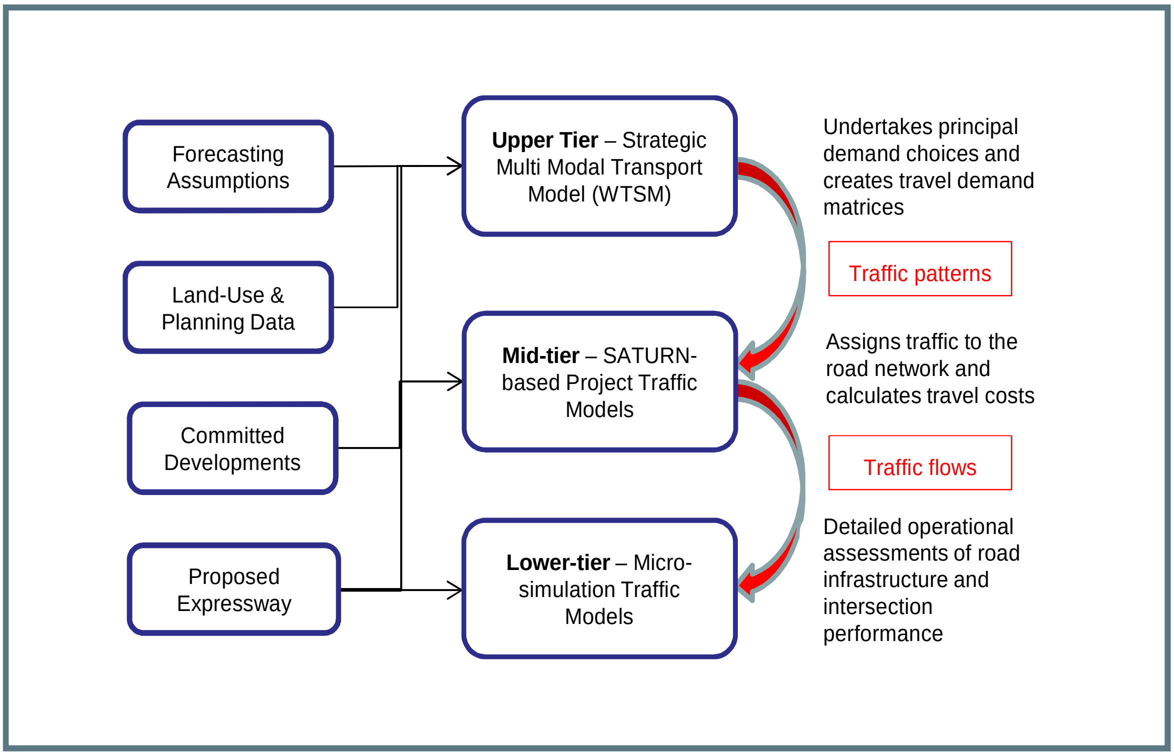

Figure 2.1 Model Structure

A hierarchy of models is required as it is not practical to develop a system in a single model to cover both strategic demand issues across the region whilst also detailing local operational effects. This hierarchical system has been successfully used on most major Projects within large conurbations in New Zealand.

In brief, each model has the following characteristics, strengths and weaknesses:

- Although covering the Greater Wellington area, the regional WTSM demand model is fairly coarse, having only 18 zones within the study area of this scheme, an area stretching across Kāpiti District from MacKays Crossing in the south to Ōtaki in the north. WTSM also uses a modelling software package that does not specifically model traffic intersections in detail; intersection delays are attributed to the individual road links rather than the intersection. This model does however consider both private and public transport modes;
- The Project assignment model represents the local area to a higher level of detail, containing 197 zones within the study area, and uses a software package within which intersections can be modelled in detail;
- The operational model models individual intersections in greater detail. The effects of merging, weaving and the blocking back of traffic at key intersections can be captured in micro-simulation modelling more accurately than in the higher tier models. It also provides a visual tool through which network performance can be tracked on screen.

It is the Project assignment and operational models that are the focus of this traffic modelling report, although an overview is provided of the WTSM demand model.

2.2 WTSM Demand Model

The WTSM model is a traditional 4-step multi-modal model. The model was developed for the year 2001, using the 2001 Census data and observed travel data. The model was comprehensively updated in 2008 using Census data from 2006, and then validated to 2006 conditions. Separate models exist for the morning and evening commuter peaks and weekday inter-peak periods.

The model itself comprises the following key modules:

- Trip Generation - the number of person-trips are estimated as a function of the land use data (population, employment, school roll etc);
- Mode Choice - the choice of preferred travel mode is determined based on the relative attractiveness of the various modes. The key modes are car-driver, car passenger, bus passenger, train passenger and ferry passenger. A process is used to also consider 'slow' modes, such as walking and cycling (albeit at a very simple, aggregate level);
- Trip Distribution - the trips produced in each zone (persons trips), are matched to a preferred destination. Distribution is predicted as a function of the relative attractiveness of each destination zone, (generally related to employment), and the travel costs[3] to reach each destination;

[3] These travel costs are 'generalised' travel costs and have a unit of generalised minutes. The 'generalised' travel costs are a combination of travel time and travel distance.

- Time of Day Modelling - this is where the proportion of daily trips occur in each peak. The proportion occurring in each peak changes in future-year models in response to the changes in travel time and costs; and
- Trip Assignment - the resulting travel demands, in the form of origin to destination trip tables, are loaded to the road and public transport networks. An iterative process is used to firstly identify the lowest-cost route between each origin and destination, followed by an estimation of the speeds and delays on each route associated with the predicted traffic flows on the route.

The WTSM model is operated by the Greater Wellington Regional Council (GWRC) and is implemented in the EMME software package, a well-used and proven platform for this kind of analysis.

The WTSM model predicts the overall regional traffic patterns, based on the inputs and forecasts of population and employment growth, together with the assumed level of road and public transport infrastructure.

2.3 Project Assignment Model – KTM2

The Project assignment model, referred to henceforth as KTM2, represents the road network within the study area in considerably more detail that the regional model. There are 197 zones in the KTM2 model, as opposed to 18 covering the same area in the regional model. The KTM2 model is implemented in the SATURN software, a meso-scopic modelling package that is used extensively within New Zealand and the UK. One of SATURN's acknowledged strengths is its ability to combine the functionality of a large network with the ability to robustly model intersection delays and, consequently, travel costs.

The KTM2 model covers a much smaller area than the regional model and was calibrated and validated to a 2006 base year. The model validation for the KTM2 model can be found in the separate model validation report, titled 'MacKays to Peka Peka SATURN Model Validation Report, August 2011'. A separate forecasting report titled 'MacKays to Peka Peka SATURN Model Forecasting Report, August 2011' details the forecasting assumptions in full; these assumptions are summarised later in this report and in the accompanying appendices.

This model represents a comprehensive update to the original Kāpiti Traffic Model (KTM).

2.4 Kāpiti Road Operational Model

Operational models are used to assess localised issues in more detail than is possible in the Project assignment model. They are primarily used to investigate specific design issues such as length of intersection turn lanes, likely length of queues and performance of motorway merges and weaves in areas where intersections are closely spaced. The operational model developed to assess the MacKays to Peka Peka Project is a simulation model developed in the VISSIM software and models a section of Kāpiti Road from just east of the intersection with Arawhata Road to just west of the intersection with Te Roto Drive. The modelled area includes the proposed interchange between Kāpiti Road and the proposed Expressway and allows the operation of this interchange to be modelled and optimised. This model obtains travel demands, in the form of origin-destination trip tables, from the Project assignment model. These trip tables are then loaded as flow rates into the simulation models, along with assumed flow profiles to represent the build-up and dissipation of peak traffic flows. Again, the simulation model has been calibrated and validated to a 2010 base year, details of which are included in the separate validation report. Later chapters in this report contain details of the forecast year demands and networks.

Figure 2.2 shows a map of Kāpiti Coast District, showing the geographic coverage of the three tiers of modelling that have been used:

- Upper Tier – WTSM regional demand model, covering Greater Wellington Region
- Middle Tier – KTM2 Project assignment model covering the Kāpiti Coast District; and
- Lower Tier – Kāpiti Road operational model, covering a short stretch of Kāpiti Road between the intersections with Arawhata Road and Te Roto Drive.

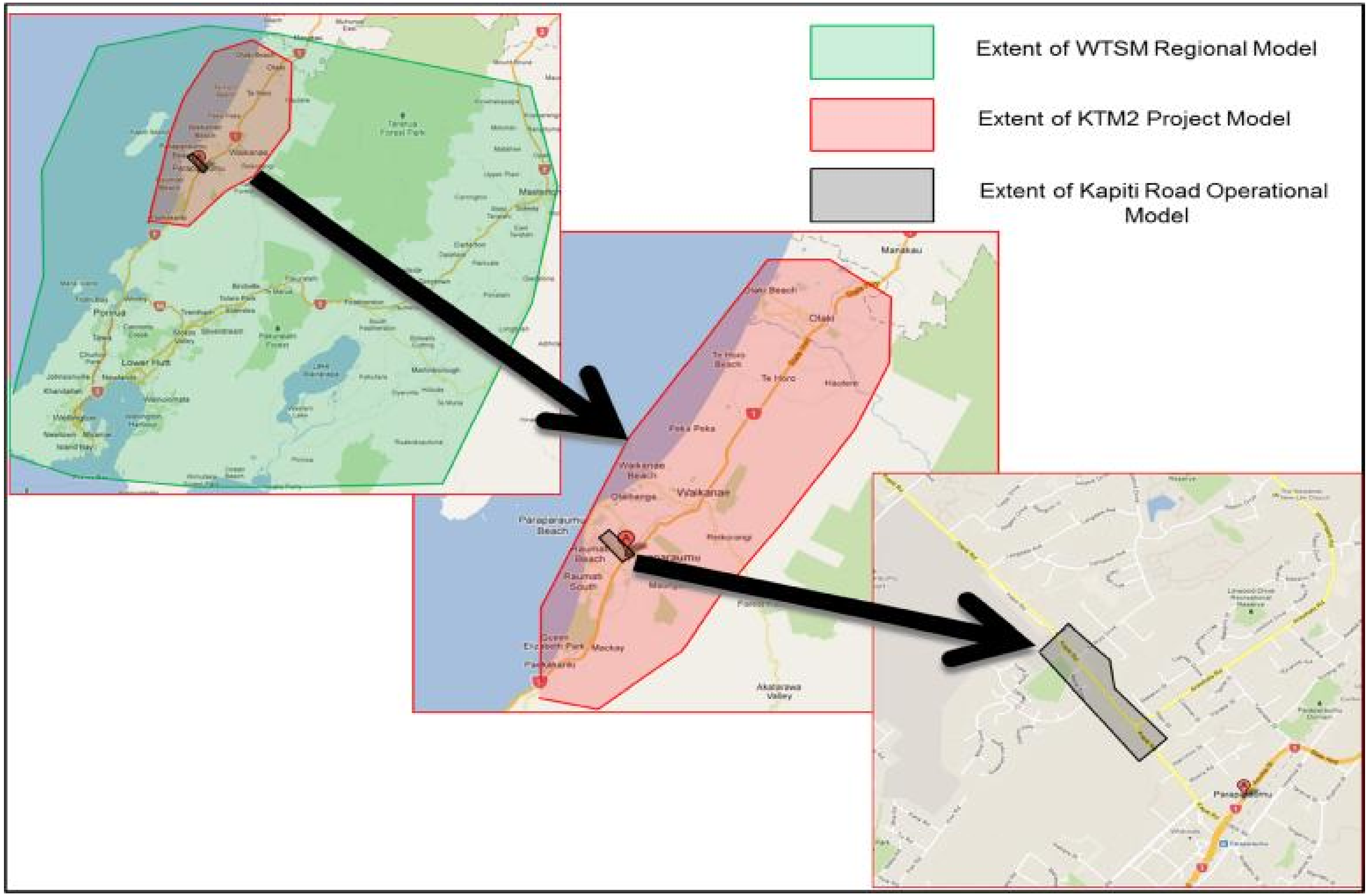

Figure 2.2 Geographic Extent of the Three Model Systems

3 Project Description

For a detailed Project description of the proposed Expressway refer to the full Project description (Construction & Operation) within Part D, Chapters 7 and 8, Volume 2 of the AEE.

Figure 3.1 shows the general Alignment of the proposed Expressway.

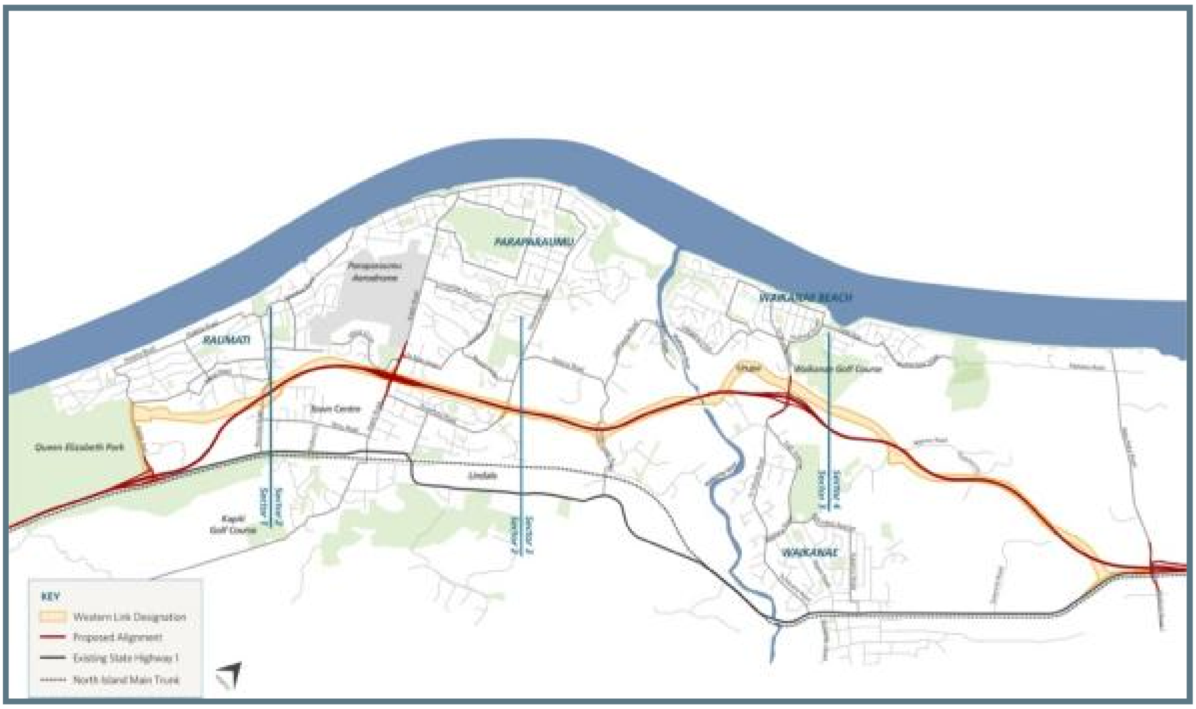

Figure 3.1 Proposed Expressway Route

3.1 Adjacent RoNS Schemes

The proposed Expressway is one of eight elements of the Wellington Northern Corridor Road of National Significance (RoNS). In combination, these schemes are designed to reduce traffic congestion and improve travel times. It is envisaged that this substantial infrastructure investment will greatly improve the resilience of the road network and help encourage continued economic development.

The RoNS elements are shown in Figure 3.2. All Wellington RoNS Projects have used WTSM and its regional inputs (with some local adjustment of land use) as the basis for assessing each individual Wellington RoNS Project. NZTA's Wellington modelling panel provides a platform for RoNS Project teams to coordinate their modelling and ensure consistent approaches are adopted across all Wellington RoNS Projects.

Figure 3.2 Wellington Northern Corridor RoNS

4 Model Inputs and Assumptions

This chapter describes the key inputs and assumptions used to create the future forecasts in the regional, Project assignment model and operational modelling.

4.1 Forecast Years

Two forecast years have been used, 2016 (to represent the opening year of the Project) and 2026 (to represent 10 years post opening). These forecast years are consistent with the requirements of other environmental assessments such as noise and air quality.

4.2 Time Periods

The WTSM model covers the following three time periods for a typical average weekday:

- AM peak – 7am to 9am;
- Inter-peak – 2hr average of 9am to 4pm; and
- Evening peak – 4pm to 6pm.

Holiday and weekend peaks are not directly assessed because there are no available regional models for such periods, and such periods only occur a few times per year and are fairly variable. The travel benefits of the Project in such periods are included through the aggregating process that calculates annual benefits, rather than directly from a model for such periods.

The Project assignment model operates with 1-hour long validated peak hours, together with a 1-hour long pre-peak hour that enables delays and suppressed traffic at the end of the pre-peak hour to be ‘passed through’ to the peak hour assignment. This method ensures that delays are well represented at the start of each peak hour. Traffic count data across the AM peak and PM peak 2 hour time periods was used to split the WTSM demand appropriately between the Project model pre-peak and peak hours. The time periods are as follows:

- AM pre-peak – 7am to 8am (un-validated);
- AM peak – 8am to 9am (validated);
- Inter-peak – 1hr average of 9am to 4pm (validated);
- PM pre-peak – 4pm to 5pm (un-validated); and
- PM peak – 5pm to 6pm (validated).

The traffic flows along SH1 are tidal in nature, reflecting the fact that a higher proportion of traffic travels into Wellington CBD in the AM peak while during the PM peak the majority of traffic travels outbound (northbound) from Wellington CBD.

The operational model focuses on the two peak hours:

- AM peak – 8am to 9am; and
- PM peak – 5pm to 6pm.

4.3 WTSM Assumptions

The following sub-sections detail the specific WTSM inputs and assumptions that have been used in terms of networks, land use and policy. The assumptions related to future Projects were agreed with NZTA and Kāpiti Coast District Council (KCDC) specifically for this Project, however, the other inputs and assumptions were largely based upon what was included in WTSM.

4.3.1 Do Minimum Assumptions

The Do Minimum scenario represents the minimum investment needed in the study corridor to maintain operations and hence represents the ‘no Project’ case. It is however assumed to include new Projects and upgrades outside of the study area, and these assumptions are assumed to be common to both the ‘no Project’ and ‘Project’ scenarios.

Appendix 34.A lists the highway and public transport infrastructure assumptions that have been used for the regional demand model.

4.3.2 Option Networks

The following was assumed for the Option networks:

- 2016 – Do Minimum plus Expressway; and
- 2026 - Do Minimum plus Expressway.

4.3.3 Land Use

Table 4.1 shows the household, population and employment assumptions relating to Kāpiti Coast District that comprised the inputs to the WTSM regional model. The zone by zone forecasts are those used in the development of WTSM and date from 2006.

	2010	2016	Growth 2010 - 2016	2026	Growth 2010 - 2026
Households	20,245	22,306	10%	25,070	24%
Population	48,075	52,043	8%	57,139	19%
Employment	14,930	16,781	12%	17,671	18%

Table 4.1 Population, Employment and Households Assumed in WTSM for Kāpiti Coast District

Table 4.1 shows that between 2010 and 2016 a 10% increase in households within the study area is forecast with a further 14%[4] increase between 2016 and 2026, giving a total increase of 24%. The rate of population growth is slightly lower across this same period, reflecting a trend of decreasing household size. There is a predicted increase in employment of 12% between 2010 and 2016 with a further 6% increase between 2016 and 2026.

The land use assumptions presented above, produced in 2006, show strong growth between 2010 and 2016. Due to the global financial crisis it is likely that growth in this period could be weaker than forecast in 2006.

As mentioned above, the land use, population and employment data used in the regional model dates from 2006. The Project team was advised by KCDC that several large, planned developments are proposed to be built between 2011 and 2026. Details of those developments and the expected traffic generated by them were obtained from KCDC. Table 4.2 shows the growth in trips between 2010 and 2026 as forecast by WTSM against the growth in trips should all the planned developments be 100% complete in 2026 and generating 100% of forecast trips. The information shows that the growth as forecast using the planned developments is between 3 and 4 times greater than the growth as forecast using regional WTSM model.

	AM Peak Period		Inter- Peak Period		PM Peak Period	
	WTSM Vehicle Trips	Developments Vehicle Trips	WTSM Vehicle Trips	Developments Vehicle Trips	WTSM Vehicle Trips	Developments Vehicle Trips
Light Vehicles	3,406	9,268	7,597	38,942	3,602	16,001
HCVs	489	737	1,920	2,294	395	899
All Vehicles	3,895	10,005	9,517	41,237	3,997	16,900

Table 4.2 Growth in Vehicle Trips between 2010 and 2026, WTSM vs Planned Development

Spatial analysis of the growth forecast by WTSM identified that none of the planned developments that generate the development trips shown in Table 4.2 were represented within WTSM.

From looking at Table 4.2 it is clear that the development trips represent a ‘very high growth’ scenario. The report authors consider that a more likely scenario would be that only a certain proportion of each planned development would be operational in each of 2016 and 2026 and this is described further in Chapter 5.

A method of creating a ‘central case’ level of future demand was developed and implemented in KTM2. It was agreed with NZTA, KCDC and the independent peer reviewer that this approach constituted an appropriate central case for the assessment of this Project. The chosen approach,

[4] As assessed relative to the 2010 Base Year

using both WTSM and committed development data, is summarised in Chapter 5 and is presented in more detail in Appendix 34.G.

4.3.4 Fuel Price

The WTSM model contains assumptions relating to fuel price, referring to the pump price for fuel. The following pump prices have been included (all in $2006):

- 2006 - $1.55 per litre
- 2010 - $2.38 per litre
- 2016 - $2.75 per litre
- 2026 - $3.46 per litre

These prices were applied to the 2006 average consumption of 10 litres per 100km. This is conservative as it is expected that fuel efficiency will improve over time. Hence, using this fixed approach means that the implied pump price will be higher than indicated above.

4.3.5 Travel Demand Management

In the modelling undertaken for the Regional Land Transport Strategy (RLTS), assumptions were made on various changes in mode share (over and above that predicted directly in WTSM), to account for potential changes in travel behaviour in response to Travel Demand Management (TDM) initiatives. These initiatives are presumed to reduce total private vehicle travel by approximately 8-10% across the region.

For WTSM the principles of the RLTS assumptions were retained, but a more conservative approach was taken[5]. The result for WTSM is that 5% of Home-Based work trips to the CBD are transferred to public transport.

4.3.6 Other Assumptions

The assumptions listed above, together with assumptions regarding future values of time, public transport fares and parking charges are summarised in Appendix 34.A.

4.4 Project Assignment Model Assumptions

4.4.1 Land Use

The land use is identical between the Option and Do Minimum versions of the Project model. A variable trip matrix method has been used to model the impacts of induced traffic, and consequently

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[5] There is currently very little evidence regarding the magnitude of these initiatives so a lower assumption has been adopted.

the Do Minimum trip matrix will differ from the Option trip matrices. The variable trip matrix approach is described in more detail in Chapter 5 and in Appendix 34.G.

4.4.2 Do Minimum Networks

Although the Project assignment model uses broadly the same network assumptions as the WTSM model, it also includes additional smaller scale local Projects. Table 4.3 and Table 4.4 detail the network assumptions in the 2016 and 2026 Do Minimum Project Assignment model.

All Wellington RoNs schemes are assumed to be in the Do Minimum networks; the only differences between the Do Minimum and Option network is the proposed MacKays to Peka Peka Expressway.

The Projects identified below are in addition to those included in the WTSM model assumptions. Appendix 34.A contains detailed diagrams for several of these schemes and network plots showing their location within the study area.

Road Network Change	Description	Comment
Emerald Glen Road Extension	- Local road connection from Emerald Glen to MacKays Crossing. Waterfall Road intersection with SH1 closed.	Opened 2011
Kāpiti Road / Rimu Road Intersection	- Change the intersection from a roundabout to traffic signals.	Scheduled for 2011 completion.
Kāpiti Road / Airport Development Access	- New roundabout west of Te Roto Drive providing access to Mitre 10 and Paraparaumu Airport.	Opened 2011
SH1 / Elizabeth St Intersection	- Additional westbound lane on Elizabeth Street at level crossing (see attached diagram)	Opened 2011
SH1 / Kāpiti Road Intersection	- Additional eastbound lane on Kāpiti Road at level crossing (see attached diagram).	Opened 2011

Table 4.3 Proposed KTM2 2016 Do-Min Network Changes

Road Network Change	Description	Comment
Extension of The Drive	- Extension of The Drive to Otaihanga Road.	
Ihakara Street extension	- Extension of Ihakara Street from its current end point west of Rimu Road, around the Airport to Kāpiti Road	Part of Paraparaumu Airport development.

Road Network Change	Description	Comment
Paraparaumu Town Centre development links	- A new north-south link connecting Kāpiti Road to Ihakara Street. - A new east-west link connecting Rimu Road to the new north-south link above. - Both links to be coded as 30kph to reflect their town-centre purpose.	Kobus Mentz 2010 concept for Paraparaumu Town Centre attached (Appendix 34.A).
Kāpiti Road intersection changes	- Roundabout at new Ihakara Street intersection - Roundabout at Langdale intersection with new Airport access. - Traffic signals at Arawhata Road intersection with new Paraparaumu Town Centre access.	In previous version of KTM, the new intersections at Ihakara Street, Langdale Ave, and the Mitre 10 access were coded as traffic signals. However a roundabout was recently constructed at the Mitre 10 access. It is assumed that the intersections west of here will also be constructed as roundabouts.

Table 4.4 Proposed KTM2 2026 Do-Min Network Changes

4.5 Operational Model Assumptions

The prime function of the operational model is to assess the operation of the Project and thereby inform the design process. Whilst a Do-Minimum model has been developed, it is used to indicate the change in local network performance.

The operational model network assumptions are identical to the Project assignment model network assumptions.

5 Forecast Demand

This chapter summarises the traffic demands originating from the WSTM model, and how they are combined with information regarding the known, planned local developments, leading to the creation of demand matrices that are used in the Project assignment and operational models.

5.1 Modelled Years

Forecast year vehicle demands have been obtained for 2 modelled years:

- 2016 – opening year; and
- 2026 – design year.

5.2 WTSM Demand

The forecast year vehicle demands for the Project model were obtained from the WTSM model for the Option (2016, 2026 and 2031) and the Do Minimum (2026 only), using the inputs and assumptions derived earlier. WTSM covers the following three time periods:

- AM peak – 7am to 9am;
- Inter peak – 2hr average of 9am to 4pm; and
- PM peak – 4pm to 6pm.

Matrices were received by period for the following purposes.

- Home based work trips;
- Home Based Education trips;
- Home Based Shopping Trips;
- Home Based Other trips;
- Non-Home Based Other trips;
- Employers Business Trips; and
- Heavy Commercial Vehicle Trips.

Tables 5.1 to 5.4 display the WTSM trip totals by purpose following conversion from person to vehicle trips. The data is presented at both a regional and study area level, for 2010, 2016 and 2026.

	Total Trips					
	2010		2016		2026	
Purpose	Region	Study	Region	Study	Region	Study
Airport	1,400	200	1,800	200	2,300	200
Employer's Business	20,800	1,300	23,100	1,700	24,800	1,800
Home Based Education	7,800	900	7,500	1,000	7,700	1,100
Home Based Shopping	23,000	2,700	23,800	2,900	25,200	3,200
Home Based Other	10,000	1,300	10,400	1,400	11,400	1,600
Home Based Work	63,500	5,900	69,700	6,600	75,700	7,600
HCV	12,600	2,200	17,100	3,000	22,600	4,100
Non-Home Based Other	33,900	3,500	35,200	3,800	37,300	4,000
Total (not inc HCVs)	160,400	15,900	171,600	17,600	184,400	19,500

Table 5.1 AM Peak WTSM Option Total Vehicle Demand (per 2-hour period)

	Total Trips					
	2010		2016		2026	
Purpose	Region	Study	Region	Study	Region	Study
Airport	1,400	200	1,800	200	2,300	200
Employer's Business	96,000	6,900	103,900	7,400	110,800	8,100
Home Based Education	6,600	800	6,400	900	6,500	900
Home Based Shopping	76,300	9,400	79,200	9,800	83,800	10,500
Home Based Other	116,300	16,200	121,800	16,600	132,800	18,100
Home Based Work	38,400	4,200	43,600	4,700	46,800	5,200
HCV	12,600	2,400	17,100	3,300	22,700	4,400
Non-Home Based Other	219,600	24,300	217,200	25,500	240,600	27,200
Total (not inc HCVs)	554,600	62,000	573,900	65,100	623,700	70,200

Table 5.2 Inter-peak Peak WTSM Option Total Vehicle Demand (per 6-hour period)

	Total Trips					
	2010		2016		2026	
Purpose	Region	Study	Region	Study	Region	Study
Airport	1,400	200	2,100	200	2,600	300
Employer's Business	20,200	1,400	22,300	1,600	23,900	1,700
Home Based Education	1,600	200	1,600	200	1,600	200
Home Based Shopping	41,800	5,000	43,500	5,800	45,800	6,300
Home Based Other	38,100	5,100	40,600	5,400	44,200	5,900
Home Based Work	39,600	4,100	44,700	4,300	48,600	4,900
HCV	10,900	1,800	14,800	2,500	19,600	3,300
Non-Home Based Other	75,500	8,500	74,900	8,200	79,100	8,800
Total (not inc HCVs)	218,300	24,400	229,600	25,700	245,800	28,100

Table 5.3 PM Peak WTSM Option Total Vehicle Demand (per 2-hour period)

	Total Trips					
	2010		2016		2026	
Purpose	Region	Study	Region	Study	Region	Study
Airport	4,300	500	5,600	600	7,100	700
Employer's Business	137,000	9,700	149,300	10,700	159,500	11,600
Home Based Education	16,100	1,900	15,500	2,100	15,900	2,200
Home Based Shopping	141,100	17,000	146,500	18,500	154,800	20,000
Home Based Other	164,400	22,700	172,800	23,400	188,500	25,600
Home Based Work	141,500	14,300	158,000	15,600	171,100	17,600
HCV	36,200	6,400	49,000	8,800	64,900	11,700
Non-Home Based Other	329,000	36,300	327,200	37,400	357,000	40,000
Total (not inc HCVs)	933,300	102,300	975,100	108,400	1,053,900	117,800

Table 5.4 Daily 11hr (7am to 6pm) WTSM Option Total Vehicle Demand (per 2-hour period)

From Table 5.1 to Table 5.4 the following can be determined:

- Between 2010 and 2026 daily non-HCV demand within the study area is forecast to increase by around 15%;
- Between 2010 and 2026 the percentage increase in daily non-HCV demand within the study area varies for each travel purpose;
- Within the study area the AM peak experienced a larger than average increase in demand (23%), compared to the PM peak and Inter-peak; and
- The HCV growth rates are considerably higher, being 37% and 79% between 2010 and 2016 / 2026 respectively for the both the study area and region as a whole.

5.3 Project Assignment Model Demand

The future year Project assignment model demands for the Option are derived from the Option demands taken from the regional WTSM model.

The process is as follows:

- Convert the matrices from the WTSM to KTM2 model and zone system;
- Convert from period (2hr) to 1hr demand;
- Apply adjustments to account for base year origin-destination survey factoring;
- Apply factors to account for manual adjustment of the base year matrices (pre matrix estimation); and

- Apply factors to adjust for the effects of matrix estimation in the base year.

This process is described in more detail in Appendix 34.F. The Do Minimum demands were created from the Option demands by applying an elasticity to the difference in travel costs between the Option and Do Minimum. This is described further in Section 5.5.

5.3.1 HCV Assumptions

As previously mentioned the level of HCV growth forecast by WTSM is higher than the forecast employment growth. HCV growth is forecast to be 79% between 2006 and 2026, with employment growth for the region predicted to be only 17%. This level of HCV growth is considered too high, due to possible double counting of growth related directly to employment and additive growth factor related to Gross Domestic Product (GDP) growth.

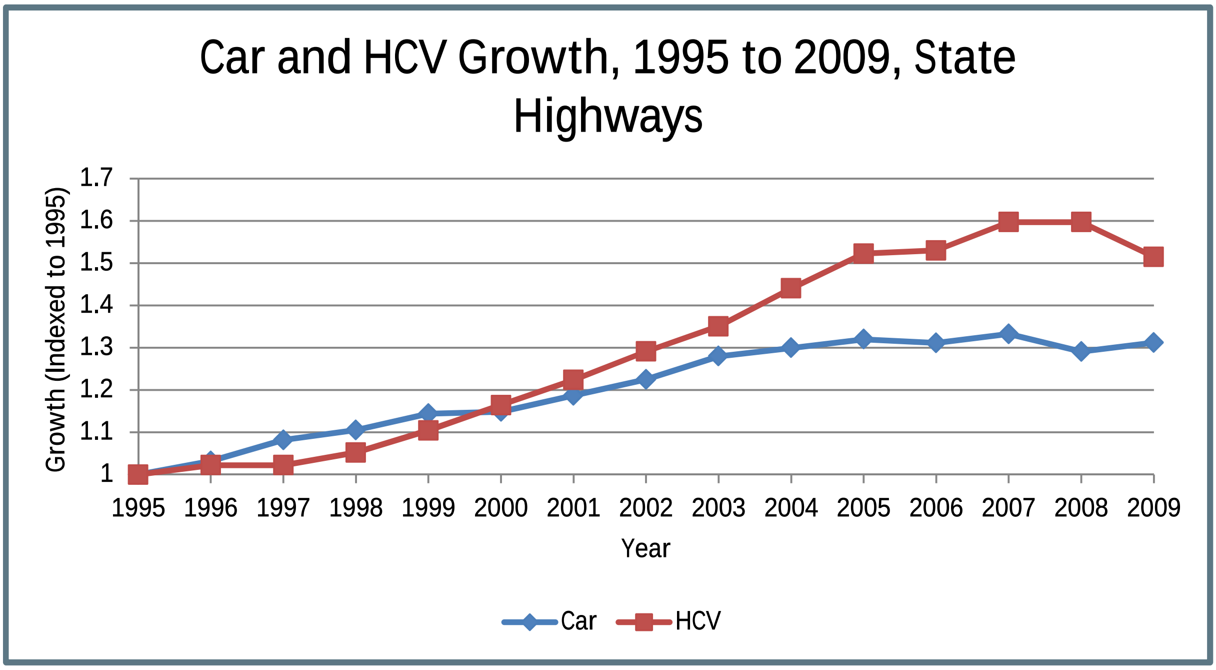


Figure 5.1 Car and HCV Growth, 1995 to 2009, State Highways

Figure 5.1 (source: NZTA website) shows car and HCV growth rates on State Highways between 1995 and 2009. On average, the HCV growth on State Highway was 66% greater than light vehicle growth during the corresponding time period. This factor was applied to the daily light vehicle growth predicted by WTSM to derive HCV growth rates by year (assumed to be constant across all time periods). The revised and WTSM HCV growth rates are presented in Table 5.5.

	2010 – 2016		2010 – 2026	
Scenario	Lights	HCV	Lights	HCV
WTSM	5%	37%	14%	83%
Revised	5%	9%	14%	24%

Table 5.5 Initial HCV and Light Vehicle Daily Growth Rates, 2010 to 2026

Given the level of growth (24%) in 2026 is greater than the employment growth across the Kāpiti District (17%) predicted for the same time period, it implies that employment growth is catered for in this revised forecast along with a small additional GDP related growth. This approach reduced the potential double counting of growth and brought the proportion of HCV traffic back to expected levels.

5.4 Development Growth

As described earlier in Chapter 5, differences in land use growth rates were identified between those in the regional model and the local growth plans identified by KCDC. This section describes how those differences were addressed in developing the traffic forecasts within the local models. The developments included in the modelling are described in detail in Section 5.4.1 as well as the methodology for representing the trips generated within the model demands.

5.4.1 Planned Developments

As mentioned in Chapter 4, there are four significant planned developments within the study area, all of which have gone through plan change processes, that are not reflected in the WTSM future year demand forecasts. The developments are as follows:

- Paraparaumu Town Centre:
  - A mix of residential, retail and mixed use
- Paraparaumu Airport:
  - Predominantly a mix of retail, office and warehousing / distribution
- Waikanae North:
  - Two mainly residential development at Ngarara and Waikanae North
- Ōtaki:
  - Mixed use development, situated off Riverbank Road.

Table 5.6 shows the number of vehicle trips forecast for each of these developments, derived from agreed trip rates used during the plan change submissions and based upon the most up-to-date knowledge regarding planned land uses at each of the sites. The data presented assumes 100% uptake of land at each site and 100% of all predicted trip generation.

	Trip Generation		
Development	Inbound	Outbound	Total Trips
Paraparaumu Town Centre	12,000	11,900	23,900
Paraparaumu Airport	11,700	11,600	23,300

Waikanae North	8,300	8,800	17,000
Ōtaki (Riverbanks)	1,700	1,700	3,400
Total	33,700	33,900	67,600

Table 5.6 Daily 11hr Development Trips (Vehicles)

For comparison, in the base year model there are approximately 120,000 daily trips to / from and within the whole study area, so these developments alone would represent a 50% increase in traffic.

Table 5.7 shows the WTSM and development growth rates between 2006 and 2031. If all committed developments are 100% complete in 2031 and generate the predicated level of trips, traffic growth across the Kāpiti District solely attributable to the above development traffic averages 60% across the whole day. This compares with 18% growth in the same period predicted by the regional WTSM model.

The 'trend growth' is also presented in Table 5.7. This is calculated by taking the data presented in Figure 5.1, showing average growth for state highways between 1995 and 2010, and extrapolating forward to 2031. According to this data vehicle traffic is predicted to grow as follows:

- 2010 to 2016 – 12%;
- 2010 to 2026 – 37%; and
- 2010 to 2031 – 50%.

Using past data to predict future trends relies upon the rate of traffic growth over time being maintained in the future. Between 1995 and 2005 there was a rapid growth in car usage on state highways[6]. This can be partly attributed to economic growth during this period and a (relative) reduction in the cost of motoring, resulting in car travel becoming more affordable for a large percentage of the population.

The same research states that it is 'unlikely that the downward trend in real car prices over the last 30 years will continue' and that 'there is considerable uncertainty over factors that could have a significant impact on car ownership, such as forecast GDP and car prices'.

Given the information presented above, it is likely that the 'trend growth' scenario presented below represents a 'high growth' scenario for Kāpiti District. Whilst SH1 passes through the study area a sizeable proportion of traffic will be local traffic using local roads within Kāpiti District. Growth rates for such urban areas are generally lower than those for strategic routes such as state highways, lending further weight to 'trend growth' representing a high growth scenario.

[6] http://www.nzta.govt.nz/resources/research/reports/394/docs/394.pdf

	WTSM	Only Development	WTSM Plus Development	Trend Growth
AM Peak Period (2 hr)	25%	56%	81%	
Inter-peak Period (7 hr)	17%	59%	75%	
PM Peak Period (2 hr)	19%	65%	84%	
Daytime (11hr)	18%	60%	78%	50%

Table 5.7 Growth Rates Between 2010 and 2031 Under Different Growth Scenarios (Vehicles)

5.4.2 Resulting Adopted Growth Rates

In order to address the apparent mismatch between growth predicted by the regional model and for significant known growth areas a ‘composite growth’ approach was chosen. This approach takes some of the planned development traffic for the area along with a proportion of the regional WTSM growth for the area, remaining broadly consistent with WTSM whilst also accounting for major planned developments within the area. The approach is detailed in Appendix 34.G.

Table 5.8 shows the resulting 2016 and 2026 Option matrices that form inputs to the KTM2 Project assignment model.

	2010		2016			2026		
Scenario	Lights	HCV	Lights	HCV	Total % Diff 2016 cf 2010	Lights	HCV	Total % Diff 2026 cf 2010
AM Peak	11,300	1,500	12,500	1,700	11%	15,000	2,100	33%
Inter-peak	9,600	1,500	10,600	1,600	10%	12,700	2,000	32%
Evening Peak	12,400	1,000	14,000	1,100	13%	16,700	1,500	35%

Table 5.8 Option Trip Matrix Totals – Composite Growth Scenario (1 hr peak hour)

5.5 Do Minimum Demand

The Project model Option matrices that were created from the WTSM regional model have been documented in this chapter. This section briefly documents the principles behind creating the Do minimum matrices.

5.5.1 Elasticity Model Calibration

The Project is likely to have a significant impact upon trip making within the area. Possible effects are:

- Time of Day Choice – increased road capacity could lead to an increase in traffic in the peak periods;

- Mode Split - improved road travel times could result in a switch from rail to car for some journeys within the Wellington Region; and
- Trip Distribution – the proposed Expressway will improve accessibility to / from the study area and between key areas within the study area (such as Waikanae and Paraparaumu). There could be a significant re-distribution of trips within the study area, due to changes in travel costs.

Given these potential effects, a variable demand matrix (VDM) based approach to appraising the proposed Expressway was deemed most appropriate. The principle behind a VDM approach is that the demand matrix varies between the Option and Do Minimum, the differences being a function of changes in the supply networks and associated changes in travel costs. For example, additional induced traffic will occur because the proposed Expressway provides additional capacity, removes bottlenecks and reduces intersection delays, resulting in certain journeys becoming relatively less expensive when comparing the Do Minimum and Option scenarios.

Given that the Project assignment model contains much more detail in the study area than the regional demand model and also has enhanced intersection modelling capability it was decided that the variable demand matrix approach should be implemented in the Project assignment model, rather than relying directly on the WTSM Do Minimum demands.

The method chosen to calibrate the elastic demand response of the Project assignment model was as follows:

- Determine the demand change between the 2026 Option and 2026 Do Minimum (by time period) for key movements within the study area from WTSM;
- Using an elasticity function attempt to replicate this demand change, by time period, in KTM2; and
- Apply this elasticity function to other years in KTM2 to create Do Minimum demands.

Whilst the over-arching aim is to replicate the demand change, this was tempered by the need to stay broadly within the expected range of elasticities, including those specified in NZTA's Economic Evaluation Manual (EEM). A range of elasticity functions and values were used and a preferred method adopted in liaison with the peer reviewer.

Table 5.9 shows the percentage change in demand between the 2026 Option and Do Minimum in WTSM along with the percentage change in the KTM2 Project assignment model for the same movements, by time period. Figure 5.2 shows the sector system used for estimating the elastic demand response in both the regional and Project models.

Figure 5.2 Sector System for Calculating Elastic Demand Response

	AM Peak		Inter-peak		PM peak	
	WTSM % Diff	KTM2 % Diff	WTSM % Diff	KTM2 % Diff	WTSM % Diff	KTM2 % Diff
Waikanae River Crossing - Southbound	-22%	-15%	-20%	-8%	-22%	-10%
Waikanae River Crossing - Northbound	-22%	-6%	-19%	-9%	-21%	-17%
to / from North Sector (not within)	3%	-1%	<-1%	-<1%	1%	-<1%
to / from South Sector (not within)	-1%	-4%	2%	-1%	<1%	-3%
Northern Screenline - Southbound	-4%	-4%	<1%	-2%	<1%	-2%
Northern Screenline - Northbound	0%	-2%	<1%	-2%	-3%	-5%
Southern Screenline - Southbound	-5%	-5%	-1%	-2%	-1%	-4%
Southern Screenline - Northbound	-2%	-2%	-1%	-2%	-5%	-5%
Intra Southern Sector	3%	-2%	3%	<1%	3%	-4%
Intra Northern Sector	5%	-1%	4%	-<1%	4%	-1%
Total Demand	-4%	-4%	-2%	-1%	-3%	-5%

Table 5.9 SATURN Elasticity Calibration Results, 2026

The main points that can be drawn from Table 5.9 are:

- The reduction in 2026 Do Minimum demand compared with the 2026 Option is greatest at the Waikanae River Crossing in both WTSM and the Project assignment model;
- The demand response is broadly similar between WTSM and the Project assignment model; and
- Whilst the regional model has a similar response between the 'peak' and 'counter-peak' directions the Project assignment model shows a greater demand response in the more congested 'peak' direction as opposed to the less congested 'counter-peak' direction.

Although the elastic response does not exactly replicate the WTSM response, it is considered appropriate as it uses the more precise network in KTM2 rather than the coarser network and costs in WTSM. This approach was discussed and agreed with the independent peer reviewer.

5.5.2 Resulting Trip Totals

Table 5.10 and Table 5.11 compare the Option and Do Minimum demand totals for 2016 and 2026 across all time periods for the composite growth approach.

	Option		Do Minimum	
Time Period	Lights	HCV[7]	Lights	HCV
AM peak	12,500	1,700	12,300	1,700
Inter-peak	10,600	1,600	10,600	1,600
PM peak	14,000	1,100	13,700	1,100

Table 5.10 2016 Option and Do Minimum Matrix Totals

	Option		Do Minimum	
Time Period	Lights	HCV	Lights	HCV
AM peak	15,100	2,100	14,400	2,100
Inter-peak	12,700	2,000	12,500	2,000
PM peak	16,700	1,500	15,800	1,400

Table 5.11 2026 Option and Do Minimum Matrix Totals

The magnitude and effects of this induced traffic is discussed further in Chapter 6.

[7] Elastic demand has not been applied to HCVs.

6 Wider Network Results

This chapter describes the effect of the Project in the wider Kāpiti area, as well as the local network effects. It is based on comparisons between the Do Minimum and Option scenarios (as described in Chapter 5). The performance of the proposed Kāpiti Road interchange is described later in Chapter 7.

The following abbreviations are used in this section of the report for the scenarios assessed:

- DM = Do Minimum; and
- OPT = Option.

This chapter concentrates on the effect of traffic flows on both the wider state highway network and also the local road network. The effects on traffic and public transport travel patterns are described, as well as the effects of induced traffic, and how this has been captured in the Project assignment model.

Daily flows have been calculated from the Project assignment model by factoring the AM peak, Inter-peak and PM peak 2-hour flows and combining them to derive daily flows. This calculation is done by applying the following factors:

- AM peak = 1.86 (lights), 1.76 (HCVs) or 1.85 (all vehicles);
- Inter-peak = 9.93 (lights), 13.57 (HCVs) or 10.15 (all vehicles); and
- PM peak = 2.00 (lights), 2.50 (HCVs) or 2.01 (all vehicles).

These factors were derived following detailed analysis of a sub-set of 2010 count data across the network. Details on this analysis can be found in Appendix 34.C.

It should be noted that all results shown here are for a typical, average weekday and do not reflect holiday of weekend peaks.

6.1 Overall Effect on Traffic Flows

Figure 6.1 and Figure 6.2 show the predicted changes in daily traffic between the Do Minimum and Option in 2026 across Kāpiti District. These changes are discussed in greater detail in the following sections. Positive (green) shows where the traffic is predicted to increase compared to the Do Minimum with negative (blue) indicating where traffic is expected to decrease.

Note that it is not possible to present comparisons where the network differs; therefore in this instance flows along the proposed Expressway (which would be positive) cannot be displayed. What can be seen is the magnitude of the change in flows along SH1 and other roads within the study area, such as Te Moana Road and Otaihanga Road, as a result of opening the proposed Expressway.

These diagrams are provided to show an overview of the changes in traffic flows across the network. Actual forecast flows on key roads are tabulated later in Sections 6.2-6.3.

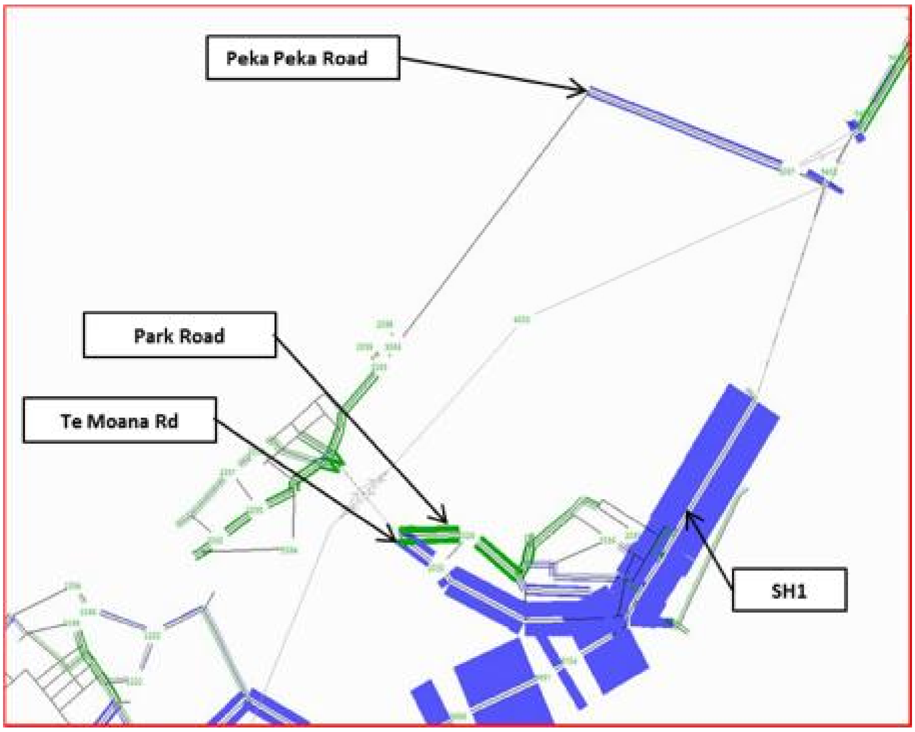


Figure 6.1 Difference in Daily Flows, Waikanae: Do Minimum vs Option, 2026

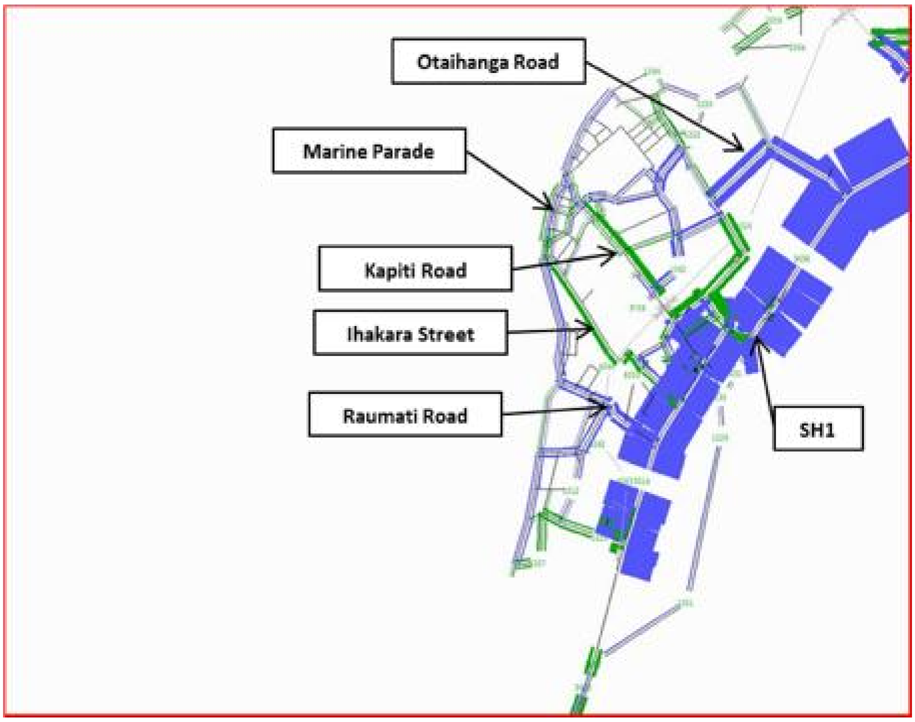


Figure 6.2 Difference in Daily Flows, Paraparaumu: Do Minimum vs Option, 2026

6.2 Effects on SH1

The results in Table 6.1 detail the effects of the Project on SH1 traffic volumes at a daily level with Table 6.2 and Table 6.3 showing the effects upon peak hour flows. Figure 6.3 shows the locations for which state highway and proposed Expressway traffic volumes have been extracted.

Figure 6.3 Location of Traffic Volumes obtained from SH1 and proposed Expressway

	Location	2010 Base	2016 DM	2016 OPT	% Change DM - OPT	2026 DM	2026 OPT	% Change DM - OPT
1	South of Peka Peka Road	17,000	18,100	7,800	-57%	20,500	8,900	-57%
2	South of Te Moana Road	26,900	27,500	13,100	-52%	31,900	14,700	-54%
3	South of Otaihanga Road	22,400	22,700	10,500	-54%	25,800	11,700	-55%
4	South Kāpiti Road	27,000	29,100	19,500	-33%	31,900	21,100	-34%
5	South of Poplar Ave	22,700	23,000	23,100	0%	26,400	26,900	2%
6	Expressway North of Poplar Avenue	-	-	12,000		-	13,900	
7	Expressway North of Kāpiti Interchange	-	-	16,200		-	20,200	
8	Expressway North of Te Moana Interchange	-	-	10,400		-	12,400	

Table 6.1 Daily Traffic Volumes on SH1 (two directional, vehicles)

The results in Table 6.1 show that the proposed Expressway results in a 33% to 57% reduction in daily flows along the existing SH1. Figure 6.4 below displays the 2010 and 2026 data graphically, showing an increase in traffic between the base year (2010) and the 2026 Do Minimum, followed by a reduction between the 2026 Do Minimum and Option as a result of the opening of the proposed Expressway.

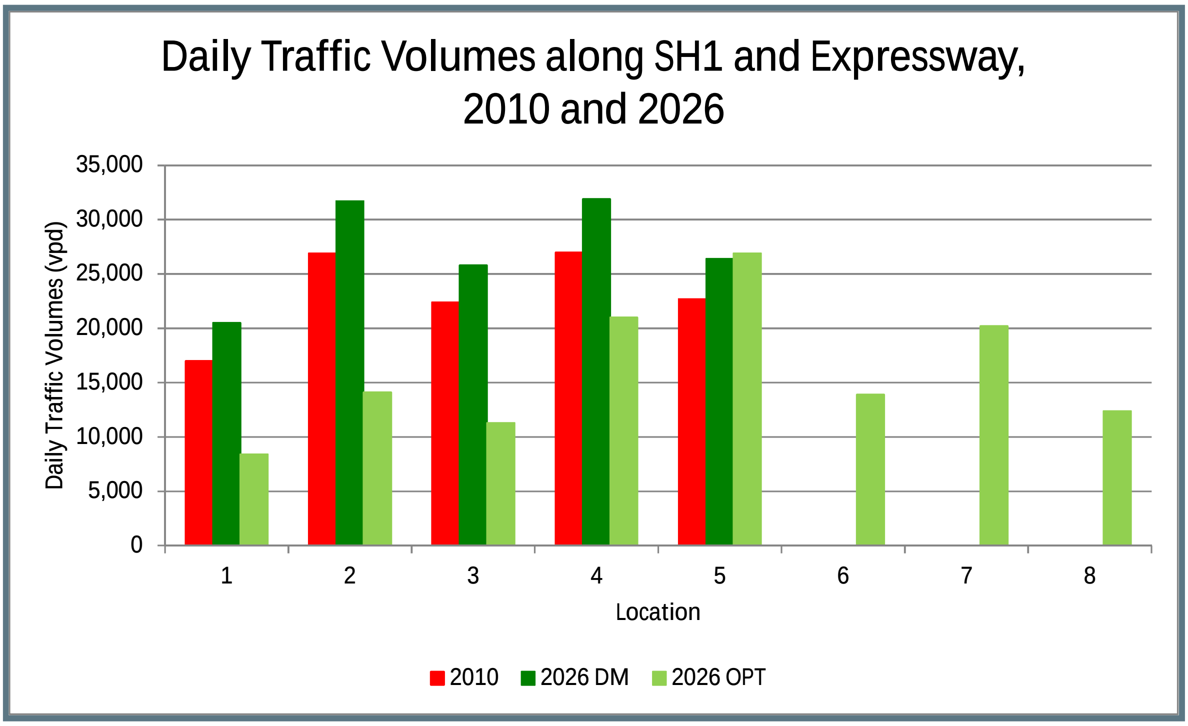


Figure 6.4 Daily Traffic Volumes along SH1, 2010 and 2026 (vpd)

	Location	2010	2016 DM	2016 OPT	% Change 2016 DM - OPT	2026 DM	2026 OPT	% Change 2026 DM - OPT
1	South of Peka Peka Road	700	800	400	-50%	1,000	400	-60%
2	South of Te Moana Road	1,300	1,300	600	-54%	1,600	800	-50%
3	South of Otaihanga Road	1,100	1,100	600	-45%	1,300	700	-46%
4	South Kāpiti Road	1,300	1,300	900	-31%	1,500	1,000	-33%
5	South of Poplar Ave	1,200	1,200	1,200	0%	1,300	1,400	8%
6	Expressway North of Poplar Avenue	-	-	600	-	-	800	-
7	Expressway North of Kāpiti Interchange	-	-	800	-	-	1,200	-
8	Expressway North of Te Moana Interchange	-	-	500	-	-	600	-

Table 6.2 AM Peak Vehicle Flows on SH1 (1 hour, Southbound)

	Location	2010	2016 DM	2016 OPT	% Change, 2016 DM - OPT	2026 DM	2026 OPT	% Change, 2026 DM - OPT
1	South of Peka Peka Road	800	900	400	-56%	1,000	400	-60%
2	South of Te Moana Road	1,400	1,300	600	-54%	1,500	700	-53%
3	South of Otaihanga Road	1,200	1,100	600	-45%	1,300	600	-54%
4	South Kāpiti Road	1,600	1,500	1,000	-33%	1,600	1,100	-31%
5	South of Poplar Ave	1,600	1,600	1,600	0%	1,700	1,800	6%
6	Expressway North of Poplar Avenue	-	-	800	-	-	900	-
7	Expressway North of Kāpiti Interchange	-	-	800	-	-	1,100	-
8	Expressway North of Te Moana Interchange	-	-	500	-	-	600	-

Table 6.3 PM Peak Vehicle Flows on SH1 (1 hour, Northbound)

Table 6.2 and Table 6.3 show that peak hour volumes in the Do Minimum are split 50:50 between SH1 and the proposed Expressway in the Option. How these peak flows relate to the corridor capacity is discussed later in Section 6.5.

6.3 Impacts on the Local Road Network

Table 6.4 shows the daily flow on selected local roads within Kāpiti District. Figure 6.5 shows the locations for which local road volumes have been extracted.

Figure 6.5 Location of Traffic Volumes obtained from Local Roads

	Location	2010	2016 DM	2016 OPT	% Change 2016 DM - OPT	2026 DM	2026 OPT	% Change 2026 DM - OPT
1	Poplar Ave, East of Matai Rd	2,500	3,000	3,400	13%	3,300	3,800	15%
2	Matai Rd, South of Raumati Rd	4,300	4,400	4,000	-9%	5,900	5,300	-10%
3	Raumati Rd, West of Rimu Rd	13,000	15,200	14,300	-6%	17,800	16,300	-8%
4	Rimu Rd, South of Kāpiti Rd	19,600	19,500	18,700	-4%	16,100	15,500	-4%
5	Kāpiti Rd, West of SH1	16,200	16,300	13,500	-17%	18,600	13,700	-26%
6	Kāpiti Rd, West of Arawhata Rd	24,900	27,200	27,800	2%	29,400	29,700	1%
7	Kāpiti Rd, West of Te Roto Dr	15,600	17,500	19,100	9%	20,800	22,000	6%
8	Arawhata Rd, North of Kāpiti Rd	7,800	7,800	7,400	-5%	6,500	6,300	-3%
9	Te Roto Dr, North of Kāpiti Rd	10,300	11,700	11,300	-3%	12,400	12,200	-2%
10	Realm Dr, North of Guildford Dr	2,900	3,200	2,600	-19%	4,100	3,400	-17%
11	Mazengarb Rd, E of Guildford Dr	5,300	6,100	5,800	-5%	6,200	5,700	-8%
12	Ratanui Rd, N of Mazengarb Rd	7,200	7,700	5,200	-32%	7,800	4,800	-38%
13	Otaihanga Rd, West of SH1	6,500	7,300	4,800	-34%	8,600	5,500	-36%
14	Te Moana Rd, West of SH1	10,700	10,600	5,500	-48%	13,000	6,200	-52%
15	Te Moana Rd, West of Walton Ave	5,200	5,800	4,200	-28%	8,100	5,500	-32%
16	Park Ave, North of Te Moana Rd	1,800	2,900	4,200	45%	4,500	6,200	38%
17	Paetawa Rd, S of Peka Peka Rd	900	1,000	900	-10%	1,300	1,200	-8%
18	Peka Peka Rd, West of SH1	1,100	1,200	600	-50%	1,300	700	-46%

Table 6.4 Daily Flows on Local Roads (two-directional, vehicles)

The following can be determined from Table 6.4:

6.3.1 Traffic Volume Increases

- Traffic volumes on the northern section of Kāpiti Road increase between the base and Do Minimum in both years; and
- There are large increases in traffic volumes on Poplar Avenue (east of Matai Road) and on Park Avenue (north of Te Moana Road) in the Option compared with the Do Minimum.

6.3.2 Traffic Volume Decreases

- Traffic volumes along the southern section decrease between the base year and 2026. This is because the town centre link opens in 2026, providing a new link between Kāpiti Road and

Paraparaumu Town centre, relieving congestion along the southern section of Kāpiti Road and facilitating the planned development for the area;

- Traffic volumes on Te Moana and Otaihanga Road decrease substantially as a result of the proposed Expressway; and
- Traffic volumes along Raumati Road decrease in the Option compared with the Do Minimum, as traffic that used Raumati Road to access the southbound SH1 can now use the proposed Kāpiti Road Expressway intersection.

6.3.3 Traffic Volume No Material Change

- Traffic volumes on Mazengarb Road, Kāpiti Road (west of Arawhata Road) and Rimu Road remain broadly similar between the Do Minimum and Option.

Figure 6.6 shows the change in traffic volumes between 2010 and 2026 (Do Minimum and Option) in a graphical format.

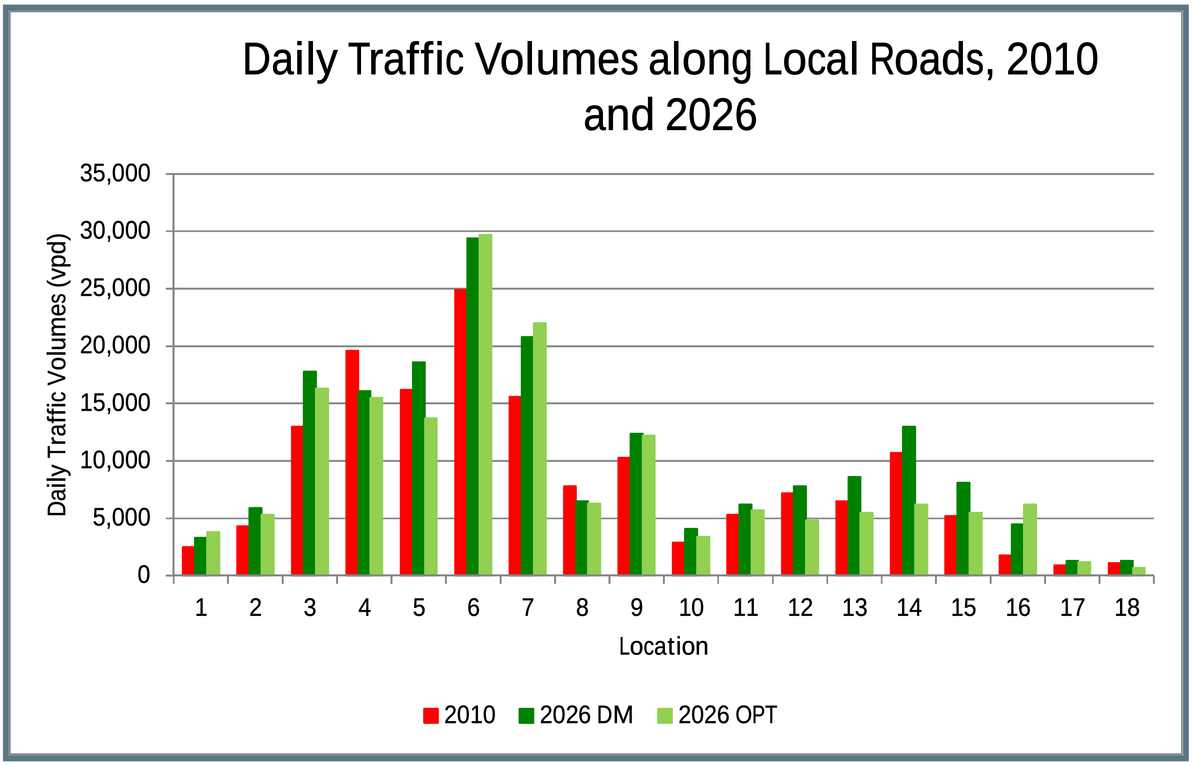


Figure 6.6 Daily Traffic Volumes along Local Roads (two-directional, vehicles)

6.4 Impacts on Key Intersections

The Level of Service (LoS) for a number of key signalised and unsignalised intersections has been assessed. This LoS rating is a 7-letter scale for characterising the perceived performance, from LoS A (very good) to LoS F (very poor performance). The performance criteria for intersections (signalised and unsignalised) have been taken the Highway Capacity Manual and is based on average delay per vehicle at a signalised or priority based (unsignalised) intersection (see Table 6.5).

	Signalised	Unsignalised	Definition
A	≤10 sec	≤10 sec	Good operation
B	10-20 sec	10-15 sec	Good with acceptable delays and spare capacity
C	20-35 sec	15-25 sec	Satisfactory
D	35-55 sec	25-35 sec	Operating near capacity
E	55-80 sec	35-50 sec	At capacity
F	≥80 sec	≥50 sec	Over-capacity

Table 6.5 LoS Criteria for Intersection – Average Delay per Vehicle

Table 6.6 and Table 6.7 show the peak hour traffic volumes (in pcus[8]), delays and LoS at several key signalised intersections within the study area:

- 1 - Elizabeth Street / SH1;
- 2 - Te Moana Road / SH1; and
- 3 - Kāpiti Road / SH1.

One of the objectives of the Project is to relieve congestion along SH1, particularly through Waikanae and Paraparaumu town centres.

Table 6.8 shows delays at the following key priority intersections within the study area:

- 4 - Poplar Avenue / SH1;
- 5 - Raumati Road / SH1;
- 6 – Ihakara Street / SH1; and
- 7 - Otaihanga Road / SH1.

Figure 6.7 shows the location of the signalised and priority intersections in question.

For each priority intersection the movement that has the greatest delay (in seconds) is provided for both the AM peak and PM peak in 2026. The flow and delay figures for this same movement are also tabulated for the Option, showing how the delay for these particular movements has been affected by the opening of the proposed Expressway.

[8] PCU = Passengers Car Unit. One light vehicle is equal to one pcu, one heavy commercial vehicle (HCV) is equal to two pcus.

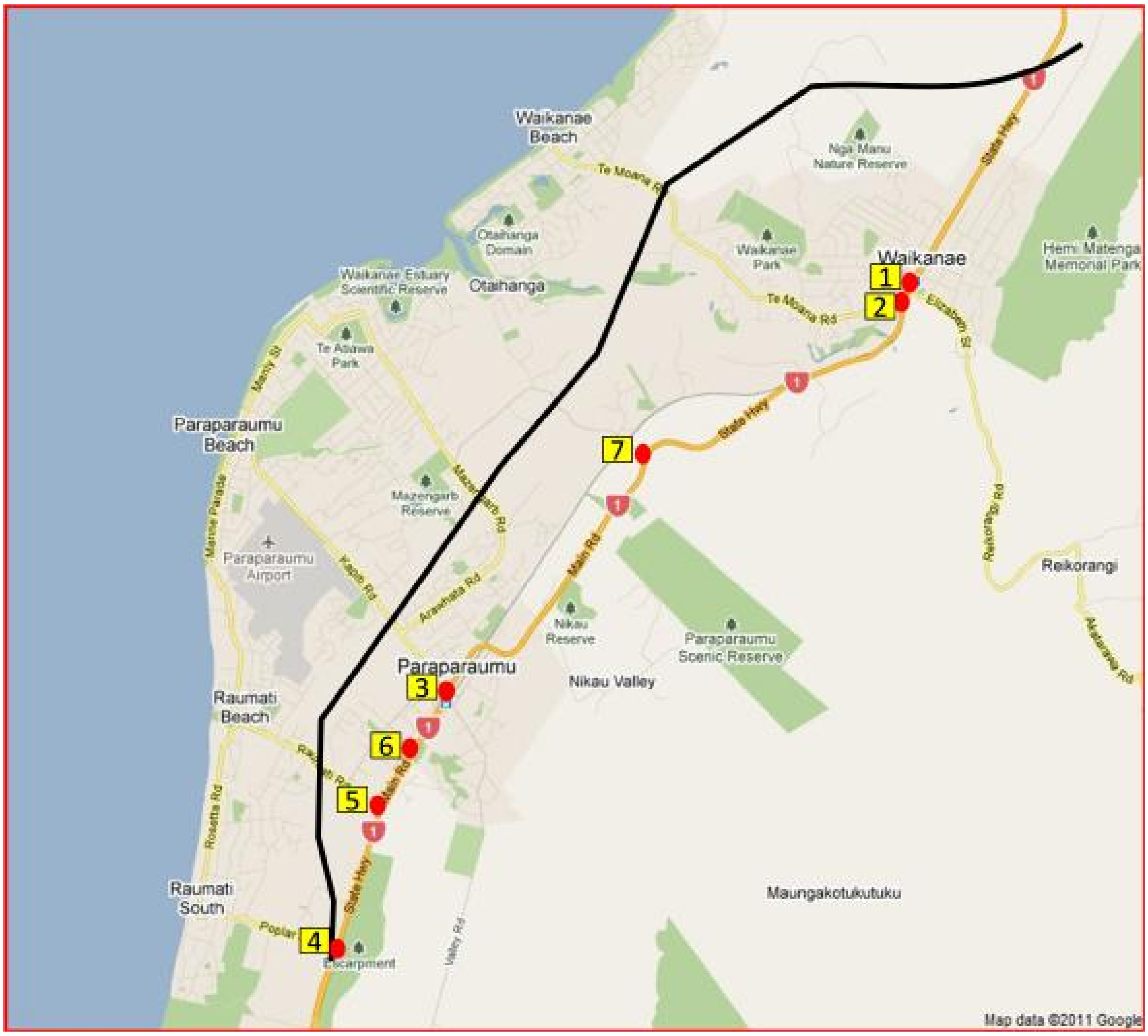


Figure 6.7 Location of Intersections

6.4.1 AM Peak

Table 6.6 presents intersection performance in the AM peak for the three major signalised intersections that lie along SH1, at Te Moana Road and Elizabeth Street in Waikanae and at Kāpiti Road in Paraparaumu.

At both Elizabeth Street and Te Moana Road, where volumes passing through each intersection decrease between the Do Minimum and Option, the reduction in delays is fairly minimal. This is because the traffic flow profiles have changed as a result of the proposed Expressway, with similar levels of traffic using the minor side roads (Elizabeth Street and Te Moana Road) and lower volumes travelling through each intersection on SH1. The signal timings are currently set up so that the minor arms have less green time (and consequently higher levels of delays). When a greater percentage of the overall traffic volume through a particular intersection is associated with these minor arms then the average delays will remain constant or even rise, despite a reduction in the pre-dominant north-south traffic.

It should be noted that only limited optimisation of signals was allowed between the Do Minimum and Option scenarios. Following completion of the proposed Expressway it is likely that more detailed optimisation of the signal timings and phasing would be undertaken, resulting in a greater reduction in delays between the Option and the Do Minimum than what is presented in Table 6.6.

The intersection of Kāpiti Road / SH1 operates at or near capacity in the Do Minimum. Overall the intersection operates at Level of Service (LoS) “E’ with six individual movements having LoS “E” or “F”, signifying that they are ‘operating at or over capacity’.

With the opening of the proposed Expressway, the overall intersection LoS is reduced to “D” and the maximum delay for any particular arm is 70 seconds. As mentioned above, further optimisation of the signal timings at this intersection would result in further improvements to the performance of the intersection.

			Do Minimum			Option		
Intersection	Arm	Movement	Flow	Delay (s)	LoS	Flow	Delay (s)	LoS
Elizabeth Street / SH1	SH1 (North)	Left	170	20	C	220	20	C
		Through	1090	20	C	500	20	C
	Elizabeth Street	Left	220	60	E	250	60	E
		Right	230	70	E	230	50	D
	SH1 (South)	Through	920	10	A	370	10	A
		Right	230	100	F	200	80	F
All Approaches (Intersection)			2860	30	C	1780	30	C
Te Moana Rd / SH1	SH1 (North)	Through	1250	10	A	690	10	A
		Right	60	80	F	70	70	E
	SH1 (South)	Left	320	0	A	140	0	A
		Through	900	10	B	370	10	A
	Te Moana Rd	Left	250	10	A	210	0	A
		Right	520	70	E	120	50	D
All Approaches (Intersection)			3300	20	B	1590	10	B
Kāpiti Rd/SH1	SH1 (North)	Left	0	50	D	0	40	D
		Through	1190	40	D	680	40	D
		Right	180	90	F	160	60	E
	Station Road	Left	170	50	D	170	40	D
		Through	370	60	E	290	50	D
		Right	90	60	E	30	50	D
	SH1 (South)	Left	250	40	D	130	30	C
		Through	940	40	D	410	30	C
		Right	180	90	F	190	70	E
	Kāpiti Rd	Left	170	50	D	60	40	D
		Through	380	60	E	260	50	D
		Right	260	310	F	230	70	E
All Approaches (Intersection)			4160	60	E	2620	50	D

Table 6.6 Signalised Intersection Performance, 2026, AM Peak

6.4.2 PM Peak

Table 6.7 presents intersection performance in the PM peak for the three major signalised intersections that lie along SH1, at Te Moana Road and Elizabeth Street in Waikanae and at Kāpiti Road in Paraparaumu.

The observations made about the Elizabeth Street and Te Moana Road intersections in the AM peak are equally applicable to the PM peak, with intersection performance improving only slightly between the Do Minimum and Option. Both intersections have one or two individual movements with a LoS above "E"; the opening of the proposed Expressway does not result in an improved level of service. These movements, however, are right turns off the main state highway with relatively low flows. Should both sets of signals be studied in more detail and modified it is envisaged that the overall LoS should improve further.

At the intersection of Kāpiti Road / SH1, eight movements have LoS "E" or above in the Do Minimum, including the dominant north-south movement. The maximum delay for any particular movement is 230 seconds for the right turn from Kāpiti Road onto SH1 (Southbound); a delay of this magnitude is experienced by this relatively lightly trafficked movement because capacity for this movement (and other right turn movements that require their own phase within the signal timings) is sacrificed to maintain SH1 capacity and performance. In the Option scenario there are only five movements with LoS "E" or above, with a maximum delay of 100 seconds. Whilst the Option scenario results in an enhanced level of service compared to the Do Minimum, further optimisation of the intersection would result in an even greater differential between the Do Minimum and Option levels of service.

Intersection	Arm	Movement	AM peak			PM peak		
			Flow	Delay (s)	LOS	Flow	Delay (s)	LOS
Elizabeth Street / SH1	SH1 (North)	Left	190	20	C	250	20	B
		Through	830	20	C	350	20	B
	Elizabeth Street	Left	130	50	D	130	50	D
		Right	180	60	E	180	60	E
	SH1 (South)	Through	1020	10	A	530	10	A
		Right	240	120	F	230	100	F
All Approaches (Intersection)			2590	30	C	1670	30	C
Te Moana Rd / SH1	SH1 (North)	Through	940	0	A	470	0	A
		Right	20	70	E	20	70	E
	SH1 (South)	Left	530	0	A	150	0	A
		Through	1050	20	B	610	10	A

	Te Moana Rd	Left	210	10	B	150	10	A
		Right	290	70	E	140	60	E
All Approaches (Intersection)			3040	20	B	1540	10	B
Kāpiti Rd/SH1	SH1 (North)	Left	0	30	C	30	30	C
		Through	780	30	C	450	30	C
		Right	180	90	F	50	50	D
	Station Road	Left	180	50	D	220	40	D
		Through	300	60	E	230	50	D
		Right	80	60	E	20	50	D
	SH1 (South)	Left	350	50	D	220	30	C
		Through	1160	60	E	700	30	C
		Right	200	110	F	240	100	F
	Kāpiti Rd	Left	400	80	F	110	50	D
		Through	330	90	F	320	60	E
		Right	240	230	F	190	80	E
All Approaches (Intersection)			4180	70	E	2770	50	D

Table 6.7 Signalised Intersection Performance, 2026, PM Peak

6.4.3 Priority Intersections

Table 6.8 presents turning movements with the worst levels of service in the 2026 Do minimum scenario for both the AM and PM peak at selected critical priority intersections along SH1. All four intersections have at least one movement with LoS "F", the highest category, in both the AM and PM peak. The maximum delay is 590 seconds for traffic attempting to turn right out of Poplar Avenue in the AM peak heading southbound onto SH1.

In the Option scenario all these severe delays disappear. The worst performing movement is the right turn from Ihakara Street onto SH1 (Southbound), operating at LoS "F" and experiencing a delay of 50 seconds in the PM Peak hour.

Intersection		Arrival Arm	Destination Arm	Do Minimum Delay	Do Minimum Flow	Do Minimum LOS	Option Delay	Option Flow	Option LOS
Poplar Ave / SH1	AM	Poplar Ave	SH1 (South)	590	60	F	0	210	A
	PM	Poplar Ave	SH1 (South)	210	60	F	0	70	A
Raumati Ave / SH1	AM	Raumati Rd	SH1 (South)	370	160	F	10	130	B
	PM	Raumati Rd	SH1 (South)	290	110	F	20	120	C
Ihakara St / SH1	AM	Ihakara St	SH1 (South)	380	60	F	20	160	C
	PM	Ihakara St	SH1 (South)	330	70	F	50	300	F
Otaihanga Rd / SH1	AM	Otaihanga Rd	SH1 (North	10	360	B	0	190	A
	PM	Otaihanga Rd	SH1 (North)	240	310	F	0	260	A

Table 6.8 Movements with Worst Delay at Key Priority Intersections, Option and Do Minimum, 2026

6.4.4 Intersection Performance Summary

Volumes through the major intersections along SH1 decrease considerably as a result of the proposed Expressway. The most noticeable consequence of this is improved performance at all priority intersections along SH1 and at the intersection between Kāpiti Road and SH1. The key signalised intersections remain fairly busy, however with the significant reduction in through traffic, the signals can be operated to give access to the local movements.

Further detailed analysis of intersection performance along Kāpiti Road is presented in Chapter 7 as part of the Kāpiti Road Operational Model assessment.

6.5 Corridor Capacity

Figures 6.8 and 6.9 display the 2026 Do Minimum and Option highway traffic volumes (demand flows) in pcus along SH1 between MacKays and Peka Peka, and the existing capacity. The data is only presented for the peak directions, namely southbound in the AM peak and northbound in the PM peak.

It should be noted that the Do Minimum demands have been developed through a variable-demand process, meaning that a proportion of traffic that would like to travel through the corridor has been suppressed.

6.5.1 AM Peak

Figure 6.8 shows that SH1 operates at capacity in the Do Minimum for a three kilometre stretch between Waikanae and the intersection with Otaihanga Road, punctuated only by a short passing lane in the middle of this section. The subsequent 4km section between Otaihanga a point just past the intersection of SH1 and Kāpiti Road also operates close to capacity. Southbound traffic flows at the intersections with Te Moana Road (km 4.5) and, particularly, Kāpiti Road (km 11.5) also operates near capacity suggesting an increase in capacity is likely to be required at some stage in the future. In the Option scenario SH1 operates at less than 50% of capacity for most of its length.

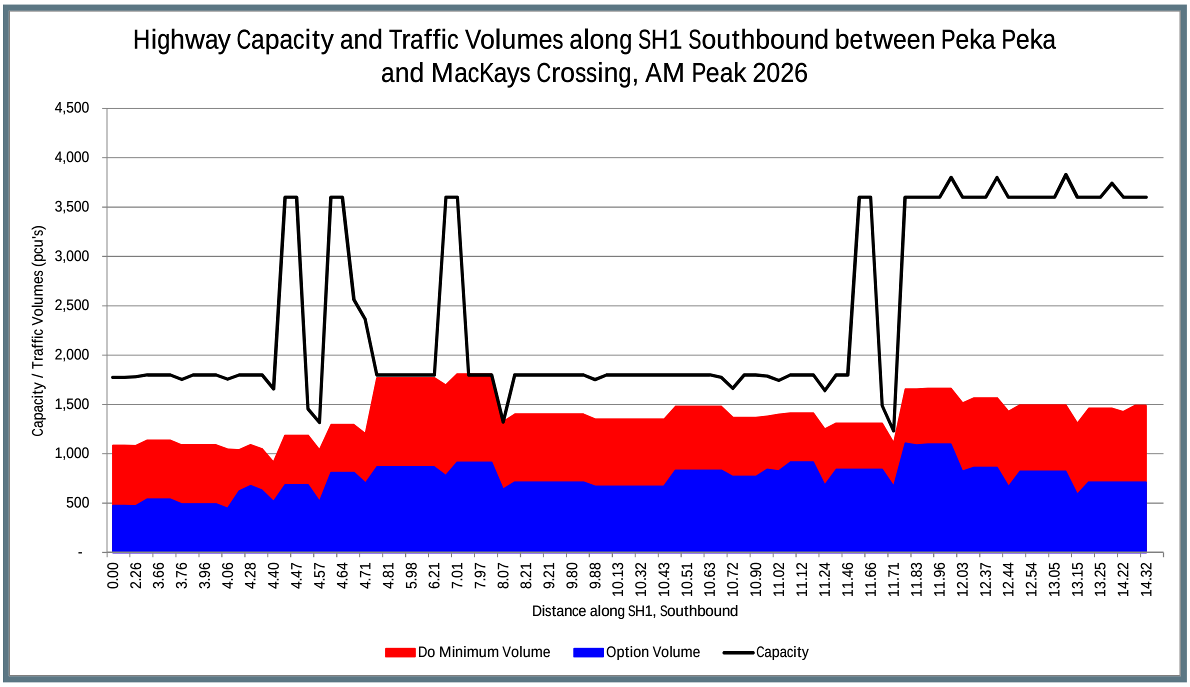


Figure 6.8 Highway Capacities and Hourly Traffic Volumes along SH1, AM Peak 2026, Southbound

6.5.2 PM Peak

Figure 6.9 shows that SH1 generally operates at or near capacity between Poplar Avenue and the intersection of SH1 and Te Moana Road (km 11), leading to the occurrence of both intersection and mid-block delays. The intersection of SH1 and Kāpiti Road (km 3.6) operates at capacity for the major south-north movement in the PM peak. SH1 operates well under capacity in the Option scenario. The exception is the intersection of Kāpiti Road / SH1, which operates at around 80% capacity for the dominant south-north movement.

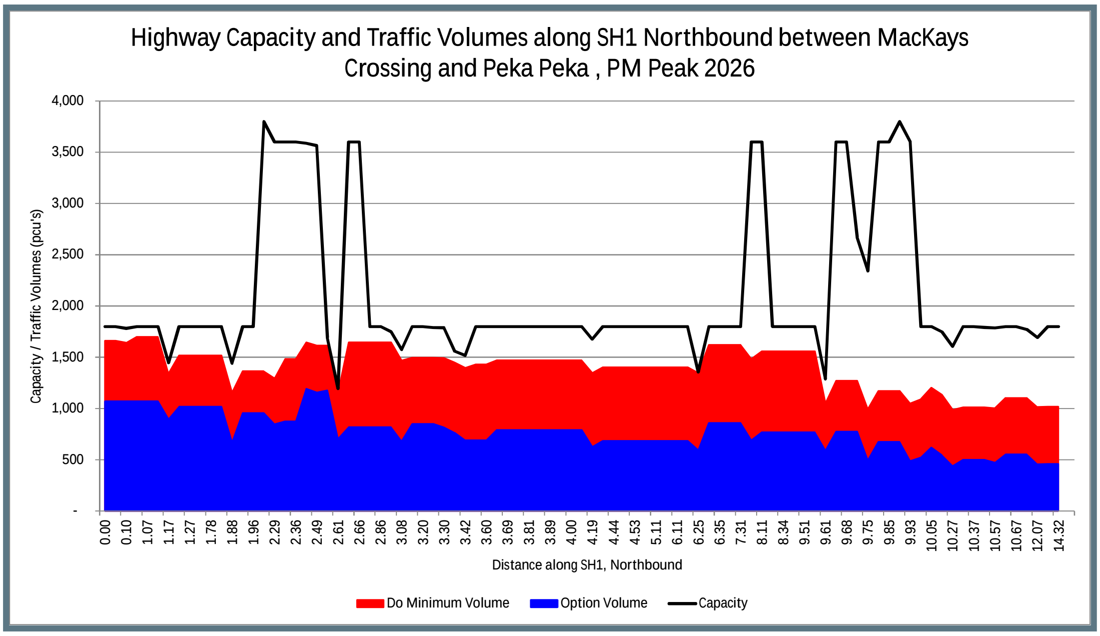


Figure 6.9 Highway Capacities and Traffic Volumes along SH1, PM Peak 2026, Northbound

6.6 Users of Expressway

In 2026, 25,000 vehicles per day are forecast to use one or more sections of the proposed Expressway for their journey (Table 6.11). In 2016 this figure is forecast to be 21,000.

Table 6.9 details the daily users of the ramps and mainline in 2016 and 2026, with Table 6.10 showing the number of users in the peak hours in the peak direction.

	Origin	Direction	2016	2026	Increase 2016 - 2026
1	Expressway South of Poplar	NB	11,800	13,900	18%
		SB	11,200	13,000	16%
2	Expressway between Poplar and Kāpiti	NB	6,100	7,100	16%
		SB	6,000	6,800	13%
3	Expressway between Kāpiti and Te Moana	NB	8,200	10,300	26%
		SB	8,300	10,500	27%
4	Expressway between Te Moana and Peka Peka	NB	5,400	6,400	19%
		SB	5,200	6,300	21%
5	Expressway North of Peka Peka	NB	6,900	8,100	17%
		SB	6,600	7,800	18%
6	Poplar Ave Ramp South-Facing Ramps	NB (Off)	5,800	6,800	17%
		SB (On)	5,200	6,200	19%

	Origin	Direction	2016	2026	Increase 2016 - 2026
7	Kāpiti Road South Facing Ramps	NB (Off)	2,000	2,400	20%
		SB (On)	1,800	1,900	6%
8	Kāpiti Road North Facing Ramps	NB (On)	4,200	5,600	33%
		SB (Off)	4,000	5,600	40%
9	Te Moana Road South Facing Ramps	NB (Off)	3,300	4,500	36%
		SB (On)	3,500	4,800	37%
10	Te Moana Road North Facing Ramps	NB (On)	530	670	26%
		SB (Off)	400	510	28%
11	Peka Peka North Facing Ramps	NB (On)	1,500	1,700	13%
		SB (Off)	1,400	1,500	7%

Table 6.9 Daily Users of Expressway (two-way, vehicles)

			2016		2026	
	Origin	Direction	AM	PM	AM	PM
1	Expressway South of Poplar	NB	900	1,600	1,100	1,800
		SB	1,200	800	1,400	1,000
2	Expressway between Poplar and Kāpiti	NB	500	800	600	900
		SB	600	400	800	500
3	Expressway between Kāpiti and Te Moana	NB	600	800	700	1,100
		SB	800	600	1,200	700
4	Expressway between Te Moana and Peka Peka	NB	500	500	600	600
		SB	500	400	600	500
5	Expressway North of Peka Peka	NB	600	600	700	700
		SB	600	500	800	600
6	Poplar Ave Ramp South-Facing Ramps	NB (Off)	400	800	500	900
		SB (On)	600	400	700	500
7	Kāpiti Road South Facing Ramps	NB (Off)	100	400	200	400
		SB (On)	300	100	300	100
8	Kāpiti Road North Facing Ramps	NB (On)	200	400	300	500
		SB (Off)	500	200	700	300
9	Te Moana Road South Facing Ramps	NB (Off)	200	400	200	500

	Origin	Direction	2016 AM	2016 PM	2026 AM	2026 PM
		SB (On)	400	200	600	200
10	Te Moana Road North Facing Ramps	NB (On)	50	40	70	50
		SB (Off)	50	30	70	40
11	Peka Peka North Facing Ramps	NB (On)	100	200	100	200
		SB (Off)	200	100	200	100

Table 6.10 Peak Hour Users of Expressway (vehicles)

From Table 6.9 and Table 6.10 the following points can be made:

- The highest daily flow north of Poplar Avenue (nearly 10,000 vpd in one direction) occurs between Kāpiti Road and Te Moana intersections; and
- The Kāpiti Road north facing ramps are the busiest, followed by the Te Moana south facing ramps.

Figure 6.10 below presents the daily Expressway users in 2016 and 2026 in a graphical format. Locations 1 through 11 correspond to the origins listed in Table 6.10.

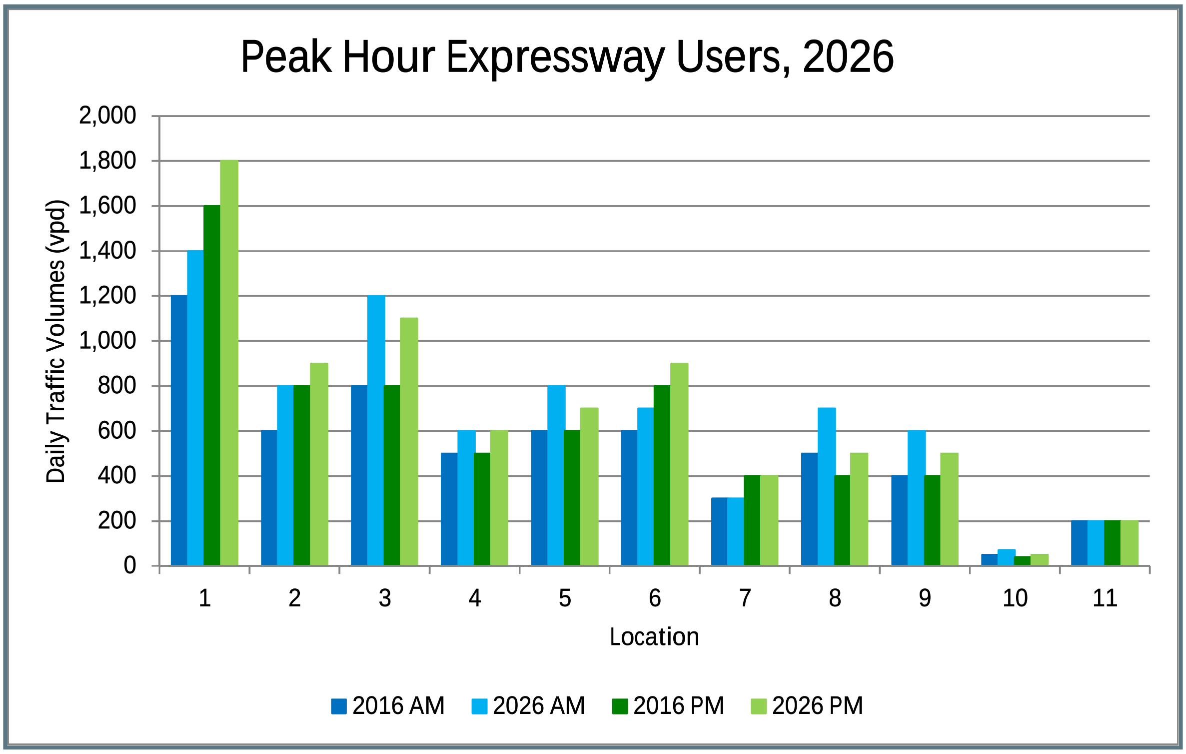


Figure 6.10 Expressway Users, AM Peak (Southbound), PM Peak (Northbound), 2016 & 2026

Table 6.11 is a matrix of daily Expressway users, showing journeys according to their origin point and destination point.

	South of MacKays Crossing	Kāpiti Rd	Te Moana	North of Peka Peka	Total
South of MacKays Crossing	-	2,400	1,100	3,500	7,000
Kāpiti Rd Intersection	1,900	-	3,400	2,100	7,400
Te Moana Intersection	1,400	3,400	-	700	5,500
North of Peka Peka	3,300	2,200	500	-	6,100
Total	6,700	8,000	5,100	6,200	26,000

Table 6.11 Matrix of Daily Users of Expressway, 2026

Table 6.11 shows that:

- Over 75% of trips have either or both the origin / destination end of their journey north of Peka Peka or south of MacKays Crossing;
- Around 25% of daily users travel between Waikanae and Paraparaumu;
- Around 60% of journeys join / leave at Kāpiti Intersection; and
- Approximately 40% of journeys join / leave at Te Moana intersection.

Further detailed analysis was undertaken to understand where in the wider network traffic using the proposed Expressway comes from. The origins and destination of vehicles using the proposed Expressway are shown in terms of 13 sector-to-sector movements in Figure 6.11 overleaf. The percentage shown is based upon the table total.

The sector system is as follows:

- Sector One – South of Poplar Avenue / MacKays Crossing;
- Sector Two – North of Peka Peka;
- Sector Three – Raumati Beach / Raumati;
- Sector Four – Paraparaumu East;
- Sector Five – Paraparaumu Town Centre;
- Sector Six – Paraparaumu;
- Sector Seven – Paraparaumu Beach;
- Sector Eight – Otaihanga;
- Sector Nine – Waikanae Beach;
- Sector Ten – Waikanae;
- Sector Eleven – Waikanae East;
- Sector Twelve – Waikanae North; and
- Sector Thirteen – Peka Peka.

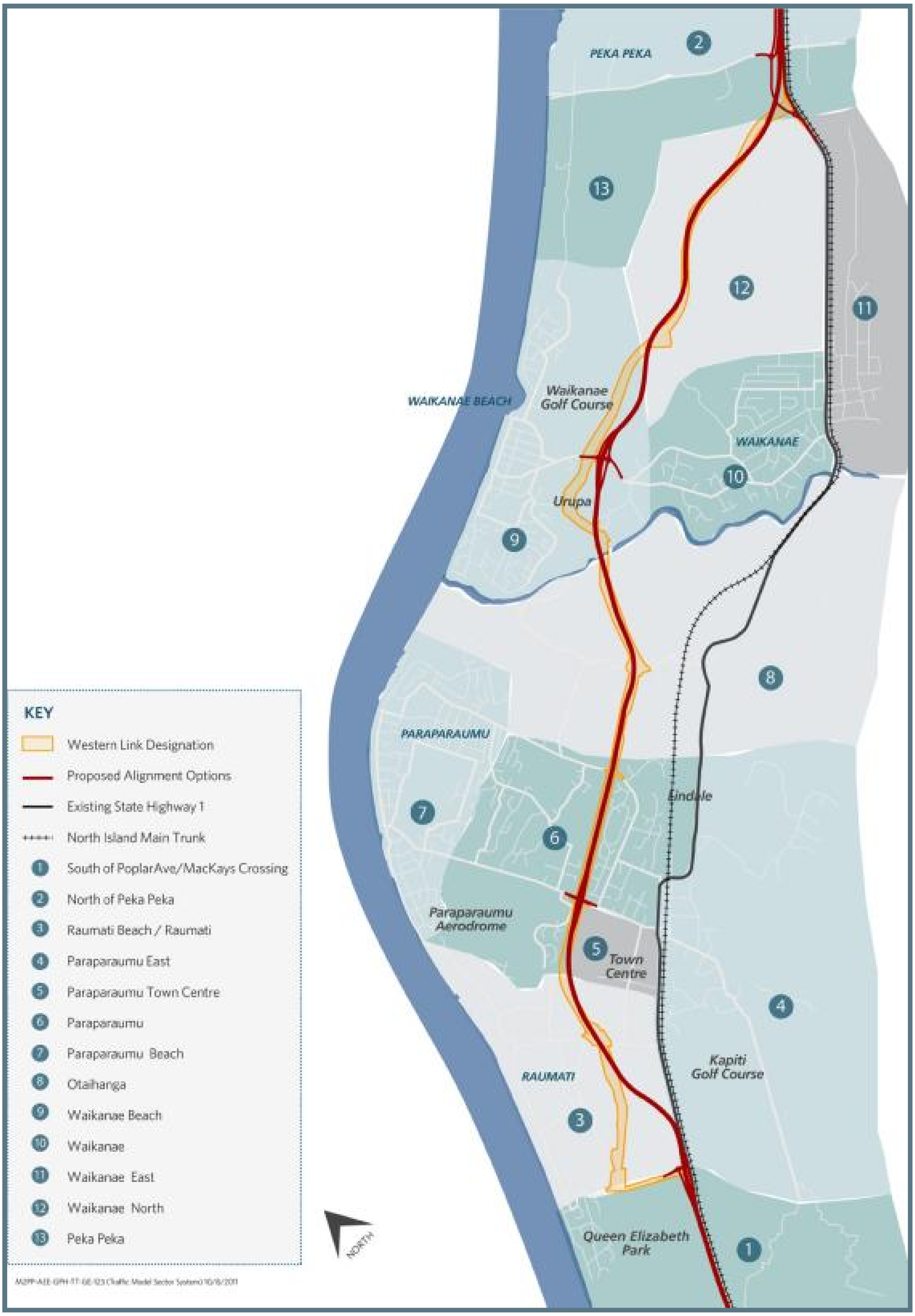


Figure 6.11 Sector System

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	Total
S1	-	3,500	-	-	-	1,300	1,000	100	500	400	-	200	100	7,100
S2	3,300	-	300	-	800	600	400	-	400	100	-	100	-	6,000
S3	-	300	-	-	-	-	-	-	200	-	-	-	-	500
S4	-	-	-	-	-	-	-	-	100	-	-	-	-	100
S5	-	800	-	-	-	-	-	-	1,000	200	-	100	-	2,100
S6	1,000	600	-	-	-	-	-	-	600	300	-	100	-	2,600
S7	800	400	-	-	-	-	-	-	400	100	-	100	-	1,800
S8	100	-	-	-	-	-	-	-	-	-	-	-	-	100
S9	700	400	200	200	900	600	400	-	-	-	-	-	-	3,400
S10	500	100	-	-	200	300	100	-	-	-	-	-	-	1,200
S11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S12	200	100	-	100	100	100	100	-	-	-	-	-	-	700
S13	100	-	-	-	-	-	-	-	-	-	-	-	-	100
Total	6,700	6,300	600	300	2,100	3,000	1,900	100	3,300	1,000	-	600	200	26,100

Table 6.12 Daily Users of MacKays to Peka Peka Expressway, 2026

When interpreting this data, care should be taken when estimating the proportion of users associated within each sector. Because each movement involves an origin and a destination, the sector totals will involve double counting. This double counting is avoided by considering the total origins and destination (52,000). On this basis, the following can be noted from Table 6.12:

- 50% of Expressway users start / finish their trip at a point south of MacKays Crossing;
- Around 25% of users start / finish their trip at points north of Ōtaki;
- Around 15% of trips are through trips from MacKays Crossing to Paraparaumu (and vice-versa)
- Approximately 10% of Expressway trips are associated with the Ōtaki area; and
- Around 15% of trips are between Waikanae and Paraparaumu localities.

6.7 Origin to Destination Travel Times

The completion of the proposed Expressway has an impact on travel times across the network. The effect on travel times between a number of origin and destination sectors were calculated. The origins and destinations are shown in Figure 6.11.

Table 6.13 and Table 6.14 detail the change in average travel time between the selected origin and destination when the Project is in place, compared with the Do Minimum. The actual travel times for both the Do Minimum and Option can be found in Appendix 34.E.

The majority of origin-destination movements in both the AM peak and the PM peak experience an improvement in travel times of between 0 and 5 minutes. Movements that experience improvements in excess of 5 minutes are shaded blue; those that experience a slight increase in travel times are shaded red.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	Total
S1	0.0	-4.3	-0.2	-1.1	-0.7	-2.6	-1.9	-1.0	-8.3	-1.9	-1.5	-4.6	-2.1	-2.4
S2	-7.1	0.0	-4.8	-3.5	-5.3	-5.5	-4.6	-1.5	-2.1	-0.1	-0.1	-1.3	0.6	-1.1
S3	-9.5	-1.3	0.0	-0.9	-0.2	0.1	0.0	-0.7	-3.8	-1.1	-1.4	-2.1	-0.6	-0.8
S4	-0.7	-0.9	-1.0	-0.1	-0.6	-0.2	0.0	-0.4	-1.7	-1.1	-1.5	-1.0	-0.8	-0.7
S5	-6.3	-1.7	-0.4	-0.3	-0.1	0.4	0.2	-0.6	-4.4	-0.9	-1.2	-1.6	-0.5	-0.3
S6	-5.6	-2.2	-0.3	-0.3	-0.1	0.2	0.1	-0.1	-5.2	-0.8	-0.8	-2.2	-0.7	-0.4
S7	-5.8	-1.6	-0.1	-0.1	0.1	0.1	0.0	-0.1	-4.4	-0.6	-0.8	-1.7	-0.4	-0.3
S8	-2.0	0.0	-2.1	-1.5	-1.9	-0.6	-0.4	-2.0	-0.1	-0.3	-0.6	-0.3	0.0	-1.5
S9	-11.3	-2.0	-7.7	-5.3	-8.4	-8.8	-7.4	-1.7	0.0	0.1	-0.3	0.0	0.2	-2.3

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	Total
S10	-5.6	0.1	-4.6	-3.8	-4.6	-4.1	-3.6	-1.9	0.0	0.0	-0.4	0.0	0.3	-1.1
S11	-4.0	0.1	-4.3	-3.5	-4.1	-3.2	-3.0	-1.5	-0.1	-0.2	-0.2	-0.2	0.2	-1.4
S12	-7.8	-1.0	-5.9	-4.3	-5.5	-5.6	-4.7	-2.3	0.0	-0.1	-0.6	-0.2	0.2	-1.5
S13	-4.9	1.2	-4.0	-3.2	-4.0	-3.6	-3.1	-1.4	0.1	0.0	0.0	0.1	0.2	-0.8
Total	-6.7	-0.5	-0.6	-1.2	-0.9	-0.3	-0.4	-1.4	-0.9	-0.2	-0.7	-0.3	0.2	-1.0

Table 6.13 Change in AM Peak Origin-Destination Travel Times compared to the Do Minimum (minutes)

From the information in Table 6.13 the following points can be made:

- The greatest time savings are associated with trips to / from Waikanae Beach (Sector 9) and trips heading towards Wellington CBD (Sector 1);
- Most sector to sector movements experience travel time savings in the AM peak as a result of the proposed Expressway, with several movements experiencing increases in time savings of greater than 5 minutes;
- The magnitude of the travel time saving is generally greater for trips heading in the peak direction (north to south) than those heading in the counter-peak direction.
- Some sector to sector movements experience slight increases in average travel times as a result of the proposed Expressway;
  - Journeys between sector 13 (Peka Peka) and sectors 9 to 13 (Waikanae) – this is expected as the interchange between the proposed Expressway and SH1 at Peka Peka will result in slightly longer travel times for traffic heading between Peka Peka Road and the old SH1 (and vice-versa);
  - Journeys between sector 5 (Paraparaumu Town Centre) and sectors 6 and 7 (Paraparaumu Beach) – the slight increases presented above are not unexpected as the two additional sets of signals at the intersection of the proposed Expressway and Kāpiti Road will slightly increase travel times for traffic between Paraparaumu Town Centre and Paraparaumu Beach.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	Total
S1	0.0	-9.9	-3.3	-1.6	-3.5	-5.7	-4.7	-5.4	-13.6	-7.6	-6.9	-9.7	-7.9	-5.7
S2	-3.1	0.0	-1.5	0.0	-1.4	-4.1	-3.7	-0.5	-1.9	0.2	0.2	-0.9	0.7	-0.4
S3	-5.3	-5.4	-0.1	-1.9	-0.7	-0.4	-0.1	-2.3	-7.5	-4.6	-5.0	-5.6	-4.4	-0.8
S4	-0.2	-3.6	-1.4	-0.1	-0.3	-0.5	-0.4	-2.0	-4.0	-3.4	-3.9	-3.4	-3.3	-1.1

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	Total
S5	-5.7	-5.3	-0.7	-1.0	-0.1	0.1	0.2	-1.9	-7.7	-4.2	-4.6	-4.9	-3.9	-1.1
S6	-5.1	-7.2	-0.4	-0.8	-0.4	0.2	0.1	-1.5	-9.8	-5.4	-5.4	-6.6	-5.5	-0.7
S7	-5.0	-6.9	-0.1	-0.7	-0.1	0.1	0.0	-1.7	-9.3	-5.4	-5.6	-6.3	-5.3	-0.5
S8	-0.3	-1.7	-1.0	-0.5	-0.7	-0.6	-0.6	-2.4	-1.6	-1.6	-2.0	-2.3	-1.7	-1.4
S9	-7.8	-1.9	-4.7	-1.8	-5.1	-7.7	-6.9	-0.8	0.0	0.1	-0.3	0.1	0.1	-0.8
S10	-1.6	0.1	-2.0	-0.7	-1.3	-3.2	-3.4	-0.8	0.0	0.0	-0.5	0.0	0.2	-0.3
S11	-0.4	0.2	-1.6	-0.4	-0.9	-2.4	-2.9	-0.5	0.1	0.0	-0.1	0.0	0.3	-0.4
S12	-4.2	-0.9	-3.1	-1.0	-2.0	-4.6	-4.4	-1.4	0.0	-0.1	-0.5	-0.2	0.2	-0.5
S13	-0.8	0.9	-1.1	-0.1	-0.5	-2.5	-2.8	-0.5	0.1	0.2	0.2	0.2	0.1	0.1
Total	-3.8	-1.3	-1.0	-1.4	-0.8	-0.5	-0.4	-2.3	-2.1	-1.0	-2.3	-1.2	-0.7	-1.2

Table 6.14 Change in PM Peak Origin-Destination Travel Times compared to the Do Minimum (minutes)

From the information in Table 6.14 the following points can be made:

- Similar to the AM peak, the magnitude of the travel time savings is greater in the peak direction (northbound) than in the counter-peak direction (southbound);
- Waikanae Beach, the southern and north external sectors and Paraparaumu Town Centre experience the greatest improvements in travel times as a result of the proposed Expressway, with time savings of greater than 5 minutes for several origin-destination movements; and
- The same sector to sector movements that experience slight increases in travel times in the AM peak also experience similar increases in the PM peak for the same reasons.

6.8 Travel Times On Selected Routes

The origin-destination savings do not directly indicate the changes in speeds on specific routes, only the average of all routes used. Therefore the predicted travel time along a number of specified routes was calculated for the Do Minimum and the Option. The chosen routes are as follows:

- Poplar Avenue – The Esplanade to SH1;
- Raumati Road – Rosetta Road to SH1;
- Kāpiti Road – Marine Drive to Station Road level crossing;
- Rimu Road / Mazengarb Road – Hadfield Place to SH1;
- Te Moana Road – Tutere Street to Elizabeth Street level crossing;

- SH1 – Poplar Avenue to MacKays Crossing: and
- Expressway – Poplar Avenue to MacKays Crossing.

Figure 6.12 shows the travel time routes.

Figure 6.12 Travel Time Routes

Table 6.15 details the travel times along the selected routes in 2026 for the AM and PM.

Origin	Direction	Length (km)	DM AM	OPT AM	Absolute Change	% Change	DM PM	OPT PM	Absolute Change	% Change
Expressway	SB	16	-	9.4	-	-	-	9.4	-	-
	NB	16	-	9.4	-	-	-	9.4	-	-
SH1	SB	15	16.4	13.1	-3.3	-20%	12.6	12.8	0.2	2%
	NB	15	14.6	13.3	-1.3	-9%	20.2	13.6	-6.6	-33%
Te Moana Rd	WB	5	7.4	7.1	-0.3	-4%	7.7	7.4	-0.3	-4%
	EB	5	8.0	7.8	-0.2	-3%	7.6	7.7	0.1	1%
Rimu Rd – Mazengarb Rd	EB	6.5	16.8	10.5	-6.3	-38%	16.8	11.2	-5.6	-33%
	WB	6.5	9.2	8.7	-0.5	-5%	10.0	9.4	-0.6	-6%
Kāpiti Rd	EB	3.7	6.3	7.0	0.7	11%	6.8	6.9	0.1	1%
	WB	3.7	6.6	7.3	0.7	11%	6.6	7.3	0.7	11%

Origin	Direction	Length (km)	DM AM	OPT AM	Absolute Change	% Change	DM PM	OPT PM	Absolute Change	% Change
Raumati Avenue	EB	5	12.6	6.6	-6.0	-48%	11.1	6.6	-4.5	-41%
	WB	5	6.4	6.2	-0.2	-3%	6.8	6.3	-0.5	-7%
Poplar Avenue	EB	3	12.9	3.3	-9.6	-74%	6.6	3.5	-3.1	-47%
	WB	3	3.1	3.3	0.2	6%	5.4	3.5	-1.9	-35%

Table 6.15 2026 Travel Times (minutes) along Key Routes

From Table 6.15 it can be seen that in the AM peak the proposed Expressway provides a route that is approximately 7 minutes faster between Peka Peka and MacKays Crossing compared with the parallel SH1 route in the Do Minimum.

In the PM peak the proposed Expressway provides a route that is over 10 minutes faster than the parallel SH1 corridor, due to congestion within Paraparaumu and Waikanae town centres in the PM peak Do Minimum networks.

The travel time data shows that:

- AM peak travel times along SH1 (southbound) are 20% quicker in the Option than the Do Minimum;
- In the PM peak the northbound SH1 travel time is approximately 7 minutes slower than the northbound travel time in the Option;
- Travel times along Kāpiti Road increase slightly in the Option, as a result of traffic signals at the Kāpiti Road interchange; and
- Raumati Road, Poplar Avenue and Rimu Road / Mazengarb have improved travel times in the Option compared to the Do Minimum – this is most noticeable in the PM peak.

6.9 Travel Time Reliability

Although not directly forecast by the models (which predict average travel times), it is known that travel time variability increases as traffic levels approach the capacity of the network, as expected in this corridor. Therefore the significant increase in capacity provided as part of this Project is also expected to significantly improve travel time reliability. There is a proven link between congestion and reliability, i.e. in general, reduced congestion results in improved reliability, largely through reductions in Day to Day Variability (DTDV).

The introduction of the proposed Expressway not only provides increased capacity but alternative routes also. The proposed Expressway itself provides a north-south arterial and this is complimented by improved road connectivity and upgrades for east-west movements. Hence, there is greater route choice and resilience internal to and through the study area which is likely to contribute to improved travel time reliability.

The proposed Expressway improves travel times and reduces congestion throughout much of the study area due to the extra road capacity and alternative routes that are made available. The reductions in congestion levels on the existing SH1, as well the improved travel times, are therefore likely to improve travel time reliability along the MacKays to Peka Peka corridor.

6.10 Impact on HCVs

An assessment was undertaken to assess the potential effect of the routes taken by HCVs when the proposed Expressway is completed. Tables 6.16 to 6.18 below shows the changes in HCV traffic volumes as a result of the proposed Expressway.

Location on Expressway	2016 HCV Volume	2016 Total Traffic Volume	HCV % 2016	2026 HCV Volume	2026 Total Traffic Volume	HCV % 2026
South of Poplar Ave	3,170	23,100	14%	4,640	26,900	17%
Between Poplar and Kāpiti	1,640	12,100	14%	2,190	13,900	16%
Between Kāpiti and Te Moana	1,950	16,600	12%	2,760	20,700	13%
Betweeen Te Moana and Peka Peka	1,760	10,600	17%	2,560	12,700	20%
North of Peka Peka	2,060	13,500	15%	2,930	15,900	18%

Table 6.16: Volume and Per cent Heavy Vehicles on the Expressway in 2016 and 2026 (Vehicles per Day)

As summarised above the proposed Expressway is predicted to carry between 12 and 20% HCVs. This is consistent with the character of an Expressway and well within its capacity.

Location on Existing SH1	2016 DM	2016 OPT	2016 DM-OPT Change	2026 DM	2026 OPT	2026 DM-OPT Change
South of Poplar Ave	3,180	3,170	0%	4,650	4,640	0%
South Kāpiti Road	3,250	1,670	-49%	4,100	1,830	-55%
South of Otaihanga Road	2,930	1,210	-59%	3,470	1,300	-63%
South of Te Moana Road	3,050	1,100	-64%	3,960	1,200	-70%
North of Peka Peka Road	2,580	800	-69%	3,470	890	-74%

Table 6.17 HCV Daily Flows on SH1 (two-directional)

The Project is expected to significantly reduce the volume of heavy vehicles on SH1.

The impact of the Project on HCVs on other selected local roads is summarised below.

Location	2016 DM	2016 OPT	2016 DM-OPT Change	2026 DM	2026 OPT	2026 DM-OPT Change
Poplar Ave, East of Matai Rd	210	220	5%	240	250	4%
Matai Rd, South of Raumati Rd	140	130	-7%	180	170	-6%
Raumati Rd, West of Rimu Rd	780	720	-8%	1,310	1,130	-14%
Rimu Rd, South of Kāpiti Rd	900	840	-7%	700	590	-16%
Kāpiti Rd, West of SH1	1,140	860	-25%	1,710	850	-50%
Kāpiti Rd, West of Arawhata Rd	1,530	1,690	10%	1,900	1,880	-1%
Kāpiti Rd, West of Te Roto Dr	1,000	1,190	19%	1,390	1,870	35%
Arawhata Rd, North of Kāpiti Rd	280	330	18%	260	240	-8%
Te Roto Dr, North of Kāpiti Rd	990	1,020	3%	1,140	1,100	-4%
Realm Dr, North of Guildford Dr	310	240	-23%	440	280	-36%
Mazengarb Rd, East of Guildford Dr	580	480	-17%	840	500	-40%
Ratanui Rd, North of Mazengarb Rd	570	330	-42%	900	290	-68%
Otaihanga Rd, West of SH1	640	400	-38%	1,060	450	-58%
Te Moana Rd, West of SH1	490	250	-49%	560	270	-52%
Te Moana Rd, West of Walton Ave	370	330	-11%	410	370	-10%
Park Ave, North of Te Moana Rd	140	200	43%	150	210	40%
Paetawa Rd, South of Peka Peka Rd	90	110	22%	110	120	9%
Peka Peka Rd, West of SH1	110	50	-55%	130	60	-54%

Table 6.18: Change in Heavy Vehicles on Selected Local Roads in 2016 and 2026 (Vehicles per Day)

The results show that:

- HCV volumes along the old SH1 decline by around half following the completion of the proposed Expressway; and
- HCV volumes on local roads such as Te Moana Road, Otaihanga Road and Kāpiti Road also decline substantially.

6.11 Impacts on Total Vehicle Kilometres Travelled, Including Induced Traffic Effects

Table 6.19 shows the average hour vehicle kilometres travelled (VKT) by varying road types in 2026. These VKT statistics are aggregate across the whole Kāpiti network but reported by different road type.

	Morning Peak			Inter-peak			PM Peak		
Location	DM	OPT	Change	DM	OPT	Change	DM	OPT	Change
All Roads	100,100	104,500	4%	73,900	74,900	1%	99,200	104,900	6%
Expressway	15,800	43,700	177%	10,100	28,300	181%	13,600	40,900	200%
Arterial	70,900	47,700	-33%	52,800	35,600	-33%	71,500	49,900	-30%
Local / Rural	13,500	13,000	-3%	11,000	11,000	0%	14,200	14,100	-1%

Table 6.19 VKT by Road Type (2026)

Table 6.19 shows that there is a small increase in overall VKT throughout the study area across all time periods.

VKT on the roads categorised as 'Expressway,' which includes SH1 on the Raumati Straights, (the Peka Peka to Ōtaki North RoNs scheme is built to an Expressway standard and included in the Do Minimum) increases by over 175% between the Do Minimum and Option. VKT on rural roads remains roughly the same whilst VKT on arterial routes declines by 33%, as a result of traffic diverting from major arterial roads (such as SH1) onto the proposed Expressway.

6.12 Impacts on Total Vehicle Kilometres Travelled, No Induced Traffic Effects

Changes in the total amount of travel (VKT) are due to a combination of induced traffic (new or longer trips) and rerouting (where vehicles select a longer-distance but quicker route). To distinguish between these effects the Option models were re-run using the Do Minimum (suppressed) demands.

Table 6.20 shows the average hour vehicle kilometres travelled (VKT) by varying road types in 2026, following the removal of induced traffic from the Option figures.

	Morning Peak			Inter-peak			PM Peak		
Location	DM	OPT	Change	DM	OPT	Change	DM	OPT	Change
All Roads	99,600	98,200	-1%	73,500	72,600	-1%	98,800	97,800	-1%
Expressway	15,800	40,500	156%	10,000	26,800	168 %	13,600	37,700	177%
Arterial	70,600	45,200	-36%	52,600	34,900	-34%	71,000	46,700	-34%
Local / Rural	13,300	12,500	-6%	10,900	10,800	-1%	14,200	13,500	-5%

Table 6.20 VKT by Road Type, Induced Traffic Removed (2026)

Once the effects of induced traffic are removed, the Option results in approximately 1% to 2% fewer vehicle kilometres travelled across all times periods. This is partly due to the proposed Expressway providing a shorter route for many trips (such as from Waikanae Beach to the South) and partly due to a reduction in congestion in Paraparaumu Town Centre, meaning journeys that used to bypass congested locations (leading to longer but faster travel times) will now be able to travel by the most direct route, thereby reducing the travel distance.

6.13 HCV Total Daily Vehicle Kilometres by Road Type

Table 6.21 displays the daily VKT travelled by HCVs on the varying road types. This shows the same patterns as can be seen in Table 6.16, with the HCV VKT increasing on proposed Expressway with the introduction of the Project, and a decrease seen on the arterial and local/rural roads.

Location	2010	2016 DM	2016 OPT	Change	2026 DM	2026 OPT	Change
All Roads	192,000	221,000	220,000	0%	297,000	295,000	-1%
Expressway	-	42,000	109,000	157%	60,000	155,000	158%
Arterial	176,000	159,000	93,000	-42%	209,000	113,000	-46%
Local / Rural	16,000	20,000	19,000	0%	28,000	26,000	-7%

Table 6.21 HCV Daily VKT by Road Type

6.14 Induced Traffic

The construction of the proposed MacKays to Peka Peka Expressway provides a new, high quality route running north to south through the study area. The proposed Expressway improves travel times and reduces congestion throughout much of the study area due to the extra road capacity that is made available. These induced trips will include newly created trips, as well as trips that change their destination, travel modes or time of travel. The model estimates that around 3,000 of the 24,000 daily vehicle trips using the proposed Expressway are due to induced traffic.

The regional model does not generate purely 'new' trips; such trips come from the redistribution of existing trips, modal-shift and from time shifting. WTSM retains the total number of person trips when different options are tested, but the amount of car trips changes. The additional car trips are not 'new' trips - they are existing person trips changing their origin / destination, time of travel, mode of travel or frequency travel.

As the Project assignment model is not a demand model it does, in effect, generate new trips. This response, however, has been calibrated to replicate the highway response of the regional model where the total number of trips does not change between Do Minimum and Option scenarios. Therefore the method chosen for this Project, and agreed with both NZTA and the independent peer reviewer, is a proxy for changes in demand as a result of land use changes, re-distributional impacts, modal shift and time of day shift.

Figure 6.13 and Figure 6.14 are daily flow difference plots showing both the Option and Do Minimum matrices assigned to a common (Option) network. The rationale behind this test is that by having a common network, any changes in flows between the Option and Do Minimum due to changes in travel costs should be negligible, as the supply networks are the same. Thus changes in flows in Figure 6.13 and Figure 6.14 are solely due to induced traffic.

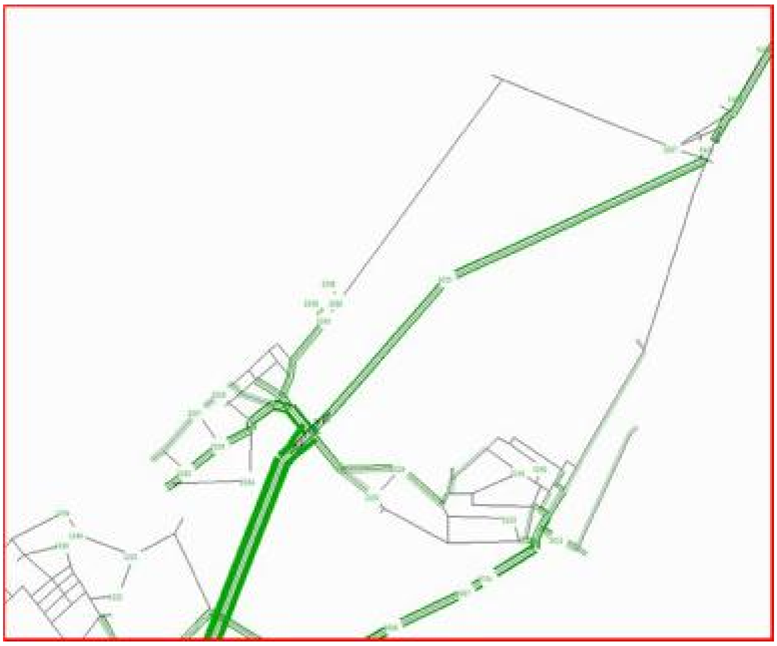


Figure 6.13 Daily Induced Vehicle Traffic – Waikanae Area, 2026

Figure 6.14 Daily Induced Vehicle Traffic – Paraparaumu Area, 2026

The following comments can be made from Figure 6.13 and Figure 6.14:

- The greatest induced traffic volumes are seen on the proposed Expressway between Waikanae Beach and Paraparaumu, as travel costs (both in terms of time and delay) are substantially reduced by the completion of the proposed Expressway; and
- There are lower levels of induced traffic associated with trips to and from the north (Levin / Ōtaki) and the south (Wellington).

Table 6.22 below shows changes in daily flows along key routes between the Option and Do Minimum matrices assigned to a common (Option) network.

Location	DM Demand	OPT Demand	Change	% Change
Expressway – Peka Peka to Te Moana Rd	10,700	11,300	600	5%
SH1 – Peka Peka to Waikanae	9,300	9,400	100	0%
Expressway – Kāpiti Rd to Te Moana Rd	16,700	19,400	2,700	14%
SH1 – North of Otaihanga Rd	13,100	13,800	800	6%
Expressway – Kāpiti Rd – MacKays Crossing	12,100	12,800	700	6%
SH1 – South of Raumati Rd	13,800	14,000	200	1%
Te Moana Rd (North of Expressway)	9,300	10,700	1,400	13%
Te Moana Rd (South of Expressway)	9,200	9,800	600	6%
Kāpiti Rd (North of Expressway)	21,300	21,300	0	0%
Kāpiti Rd (South of Expressway)	29,000	29,100	100	0%

Table 6.22 Comparison of Daily Flow between Do Minimum and Option Matrices assigned to the Option Network (2026)

The following comments can be made from Table 6.22:

- The greatest level of induced traffic (circa 2,700 vpd) occurs along SH1 / proposed Expressway between Paraparaumu and Waikanae, i.e. Kāpiti Road (Paraparaumu) to Te Moana Road (Waikanae);
- Te Moana Road sees high levels of induced traffic, particularly to the north of the proposed Expressway interchange associated with Waikanae Beach; and
- Induced traffic volumes on the proposed Expressway are greater along the southern section of the road, between Kāpiti Road and MacKays Crossing, than they are on the Northern section of the road, between Te Moana Interchange and Peka Peka.

6.14.1 Summary of Induced Traffic Effects

When only looking at traffic using one or more sections of the proposed Expressway, 12% of daily Expressway users are induced trips, the remaining 88% of users travelling along the proposed

Expressway due to enhanced route choice opportunities and improved travel times relative to the Do Minimum scenario. The percentage of induced trips relative to existing trips will vary for each section of the proposed Expressway; those sections that have the greatest absolute or percentage decreases in costs between the Do Minimum and Option will see a greater percentage of induced traffic compared with those sections for which the change in costs between the Do Minimum and option is minimal.

From previous analysis comparing changes in vehicle kilometres travelled (VKT) in the Option with induced traffic included and without induced traffic included, in daily terms induced traffic results in a 4% to 5% increase in vehicle kilometres travelled.

At a daily level the difference in vehicle trips between the Option and Do Minimum matrices (daily totals of which have been derived from Table 5.10 2016 Option and Do Minimum Matrix Totals); induced traffic comprises approximately 3% of total trips.

6.15 Public Transport

As mentioned above, the induced traffic (new trips) will be generated by a number of demand responses operating at the same time:

- The redistribution of existing trips to new origins and destinations;
- Changes in mode choice between PT, car and other modes (cycle, walk) in relation to changes in trip costs; and
- Changes to the time period during which a journey is made due to changes in trip costs (i.e. shifting from the Inter-peak to AM peak if congestion in the AM peak is reduced).

Current public transport provision within the area includes an internal bus network within both Paraparaumu and Waikanae (but no bus service connecting the two settlements) and a direct rail service from Waikanae to Paraparaumu and onwards to Wellington. The rail service has recently been enhanced - previously the service only extended up the coast as far as Paraparaumu.

Under current highway conditions, rail is a viable alternative to car for travel between the Kāpiti Coast and Wellington CBD, especially during the peak commuter periods. With the advent of the proposed Expressway and the consequent improvement in road accessibility it is expected that the public transport modal share of trips between Kāpiti District and Wellington CBD will decrease.

Table 6.23 presents daily public transport trips by origin and destination for WTSM zones within Kāpiti District for the Do Minimum and Option (with Expressway) scenarios. These results are from the WTSM multi-modal model.

WTSM Zone	Locality	Origins			Destinations		
		Do Min	Option	% Diff	Do Min	Option	% Diff
Raumati South	Raumati	450	440	-2%	390	380	-3%
Raumati Beach	Raumati	490	480	-2%	480	470	-2%
Paraparaumu Central	Paraparaumu	530	510	-5%	550	520	-6%
Paraparaumu Central	Paraparaumu	500	440	-11%	480	420	-13%
Paraparaumu Central	Paraparaumu	430	440	0%	360	360	-1%
Paraparaumu Beach South	Paraparaumu	420	410	-2%	380	370	-2%
Paraparaumu Beach North	Paraparaumu	570	550	-4%	580	550	-5%
Otaihanga	Paraparaumu	140	140	0%	110	110	0%
Waikanae Beach	Waikanae	360	270	-26%	310	230	-25%
Waikanae West	Waikanae	780	710	-9%	650	600	-8%
Waikanae East	Waikanae	260	230	-11%	220	200	-9%
Kaitawa	Ōtaki	70	70	-9%	60	60	-9%
Te Horo	Ōtaki	130	120	-9%	100	100	-9%
Ōtaki	Ōtaki	390	370	-4%	340	330	-4%
Ōtaki	Ōtaki	100	100	-8%	80	80	-8%
Ōtaki Forks	Ōtaki	20	20	-3%	20	20	-4%
Total		5,660	5,290	-6%	5,120	4,780	-7%

Table 6.23 Daily Public Transport Demand By Zone, Kāpiti District, 2026

Overall public transport demand presented in Table 6.23 decreases between the Option and Do Minimum by approximately 6 to 7%. At a zonal level the percentage decrease is most pronounced for areas such as Waikanae Beach and Waikanae East as users in these areas have the most to gain from the proposed Expressway in terms of improved highway travel times.

Table 6.24 and Table 6.25 below show matrices of daily public transport trips for the Option and Do Minimum. The 'External' category covers all areas outside of the study area, although the majority of external trips will be associated with Wellington CBD.

It can be seen from Table 6.24 and Table 6.25 that approximately two-thirds of all public transport trips have either their origin or destination outside of the study area.

Origin	External	Raumati	Paraparaumu	Waikanae	Ōtaki	Total
External (Porirua, Wellington)	-	390	940	650	300	2,270
Raumati	470	100	270	90	10	940
Paraparaumu	1,120	260	660	390	80	2,510
Waikanae	750	20	390	110	50	1,310
Ōtaki	410	10	90	50	160	710
Total	2,750	770	2,340	1,280	600	7,740

Table 6.24 Do Minimum Matrix of Public Transport Daily Trips, 2026

Origin	External	Raumati	Paraparaumu	Waikanae	Ōtaki	Total
External (Porirua, Wellington)	-	380	920	550	280	2,130
Raumati	460	100	260	90	10	920
Paraparaumu	1,110	250	650	330	60	2,410
Waikanae	640	20	310	110	50	1,130
Ōtaki	380	10	70	50	170	670
Total	2,590	750	2,210	1,130	570	7,250

Table 6.25 Option Matrix of Public Transport Daily Trips, 2026

Table 6.26 shows what percentage of the overall decrease in daily public transport trips between the Option and Do Minimum can be attributed to each individual sector to sector movement. Trips between Waikanae and outside of the study area comprise 24% of the overall decrease in trips. Trips between Waikanae and Paraparaumu comprise a further 27% of the overall decrease in trips. Overall the proposed Expressway results in a 6% to 7% decrease (490 persons) in public transport trips associated with the Kāpiti Coast.

Origin	External	Raumati	Paraparaumu	Waikanae	Ōtaki	Total
External (Porirua, Wellington)	-	1%	3%	18%	6%	28%
Raumati	1%	0%	2%	1%	0%	4%
Paraparaumu	1%	2%	3%	12%	3%	21%
Waikanae	24%	0%	15%	-2%	0%	37%
Ōtaki	7%	0%	4%	0%	-2%	9%
Total	34%	3%	26%	30%	7%	100%

Table 6.26 Percentage of Total Change in Daily Public Transport Trips between Option and Do Minimum by Sector, 2026

WTSM Model Public Transport Modal Share

Table 6.27 and Table 6.28 overleaf outlines the daily public transport modal share for both the 2026 Do Minimum and 2026 Option (i.e. with Expressway) scenarios respectively. These results are from the WTSM multi-modal model and for simplicity a car occupancy factor of 1.2 has been applied to the car trips for each sector to convert into person trips (hence the public transport matrices are already in person trips).

Origin	External	Raumati	Paraparaumu	Waikanae	Ōtaki	Total
External (Porirua, Wellington)	-	15%	15%	20%	6%	13%
Raumati	16%	1%	4%	22%	13%	5%
Paraparaumu	17%	4%	2%	9%	9%	5%
Waikanae	23%	17%	18%	1%	4%	5%
Ōtaki	8%	13%	11%	4%	1%	4%
Total	15%	5%	5%	5%	3%	6%

Table 6.27 – 2026 Do Minimum Public Transport Modal Share

Origin	External	Raumati	Paraparaumu	Waikanae	Ōtaki	Total
External (Porirua, Wellington)	-	15%	15%	16%	5%	13%
Raumati	15%	1%	4%	15%	11%	5%
Paraparaumu	17%	4%	2%	6%	7%	4%
Waikanae	19%	10%	9%	1%	3%	5%
Ōtaki	7%	11%	8%	3%	1%	3%
Total	14%	5%	4%	4%	3%	5%

Table 6.28 – 2026 Option Public Transport Modal Share

Table 6.27 and Table 6.28 show a similar pattern in public transport modal share across most movements. The differences between the Option and Do Minimum are shown below in Table 6.29 and are explained below.

Origin	External	Raumati	Paraparaumu	Waikanae	Ōtaki	Total
External (Porirua, Wellington)	-	0%	0%	-4%	-1%	-1%
Raumati	-1%	0%	0%	-7%	-2%	0%
Paraparaumu	0%	0%	0%	-3%	-2%	0%
Waikanae	-4%	-7%	-9%	0%	-1%	-1%

Origin	External	Raumati	Paraparaumu	Waikanae	Ōtaki	Total
Ōtaki	-1%	-2%	-3%	-1%	0%	0%
Total	-1%	0%	-1%	-1%	0%	0%

Table 6.29 – Percentage Change between 2026 Option and 2026 Do Minimum

It can be seen from Table 6.29 the largest decreases in public transport modal share as a result of the proposed Expressway in place, occur for movements from the Waikanae sector to Paraparaumu (-9%) and Raumati (-7%). These decreases appear reasonable given the improved road accessibility the proposed Expressway is likely to bring to trips making these movements. In addition, Public transport trips between Waikanae and Paraparaumu must be made by rail, with a transfer to local Waikanae or Paraparaumu bus routes depending on the origin/destination. Hence, the relative attractiveness of public transport for this movement is less when compared to road.

Furthermore, there is a decrease from all sectors to areas outside the study area, i.e. towards Porirua and Wellington. Note that in the Table 6.29, PT modal share from Paraparaumu is noted as 0%. However, there is a small reduction (-0.2%) but this is lost when rounding. As mentioned in the introduction to this section, with the proposed Expressway in place, and consequent road accessibility improvements, it is expected that the public transport modal share of trips between Kāpiti District and Wellington CBD will decrease.

There are certain movements which see no material change in public transport modal share, namely, intra-sector movements (ie movements within the same sector). This result appears intuitive since with the proposed Expressway in place, trips which will benefit the most are likely to be longer distance trips travelling through the Kāpiti District.

6.16 Trip Length Distribution

Table 6.30 shows the average vehicle trip length by time period for the base year, 2026 Option and 2026 Do Minimum (from the KTM2). The average trip length declines between the base year and forecast year in the Inter-peak and PM peak and increases slightly in the AM peak. This is because whilst longer distance trips are attracted to the proposed Expressway in the future due to reduced travel times (and network improvements elsewhere in the Wellington Region due to the other proposed ‘RoNS’ schemes), shorter distance trips are also generated by the major new proposed developments in Paraparaumu and Waikanae.

Between the Option and Do Minimum the average trip length remains very similar, showing that the induced traffic comprises both short and long distance trips.

Time Period	Base (2010)	DM (2026)	OPT (2026)
AM	11.9	12.2	12.2
IP	10.1	9.4	9.4
PM	12.2	11.7	11.7

Table 6.30 Average Vehicle Trip Length across the Kāpiti Study Area

Table 6.31 shows the average trip length for trips using the proposed Expressway. It is broken down into the 3 sections:

- Section 1 (Northern) – Peka Peka to Te Moana Road (and vice versa)
- Section 2 (Middle) – Te Moana Road to Kāpiti Road (and vice versa); and
- Section 3 (Southern) – Kāpiti Road to MacKays Crossing (and vice versa).

Section 2 has the shortest average trip length; this is reasonable as this segment of the proposed Expressway will have a higher percentage of local trips (between Waikanae and Paraparaumu) than the northern and southern sections.

Section	AM	IP	PM
Section 1 (Northern)	44.9	45.2	46.4
Section 2 (Middle)	35.6	34.2	37.0
Section 3 (Southern)	51.3	51.3	50.8

Table 6.31 Average Vehicle Trip Length for Expressway Users, 2026

7 Kāpiti Road Operational Model

7.1 Overview

Operational models have been developed to provide an assessment of the future year traffic performance along the Kāpiti Road corridor between the intersections of Kāpiti Road with Te Roto Drive and Arawhata Road. The performance of the road corridor has been assessed using VISSIM, an industry standard micro-simulation package. Micro-simulation models represent vehicles individually, allowing interaction effects between vehicles and with the roading environment to be simulated, and therefore is seen to be highly appropriate for operational assessments of this type of Project. This level of detailed modelling was considered necessary at this location due to the closely-spaced intersections and the likely interaction between them, which would require a greater level of precision than is possible in the KTM2 model.

The micro-simulation models cover two, one-hour weekday time periods:

- AM Peak Hour – 08:00-09:00; and
- PM Peak Hour – 17:00-18:00.

Model warm-up and cool-down periods have been applied before and after the first and last 15 minutes for each time period respectively, which allows traffic in the network to reach a state which represents the condition at the start of the peak hours.

The remainder of this section of the report provides a brief overview of how the future year models were developed and a summary of the results which highlight the forecast travel conditions along the Kāpiti Road study corridor. Conclusions have been drawn as a result of the modelling which shall inform the design and the future operation with the development proposals in place.

7.1.1 Model extent

The geographical coverage of the model is such as to capture the effects of the proposed changes to the road network in the study area, i.e. on the Kāpiti Road corridor in the vicinity of the proposed new interchange. The model is also able to assess the effects of the future town centre connection in the option and 'do-minimum' models. Figure 7.1 highlights the extent of the road network which has been modelled.

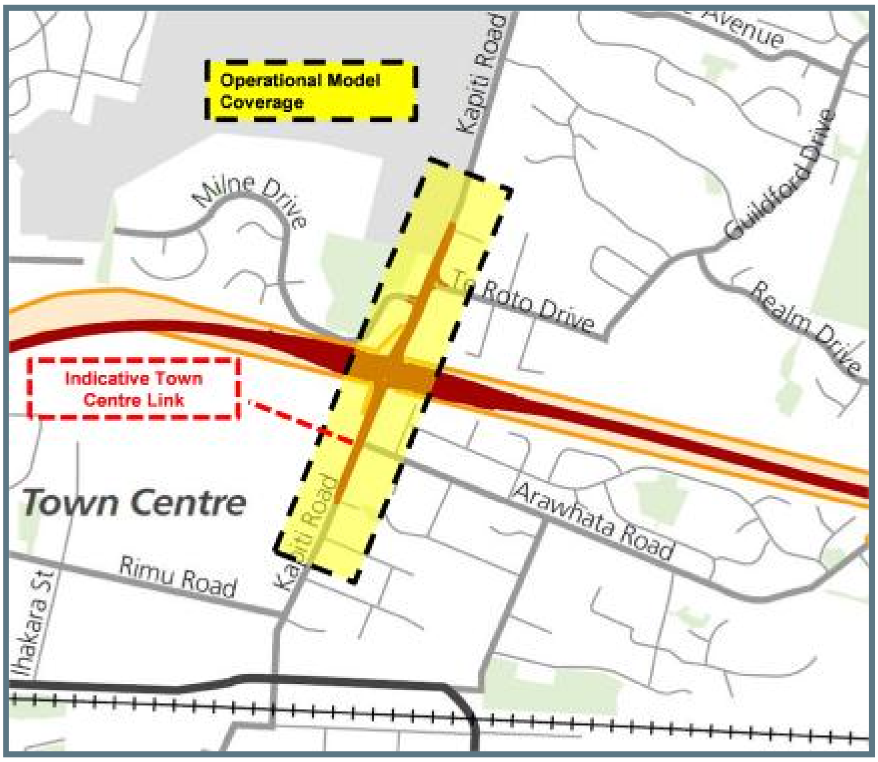


Figure 7.1: Operational Model Geographical Coverage

7.1.2 Model scenarios

The assessment identifies the traffic conditions based on a do-minimum (DM) and an option (OPT) scenario for the future years of 2016 and 2026. Road network arrangements and intersection layout details for each of the aforementioned scenarios are listed below:

- DM 2016. This scenario retains all existing (2011) intersection layouts and assumes no changes to the road corridor, within the extent of the operational model.
- DM 2026. This scenario is as per the 2016 DM network, with the introduction of the Arawhata Road extension which creates a connection between Kāpiti Road and the Paraparaumu town centre. The new Kāpiti Road/Arawhata Road intersection will be signalised.
- OPT 2016. The 2016 OPT scenario is based on the 2016 DM network, but includes two signalised intersections which connect Kāpiti Road to the proposed Expressway on and off ramps.
- OPT 2026. This scenario is based on the 2026 DM scenario, but includes the two signalised Kāpiti Road/ M2PP Expressway ramps intersections.

Figure 7.2 provides a diagrammatical representation of the differences between each scenario.

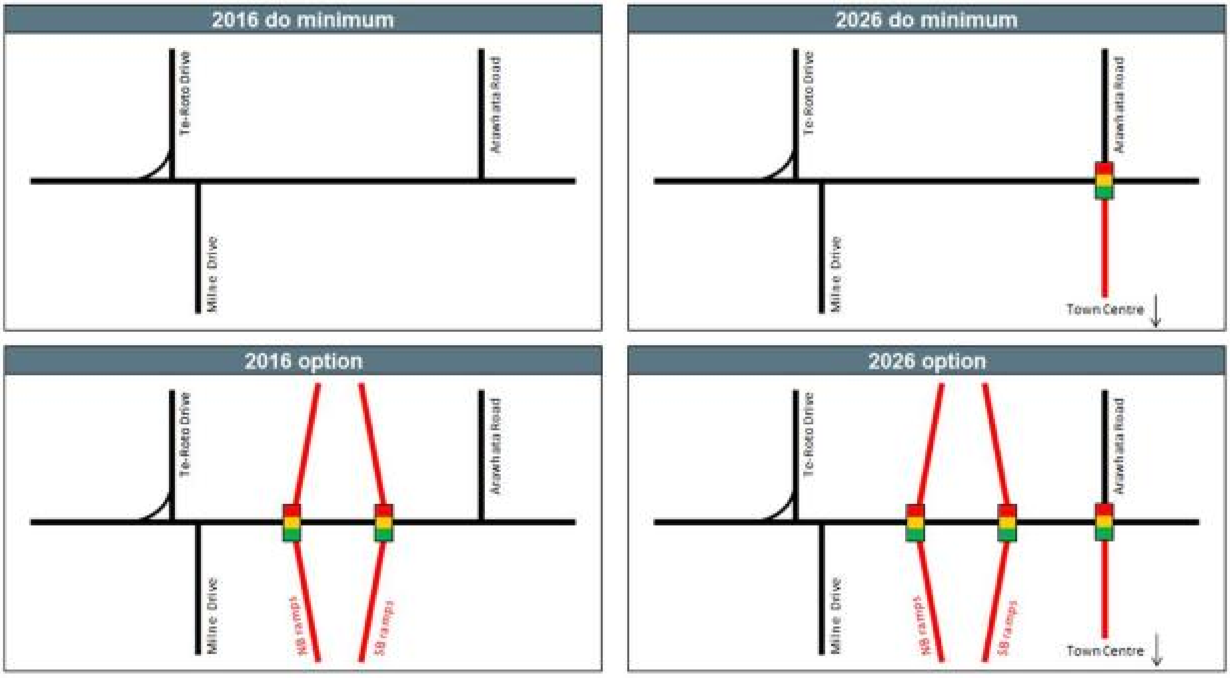


Figure 7.2: Future year model scenarios

7.2 Model Inputs

7.2.1 Base year model

Prior to the investigation of future year network performance, a base model (year 2010) was developed so that key parameters such as gap acceptance and headway distance, which are often specific to geographical locations, could be determined for use within future year models. Traffic flow and travel time survey data was used to validate and calibrate the base model. Based on model observations and a review of the model outputs, it can be concluded that the base 2011 model reflected to a high standard the observed conditions within the study area.

Further details regarding the base model validation and calibration are reported in the *'MacKays to Peka Peka Base Year Micro Simulation Model Validation Report'.*

7.2.2 Matrices

The 2010, 2016 and 2026 KTM2 (SATURN) cordon matrices were used as the key inputs in the development of the future year AM and PM peak VISSIM input matrices. The KTM2 is a wide area Project model, so accuracy at individual turning movement level will not be as high as needed for corridor model.

The 2010 base demand matrices were taken from the KTM2 model; however, as stated in the base model validation and calibration report, manual modifications to these demand matrices were made using the surveyed traffic flow data, for the base flow validation process. This provided the base 2010 VISSIM matrices.

A process was then undertaken to include the base-model calibration adjustments to the future years. The first step in the adjustment process was to make a comparison between 2010 VISSIM matrix and the 2010 KTM2 cordon matrix. The absolute (additive) and percentage (multiplicative) differences between these two matrices were then established. A half additive and half multiplicative methodology was adopted for adjusting the future demand matrices based on the differences between the KTM2 2010 cordon matrix and the VISSIM 2010 demand matrix.

The 'additive' methodology applies absolute change in trip numbers in 2010 demand matrices (KTM2 and VISSIM) to the future year matrices. The 'multiplicative' methodology includes applying the ratio of the 2010 changes to the future year matrices. The half additive and half multiplicative methodology thus applied a weighted average of the additive (50%) and multiplicative (50%). The formula used is shown below:

$$T1\,F = (TF * F2010/P2010) * 0.5 + (TF + F2010 – P2010) * 0.5$$

Where:

T1F = Final Future Year Trips

TF = Raw KTM2 Future Year Trips

F2010 = Final 2010 Matrix (VISSIM Matrix)

P2010 = Prior 2010 Matrix (KTM2 Matrix)

The half additive and half multiplicative approach to matrix adjustment was used as it is believed that this would produce the most representative future year model. Note that this is what was proposed in the variable trip matrix work carried out by the Wellington Modelling Panel, "Variable Trip Matrix Approaches in Wellington, SKM Final Report, 17 October 2011."

It is noted that additional zones were added to the future year models to represent the proposed Expressway interchange with the demands at the on/off ramps taken directly from the KTM2 cordon matrices.

7.2.3 Signal Timings

In order to optimise the signal operations within the VISSIM models, additional models were created using the LINSIG modelling package. LINSIG models allows for the optimisation of signal timings to reduce delay or increase capacity at an intersection or a group of interlinked intersections.

The modelled network was replicated within LINSIG using the same traffic flows that have been used for the VISSIM models to obtain signal timings that were then exported into the VISSIM models with fixed cycle and phase times over the one hour modelled period. Refinement of these phase times were then made in the VISSIM models to further optimise the signal timings to allow for the upstream and downstream effects of the road network modelled in VISSIM, on the individual intersections. It is noted that pedestrian movements and crossings have been taken into consideration within all models. The signal cycle lengths modelled in all scenarios and all signalised intersections is 90 seconds. The signals were coordinated for the peak direction movement on Kāpiti Road in the AM (eastbound) and PM (westbound) models, to provide for efficient operation of the road network.

7.2.4 Vehicle Classes and Flow Profiles

Vehicles within the VISSIM model are split into light (primarily car) and heavy (HCV) vehicles. Six matrices have been setup for each of these two groups to present traffic volume distribution in 15 minute periods (including warm-up and cool-down periods). 15-minute matrices for each future year model have been derived using the same peak hour to 15-minute profile as used in the base model.

7.3 Assessment Criteria

7.3.1 Level of Service

The Level of Service (LoS) for each intersection in the corridor has been assessed for each approach. The performance criteria for intersections (signalised and unsignalised) and their definitions have been taken from the Highway Capacity Manual (HCM 2000) and are as follows:

LoS	Signalised	Unsignalised	Definition
A	≤10 sec	≤10 sec	Free flow operations with vehicles completely unimpeded to manoeuvre within the traffic stream. Minimal control delays at signalised intersections.
B	10-20 sec	10-15 sec	Relatively unimpeded operations. Only slight restrictions with manoeuvrability within the traffic stream with no significant control delays at signalised intersections. 70% of the free flow speed (FFS) for the given street class.
C	20-35 sec	15-25 sec	Stable operations however, manoeuvrability and lane changings in mid-block sections is more restricted than at LoS B. 50% of the FFS for the given street class.
D	35-55 sec	25-35 sec	Small increases in flow may cause significant increase in delay and decrease in travel time. Average travel speeds are around 40% of FFS.
E	55-80 sec	35-50 sec	Significant delays with average speeds of 33% or less of the FFS. High volumes and extensive delays at critical intersections.
F	≥80 sec	≥50 sec	Intersection congestion with high delays and volumes, and extensive queuing. Average travel speeds around 25-33% of the FFS.

Table 7.1 – LoS criteria for Intersection – Average Delay per Vehicle

Table 7.1 indicates the LoS criteria based on average delays per vehicle at a signalised or priority (unsignalised) intersection.

The LoS for each movement at an intersection and for overall intersection was determined based on the flows and average delays calculated. The intersection LoS for a signalised intersection is based on the weighted average of the flows and delays for all movements at the intersection.

However, it is noted that the overall intersection LoS analysed based on average delays for all movements are not considered appropriate at priority-controlled intersections. This is because the intersection includes priority movements which experience no or very little delays and carry high volumes of traffic, which generally improves the LoS at an intersection, even if the minor arm movement(s) experience significant delays. Therefore, the overall intersection LoS has been assessed as weighted-average excluding the priority movements (Kāpiti Road through eastbound and westbound movements).

7.3.2 Queue Lengths

Queue lengths at key approaches of modelled intersections have been collected recorded as maximum and average queue lengths over the one hour modelled period, for all vehicle types.

7.3.3 Design Criteria

The NZTA and Kāpiti Coast District Council (KCDC) developed a set of objectives for the Project which are set out in the document Guiding Objectives for the Alliance Board (Guiding Objectives).

The Guiding Objectives include a number of transportation-related objectives and two of which are considered relevant for this micro-simulation modelling works undertaken are listed below.

- (3) Levels of Service:
  - (b) Level of Service 'C' is achieved at the intersections between the proposed Expressway and local network [in the year 2026].
  - (c) that the overall network operates to significantly improve travel times.

It is noted that these guiding objectives relate to the interchange (the signals at the ramps) only and not Te Roto Drive / Kāpiti Road, Milne Drive / Kāpiti Road and Arawhata Road and Kāpiti Road intersections.

7.3.4 Model Output

The reported results for queues and delays are based the outputs of 10 model runs undertaken with different random seeds to represent the stochastic (random) behaviour inherent in a micro-simulation model. This ensures that the arrival of vehicles and their behaviour and interactions within the model network differ to a certain degree between each model run.

7.4 2016 Do Minimum

The average delay per vehicle and the LoS results for each movement and the intersection are shown in Table 7.2 below.

Intersection	Arm	Movement	AM peak Ave Delay (s)	AM peak LoS	PM peak Ave Delay (s)	PM peak LoS
Kāpiti Rd/Te Roto Drive	Kāpiti Rd West	Left	0	A	9	A
		Through	1	A	25	C
	Te Roto Drive	Left	12	B	196	F
		Right	56	F	246	F
	Kāpiti Rd East	Through	2	A	6	A
		Right	11	B	11	B
Average of Controlled Movements (Intersection)			16	C	100	F
Kāpiti Rd/Milne Drive	Kāpiti Rd West	Through	0	A	0	A
		Right	19	A	68	F
	Milne Drive	Left	7	B	375	F
		Right	69	F	1426	F
	Kāpiti Rd East	Left	0	A	0	A
		Through	1	A	2	A

Intersection	Arm	Movement	AM peak Ave Delay (s)	AM peak LoS	PM peak Ave Delay (s)	PM peak LoS
Average of Controlled Movements (Intersection)			24	C	203	F
Kāpiti Rd/Arawhata Rd	Kāpiti Rd West	Left	1	A	1	A
		Through	0	A	0	A
	Arawhata Rd East	Left	1	A	3	A
		Right	23	C	50	D
	Kāpiti Rd East	Through	0	A	0	A
		Right	8	A	8	A
Average of Controlled Movements (Intersection)			6	A	11	B

Table 7.2 - 2016 Do-Min Model: Average Delay and LoS Results

The following key observations are noted for the AM and PM 2016 Do-Minimum models:

- Large volumes of eastbound traffic wait to turn right into Milne Drive (from Kāpiti Road west) and block back across the Te Roto Drive intersection. This effect is due to the limited length of the turning bay, meaning that vehicles are unable to find appropriate gaps in the westbound through traffic stream, in order to make the right turn. This then creates increased delays for left turning traffic from Te Roto Drive who are looking to continue along Kāpiti Road or manoeuvre into the turning bay to make the right turn into Milne Drive.
- The Milne Drive arm of the intersection experiences LoS F for both peak periods. In the PM peak, the right turn traffic at the Milne Drive approach records delays of over 20 minutes which highlights the long duration of continuous through traffic along Kāpiti Road. It is noted that the majority of motorists in reality would not queue for such a long period of time and would re-route prior to arriving at the intersection or re-time their trip. As this is a micro simulation model which does not include the wider area network, the rerouting effect could not be modelled. However, even with a degree of rerouting, the intersection is expected to experience large delays.
- Right turning traffic at Milne Drive is delayed further due to a heavy volume of traffic on Kāpiti Road waiting to turn into Milne Drive. During the PM peak, the delay is significantly higher than the AM peak due to higher volume of westbound traffic on Kāpiti Road.
- High volumes of through westbound traffic create delays for right turning traffic from Arawhata Road, which attempts to merge with this through traffic. For the AM and PM peak hours this movement achieves a level of service of C and D respectively.
- Eastbound through traffic on Kāpiti Road at Te Roto Drive intersection experiences greater delays when compared to the left turn movement at this approach. This is considered to be due the downstream queues blocking back from the right turn bay at Milne Drive intersection, as discussed above.

The travel times and average speeds along Kāpiti Road in the westbound and eastbound direction in the study corridor is shown in Table 7.3 below.

Travel Time (s) (Average Speeds (kph)) Along Kāpiti Road Corridor		
Direction of Travel	AM Peak	PM Peak
Kāpiti Road - Westbound	40 (48)	43 (49)
Kāpiti Road - Eastbound	38 (50)	38 (50)

Table 7.3 - 2016 Do-Minimum Model: Average Travel Times and Average Speeds along Kāpiti Road Modelled Corridor

The average travel times for vehicles were measured between the mid-sections of Arawhata Road and Arko Place intersections. Table 7.3 indicates that the travel times in both models are similar in each direction of travel. The average speed along the modelled corridor is as the posted speed limit (50kph) is both directions, in the AM and PM peaks, which indicate that the through vehicles are travelling along the corridor without any added delays.

Queue lengths were recorded for the critical movements on Kāpiti Road. The critical movements for which the queue data was recorded for are the right turn movements at Te Roto Drive and Milne Drive intersections. These two movements were considered critical because the model demands and observations indicate that high volumes of right turning traffic turn at these intersections and block back from the turning bays onto Kāpiti Road. The queue length data was therefore recorded to determine whether the right turning traffic may impact upstream intersections and other movements at the intersection.

This data was recorded as the queue extending back from the stop line on each intersection approach. The available length for queuing without impacting on upstream intersections has been determined from the models and these are shown as the 'critical queuing length' in the Table 7.4 overleaf.

				AM Peak		PM Peak	
Intersection	Approach	Movement[9]	Critical Queuing Length (m)	Average (m)	Max (m)	Average (m)	Max (m)
Kāpiti Rd/Te Roto Drive/Mile	Kāpiti Road East at Milne Drive	Right Turn into Milne Drive	70	8	247	222	517

[9] Queue lengths are recorded from a give way/stop line at a priority intersection and from a limit line at a signalised intersection. Therefore, for the above scenario the through movements at Te Roto Drive and Milne Drive intersections have not been recorded as they are priority movements and do not stop for or give way to other movements at the intersections.

Intersection	Approach	Movement[9]	Critical Queuing Length (m)	AM Peak Average (m)	AM Peak Max (m)	PM Peak Average (m)	PM Peak Max (m)
Drive	Kāpiti Road West at Te Roto	Right Turn into Te Roto Drive	50	11	207	183	219

Table 7.4 - 2016 DM Model: Queue Length Results

The critical queue length of 70m and 50m is the length of the right turn bays (from the give way line to the end of the right turn bay) at Milne Drive and Te Roto Drive intersections, in the eastbound and westbound direction respectively. In both AM and PM models, it is observed that vehicles that want to turn right into Milne Drive from Kāpiti Road (west), block back from the turning bay and impede the through eastbound movement traffic. The PM peak is expected to experience significant delay for the right turning traffic with queues expected to extend to a maximum length of around 500m.

The queue length for right turning traffic into Te Roto Drive from Kāpiti Road east is expected to extend to a maximum of around 200m, meaning it will exceed the critical queuing length and impede the traffic travelling through on Kāpiti Road and waiting to turn into/out of Milne Drive intersection. This effect is also partially caused by the location of pedestrian signals just west of the Te Roto Drive intersection.

The results indicate that the average and maximum queue lengths exceed the critical queuing lengths at these approaches over the entire one hour modelled period.

7.4.1 Summary of 2016 Do-Minimum Performance

The 2016 DM results indicate that with the expected demands accessing the study network, some movements at intersections along the Kāpiti Road corridor, within the modelled network will be operating at a LoS D, E and F (during PM peak). During the AM peak hour period these intersections are predicted to operate at LoS A. The movements that are most affected by the increase in traffic volume on the road network (compared to the existing) are the right turning movements at the Te Roto Drive and Milne Drive intersections on Kāpiti Road.

7.5 2016 Option

The average delay per vehicle and the LoS results for each movement and the intersection are shown in Table 7.5.

Intersection	Arm	Movement	AM peak Delay (s)	AM peak LoS	PM peak Delay (s)	PM peak LoS
Kāpiti Rd/Te Roto	Kāpiti Rd	Left	4	A	4	A

			AM peak		PM peak	
Intersection	Arm	Movement	Delay (s)	LoS	Delay (s)	LoS
Drive	West	Through	5	A	5	A
	Te Roto Drive	Left	9	A	8	A
		Right	57	F	86	F
	Kāpiti Rd East	Through	7	A	6	A
		Right	12	B	11	B
Average of Controlled Movements (Intersection)			14	B	9	A
Kāpiti Rd/Milne Drive	Kāpiti Rd West	Through	0	A	0	A
		Right	10	B	17	C
	Milne Drive	Left	7	A	10	B
		Right	16	C	45	E
	Kāpiti Rd East	Left	1	A	1	A
		Through	2	A	3	A
Average of Controlled Movements (Intersection)			9	A	15	B
Kāpiti Rd/Arawhata Rd	Kāpiti Rd West	Left	2	A	3	A
		Through	2	A	2	A
	Arawhata Rd East	Left	1	A	1	A
		Right	15	C	13	B
	Kāpiti Rd East	Through	1	A	1	A
		Right	7	A	6	A
Average of Controlled Movements (Intersection)			6	A	4	A
Kāpiti Rd/Ramps	Northbound Off-ramp	Left	21	C	41	D
		Right	44	D	41	D
	Kāpiti Rd West	Left	12	B	14	B
		Through	14	B	26	C
	Southbound Off-ramp	Left	27	C	27	C
		Right	42	D	52	D
	Kāpiti Rd East	Left	43	D	27	C
		Through	37	D	28	C
All Approaches (Intersection)			25	C	30	C

Table 7.5 – 2016 Option Model Results

The following observations are noted from the 2016 AM and PM Option models:

- The southbound off-ramp is expected to operate at a saturated level. This arm of the Kāpiti Road/ramps intersection is forecast to operate at a LoS D during both AM and PM peaks. This is due to heavy traffic flows (both on Kāpiti Road and the ramps) at the intersection (meaning only limited green time is allocated to this arm) as well as the downstream lane merge on Kāpiti Road. The limited green time is due to priority being given to the high volume of westbound through traffic on Kāpiti Road, on the east approach of the interchange. Hence, the operations of the southbound traffic could be improved by allocating more green time to this movement; however, this would be at the expense of Kāpiti Road traffic which then will experience larger delays. It is however noted that the modelled signal timings have been optimised so that the queues on the ramps do not exceed the available storage length and hence do not block back onto the proposed Expressway.
- Right turn traffic from Te Roto drive experiences delays of around 60 and 90s in the AM and PM period respectively. This result is mainly due to the high volume on the conflict movement of traffic turning right from Kāpiti Road into Te Roto Drive.
- The delays experienced by the right and left turn movements at Te Roto Drive and Milne Drive intersections are significantly reduced in this scenario when compared to the 2016 DM. This is due to the traffic signals at the interchange, which helps provide wider gaps in the through traffic stream, through creating 'platooning' of vehicles along the Kāpiti Road corridor.

The travel times and average travel times along Kāpiti Road in the westbound and eastbound direction in the study corridor is shown in Table 7.6 overleaf.

Travel Time (s) (Average Speeds (kph)) Along Kāpiti Road Corridor (s)		
Direction of Travel	AM Peak	PM Peak
Kāpiti Road - Westbound	80 (24)	73 (26)
Kāpiti Road - Eastbound	54 (35)	67(28)

Table 7.6 - 2016 Option Model: Average Travel Times along Kāpiti Road Modelled Corridor

Table 7.6 indicates that the travel times in the 2016 AM peak OPT scenario is expected to increase by 40 seconds, in the westbound direction and by 20 seconds in the eastbound direction, when compared to the 2016 DM scenario. The travel times along the study corridor is expected to increase by 30 seconds (both directions); during the PM peak hour period, when compared to the 2016 DM scenario. These increases in travel times are due to the traffic signals at the proposed interchange, as well as increase in demands in the road network with the 2016 option scenario.

The average speeds are therefore expected to also reduce along the modelled corridor in both directions of travel. In the westbound direction, the average speeds are reduced by over around 24 kph when compared to the 2016 DM scenario. In the eastbound direction, the average speed is expected to reduce by 15kph in AM peak and around 20 kph in the PM peak.

The queue lengths extracted for the key movements at intersections in the network are shown in Table 7.7.

Intersection	Approach	Movement	Critical Queuing Length (m)	AM Peak Average (m)	AM Peak Max (m)	PM Peak Average (m)	PM Peak Max (m)
Kāpiti Rd/Te Roto Drive/Milne Drive	Kāpiti Road East at Milne Drive	Right Turn into Milne Drive	70	1	33	3	80
	Kāpiti Road West at Te Roto	Right Turn into Te Roto Drive	50	7	90	14	115
Kāpiti Road / Ramps	Northbound Off-ramp	Right + Left	310	7	74	27	155
	Kāpiti Rd West	Through + Left	170	12	95	14	88
	Southbound Off-ramp	Right + Left	310	14	95	8	67
	Kāpiti Rd East	Through + Left	185	22	111	21	121

Table 7.7 - 2016 Option Model: Queue Length Results

During PM peak, the maximum queue lengths for the right turn movement on Kāpiti Road at Te Roto Drive and Milne Drive intersections are expected to exceed the critical queuing lengths. The maximum queue lengths are experienced within the one hour modelled period at Te Roto Drive intersection and within the last 15 minute of the modelled period (17.30-18.00 in the PM). These maximum queue lengths are however, not experienced over the full one hour period at Te Roto Drive intersection, and only experienced within the last 15 minute period at Milne Drive intersection, therefore the average is considerably less than the maximum length for both right turn movements at these intersections.

The northbound and southbound off ramp maximum queue lengths are not expected to extend beyond the ramp length (critical queuing length) and impede through traffic on the proposed Expressway, during both AM and PM peak periods.

7.5.1 Summary of 2016 Option Performance

Overall, the 2016 OPT scenario is expected to operate with high delays for right turning traffic at Te Roto Drive and Milne Drive intersections. These delays are experienced by the turning movements at these intersections due to high volumes of conflicting through movement on Kāpiti Road, which have priority over the turning traffic. The average queue lengths of the right turning traffic is expected to be less than the critical queuing length however, the maximum queue lengths within the modelled periods is expected to exceed this critical length.

The westbound and eastbound travel times along the modelled Kāpiti Road corridor is expected to increase when compared to the 2016 DM scenario. This increase in travel time is caused by the signals at the proposed interchange which create delays for the through movements on Kāpiti Road. However, the delays for the turning movements at Te Roto and Milne Drive intersections are significantly less, when compared to the 2016 DM scenario.

Arawhata Road / Kāpiti Road intersection is expected to experience similar delays in the two scenarios; however the LoS for the traffic turning right out of Arawhata Road is expected to improve slightly due to reduction in average delays for this movement.

The maximum queue length for the right turning traffic on Kāpiti Road, at Milne Drive and Te Roto Drive intersections is expected to reduce by 50% and over 80%, during both peak periods respectively.

7.5.2 2016 Do Minimum versus Option

The 2016 OPT scenario increases the travel times for the through movements along Kāpiti Road by up to 40s during peak periods. However, the overall Te Roto Drive / Kāpiti Road and Milne Drive / Kāpiti Road intersections perform significantly better in the OPT scenario when compared to the DM scenario, during the PM peak. During the AM peak these intersections perform at the same LoS between the two scenarios. Reduction in average delays of up to 40s (in PM peak) is also expected for the right turn movement out of Arawhata Road. The maximum queue length for the right turn movement on Kāpiti Road at Te Roto Drive and Milne Drive intersections is expected to reduce significantly (up to 80% at Te Roto Drive) with the OPT scenario. The overall intersection performances in the 2016 OPT scenario are considered satisfactory with LoS C or better achieved at all intersections, in both peak periods. The DM scenario results indicate that both Te Roto Drive and Milne Drive intersection will operate at LoS E and D (in the PM model) respectively and hence does not meet the criteria set in the guiding objectives.

7.6 2026 Do-Minimum

Table 7.8 shows the delays and LoS for the AM and PM 2026 Do-Minimum scenario.

			AM peak		PM peak	
Intersection	Arm	Movement	Delay (s)	LOS	Delay (s)	LOS
Kāpiti Rd/Te Roto Drive	Kāpiti Rd West	Left	4	A	5	A
		Through	5	A	6	A
	Te Roto	Left	8	A	75	F

Intersection	Arm	Movement	AM peak Delay (s)	AM peak LOS	PM peak Delay (s)	PM peak LOS
	Drive	Right	49	E	246	F
	Kāpiti Rd East	Through	6	A	6	A
		Right	9	A	14	B
Average of Controlled Movements (Intersection)			14	B	53	F
Kāpiti Rd/Milne Drive	Kāpiti Rd West	Through	0	A	0	A
		Right	15	B	41	E
	Milne Drive	Left	6	A	49	E
		Right	22	C	207	F
	Kāpiti Rd East	Left	0	A	1	A
		Through	1	A	4	A
Average of Controlled Movements (Intersection)			10	B	62	F
Kāpiti Rd/Arawhata Rd/Town Centre Link	Kāpiti Rd East	Left	18	B	20	B
		Through	17	B	19	B
	Arawhata Rd	Left	8	A	4	A
		Through	36	D	33	C
		Right	50	D	63	E
	Kāpiti Rd West	Left	30	C	30	C
		Through	17	B	22	C
		Right	38	D	39	D
	Town Centre Link	Left	46	D	83	F
		Through	64	E	64	E
		Right	-	-	-	-
All Approaches (Intersection)			23	C	30	C

Table 7.8 – 2026 DM Scenario Results

The following observations are noted from the DM 2026 AM and PM models:

- Vehicles waiting at the Milne Drive approach are delayed significantly in the PM peak period. As the majority of the vehicles on this approach want to turn right onto Kāpiti Road, as with the 2016 DM scenario, due to the high volume of westbound through traffic on Kāpiti Road, these vehicles are unable to find an acceptable gap to make the turn. Hence, long delays are experienced for this movement. Vehicles trying to turn left onto Kāpiti Road (west) from Milne Drive are observed to be blocked by the queue of right turning vehicles and hence the delays experienced by the left turning traffic is also increased at this approach. The Milne Drive approach is predicted to operate at LoS F.

- However, the average delay expected for vehicles at Milne Drive is less than that in 2016 DM scenario, during both peak periods. This is due to longer gaps created in the through traffic on Kāpiti Road by the signals at Arawhata Road intersections. Hence, reducing the delays experienced by vehicles trying to turn onto Kāpiti Road.
- Right turn movement at Te Roto Drive approach experiences significant delays in the PM peak period. As with the Milne Drive approach, it is observed that due to large westbound and eastbound traffic flows on Kāpiti Road high delays will be experienced on this arm, particularly by the right turn movement.
- The town centre link operates at a LoS E. This has been observed to be due to the signal timings and coordination, where longer green times have been allocated to the Kāpiti Road movements at the intersection, thereby reducing the green time for the volume of traffic exiting the town centre link.
- However, the overall Arawhata Road/Kāpiti Road/ Town Centre Link intersection operates at a LoS C during both peak periods.
- The PM period operates significantly worse. At the priority based intersections (Te Roto Drive and Milne Drive) high delays are experienced on the minor arms. As discussed above, this is generally caused by the high volume of through traffic on Kāpiti Road whereby the left and right turning movements wait for an extended period of time to find an acceptable gap to make the turn.

The average travel times and average speeds along Kāpiti Road in the westbound and eastbound direction in the study corridor is shown in Table 7.9 below.

Travel Time (s) (Average Speeds (kph)) Along Kāpiti Road Corridor		
Direction of Travel	AM Peak	PM Peak
Kāpiti Road - Westbound	46 (42)	63 (30)
Kāpiti Road - Eastbound	54 (35)	59 (32)

Table 7.9 - 2026 DM Model: Average Travel Times along Kāpiti Road Modelled Corridor

When compared to the 2016 DM scenario the travel times along the modelled Kāpiti Road corridor is expected to increase by up to 20s in both directions, in the PM peak. In the AM peak period the average travel time in the westbound direction is expected to be similar between the 2016 and 2026 DM scenario whilst the eastbound travel time is expected to increase by less than 20s. The increase in travel time along the corridor in the 2026 scenario is considered to be due to increase in traffic volumes travelling along Kāpiti Road.

The average speeds are expected to decrease by up to 20kph in the westbound direction, in the PM peak when compared to the 2016 DM. In the eastbound direction there is expected to be a reduction in average speeds of up to 15kph, in the AM peak period. As for the travel times discussed above, this is considered to be due to high traffic volumes travelling along the modelled corridor.

The queue lengths extracted for the key movements at intersections in the network are shown in Table 7.10 below.

Intersection	Approach	Movement	Critical Queuing Length (m)	AM Peak		PM Peak	
				Average (m)	Max (m)	Average (m)	Max (m)
Kāpiti Rd/Te Roto Drive/Milne Drive	Kāpiti Road East at Milne Drive	Right Turn into Milne Drive	70	2	60	35	505
	Kāpiti Road West at Te Roto	Right Turn into Te Roto Drive	50	4	81	59	213
Kāpiti Rd/Arawhata Road	Kāpiti Road West	Through + Left Eastbound	185	8	80	14	458
		Right	50	16	97	33	459
	Kāpiti Road East	Through + Left Westbound	550	10	84	19	320

Table 7.10 - 2026 Do-Minimum Model: Queue Length Results

During the PM peak, the queue length on Kāpiti Road east and west is observed to exceed the critical queuing length and block back to the upstream intersections. The congestion at the approach to Milne Drive on Kāpiti Road (east) is observed to be due to queues from right turn traffic (waiting to turn into Te Roto Drive) extending back from the turning bay onto Kāpiti Road.

At Arawhata Road intersection, the right turn traffic on Kāpiti Road (west) is expected to block back from the right turn back onto the through lane, during both AM and PM peaks. In the PM peak, the eastbound approach is expected to have queue extending back to the upstream intersections (Te Roto and Milne Drive). Maximum queue length of around 300m is expected at the westbound approach on Kāpiti Road. However, this does not exceed the critical queuing length to impede the traffic at the upstream intersection of Rimu Road / Kāpiti Road intersection.

7.6.1 Summary of 2026 Do-Minimum Performance

Overall, the intersections in the 2026 DM scenario are expected to operate at LoS C during the PM peak and LoS A and C during the AM peak and thus operating at a satisfactory level during both peak periods. However, it is noted that the right turn movements on Te Roto Drive and Milne Drive approaches experience high delays (3 to 4 minutes) during the PM peak period. These delays are caused by high volume of through traffic on Kāpiti Road which has priority over the movements waiting on the side roads.

The maximum queue lengths for the right movements on Kāpiti Road at Te Roto Drive, Milne Drive and Arawhata Road (west approach) is expected to exceed the critical queuing length and hence impede the traffic at the respective upstream intersections.

7.7 2026 Option

Table 7.11 show the delays and LoS for the AM and PM 2026 OPT scenario.

Intersection	Arm	Movement	AM peak		PM peak	
			Delay (s)	LOS	Delay (s)	LOS
Kāpiti Rd/Te Roto Drive	Kāpiti Rd West	Left	4	A	4	A
		Through	4	A	5	A
	Te Roto Drive	Left	30	D	54	F
		Right	106	F	194	F
	Kāpiti Rd East	Through	6	A	7	A
		Right	12	B	17	C
Average of Controlled Movements (Intersection)			29	D	39	E
Kāpiti Rd/Milne Drive	Kāpiti Rd West	Through	0	A	1	A
		Right	15	B/C	30	D
	Milne Drive	Left	7	A	30	D
		Right	27	D	115	F
	Kāpiti Rd East	Left	1	A	2	A
		Through	3	A	5	A
Average of Controlled Movements (Intersection)			13	B	37	D
Kāpiti Rd/Arawhata Rd	Kāpiti Rd West	Left	17	B	19	B
		Through	16	B	16	B
		Right	16	B	34	C
	Arawhata Rd North	Left	1	A	1	A
		Through	20	B	16	B
		Right	30	C	35	C/D
	Kāpiti Rd East	Through	18	B	21	C
		Right	15	B	26	C
	Town Centre Link	Left	18	B	17	B
		Through	18	B	18	B
		Right	18	B	14	B
All Approaches (Intersection)			17	B	20	C

Intersection	Arm	Movement	AM peak		PM peak	
			Delay (s)	LOS	Delay (s)	LOS
Kāpiti Rd/Ramps	Northbound Off-ramp	Left	22	C	27	C
		Right	59	E	71	E
	Kāpiti Rd West	Left	44	D	37	D
		Through	34	C	29	C
	Southbound Off-ramp	Left	18	B	14	B
		Right	61	E	42	D
	Kāpiti Rd East	Left	55	D	29	C
		Through	22	C	44	D
All Approaches (Intersection)			32	C	30	C

Table 7.11 – 2026 Option Model Results

The following observations are noted from the 2026 AM and PM Option models:

- A high level of congestion and delay is expected for the Te Roto Drive and Milne Drive approaches. Although the LoS on these approaches remains at LoS F, the delays experienced by the movements on Te Roto Drive and Milne Drive is significantly less when compared to the DM scenario. This is observed to be due to interchange signals which create 'platooning' of through vehicles on Kāpiti Road approaching these priority intersections, and hence provides wider gaps in the through traffic streams for turning traffic.
- A high volume of traffic also turns from the off-ramps to travel west on Kāpiti Road in the PM peak. Hence, the lane drop creates a bottleneck at a point where the two traffic lane merges into a single lane.
- The delays experienced by the right and left turn movements waiting at Te Roto Drive and Milne Drive approaches, are significantly reduced in the PM peak when compared to the 2016 DM (up to 50% for the right turn movement out of Milne Drive). This is again considered to be due to the traffic signals at the interchange, which helps provide wider gaps in the through traffic stream for the turning movements.
- In the AM peak however, the average delays at right turn movement at Te Roto Drive approach is expected to increase whilst the delay for the right turn out of Arawhata Road approach is expected to reduce significantly.
- The right turn movement from the northbound and southbound ramps experience average delays of 40s – 60s (LoS of D and E). It is noted that as for the 2016 OPT model, limited green time has been allocated to the ramp movements to provide priority to the through traffic on Kāpiti Road. Additional green times can be allocated to the ramp movements at the interchange however this would be at the expense of the through movement on Kāpiti Road which would then experience higher delays.

- However, the overall intersection LoS at the interchange is LoS C, during both AM and PM peaks. It is therefore considered that the interchange operates at a satisfactory level.

Travel Time (s) (Average Speeds (kph)) Along Kāpiti Road Corridor		
Direction of Travel	AM Peak	PM Peak
Kāpiti Road - Westbound	66 (29)	81 (25)
Kāpiti Road - Eastbound	88 (22)	87 (22)

Table 7.12 - 2026 Option Model - Average Travel Times along Kāpiti Road Modelled Corridor

The average travel times along the modelled Kāpiti Road corridor in the 2026 OPT scenario, in the westbound direction increase by around 20 seconds when compared to the 2026 DM (in both peak periods). In the westbound direction the average travel times increase by approximately 30s in both peaks, when compared to the 2026 DM scenario.

The average speed along the modelled corridor, in the eastbound direction is expected to be around 20kph in both peaks. In the westbound direction, the average speeds are expected to be just under 30kph and 25kph in the AM and PM peaks respectively.

As for the 2016 OPT scenario, these increases in travel times and reductions in speeds are due to the traffic signals on Kāpiti Road as well as increase in demands in the road network with the 2026 option scenario. It is noted that the signals at the interchange provide less delay to the side road movements (especially right turn out of Te Roto Drive and Milne Drive approaches) during the PM peak period (when higher volumes of traffic is travelling along Kāpiti Road) and hence considered not to create any detrimental effect on the Kāpiti Road corridor.

The queue lengths extracted for the key movements at intersections in the network are shown in Table 7.13.

Intersection	Approach	Movement	Critical Queuing Length (m)	AM Peak Average (m)	AM Peak Max (m)	PM Peak Average (m)	PM Peak Max (m)
Kāpiti Rd/Te Roto Drive/Milne Dr	Kāpiti Road East at Te Roto Drive	Right Turn into Milne Drive	70	4	288	38	207
	Kāpiti Road West at Milne Drive	Right Turn into Te Roto Drive	50	8	86	25	429
Kāpiti Rd/Arawhata Road	Kāpiti Road West	Through + Left Eastbound	185	6	70	7	121
		Right	50	8	81	11	74

Intersection	Approach	Movement	Critical Queuing Length (m)	AM Peak Average (m)	AM Peak Max (m)	PM Peak Average (m)	PM Peak Max (m)
	Kāpiti Road East	Through + Left Westbound	550	8	57	14	83
Kāpiti Road / Ramps	Northbound Off-ramp	Right + Left	310	8	85	22	156
	Kāpiti Rd West	Through + Left	170	35	134	37	202
	Southbound Off-ramp	Right + Left	310	26	265	7	75
	Kāpiti Rd East	Through + Left Westbound	185	14	80	23	163

Table 7.13 - 2026 Option Model - Queue Length Results

The northbound and southbound off ramp maximum expected queue lengths are shorter than the critical queuing length, during both AM and PM peak periods. This indicates that the off ramp queue is not expected to block back onto the proposed Expressway. Although the average delays for right turn movement at the northbound and southbound ramps is expected to be high (40s – 60s), the overall interchange operates at a LoS C as the volume of this right turning traffic is significantly less when compared to the left turning movement at the ramp or the through traffic on Kāpiti Road.

The maximum queue lengths for the through movements at the Kāpiti Road approaches to Arawhata Road intersection are less than the critical queuing length. Therefore, these movements are not expected to block back to the upstream intersections. The maximum queue length of the right turn traffic at Kāpiti Road (west) however is expected to exceed the critical length (length of the right turn bay) in both peak periods and block back onto the through lane. It is noted that this is however, not expected to occur over the full peak hour period and that the average queue length is around only 10m, in both peak periods.

7.7.1 Summary of 2026 Option Performance

The operations of the intersections along the modelled Kāpiti Road corridor in the 2026 OPT scenario meets the guiding objective of the Project Alliance Board (3b) (as discussed in Chapter 4, Section 4.2) which states that a LoS C is to be achieved at intersections between the proposed Expressway and the local road network in the year 2026.

The average travel times along the modelled Kāpiti Road corridor is expected to increase slightly (by up to 30s) due to the traffic signals at Arawhata Road / Kāpiti Road intersection and the interchange, when compared to the 2026 DM scenario. However, with increase in demands (compared to 2026 DM) on the road network, the average delays at the three intersections remain similar to that for the 2026 DM scenario. The maximum queue length for key movements at intersections are expected to decrease at all but one approach (right turn into Milne Drive in AM peak). Hence, the congestion along Kāpiti Road corridor and for vehicles on side roads are generally observed to reduce with the 2026 OPT scenario. It is noted that the delays for the right turn movement out of Te Roto Drive increase with the proposed option in place, in the AM peak, however the Te Roto Drive/ Kāpiti Road intersection experience similar delays in both DM and OPT scenarios.

7.7.2 2026 Do-Minimum versus Option

Both scenarios meet the guiding objective (3b) set out by NZTA and KCDC for the Project Alliance Board that intersections between the proposed Expressway and the local road network are to achieve a LoS C or better.

The 2026 OPT AM model results indicate that this scenario operates more efficiently at Arawhata Road / Kāpiti Road intersection (LoS B) when compare to 2026 DM. The overall intersection delay with the OPT scenario is higher at Te Roto Drive intersection, in the AM peak when compared to the DM scenario. This is mainly due to increase in delay experienced by the right turn movement at Te Roto Drive approach. With 2026 OPT AM scenario there is an increase in eastbound peak direction traffic (when compared to the 2026 DM), which reduces the available appropriate gap in the through traffic stream which hence is observed to increase the delays for the right turn traffic from Te Roto Drive. It is noted that however, the increase in the overall intersection delay in 2026 OPT scenario is considered to be minor as the number of vehicles at this approach is not significant when compared to the high volumes of through vehicles travelling on Kāpiti Road.

The OPT model is observed to have significantly lesser queues at all approaches, in the PM peak period. The PM peak operates much better with less delays and shorter queue lengths at all intersections, when compared to the 2026 DM scenario.

7.8 Overall Summary of Operational Modelling

The main constraint in all scenarios is the limited availability of right turning bay lengths, as well as lane capacity on Kāpiti Road at Te Roto and Milne Drive intersections. Currently only a single lane runs through these intersections, however, the future peak period traffic demand (Do-Minimum and Option) on Kāpiti Road (as well as movements into and out of Te Roto and Milne Drive) is expected to increase substantially when compared to the existing demand. Hence, as a mitigation to accommodate these additional trips in the study network, provision for an extra lane capacity on Kāpiti Road is recommended, irrespective of the proposed Expressway being present.

The following form the overall summary to the micro-simulation modelling undertaken for the Kāpiti Road study corridor:

- Option scenario generally operates significantly better than the DM scenario;

- An additional lane on Kāpiti Road in the section between the proposed interchange and Te Roto Drive / Kāpiti Road and Milne Drive / Kāpiti Road intersection is recommended to help increase the capacity of the road and operates of these intersections;
- Overall, the proposed interchanges meet the Guiding Objective of the Project Alliance (to operate at LoS C or better) although it is noted that some movements at the ramps have a LoS E. However, the queues at the ramps do not exceed the ramp length.
- The delays at Te Roto Drive and Milne Drive generally improve significantly in the option scenarios, due to platooning of vehicles created by the signals at the interchange. It is noted however, that in the AM 2026 Option scenario, the delays at Te Roto Drive increase slightly at Te Roto Drive approach when compared to the 2026 Do-Minimum. However, this increase in delay is considered to be minor.
- Overall the average speed along Kāpiti Road is slightly worse in the option scenario due to the signals at the interchange and Arawhata Road / Kāpiti Road intersection. However, it is considered that increase in traffic volumes on Kāpiti Road (when compared to the Do-Minimum) also contributes to the reduction in speeds along this corridor.

8 Sensitivity Testing

8.1 Introduction

Sensitivity testing allows the model user to test and determine the effects of “what if” scenarios which are different to an expected forecast situation. This type of testing compounds the robustness and credibility of the recommendations put forth for the expected forecast situation. An example of a sensitivity test, and as described in this chapter, could be an increase in traffic growth from a development should the ‘uptake’ of the development occur earlier than expected.

8.2 Scope of Sensitivity Testing

As discussed earlier, differences were identified between the Kāpiti land use growth regional forecasts and the local growth plans of KCDC. While a “Composite” growth scenario was developed for the core forecasting, sensitivity testing was undertaken to assess the performance of the road network with “Full Growth” in the Kāpiti District. The “Full Growth” land use includes full development (by 2026) of four significant growth areas in Kāpiti:

- Paraparaumu Town Centre;
- Paraparaumu Airport;
- Waikanae North; and
- Ngarara.

Three network scenarios were initially considered using the “Full Growth” land use:

- The Do-Minimum (as described earlier in this report);
- With the Project in place; and
- With the Project and a northbound Expressway off ramp to the proposed Ihakara Street Extension.

Note: the Paraparaumu Airport requested a sensitivity test of a northbound Expressway off ramp to the proposed Ihakara Street Extension to identify whether the KTM2 traffic modelling would indicate a reduction in traffic volumes along Kāpiti Road. This was the main objective of their request and, as such, only a high level analysis of the model outputs is presented in Section 8.8 of this report.

Only the two scenarios with the Project in place were assessed as a result of Do Minimum model convergence issues with the "Full Growth" land use in place. See Section 8.6, for further information.

The network modelling was undertaken using the KTM2. Operational model assessments were also undertaken of the Project. VISSIM was used to assess the performance of the Kāpiti Road interchange and SIDRA[10] was used to assess the performance of the Poplar Ave, Te Moana Road, and Peka Peka Road interchanges.

8.3 Detailed Trip Generation Assumptions

An overview of the "Full Growth" land use assumptions are described below in Section 8.4. More detailed trip generation assumptions and results are outlined in Appendix 34.H, covering the following key elements in predicting the likely level of traffic to and from each of the four significant growth areas in 2026:

- Tim Kelly Transportation Planning Ltd Paraparaumu Airport Trips (as agreed with KCDC);
- Trip rates and their sources (as agreed with KCDC); and
- Time period specific trip proportions to / from land use types.

The likely level of traffic to and from each of the four significant growth areas is outlined in Appendix 34.H. A comparison with the "Composite Growth" approach (as described in Chapter 5) which has been used to inform the Assessment of Environmental Effects (AEE), is also presented and discussed in Appendix 34.H. The purpose of this comparison is to highlight the differences in the number of trips to and from each of the four significant growth areas and to ensure these differences support the modelling outputs, and, in this case, in terms of travel time and traffic volumes on key roads in the Kāpiti area. This analysis is described in Section 8.7.

[10] SIDRA is modelling software used to assess the performance of isolated, individual intersections.

8.4 Overview of "Full Growth" Land Use Assumptions

8.4.1 2026 Land Use Assumptions

This section outlines an overview of the "Full Growth" land use assumptions (as agreed with KCDC) for each of the four significant growth areas.

Table 8.1 outlines the level of 2026 land use development associated with Paraparaumu Town Centre, Waikanae North and Ngarara. These land use assumptions formed the basis for predicting the likely level of traffic to and from those developments in 2026. The likely level of traffic associated with Paraparaumu Airport has been taken directly from Tim Kelly's trip generation analysis and is included in Tables 8.2 and 8.3 in Appendix 34.H as total number of trips by vehicle type.

	Paraparaumu Town Centre		Waikanae North		Ngarara	
Land Use Type	GFA[11] (100m2)	Dwelling units	GFA (100m2)	Dwelling units	GFA (100m2)	Dwelling units
Business Services / Offices	231	-	-	-	-	-
Civic	50	-	-	-	-	-
Commercial / Light Industrial	324.75	-	-	-	-	-
Commercial (Local Services)	-	-	8	-	16	-
Higher Density Housing	217.5	-	-	-	-	-
Medium Density Housing	561.2	-	-	-	-	-
Mixed Development	83.1	-	-	-	-	-
Residential (Dwellings)	-	-	-	700	-	1,689
Retail (Large Format)	200	-	-	-	-	-
Retail (Specialist / Convenience)	226.5	-	-	-	-	-
Retail (Local Convenience)	-	-	12	-	24	-
Retirement Dwellings (units)	-	-	-	100	-	-
Total	1,894.05	-	20	800	40	1,689

Table 8.1 Significant Growth Areas 2026 Land Use Assumptions

It can be seen from Table 8.1, Paraparaumu Town Centre development contains a mix of different land use types, covering housing, retail and office space. Waikanae North and Ngarara developments on the other hand are predominantly made up of residential and retirement dwellings. These types of developments are conducive to the current land uses in Paraparaumu, Waikanae North and Ngarara.

[11] Gross Floor Area

8.5 KTM2 Model Inputs

This section provides an overview of the KTM2 model basis for the “Full Growth” sensitivity tests, covering networks, zone system and traffic demand matrices.

8.5.1 Networks and Zone System

The network basis for the sensitivity testing was the 2026 Do Minimum (ie without Project) and 2026 Option (ie with Project) model networks as used to inform the AEE. The zone system remained unchanged bar the following change to the way in which traffic was “loaded” onto the network from the Ngarara development.

a. Ngarara Zone Change

The original zone system for the Ngarara development assumed a 50% / 50% split of traffic “loading” onto Ngarara Road (50%), and Ngarara Road and Parata Street sharing the other 50% - hence a bias towards Ngarara Road.

The revised zone system assumes a 70% / 30% split of traffic “loading” onto Te Moana Road (east of the proposed Expressway interchange) and Ngarara Road respectively from the Ngarara development. This split was based on potential access arrangements with the proposed Expressway in place, in that 70% of the households would be in land parcels with potential access via Te Moana Road. The remaining 30% would not have direct access to Te Moana Road due to the Alignment of the proposed Expressway, however they would have potential access to Ngarara Road on the west side of the proposed Expressway.

8.5.2 Traffic Demand Matrices

The “Composite” growth traffic demand matrices, as discussed in Chapter 5, formed the basis for the “Full Growth” sensitivity tests. The underlying traffic patterns were maintained and only the magnitude of the traffic demand was changed (ie increased) for each of the significant growth areas. No development zones were factored down during the creation of the “Full Growth” scenario matrices.

8.6 Model Convergence

The KTM2 includes an iterative process of path building (where traffic is loaded to the least-cost paths through the network) and capacity constraint (where the resulting speeds, delays and queues are recalculated from the new flows). Convergence of this process is critical to providing valid model output, and from the outset, i.e. during base year model calibration and validation, strict model convergence parameters and criteria were defined. These convergence parameters and criteria dictate when the road assignment terminates, i.e. when there is a sufficient balance in the changes in “global” travel costs (route choice) with respect to traffic demand. It is important that these convergence parameters and criteria are not altered once the base year model calibration phase is complete.

As a result of implementing the “Full Growth” scenario into the Do Minimum models, the AM and PM peak hour models in particular, were found to not converge. Large fluctuations in travel costs between each successive assignment iteration were still evident at the maximum number of iterations (399).

This indicates that the traffic demands exceed the available capacity too much to achieve a stable, converged model (it is a fundamental requirement of a valid model for the demands to be in equilibrium with the supply, which cannot be achieved if the models do not converge).

This suggests that additional road network capacity would need to be provided to support the anticipated “Full Growth” land use scenario, if the Project was not in place.

This in itself is a key conclusion of the modelling, however it is beyond the scope of this work to identify what infrastructure would be required to support such growth if the Project was not in place.

8.7 KTM2 Model Results

As a result of the non-converged Do Minimum models with “Full Growth” land use, only two 2026 Option models have been taken forward for assessment with the “Full Growth” land use in place since these models successfully converge. As mentioned previously, these are:

- Test (A): 2026 with the Project in place; and
- Test (B): 2026 with the Project in place and a northbound Expressway off-ramp to the proposed Ihakara Street Extension.

For simplicity, this section outlines combined-direction daily traffic volumes on key roads and AM and PM peak hour travel times for Test (A) only. A high level analysis of Test (B) is also presented.

A comparison with the 2026 Option model with “Composite” growth is also outlined. The purpose of this comparison is to highlight the likely impacts of the “Full Growth” scenario on key roads and travel time routes compared to the traffic modelling reporting for the AEE (Chapter 6).

8.7.1 2026 Option (Full Growth) Traffic Volumes

The combined daily traffic volumes on key roads are outlined in Tables 8.2 and 8.3 overleaf. The locations from which these traffic volumes have been extracted from the model are shown in Figures 8.1 (State Highway 1 and Expressway) and 8.2 (Local roads).

	Location	2026 Option (Composite Growth)	2026 Option[12] (Full Growth)	Absolute Change	% Change
1	South of Peka Peka Road	8,400	11,900	3,500	42%
2	South of Te Moana Road	14,100	20,400	6,300	45%
3	South of Otaihanga Road	11,300	17,200	5,900	52%
4	South of Kāpiti Road	21,000	29,000	8,000	38%
5	South of Poplar Avenue	26,900	31,900	5,000	19%
6	Expressway North of Poplar Avenue	13,900	17,100	3,200	23%
7	Expressway North of Kāpiti Interchange	20,700	23,700	3,000	14%
8	Expressway North of Te Moana Interchange	12,700	13,200	500	4%

Table 8.2 – Daily Traffic Volumes on SH1 (two directional, vehicles)

[12] Test (A): Option (ie with the Project in place) without the northbound Expressway off ramp to the proposed Ihakara Street Extension.

	Location	2026 Option (Composite Growth)	2026 Option[13] (Full Growth)	Absolute Change	% Change
1	Poplar Ave, East of Matai Rd	3,800	5,900	2,100	55%
2	Matai Rd, South of Raumati Rd	5,300	4,800	-500	-9%
3	Raumati Rd, West of Rimu Rd	16,300	26,000	9,700	60%
4	Rimu Rd, South of Kāpiti Rd	15,500	19,500	4,100	26%
5	Kāpiti Rd, West of SH1	13,700	27,900	14,300	104%
6	Kāpiti Rd, West of Arawhata Rd	29,700	31,800	2,500	7%
7	Kāpiti Rd, West of Te Roto Dr	22,000	29,000	7,000	32%
8	Arawhata Rd, North of Kāpiti Rd	6,300	11,300	5,100	79%
9	Te Roto Dr, North of Kāpiti Rd	12,200	8,900	-3,300	-27%
10	Realm Dr, North of Guildford Dr	3,400	5,600	2,200	65%
11	Mazengarb Rd, East of Guildford Dr	5,700	8,500	2,700	49%
12	Ratanui Rd, North of Mazengarb Rd	4,800	7,800	2,900	63%
13	Otaihanga Rd, West of SH1	5,500	9,900	4,200	80%
14	Te Moana Rd, West of SH1	6,200	10,200	4,400	65%
15	Te Moana Rd, West of Walton Ave	5,500	12,300	8,100	124%
16	Park Ave, North of Te Moana Rd	6,200	10,900	6,000	76%
17	Paetawa Rd, South of Peka Peka Rd	1,200	2,100	1,100	75%
18	Peka Peka Rd, West of SH1	700	1,100	300	57%

Table 8.3 – Daily Traffic Volumes on Local Roads (two-directional, vehicles)

[13] Test (A): Option (ie with the Project in place) without the northbound Expressway off ramp to the proposed Ihakara Street Extension.

Figure 8.1 – Location of Traffic Volumes on SH1 and Expressway

Figure 8.2 – Location of Traffic Volumes on Local Roads

8.7.2 Summary of 2026 Option (Full Growth) Traffic Volumes

a. State Highway 1

It can be seen from Table 8.2 there are significant increases in daily traffic volumes (combined directions) on the existing State Highway 1 between Waikanae in the north to Poplar Avenue in the south (locations 1 to 5 in Figure 8.1) in the 2026 Option (Full Growth) test when compared with the 2026 Option (Composite Growth) test.

The largest absolute difference (+8,000 daily vehicles) occurs south of Kāpiti Road (location 4); this area being influenced greater by Paraparaumu Airport and Town Centre developments. This result relates well to the trip generation process, as discussed in Appendix 34.H, as these developments are predicted to be the top two largest trip generators of the four significant growth areas. This provides confidence that the anticipated level of trips from these significant growth areas has filtered through the trip generation process appropriately. We also have to consider re-routing effects of existing traffic (ie not associated with the four development growth areas) as well as the traffic associated with these two significant growth areas since re-routing of existing traffic will have undoubtedly contributed to the traffic volume increase seen south of Kāpiti Road.

The smallest absolute difference (+3,500 daily vehicles) occurs south of Peka Peka Road, north of Waikanae (location 1); this area being influenced by the Waikanae North development. This result relates well to the trip generation process since this development is predicted to generate the least number of trips of the four significant growth areas.

b. Expressway

Traffic volumes on the proposed Expressway increase modestly. North of the Kāpiti Road Interchange (location 7) exhibits an increase of 3,000 daily vehicles and north of Poplar Avenue (location 6) exhibits an increase of 3,200 daily vehicles; these two locations showing the largest increases. A minor increase of +500 daily vehicles is evident on the proposed Expressway north of Te Moana Interchange (location 8). This, in a general sense, indicates that the predicted trips from the four significant growth areas have a greater effect, in terms of daily traffic volumes, on the existing State Highway 1 than the proposed Expressway, between Poplar Avenue in the south and Peka Peka Road in the north.

c. Local Roads

It can be seen from Table 8.3 there are significant daily traffic volume increases on the majority of local road locations, in particular, from north to south, Te Moana Road, Park Avenue, Kāpiti Road, Rimu Road and Raumati Road. This appears reasonable given the locations of the significant growth areas and their access / egress points on the local road network. These are outlined overleaf:

- Ngarara development – a significant proportion of traffic (70%) with immediate access onto Te Moana Road with the remainder (30%) onto Ngarara Road and Park Avenue;
- Paraparaumu Town Centre and Airport developments – immediate access onto Kāpiti Road, Rimu Road and Ihakara Street Extension. Trips from the south to the airport "parcels," west of the runway, are likely to influence the level of traffic on Raumati Road; and
- Waikanae North – access onto Te Moana Road and Park Avenue.

Table 8.3 also highlights a significant daily traffic volume decrease on Te Roto Drive (-3,300 daily vehicles). This is explained further in Section 8.8 (Operational Model Sensitivity Testing).

8.7.3 2026 AM and PM Peak Hour Traffic Flow Difference Plots

The following figures illustrate AM and PM Peak hour traffic flow difference plots between the 2026 Option with "Full Growth" and the 2026 Option with "Composite" Growth on key roads in and around Paraparaumu and Waikanae. These two settlements contain the four significant growth areas.

8.7.4 Paraparaumu

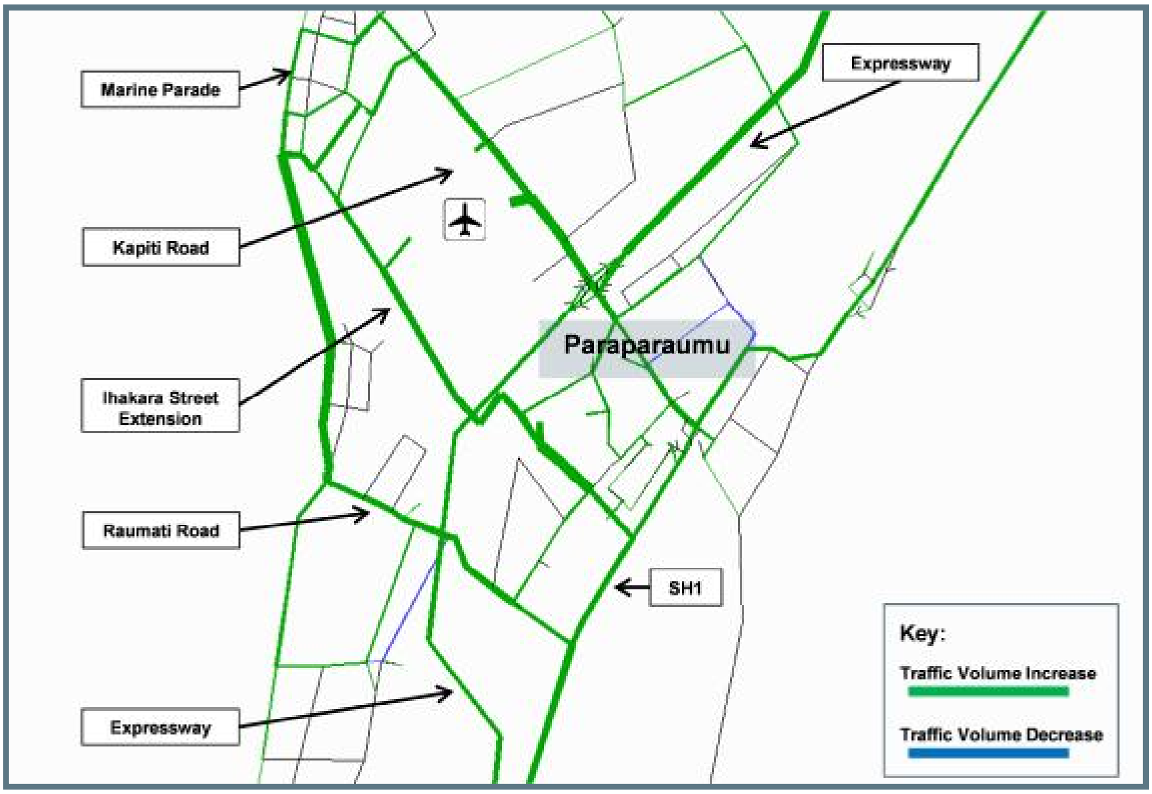


Figure 8.3 2026 AM Peak Hour Option (Full Growth) minus Option (Composite Growth)

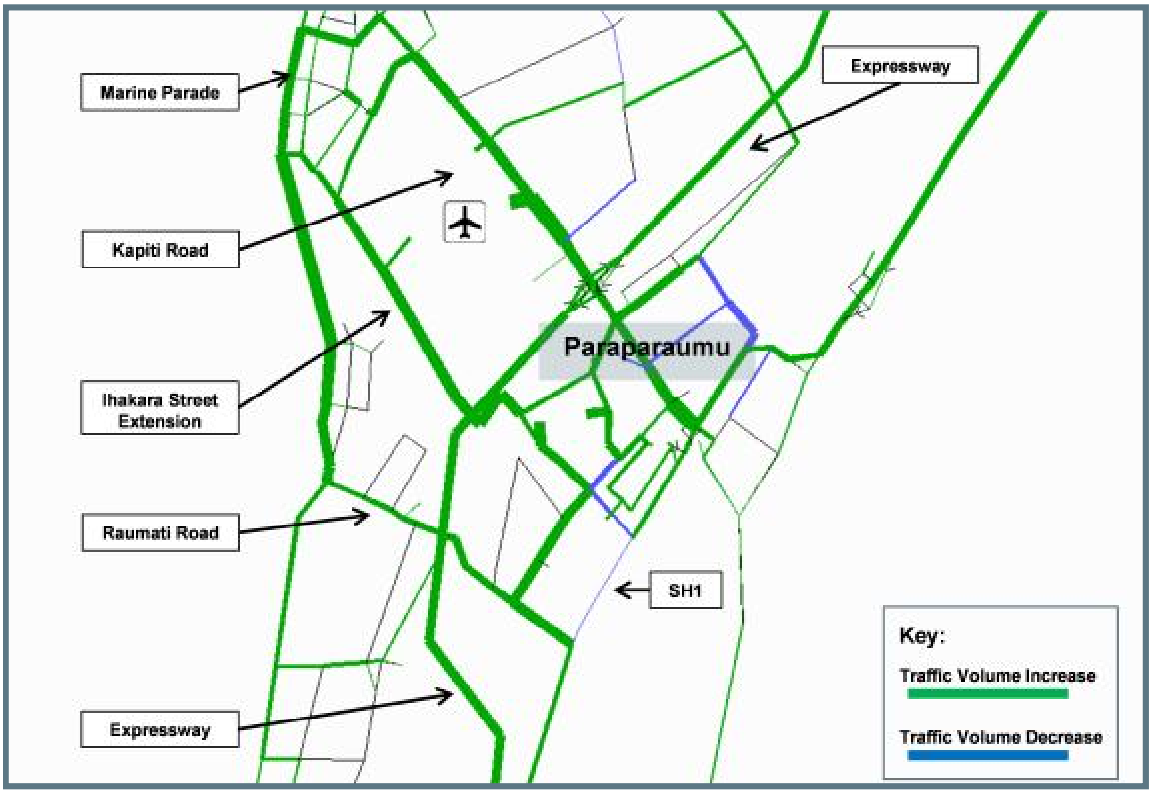


Figure 8.4 2026 PM Peak Hour Option (Full Growth) minus Option (Composite Growth)

It can be seen from Figures 8.3 and 8.4, the largest increases in traffic flow occurs on the proposed Expressway, Raumati Road, Ihakara Street Extension and Kāpiti Road (the PM Peak hour showing slightly larger increases). Given the location of the significant growth areas in Paraparaumu (ie the Airport and Town Centre) and their access / egress points onto the road network, as described above, these results appear intuitive. It must be borne in mind, however, the traffic flow increases (and decreases) do not solely represent the significant development growth; we also have to consider re-routing effects of existing traffic (ie not associated with the significant growth areas). This will be affecting the difference plots results.

8.7.5 Waikanae

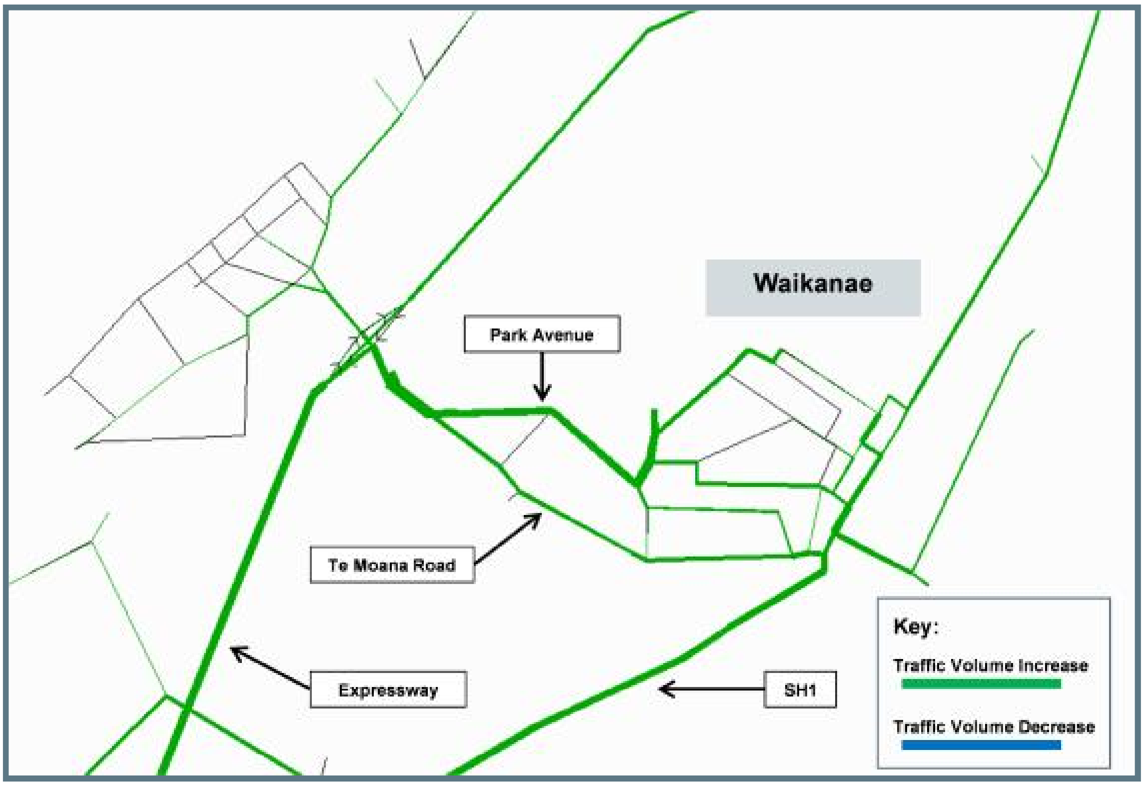


Figure 8.5 2026 AM Peak Hour Option (Full Growth) minus Option (Composite Growth)

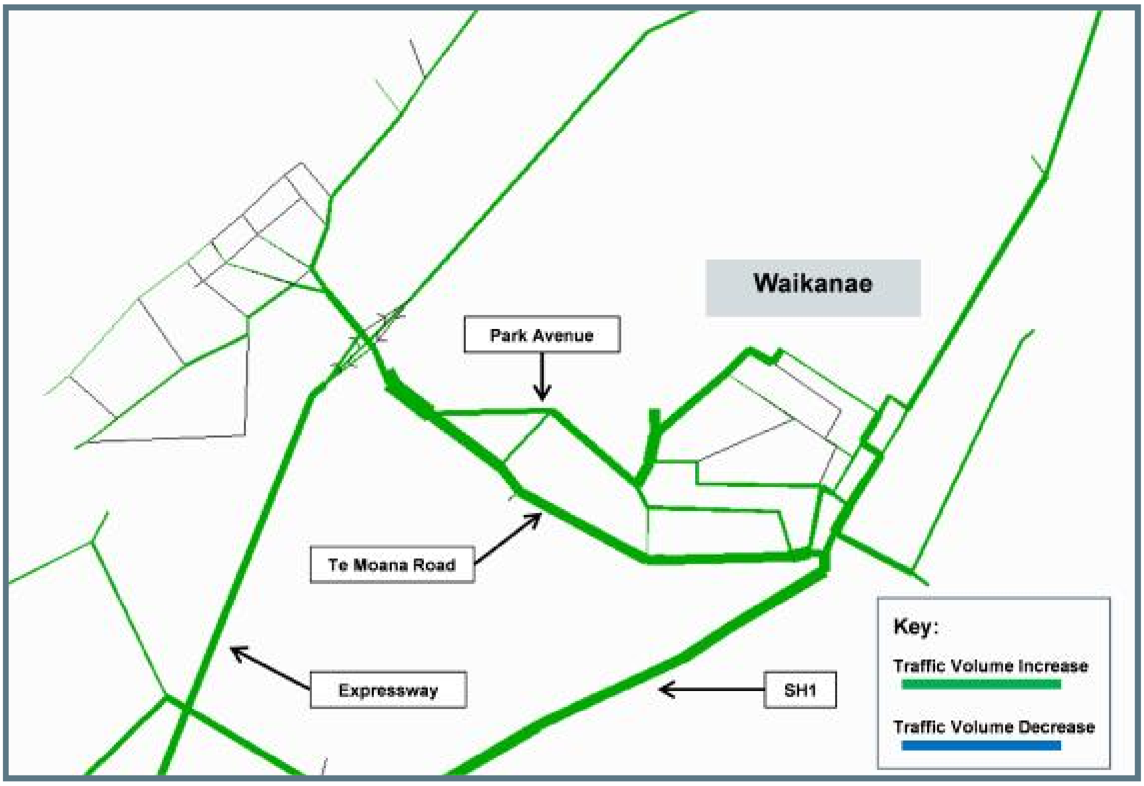


Figure 8.6 2026 PM Peak Hour Option (Full Growth) minus Option (Composite Growth)

A similar theme is evident in Figures 8.5 and 8.6, but this time with significant development growth and re-routing of existing traffic affecting roads in and around Waikanae. Significant growth areas in Waikanae are Ngarara and Waikanae North. The largest increases are shown to be on all four roads depicted in the figures. Once again, this appears reasonable given the location of the significant growth areas in Waikanae and their access / egress points on to the road network.

8.7.6 2026 Option AM and PM Peak Hour Travel Times

The travel time differences between the 2026 Option (Composite Growth) and Option (Full Growth) for the AM and PM peak hours are outlined below in Table 8.4. The majority of travel times in both the AM peak and the PM peak hours are adversely affected as a result of the additional demand in the "Full Growth" scenario. Travel times that experience an increase of 3 minutes or more are shaded red; those that experience a slight improvement in travel times are shaded blue.

The travel time routes are presented in Figure 8.7 overleaf.

Origin	Direction	Length (km)	Option AM (Composite Growth)	Option[14] AM (Full Growth)	Absolute Change
Expressway	SB	16	9.4	9.5	0.1
	NB		9.4	9.5	0.1
SH1	SB	15	13.1	14.0	0.9
	NB		13.3	13.5	0.2
Te Moana Road	WB	5	7.0	7.5	0.5
	EB		7.8	8.2	0.4
Rimu Rd – Mazengarb Road	EB	6.5	10.5	15.7	5.2
	WB		8.7	9.2	0.5
Kāpiti Road	EB	3.7	7.0	7.5	0.5
	WB		7.3	11.2	3.9
Raumati Avenue	EB	5	6.6	9.5	2.9
	WB		6.2	11.5	5.3
Poplar Avenue	EB	3	3.3	4.8	1.5
	WB		3.3	3.3	0.0

[14] Test (A): Option (ie with the Project in place) without the northbound Expressway off ramp to the proposed Ihakara Street Extension.

Origin	Direction	Length (km)	Option PM (Composite Growth)	Option PM (Full Growth)	Absolute Change
Expressway	SB	16	9.4	9.5	0.1
	NB		9.4	9.5	0.1
SH1	SB	15	12.8	12.8	0.0
	NB		13.6	16.8	3.2
Te Moana Road	WB	5	7.4	11.0	3.6
	EB		7.7	8.5	0.8
Rimu Rd – Mazengarb Road	EB	6.5	11.2	24.0	12.8
	WB		9.4	17.8	8.4
Kāpiti Road	EB	3.7	6.9	11.3	4.4
	WB		7.3	15.5	8.2
Raumati Avenue	EB	5	6.6	9.3	2.7
	WB		6.3	13.8	7.5
Poplar Avenue	EB	3	3.5	3.3	-0.2
	WB		3.5	4.5	1.0

Table 8.4 – 2026 Travel Times (Minutes) along Key Routes

It can be seen from Table 8.4, the largest increases in travel times occur on Rimu Road, Kāpiti Road, Raumati Avenue and Te Moana Road. This is evident in both the AM and PM peak hours with the PM peak hour, on the whole, illustrating the largest absolute changes. This relates well to the level of traffic seen in this time period, i.e. there is a larger amount of traffic contained within the PM peak hour traffic demand matrices than the AM peak hour, and therefore, in some instances, we would expect the PM peak hour travel times to be higher.

The travel time impacts of the significant growth areas are concentrated on the more “local” area routes (east to west) rather than the more strategic proposed Expressway (north to south). This is a reasonable reflection given the location of the developments access / egress points onto the road network and, importantly, the travel patterns to and from the developments.

There is an increase of traffic on the proposed Expressway brought about by the anticipated level of traffic and underlying travel patterns to and from the four significant growth areas but not to the same extent as the more “local” east to west roads. There is sufficient capacity to accommodate this extra demand without having a detrimental impact on Expressway travel times.

Figure 8.7 – Travel Time Routes

8.8 Impacts of Northbound Expressway Off-Ramp to Ihakara Street Extension

8.8.1 Overview

Paraparaumu Airport requested a sensitivity test to identify whether the KTM2 traffic modelling would indicate a reduction in traffic volumes along Kāpiti Road if a northbound Expressway off ramp to the proposed Ihakara Street Extension were introduced (see Figure 8.8 overleaf). This was the main objective of their request and, as such, this section outlines only a very high level summary of the 2026 AM Peak hour traffic-related impacts covering:

- traffic volume difference plots (ie showing traffic re-routing effects); and
- traffic volume differences on the following key roads:
- The proposed Expressway;
- Existing SH1;
- Raumati Road

- Ihakara Street; and
- Kāpiti Road.

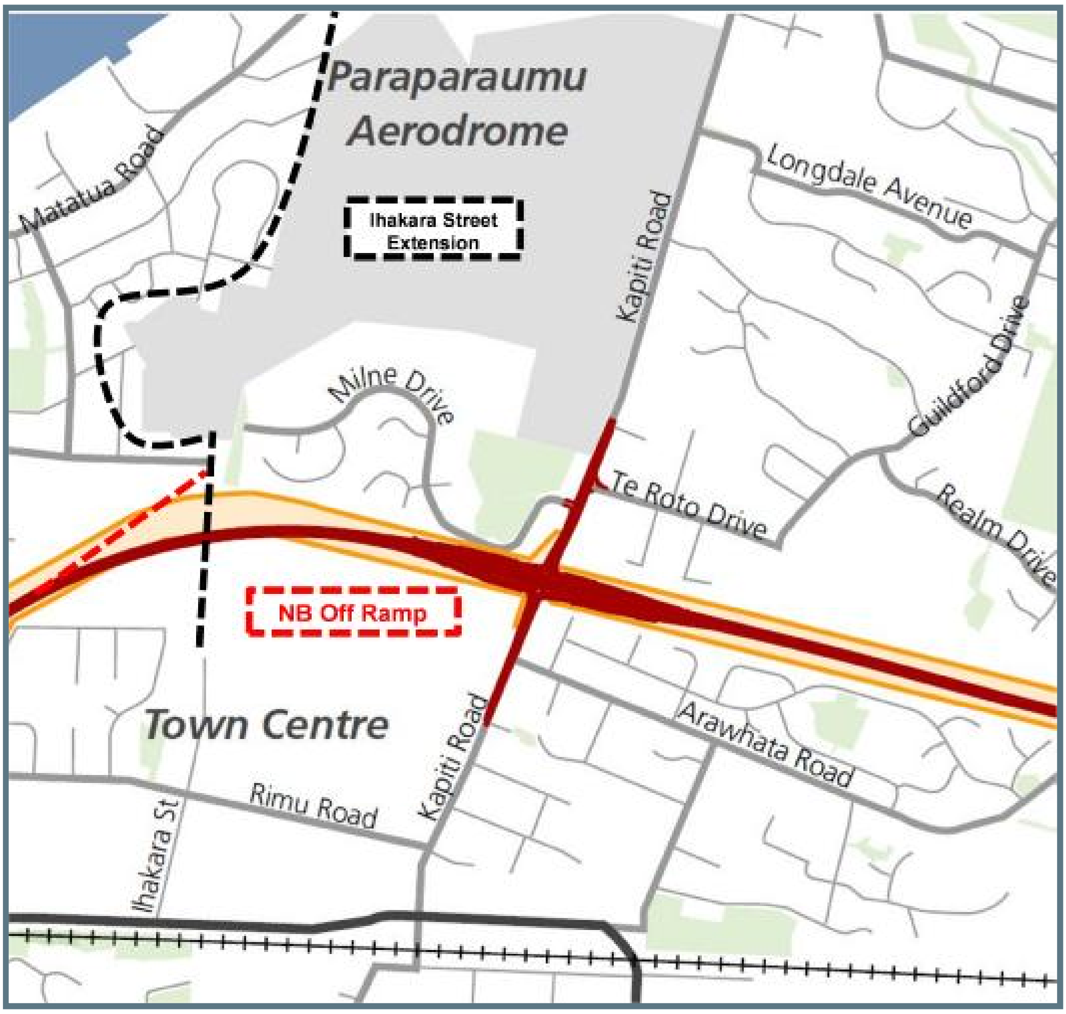


Figure 8.8 – Indicative Location of Northbound Off Ramp

8.8.2 Traffic Volume Difference Plots (traffic re-routing effects)

The key traffic re-routing effects (combined directions) as a result of introducing the northbound Expressway off-ramp to the proposed Ihakara Street Extension are represented overleaf in Figure 8.9.

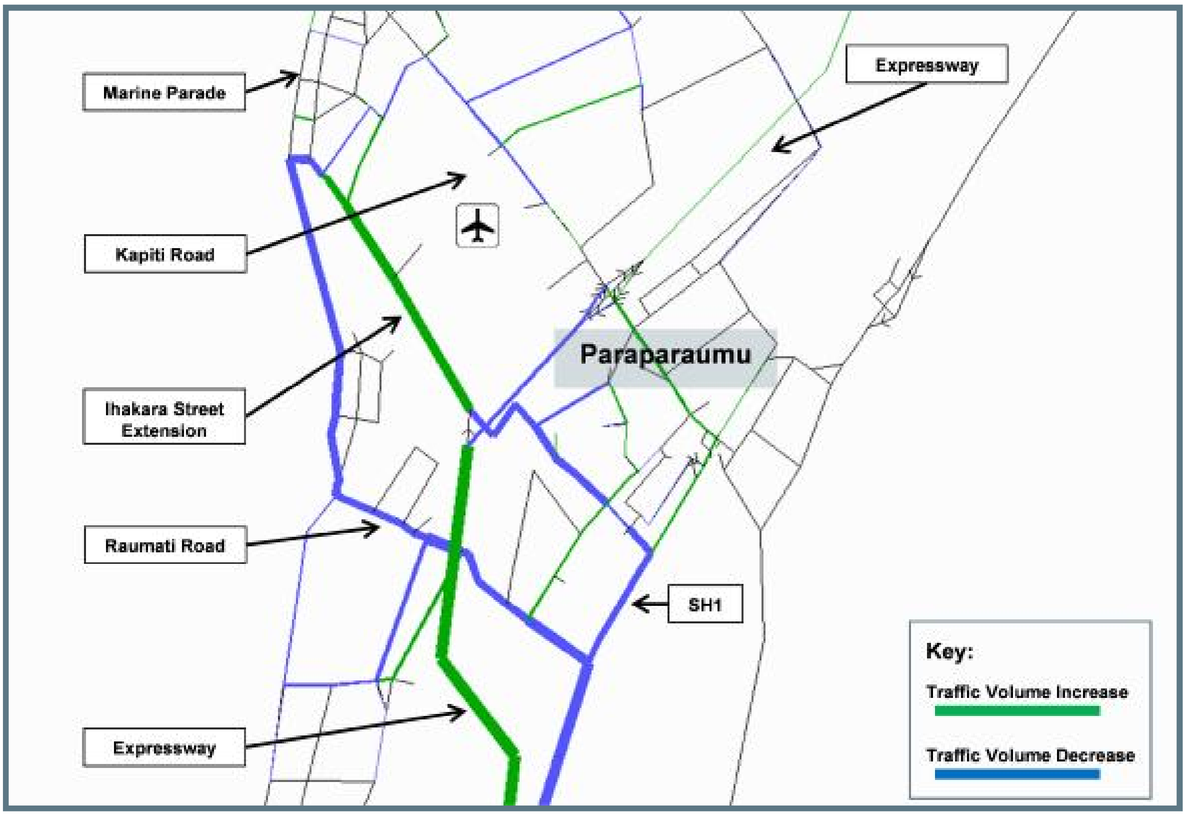


Figure 8.9 – 2026 AM Peak Hour Traffic Volume Difference Plot (Combined Directions)

It can be seen from Figure 8.9, there is a pronounced "switch" in traffic volumes away from the existing SH1 and Raumati Road to the proposed Expressway and proposed Ihakara Street Extension. This appears intuitive since the off ramp has now improved accessibility and travel times from the south to the Paraparaumu Airport development areas. Traffic can remain on the high quality proposed Expressway rather than using the slower, existing SH1 and Raumati Road route. There is also "switch" in traffic away from the existing SH1 and Ihakara Street with a proportion of traffic choosing to remain on the proposed Expressway and then use the off ramp to the proposed Ihakara Street Extension to avoid the slower, existing SH1 and Ihakara Street route.

The re-routing effects of introducing the off ramp have a smaller impact on Kāpiti Road. Despite this, however, there is a reduction in traffic along Kāpiti Road. The magnitude of this traffic volume, along with the other roads outlined in Figure 8.9, is outlined in Table 8.5 overleaf.

8.8.3 Traffic Volume Differences (Combined Directions)

Traffic volumes on key roads (ie those associated with Figure 8.9) with and without the off ramp are outlined in Table 8.5 overleaf.

Road	Without Off Ramp	With Off Ramp	Absolute Difference	% Difference
Marine Parade	500	500	0	0%
Kāpiti Road (north of Cedar Avenue)	1,600	1,500	100	-6%
Ihakara Street Extension	800	1,000	200	+25%
Raumati Road (at SH1)	900	700	-200	-22%
SH1 (south of Raumati Road)	1,900	1,700	-200	-11%
Expressway (south of off ramp)	1,700	2,000	300	+18%

Table 8.5 – 2026 AM Peak Hour Traffic Volume Differences (Combined Directions)

It can be seen from Table 8.5, the largest traffic volume increases occur on the proposed Ihakara Street Extension (+25%) and the proposed Expressway, south of the off ramp (+18%). Conversely, the largest traffic volume decreases are evident on Raumati Road (-22%) and the existing SH1 (south of Raumati Road (-11%). Kāpiti Road sees a small reduction (-6%) in traffic volume with the off ramp in place. These results appear intuitive given the location of the off ramp and the accessibility and travel time improvements the off ramp brings.

8.9 Operational Model Sensitivity Testing

8.9.1 Overview

As discussed in Section 8.2, sensitivity testing was undertaken for the 2026 Option with "Full Growth" (Test A) to assess the road network performance using the KTM2 traffic model. In order to gain a firmer understanding of the more detailed impacts of the 2026 Option with "Full Growth" on the Kāpiti Road corridor, an assessment was undertaken using the VISSIM[15]-based operational traffic model as developed for the initial operational Do Minimum and Option assessments (see Chapter 7, Section 7.1.1). The geographical coverage of this model therefore extends along Kāpiti Road between Te Roto Drive and Arawhata Road intersections as shown overleaf in Figure 8.10.

[15] VISSIM is a micro-simulation package and is used to undertake operational scheme assessments at the most detailed level.

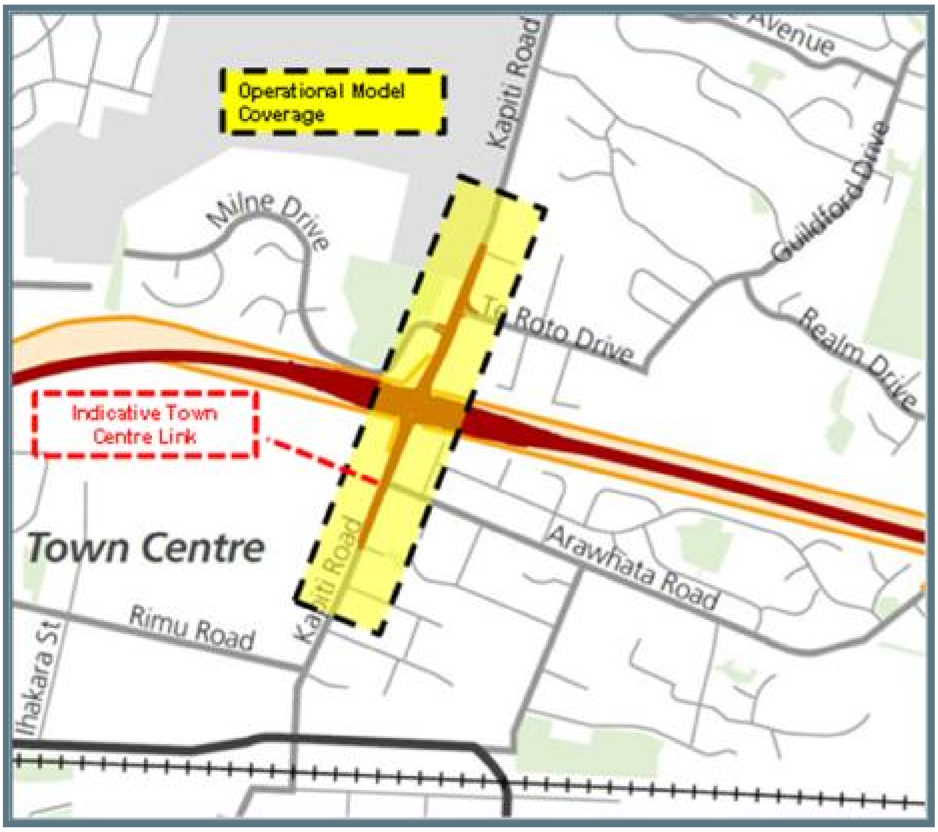


Figure 8.10 – Operational Model Geographical Coverage

The road network and intersection layout details include (a) Arawhata Road extension which creates a connection between Kāpiti Road and Paraparaumu Town Centre (the new Kāpiti Road / Arawhata Road intersection has been signalised); and (b) two signalised Kāpiti Road / Expressway ramp intersections.

The assessment was undertaken for the 2026 PM Peak hour (5pm – 6pm) only and this hour represents the busiest period during an average weekday along Kāpiti Road. Therefore, the results presented in this chapter provide the "worst case" scenario in terms of the operational performance of Kāpiti Road.

Model warm-up and cool-down periods have been applied before and after the first and last 15 minutes respectively for the PM Peak hour. This allows traffic in the network to reach a state which represents the condition at the start of the PM Peak hour.

8.9.2 Model Inputs

The 2026 KTM2 Option PM Peak hour cordon traffic demand matrices (cars/LCVs and HCVs) were used as the key inputs in the development of the PM Peak hour operational traffic model. As discussed in Chapter 7, Section 7.2.2, a half additive and half multiplicative methodology process was adopted for adjusting the future year traffic demand matrices based on the differences between the KTM2 2010 cordon matrix and the VISSIM 2010 demand matrix.

The total number of PM Peak hour trips in the sensitivity Test (A) was expected to increase when compared to the 2026 Option with “Composite” growth scenario (as used to inform the AEE) and this is shown in Table 8.6.

Scenario	PM Peak Hour Trips (Lights + HCVs)	Absolute Difference	% Difference
2026 Option with “Composite” Growth	3,622	-	-
2026 Option with “Full Growth” Test (A)	4,618	996	+27%

Table 8.6 – 2026 PM Peak Hour Trip; Option (Full Growth) VS Option (Composite Growth)

8.9.3 Traffic Signal Timings

The PM Peak hour modelled network was replicated in LINSIG[16] in order to obtain traffic signal timings. LINSIG made use of the same traffic flows that have been used in the VISSIM-based operational traffic model. These signal timings then were exported into the VISSIM traffic model with fixed cycle and phase times over the one hour PM Peak modelled period.

Refinements were then made to the traffic signal phase times in the VISSIM model to further optimise the signal timings. These refinements allowed the intersections at Te Roto Drive and Arawhata Road to perform better and accommodate the upstream and downstream traffic flows.

8.9.4 Operational Modelling Results

As for the initial assessment undertaken, LoS and queue lengths at key approaches of modelled intersections have been collected and recorded over the one hour PM peak modelled period, for all vehicle types. The reported results are based on the outputs of 10 model runs undertaken with different random speeds to represent the stochastic behaviour inherent in a micro-simulation model.

The LoS for each movement at an intersection and for overall intersection LoS was determined based on the flows and average delays calculated. The intersection LoS for a signalised intersection is based on the weight average of the flows and delays for all movements at the intersection. At priority intersections, the average delays based on all movements are not considered appropriate as priority movements experience no or very little delays and carry high volumes of traffic. Therefore, the overall LoS at priority intersection has been assessed as weighted average of all movement excluding priority movements (Kāpiti Road through eastbound and westbound movements).

a. Test (A) – 2026 PM Peak Hour Option with “Full Growth”

[16] LINSIG models allows for the optimisation of signal timings to reduce delay or increase capacity at a junction or a group of interlinked junctions.

Test (A) is expected to have approximately 1,000 additional trips (total vehicles) when compared to the 2026 Option with “Composite” growth. The majority of the increase in the number of trips is from the Kāpiti Road west zone (just west of Arko Place) to the Kāpiti Road east zone (just east of Arawhata Road / Town Centre link).

A total of 511 additional trips (51% of total increase), over the PM Peak hour, is expected to be generated from the Kāpiti Road west zone and travelling east to Arawhata Road, Te Roto Drive, northbound Expressway on-ramp and Kāpiti Road east zone. The total number of trips going to Kāpiti Road east zone increases to 291 trips (29% of total increase), when compared to 2026 Option with “Composite” growth.

The number of trips from Te Roto Drive decreases by 129 trips in Test (A). The total number of trips travelling to Te Roto Drive from the east is expected to decrease by 130 trips in Test (A). This is observed to create a lesser queue and blocking back along Kāpiti Road from the Te Roto Drive intersection to the Kāpiti Road interchange.

8.9.5 Intersection Level of Service (LoS) and Delay

The average delay (seconds) per vehicle and the LoS results for each movement and the intersections are shown in Table 8.7 below.

			Option (Full Growth)		Option (Composite Growth)	
Intersection	Arm	Movement	Delay (s)	LOS	Delay (s)	LOS
Kāpiti Rd/Te Roto Drive	Kāpiti Rd West	Left	4	A	4	A
		Through	9	A	5	A
	Te Roto Drive	Left	34	D	54	F
		Right	209	F	194	F
	Kāpiti Rd East	Through	5	A	7	A
		Right	34	D	17	C
Average of Controlled Movements (Intersection)			28	D	39	E
Kāpiti Rd/Milne Drive	Kāpiti Rd West	Through	2	A	1	A
		Right	47	E	30	D
	Milne Drive	Left	97	F	30	D
		Right	329	F	115	F
	Kāpiti Rd East	Left	2	A	2	A
		Through	6	A	5	A
Average of Controlled Movements (Intersection)			94	F	37	D

Intersection	Arm	Movement	Option (Full Growth)		Option (Composite Growth)	
Kāpiti Rd/Arawhata Rd	Kāpiti Rd West	Left	53	D	19	B
		Through	52	D	16	B
		Right	46	D	34	C
	Arawhata Rd North	Left	0	-	1	A
		Through	13	B	16	B
		Right	81	F	35	C/D
	Kāpiti Rd East	Through	29	C	21	C
		Right	42	D	26	C
	Town Centre Link	Left	46	D	17	B
		Through	44	D	18	B
		Right	32	C	14	B
All Approaches (Intersection)			39	D	20	C
Kāpiti Rd/Ramps	Northbound Off-ramp	Left	23	C	27	C
		Right	75	E	71	E
	Kāpiti Rd West	Left	40	D	37	D
		Through	41	D	29	C
	Southbound Off-ramp	Left	23	C	14	B
		Right	53	D	42	D
	Kāpiti Rd East	Left	47	D	29	C
		Through	65	E	44	D
All Approaches (Intersection)			42	D	30	C

Table 8.7 - 2026 PM Peak Hour Results; Option (Full Growth) VS Option (Composite Growth)

The following observations are noted from the 2026 PM Peak hour Option (ie with Project in place) with “Full Growth”:

- A high level of congestion and queuing is observed along Milne Drive and Te Roto Drive, which is a result of significant right turning traffic attempting to cross the busy Kāpiti Road. However, as stated above, there is a decrease in the overall volume of traffic turning into Te Roto Drive and which is observed to lessen congestion and queues blocking back to the Kāpiti Road interchange;
- The intersection of Kāpiti Road and Arawhata Road is observed to operate well, with queues that dissipate within 2 cycle periods (total 90 seconds);

- The interchange is expected to operate to within capacity level without significant queuing or vehicle delay issues. However, the pedestrian crossing located north of Te Roto Drive is observed to cause traffic to block back significantly, and to the model extents. This means that some vehicles are unable to be released into the model. This may be the reason why the interchange and the intersection of Kāpiti Road / Arawhata Road operate to an acceptable level. However, the pedestrian crossing creates platoons of through movements along Kāpiti Road and which provides gaps in vehicles allowing right turning traffic to cross Kāpiti Road. Removing the pedestrian crossing is observed to create extended queues and significant congestion along Kāpiti Road and blocking back through the interchange and further upstream intersections; and
- The average delays at the Milne Drive approach is expected to increase significantly as the total volume of traffic travelling on the Kāpiti Road modelled corridor has increased. Therefore the overall intersection LoS is reduced and the delays are increased significantly.

8.9.6 Travel Times

The average travel times (seconds) along the modelled Kāpiti Road corridor in the westbound and eastbound directions are shown in Table 8.8. The average speeds (kph) are outlined in brackets.

Direction of Travel	Option (Full Growth)	Option (Composite Growth)
Kāpiti Road - Westbound	99s (19kph)	81s (25kph)
Kāpiti Road - Eastbound	152s (13kph)	87s (22kph)

Table 8.8 - 2026 PM Peak Hour Average Travel Time Results; Option (Full Growth) VS Option (Composite Growth)

When compared to the 2026 PM Peak hour Option with “Composite” growth (see Chapter 7, Section 7.7), the average travel times along the modelled Kāpiti Road corridor increases by around 20 seconds in the westbound direction and by 60 seconds in the eastbound direction. The average speed along the modelled corridor is expected to reduce by around 5kph and 10kph in the westbound and eastbound direction respectively, when compared to the 2026 PM Peak hour Option with “Composite” growth.

Increase in travel times and reductions in speeds are expected as the number of trips in the modelled network increases with the Option with “Full Growth” by around 1,000 trips (total vehicles) when compared to the Option with “Composite” growth. However, the analysis indicates a significant increase in travel times in the counter peak direction (eastbound).

This increase in the travel time is considered to be due to the increase in number of vehicles travelling from Kāpiti Road west to the zones to the east (in particular to Kāpiti Road east). Approximately 345 additional trips (over a one hour period) are expected to travel to Kāpiti Road east from Kāpiti Road west zone, Arawhata Road, Town Centre connection link and the southbound Expressway off-ramp.

8.9.7 Queue Lengths

The queue lengths extracted for the key movements at intersections in the network are shown in Table 8.9.

Intersection	Approach	Movement	Critical Queuing Length (m)	Option (Full Growth) Average (m)	Option (Full Growth) Max (m)	Option (Composite Growth) Average (m)	Option (Composite Growth) Max (m)
Kāpiti Road/Te Roto Drive/Milne Drive	Kāpiti Road East at Te Roto Drive	Right Turn into Milne Drive	70	82	517	38	207
	Kāpiti Road West at Milne Drive	Right Turn into Te Roto Drive	50	101	219	25	429
Kāpiti Road/Arawhata Road	Kāpiti Road West	Through + Left Eastbound	185	71	263	7	121
		Right	50	24	261	11	74
	Kāpiti Road East	Through + Left Westbound	550	22	364	14	83
Kāpiti Road / Ramps	Northbound Off-ramp	Right + Left	310	34	274	22	156
	Kāpiti Road West	Through + Left	170	73	211	37	202
	Southbound Off-ramp	Right + Left	310	13	99	7	75
	Kāpiti Road East	Through + Left Westbound	185	53	393	23	163

Table 8.9 - Queue Length Results; 2026 PM Peak Hour Average Travel Time Results; Option (Full Growth) VS Option (Composite Growth)

The northbound and southbound off ramp maximum expected queue lengths are expected to increase in the 2026 PM Peak hour Option with “Full Growth” when compared to the 2026 PM Peak hour Option with “Composite” Growth. However, they are expected to remain shorter than the critical queuing length and hence will not block back onto the proposed Expressway.

The maximum queue lengths for the through movements at the Kāpiti Road approaches to the Arawhata Road intersection are expected to increase significantly, when compared to the 2026 PM Peak hour Option with “Composite” Growth. The maximum queue lengths on Kāpiti Road west (all movements) are expected to exceed the critical queuing length. The average queue lengths are however less than the critical queuing length of these movements. Therefore, these movements are not expected to block back to the upstream intersections over the full PM peak hour periods.

The average queue length for the right turn into Milne Drive is expected to exceed the critical queuing length of 70m. This is due to the increase in the number of trips along the Kāpiti Road corridor and the increase in number of vehicles turning right into Milne Drive, when compared to the 2026 PM Peak hour Option with “Composite” Growth.

8.9.8 Summary of VISSIM Modelling

Test (A) – 2026 PM Peak Hour Option with “Full Growth”

This scenario is expected to have an additional 1,000 vehicle trips when compared to the 2026 Option with “Composite” growth. The majority of the increase in the number of trips is from the Kāpiti Road west zone (just west of Arko Place) to Kāpiti Road east zone (just east of Arawhata Road / Town Centre link). The reduction in right turning traffic volumes into Te Roto Drive creates lesser delays at Te Roto Drive / Kāpiti Road intersection (reduced by 10 seconds) and with the level of service improving from LoS D to LoS C. However, the overall intersection delay at Milne Drive is expected to increase by one minute. This is created by increased delays experienced by traffic waiting to turn out of Milne Drive approach.

9 Summary

The report is a technical reference document describing the inputs and outputs of the traffic modelling undertaken. The detailed assessment of effects on the transport system is based on these modelling results but reported separately.

This report provides an overview of the modelling process and extensive model outputs. Key outcomes of the modelling include the following forecasts (the interpretation and explanation of these forecasts is contained in Technical Report 32, Volume 3):

- With the proposed Expressway in place, daily two-way traffic volumes along the existing SH1 between Peka Peka and MacKays Crossing are reduced by approximately 50%;
- In 2026 over 20,000 vehicles per day are predicted to use the proposed Expressway between Kāpiti Road and Te Moana Road;
- 50% of journeys that use one or more section of the proposed Expressway originate or terminate outside of the study area. The remainder are local trips between Waikanae and Paraparaumu;
- The proposed Expressway leads to substantial improvements in travel times across a wide range of routes within the Kāpiti Coast District;
- The proposed Expressway is predicted to significantly improve travel times for through traffic between MacKays Crossing and Peka Peka, reducing the travel time in 2026 by seven minutes

in the weekday morning peak (southbound) and over ten minutes in the weekday evening peak (northbound);

- Delays experienced by traffic turning onto the existing SH1 from side roads such as Raumati Road, Ihakara St and Otaihanga Road are substantially reduced as the proposed Expressway draws traffic off the existing state highway, reducing traffic congestion along this route;
- Of the traffic using the proposed Expressway 88% is existing traffic that has migrated to the proposed Expressway whilst 12% is 'induced' traffic (new travel) forecast as a result of the Project;
- Although not directly forecast by the models (which predict average travel times), it is known that travel time variability increases as traffic levels approach the capacity of the network, as expected in this corridor. Therefore the significant increase in capacity provided as part of this Project is also expected to significantly improve travel time reliability;
- A VISSIM model was developed to assess the Kāpiti Road interchange area with and without the Project in place. The results of the VISSIM model indicated that the Kāpiti Road interchange will operate at LOS C during peak times in 2026;
- Sensitivity testing was undertaken of a "Full Growth" scenario. The KTM2 did not converge for the Do Minimum network due to the traffic demands significantly exceeding the capacity of the network, and hence a stable model result was not found. Convergence was however found with the Project in place. This indicates that substantial transport network improvements would be required to accommodate the demands predicted under the "Full Growth" scenario; and
- The VISSIM modelling for the "Full Growth" scenario indicated that the Kāpiti Road interchange will operate within capacity however the LOS will reduce to D with a number of movements operating at LOS E.

Appendix 34.A

WTSM Regional Model Assumptions

Appendix 34.A – WTSM Regional Model Assumptions

The table below summarises the projects from the 2006 WTSM update that are included in the MacKays to Peka Peka Do Minimum model runs.

Table A1 – Projects from 2006 WTSM Update

Projects from 2006 WTSM Update	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
MacKays Crossing Overbridge	Y	Y	Y	Y	Grade separation of SH1 and the rail crossing and local roads at MacKays crossing.
Inner City bypass	Y	Y	Y	Y	New road layout including new signals between the Terrace Tunnel and the Basin Reserve. Construction now complete.
Waiohine Bridge	Y	Y	Y	Y	Bridge replacement
Centennial Highway Median Barrier - Stage 1	Y	Y	Y	Y	Median barrier installation on SH1
Centennial Highway Median Barrier - Stage 2	Y	Y	Y	Y	Median barrier installation on SH2
Dowse to Petone Interchange	Y	Y	Y	Y	Grade-separation of intersections on SH2
Basin Reserve Improvements	Y*	Y	Y	Y	Part of RoNS. See next table.
Kāpiti Western	N	N	N	N	Construction of the WLR Stage 1

Projects from 2006 WTSM Update	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
Link Road - Stage 1					
Kāpiti Western Link Road - Stage 2	N	N	N	N	Construction of the WLR Stage 2
Kāpiti Western Link Road - Stage 3	N	N	N	N	Construction of the WLR Stage 3
Melling Interchange	Y	N	N	Y	Grade separation of SH2 and Melling bridge.
Kennedy Good Bridge Grade Separation	Y	N	N	Y	Grade separation of SH2 and Kennedy Good bridge. Refer to Appendix 34.A6 for layout.
Rimutaka Corner Easing (Muldoon's)	Y	Y	Y	Y	Geometric improvements on SH2 Rimutaka Hill Road
SH2/58 Grade Separation	Y	Y	Y	Y	Grade separation of SH2 and SH58.
Rugby St/Adelaide Rd Intersection	Y	Y	Y	Y	Rugby St / Adelaide Rd Intersection signalisation and amendments to lane markings. Construction completed.
Ngauranga to Terrace Tunnel ATMS	Y	Y	Y	Y	New ATMS infrastructure (VMS signage, cameras etc.) on SH1 between Ngauranga and the Terrace Tunnel.
Petone to Ngauranga ATMS	Y	Y	Y	Y	New ATMS infrastructure (VMS signage, cameras etc.) on SH2 between Petone and Ngauranga.
Ōtaki	Y	Y	Y	Y	Additional circulating lanes installed on

Projects from 2006 WTSM Update	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
Roundabout					the Ōtaki Roundabout
Old Hautere Road Safety Improvements	Y	Y	Y	Y	Intersection safety improvements
Paekakariki Improvements	N	N	N	N	New seagull layout at the SH1 / Paekakariki Hill Road / Beach Road. Refer to Appendix 34.A8 for layout.
Pukerua Bay Improvements	Y	Y	Y	Y	Safety improvements at intersections.
Ōtaki to Waikanae Sth Bd PL	Y	Y	Y	Y	Constructed
Featherston to Greytown Nth Bd PL	Y	Y	Y	Y	Northbound passing lane located between Featherston and Greytown
Greytown to Featherston Sth Bd PL	Y	Y	Y	Y	Northbound passing lane located between Featherston and Greytown
Carterton to Masterton Nth Bd PL	Y	Y	Y	Y	Northbound passing lane located between Carterton to Masterton
Masterton to Carterton Sth Bd PL	Y	Y	Y	Y	Southbound passing lane located between Masterton to Carterton
Judgeford Passing Lane	Y	Y	Y	Y	
Petone - Horokiwi					

Projects from 2006 WTSM Update	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
Cycling Facility					
Teihana Road Pedestrian Facilities					
Wellington State Highway Strategy					
SH2 Petone to Hayward Safety Review					
Wellington Cycle Strategic Audit					
TDM Impacts	Y	Y	Y	Y	Impacts of TDM strategy - the RLTS assumes 5% reduction in trips to the CBD.
Lindale Grade Separation	Y	Y	Y	Y	Already constructed.
Mana-Plimerton	Y	Y	Y	Y	Change from T2 to peak hour clearways.
Waterloo Quay Rail Grade Separation	N	N	N	N	Grade separation of Aotea Quay and the rail line to the port.
Terrace Tunnel Tidal flow	N	N	N	N	Installation of two vs one lane tidal flow in the peak periods through the Terrace Tunnel
Ngauranga – Aotea Capacity	Y*	Y	Y	N	Part of RoNS. See next table.

Projects from 2006 WTSM Update	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
Improvement					
Grenada - Gracefield Stage 1 to Petone	Y	N	Y	Y	New link between SH1 (Grenada North) and SH2 (Petone).
Grenada - Gracefield Stage 2 CVL	N	N	N	N	New link between SH2 (Petone) and Gracefield.
SH58 SH2-summit 4 laning	N	N	N	N	4-laning from SH2 to the summit
Petone - Ngauranga incl cyclelane	Y	Y	Y	Y	
Akatarawa Upgrade	N	N	N	N	
TDM, Western Corridor ATMS+HOV	N	N	N	N	
Transmission Gully Motorway Construction	Y*	Y	Y	N	Part of RoNS. See end of table.
SH58 upgrade TGM to SH2	N	N	N	N	Roundabouts at 7 locations & 70 km/h treatment: n Roundabout at Bradey Road n Roundabout at Sawmill n Roundabout at Belmont Road n Roundabout at Murphys Rd / Flightys Rd

Projects from 2006 WTSM Update	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
					n Roundabout at Mulhern Rd n Roundabout at Judgeford Golf Club entrance n Roundabout at Moonshine Road n 70 km/h speed limit from Pauatahanui to Moonshine Road Existing alignment with 100 km/h speed limit from Moonshine Road to SH2
Otaihanga Interchange (2 lane)	N	N	N	N	Grade separation of SH1 and Otaihanga Road
Waikanae Upgrade	N	N	N	N	Grade separation of SH1 and Te Moana and Elizabeth Street in Waikanae
Rail Station Maintenance and Upgrade	Y	Y	Y	Y	
Park & ride Carparks	Y	Y	Y	Y	
Porirua Interchange	N	N	N	N	
Kaiwharawhara Throat Improvements	Y	Y	Y	Y	Additional capacity at the Kaiwharawhara throat. Improved reliability.
Integrated Ticketing	Y	Y	Y	Y	Reduced boarding time as a result of improved ticketing
Integrated Fares	Y	Y	Y	Y	Passengers can pay for whole journey independent of operator

Projects from 2006 WTSM Update	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
Real Time Information Systems	Y	Y	Y	Y	New automated passenger information signs
Buslanes	Y	Y	Y	Y	
Road Pricing	N	N	N	N	

The table below summarises the Wellington Northern Corridor RoNS projects to include in the MacKays to Peka Peka model runs.

Table A2 – Wellington Northern Corridor RoNS Projects

Wellington Northern Corridor RoNS Projects	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
North Ōtaki to north of Levin	Y	N	Y	Y	*Not in WTSM area.*
Peka Peka to North Ōtaki	Y	Y	Y	Y	Use current option. Diagram attached.
MacKays Crossing to Peka Peka	N	N	N	N	(Part of Option Test)
Transmission Gully	Y	N	Y	Y	Use current option. ***The downgrading of the Coastal Route*** is as follows. Linden to Paremata : 100kph zone retained, signals at Whitford Brown rephased so that green times reflect demand (more green time to side roads)

Wellington Northern Corridor RoNS Projects	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
					Paremata to Plimmerton roundabout : Both bridges retained, new signals at Marina View intersection, all signals phased so that green times reflect demand (more green time for side roads), T2 lanes removed and permanently available for parking and dedicated to turning movements at intersections Plimmerton roundabout to Pukerua Bay : Now a 80kph zone Pukerua Bay : New signals at Grey St, Teihana Rd west, Pukerua Beach Rd and Pa Rd/Toenga Rd with pedestrian phases and signals phased to reflect demand Pukerua Bay to MacKays : Signals at Paekakariki Hill Rd/Beach Rd with signals phased to reflect demand, 70kph zone extended south to Fisherman's Table ***Local connections*** will be at SH58,, Whitby Link Rd (James Cook Dr), Waitangairua Link Rd (Warspite Ave) and Kenepuru Dr
Ngauranga to Aotea Quay	Y	Y	Y	Y	8L during AM and PM peaks and existing off peak.
Terrace Tunnel Duplication	Y	N	Y	Y	Duplicate tunnel resulting in 3L northbound (in existing tunnel) and 2L southbound (in new tunnel). 3L northbound and 2L southbound from Tunnel to Basin Reserve.
Basin Reserve Improvements	Y	Y	Y	Y	Use current option. Diagram attached. Also to include changes to ICB: • 3 lanes either direction - to and from the Basin on the one way pairs. • 3 lanes Victoria St between Webb and Vivian

Wellington Northern Corridor RoNS Projects	Include in M2PP Do-Min WTSM Runs	2016	2026	2031	Description
					• 3 lanes Willis between Karo and Ghuznee.
Mt Victoria Tunnel to Airport	Y	Y in part	Y	Y	Duplication of Mt Victoria Tunnel and four lanes from the Basin Reserve to Kilbirnie Crescent. Diagram attached. To be completed in two stages: Four lanes from Taurima St (east of tunnel) to Kilbirnie Crescent to be implemented by 2016. Duplication of tunnel to be implemented by 2026.

Figure A1 – Wellington RoNs Projects

Table A.3 below has been prepared by David Young, David Young Consulting, and outlines the assumptions that underpin the WTSM regional model. The accompanying text provides some background to the HCV growth rates used in WTSM.

Table A.3 WTSM – Inputs in Forecasting

Networks	WTSM	ART3 - RLTS	ART3 – NZTA (AMETI modelling)
Road Networks			
PT Infrastructure and Services			
Land Use Forecasts			
Population, households by category			
Employment by category			
Education rolls by category			
Economic Inputs			
Car Ownership	GDP/capita	GDP/capita	GDP/capita
Growth GDP/capita	1.8% p.a.	1.8% p.a.	1.8% p.a.
Values of time	2006 values	2006 values	Escalated in relation to GDP/Capita with elasticity of 1 for work trips and 0.8 for non-work
Fuel price	From ARC's RLTS research with adjustment for improved efficiency (1% p.a.)	From ARC's RLTS research (eg $3.71/l in 2041 ($2006))	From ARC's RLTS research, except for 2016 which is reduced to reflect current price
Vehicle efficiency and alternative fuels		2006 values	From latest MoT model
Parking costs (commuter)	2006 values	Escalated but basis uncertain	Escalated based on earnings with elasticity of 1.2 on GDP/Capita,

			which is slightly lower than in RLTS
Parking costs (non-commuter)	2006 values	2006 values	Escalated based on earnings with elasticity of 0.8
PT fares	2006 values (20% more than in 2006 model update)	2006 values	Escalated based on operating costs and earnings, with elasticity found to match historic trend
Effects of integrated ticketing	Boarding time reduced by 0.5 min	10% reduction in stop time	Reduction in stop time counterbalanced by increased patronage/bus
Effects of integrated fares	Nil	2nd boarding fare removed	2nd boarding fare removed but fares increased to give same revenue
Effects of real time information systems	Boarding time reduced by 1.0 min	Nil	Nil
Growth in HCV trips Function of employment growth and a multiplier related to GDP growth	Multiplier of 1.3	Multiplier of 1.3	Multiplier reduced to 0.6 in response to very high HCV growth
TDM effects Car trips transferred to other modes etc	5% of HBW car trips to CBD transferred to PT, active	Workplace, education, community travel plans reduce regional car travel by ~8-10%	Reduced to 15% of RLTS effects

HCV Growth:

The delivered ART3 (Auckland Regional Transport Model version 3) utilised the same HCV growth model as in WTSM currently. This was reviewed as part of the latest Waitemata Harbour Crossing Study in light of concerns, from both the ARC and other users of model outputs, at the high level of growth.

The outcome of the review was to retain the distribution of HCV demand in accordance with the changed distribution of employment and households (based on the HCV trip end calculations), but to modify the relationship of overall growth to GDP/capita growth.

An assumed growth in GDP/head of 1.8% p.a. and growth in Auckland population of 49% to 2041 implies a GDP growth assumption of 3% p.a. With the current HCV model, employment growth of 60%, and an elasticity of 1.3 to GDP/capita, this gives a 260% increase in HCV trips.

In Wellington the corresponding figures to 2031 would be a 2.2% growth in GDP and a 24% growth in employment, giving an increase in HCV trips of around 120%.

The historic overall national elasticity of HCV vkt to GDP (real) appears to be about 1.0, but this may be too high in urban areas. In other studies a value of around 0.6 has proved to be more appropriate in urban areas. In Wellington this (0.6) would halve the present forecasts of HCV growth; that is about 60% growth between 2006 and 2031.

David Young

21 March 2011

Figures A2 to A6 outline the network improvements that are assumed to take place within the study area.

Figure A2 – 2010 Paraparaumu Town Centre Concept Plan (Kobus Mentz)

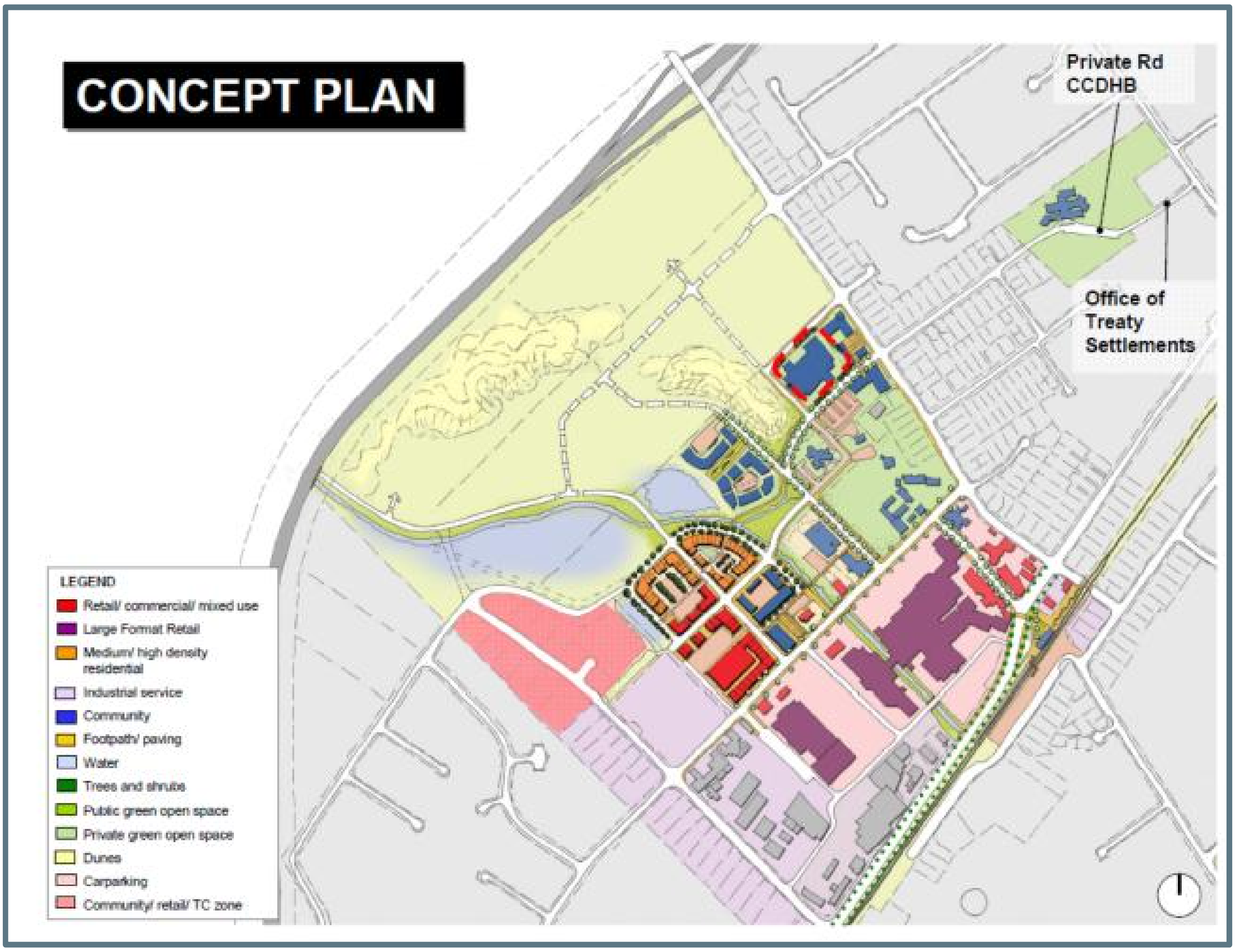


Figure A3 – Proposed Network Changes in Paraparaumu

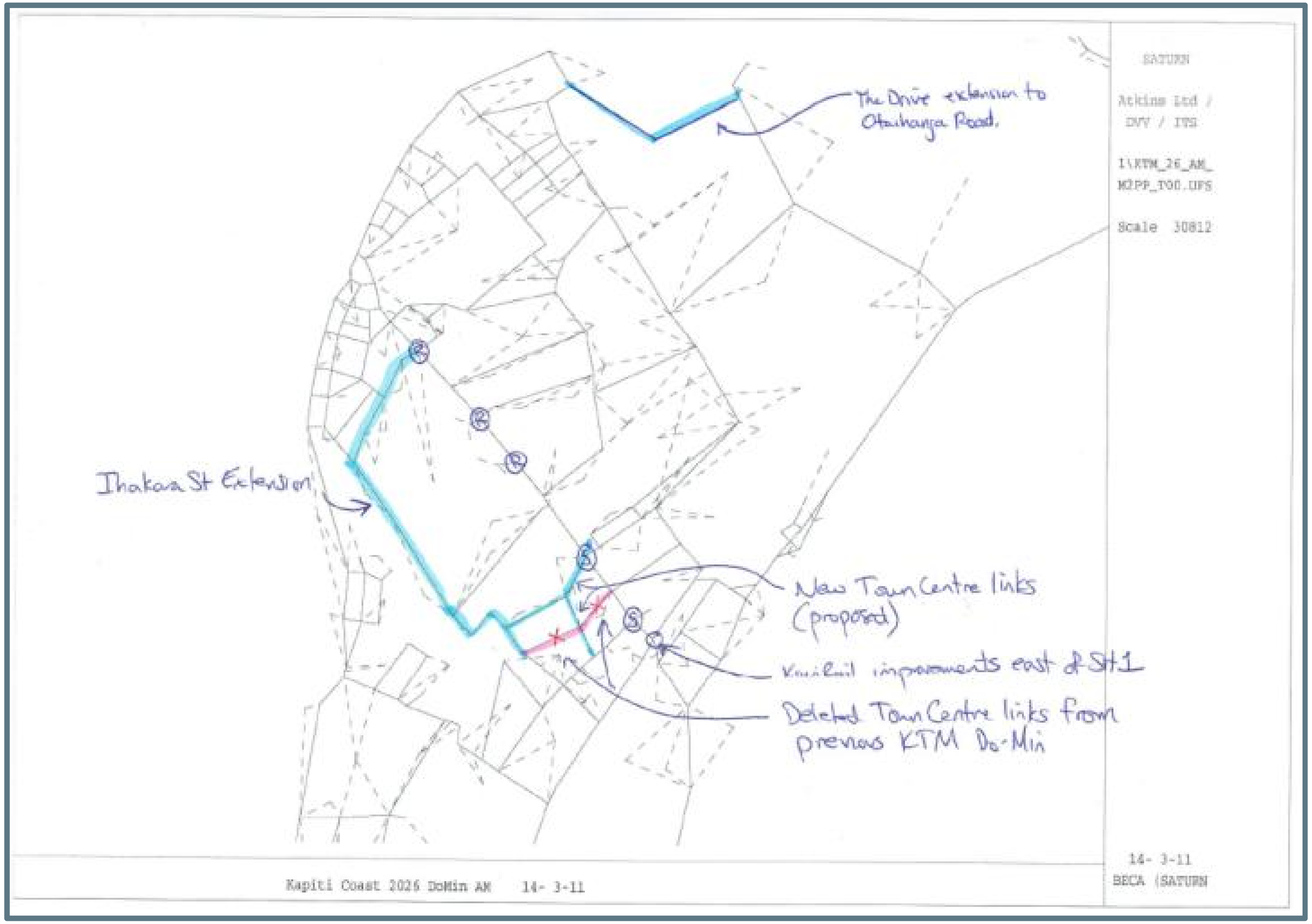


Figure A4 – Proposed Network Changes in Waikanae

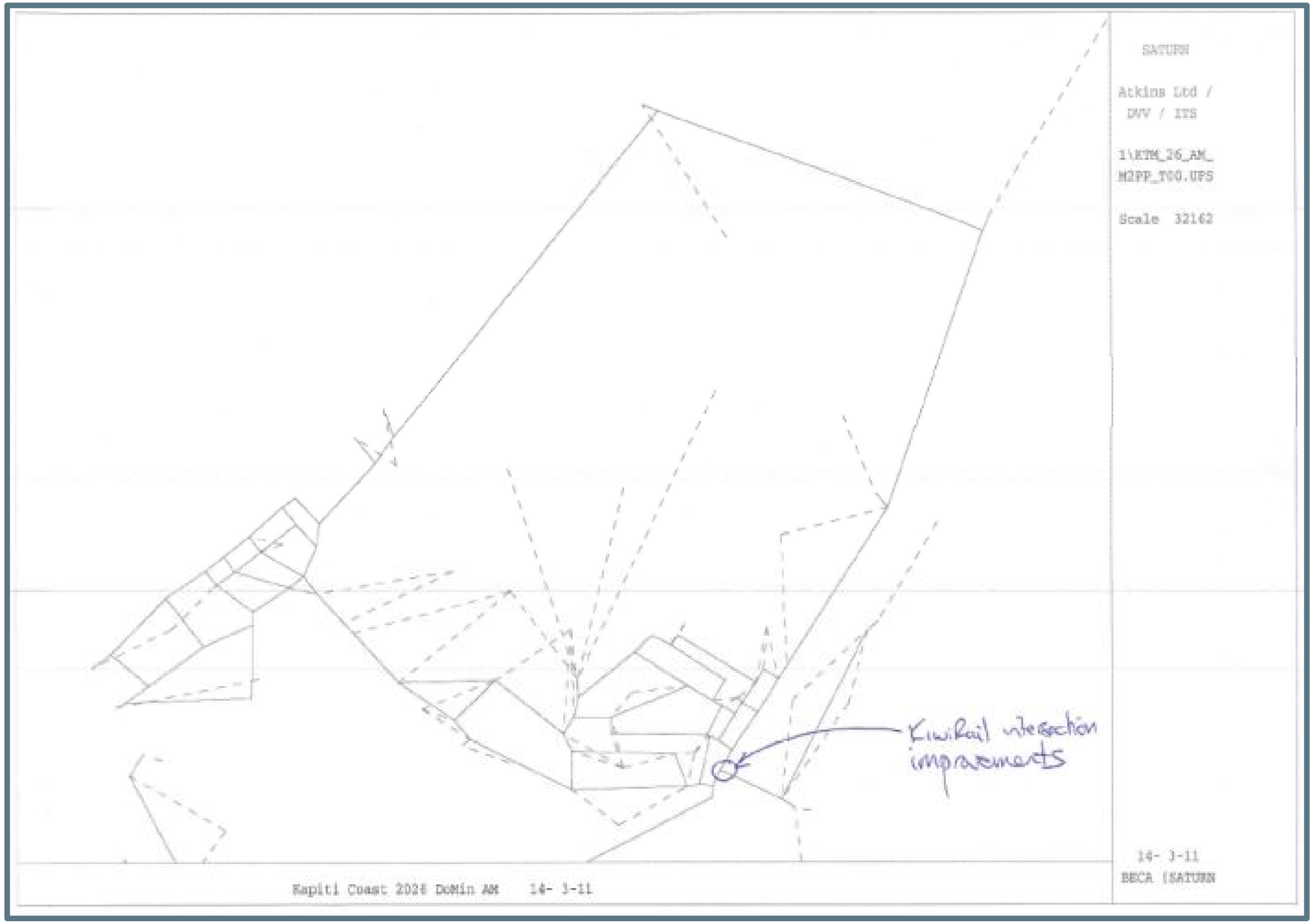


Figure A5 – KiwiRail Changes to SH1 / Elizabeth Street Intersection in Waikanae

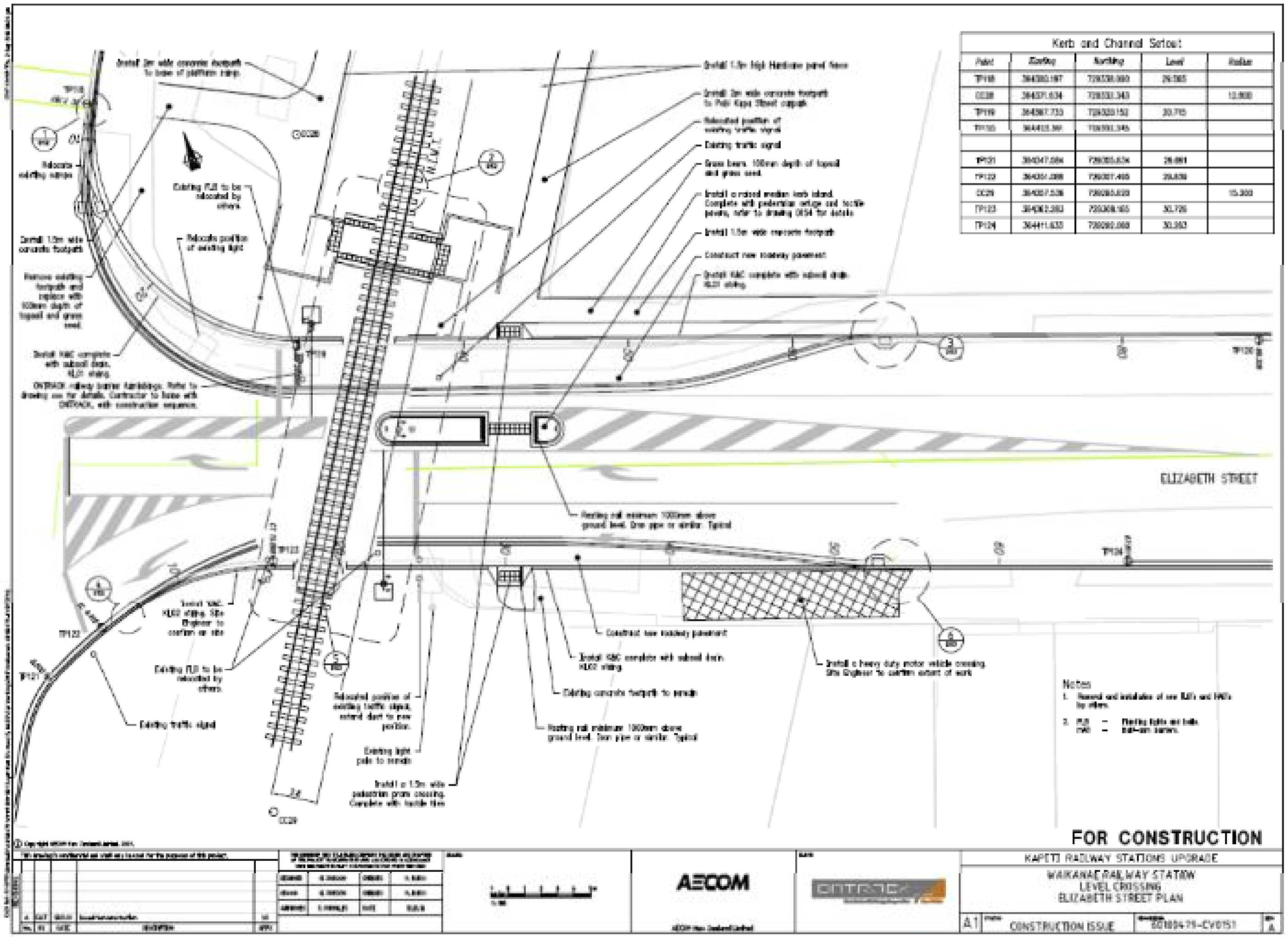
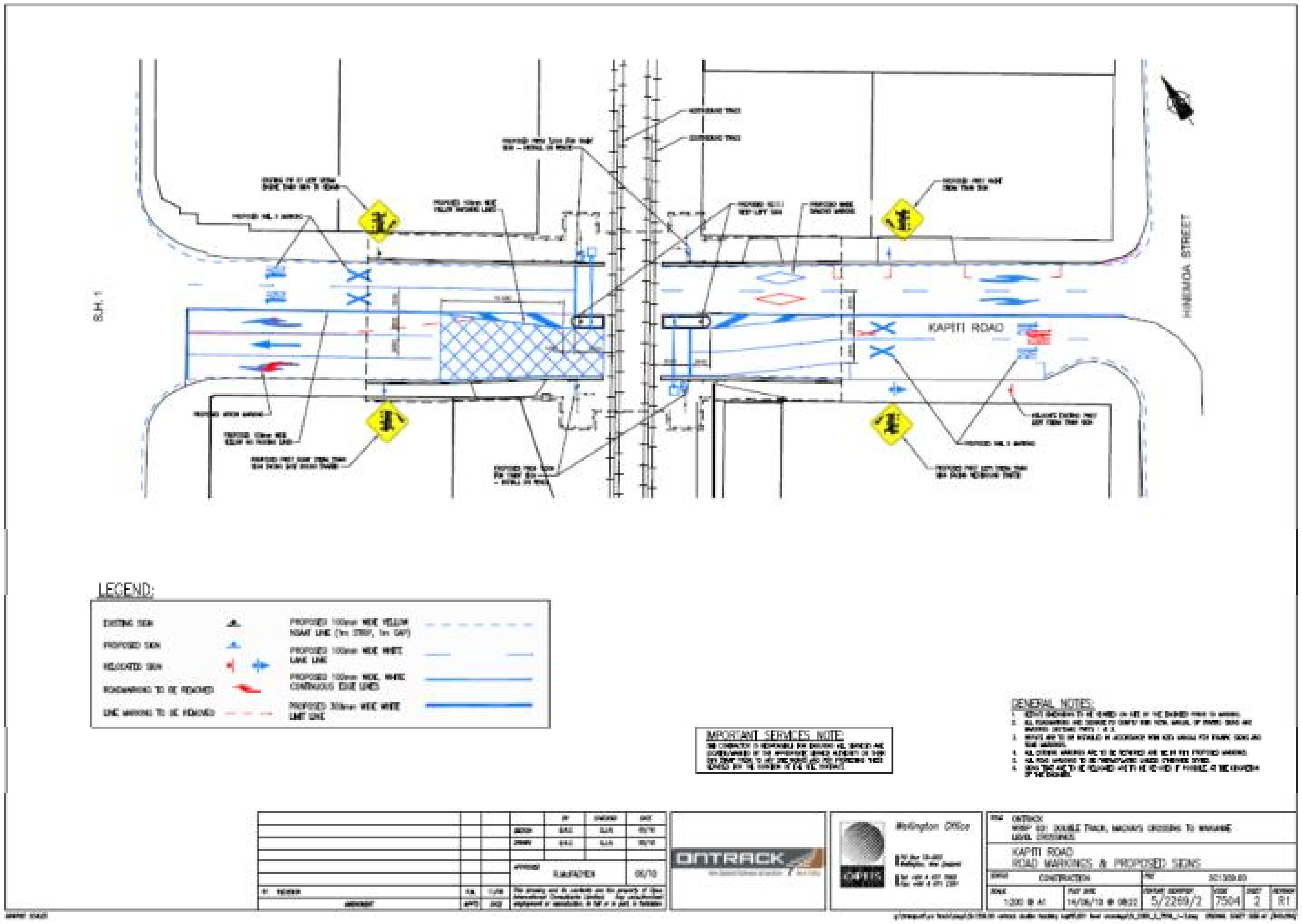


Figure A6 – KiwiRail Changes to SH1 / Kāpiti Road Intersection in Paraparaumu



Appendix 34.B

Development Assumptions and Trip Generation

Appendix 34.B – Development Assumptions and Trip Generation

The tables overleaf outline the trip generation and phasing assumptions relating to four committed developments that are proposed for Kāpiti District. The developments are as follows:

- Paraparaumu Town Centre – mixed use, retail and housing;
- Paraparaumu Airport – business, light industry, warehousing and retail;
- Waikanae North – two significant housing developments to the north of Waikanae; and
- Riverbanks – a smaller mixed used development in Ōtaki.

Figure B1 details the trip rates that have been used to generate trips for each development according to the planned land use. The detailed land use information and trip rates were taken from previous work that assessed the impact that the various planned developments had upon the road network; whilst the information was agreed with stakeholders back in 2006, following review it was agreed with the stakeholders that this information could be used for assessing the effects of the proposed MacKays to Peka Peka Expressway.

Figures B2 to B5 show the level of trip generation for each planned development, broken down by time period, user class (light vehicles or HCVs) and model zone. Data for both the “composite” growth scenario (used for this report and Technical Report 33, Volume 3) and the “controlled” to WTSM growth scenario (used for the Project economic assessment) are presented, together with the full level of growth should this ever be assumed and modelled.

Figure B1 – Trip Rates

TRIPS Generation Information Summary Sheet (based on meeting with KCDC, TKTP, FFTP, Duffill Watts and TSE Ltd, Opus on 12 July 2006)

Usage	Daily Trip Generation	Unit	Proportions					Adjustments	Trip Rates (hourly)					
			AM	IP	PM	Car	HCV Daily	(%)	Am In	Am Out	Ip In	Ip Out	Pm In	Pm Out
Office	15	/100m2	2.00	1.40	2.00	1.00	0	15	0.85	0.15	0.50	0.50	0.20	0.80
Warehouse / Storage	1.85	/100m2	0.20	0.20	0.20	0.95	0.05	5	0.50	0.50	0.50	0.50	0.50	0.50
Warehouse / Distribution	3	/100m2	0.50	0.30	0.50	0.50	0.5	0	0.60	0.40	0.50	0.50	0.40	0.60
Business Services	14	/100m2	1.10	1.35	1.25	0.95	0.05	15	0.68	0.32	0.50	0.50	0.36	0.64
Service	14	/100m2	1.10	1.35	1.25	0.95	0.05	15	0.68	0.32	0.50	0.50	0.36	0.64
Warehouse / Trading	20	/100m2	2.40	2.60	0.60	0.84	0.16	20	0.54	0.46	0.50	0.50	0.16	0.84
Large Format Retail	30	/100m2	2.00	2.60	3.00	0.98	0.02	20	0.70	0.30	0.50	0.50	0.47	0.53
Education	30	/100m2	2.00	2.60	1.00	1.00	0	5	0.90	0.10	0.50	0.50	0.50	0.50
Retail - Specialist/Convenience	120	/100m2	4.00	10.00	20.00	0.99	0.01	75	0.60	0.40	0.50	0.50	0.50	0.50
Supermarket	120	/100m2	4.00	10.00	20.00	0.99	0.01	45	0.60	0.40	0.50	0.50	0.50	0.50
Mixed Use	20	/100m2	1.80	1.80	1.8	0.95	0.05	40	0.85	0.15	0.50	0.50	0.30	0.70
Tourist Accommodation	9.08	/100m2	0.67	0.50	0.64	0.97	0.03	10	0.20	0.80	0.50	0.50	0.65	0.35
Medium Density Housing	2.5	/dwelling	0.25	0.13	0.25	1.00	0	10	0.20	0.80	0.50	0.50	0.65	0.35
Higher Density Housing	2.5	/dwelling	0.25	0.13	0.25	1.00	0	10	0.20	0.80	0.50	0.50	0.65	0.35
Health	40	/100m2	0.09	0.50	0.35	1.00	0	15	0.59	0.41	0.10	0.90	0.50	0.50
Civic Amenity	1325	/day	144	119	186	1.00	0	20	0.50	0.50	0.50	0.50	0.50	0.50
Airport - Terminal Buildings	20	/day	2.67	1.87	2.67	0.98	0.02	15	0.75	0.25	0.50	0.25	0.75	0.80
Airport - 10% Aviation Use	2	/day	0.27	0.19	0.27	0.90	0.1	10	0.75	0.25	0.50	0.25	0.75	0.80
Airport - Core	2	/day	0.27	0.19	0.27	0.95	0.05	10	0.75	0.25	0.50	0.25	0.75	0.80

Figure B2 – Car Trip Generation Data Input to KTM2 (50% Composite Growth)

2016 Car

Area	KTM Zone	AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out
2. PPTC	50	92	55	154	92	197	197	284	328	255	295
	51	68	54	113	90	84	86	93	96	84	86
	52	37	26	62	43	76	76	119	127	107	114
3. Airport	82	60	28	99	47	64	64	71	112	64	101
	83	30	11	50	18	26	26	24	52	22	47
	84	44	15	73	24	47	47	47	77	42	69
	85	47	20	79	33	77	77	114	148	102	133
	86	54	26	91	43	66	66	57	86	52	77
	87	70	22	116	37	60	60	44	113	40	102
4. WNL	142	46	100	77	166	85	85	171	121	154	109
	148	46	100	77	166	85	85	171	121	154	109
	149	22	75	37	126	51	51	125	80	113	72
	PPTC	197	134	329	224	356	359	496	551	446	495
	Airport	305	122	508	203	340	340	358	587	322	528
	WNL	114	275	190	458	221	221	467	321	420	289
		616	**531**	**1,027**	**885**	**917**	**919**	**1,320**	**1,459**	**1,188**	**1,313**

2026

Area	KTM Zone	AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out
2. PPTC	50	235	140	392	234	501	501	722	835	650	751
	51	173	137	288	228	213	219	236	244	213	220
	52	94	65	157	108	193	193	304	323	273	290
3. Airport	82	152	72	253	120	162	162	182	284	164	256
	83	76	28	127	47	65	65	62	132	56	119
	84	111	37	186	62	121	121	120	196	108	176
	85	120	50	201	83	196	196	290	376	261	338
	86	139	66	231	110	169	169	146	218	131	197
	87	178	57	296	95	152	152	113	288	101	260
4. WNL	142	117	254	195	423	216	216	434	307	391	277
	148	117	254	195	423	216	216	434	307	391	277
	149	56	192	93	320	130	130	319	203	287	182
	PPTC	502	342	837	570	907	913	1262	1401	1136	1261
	Airport	776	310	1293	516	864	864	912	1495	821	1345
	WNL	290	699	484	1165	562	562	1187	817	1069	735
		1,568	**1,351**	**2,614**	**2,252**	**2,333**	**2,340**	**3,361**	**3,713**	**3,025**	**3,342**

2031

Area	KTM Zone	AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out
2. PPTC	50	280	167	467	278	596	596	859	994	773	894
	51	206	163	343	272	253	261	282	291	253	262
	52	112	77	187	129	230	230	362	384	325	346
3. Airport	82	181	86	301	143	193	193	216	339	195	305
	83	90	33	151	56	77	77	74	157	67	141
	84	133	44	221	73	144	144	143	233	128	210
	85	143	59	239	99	233	233	345	447	310	402
	86	165	78	275	130	201	201	174	260	156	234
	87	211	68	352	113	181	181	134	343	121	309
4. WNL	142	139	302	232	503	257	257	517	366	465	329
	148	139	302	232	503	257	257	517	366	465	329
	149	67	229	111	381	155	155	379	241	341	217
	PPTC	598	407	996	679	1079	1087	1502	1668	1352	1501
	Airport	924	369	1540	614	1029	1029	1085	1779	977	1601
	WNL	345	832	576	1387	669	669	1414	973	1272	875
		1,867	**1,608**	**3,112**	**2,680**	**2,778**	**2,786**	**4,001**	**4,420**	**3,601**	**3,978**

Figure B3 – HCV Trip Generation Data Input to KTM2 (pcus) (50% Composite Growth)

2016 HCV

Area	KTM Zone	AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out
2. PPTC	50	3	1	5	2	5	5	5	7	4	7
	51	2	0	3	1	2	2	1	3	1	3
	52	1	0	1	0	1	1	1	2	1	2
3. Airport	82	15	10	26	17	13	13	18	26	16	23
	83	10	7	17	11	8	8	11	17	10	15
	84	4	3	7	4	4	4	5	7	4	6
	85	3	2	6	4	4	4	5	6	4	6
	86	3	3	6	4	5	5	1	3	1	3
	87	14	9	23	15	12	12	15	23	14	21
4. WNL	142	0	0	0	0	0	0	0	0	0	0
	148	0	0	0	0	0	0	0	0	0	0
	149	0	0	0	0	0	0	0	0	0	0
	PPTC	5	2	9	3	8	8	7	12	7	11
	Airport	50	34	84	56	46	46	55	82	49	74
	WNL	0	0	0	0	0	0	0	0	0	0
		56	**36**	**93**	**59**	**54**	**54**	**62**	**94**	**56**	**85**

2026

Area	KTM Zone	AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out
2. PPTC	50	7	4	12	6	12	12	12	19	11	17
	51	5	1	9	2	5	5	3	7	3	7
	52	1	1	2	1	3	3	3	4	3	4
3. Airport	82	39	26	65	44	33	33	45	66	40	59
	83	25	17	42	28	21	21	28	42	25	38
	84	11	7	18	11	10	10	12	18	11	16
	85	9	6	14	9	9	9	12	16	11	15
	86	8	7	14	11	14	14	3	7	3	7
	87	36	23	59	39	31	31	39	60	35	54
4. WNL	142	0	0	0	0	0	0	0	0	0	0
	148	0	0	0	0	0	0	0	0	0	0
	149	0	0	0	0	0	0	0	0	0	0
	PPTC	14	5	23	9	20	20	19	30	17	27
	Airport	128	86	213	143	117	117	140	209	126	188
	WNL	0	0	0	0	0	0	0	0	0	0
		142	**91**	**236**	**151**	**138**	**138**	**158**	**239**	**142**	**215**

2031

Area	KTM Zone	AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out
2. PPTC	50	9	4	14	7	15	15	15	22	13	20
	51	6	1	11	2	6	6	4	9	3	8
	52	2	1	3	1	3	3	4	5	3	5
3. Airport	82	46	31	77	52	40	40	53	78	48	70
	83	30	20	50	33	25	25	33	50	30	45
	84	13	8	21	13	11	11	15	21	13	19
	85	10	7	17	11	11	11	14	20	13	18
	86	10	8	17	13	16	16	4	9	4	8
	87	42	28	71	46	37	37	47	71	42	64
4. WNL	142	0	0	0	0	0	0	0	0	0	0
	148	0	0	0	0	0	0	0	0	0	0
	149	0	0	0	0	0	0	0	0	0	0
	PPTC	17	6	28	10	24	24	22	36	20	32
	Airport	152	102	253	170	140	140	166	249	150	224
	WNL	0	0	0	0	0	0	0	0	0	0
		168	**108**	**281**	**180**	**164**	**164**	**188**	**285**	**169**	**256**

Figure B4 – Summary of Development Related Trips, Full, Composite and WTSM Controlled Scenarios, Including Implied GFA

Summary of Development Trips

Assumed GFA (Fully Developed)	
Town Centre	285,000
Airport	331,648

Scenario - Full Growth

2016 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	162	109	270	182	291	293	402	450	362	405	75,240
	Airport	284	124	473	207	309	309	330	535	297	482	87,555
	WNL	91	220	152	366	177	177	373	257	336	231	
		537	453	896	755	777	779	1,106	1,242	995	1,118	
			990		1,651		1,555		2,348		2,113	

2026 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	516	347	860	579	927	934	1281	1432	1153	1288	239,400
	Airport	904	395	1506	659	982	982	1051	1703	946	1533	278,584
	WNL	290	699	484	1165	562	562	1187	817	1069	735	
		1,710	1,442	2,850	2,403	2,471	2,478	3,519	3,952	3,167	3,557	
			3,152		5,253		4,948		7,471		6,724	

2031 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	614	413	1024	689	1103	1112	1524	1704	1372	1534	285,000
	Airport	1076	471	1793	784	1169	1169	1252	2028	1126	1825	331,648
	WNL	345	832	576	1387	669	669	1414	973	1272	875	
		2,035	1,716	3,392	2,861	2,941	2,950	4,190	4,705	3,771	4,234	
			3,752		6,253		5,891		8,895		8,005	

Scenario - Composite Growth

2016 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	81	55	135	91	146	147	201	225	181	202	37,620
	Airport	142	62	237	104	154	154	165	268	149	241	43,778
	WNL	46	110	76	183	88	88	187	128	168	116	
		269	227	448	378	388	389	553	621	498	559	
			495		825		778		1,174		1,057	

2026 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	258	174	430	289	463	467	640	716	576	644	119,700
	Airport	452	198	753	329	491	491	526	852	473	767	139,292
	WNL	145	350	242	583	281	281	594	409	534	368	
		855	721	1,425	1,201	1,235	1,239	1,760	1,976	1,584	1,778	
			1,576		2,626		2,474		3,736		3,362	

2031 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	307	207	512	344	552	556	762	852	686	767	142,500
	Airport	538	235	896	392	584	584	626	1014	563	913	165,824
	WNL	173	416	288	694	335	335	707	486	636	438	
		1,018	858	1,696	1,430	1,471	1,475	2,095	2,352	1,885	2,117	
			1,876		3,127		2,945		4,447		4,003	

Scenario - Controlled to WTSM (Approximate)

2016 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	98	66	191	129	103	103	101	113	102	114	28,797
	Airport	167	72	319	135	112	112	87	140	86	139	35,885
	WNL	56	134	109	262	62	62	93	64	94	65	
		321	272	618	526	276	277	281	318	282	318	
			593		1,144		553		600		600	

2026 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	218	147	359	242	234	236	327	366	299	335	70,972
	Airport	371	159	611	262	261	261	272	440	245	397	85,741
	WNL	123	297	203	489	141	141	303	208	278	191	
		713	604	1,173	994	636	638	901	1,014	822	923	
			1,316		2,167		1,274		1,915		1,745	

2031 Vehicles

Area		AM Pre In	AM Pre Out	AM Pk In	AM Pk Out	Ip In	Ip Dest Out	Pm Pre In	Pm Pre Out	Pm Pk In	Pm Pk Out	GFA
	PPTC	242	163	397	268	290	292	412	461	431	481	88,312
	Airport	420	182	681	294	321	321	342	554	345	560	105,162
	WNL	136	329	225	541	174	174	382	263	401	276	
		798	674	1,303	1,103	785	787	1,136	1,277	1,177	1,317	
			1,472		2,406		1,573		2,413		2,494	

Figure B5 – Trip Generation for Riverbank Development in Ōtaki

River Bank Development

Veh/hr	inbound			outbound			2-way		
time period	lights	HCV's	total	lights	HCV's	total	lights	HCV's	total
am peak period (/hour)	205	45	250	87	23	110	292	68	360
inter peak period (/hour)	94	46	140	94	46	140	188	92	280
pm peak period (/hour)	96	24	120	197	43	240	295	65	360
all day (/day)	1,234	456	1,690	1,234	456	1,690	2,467	913	3,380

Multiply by 50% for Composite Growth

River Bank Development

	Veh/hr	inbound			outbound			2-way		
	time period	lights	HCV's	total	lights	HCV's	total	lights	HCV's	total
0.5	am peak period (/hour)	103	23	125	44	12	55	146	34	180
	inter peak period (/hour)	47	23	70	47	23	70	94	46	140
	pm peak period (/hour)	48	12	60	99	22	120	148	33	180
	all day (/day)	617	228	845	617	228	845	1,234	457	1,690

Multiply by 34% for 2016

River Bank Development - 2016

	Veh/hr	inbound			outbound			2-way		
	time period	lights	HCV's	total	lights	HCV's	total	lights	HCV's	total
0.34	am peak period (/hour)	35	8	43	15	4	19	50	12	61
	inter peak period (/hour)	16	8	24	16	8	24	32	16	48
	pm peak period (/hour)	16	4	20	33	7	41	50	11	61
	all day (/day)	210	78	287	210	78	287	419	155	575

Multiply by 84% for 2026

River Bank Development - 2026

	Veh/hr	inbound			outbound			2-way		
	time period	lights	HCV's	total	lights	HCV's	total	lights	HCV's	total
0.84	am peak period (/hour)	86	19	105	37	10	46	123	29	151
	inter peak period (/hour)	39	19	59	39	19	59	79	39	118
	pm peak period (/hour)	40	10	50	83	18	101	124	27	151
	all day (/day)	518	192	710	518	192	710	1,036	383	1,420

Multiply by 100% for 2031

River Bank Development - 2031

	Veh/hr	inbound			outbound			2-way		
	time period	lights	HCV's	total	lights	HCV's	total	lights	HCV's	total
1	am peak period (/hour)	103	23	125	44	12	55	146	34	180
	inter peak period (/hour)	47	23	70	47	23	70	94	46	140
	pm peak period (/hour)	48	12	60	99	22	120	148	33	180
	all day (/day)	617	228	845	617	228	845	1,234	457	1,690

Appendix 34.C

Annualisation Factors

Appendix 34.C – Annualisation Factors Background

The Kāpiti Coast Traffic Model (KCTM) has been updated to assist with the option assessment phase of the MacKays to Peka Peka Expressway (M2PP) Project. The new model is referred to as the Kāpiti Transport Model (KTM2).

This technical note outlines the following:

- The method used to combine peak and pre-peak modelled hourly flows and obtain average daily flows;
- The method used to combine peak and pre-peak modelled hourly flows and obtain average weekend flows; and
- The process used to develop a profile of scheme benefits for both the off-peak and weekend that can then be applied to model outputs in order to provide a more accurate assessment of the economic benefits accrued during such 'non-modelled' time periods.

Methodology

Two different methods were tested for factoring and combining modelled flows to obtain average daily 5 day traffic flows (ADT_5) and average daily 7 day traffic flows (ADT_7):

Full Method (1): $ADT_5 = x\text{AM} + y\text{IP} + z\text{PM} + a\text{Pre-AM} + b\text{Pre-PM} \;(+\; c\text{ IP} + d\text{ IP})$

Simplified (2): $ADT_5 = x\text{AM} + y\text{IP} + z\text{PM}$

Where:

x= AM peak hour factor (8am to 9am)

y= Inter-peak average hour factor (avg 9am to 4pm)

z= PM peak hour factor (5pm to 6pm)

a= AM pre-peak hour factor (7am to 8am)

b= PM pre-peak hour factor (4pm to 5pm)

c= Off-peak period factor (6pm to 7am)

d= Weekend period factor (Saturday and Sunday, 48hr)

Table 9.1 overleaf shows the time periods for which modelled flows and observed traffic volumes have been extracted.

Table 9.1 Modelled Time Periods

Factor	Model	Time Period
AM	Validated	Morning Peak – 8am to 9am
IP	Validated	Inter-peak – Average of 9am to 4pm
PM	Validated	Evening Peak – 5pm to 6pm
Am-Pre	Not Validated	Morning Pre-peak – 7am to 8am
PM-Pre	Not Validated	Evening Pre-peak – 4pm to 5pm

Table 1.2 below details the factors that were required to translate from hourly traffic volumes to the respective time period traffic volumes.

In order to adjust the modelled period traffic volumes from average 3 day (ADT_3) to modelled average 5 day (ADT_5) values factors have been calculated from the observed ADT_3 and observed ADT_5 count data and applied accordingly to each respective time period.

The modelled traffic volumes in the validated time periods (shaded in red) do not require scaling to observed counted volumes. The models were calibrated and validated according to average weekday counts obtained between Tuesday and Thursday (ADT_3). No adjustment is required to factor the modelled traffic volumes to counted traffic volumes as all time periods have been satisfactorily validated and reported in the '*MacKays to Peka Peka SATURN Model Validation Report'*. The resulting AM peak and PM peak factors are therefore 1; the average inter-peak hour traffic volumes are multiplied by 7 to obtain inter-peak period traffic volumes.

Modelled traffic volumes in the non-validated pre peaks were controlled to observed traffic volumes. The ratio of pre-peak to peak hour observed traffic volumes was used to derive the pre-peak matrices.

To obtain average off-peak and average weekend traffic volumes the inter-peak average hour modelled volumes are taken and factored up according to the observed traffic volumes.

Table 1.2 Time Periods and Factors

Factor	Description	Modelled Flow Applied To	Factor from ADT_3 to ADT_5	Factor Modelled to Count
x	Weekday Morning Peak – 8am to 9am	AM	Y	N
y	Weekday Inter-peak – 9am to 4pm	IP	Y	N
z	Weekday Evening Peak – 5pm to 6pm	PM	Y	N
a	Weekday Morning Pre-Peak – 8am to 9am	AM-Pre	Y	Y
b	Weekday Evening Pre-Peak – Average 9am to 4pm	PM-Pre	Y	Y
c	Weekday Average Off-peak – 6pm to 7am	IP	Y	Y
d	Average weekend – Saturday, Sunday, 48hr	IP	Y	Y

Derivation of Scaling Factors

This section outlines how the scaling factors to convert from modelled hourly traffic volumes to modelled period traffic volumes were derived.

Traffic Counts

A subset of traffic counts was obtained from those used in the validation of the base year model to represent the actual observed network volumes:

- 64 link counts on local roads provided by KCDC (5 day count);
- 12 link counts on SH1 (1 day count); and
- A total of 76 counts in each direction.

Calculation of Average 3 day and Average 5 day observed traffic volumes

Average 3-day ADT_3 and 5-day ADT_5 hourly volumes were calculated for the 64 local road links and compared against each other. Factors were created for both light vehicles and HCVs for the following time periods to convert from ADT_3 observed traffic volumes to ADT_5 observed traffic volumes:

- AM peak – 8am to 9am;
- Inter-peak – Average hour between 9am to 4pm;
- Evening peak – 5pm to 6pm;
- AM pre-peak – 7am to 8am; and
- PM pre-peak – 4pm to 5pm.

Modelled to Observed Factoring

Modelled and observed traffic volumes were plotted against each other and a line of best fit going through the vertex was created along with an R^2 statistic. The R^2 statistic is a measure showing the goodness of fit between two variables. It ranges between 0 and 1, with 1 signifying a perfect match and 0 signifying no match whatsoever. The higher the R^2 value the more satisfactory the correlation between both two data sets.

Table 1.3 and Table 1.4 below shows the variables that were compared against each other for both the ‘full’ method and ‘simplified’ method.

Table 1.3 Comparison between Modelled and Observed – Full Method

Factor	Time Period	X Axis		Y Axis	
		Observed	Duration	Modelled	Duration
x	AM Peak	8am to 9am	1 hr	8am to 9am	1 hr
y	Inter-peak	9am to 4pm	7 hr	Avg hr – 9am to 4pm	1 hr
z	PM Peak	5pm to 6pm	1 hr	5pm to 6pm	1 hr

Factor	Time Period	X Axis		Y Axis	
		Observed	Duration	Modelled	Duration
x	AM Peak	8am to 9am	1 hr	8am to 9am	1 hr
a	AM Pre-peak	7am to 8am	1 hr	7am to 8am	1 hr
b	PM Pre-peak	4pm to 5pm	1 hr	4pm to 5pm	1 hr
c	Off-Peak	6pm to 7am	13 hr	Avg hr – 9am to 4pm	1 hr
d	Weekend	12 am to 12pm	48 hr	Avg hr – 9am to 4pm	1 hr

Table 1.4 Comparison between Modelled and Observed – Simplified Version

Factor	Time Period	X Axis		Y Axis	
		Observed	Duration	Modelled	Duration
x	AM Peak	7am to 9am	2 hr	8am to 9am	1 hr
y	Inter-peak	9am to 4pm, 6pm to 7am	20 hr	Avg hr – 9am to 4pm	1 hr
z	PM Peak	4pm to 6pm	2 hr	5pm to 6pm	1 hr
d	Weekend	12 am to 12pm	48 hr	Avg hr – 9am to 4pm	1 hr

Combined ADT and Scaling Factors

The modelled variables shown in Table 1.3 and Table 1.4 required factoring in order to replicate observed volumes for the required time slice. Table 1.5 and Table 1.6 below show the following factors for each time slice:

- ADT_3 to ADT_5 factors; and
- Scaling factors derived from the observed traffic volumes and applied to the modelled hourly volumes to obtain modelled time period traffic volumes.

The entries shaded in red for the full method do not require factoring as the data is taken from the fully validated modelled time periods.

Note that for the simplified method both pre-peak periods are discarded; the relevant peak period traffic flows are simply factored according to the overall observed time period traffic volumes.

Table 1.5 Full ADT and Scaling Factors – Full Method

Factor	Time Period	Car			HCV		
		ADT3 to ADT5	Mod to Count Vol	Comb	ADT3 to ADT5	Mod to Count Vol	Comb
x	Morning Peak (1hr)	1.00	1	1	1.00	1	1
y	Inter-peak (7hr)	1.00	7	7	1.00	7	7
z	Evening Peak (1hr)	0.99	1	1	0.99	1	1
a	Morning Pre-peak (1hr)	0.99	1.02	1.00	0.99	0.97	0.96
b	Evening Pre-peak (1hr)	1.00	0.95	0.96	1.00	1.09	1.09
c	Off Peak (13hr)	1.00	2.61	2.61	1.00	3.48	3.48
d	Weekend (48hr)	1.00	24.59	24.59	1.00	16.8	16.8

Table 1.6 Simplified ADT and Scaling Factors – Simplified Method

Fac	Car	Car			HCV			All Vehicles
		ADT to ADT5	Mod to Count Vol	Comb	ADT3 to ADT5	Mod to Count Vol	Comb	Comb
x	Morning Peak (2hr)	0.99	1.86	1.86	0.99	1.76	1.76	1.85
y	Inter-peak / Off-peak (7hr)	1.00	9.94	9.93	1.00	13.59	13.57	10.19
z	Evening Peak (2hr)	0.99	2.00	1.99	0.99	2.50	2.50	2.01
d	Weekend (48hr)	1.0	24.59	24.59	1.00	16.8	16.8	24.03

The simplified method was applied to the relevant hourly traffic volumes to obtain Average Annual Daily Two-Way Traffic Volumes (AADT) by user class. It is these traffic volumes that are then presented in the Traffic Modelling Report.

Validation of Factors

The overall effectiveness of the scaling factors and ADT expansion factors in adjusting modelled volumes to match observed volumes is summarised below. The effectiveness was assessed by comparing the daily observed traffic volumes used to derive the scaling factors against the calculated daily modelled traffic volumes at each of the 76 count sites.

A plot of the daily (excluding weekends) 24hr modelled and observed traffic volumes is presented in Figure 1.1 for the full method and Figure 1.2 using the simplified method.

The goodness of fit between the modelled and observed traffic volumes was measured using the R^2 statistics and is presented in Table 1.7 for lights, HCVs and total pcus.

The results show a good correlation between modelled and observed daily traffic volumes using both methods, demonstrating that the methodology is robust and can be used with confidence to predict annual daily traffic volumes for the proposed MacKays to Peka Peka Expressway.

Table 1.7 R^2 Squared Comparison between Counted and Observed Daily Traffic Volumes

	User Class		
Method	Total	Car	HCV
Standard	0.95	0.95	0.85
Simplified	0.95	0.95	0.85

Figure 1.1 Modelled vs Observed Daily Traffic Volumes – Full Method

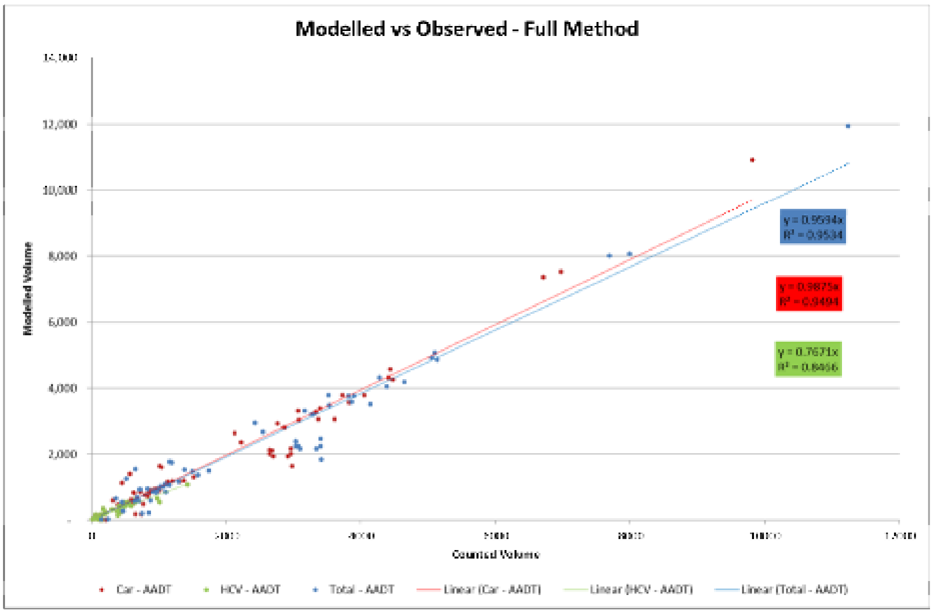
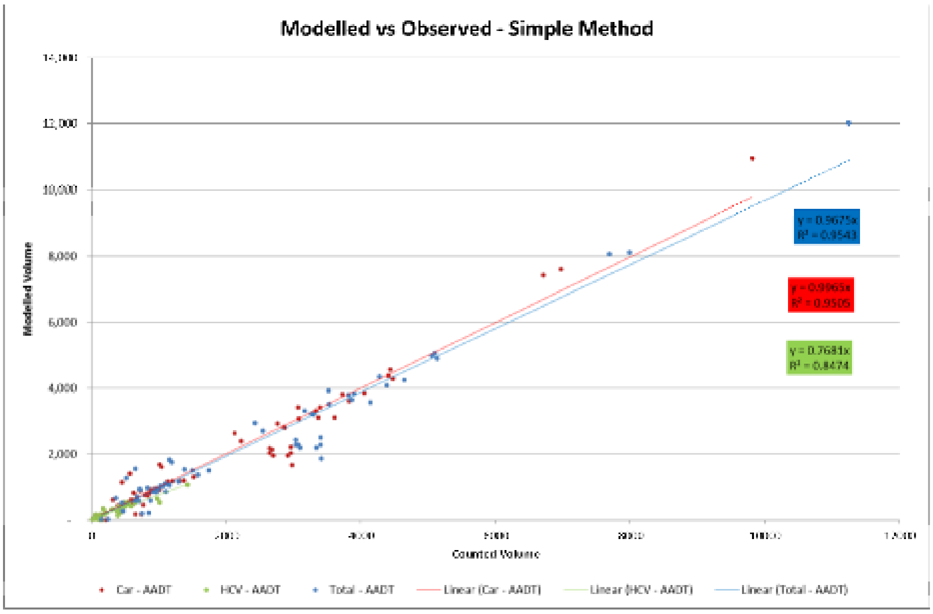


Figure 1.2 Modelled vs Observed Daily Traffic Volumes – Simplified Method



Weekend Expansion Factors

The weekend expansion factor outlined in Table 1.6 will transforms the average Inter-peak hour modelled traffic volumes to whole weekend (48 hr) traffic volumes.

During the course of a weekend, however, traffic volumes can fluctuate substantially in the same way that traffic volumes fluctuate during the course of a typical weekday. For example, it is known that

Paraparaumu Town Centre gets very congested at the weekends as it is a major retail hub for the area.

In order to assess the extent and magnitude of these fluctuations the weekend was split up into 10 separate time slices per day, broadly corresponding to intuitive 'peak' and 'off-peak' times:

- TP1 (TP10 – Sunday) – 12am to 6am;
- TP 2 (TP11) – 6am to 8am;
- TP 3 (TP12) – 8am to 10am;
- TP 4 (TP13) – 10am to 12am;
- TP 5 (TP14) – 12am to 2pm;
- TP 6 (TP15) – 2pm to 4pm;
- TP 7 (TP16) – 4pm to 6pm;
- TP 8 (TP17) – 6pm to 9pm; and
- TP 9 (TP18) – 9pm to 12am.

Average hourly observed traffic volumes were obtained for each time slice and compared against the average inter-peak hour observed traffic volumes.

Table 1.8 and Table 1.9 below presents the traffic volumes for each specified time slice as a percentage of traffic volumes in the average inter-peak hour. For example, a factor of 0.25 signifies that the traffic volumes in that particular time slice equate to one-quarter of the observed traffic volumes in the average inter-peak hour.

The main points to note are:

- Between 10am and 4pm on Saturday (TP4 to TP7) traffic volumes are between 20% to 30% greater than traffic volumes during the average inter-peak hour;
- On Sunday light vehicle traffic volumes between noon and 4pm (TP14 and TP15) are similar to light vehicle traffic volumes during the average inter-peak hour; and
- Traffic volumes tail off quickly either side of the 10am to 6pm period on both Saturday and Sunday.

Table 1.8 Saturday Traffic Flow Profile – Average Hour within Time Slice

Car	Day	TP1	Tp2	TP3	Tp4	TP5	TP6	TP7	TP8	TP9
Time Slice		12am – 6am	6am – 8am	8am to 10am	10am – 12pm	12pm – 2pm	2pm – 4pm	4pm – 6pm	6pm – 8pm	8pm – 12am
Duration of Time Slice	24hr	6hr	2hr	2hr	2hr	2hr	2hr	2hr	2hr	4hr
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (lights)	14.13	0.24	0.36	1.72	2.65	2.59	2.37	2.11	1.47	0.61

Car	Day	TP1	Tp2	TP3	Tp4	TP5	TP6	TP7	TP8	TP9
Time Slice		12am – 6am	6am – 8am	8am to 10am	10am – 12pm	12pm – 2pm	2pm – 4pm	4pm – 6pm	6pm – 8pm	8pm – 12am
Duration of Time Slice	24hr	6hr	2hr	2hr	2hr	2hr	2hr	2hr	2hr	4hr
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (HCVs)	8.61	0.15	0.22	1.05	1.62	1.58	1.45	1.28	0.89	0.37

Table 1.9 Sunday Traffic Flow Profile – Average Hour within Time Slice

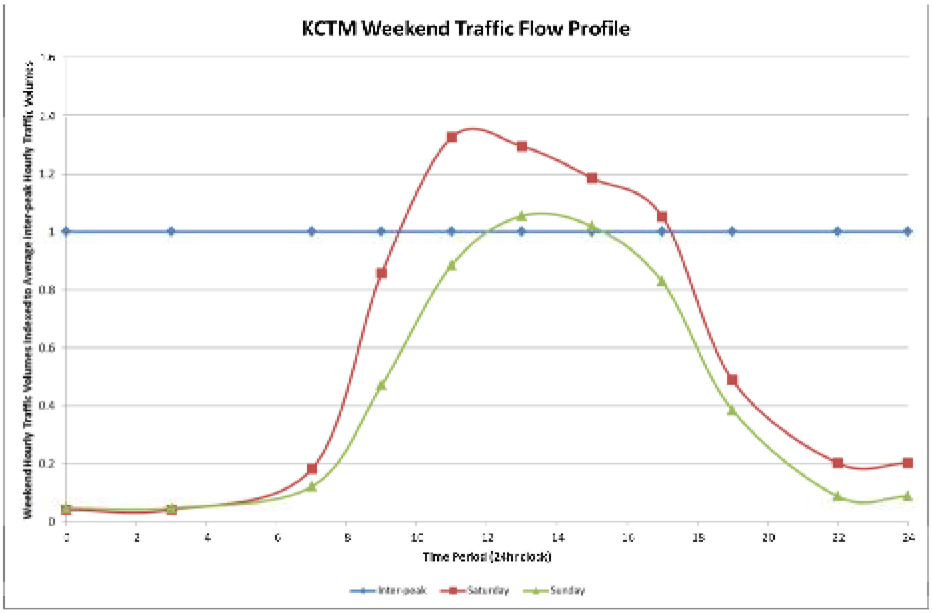
Car	Day	TP1	Tp2	TP3	Tp4	TP5	TP6	TP7	TP8	TP9
Time Slice		12am – 6am	6am – 8am	8am to 10am	10am – 12pm	12pm – 2pm	2pm – 4pm	4pm – 6pm	6pm – 8pm	8pm – 12am
Duration of Time Slice	24hr	6hr	2hr	2hr	2hr	2hr	2hr	2hr	2hr	4hr
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (lights)	10.46	0.28	0.24	0.94	1.77	2.11	2.04	1.66	1.16	0.26
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (HCVs)	6.38	0.17	0.15	0.58	1.08	1.29	1.24	1.01	0.70	0.16

When the Saturday and Sunday factors are aggregated across the weekend, light vehicle, HCV and total vehicle traffic volumes are 24.59, 16.84 and 24.03 times greater respectively than traffic volumes in the average Inter-peak hour.

Using the factors presented above, weekend traffic volumes can be estimated and used to inform the design of proposed Expressway intersections and local road improvements along Kāpiti Road and within Paraparaumu Town Centre.

Figure 1.3 overleaf shows the weekend traffic profile; a peak between 11am and 5pm on Saturday and (to a lesser extent) 1pm to 3pm on Sunday are clearly visible.

Figure 1.3 KTM2 Weekend Observed Light Vehicle Traffic Flow Profile



Weekend Benefits

The profile of weekend scheme benefits relative to inter-peak scheme benefits may not follow the same profile as that seen in Figure 1.3 above.

When the network is uncongested the benefits of schemes such as the proposed MacKays to Peka Peka Expressway may be minimal as the existing through route will still provide satisfactory travel times. As the network becomes more congested, particularly around Paraparaumu and Waikanae on SH1, the proposed Expressway will become more attractive. When the network is very congested and the network around Paraparaumu / Waikanae is close to or exceeding capacity the proposed Expressway will substantially reduce this congestion.

The relationship between the level of congestion and the level of travel time savings (a proxy for benefits) is not linear. As traffic volumes increase the level of benefits may increase at a similar rate for a while. However there will become a point, generally when the network reaches capacity in certain key areas, where a small increase in traffic volumes can lead to an exponential increase in delays. From this point onwards the relationship between traffic volumes and scheme benefits becomes non-linear.

A method has been developed to look at the relationship between the inter-peak average hour benefits and weekend scheme benefits. The end result of this process is a factor that can be applied to the inter-peak average hour benefits across all modelled years to estimate the level of weekend benefits accrued by the MacKays to Peka Peka Project.

The method is as follows:

- Take the matrices from the 2026 Do Minimum and Option inter-peak assignments;
- Apply the factors in Table 1.8 and Table 1.9 above to create average hour matrices for each required time slice for the Do Minimum and Option scenarios;
- Assign the matrices in-elastically to the relevant networks;
- Obtain travel time and demand matrix totals for the all Do Minimum and Option scenarios along with the inter-peak average hour;
- Calculate an estimate of the scheme benefits for each scenario using a modified variable matrix method[17]; and
- Create a profile of these benefits and determine the relationship between overall Saturday / Sunday benefits and benefits in the average inter-peak hour.

The resulting benefit profiles for each time slice, relative to benefits in the average inter-peak hour, are detailed in

[17] Average travel time per pcu is created by dividing total travel time by the total demand. User Costs (travel time), Resource Costs (travel time *1.15) and Demand (No of Trips) are used at a global level to calculate benefits using a variable matrix approach.

Table 1.10 and Table 9.11 below. The following conclusions can be drawn from this analysis:

- The level of benefits accrued outside of the ‘peak’ weekend time periods (10am to 6pm) is low compared to the level of benefits accrued during the average inter-peak hour;
- Whilst flows between 10am and 2pm are up to 30% greater on Saturdays than during the average inter-peak hour the benefits are around two times greater; and
- During the peak period on Sunday the level of benefits are roughly 70% to 80% the level of benefits seen during the average inter-peak hour.

Figure 1.4 overleaf summarises the data presented in

Table 1.10 and Table 1.11 – 2026 in a graphical format, with the inter-peak benefits provided for reference purposes.

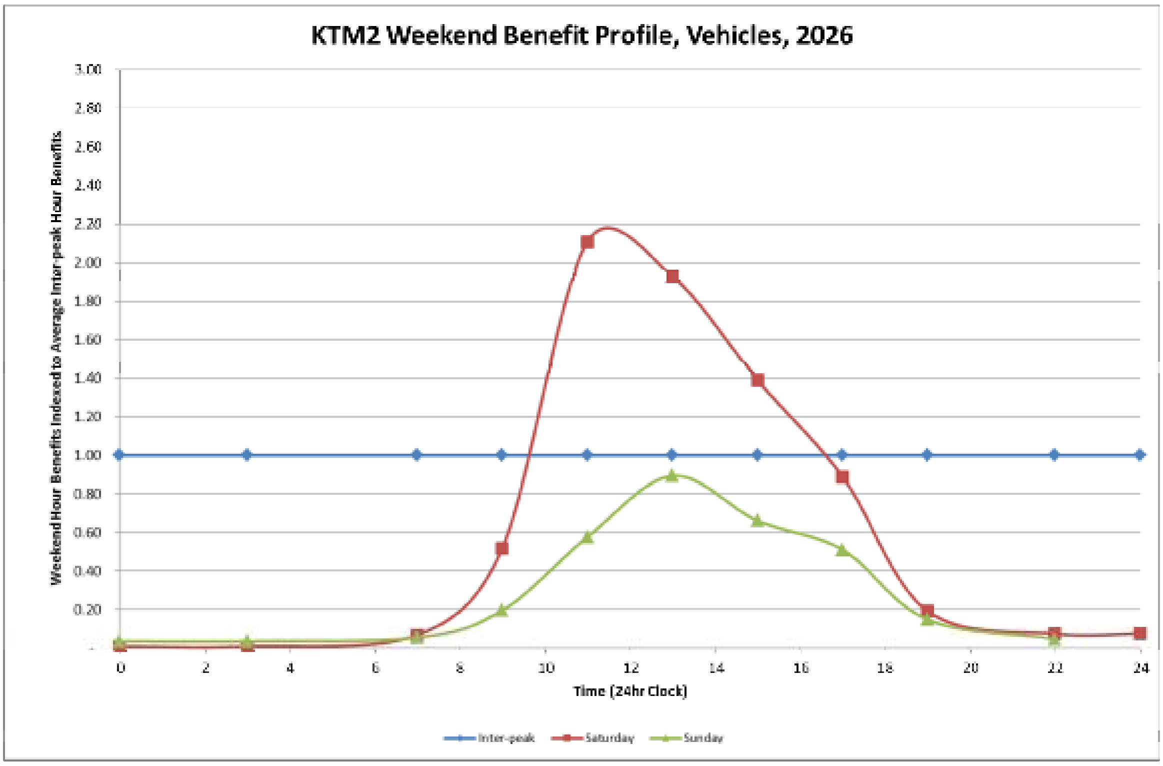
Table 1.10 – 2026 Weekend Benefit Profile – Ratio of Saturday Time Slice Benefits to Average Inter-peak Hour Benefits

		Saturday								
Car	Day	TP1	Tp2	TP3	Tp4	TP5	TP6	TP7	TP8	TP9
Time Slice		12am – 6am	6am – 8am	8am to 10am	10am – 12pm	12pm – 2pm	2pm – 4pm	4pm – 6pm	6pm – 8pm	8pm – 12am
Duration of Time Slice	24hr	6hr	2hr	2hr	2hr	2hr	2hr	2hr	3hr	3hr
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (lights)	16.03	0.05	0.13	1.08	4.71	4.29	3.05	1.90	0.59	0.22
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (HCVs)	9.27	0.24	0.11	0.39	1.21	1.91	1.38	1.07	0.44	0.15

Table 1.11 – 2026 Weekend Benefit Profile – Ratio of Sunday Time Slice Benefits to Average Inter-peak Hour Benefits

		Sunday								
Car	Day	TP1	Tp2	TP3	Tp4	TP5	TP6	TP7	TP8	TP9
Time Slice		12am – 6am	6am – 8am	8am to 10am	10am – 12pm	12pm – 2pm	2pm – 4pm	4pm – 6pm	6pm – 8pm	8pm – 12am
Duration of Time Slice	24hr	6hr	2hr	2hr	2hr	2hr	2hr	2hr	3hr	3hr
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (lights)	6.90	0.07	0.14	0.87	2.26	2.12	1.67	1.26	0.64	0.25
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (HCVs)	5.32	0.11	0.09	0.40	0.93	1.29	1.08	0.84	0.48	0.11

Figure 1.4 KTM2 Profile of Weekend Benefits, 2026



From the information presented above the following factors were derived and can be applied to the average inter-peak hour benefits in order to estimate the levels of benefits on Saturdays and Sundays:

- Saturday benefits (24 hours) – 16.03 (lights) and 9.27 (HCVs), 15.54 (All Vehicles);
- Sunday benefits (24 hours) – 6.9 (lights) and 5.32 (HCVs), 7.29 (All Vehicles); and
- Overall weekend benefits (48 hours) – 22.93 (lights) and 12.22 (HCVs), 22.33 (All Vehicles).

Off Peak Benefits

A similar process was used to estimate the 2026 off-peak benefits. The off-peak time period was firstly split up into 4 time periods as follows:

- TP1 - 6pm to 8pm (2hr);
- TP2 - 8pm to 12am (4hr);
- TP3 - 12am to 5am (5hr); and
- TP4 - 5am to 7am (2hr).

The profile of both traffic volumes and benefits relative to the average inter-peak hour were calculated and are presented in Table 1.12 and Table 1.13 overleaf.

Table 1.12 Off-Peak Flow Profile – Average Hourly Flow by Time Slice

	Off –peak (13 hr)	Off-peak Time Slice			
		TP1	Tp2	TP3	Tp4
		6pm – 8pm	8pm – 12am	12am – 5am	5am – 7am
		2hr	4hr	5hr	2hr
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (lights)	2.84	1.43	0.81	0.09	0.45
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (HCVs)	3.44	1.75	0.99	0.11	0.55

Table 1.13 Off-Peak Benefit Profile – Average Hourly Flow by Time Slice

	Off –peak (13 hr)	Off-peak Time Slice			
		TP1	Tp2	TP3	Tp4
		6pm – 8pm	8pm – 12am	12am – 5am	5am – 7am
		2hr	4hr	5hr	2hr
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (lights)	1.28	0.83	0.25	0.02	0.18
Ratio of Time Slice Traffic Volumes to Average Inter-peak Hour Traffic Volumes (HCVs)	1.84	1.38	0.34	0.02	0.09

The following observations can be made regarding the data in Table 1.12 and Table 1.13 above:

- Off-peak traffic volumes are slightly lower between 6pm-8pm (TP1) and substantially lower in all other time periods when compared against the inter-peak average hour flows; and
- The reduction in benefits is greater than the reduction in traffic volumes when comparing each off-peak time period against the average inter-peak hour.

From the information presented above the following factors were derived and can be applied to the average inter-peak hour flows / benefits in order to estimate levels of off-peak flows / benefits:

- Flows – 2.84 (lights), 3.44 (HCVs) and 2.86 (vehicles); and
- Benefits – 1.28 (lights, 1.84 (HCVs) and 1.30 (vehicles).

Annualisation Factors

The final step in this process is to annualise the various time period factors presented in this note as follows:

- A factor of 245 is applied to move from average weekday to an annualised weekday total; and
- A factor of 60 is applied to move from an average weekend to an annualised weekend total, accounting for public holidays.

The annualisation factors presented below are as follows:

- Table 1.14 - Traffic Volumes, Light Vehicles;
- Table 1.15 - Benefits, Light Vehicles;
- Table 1.16 - Traffic Volumes, HCVs; and
- Table 1.17 - Benefits, HCVs.

These factors are primarily used for the economic assessment of the scheme.

Table 1.14 Annualisation Factors – Traffic Volumes, Light Vehicles

Time Period	ADT3 to ADT5	Modelled Hour to Observed Period	Daily Factor	Annualisation Factor
AM Peak	1.00	1.00	1.00	245
AM Pre-Peak	1.00	1.02	1.02	249
PM Peak	1.00	1.00	1.00	245
PM Pre-Peak	1.00	0.95	0.95	232
Inter-peak	1.00	7.00	7.00	1,715
Off-Peak	1.00	2.78	2.77	678
Saturday	1.00	14.12	14.13	847
Sunday	1.00	10.46	10.46	627

Table 1.15 Annualisation Factors – Benefits, Light Vehicles

Time Period	ADT3 to ADT5	Modelled Hour to Observed Period	Daily Factor	Annualisation Factor
AM Peak	1.00	1.00	1.00	245
AM Pre-Peak	1.00	1.02	1.02	249
PM Peak	1.00	1.00	1.00	245
PM Pre-Peak	1.00	0.95	0.95	232

Time Period	ADT3 to ADT5	Modelled Hour to Observed Period	Daily Factor	Annualisation Factor
AM Peak	1.00	1.00	1.00	245
AM Pre-Peak	1.00	1.02	1.02	249
PM Peak	1.00	1.00	1.00	245
Inter-peak	1.00	7.00	7.00	1,715
Off-Peak	1.00	1.79	1.28	313
Saturday	1.00	16.92	16.03	961
Sunday	1.00	6.98	6.90	414

Table 1.16 Annualisation Factors – Traffic Volumes, HCVs

Time Period	ADT3 to ADT5	Modelled Hour to Observed Period	Daily Factor	Annualisation Factor
AM Peak	1.00	1.00	1.00	245
AM Pre-Peak	1.00	0.97	0.97	237
PM Peak	1.00	1.00	1.00	245
PM Pre-Peak	1.00	1.09	1.09	267
Inter-peak	1.00	7.00	7.00	1,715
Off-Peak	1.00	3.39	3.40	833
Saturday	1.00	8.61	8.61	516
Sunday	1.00	6.38	6.38	382

Table 1.17 Annualisation Factors – Benefits, HCVs

Time Period	ADT3 to ADT5	Modelled Hour to Observed Period	Daily Factor	Annualisation Factor
AM Peak	1.00	1.00	1.00	245
AM Pre-Peak	1.00	0.97	0.97	237
PM Peak	1.00	1.00	1.00	245
PM Pre-Peak	1.00	1.09	1.09	267
Inter-peak	1.00	7.00	7.00	1,715
Off-Peak	1.00	2.24	1.84	450
Saturday	1.00	9.19	9.27	556

Time Period	ADT3 to ADT5	Modelled Hour to Observed Period	Daily Factor	Annualisation Factor
AM Peak	1.00	1.00	1.00	245
AM Pre-Peak	1.00	0.97	0.97	237
PM Peak	1.00	1.00	1.00	245
Sunday	1.00	5.15	5.32	319

Combined annualisation factors are shown in Table 1.18 below for light vehicles and HCVs. The time periods are categorised as follows:

- AM period – AM peak hour + AM pre-peak hour;
- Off-peak period – Inter-peak 7hr + Off peak 13hr +Saturday 24hr + Sunday 24hr; and
- PM period – PM peak hour + PM pre-peak hour.

Table 1.18 Annualisation Factors – Traffic Volume and Benefits, by Time Period and User Class

Time Period	Light Vehicles		HCVs	
	Traffic Volumes	Benefits	Traffic Volumes	Benefits
AM Period	495	495	483	483
Off-peak	3,869	3,404	3,447	3,041
PM Period	478	478	512	512

The factors have been compared against those that have been used to assist in the appraisal of other large infrastructure projects. Following this analysis we believe the factors presented in this note have been robustly calculated and can be used with confidence to assess the economic effects of the proposed MacKays to Peka Peka Expressway.

Appendix 34.D

Origin-Destination Travel Time Information

Appendix 34.D – Origin-Destination 2026 Travel Time Information

Table 1.19 – AM Peak 2026 Do Minimum Travel Time (minutes)

Origin	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10	Sector 11	Sector 12	Sector 13	Total
Sector 1	1.3	69.6	41.4	43.8	39.8	48.4	51.3	54.5	64.4	59.6	61.4	58.1	62.6	54.4
Sector 2	76.3	6.1	32.5	26.4	28.4	28.0	29.5	18.8	19.7	14.9	16.9	17.2	10.2	18.6
Sector 3	57.9	29.4	1.9	6.7	4.2	5.9	4.9	9.3	15.7	11.7	13.8	13.5	15.2	11.1
Sector 4	50.2	24.1	6.1	0.9	3.8	5.0	7.1	3.9	11.2	7.1	9.2	8.6	10.5	8.7
Sector 5	50.2	26.3	4.2	2.8	1.9	3.6	5.8	6.7	13.3	9.2	11.2	10.6	12.5	6.3
Sector 6	57.5	25.4	7.0	5.2	4.9	2.2	3.0	5.0	12.8	8.6	10.8	10.1	12.0	9.5
Sector 7	60.7	26.5	5.8	7.4	6.3	3.3	1.8	5.6	13.5	9.2	11.3	10.7	12.7	9.8
Sector 8	57.3	17.7	10.3	5.5	8.2	5.6	5.5	3.7	6.6	3.0	5.1	5.3	6.7	11.9
Sector 9	68.0	20.3	20.0	14.8	17.8	16.4	17.2	9.0	2.2	4.5	8.0	3.3	6.5	13.4
Sector 10	63.0	15.6	15.9	10.8	13.5	12.1	12.9	5.3	3.5	1.2	3.9	2.4	5.0	9.1
Sector 11	64.2	18.0	16.5	11.4	14.2	12.8	13.7	5.6	8.3	4.4	3.7	5.9	6.9	12.8
Sector 12	64.1	17.7	17.3	12.2	14.8	13.3	14.0	7.7	2.9	2.3	5.4	3.8	5.5	10.7
Sector 13	65.3	9.6	18.6	13.5	16.2	14.8	15.7	8.1	6.6	5.1	6.1	5.7	0.4	13.4
Total	61.7	18.2	8.2	9.5	8.2	7.3	7.7	10.2	10.4	6.7	9.5	7.1	9.3	14.2

Table 1.20 – AM Peak 2026 Option Travel Time (minutes)

Origin	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10	Sector 11	Sector 12	Sector 13	Total
Sector 1	1.3	65.3	41.2	42.7	39.1	45.8	49.3	53.5	56.1	57.7	59.9	53.5	60.5	51.9
Sector 2	69.2	6.1	27.7	22.9	23.1	22.5	24.8	17.3	17.6	14.7	16.8	15.9	10.8	17.5
Sector 3	48.4	28.1	1.9	5.8	4.0	6.0	4.9	8.6	11.9	10.6	12.4	11.4	14.6	10.3
Sector 4	49.5	23.1	5.1	0.8	3.1	4.9	7.0	3.4	9.5	6.0	7.7	7.6	9.7	8.0
Sector 5	43.9	24.6	3.8	2.4	1.8	4.0	6.0	6.2	8.9	8.3	10.0	8.9	12.1	6.0
Sector 6	52.0	23.3	6.7	4.9	4.8	2.4	3.1	4.8	7.6	7.8	9.9	7.9	11.3	9.1
Sector 7	55.0	25.0	5.7	7.2	6.4	3.4	1.8	5.5	9.1	8.6	10.5	9.1	12.3	9.5
Sector 8	55.3	17.7	8.2	4.0	6.3	5.0	5.1	1.7	6.5	2.7	4.5	5.0	6.7	10.4
Sector 9	56.6	18.3	12.3	9.5	9.4	7.6	9.8	7.3	2.2	4.6	7.7	3.4	6.6	11.1
Sector 10	57.4	15.7	11.2	7.0	8.9	8.0	9.3	3.4	3.5	1.2	3.5	2.3	5.3	8.0
Sector 11	60.2	18.1	12.2	7.9	10.1	9.6	10.7	4.2	8.2	4.2	3.5	5.7	7.0	11.5
Sector 12	56.3	16.7	11.4	7.9	9.2	7.8	9.3	5.4	2.9	2.2	4.7	3.6	5.7	9.1
Sector 13	60.5	10.8	14.6	10.3	12.3	11.3	12.6	6.7	6.7	5.1	6.1	5.8	0.6	12.6
Total	55.0	17.7	7.6	8.3	7.3	7.0	7.3	8.8	9.5	6.5	8.8	6.8	9.6	13.2

Table 1.21 – AM Peak Absolute Difference between 2026 Option and 2026 Do Minimum Travel Time (minutes)

Origin	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10	Sector 11	Sector 12	Sector 13	Total
Sector 1	0.0	-4.3	-0.2	-1.1	-0.7	-2.6	-1.9	-1.0	-8.3	-1.9	-1.5	-4.6	-2.1	-2.4
Sector 2	-7.1	0.0	-4.8	-3.5	-5.3	-5.5	-4.6	-1.5	-2.1	-0.1	-0.1	-1.3	0.6	-1.1
Sector 3	-9.5	-1.3	0.0	-0.9	-0.2	0.1	0.0	-0.7	-3.8	-1.1	-1.4	-2.1	-0.6	-0.8
Sector 4	-0.7	-0.9	-1.0	-0.1	-0.6	-0.2	0.0	-0.4	-1.7	-1.1	-1.5	-1.0	-0.8	-0.7
Sector 5	-6.3	-1.7	-0.4	-0.3	-0.1	0.4	0.2	-0.6	-4.4	-0.9	-1.2	-1.6	-0.5	-0.3
Sector 6	-5.6	-2.2	-0.3	-0.3	-0.1	0.2	0.1	-0.1	-5.2	-0.8	-0.8	-2.2	-0.7	-0.4
Sector 7	-5.8	-1.6	-0.1	-0.1	0.1	0.1	0.0	-0.1	-4.4	-0.6	-0.8	-1.7	-0.4	-0.3
Sector 8	-2.0	0.0	-2.1	-1.5	-1.9	-0.6	-0.4	-2.0	-0.1	-0.3	-0.6	-0.3	0.0	-1.5
Sector 9	-11.3	-2.0	-7.7	-5.3	-8.4	-8.8	-7.4	-1.7	0.0	0.1	-0.3	0.0	0.2	-2.3
Sector 10	-5.6	0.1	-4.6	-3.8	-4.6	-4.1	-3.6	-1.9	0.0	0.0	-0.4	0.0	0.3	-1.1
Sector 11	-4.0	0.1	-4.3	-3.5	-4.1	-3.2	-3.0	-1.5	-0.1	-0.2	-0.2	-0.2	0.2	-1.4
Sector 12	-7.8	-1.0	-5.9	-4.3	-5.5	-5.6	-4.7	-2.3	0.0	-0.1	-0.6	-0.2	0.2	-1.5
Sector 13	-4.9	1.2	-4.0	-3.2	-4.0	-3.6	-3.1	-1.4	0.1	0.0	0.0	0.1	0.2	-0.8
Total	-6.7	-0.5	-0.6	-1.2	-0.9	-0.3	-0.4	-1.4	-0.9	-0.2	-0.7	-0.3	0.2	-1.0

Table 1.22 – AM Peak Percentage Difference between 2026 Option and 2026 Do Minimum Travel Time (minutes)

Origin	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10	Sector 11	Sector 12	Sector 13	Total
Sector 1	0%	-6%	0%	-3%	-2%	-5%	-4%	-2%	-13%	-3%	-2%	-8%	-3%	-4%
Sector 2	-9%	0%	-15%	-13%	-19%	-20%	-16%	-8%	-11%	-1%	0%	-7%	6%	-6%
Sector 3	-16%	-4%	-2%	-14%	-4%	1%	0%	-8%	-24%	-9%	-10%	-15%	-4%	-7%
Sector 4	-1%	-4%	-17%	-10%	-17%	-3%	0%	-12%	-15%	-16%	-16%	-12%	-8%	-8%
Sector 5	-13%	-6%	-9%	-12%	-6%	10%	4%	-8%	-33%	-10%	-11%	-16%	-4%	-5%
Sector 6	-10%	-9%	-4%	-6%	-2%	9%	3%	-3%	-40%	-10%	-8%	-22%	-6%	-4%
Sector 7	-10%	-6%	-1%	-2%	2%	3%	0%	-2%	-32%	-6%	-7%	-16%	-3%	-3%
Sector 8	-3%	0%	-20%	-27%	-23%	-11%	-7%	-54%	-2%	-10%	-12%	-6%	0%	-12%
Sector 9	-17%	-10%	-39%	-36%	-47%	-54%	-43%	-19%	2%	2%	-4%	1%	2%	-17%
Sector 10	-9%	1%	-29%	-35%	-34%	-34%	-28%	-35%	1%	-3%	-11%	-2%	6%	-12%
Sector 11	-6%	1%	-26%	-31%	-29%	-25%	-22%	-26%	-1%	-5%	-5%	-4%	2%	-11%
Sector 12	-12%	-5%	-34%	-35%	-38%	-42%	-34%	-30%	1%	-5%	-12%	-6%	4%	-14%
Sector 13	-7%	12%	-21%	-24%	-24%	-24%	-20%	-18%	2%	0%	0%	2%	60%	-6%
Total	-11%	-3%	-7%	-12%	-11%	-5%	-5%	-13%	-9%	-3%	-7%	-5%	2%	-7%

Table 1.23 – PM Peak 2026 Do Minimum Travel Time (minutes)

Origin	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10	Sector 11	Sector 12	Sector 13	Total
Sector 1	1.3	81.2	53.6	53.8	49.6	58.7	62.1	64.2	73.4	68.5	71.7	69.9	71.3	61.6
Sector 2	69.1	5.7	30.1	23.2	24.8	27.1	29.2	18.0	19.9	14.3	16.8	16.4	9.1	17.6
Sector 3	46.7	33.4	2.0	7.8	4.5	6.9	5.8	11.2	19.4	15.5	18.1	16.9	18.9	7.2
Sector 4	43.2	26.4	6.4	1.0	2.9	5.3	7.4	6.0	13.7	9.7	12.4	11.1	13.2	8.3
Sector 5	46.9	28.1	5.0	4.2	2.1	4.4	6.2	8.8	17.0	12.9	15.5	14.0	16.2	8.5
Sector 6	51.0	29.9	7.1	5.8	5.1	2.3	3.4	6.8	17.5	13.4	16.0	14.5	16.8	7.2
Sector 7	56.1	32.0	5.5	7.9	6.3	3.2	1.8	7.6	18.8	14.6	17.2	15.6	17.9	6.9
Sector 8	53.5	19.2	9.6	4.6	7.2	5.2	5.7	4.3	8.3	4.8	7.1	7.5	8.4	8.8
Sector 9	63.2	19.1	17.1	11.3	14.6	15.5	16.9	8.0	2.2	3.8	8.1	3.4	6.4	8.6
Sector 10	58.8	13.5	12.9	7.4	10.1	11.1	12.5	3.8	4.2	1.3	4.1	2.3	5.0	6.1
Sector 11	59.1	16.7	13.2	7.7	10.5	11.5	12.8	4.4	7.4	3.8	2.9	5.3	6.6	9.7
Sector 12	57.7	15.6	14.6	8.9	11.3	12.5	13.9	6.7	3.3	2.4	5.4	3.9	5.6	6.4
Sector 13	60.4	9.0	15.7	10.1	12.8	13.8	15.2	7.1	6.5	5.3	6.2	5.5	0.3	9.2
Total	55.3	19.8	12.4	10.8	10.0	10.1	10.4	13.2	12.9	8.7	14.9	10.1	12.2	14.6

Table 1.24 – PM Peak 2026 Option Travel Time (minutes)

Origin	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10	Sector 11	Sector 12	Sector 13	Total
Sector 1	1.3	71.3	50.3	52.2	46.2	53.0	57.5	58.9	59.8	60.9	64.7	60.2	63.5	55.9
Sector 2	66.0	5.7	28.6	23.2	23.3	23.0	25.5	17.6	18.0	14.5	17.0	15.6	9.8	17.2
Sector 3	41.5	28.0	1.9	5.9	3.8	6.5	5.6	8.9	11.9	10.9	13.0	11.3	14.5	6.4
Sector 4	43.0	22.8	5.0	0.9	2.7	4.8	7.0	4.0	9.7	6.3	8.4	7.7	9.9	7.2
Sector 5	41.3	22.8	4.3	3.2	1.9	4.4	6.4	6.8	9.2	8.7	10.8	9.1	12.3	7.4
Sector 6	45.9	22.6	6.7	5.0	4.7	2.5	3.4	5.3	7.7	8.0	10.6	8.0	11.3	6.5
Sector 7	51.0	25.0	5.4	7.2	6.2	3.3	1.8	5.9	9.5	9.2	11.7	9.4	12.6	6.4
Sector 8	53.1	17.5	8.5	4.1	6.5	4.6	5.1	1.9	6.7	3.1	5.1	5.2	6.8	7.3
Sector 9	55.4	17.1	12.4	9.6	9.5	7.8	10.0	7.2	2.3	3.8	7.8	3.5	6.5	7.8
Sector 10	57.2	13.6	11.0	6.7	8.8	7.9	9.1	3.0	4.2	1.2	3.6	2.3	5.2	5.8
Sector 11	58.7	16.9	11.6	7.3	9.6	9.1	9.9	3.9	7.5	3.8	2.9	5.2	6.8	9.3
Sector 12	53.5	14.7	11.5	7.9	9.3	7.9	9.4	5.3	3.4	2.3	4.9	3.7	5.8	5.9
Sector 13	59.7	9.9	14.6	10.0	12.3	11.3	12.4	6.6	6.6	5.4	6.4	5.7	0.4	9.3
Total	51.5	18.4	11.4	9.4	9.2	9.6	10.1	10.9	10.8	7.8	12.6	8.9	11.5	13.4

Table 1.25 – PM Peak Absolute Difference between 2026 Option and 2026 Do Minimum Travel Time (minutes)

Origin	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10	Sector 11	Sector 12	Sector 13	Total
Sector 1	0.0	-9.9	-3.3	-1.6	-3.5	-5.7	-4.7	-5.4	-13.6	-7.6	-6.9	-9.7	-7.9	-5.7
Sector 2	-3.1	0.0	-1.5	0.0	-1.4	-4.1	-3.7	-0.5	-1.9	0.2	0.2	-0.9	0.7	-0.4
Sector 3	-5.3	-5.4	-0.1	-1.9	-0.7	-0.4	-0.1	-2.3	-7.5	-4.6	-5.0	-5.6	-4.4	-0.8
Sector 4	-0.2	-3.6	-1.4	-0.1	-0.3	-0.5	-0.4	-2.0	-4.0	-3.4	-3.9	-3.4	-3.3	-1.1
Sector 5	-5.7	-5.3	-0.7	-1.0	-0.1	0.1	0.2	-1.9	-7.7	-4.2	-4.6	-4.9	-3.9	-1.1
Sector 6	-5.1	-7.2	-0.4	-0.8	-0.4	0.2	0.1	-1.5	-9.8	-5.4	-5.4	-6.6	-5.5	-0.7
Sector 7	-5.0	-6.9	-0.1	-0.7	-0.1	0.1	0.0	-1.7	-9.3	-5.4	-5.6	-6.3	-5.3	-0.5
Sector 8	-0.3	-1.7	-1.0	-0.5	-0.7	-0.6	-0.6	-2.4	-1.6	-1.6	-2.0	-2.3	-1.7	-1.4
Sector 9	-7.8	-1.9	-4.7	-1.8	-5.1	-7.7	-6.9	-0.8	0.0	0.1	-0.3	0.1	0.1	-0.8
Sector 10	-1.6	0.1	-2.0	-0.7	-1.3	-3.2	-3.4	-0.8	0.0	0.0	-0.5	0.0	0.2	-0.3
Sector 11	-0.4	0.2	-1.6	-0.4	-0.9	-2.4	-2.9	-0.5	0.1	0.0	-0.1	0.0	0.3	-0.4
Sector 12	-4.2	-0.9	-3.1	-1.0	-2.0	-4.6	-4.4	-1.4	0.0	-0.1	-0.5	-0.2	0.2	-0.5
Sector 13	-0.8	0.9	-1.1	-0.1	-0.5	-2.5	-2.8	-0.5	0.1	0.2	0.2	0.2	0.1	0.1
Total	-3.8	-1.3	-1.0	-1.4	-0.8	-0.5	-0.4	-2.3	-2.1	-1.0	-2.3	-1.2	-0.7	-1.2

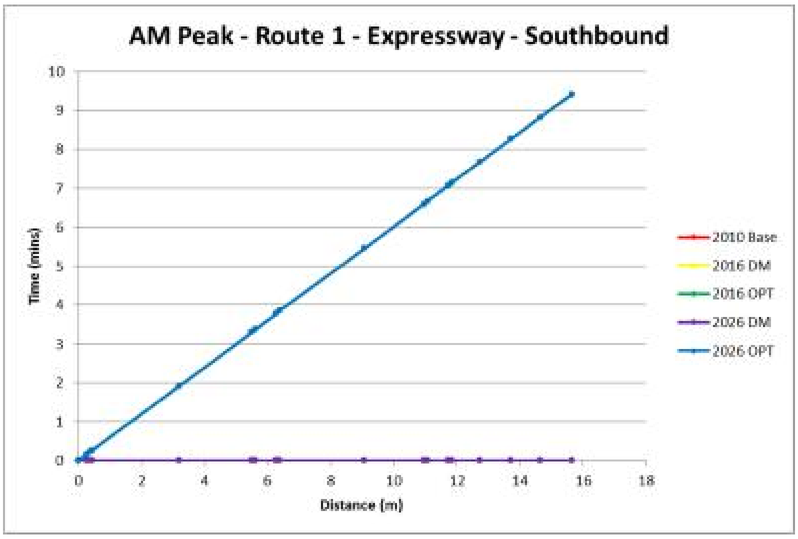
Table 1.26 – PM Peak Percentage Difference between 2026 Option and 2026 Do Minimum Travel Time (minutes)

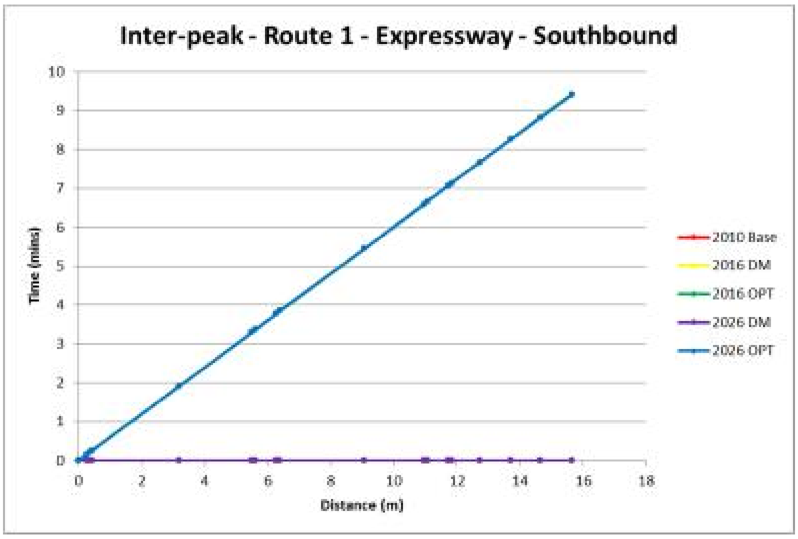
Origin	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8	Sector 9	Sector 10	Sector 11	Sector 12	Sector 13	Total
Sector 1	0%	-12%	-6%	-3%	-7%	-10%	-8%	-8%	-18%	-11%	-10%	-14%	-11%	-9%
Sector 2	-4%	0%	-5%	0%	-6%	-15%	-13%	-3%	-10%	1%	1%	-5%	8%	-2%
Sector 3	-11%	-16%	-5%	-24%	-15%	-6%	-3%	-20%	-39%	-30%	-28%	-33%	-23%	-11%
Sector 4	0%	-14%	-21%	-9%	-10%	-9%	-5%	-33%	-29%	-35%	-32%	-31%	-25%	-13%
Sector 5	-12%	-19%	-14%	-23%	-7%	1%	4%	-22%	-46%	-33%	-30%	-35%	-24%	-13%
Sector 6	-10%	-24%	-5%	-14%	-8%	9%	2%	-22%	-56%	-40%	-34%	-45%	-33%	-9%
Sector 7	-9%	-22%	-1%	-9%	-2%	3%	0%	-22%	-50%	-37%	-32%	-40%	-30%	-7%
Sector 8	-1%	-9%	-11%	-10%	-10%	-11%	-11%	-56%	-19%	-34%	-28%	-31%	-20%	-16%
Sector 9	-12%	-10%	-27%	-16%	-35%	-50%	-41%	-10%	1%	2%	-4%	2%	2%	-9%
Sector 10	-3%	1%	-15%	-10%	-13%	-29%	-27%	-21%	1%	-2%	-13%	-2%	3%	-5%
Sector 11	-1%	1%	-12%	-5%	-8%	-21%	-23%	-12%	1%	0%	-3%	-1%	4%	-4%
Sector 12	-7%	-6%	-21%	-12%	-18%	-37%	-32%	-20%	1%	-4%	-9%	-6%	3%	-7%
Sector 13	-1%	10%	-7%	-1%	-4%	-18%	-18%	-6%	1%	3%	4%	3%	52%	1%
Total	-7%	-7%	-8%	-13%	-8%	-5%	-3%	-17%	-16%	-11%	-15%	-12%	-6%	-8%

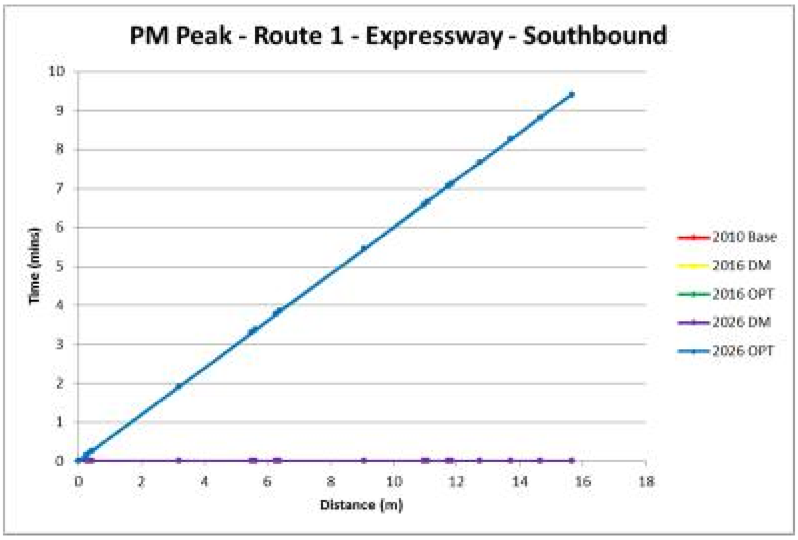
Appendix 34.E

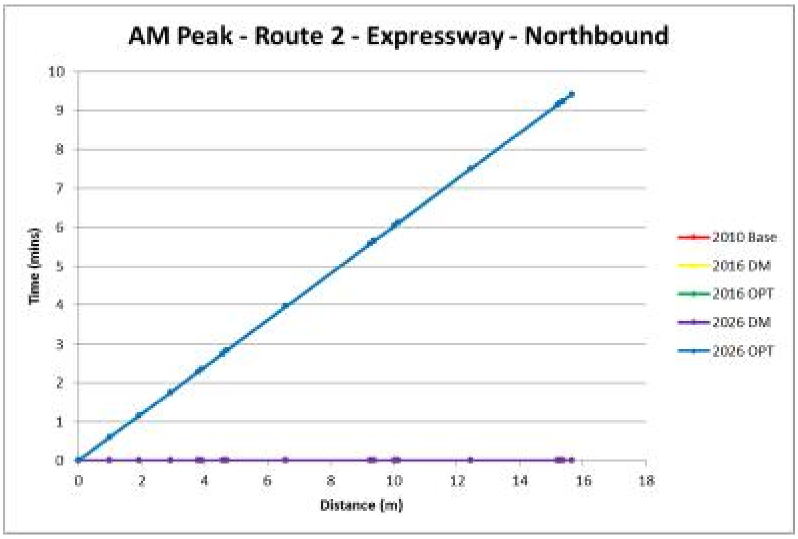
Travel Time Route Information

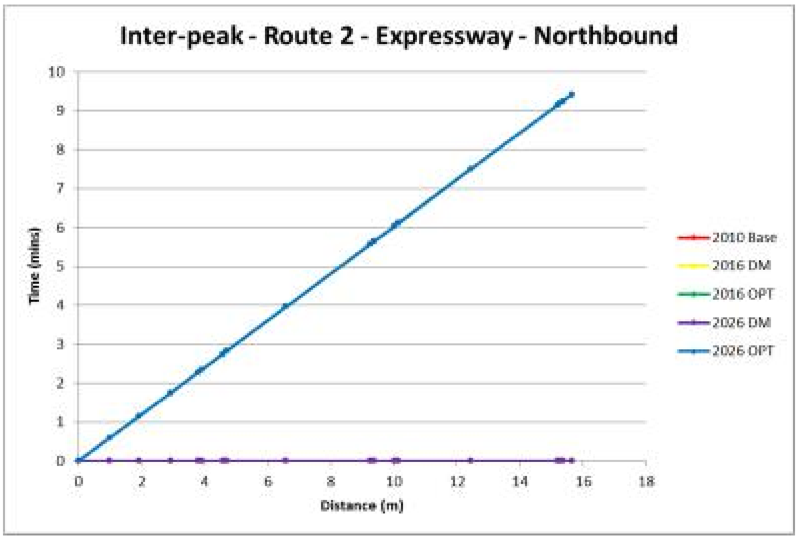
Appendix 34.E – Travel Time Route Information

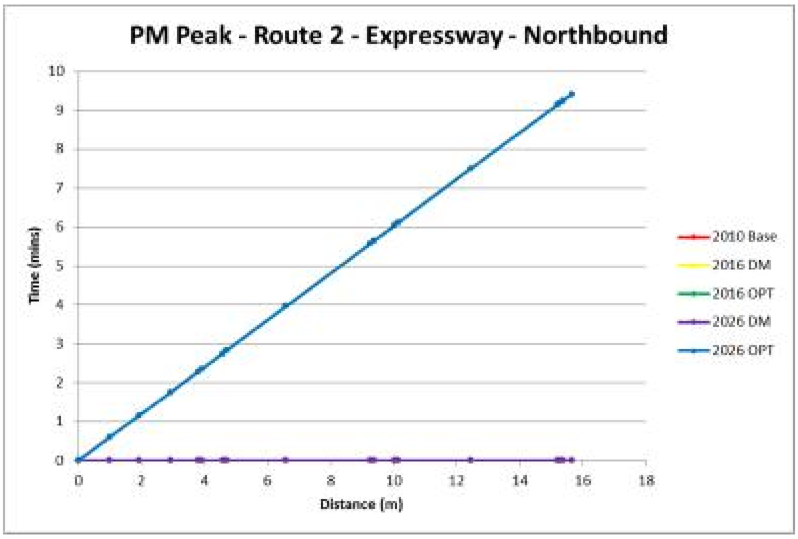


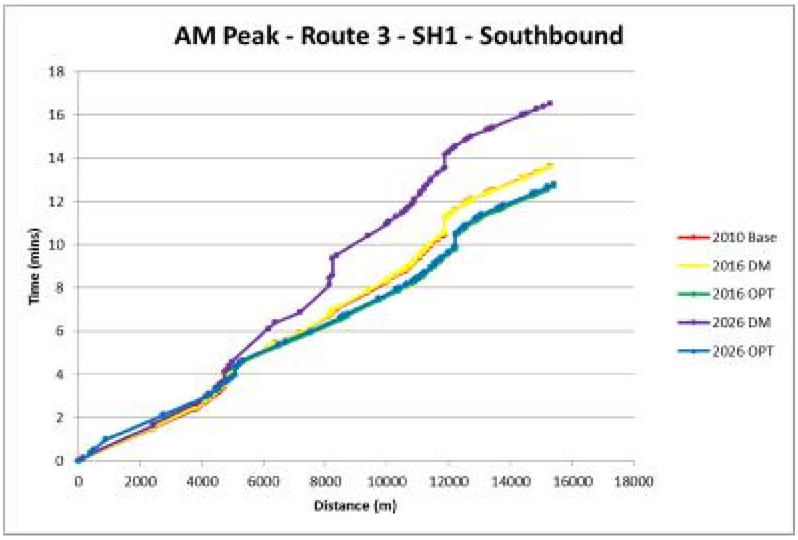




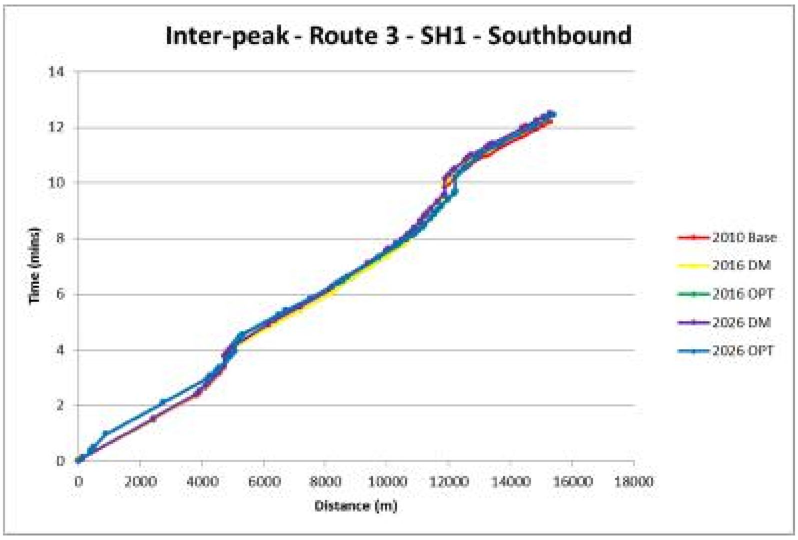

AM Peak - Route 2 - Expressway - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT


Inter-peak - Route 2 - Expressway - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

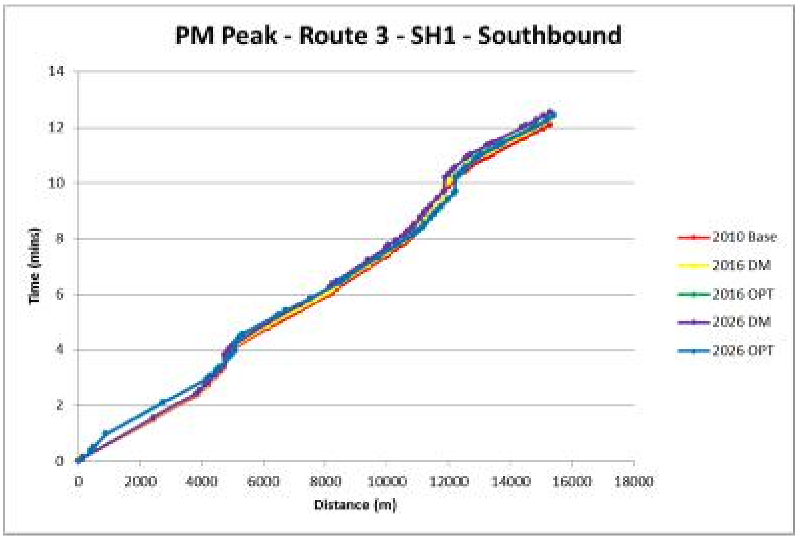

PM Peak - Route 2 - Expressway - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT



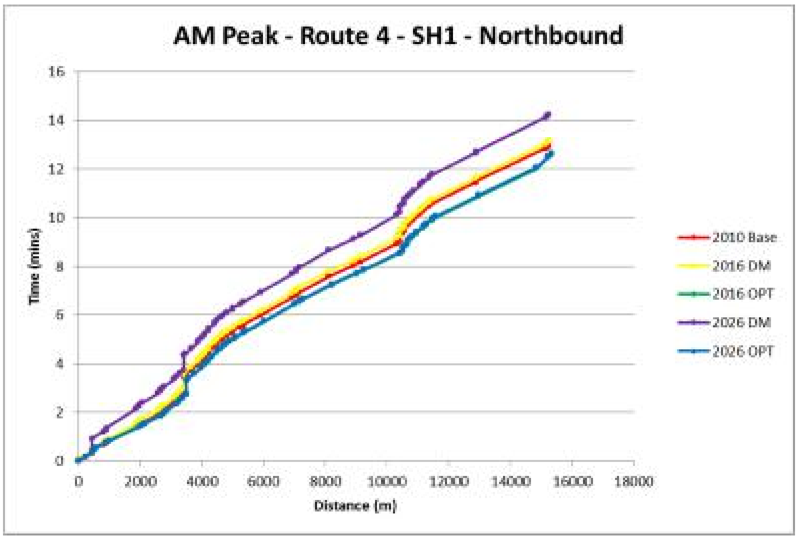
AM Peak - Route 3 - SH1 - Southbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

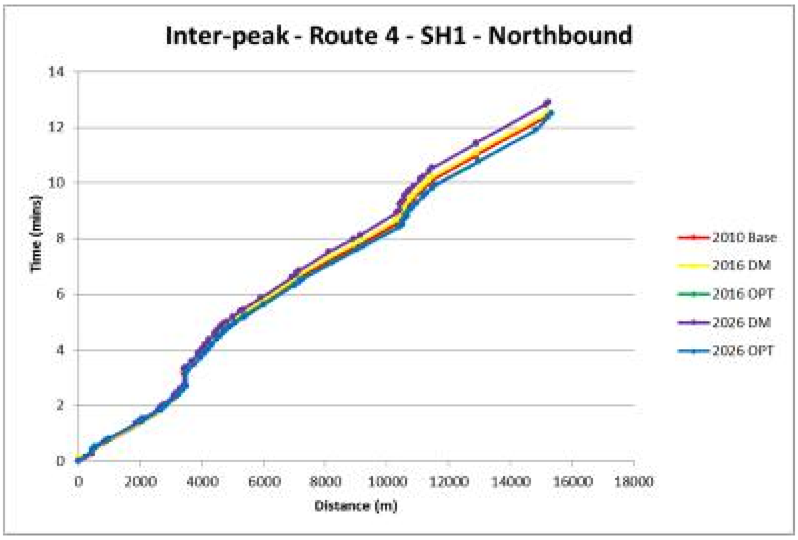


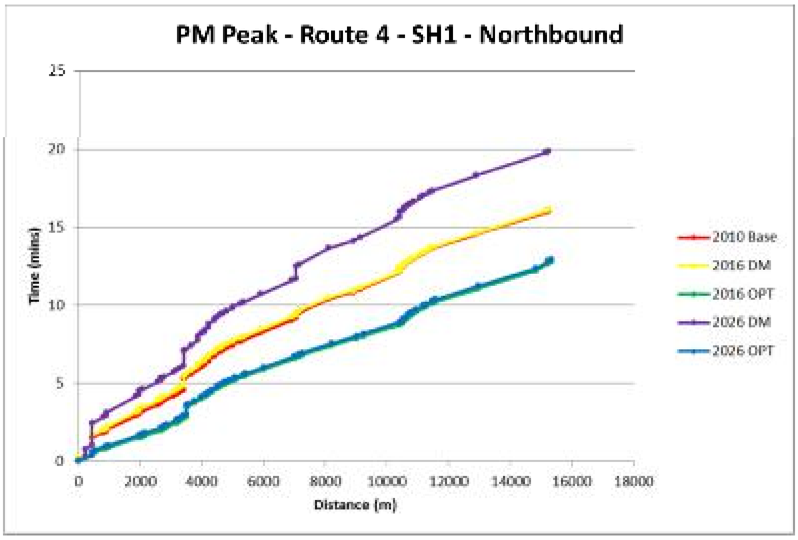
Inter-peak - Route 3 - SH1 - Southbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

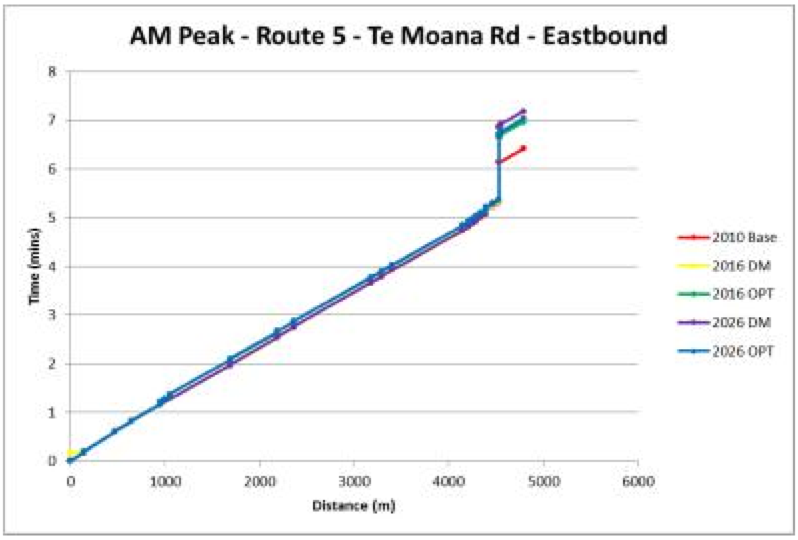


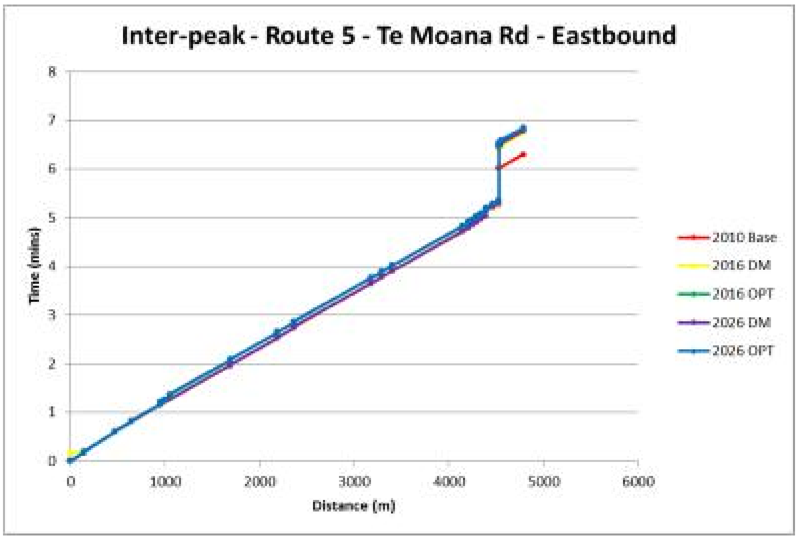
PM Peak - Route 3 - SH1 - Southbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

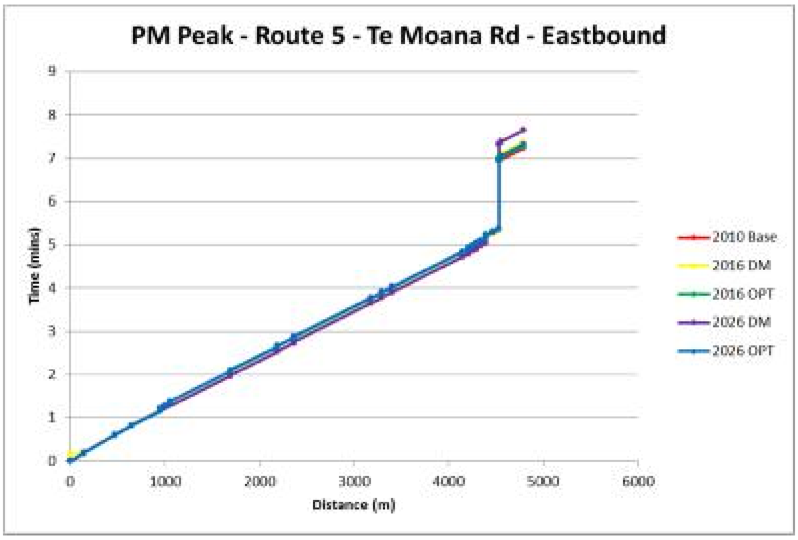

AM Peak - Route 4 - SH1 - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

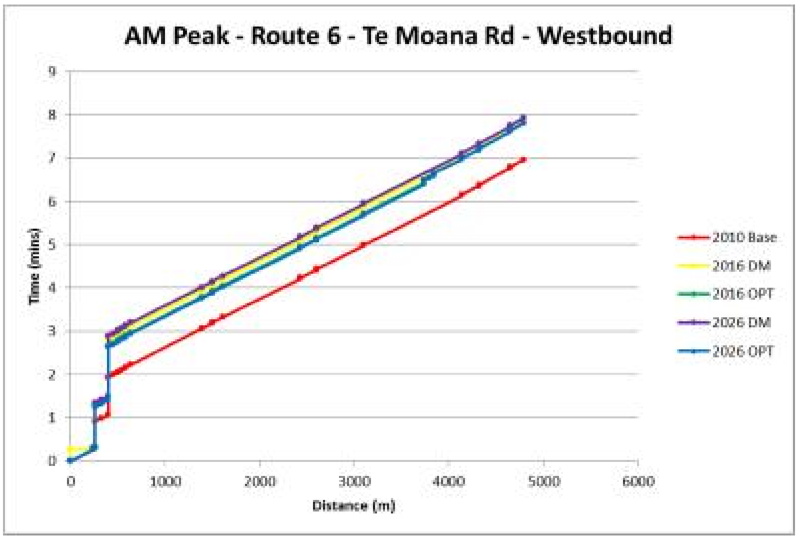

Inter-peak - Route 4 - SH1 - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

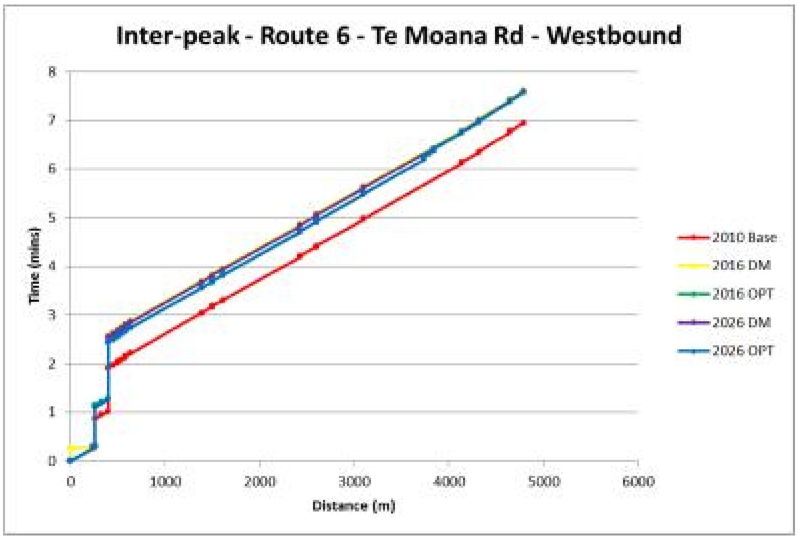

PM Peak - Route 4 - SH1 - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

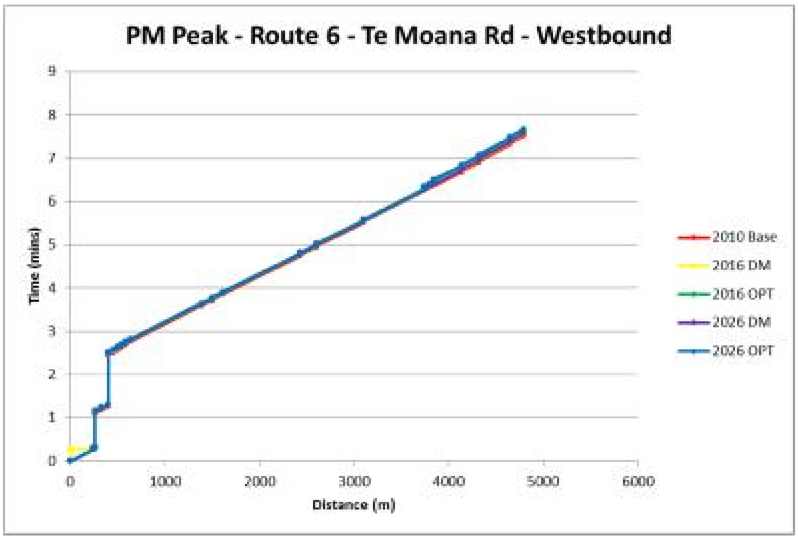

AM Peak - Route 5 - Te Moana Rd - Eastbound
Time (mins)
Distance (m)
0
1
2
3
4
5
6
7
8
0
1000
2000
3000
4000
5000
6000
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

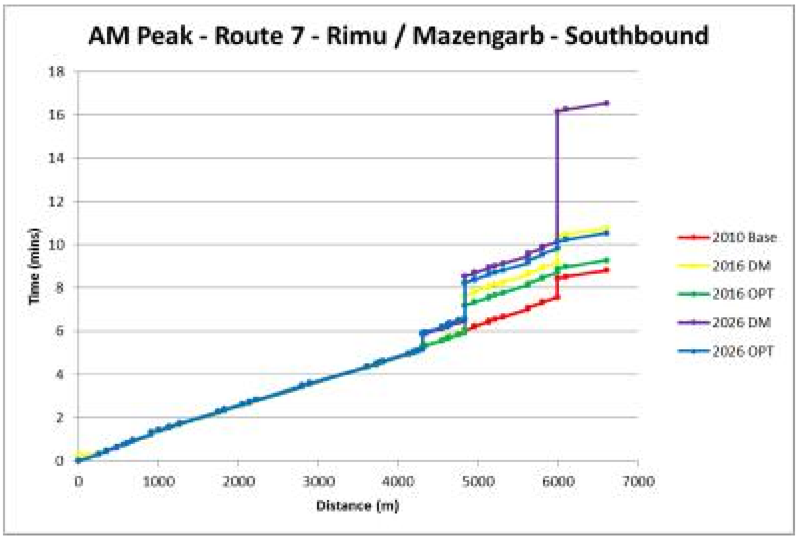

Inter-peak - Route 5 - Te Moana Rd - Eastbound
Time (mins)
Distance (m)
0
1
2
3
4
5
6
7
8
0
1000
2000
3000
4000
5000
6000
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

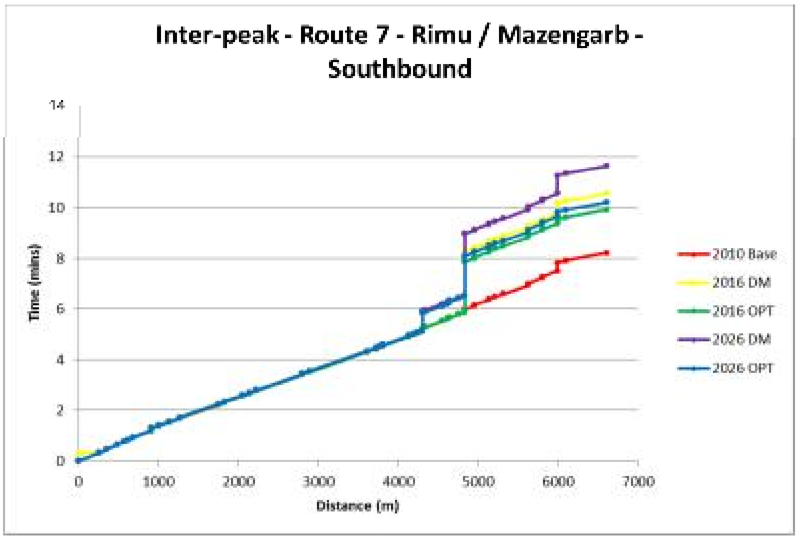

PM Peak - Route 5 - Te Moana Rd - Eastbound
Time (mins)
Distance (m)
0
1
2
3
4
5
6
7
8
9
0
1000
2000
3000
4000
5000
6000
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

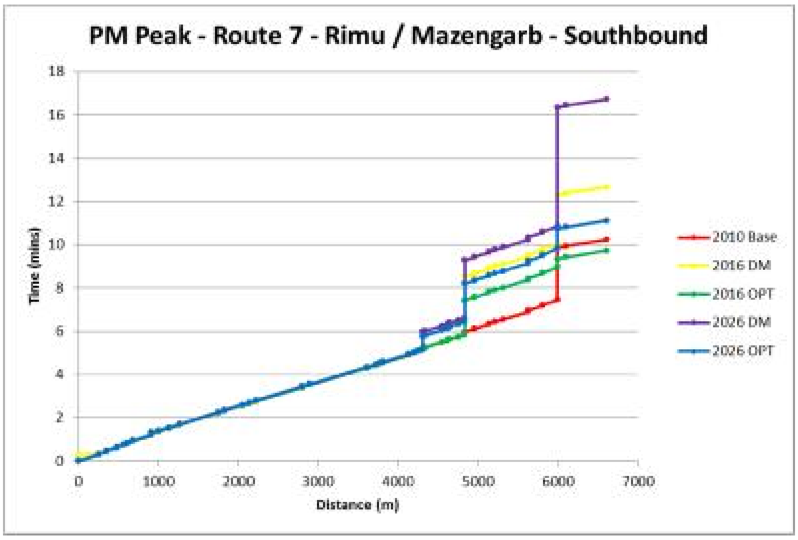

AM Peak - Route 6 - Te Moana Rd - Westbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

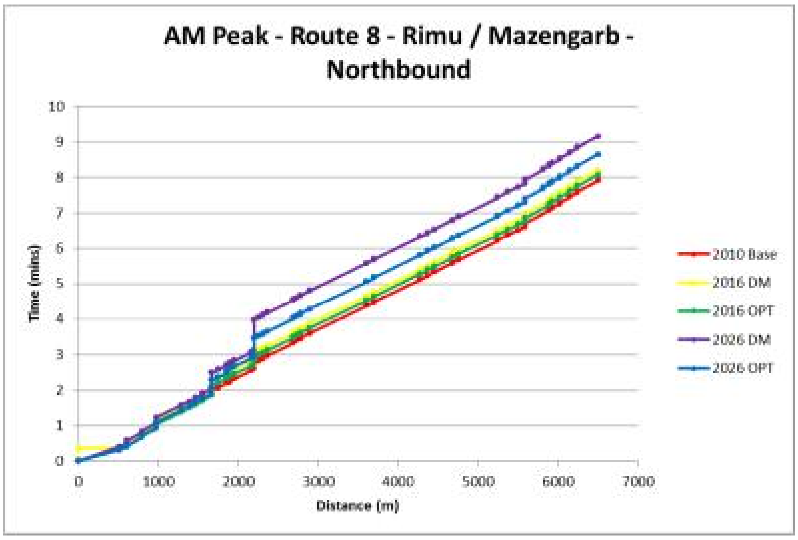

Inter-peak - Route 6 - Te Moana Rd - Westbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

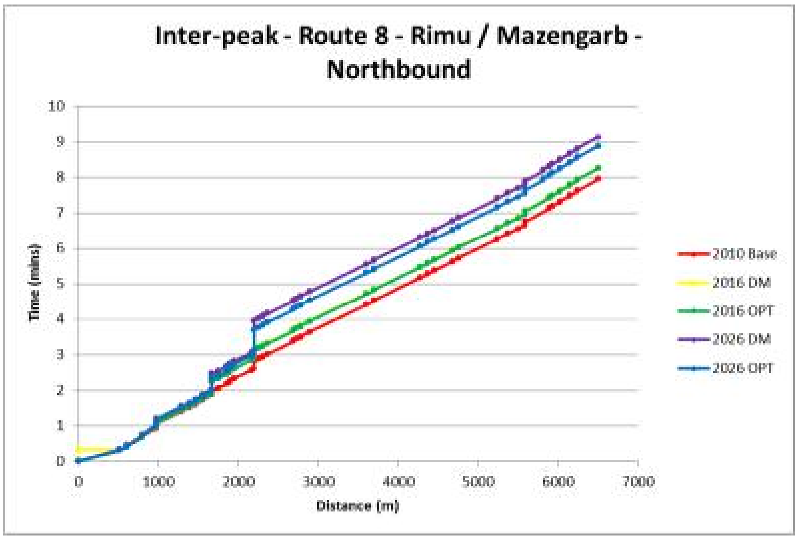

PM Peak - Route 6 - Te Moana Rd - Westbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

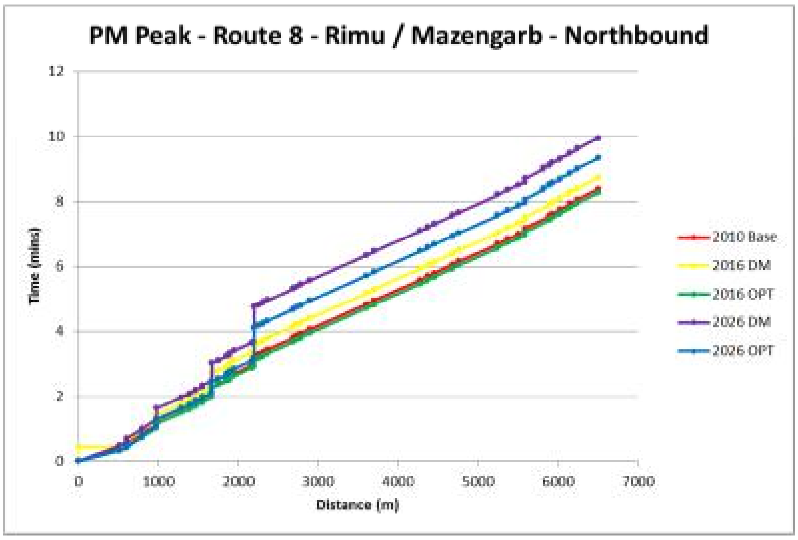

AM Peak - Route 7 - Rimu / Mazengarb - Southbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

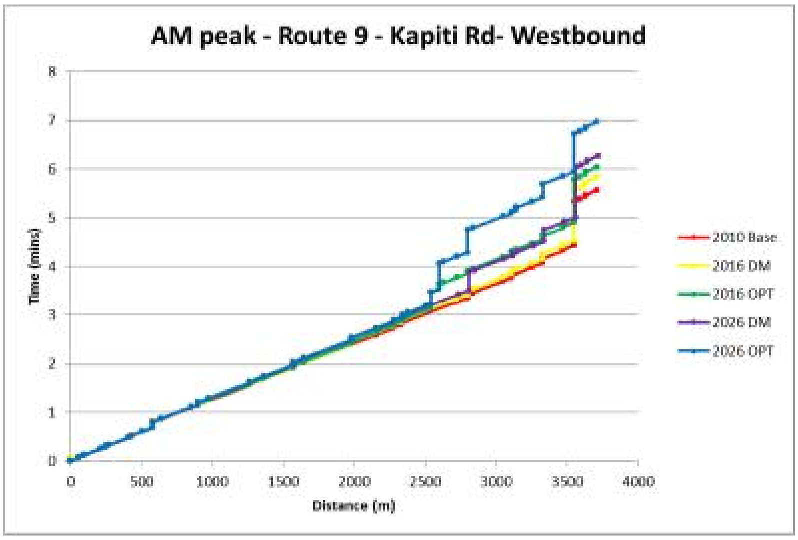

Inter-peak - Route 7 - Rimu / Mazengarb - Southbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

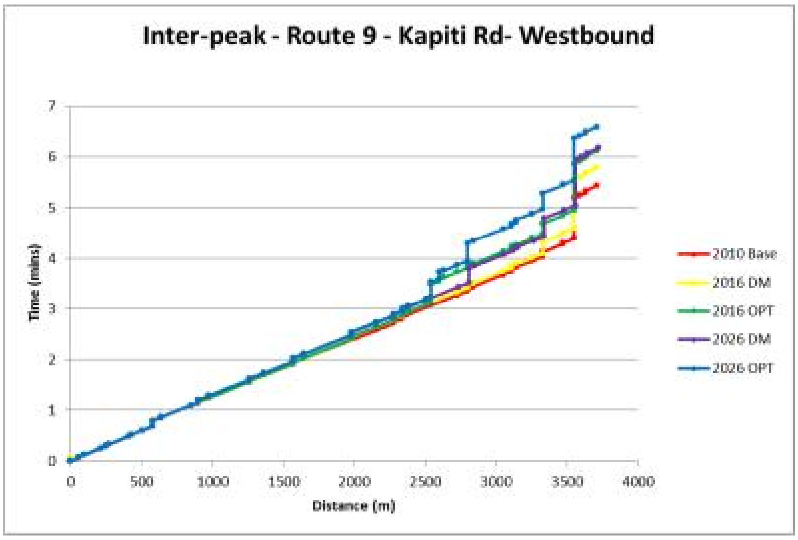

PM Peak - Route 7 - Rimu / Mazengarb - Southbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

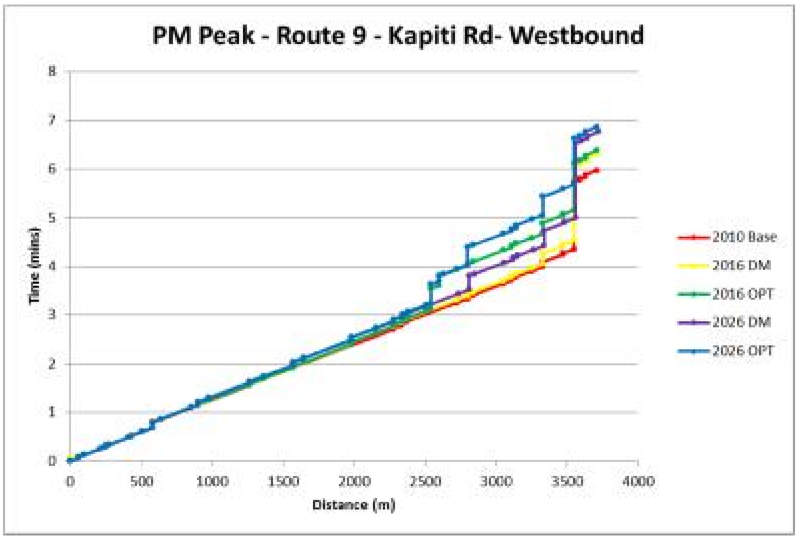

AM Peak - Route 8 - Rimu / Mazengarb - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

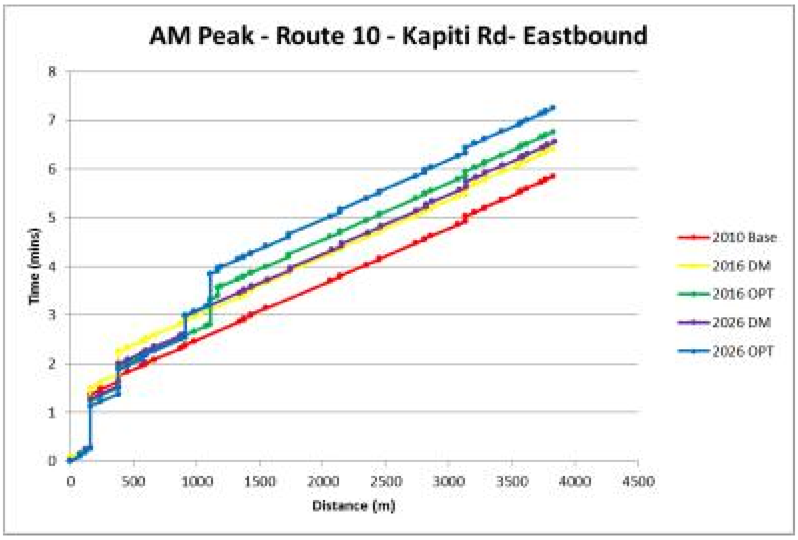

Inter-peak - Route 8 - Rimu / Mazengarb - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT


PM Peak - Route 8 - Rimu / Mazengarb - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

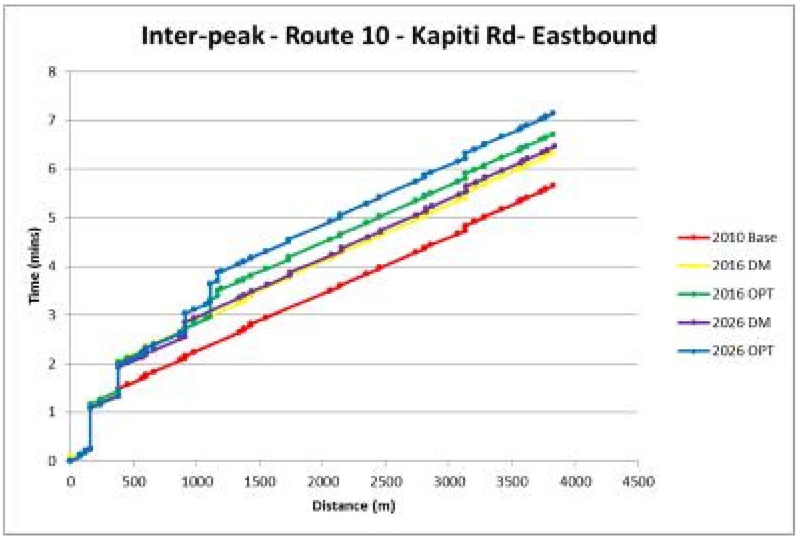

AM peak - Route 9 - Kapiti Rd- Westbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT


Inter-peak - Route 9 - Kapiti Rd- Westbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

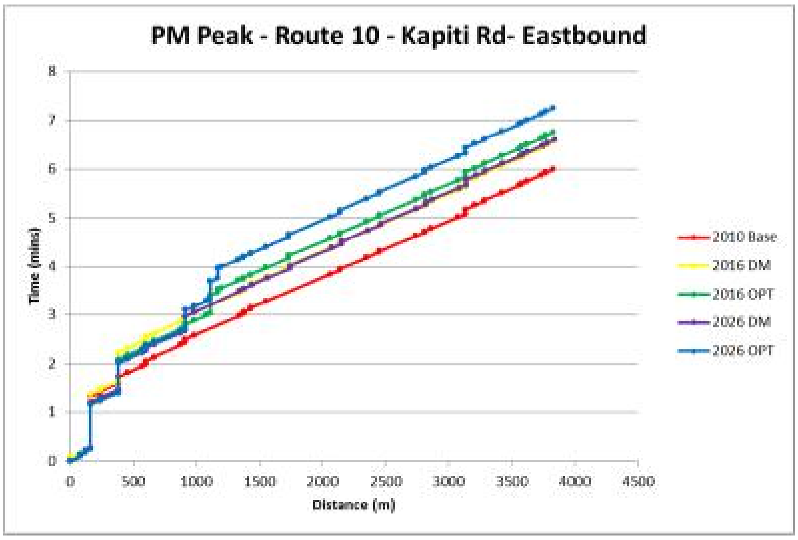

PM Peak - Route 9 - Kapiti Rd- Westbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT



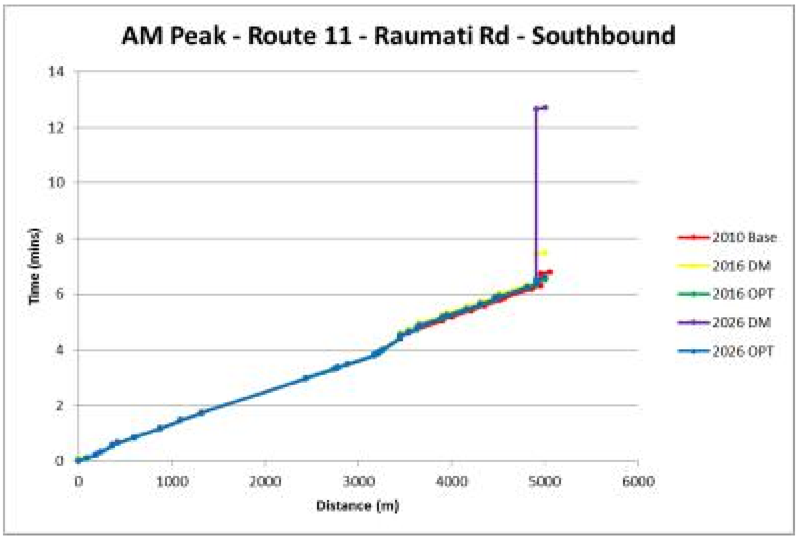
AM Peak - Route 10 - Kapiti Rd- Eastbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

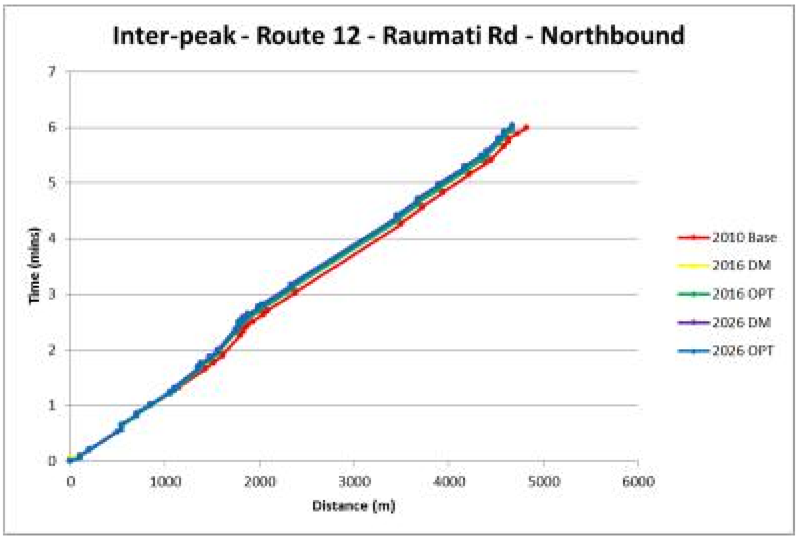


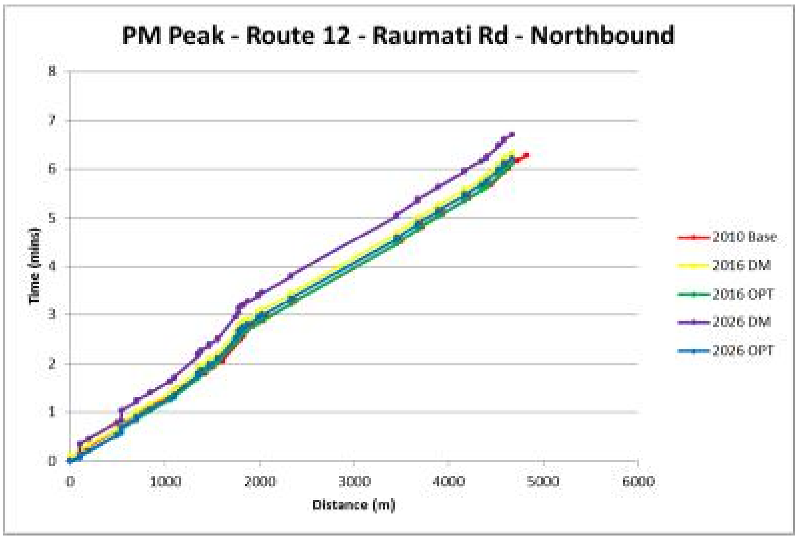
Inter-peak - Route 10 - Kapiti Rd- Eastbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

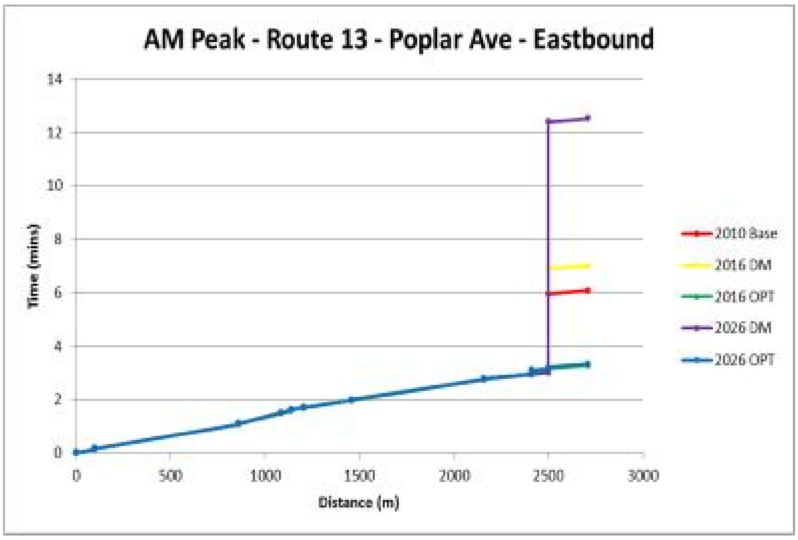


PM Peak - Route 10 - Kapiti Rd- Eastbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

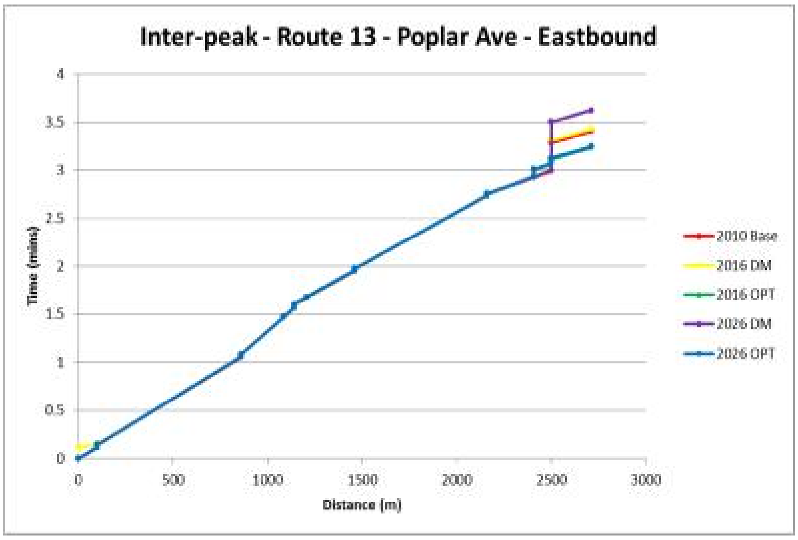

AM Peak - Route 11 - Raumati Rd - Southbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT


Inter-peak - Route 12 - Raumati Rd - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

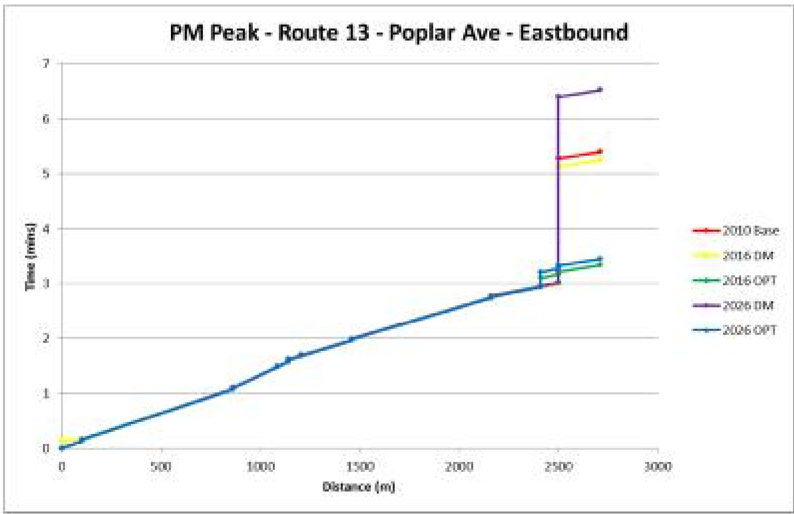

PM Peak - Route 12 - Raumati Rd - Northbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT



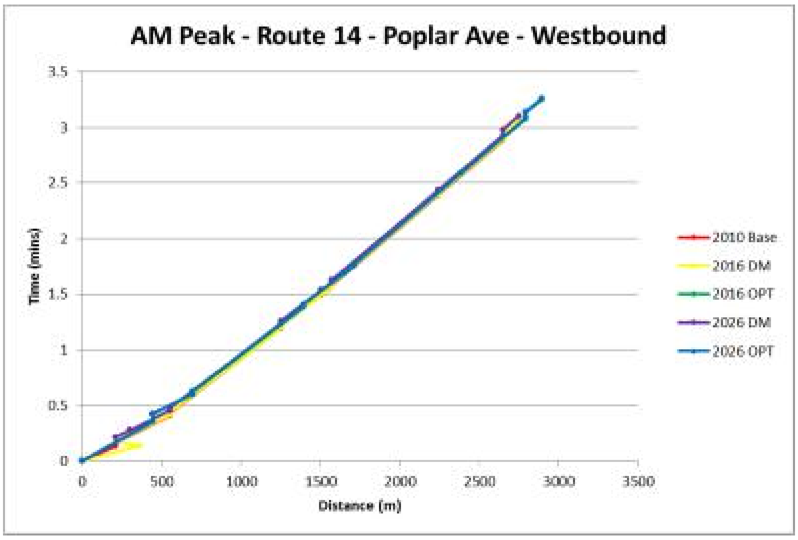
AM Peak - Route 13 - Poplar Ave - Eastbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

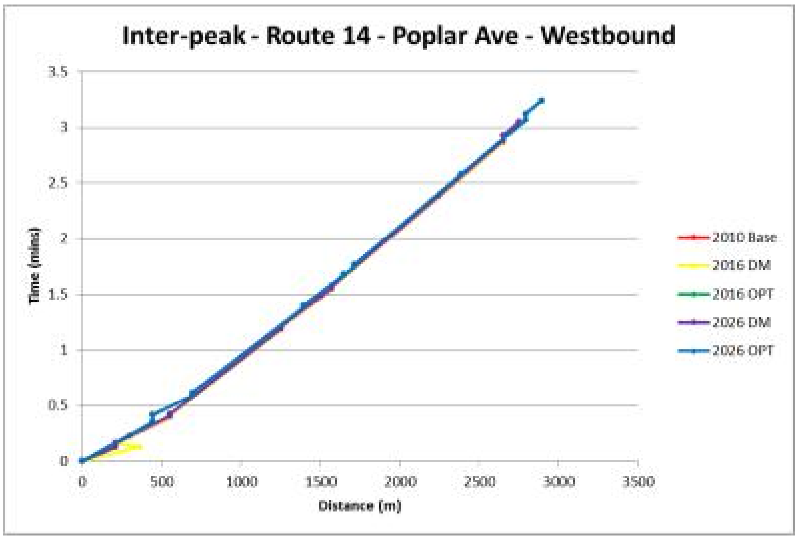


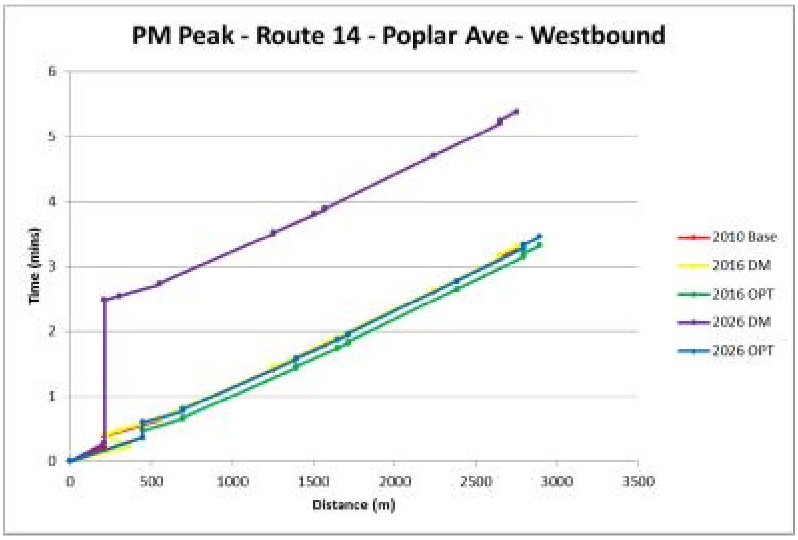
Inter-peak - Route 13 - Poplar Ave - Eastbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT



PM Peak - Route 13 - Poplar Ave - Eastbound
Time (mins)
Distance (m)
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT


AM Peak - Route 14 - Poplar Ave - Westbound
Time (mins)
Distance (m)
0
0.5
1
1.5
2
2.5
3
3.5
0
500
1000
1500
2000
2500
3000
3500
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT


Inter-peak - Route 14 - Poplar Ave - Westbound
Time (mins)
Distance (m)
0
0.5
1
1.5
2
2.5
3
3.5
0
500
1000
1500
2000
2500
3000
3500
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT


PM Peak - Route 14 - Poplar Ave - Westbound
Time (mins)
Distance (m)
0
1
2
3
4
5
6
0
500
1000
1500
2000
2500
3000
3500
2010 Base
2016 DM
2016 OPT
2026 DM
2026 OPT

Appendix 34.F

Project Assignment Model Demand

Appendix 34.F – Project Assignment Model Demand

The future year project assignment model demands for both the Option and Do Minimum are derived from the Option demand taken from WSTM.

Disaggregation

The disaggregation process used to convert the WTSM model zones (18 with the Project area) to the Project assignment model zones (197 within the Project area) is documented in the validation report.

Disaggregation factors were developed for the 2006 model to convert the WSTM demand into the Project model zoning system. These factors were reviewed for the future years, as greater growth might have occurred in some sub-zones than others. Following analysis of the future year land use inputs and demand, however, no changes were made to the disaggregation process in the future.

Application of Matrix Adjustment Factors

Following the development of the base year model, a set of adjustment factors were derived to calibrate the model to existing conditions. These factors were then applied to the future year model. Development of these factors is briefly described below.

Period to Hour Splitting

The 2hr WTSM demand is split between the ‘pre-peak’ and ‘peak’ hour Project assignment models using count data obtained from local roads within the study area. The final factors are as follows:

Table 1.1 Period to Hour Factors

Time Period	User Class	Period to Pre-Peak Hour	Period to Peak Hour
Morning Peak	Lights	0.38	0.62
	HCV	0.4	0.6
Inter-peak	Lights	0.5	0.5
	HCV	0.5	0.5
Evening Peak	Lights	0.52	0.48
	HCV	0.61	0.39

Origin Destination Survey Factoring

Origin-destination surveys, using number plate matching technology, were conducted at 3 points within the study area along State Highway 1:

- Peka Peka Road (north);
- Waikanae River Crossing (central); and
- MacKays Crossing (south).

From this data a 4 by 4 matrix was constructed, showing light vehicle and HCV travel patterns between the 4 sectors within the model for all time periods (including the pre-peak hours). This data was used to factor the matrices accordingly to adjust for observed sector to sector movements.

Table 1.2 below shows ADT traffic volumes for the Origin-Destination surveys.

Table 1.2 Daily Observed Traffic Volumes from Origin Destination Surveys, Vehicles

	South of MacKays Crossing	Paraparaumu	Waikanae	North of Peka Peka Rd	Total
South of MacKays Crossing	-	10,785	2,548	6,156	19,490
Paraparaumu	9,540	-	10,118	4,325	23,983
Waikanae	3,465	8,896	353	3,297	16,011
North of Peka Peka Rd	5,279	4,205	2,558	-	12,042
Total	18,284	23,887	15,576	13,778	71,525

The absolute difference between the 'factored' and 'un-factored' base matrices was subsequently applied to the future year matrices.

Figure 1.1 and Figure 1.2 overleaf show the percentage of the daily demand from the origin-destination surveys categorised into the following sectors:

- South of MacKays Crossing;
- Paraparaumu;
- Waikanae; and
- North of Peka Peka.

Figure 1.1 shows that around 33% of daily demand crossing one or more screenline originates in Paraparaumu. Around 45% of daily demand originates from north of Peka Peka or South of MacKays Crossing.

The patterns of destinations is very similar (shown in Figure 1.2), with around 55% of daily demand crossing one or more screenline terminating their journey within the study area (Paraparaumu and Waikanae) whilst 45% terminate their trip outside of the study area.

Figure 1.1 – OD Survey Origins

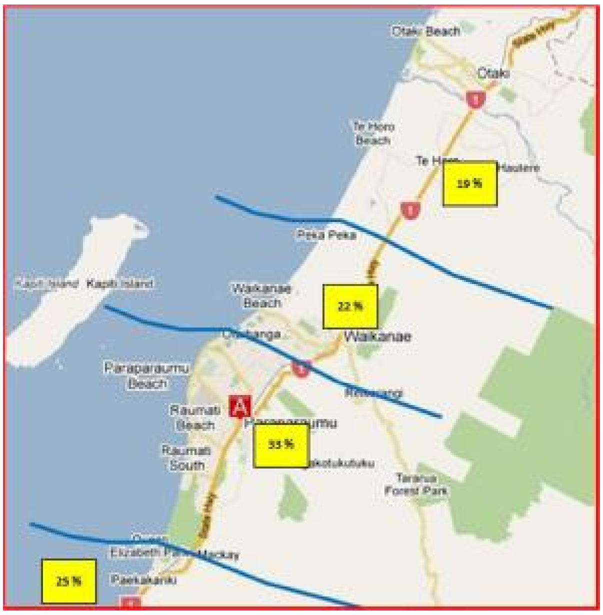
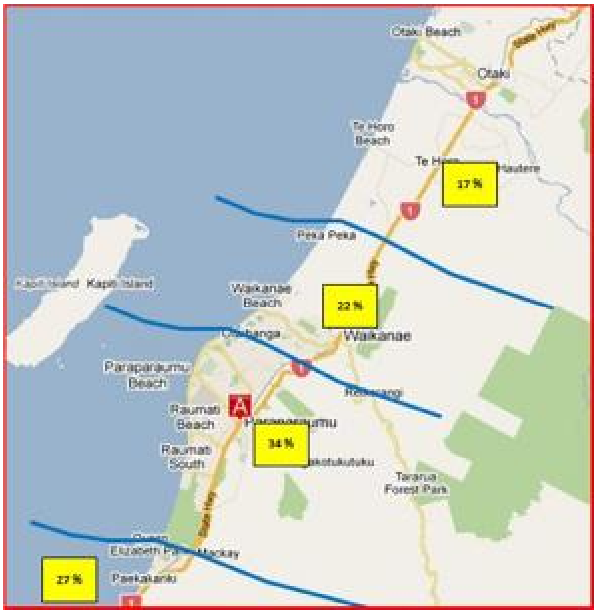


Figure 1.2 – OD Survey Destinations



Manual Adjustment

Initial assignment of the prior matrices showed that there were some global differences between modelled and observed flows across the three time periods. Further analysis showed that this was mainly confined to local trips within the study area (non-State Highway trips).

Therefore a manual adjustment was applied to the matrices (excluding those movements that had been modified through the O-D surveys) in order to create a more robust prior matrix.

The factors were as follows:

Table 1.3 ADT Traffic Volumes, Vehicles

Time Period	Lights	HCVs
AM Peak	1.10	1.1
Inter-peak	1.00	1.0
PM Peak	0.9	0.9

These factors were subsequently applied to the future year WTSM demand.

Matrix Estimation Adjustments

During the calibration of the base year model, a set of matrix estimation factors were derived to calibrate the model to existing conditions. These factors were then applied to the future year model.

A number of different methods for applying these factors were evaluated:

- 100% additive (where the absolute change in trip numbers in 2006 are applied to the future year);
- 100% multiplicative (where the ratio of the 2006 changes are applied); and
- Composite:
  - For any zones where the change in trips due to ME was less than 10% or less than 15 in absolute terms a multiplicative method was used; and
  - For all other zones an additive method was used.

A sensitivity test was undertaken using the three methods above, and showed that there was little overall difference in the methods. Therefore the composite method was chosen.

Further information regarding the calibration and validation of the Project assignment model and the development of future year Project assignment model forecasts can be found in the following technical reports that are available on request:

- MacKays to Peka Peka SATURN Model Validation Report, August 2011;

Appendix 34.G

Composite Growth Approach

Appendix 34.G – Composite Growth Approach

In order to address this apparent mis-match between growth predicted by the regional model and for significant known growth areas a 'composite growth' approach was chosen. This approach takes some of the planned development traffic for the area along with a proportion of the regional WTSM growth for the area, remaining broadly consistent with WTSM whilst also accounting for major planned developments within the area.

These planned developments will generate significant levels of traffic within the study area, leading to increased congestion along Kāpiti Road, Te Moana Road and SH1. As traffic volumes on these roads might change considerably following construction of the proposed Expressway it is important that for design purposes these committed developments are accounted for in the traffic modelling.

A composite method to account for both WTSM growth and development growth has been used, whereby 50% of the regional WTSM growth is taken for each KTM2 zone unless the KTM2 zone contains specific consented developments, in which case the full level of WTSM growth is taken along with a proportion of development growth such that the overall growth in trip generation for that zone is equal to 50% of the development trip generation total.

In summary:

- If a specified development is not in the WTSM zone then only 50% of the WTSM growth is applied; and
- If a specified development is in the WTSM zone then the full WTSM growth is applied, plus additional growth to bring the total growth in trips up to 50% of the development total.

This method results in growth being concentrated in areas where known developments are planned yet also accounts for WTSM growth (albeit at a lower level) throughout the rest of the study area.

The following three examples demonstrate how this method works:

Example 1

- WTSM growth – 100 trips;
- Development growth – 0 trips;
- Composite growth = 50% of WTSM growth = 50 trips; and
- Distribution taken from WTSM growth.

Example 2

- WTSM growth - 0 trips;
- Development growth = 100 trips;
- Composite growth = 50% of development trip ends = 50 trips; and

- Distribution taken from SATURN zone with similar land use characteristics and a suitable number of trips such that the distribution is reasonable and not 'lumpy'.

Example 3

- WTSM growth - 50 trips;
- Development growth - 400 trips;
- Composite growth = 50% of development trip ends = 200 trips;
- Breakdown of growth:
  - 50 trips from WTSM growth, distribution from WTSM; and
  - 150 trips from Development growth, distribution taken from SATURN zone with similar land use characteristics.

If the same method outlined above was applied using 100% of WTSM and / or 100% of development growth the resulting composite growth rates would be high, potentially unrealistically so.

Given that the previously agreed vehicle trip rates may not take into account the effects of mode shift, time of day shift and peak spreading, it is considered appropriate not include 100% of the development growth as this could be deemed an overestimation of trip making.

Table 1.1 and Table 1.2 below compare the WTSM growth, development growth and chosen composite growth for 2016 and 2026. The phasing of the growth between different modelled years is explained in more detail in Chapter 5, Section 5.5.

Table 1.1 Composite Growth between 2010 and 2016, Vehicles

Time Period	WTSM Growth	Development Growth	Composite Growth
AM Peak Period (2 hr)	10%	19%	14%
Inter-peak Period (7 hr)	5%	19%	12%
PM Peak Period (2 hr)	5%	22%	13%
Daytime (11hr)	6%	20%	13%

Table 1.2 Composite Growth between 2010 and 2026, Vehicles

Time Period	WTSM Growth	Development Growth	Composite Growth
AM Peak Period (2 hr)	22%	47%	35%
Inter-peak Period (7 hr)	14%	49%	32%

Time Period	WTSM Growth	Development Growth	Composite Growth
PM Peak Period (2 hr)	15%	55%	35%
Daytime (11hr)	15%	50%	33%

Further information regarding the calibration and validation of the Project assignment model and the development of future year Project assignment model forecasts can be found in the following technical reports that are available on request:

- MacKays to Peka Peka SATURN Model Validation Report, August 2011;
- MacKays to Peka Peka SATURN Model Forecasting Report, August 2011.

Appendix 34.H

Sensitivity Tests

Appendix 34.H – Sensitivity Tests

Overview

This appendix outlines the development of the "full growth" land use scenario as well as the development and outputs of the detailed operational modelling (using VISSIM[18] software).

Firstly, the following key elements in predicting the likely level of traffic to and from each of the four significant growth areas in 2026 (with each being described in turn) are covered:

- Tim Kelly Transportation Planning Ltd Paraparaumu Airport Trips (as agreed with KCDC);
- Trip rates and their sources (as agreed with KCDC); and
- Time period specific trip proportions to / from land use types.

Secondly, and finally, the development of the operational model and its key outputs are outlined and summarised.

Development of Full Growth Land Use Scenario

Tim Kelly Transportation Planning Ltd – Paraparaumu Airport 2026 Total Traffic

Tim Kelly supplied the anticipated total number of 2026 trips to and from Paraparaumu Airport as outlined in Tables 1 (Cars / LCVs) and 2 (HCVs). The "composite growth" total traffic to and from the airport is highlighted in red brackets.

The traditional trip generation process, as carried out for the three other significant growth areas, and as described later in this appendix, was therefore not required for the development associated with Paraparaumu Airport.

The 'parcels' column in Tables 1 and 2 relate to the location of developments in the vicinity of the airport as depicted in Figure 1. The disaggregate nature of the development was taken into consideration in the traffic modelling as this ensured the "loading" of the trips onto the road network was robustly represented and reflected the layout of the most recent airport master plan.

Table 1 – 2026 Total Car / LCV (Vehicle) Trips to / from Paraparaumu Airport

Parcel	Total Cars / LCV TO Airport			Total Cars / LCV FROM Airport		
	AM[19]	IP[20]	PM[21]	AM	IP	PM
1	60	51	8	41	51	33

[18] VISSIM is a micro-simulation package and is used to undertake operational scheme assessments at the most detailed level

[19] AM was assumed to represent the modelled AM Peak Hour (8am – 9am)

[20] IP was assumed to represent the modelled average inter peak hour between 9am and 4pm

[21] PM was assumed to represent the modelled PM Peak Hour (5pm – 6pm)

Parcel	Total Cars / LCV TO Airport			Total Cars / LCV FROM Airport		
	AM[19]	IP[20]	PM[21]	AM	IP	PM
2	100	81	55	50	81	90
3	137	156	264	59	156	323
4	43	30	22	18	30	44
5	152	114	116	63	114	166
6	41	34	44	18	34	65
7	55	42	53	21	42	84
8	4	4	4	4	4	4
9	61	31	22	16	31	66
10	28	36	64	29	36	58
11	38	17	14	14	17	38
12	89	62	63	38	62	96
13	75	45	46	34	45	78
14	73	33	27	27	33	73
15	52	25	22	22	25	52
16	0	0	0	0	0	0
17	72	32	25	25	32	72
18	42	24	28	16	24	52
19	45	21	19	19	21	45
20	0	0	0	0	0	0
21	118	53	36	36	53	118
22	51	24	23	23	24	51
23	2	1	2	2	1	2
24	0	0	0	0	0	0
25	42	19	16	16	19	42
26	0	0	0	0	0	0
27	3	2	1	1	2	3
28	44	30	15	15	30	44
29	51	34	17	17	34	51
Total	1,479 (647)	999 (432)	1,004 (410)	625 (258)	999 (432)	1,750 (673)

Table 2 – 2026 Total HCV (Vehicle) Trips to / from Paraparaumu Airport

	Total HCVs TO Airport			Total HCVs FROM Airport		
Parcel	AM	IP	PM	AM	IP	PM
1	21	21	2	18	21	8
2	15	15	3	12	15	8

Parcel	Total HCVs TO Airport			Total HCVs FROM Airport		
	AM	IP	PM	AM	IP	PM
3	18	11	16	12	11	22
4	15	8	10	9	8	15
5	42	23	30	27	23	43
6	1	1	2	1	1	2
7	1	1	2	1	1	2
8	1	0	1	1	0	1
9	1	1	0	0	1	1
10	2	2	3	2	2	3
11	21	10	14	14	10	21
12	39	20	27	25	20	39
13	53	27	36	35	27	53
14	42	21	28	28	21	42
15	32	16	22	22	16	32
16	0	0	0	0	0	0
17	36	18	24	24	18	36
18	22	11	15	15	11	23
19	36	18	24	24	18	36
20	0	0	0	0	0	0
21	30	15	20	20	15	30
22	48	24	32	32	24	48
23	0	0	0	0	0	0
24	0	0	0	0	0	0
25	29	14	19	19	14	29
26	0	0	0	0	0	0
27	0	0	0	0	0	0
28	7	5	2	2	5	7
29	9	6	3	3	6	9
Total	521 (106)	291 (59)	335 (63)	346 (71)	291 (59)	510 (94)

The key points from the 2026 airport development traffic are:

- A significant increase is evident in the total number of trips to and from the airport across all time periods when compared to the “composite growth” approach totals (in red brackets);
- The airport development is predicted to generate the largest number of trips of the four significant growth areas across all modelled time periods;

- Approximately 50% of car & LCV trips and 23% of HCV trips across all time periods, to and from the airport, are concentrated in parcels 1 to 9 (to the east of the runway); their main access and egress routes feed into Kāpiti Road north of Te Roto Drive;
- The remainder of the developments, i.e. developments to the west of the runway, are likely to affect the coastal roads in the future such as Raumati Road, Matatua Road and Wharemauku Road, as well as the proposed Ihakara Street extension;
- There is a higher number of car & LCV and HCV trips to the airport in the AM peak hour than any other time period (the reverse rings true for the PM peak hour for trips from the airport); and;
- The total number of trips to and from the airport in the average hour within the inter peak period is the same.

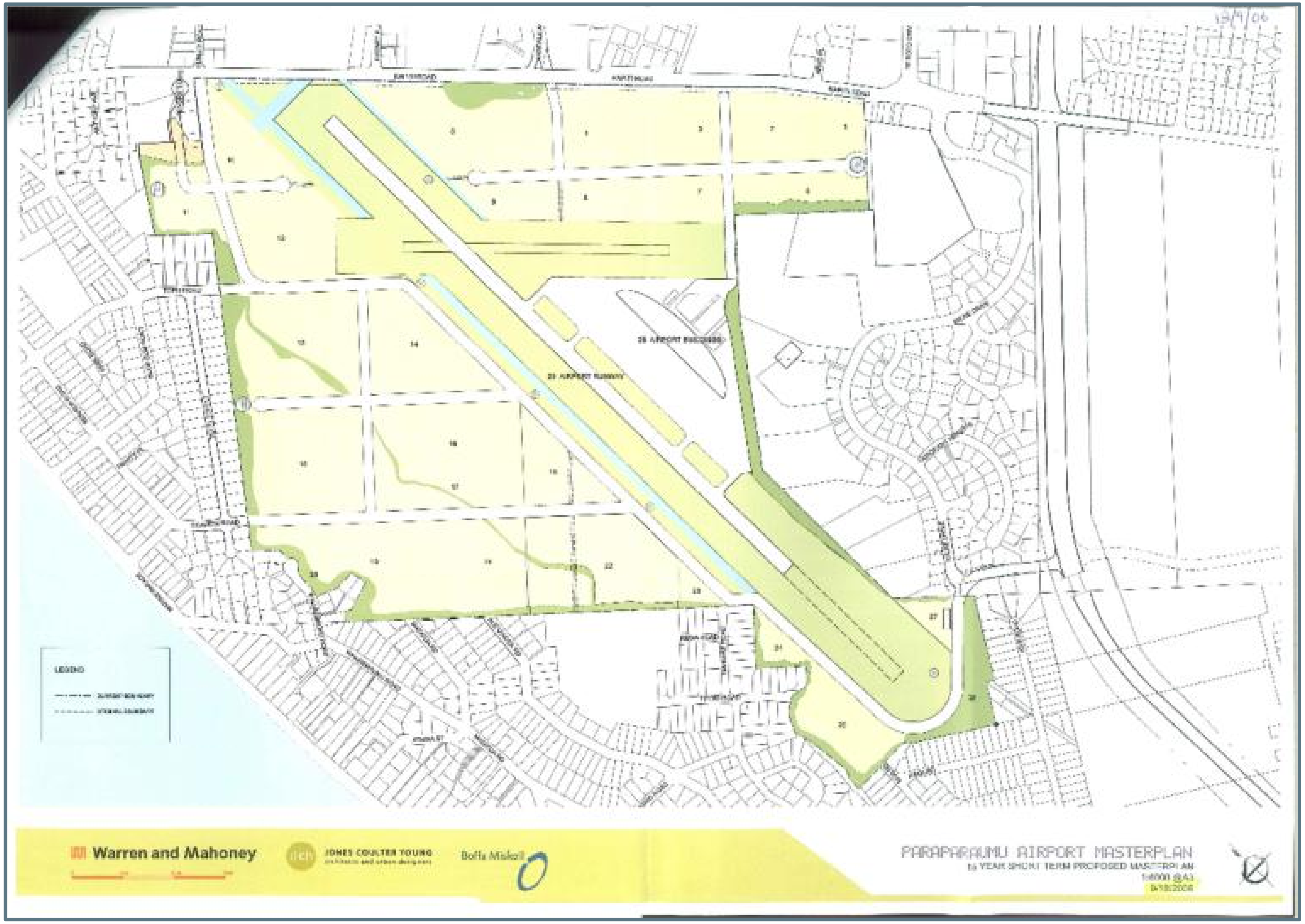


Figure 1 – Location of Airport Parcels

Trip Rates

Two sets of trip rates have been used in developing the anticipated number of 2026 total traffic trips to and from the significant growth areas. These have been sourced from:

- Opus International Consultants (Opus) – trip rates for Paraparaumu Town Centre as used in the plan change process; and
- SKM – trip rates for Waikanae North and Ngarara as outlined in Section 5 of the Ngarara Transportation Assessment, May 2008.

a. Opus Trip Rates for Paraparaumu Town Centre

Table 3 outlines the trip rates which have been used in conjunction with the Paraparaumu Town Centre land use assumptions as outlined in Chapter 8, Section 8.2, Table 8.1, of the main report.

Table 3 – Car/LCV and HCV Trip Rates by Land-Use Type

	Car / LCVs			HCVs		
Land Use Type	AM	IP	PM	AM	IP	PM
Business Services / Offices per 100 m^2	0.94	1.15	1.06	0.04	0.04	0.04
Commercial / Light Industrial per 100 m^2	1.90	1.90	1.90	0.14	0.14	0.12
Higher Density Housing per dwelling	0.23	0.11	0.23	-	-	-
Medium Density Housing per dwelling	0.23	0.12	0.23	-	-	-
Mixed Development	1.08	1.08	1.08	0.06	0.06	0.05
Retail – Large Format per 100 m^2	1.60	2.08	2.40	0.04	0.04	0.03
Retail – Specialist / Convenience per 100 m^2	1.00	2.50	5.00	0.07	0.07	0.06

Note: AM, IP and PM time periods are assumed to represent the KTM2 validated modelled peak hours as outlined in Chapter 4 of the main report.

1.2.1.1 Land Use Special Case

The “civic” land use type has been supplied as total number of trips, by vehicle type. Therefore, for this land use type, the above trip rates have not been applied in the development of the “full growth” scenario for Paraparaumu Town Centre. The total number of trips is outlined below (noting there are no HCV trips):

- AM peak hour – 102.4 car / LCV trips;
- Average inter peak hour – 84 car / LCV trips; and
- PM peak hour – 129.6 car / LCV trips.

1.2.1.2 SKM Trip Rates for Waikanae North and Ngarara

Table 4 outlines the SKM trip rates which have been used in conjunction with the Waikanae North and Ngarara land use assumptions as outlined in Chapter 8, Section 8.2, Table 8.1 of the main report.

Table 4 – SKM Trip Rates[22] by Land Use Type

Land Use Type	AM	IP	PM
Community per 100 m^2	2.00	4.00	2.00
Education per 100 m^2	2.00	2.60	1.00
Office per 100 m^2	2.00	1.40	2.00
Residential (HHU)	1.00	1.00	1.00
Residential (retirement) units	0.32	0.29	0.29
Retail per 100 m^2	4.00	10.00	20.00
Tourist per 100 m^2	0.67	0.50	0.64

These trip rates have been derived using the following assumptions (as outlined in SKM Ngarara Transportation Assessment, May 2008):

- The proposed plan change comprises of some fairly unique land uses that do not fit within the standard classifications for the purposes of defining a trip rate from similar surveyed sites in the normal way;
- With this is mind, the land uses that form the proposed development have been investigated in detail with the Project team to establish the activities that will occur there and try to obtain a close approximation from the main sources of trip rate information;
- Reference has been made to published documentation within New Zealand and Australia namely the RTA Guide to Traffic Generating Developments, the Transfund New Zealand Research Report No. 209 and the New Zealand Trips and Parking Database; and
- Where there is uncertainty about the traffic generation characteristics of a particular land use, a higher traffic generating land use category has been assumed.

1.2.1.3 Points to Note on Trip rates

[22] Trip rates have been assumed to be applicable to Cars / LCVs only. One percent of the generated Car / LCV trip has been assumed to be an HCV trip for the retail land use type.

In some instances, the trip rate land use type descriptions did not match the land use type description as outlined in Chapter 8, Section 8.2, Table 8.1 (land use assumptions) of the main report. Therefore, the following assumptions were made:

1.2.1.3.1 Opus Trip Rates for Paraparaumu Town Centre

- Retail – Specialist / Convenience trip applied to Retail – Supermarket / Speciality / Other land use type;
- Business Services / Offices trip rate applied to Commercial / Office land use type;
- Medium Density Housing per dwelling trip rate applied to Apartments land use type;
- Commercial / Light Industrial trip rate not specified therefore Industrial / Manufacturing trip rates used as a proxy from previous trip rate generation work (July 2006); and
- Mixed Development trip rates have been calculated using previous trip generation work (July 2006).

1.2.1.3.2 SKM Trip Rates for Waikanae North and Ngarara

- Retail / Local Convenience trip rate applied to Commercial / Local Services land use type; and
- Residential retirement dwellings trip rates have been taken from the 2010 NZ Trip Generation Database (Tauranga City Council) and the average inter peak hour has been assumed to be on a par with the PM peak hour.

Time period specific trip proportions to / from land use types

The trip rates which have been used in conjunction with Paraparaumu Town Centre, Waikanae North and Ngarara significant growth areas do not specify trip proportions to and from the land use types. For example, using the SKM trip rates in Table 4, we have one trip rate for the “office” land use type in the AM peak hour (ie 2 trips per 100m^2 of GFA). In reality, the number of trips travelling to the “office” land use type will be higher than the number of trips travelling from in the AM peak hour. Therefore, the same trip rate of 2 trips per 100m^2 of GFA for trips to and from this land use type in the AM peak hour cannot be applied. Rather trip proportions to and from each land use type, and by time period, needs to be applied. Table 5 outlines trip proportions to and from each land use type used in the sensitivity testing, noting that the total trip proportion (to and from) for each time period adds up to one.

Table 5 – Trip Proportions to / from Land Use Types

Land Use Type	AM to	AM from	IP to	IP from	PM to	PM from
Business Services	0.85	0.15	0.50	0.50	0.21	0.79
Higher Density Housing	0.20	0.80	0.50	0.50	0.65	0.35

Land Use Type	AM to	AM from	IP to	IP from	PM to	PM from
Large Format Retail	0.61	0.39	0.50	0.50	0.20	0.80
Medium Density Housing	0.20	0.80	0.50	0.50	0.65	0.35
Mixed Use	0.85	0.15	0.50	0.50	0.21	0.79
Retail – Specialist / Convenience	0.61	0.39	0.50	0.50	0.20	0.80
Retirement dwellings	0.52	0.48	0.50	0.50	0.56	0.44
Warehouse / Distribution	0.61	0.39	0.50	0.50	0.20	0.80

These trip proportions were derived from information gathered during previous meetings with KCDC, TKTP, FFTP, Duffill Watts and TSE Ltd (July 2006). Further information is available on request.

"Full Growth" Scenario Trips

This section outlines the total number of expected 2026 trips to and from each of the significant growth areas, by land use type, time period and vehicle type, as a result of the development of the 2026 "full growth" land use scenario. Note that the total number of trips to and from Paraparaumu Airport are outlined in Tables 1 and 2 above.

A comparison of the total number of trips to and from each of the significant growth areas with the total number of trips generated using the "composite growth" approach (highlighted in red brackets) is also presented and discussed here. The impacts of the 2026 "full growth" scenario traffic demand on the Kāpiti road network are discussed later in Chapter 8, Section 8.6 of the main report.

Paraparaumu Town Centre Development

Table 6 – Paraparaumu Town Centre 2026 “Full Growth” Scenario Car / LCV (Vehicle)Trips

Land Use Type	GFA (100m²)	AM to	AM from	IP to	IP from	PM to	PM from
Business Services / Offices	231	185	33	133	133	51	193
Civic	50	51	51	42	42	65	65
Commercial / Light Industrial	324.75	376	241	309	309	123	494
Higher Density Housing	217.50	11	44	13	13	36	19
Medium Density Housing	561.2	22	86	28	28	70	38
Mixed Development	83.1	76	13	45	45	19	71
Retail (Large Format)	200	195	125	208	208	96	384
Retail (Specialist / Convenience)	226.50	138	88	283	283	227	906
Total GFA (100 m²)	1894.05	-	-	-	-	-	-
Total Car/LCVs (Vehicle) Trips		1,054 (418)	682 (285)	1,061 (453)	1,061 (457)	687 (568)	2,170 (631)

Table 7 – Paraparaumu Town Centre 2026 “Full Growth” Scenario HCV (Vehicle) Trips

Land Use Type	GFA (100m²)	AM to	AM from	IP to	IP from	PM to	PM from
Business Services / Offices	231	8	1	5	5	2	7
Civic	50	-	-	-	-	-	-
Commercial / Light Industrial	324.75	29	18	23	23	8	31
Higher Density Housing	217.50	-	-	-	-	-	-
Medium Density Housing	561.2	-	-	-	-	-	-
Mixed Development	83.1	4	1	2	2	3	3
Retail (Large Format)	200	5	3	4	4	1	5
Retail (Specialist / Convenience)	226.50	10	6	8	8	3	11
Total GFA (100 m²)	1894.05	-	-	-	-	-	-
Total HCV (Vehicle) Trips		56 (12)	29 (4)	42 (10)	42 (10)	17 (8)	57 (14)

Waikanae North Development

Table 8 – Waikanae North 2026 “Full Growth” Scenario Car / LCV (Vehicle) Trips

Land Use Type	GFA (100m²)	Dwellings	Units	AM to	AM from	IP to	IP from	PM to	PM from
Commercial (Local Services)	8			19	12	40	40	32	127
Residential (Dwellings)		700		140	560	350	350	455	245
Retail (Local Convenience)	12			29	19	59	59	48	190
Retirement Dwellings (Units)			100	16	16	15	15	19	10
Total GFA / Dwellings / Units	20	700	100	-	-	-	-	-	-
Total Car/LCVs (Vehicle) Trips				205 (47)	606 (160)	464 (65)	464 (65)	553 (143)	572 (91)

Table 9 – Waikanae North 2026 “Full Growth” Scenario HCV (Vehicles) Trips

Land Use Type	GFA (100m²)	Dwellings	Units	AM to	AM from	IP to	IP from	PM to	PM from
Commercial (Local Services)	8			0	0	0	0	0	1
Residential (Dwellings)		700		-	-	-	-	-	-
Retail (Local Convenience)	12			0	0	1	1	0	2
Retirement Dwellings (Units)			100	-	-	-	-	-	-
Total GFA / Dwellings / Units	20	700	100	-	-	-	-	-	-
Total HCV (Vehicle) Trips				0 (0)	0 (0)	1 (0)	1 (0)	0 (0)	3 (0)

Ngarara Development

Table 10 – Ngarara 2026 "Full Growth" Scenario Car / LCV (Vehicle) Trips

Land Use Type	GFA (100m^2)	Units	AM to	AM from	IP to	IP from	PM to	PM from
Commercial (Local Services)	16		39	25	79	79	63	253
Residential (Dwellings)		1,689	338	1351	845	845	1098	591
Retail (Local Convenience)	24		58	37	119	119	95	380
Total GFA / Units	40	1,689	-	-	-	-	-	-
Total Car/LCVs (Vehicle) Trips			434 (195)	1,413 (432)	1,043 (216)	1,043 (216)	1,256 (391)	1,225 (277)

Table 11 – Ngarara 2026 "Full Growth" Scenario HCV (Vehicle) Trips

Land Use Type	GFA (100m^2)	Units	AM to	AM from	IP to	IP from	PM to	PM from
Commercial (Local Services)	16		0	0	1	1	1	3
Residential (Dwellings)		1,689	-	-	-	-	-	-
Retail (Local Convenience)	24		1	0	1	1	1	4
Total GFA / Units	40	1,689	-	-	-	-	-	-
Total HCV (Vehicle) Trips			1 (0)	0 (0)	2 (0)	2 (0)	2 (0)	7 (0)

Paraparaumu Town Centre Development Summary

It is clear from Tables 6 and 7, there is a significant increase in the number of total traffic trips to and from the Paraparaumu Town Centre development when compared with the level of trips contained within the "Composite Growth" traffic demand matrices for this area. The Paraparaumu Town Centre development is predicted to generate the second highest number of trips of the four significant growth areas.

There is an increase of 147% and 138% in car / LCV traffic to and from the town centre in the AM and PM peak hours respectively (car / LCV making up the overwhelming majority of traffic). The AM and PM peak hour tidal patterns are evident for both growth scenarios and this is reflecting the large number of business, office and retail land uses, by GFA, in the town centre. The average inter peak hour is consistent with the assumption of the number of trips to the town centre is similar to the number of trips from the town centre between both growth scenarios.

Waikanae North Development Summary

It is clear from Tables 8 and 9, that there is a significant increase in the number of total traffic trips to and from the Waikanae North development when compared with the level of trips contained within the "Composite Growth" traffic demand matrices for this area. The Waikanae North development is predicted to generate the least number of trips of the four significant growth areas.

There is a significant increase of approximately 600 car / LCV trips to and from Waikanae North in the AM peak hour and an approximate significant increase of 900 car / LCV trips to and from Waikanae North in the PM peak hour. The land use mix for the Waikanae North development mainly consists of residential and retirement dwellings; hence the pattern of travel reflects a larger number of trips travelling from this area in the AM peak hour and a similar "flat" pattern in the average inter peak and PM peak hours. There is negligible HCV traffic travelling to or from this development as expected.

Ngarara Development Summary

As summarised in Tables 10 and 11, there is a significant increase in the number of total traffic trips to and from the Ngarara development when compared with the level of trips contained within the "Composite Growth" traffic demand matrices for this area. The Ngarara development is predicted to generate approximately the same number of trips (less 300) as the Paraparaumu Town Centre development.

Similar to the Waikanae North development, the land use mix is mainly made up of residential dwellings – local convenience retail and local commercial services making up the remainder of the development. As such, the travel pattern reflects a larger number of trips travelling from this area in the AM peak hour and a similar "flat" pattern in the average inter peak and PM peak hours. There is negligible HCV traffic travelling to or from this development as expected.