Kapiti SH1 Strategy Study

Technical Report

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Executive Summary

Opus was commissioned to develop a Strategy for creating a State Highway 1 (SH1) expressway between Pukehou Bridge (north of Otaki) and MacKays Crossing (south of Paraparaumu). The study was commissioned in response to the Western Corridor Study (2005) which concluded that SH1 should be upgraded to expressway standard.

SH1 is currently the only north-south route within the study area. A key feature of the road network in Kapiti is that SH1 currently provides for both local and inter-regional movements. The additional demand from motorists making short, local trips results in congestion and delays, particularly at the SH1 intersections. The additional traffic associated with permitted development within the district is forecast to exacerbate this situation.

This study has found that it would be possible to build an expressway from north of Otaki to MacKays Crossing for $0.7B to $1.0B. It was found that while building an expressway improves journey times for those making inter-regional trips, it resulted in more congestion and longer trips for Kapiti residents wishing to drive within the district between Waikanae and Paraparaumu. Furthermore, the additional cost of increased journey times for local trips is forecast to be significantly greater than the journey time savings for inter-regional trips. To overcome poor connectivity for local trips, it is necessary to provide additional local arterials in the form of building some elements of the Western Link Road.

Between Peka Peka and Paraparaumu there are four options for locating the expressway. Two of these options will be considered for further investigation: -

(a) **Option 3: -** Expressway located along the NIMT railway plus the Western Link Road between a southern interchange and Kapiti Road.

(b) **Option 4:** - Expressway located along the NIMT railway from Paraparaumu to Otaihanga and then following the Western Link Road designation between Otaihanga and Peka Peka and the Western Link Road between a southern interchange and Kapiti Road.

The Western Link Road, being a local north south arterial that provides an additional crossing over the Waikanae River provides an alternative route for north-south trips, and has been shown to significantly reduce the number of vehicles using the SH and reduce congestion both now and in future years.

Lastly the study found that building the Western Link Road and the expressway maximises economic benefits by providing for both local trips and inter-regional trips.

The project team makes the following recommendations: -

- A four lane expressway is built between MacKays Crossing and Pukehou Bridge.
- Key elements of the Western Link Road also need to be built together with a number of west east arterials.
- Further work is undertaken during the next phase of the project to rationalise and simplify the on and off ramps around Otaki.

- NZTA consult with the public on options for a four lane expressway from MacKays Crossing to Pukehou Bridge.

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1 Introduction

Opus International Consultants Ltd (Opus) have been commissioned to develop a strategy for creating a State Highway 1 (SH1) expressway through Kapiti Coast District. The study area extends between Pukehou Bridge north of Otaki; and MacKays Crossing to the north of Paekakariki. The geographical extent of the study area is shown in Figure 1.1.

The study was commissioned in response to concerns that SH1, north of Wellington, does not adequately cater for peak traffic demand and that this may damage the regional economy and adversely affect communities living close to the road. The Western Corridor Study, completed in 2005 by Maunsells, concluded that SH1 in Kapiti should be upgraded to at least expressway standard. The New Zealand Transport Agency (NZTA) wants future highway improvements to improve network reliability and road safety.

This report includes references to, and builds upon findings of, initial scoping work documented in a Scoping Report prepared by Opus and issued to NZTA in July 2008. This report documents the findings of technical work undertaken on this contract (TNZ 266PN) since then.

1.1 Study Area

Kapiti Coast District is located on the south western end of the north island approximately 50km north of Wellington. The district has a total population of 46,200. The majority of this population live in the four main settlements of Otaki, Waikanae, Paraparaumu and Raumati. Waikanae and Paraparaumu serve as the District's primary service centres.

The study area follows the corridor from just north of Otaki to MacKay's Crossing, extending between the coast and the foot hills of the Tararua ranges. The nearest major centres outside the study area are Levin approximately 20km north of Otaki and Porirua, approximately 30km south of Raumati. Historically, the Kapiti Coast has a functional relationship with Wellington.

The topography of the study area is consistent along its length with relatively flat plains between the coast and the hills. The distance from the coast to the Tararua foothills ranges between 1.5km and 7.5km.

SH1 and the NIMT Railway are broadly parallel to each other running north - south through the district between the coast and upland areas. These links form the primary strategic transport infrastructure which currently serves the local centres as well as providing for national and regional journeys through the district. There is also a regional airport in Paraparaumu. At present this is predominantly used for short inter-regional journeys and for recreational flights. There are no strategic sea ports for freight or passenger journeys within the study area.

Figure 1.1 – State Highway 1 Kapiti Strategy Study Area

1.2 Study Objectives

The aim of the study, as defined in the scope of services for contract 266PN, is to:

"develop a long-term plan for SH1 through Kapiti that provides for the sustainability of the highway while facilitating strategic, planned connectivity with the Kapiti community and the passenger transport network. The long term plan for SH1 will compliment the committed rail upgrades to achieve a balanced transport network on Wellington's Western Transport Corridor."

1.3 Strategy Objectives

To guide the future direction of the study and help achieve this aim the study team developed strategy objectives. These objectives were developed following a workshop attended by representatives of regional stakeholder organisations. The objectives for the Kapiti State Highway 1 Strategy are to:

(a) improve the safety and efficiency of national and regional trips to strategic destinations (e.g. ports, hospitals, airport etc) made using SH1;

(b) develop SH1 so that it supports committed land-use proposals and agreed urban design aspirations;

(c) maintain / improve access to local centres and passenger transport hubs in Waikanae, Paraparaumu and Otaki for pedestrians / cyclists and bus users;

(d) maintain / improve current levels of access for motorists travelling to railway stations;

(e) reduce or maintain the current degree of severance experienced by communities living on either side of State Highway 1; and

(f) reduce the negative impact of State Highway 1 upon the air quality, ambient noise and public amenity in the local centres of Waikanae, Paraparaumu and Otaki.

1.4 Previous Studies

Several studies have investigated improvement options for the transport corridor linking Wellington and the north along the Kapiti Coast. Maunsell's Western Corridor Study, completed in 2005, considered several options for multi-modal enhancements to the transport corridor. One of the study's key recommendations: that rail capacity be increased between Waikanae and Wellington; will be implemented by 2010. The Western Corridor Study also found that even with rail enhancements, road upgrades were needed. Local residents were consulted on the proposal to improve SH1. The community was supportive of widening SH1 to four lanes through Paraparaumu as far north as Waikanae.

In 2002, Maunsell also completed an assessment of a four lane expressway between Pukehou Bridge and Peka Peka. As a result of this scheme assessment, Maunsell recommended an alignment which was subsequently accepted by the (then) Transit NZ Board.

A common theme of the previous work is conflict between local trips within the district and inter-regional trips. These studies have shown that through necessity, a significant number of motorists use SH1 for relatively short, local trips. Roading improvements must therefore address the strategic objective of reliable and efficient long distance journeys on SH1 and the need to provide access to local services in Kapiti.

1.5 Kapiti SH1 Strategy Scoping Report

The Scoping Report documented the base-line situation and defined the issues which the strategy must address. It was intended that the report would provide a basis for developing consensus between stakeholders and agreement on the direction for progressing the strategy. The scoping report documented:

- the policy rationale for developing the strategy;
- an initial catalogue of planning issues that influenced the formulation of a realistic and achievable strategy;
- urban design issues and opportunities associated with SH1 in Otaki, Waikanae and Paraparaumu;
- the demographic characteristics of the district and statistics that demonstrate how people live and choose to travel in Kapiti Coast District;
- initial forecast for future traffic conditions if no changes are made to SH1; and
- the engineering standards to which a state highway expressway design should comply.

As a result of this initial scoping report, the study team derived the principles from which the strategy would be developed. These principles are discussed in more detail in the following chapter.

1.6 Policy Context

The policy context documented in the scoping report is still relevant. To avoid duplicating material, it is not reproduced here. A significant change has been the election of a new Government in November 2008 and release of a new Government Policy Statement (GPS) on Land Transport Funding 2009/10 – 2018/19.

The GPS details the current government's desired outcomes and funding priorities for the use of the National Land Transport Fund. The GPS emphasises the Government's focus on economic growth and productivity. It envisages this will be achieved through investment in high quality infrastructure that supports the efficient movement of people and freight.

As part of this new direction, seven Roads of National Significance (RoNS) have been identified. The Government sees these as essential routes that require significant development to reduce congestion, improve safety and support economic growth. The Government's objective in listing roads as nationally significant is to ensure that improvement schemes are prioritised when the NZTA develops the National Land Transport Programme. SH1 from Wellington to Levin (Wellington Northern Corridor) has been identified as a RoNS.

When assessing and prioritising projects, NZTA will continue to consider

- effectiveness,
- economic efficiency, and
- contribution to the national economy.

In particular initiatives that improve journey time reliability, ease severe congestion and provide more efficient freight supply chains on nationally significant routes will be prioritised.

1.7 Scope of Work

The scope of this project has evolved during the study. This has helped the project team understand the wider transportation needs of the Kapiti District. Initially, the project team worked on the basis that the WLR would be constructed between Poplar Avenue and Peka Peka. The design of the WLR, including its staging, evolved during the course of the study. This led to investigation of a wider group of scenarios for the route of the SH1 expressway, including on land that is currently designated for the WLR.

2 Rationale for Strategy Development

This chapter presents the overall principles that have guided development of the strategy. The key assumptions on which much of the technical assessment is founded are also described. The last section highlights the questions that were used to frame the problem and subsequently to inform strategy development.

2.1 Overall Principles

A key feature of the existing road network in Kapiti is that the state highway currently provides for both local and inter-regional movements. This compromises the efficiency and effectiveness of the corridor. Good transport planning would see:

- a single strategic route providing inter-regional connectivity, developed as a high capacity motorway or expressway with only limited access to the local road network;
- a number of arterial routes connecting key trip generators (i.e. places of employment, recreation etc) to the strategic route; and
- local roads linking residential properties with the arterial network.

In such a scenario, access to the strategic route would be limited. The arterials and local roads would, in contrast, have active frontages and provide facilities for walking and cycling. Ideally the arterials would be designed to encourage movement between spaces on either side. They would provide numerous connections to the local roads with intersections as close as 800m apart to maximise traffic dispersal. This is important to prevent key intersections becoming congested.

From an urban design perspective land-uses that generate high numbers of inter-regional trips such as industrial areas should be located on arterials as close as possible to the strategic route. The urban areas should be located to one side of the strategic route so as to avoid the severance that a strategic route can create.

In developing a strategy for creating a SH1 expressway in Kapiti it is necessary to be aware of the constraints arising from the topography, urban form and existing infrastructure. The main findings of the scoping study were that:

- the existing urban form with development extending between the coast and the hills means that it is not possible to locate the strategic route outside of the urban area;
- the location of the NIMT railway relative to the urban areas already results in community severance; and
- there are currently no local arterials that can be used as an alternative to SH1 for north-south travel.

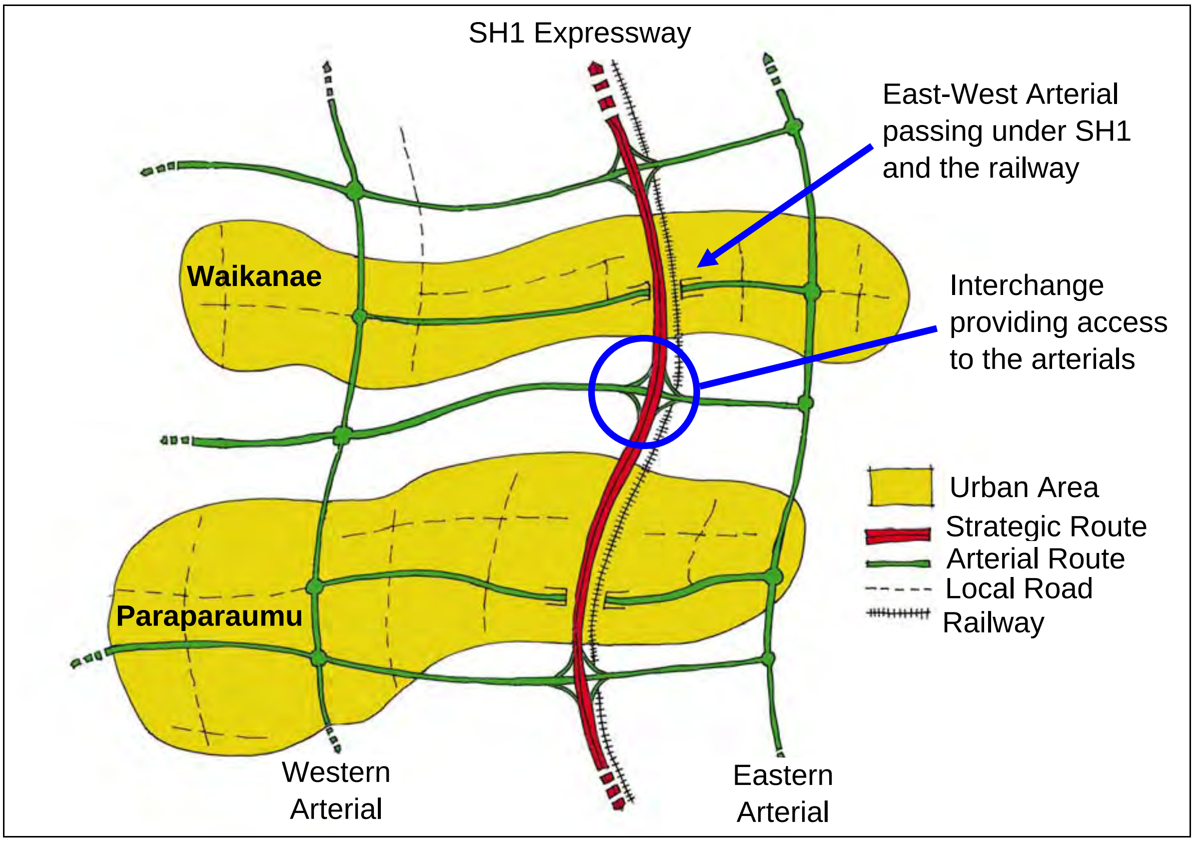
Given the existing urban development, there are a limited number of opportunities for creating a SH1 expressway and supporting infrastructure:

- accept that the NIMT railway creates severance and co-locate the strategic highway within the same corridor to avoid creating additional severance;
- locate the SH1 expressway in land presently designated for the WLR, as this designation has created severance already.

There are a number of principles that the team used in developing the strategy, as shown in Figure 2.1. These were: -

- create a high capacity through route with limited number of connections to the local arterial roading network;
- create additional north-south arterials to the east of the strategic state highway route.

Figure 2.1 – Principles for Developing an Expressway in Kapiti



SH1 in Kapiti currently performs a dual function, acting as both a strategic route but also as the only true arterial route connecting the north and south parts of the district. Motorists travelling between north of the Waikanae River and Paraparaumu have no alternative to SH1. If motorists are prevented from using a SH1 expressway in Kapiti for local trips it will be necessary to create at least one local north-south arterial.

2.2 Accessibility and Intersection Spacing

At present SH1 is the only significant arterial route that passes through the Kapiti Coast along a north-south alignment. This means that the community and visitors travelling to the district using private transport rely heavily on SH1 for access.

At present there are frequent intersections between SH1, adjacent land-use and local distributors. This affects the efficiency of SH1 for national and inter-regional travel. Limiting access from local roads will improve the efficiency of SH1 and reduce the likelihood of crashes but could reduce access to key community facilities and service centres unless alternative, local arterial routes are provided.

Good expressway design limits the number of high quality interchanges in order to minimise vehicle interaction and conflict at speed. There is a need to ensure that large grade-separated interchanges are located outside urban areas to minimise negative impacts upon amenity and urban form. The locations must however be chosen to optimise the use of the local road network.

2.3 Key Assumptions

The success of a future SH1 expressway in Kapiti is reliant on the provision of an adequate local roading network.

There is significant potential for land development within Kapiti Coast district. There are several proposals for residential and / or commercial land developments. Land Developers are working to achieve District Plan changes that will make development possible. Development that is permitted or that is conditional on construction of the WLR is included in the forecast year do-minimum scenarios. Developments that are not currently permitted are not included. The key developments included in the 2016 and 2026 forecast year do-minimum and test scenarios include:

- Paraparaumu Aerodrome (Plan Changes 18 & 73)
- Paraparaumu Town Centre (Plan Changes 72A)
- Waikanae North

2.4 Decision Making Criteria

One of the challenges associated with developing a strategy for creating an expressway in Kapiti is to adequately understand the interaction between SH1 and the WLR. There is potential for the provision of a new arterial road to erode the need and benefits associated with the upgrade of SH1 and vice-versa. This interaction between the two road schemes also adds an additional level of complexity to project staging. It has also been necessary to accommodate uncertainty relating to the form of the WLR.

The approach adopted to deal with this uncertainty has been to clearly identify and state the assumptions used as a basis for progressing the study. The assumptions are then consistently applied to aid option comparison. This approach was considered appropriate for a strategic study intended to provide a direction for development of the district. Future scheme assessments and localised traffic studies will provide more detailed analysis that will inform NZTA.

The study team determined that answers to three questions were needed in order to formulate a robust strategy. These answers have helped the study team better understand future traffic demand, the interaction of SH1 with the local arterials and the contribution of each element of the future road network to meeting the strategy objectives. The answers may also be used by decision-makers to determine the future. The questions, answers to which are presented in the following chapters, are:

(a) Why are local arterials necessary?

(b) What options are available for providing a SH1 expressway in Kapiti?

(c) In which order should stages of a SH1 expressway and local arterials be constructed?

3 Why Local Arterials are Necessary

The need for a north-south arterial within the district results from poor accessibility and a reliance on SH1 for local trips. At present, only SH1 links the towns of Paraparaumu and Waikanae. To an extent the coastal link (Rosetta Road, Marine Drive etc) provides for north-south connectivity. It does not, however, provide a Waikanae River crossing.

This lack of connectivity focuses motor traffic on SH1 and the east - west arterials. This results in congestion and delays. Local arterials such as Kapiti Road are close to capacity because traffic is focused on a limited number of arterials.

SH1 currently provides the only Waikanae River crossing suitable for motor vehicles. A local arterial bridge over the Waikanae River could improve route security by providing an alternative crossing for inter-regional traffic in the event that the SH1 bridge was to close.

Urban design reviews commissioned by KCDC[1] have concluded that there are several areas of land within the district that are not realising their growth potential. KCDC are designing the WLR to optimise the economic return that development at these sites could bring to the District. The Council are promoting the WLR as a social and economic catalyst that will re-energise the Kapiti Coast economy and communities.

The Kapiti SH1 Strategy scoping report presented the principles for providing an expressway in Kapiti. This chapter presents the results of tests designed to challenge these principles and to quantify the benefits of local arterials. Tests were undertaken using the Kapiti SATURN Model. This chapter presents the tangible benefits for combinations of a generic SH1 expressway and an additional north-south local arterial.

The tests represent an expressway option that follows the rail corridor through Paraparaumu and Waikanae. Between these two towns the existing SH1 alignment would become an eastern arterial. Grade separated intersections would be created somewhere south of Paraparaumu (south facing ramps), at Otaihanga Road (full diamond interchange) and north of Waikanae (south facing ramps). Half diamond interchanges reinforce the roading hierarchy and discourage motorists from using the expressway for local trips within the district. If the WLR is not built it becomes necessary to construct full diamond interchanges to maintain local access. The roads tested are shown schematically in Figure 3.1. The two-lane WLR with local level of service was used to represent an additional north-south arterial.

The tests were completed before alignment options were scoped. This means that the results are only illustrative. They are, however, adequate for showing how an expressway and an additional local arterial could work together. The three scenarios are:

- Scenario 1: SH1 Expressway Only;
- Scenario 2: WLR Only (Local Level of Service); and
- Scenario 3: WLR and SH1 Expressway.

[1] Urban Design Framework – Integrated Land Use and Transport Report, Common Ground, June 2009

Figure 3.1 – Generic SH1 Expressway and Local Arterial Road Option

3.1 Do Minimum Scenario

The do minimum scenario includes permitted developments (see section 2.3) in both the 2016 and 2026 forecast years. The do minimum model includes new internal roads associated with each of the proposed developments. It also includes the Ihakara Road extension that links the town centre development with the airport development. No WLR or expressway elements are included in the do minimum model.

3.2 Network Summary Statistics

Table 3.1 and Table 3.2, overleaf, show the network summary statistics for each of the three scenarios in the 2016 and 2026 forecast years respectively. The tables present average travel speed for all trips undertaken within the network. They also present total travel time, delayed time and queued time for each scenario.

Scenario One: SH1 Expressway Only

In this scenario, the old SH1 becomes an eastern arterial. Motorists making inter-regional trips would use the new expressway. Those making short local trips would continue to use the old SH1. Local trips would be able to cross the Waikanae River using the existing bridge on the old SH1 (which is becoming an eastern arterial) while a new crossing would be provided as part of the expressway for inter-regional trips. Someone driving from Kapiti Road to Waikanae would use a new underpass below SH1 and the railway to reach Ruapehu Street. From here they would drive along Ruahine Street before joining the old SH1 just south of Lindale and crossing the Waikanae River on the existing bridge. No new north-south routes are provided in the west of the district.

The tables show that introducing a SH1 expressway increases the network travel speed by 5km / hour in 2016 and reduce travel times from the do minimum scenario. These improvements result from eliminating all queuing on SH1. Motorists using the new expressway would be able to drive in uninterrupted traffic conditions. There would be no at-grade intersections to create queues on SH1. Providing two lanes in each direction would also allow motorists to overtake slow moving vehicles.

Even though the SH1 expressway is shorter than the existing SH1 route, Scenario One actually increases the total travel distances by 3,000 PCU - km in each 2016 peak hour. This is because motorists making local trips would travel longer distances to make the same journeys. Reasons for this include:

(a) the lack of connectivity to the SH1 expressway means that some trips (e.g. from Kapiti Road to Waikanae) will be slightly longer. However the large number of people making this journey means that the cumulative increase in travel distance is large.

(b) The lack of connectivity to the expressway in Paraparaumu means that motorists are forced to use local roads to drive within the town. Rimu and Kapiti Roads are already congested. The additional trips associated with new development exacerbate the situation and motorists travel further to bypass congested roads such as these.

Table 3.1– Network Summary Statistics 2016

	Do Minimum			Scenario One SH1 Expressway Only			Scenario Two WLR Only			Scenario Three WLR & SH1 Expressway		
Time Period	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**
Network Speed (km / hr)	43	45	39	48	46	41	49	48	46	54	50	45
Travel Distance (PCU-kms/Hr)	65,558	60,053	78,583	68,597	62,933	81,363	61,706	56,916	74,633	61,433	56,177	73,016
Travel Time (PCU Hrs / Hr)	1,533	1,328	2,016	1,445	1,373	1,982	1,257	1,199	1,637	1,135	1,120	1,621
Delayed Time (PCU Hrs)	88	88	106	2	1	3	41	31	62	1	1	2
Queued Time (PCU Hrs)	395	395	605	323	3	607	223	237	347	142	180	404

Table 3.2 – Network Summary Statistics 2026

	Do Minimum			Scenario One SH1 Expressway Only			Scenario Two WLR Only			Scenario Three WLR & SH1 Expressway		
Time Period	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**
Network Speed (km / hr)	39	41	33	45	43	39	49	48	44	54	47	43
Travel Distance (PCU-kms/Hr)	71,494	65,299	84,138	73,606	68,815	89,050	67,647	62,567	81,262	67,197	61,570	79,562
Travel Time (PCU Hrs / Hr)	1,826	1,593	2,616	1,656	1,603	2,271	1,392	1,311	1,862	1,250	1,307	1,841
Delayed Time (PCU Hrs)	110	71	127	3	1	4	52	40	74	2	1	3
Queued Time (PCU Hrs)	561	458	979	453	445	764	254	248	445	165	278	518

Notes		
PCU		= Passenger Car Unit (1 Car = 1 PCU, 1 HCV = 2 PCU etc)
Network Speed	km / hr	= the average speed of all trips from origin to destination
Travel Distance	PCU-kms / Hr	= the total distance travelled for every trip (PCU) from origin to destination within the modelled hour
Travel Time	PCU Hrs / Hr	= the total travel time for every trip (PCU) from origin to destination within the modelled hour
Delayed Time	PCU Hrs	= the total delay between intersections caused by high volumes for every trip (PCU) within the modelled hour
Queued Time	PCU Hrs	= the total queuing delay for every trip (PCU) within the model hour

Table 3.1 and Table 3.2 show that Scenario One is forecast to have lower total travel time and queued time than the do minimum. Removing local trips from a SH1 expressway and providing additional capacity means that there would be a substantial reduction in delays between intersections (delayed time).

Examination of the tangible traffic benefits for Scenario One indicates that the dis-benefit associated with increased travel distances for motorists making local trips outweighs the travel time savings for motorists using a SH1 expressway. The tangible benefits for Scenario One (SH1 expressway only) were approximately -$230M[2]. A negative benefit indicates that traffic efficiency would be worse for this scenario than for the do minimum.

Scenario Two: WLR Only (Local Level of Service)

Creating an additional north-south local arterial in the west of Kapiti District increases accessibility. It provides more direct routes for the journeys that motorists want to make. It also provides an alternative to driving on SH1. In this scenario there are two crossings of the Waikanae River: as part of the WLR and the existing crossing on SH1. Scenario Two is forecast to reduce the total travel distance in the modelled area by approximately 4000 PCU km / hour from the do minimum in each of the 2016 peak hours. Inter peak (IP) travel distances are forecast to decrease by just over 3000 PCU km / hour in 2016.

As well as reducing total travel distance and hence vehicle operating costs, Scenario Two is also forecast to reduce total travel time. The travel time reductions associated with this option for the 2016 AM peak are forecast to be around three times as great as for Scenario One. In the 2016 PM peak, total travel time reductions are more than 10 times as great as for Scenario One.

An additional north-south local arterial reduces congestion at intersections and hence queuing time. However because no additional capacity is provided for SH1 traffic, delays on SH1 links (delayed time) are not reduced as much as they were in Scenario One. Any reduction in delayed time is as a result of reduced traffic flows on SH1. The reductions in delayed time result from fewer motorists using the existing SH1 for local trips. This improves traffic flow for people making inter-regional trips.

The tangible benefits for the WLR alone were approximately +$390M[2].

Scenario Three: SH1 Expressway and WLR

Providing a SH1 expressway and an additional north-south local arterial brings benefits for both motorists using the SH1 expressway and people making shorter trips within the district. This scenario provides three points where motorists can cross the Waikanae River: on the WLR, on the SH1 expressway, and on the old SH1 (which would become an eastern arterial). In the 2016 and 2026 AM peak periods the difference between total travel distance for this scenario and the do minimum, is forecast to be similar to that for Scenario 2, at around 4000 PCU km / hour. For the PM peak, Scenario Three is forecast to bring travel distance savings that are about 50% more than for Scenario Two.

[2] These benefits assume a 30 year return period and are based purely on travel time and vehicle operating costs. Crash costs are not included.

The additional capacity provided on the SH1 expressway means that delays on SH1 links are reduced by a similar amount as in Scenario One. The new local arterial allows traffic to be more widely dispersed around the road network. This results in a reduction of queued time of a similar magnitude to Scenario Two.

There is a substantial degree of synergy between providing both a SH1 expressway and an additional north-south arterial for local traffic. We use the word synergy here because the total economic benefits achieved by building both the WLR and state highway expressway is significantly greater than the sum of benefits calculated by providing each as a stand alone scheme. The tangible benefits for a SH1 expressway with a supporting WLR are approximately +$470M. This is primarily because both inter-regional and local traffic would benefit.

3.3 Inter-Regional Travel Time Savings

Table 3.3, overleaf presents forecast travel times on SH1 for the three test scenarios. If neither the SH1 expressway nor the WLR are introduced, AM peak hour travel times are forecast to increase by up to 25% from 2016 to 2026. In the PM peak do minimum scenario travel times are forecast to increase by up to 70% between 2016 and 2026.

All three scenarios reduce travel times for inter-regional trips on SH1. Scenario 2 is forecast to reduce SH1 travel times by between 50 and 250 seconds per trip. In scenarios where a SH1 expressway is provided (Scenarios One & Three) the savings could be up to six times as much than for Scenario Two. It is also evident that SH1 travel time savings where both an expressway and the WLR are constructed are no greater than if only the expressway were provided.

3.4 Inter-Regional Traffic Volumes

Comparing traffic volumes in each of the scenarios illustrates the degree that local traffic is forced or encouraged onto local roads. Table 3.4 presents forecast traffic volumes across four screen lines –as shown in Figure 3.1.

Restricting access to SH1 (Scenarios One and Three) reduces its attractiveness relative to the alternative routes because some journeys (e.g. Paraparaumu to Waikanae) would be longer using the expressway. Providing a new arterial in the west of the district (Scenarios Two and Three) reduce traffic flows on SH1 because some trips would be shorter using the new arterial.

Table 3.4 shows that Scenarios One and Three result in the lower traffic volumes using the SH1 than Scenario Two. SH1 traffic flows for Scenario One and Scenario Three are up to 50% lower than the do minimum. For Scenario Two, the largest reduction from the do minimum is 30%. The SH1 traffic reduction is smaller for Scenario Two because the old SH1 retains a large number of local connections allowing people to continue to use it for some of their trips.

Table 3.3 – Forecast SH1 Travel Times between MacKays Crossing and Peka Peka (Seconds)

	Do Minimum			Scenario 1 - Expressway Only			Scenario 2 – WLR Only			Scenario 3 – WLR & SH1 Expressway		
Time Period	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**
2016 Northbound	964	896	1,178	567 (-397)	567 (-329)	571 (-607)	886 (-78)	833 (-63)	885 (-293)	566 (-398)	566 (-330)	570 (-608)
2016 Southbound	1088	836	840	569 (-519)	567 (-269)	567 (-273)	838 (-250)	789 (-47)	787 (-53)	568 (-520)	566 (-270)	566 (-274)
2026 Northbound	1,197	1,036	1,278	568 (-629)	567 (-469)	573 (-705)	911 (-286)	846 (-190)	975 (-303)	566 (-631)	567 (-469)	571 (-707)
2026 Southbound	1,258	860	1,434	570 (-688)	567 (-293)	567 (-867)	867 (-391)	809 (-51)	800 (-634)	569 (-689)	566 (-294)	567 (-867)

Table 3.4 – Forecast SH1 and WLR Link Flows (AADT): 2016 and 2026

Screen Line		2016				2026			
		Do Minimum	Scenario 1 - Expressway Only	Scenario 2 - WLR Only	Scenario 3 - WLR & SH1 Expressway	Do Minimum	Scenario 1 - Expressway Only	Scenario 2 - WLR Only	Scenario 3 - WLR & SH1 Expressway
Waikanae River	**Existing SH1**	36,315	12,663	26,221	8,815	39,323	15,195	28,921	10,288
	SH1 Expressway		23,752		16,631		25,795		18,344
	WLR	n/a	n/a	10,893	11,619	n/a	n/a	13,008	13,198
Otaihanga Road	**Existing SH1**	31,975	8,972	23,725	6,278	37,686	11,305	26,445	7,374
	SH1 Expressway		15,695		15,033		17,126		16,662
	WLR	n/a	n/a	10,340	14,673	n/a	n/a	11,775	16,584
Kapiti Road	**Existing SH1**	29,034	n/a	25,362	n/a	31,076		26,638	
	SH1 Expressway		15,695		15,033		17,126		16,662
	WLR	n/a	n/a	9,137	9,805	n/a	n/a	9,511	10,677
Raumati Road	**Existing SH1**	29,966	n/a	21,648	n/a	31,534		23,778	
	SH1 Expressway		16,278		15,216		17,638		16,942
	WLR	n/a	n/a	12,214	12,365	n/a	n/a	11,805	13,061

The largest reduction in hourly traffic flow on SH1 is forecast for Scenario 3 where both the WLR and an expressway would be provided. Traffic flows of approximately 900 PCUs per hour are forecast for 2026 PM peak compared to 1,400 for the do minimum scenario in the same year. Limiting connectivity with local roads and providing an attractive alternative encourages more appropriate use of a Kapiti road hierarchy.

The difference between the scenarios is most evident at the SH1 Waikanae River crossing where the road network is least dispersed. Providing a second river crossing reduces flows on the existing SH1. Many trips, are however, still faster using the existing SH1. Creating a limited access SH1 expressway and removing all connections from the expressway to the local road network in Waikanae forces motorists to use the eastern arterial (i.e. the old SH1 alignment) rather than the SH1 expressway.

3.5 Summary

This chapter has shown that providing a limited access SH1 expressway in Kapiti would reduce travel times for inter-regional traffic. It would also reduce the number of motorists that would use SH1 for local trips.

In Paraparaumu, SH1 is currently the only north-south route within the urban area. Providing Scenario One (SH1 Expressway Only) would result in increased congestion and delays for motorists making local trips. The travel costs associated with these delays are likely to outweigh the savings for inter-regional traffic. A new local arterial providing for access to and movement within Paraparaumu is therefore a fundamental requirement for any proposal to enhance the road network in this part of the study area.

Many motorists travelling between Arawhata Road in Paraparaumu (shaded blue in Figure 3.2) and the north of the district currently join SH1 at the Kapiti Road intersection. If this connection were removed these motorists would need to travel via Marzengarb, Ratanui and Otaihanga Road to access either the expressway or the old SH1. They could also pass under the expressway and along Ruapehu and Ruahine Street before joining the old SH1 south of Lindale. Both of these routes would be longer than at present. Removing connections between Kapiti Road and a SH1 expressway in Paraparaumu would therefore increase local trip lengths and travel times.

The travel costs associated could be avoided by providing a more direct route between Arawhata Road and the old SH1. Figure 3.2 shows the potential desire lines. This movement could be accommodated by providing a new link either:

(a) between Arawhata Road and Otaihanga Road (i.e. part of the WLR); or

(b) between Arawhata Road and the old SH1 at Lindale.

Between Paraparaumu and Waikanae a new local arterial is desirable but not essential. In this part of the study area, the old SH1 adequately mitigates the traffic effects of a restricted access SH1 expressway. A new local arterial would nonetheless increase local access, reduce travel times and travel distances. A new local arterial between Paraparaumu and Waikanae would therefore improve traffic efficiency within Kapiti District.

Figure 3.2 - Routes from Arawhata Road

4 Options for Providing a SH1 Expressway North of Waikanae

Between Pukehou Bridge and Peka Peka an alignment for a four lane expressway has been approved by the NZTA Board (formerly Transit NZ). The preliminary design, prepared by Maunsell in 2002, closely follows the rail corridor. In the scheme assessment report[3] the preferred alignment is referred to as the "enhanced eastern alignment". The preferred alignment as presented in the Scheme Assessment report is shown in Appendix A. The board approved this alignment with changes to the form of interchanges. The alignment adopted by the then, Transit NZ Board is shown in Appendix A.

In each, the expressway follows the eastern side of the railway. South of Te Horo, the expressway crosses the railway to follow the existing SH1 alignment on the western side. The preferred alignment involves closure of all side roads and the provision of grade separated interchanges and / or local connections across SH1 at strategic locations. No at-grade connections to the expressway are proposed. Service roads would provide access to local roads.

The cross section for the proposed expressway north of Peka Peka is consistent with that proposed south of Peka Peka[4]. This chapter describes the expressway design. It also presents the findings of a review that aimed to update:-

- the Maunsell cost estimate;
- the transport economic efficiency benefit forecasts; and
- whether the project could be staged to maximise return on investment.

4.1 SH1 Expressway Alignment between Pukehou Bridge and Peka Peka

This section describes the alignment adopted by the NZTA board (see Appendix A). The expressway passes to the east of the Otaki retail village. The old SH1 would continue to provide access to these shops. Motorists travelling on the new SH1 expressway towards Wellington or Levin would be able leave the expressway to access Otaki shops. Within Otaki, a minor realignment of the railway is required to minimise the overall effects of the expressway.

Interchanges

Maunsell recommended the provision of interchanges at:

- Peka Peka Road (full diamond),
- Gear Road, Te Horo (full diamond);
- Otaki Gorge Road, (a north and southbound exit ramp) and
- at Otaki (a three-quarter interchange without a northbound exit ramp).

[3] North Otaki to Peka Peka Road Scheme Assessment Report, Contract TNZ 114PN, Maunsell, Sept 2002
[4] See Chapter 3, Kapiti SH1 Strategy Scoping Report, Opus, July 2008

Structures

The alignment adopted by the Transit NZ Board includes a new bridge north of Otaki, close to the site of the existing SH1 rail overbridge. This new bridge will carry the old SH1 over the new expressway and the existing NIMT railway. Other connections across the railway and the expressway are provided at:

- Te Horo, linking Te Horo Beach Road and School Road over the expressway; and
- south of the Otaki River, linking Addington Road and Otaki Gorge Road under the expressway.

Two new bridges carrying the four lane SH1 expressway are required:

- to cross the Otaki River; and
- to cross the NIMT railway immediately to the south of Te Horo.

Local Access

Between Otaki and Te Horo, the old state highway would become a local north-south arterial, providing access to adjacent properties and local access roads. In this section, only a limited number of new service roads would need to be provided. South of Te Horo, the expressway will be built on the existing SH1 and a new service road would be built on its western side.

4.2 Opus Design Review

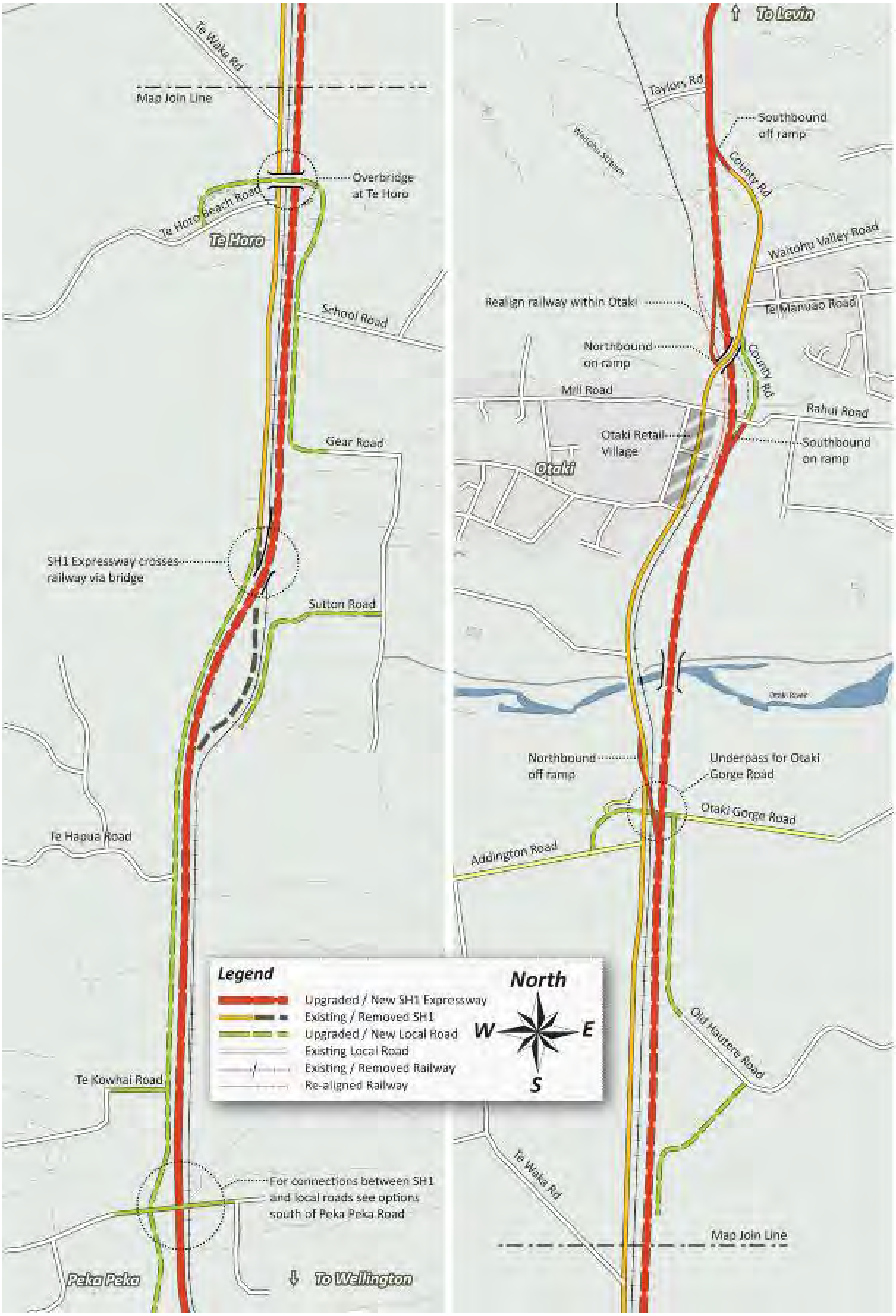
The project team reviewed the adopted alignment and recommended several changes. The alignment we recommended was taken to public consultation is shown in Figure 4.1, below. Appendix A includes the approved alignment developed by Maunsell, revised to reflect our recommendations.

The project team felt that the provision of several interchanges within 4km is excessive for an area that is basically rural. We concluded that the interchange at Te Horo could be eliminated as long as a direct east-west link under the expressway, rail and SH1 is constructed between Otaki Gorge and Addington Road.

We also concluded that the southbound exit ramp at Otaki Gorge Road could be removed. Motorists travelling on the expressway from north of Otaki to Otaki Gorge Road could instead leave the expressway north of Otaki and use the old SH1 to travel to Otaki Gorge Road.

The recommended alignment would have motorists travelling from Otaki Gorge Road, towards Wellington would join the expressway at Peka Peka Road. It would be possible to provide a southbound entry slip from Otaki Gorge Road. If this were provided it would not be necessary to also provide an entry ramp from County Road in Otaki. The preferred location should be investigated further in a Scheme Assessment.

Figure 4.1 – Preferred Expressway Alignment between Pukehou Bridge & Peka Peka



In the recommended option (see Figure 4.1 and Appendix A) motorists travelling from Te Horo or Otaki to the north (e.g. Levin) would join the expressway north of Otaki. When returning they would be able to leave the expressway north of Otaki and drive to their homes using the old SH1. These journeys would be no longer than they are at present.

People travelling from this part of the study area to the Wellington would be able to use an interchange north of Waikanae. Ideally such an intersection would be located outside the Waikanae urban area. It would need to provide south facing ramps. Options for an intersection north of Waikanae are described in chapter 5.

In summary the changes to the alignment adopted by the NZTA Board are:

(a) remove Te Horo Intersection but provide an overbridge;

(b) remove the southbound exit ramp at Otaki Gorge Road; and

(c) provide for all movements (e.g. full diamond) at an interchange north of Waikanae.

Staging

The opportunity for staging construction of this section was also assessed. The majority of the transport economic efficiency benefits result from the ability for motorists to bypass Otaki. To avoid costs and delays associated with a bridge over the Otaki River, an Otaki bypass would need to reconnect with the existing SH1 alignment north of the river. The limited space and constraints associated with the location of the NIMT railway mean that this is not geometrically feasible. The section from Pukehou Bridge to Peka Peka must therefore be treated as one stage.

Cost Estimate

An indication of the costs for upgrading the existing SH1 alignment was estimated using a parameter based approach. The parameters were developed from a database of detailed design estimates and outcome costs for completed projects. Appendix B documents the parameter values and other assumptions used in developing the estimate. Table 4.1 presents our estimate of the indicative costs for providing an expressway between Peka Peka and Pukehou Bridge.

Table 4.1 – Indicative Cost Estimates (2009 Prices)

	Cost Indication ($ Millions)	
Option	**Expected**	**95%ile**
Alignment Approved by Transit NZTA Board	215	355

4.3 Forecast Transport Economic Efficiency Benefits

Traffic forecasts and transport economic efficiency calculations for SH1 between Peka Peka and Pukehou Bridge were developed using spreadsheet analysis. The following data was used as inputs to these calculations:

- traffic count data from NZTA's monitoring database;
- crash history data for the existing highway from the NZTA Crash Analysis System;
- Weekday AM, Inter and PM Peak period travel times (June 2009); and,
- Weekend and holiday peak period journey times (October 2008).

Neither the Wellington (Regional) Transport Strategic Model (WTSM) nor the Kapiti SATURN model are able to accurately forecast traffic flows on SH1 north of Peka Peka. Instead traffic growth included in the Kapiti SATURN model for SH1 between Waikanae and Peka Peka was used. The benefit forecasts therefore assume that SH1 traffic will increase by 2.2% between 2009 and 2016 and by 0.9% between 2016 and 2026. These are conservative growth projections. Table A2.5 of the NZTA Economic Evaluation Manual (EEM) Part 1 specifies 2% per annum for a rural strategic highway in the Wellington Region. The effect of this assumption was challenged using a sensitivity test.

Traffic Benefits

On the basis of the growth forecasts and using the recorded traffic data the following performance statistics were forecast for 2009, 2016 and 2026 for both the do nothing and option:

- Traffic Flow (Veh/h);
- Journey Time (seconds);
- Speed (km/h);
- Travel Time (Veh-hrs/h);
- Congestion Relief (Veh-hrs/h); and
- Travel Distance (Veh-km/h).

Performance statistics were forecast on the basis that average operating speeds for the expressway would be 105km/h. The forecasts indicate that traffic volumes would be well below the capacity of the new expressway in 2026 and the preceding years. This would mean that there would be no congestion and that motorists would be able to drive at or close to the speed limit and overtake slower vehicles at will.

Currently it takes just over four minutes to drive through Otaki between Addington Road and Taylors Road. On Friday evenings or public holidays the same trip can take significantly longer. An expressway would enable motorists to legally drive at speeds of up to 100kmph and would accommodate higher traffic volumes than at present. It is expected the expressway would enable motorists to drive between Addington Road and Taylors Road in approximately two and a half minutes.

Crash Benefits

The crash saving was forecast by assuming that particular types of crashes would be eliminated as a result of the new expressway. The validity of this assumption was tested by comparing the results against a crash rate forecast. The crash reduction percentages used in this assessment were found to be conservative. They are however appropriate for a strategy study. The following crash savings were applied to the historic crash record:

- 100% Head On;
- 100% U-Turn;
- 40% Fatal, 30% Serious, 10% Minor, 10% Non-Injury for Loss of Control, Changing Lanes, Overtaking;
- 100% Pedestrian (only 1 minor pedestrian crash observed);
- 100% Train Related;
- 100% Parking Related;
- 25% Reduction for miscellaneous (trailer loss of control/hitting misc. objects) due to improved geometrics; and
- 50% Manoeuvring, Turning, Rear-End.

Transport Economic Efficiency Benefits

Net present value (NPV) benefits for the project are shown in Table 4.2, below. Detailed results of the transport benefits are included as Appendix C.

Table 4.2 – Peka Peka to North of Otaki NPV Benefits

Description	**NPV Benefits ($ Millions)**
Travel Time	60.5
Congestion Relief	1.3
Vehicle Operating	-25.3
Accidents	56.0
Carbon Dioxide (4% of VOC)	-1.0
Total NPV Benefits	**91.5**

Transport Economic Efficiency

Although significant benefits are forecast to result from the scheme over the 30 year benefit period, they are not sufficient to cover the expected costs. A BCR of between 0.5 and 0.9 is forecast.

In the main assessment an annual 2.2% traffic growth rate is assumed in the early years to 2016, with 0.9% per annum assumed thereafter. If traffic growth is assumed as the EEM default for Wellington Region (2% per annum) a slightly higher BCR of between 0.6 and 1.0 is forecast (see Appendix C).

5 Options for Providing a SH1 Expressway MacKays Crossing to Peka Peka

The Scoping Report identified the desired cross sections and design principles for a four lane expressway concept for SH1 through Kapiti Coast District. The Scoping Report also identified the key opportunities and constraints associated with the development of SH1 within the district.

One of the most significant conclusions was that geographical separation of the North Island Main Trunk (NIMT) railway and SH1 at some locations resulted in two occurrence of east-west severance. Aligning SH1 immediately adjacent to the NIMT railway would mean a single major barrier to east-west movement in the District rather than two.

Another significant but conflicting aspiration is for the expressway to bypass town centres, thus avoiding the negative effects associated with roads in urban areas. At present SH1 and the NIMT railway pass directly through Paraparaumu and Waikanae. As a result Paraparaumu has already turned its back on the transport corridor. Over time, KCDC plan to shift Paraparaumu town centre away from the existing SH1 alignment. Land west of the civic centre buildings is designated in the district plan as town centre development.

Four options for a SH1 expressway between Peka Peka and MacKays Crossing were developed. Each option meets the aspirations of avoiding severance or passing through town centres with varying degrees of success. The options are:

Option 1 upgrade the existing SH1 alignment
Option 2 follow WLR designation
Option 3 follow rail corridor; and
Option 4 avoid future town centres.

This chapter presents the key features and considerations for each option. All of the options would restrict access to the expressway. In places, service roads would be provided to maintain property access. Each option includes three new grade separated interchanges:

(a) south of Paraparaumu,

(b) at Otaihanga Road, and

(c) north of Waikanae.

Locating grade separated interchanges outside urban areas minimises the impact on the communities they are designed to serve. There are several variations relating to the location of interchanges. These variations and the implications for local access are presented in Chapter 6.

Options 1, 3 and 4 all follow the existing SH1 in Paraparaumu. Because all connections between the upgraded SH1 expressway and local arterials are relocated to be outside urban areas, the present connection between Kapiti Road and SH1 will be closed. Although vehicles can make local trips across the SH1 expressway in an underpass, they cannot access the State Highway. This imposes longer journey times for many local trips which must travel further on congested roads to reach their destination. The dis-benefit of this re-assignment and congestion is forecast to be more than $40M. Building the WLR between a southern interchange and Kapiti Road would fully mitigate these dis-benefits. Options 1, 3 & 4 therefore all include this part of the WLR. We acknowledge that sections of the WLR north of Kapiti Road would further increase the total network benefits, but are not essential for the SH1 project to proceed.

5.1 Option 1 - Upgrade the Existing SH1 Alignment

Figure 5.1 shows an option for upgrading the existing SH1 alignment. The existing SH1 corridor would need to be widened along its entire length. Re-alignments are necessary at several locations in order to build to expressway standards and to mitigate existing safety problems. This would require changes to the existing designation. Several new structures are required and many existing structures would need to be re-built.

Interchanges

Three new grade separated intersections are proposed.

(a) south of Paraparaumu;

(b) at Otaihanga Road; and

(c) north of Waikanae.

There is currently a grade separated intersection providing access to Lindale and Nikau Palm Road. The existing interchange would not be safe if SH1 became an expressway. The interchange would need to be re-built to expressway standard. The wider carriageway and longer entry / exit ramps would mean that additional land would be required.

Other Structures

Other structures would be needed to maintain road connections between the east and west of the district and to cross rivers or the NIMT railway. Grade separated connections east-west across the expressway and NIMT railway are proposed within Paraparaumu at Kapiti Road and within Waikanae town centre connecting Te Moana / Elizabeth Streets.

Paraparaumu rail overbridge would need to be reconstructed. The new bridge would be wider, providing two lanes in each direction and shoulders at the side of the road. It would also have larger horizontal radii enabling higher vehicle speeds and reducing the risk of crashes.

Figure 5.1 – Option 1 - Upgrading the Existing SH1 Alignment

South of the Waikanae River, SH1 currently passes under the NIMT railway. It would not be feasible to create an expressway following the existing horizontal and vertical alignments for a number of reasons. The distance between the supports for the NIMT rail overbridge is not sufficient to accommodate four-lanes and the horizontal and vertical alignment is not adequate for a 100km/h speed zone. There is also a need to connect Kebbel Drive with the local road network. Therefore a new rail overbridge is proposed immediately south of Kebbel Drive. The SH1 expressway would follow the western side of the NIMT railway over a new Waikanae River bridge before reconnecting with the upgraded SH1 alignment in Waikanae.

The existing SH1 alignment between Waikanae and Kebbel Drive would become a local access road. A new rail underpass and a short section of new road would need to be constructed to connect Elizabeth Street with the existing SH1 alignment and Kebbel Drive.

Properties

Depending on the outcomes of any future detailed design, Option 1 is expected to affect around 250 - 350 land parcels. A high number of properties would be affected because a greater amount of sub-division has occurred adjacent to SH1 where most access is currently provided.

Local Access

Access to properties adjacent to the existing SH1 alignment would be maintained through the provision of two-lane service roads adjacent to the expressway. Service roads would need to be provided along the Raumati straight and close to the new Otaihanga Interchange.

Creating an expressway along the existing SH1 alignment and limiting local connections makes the WLR between a southern interchange and Kapiti Road a necessity. This concept was explained in chapter 3.

Considerations

The following issues should be considered in more detail if Option 1 is progressed:

- Limiting SH1 expressway connections to Poplar Avenue, Otaihanga Road and Peka Peka is likely to increase the value of land close to the interchanges.
- Likely to be lengthy disruption to SH1 traffic during construction. This would impact on efficiency of freight movements and travel for business.
- If the WLR river crossing is not built, the SH1 expressway will provide the only route for motorists travelling between the north and south parts of the district which will erode its ability to perform its highway function (which is similar to the existing).
- Any increase in traffic noise is expected to be small.
- The SH1 expressway is likely affect the amenity of Waikanae town centre.
- Creating a SH1 expressway along the existing alignment without an additional local Waikanae River crossing (i.e. WLR) forces the provision of a grade separated interchange with north and south facing ramps in Waikanae town centre.

- Improving the connection between SH1 and Otaihanga Road will create opportunities for future land development close to Otaihanga Road.
- Land situated between the NIMT railway and SH1 expressway north and south of Otaihanga Road will be difficult to access. This may restrict further development opportunities and affect land values for the areas furthest from the interchange.
- Removing connections to the SH1 expressway within Paraparaumu town centre and along Raumati straights results in severe congestion and delays within Paraparaumu town centre. However, the WLR between Poplar Avenue and Kapiti Road would mitigate this.
- This option has greatest length of new service road to the need to provide access to properties currently fronting SH1.

5.2 Option 2 - Expressway follows WLR Designation

Figure 5.2 shows an option for building a SH1 expressway within the WLR designation. The existing state highway would become a local road. Links between the east and west sides of the new expressway will be maintained with grade separated connections. It is likely that these would need to be supplemented with pedestrian / cyclist bridges.

It is likely that the expressway will pass outside the designation at three locations if a 110kmph design speed is to be maintained along the entire length. These locations are:

(a) south of Poplar Avenue at the southern end;

(b) immediately north of the new Waikanae River Crossing; and

(c) at the northern end south of Peka Peka Road.

On the northern side of the Waikanae River crossing, the expressway would pass close to an Urupa and the Christian Holiday Camp. Work undertaken as part of this study has found that if the expressway is built within the designation south of the river and north of Waikanae, it will be difficult to avoid the Urupa. If the expressway were built outside the designation for a longer length it may however be possible to avoid this site. Further work is needed to confirm the details of an alignment in this area.

Interchanges

Interchanges are again proposed at the northern and southern ends of the study area with a grade separated interchange between SH1 and Otaihanga Road. No other interchanges are proposed. To enable the expressway to stay within the designation as much as possible it is necessary to locate the north and south interchanges close to Peka Peka Road and Poplar Avenue respectively. Providing a SH1 expressway along the WLR designation requires a different form of interchanges to be able to maintain access to town centres and properties adjacent to the existing SH1.

Figure 5.2 – Option 2 - Expressway follows WLR Designation

Other Structures

In addition to the grade separated interchanges, several bridge structures are needed to maintain connections across the expressway. Keeping local roads at grade with the expressway passing underneath will minimise negative impacts for pedestrians and cyclists. In urban areas it may be necessary to provide pedestrian / cycle bridges at more locations than just the road crossings. Placing the expressway in a trench also help to mitigate additional traffic noise associated with the expressway. Further investigations are needed to ascertain the ground conditions and the engineering feasibility of sinking the expressway. As a minimum, road bridges across the expressway should be provided for the following local arterials:

- Poplar Avenue;
- Raumati Road;
- Kapiti Road;
- Marzengarb Road; and
- Te Moana Road.

The expressway would be carried over the Waikanae River on a new four lane bridge. Options to incorporate an off-road pedestrian / cycle path should be investigated.

To a degree the WLR designation already severs the district. The expectation that the WLR would be constructed has led to development facing away from the designation. At a macro-scale, constructing the expressway along this designation will not increase community severance as much as if the expressway passed through an existing urban area. Nonetheless it is acknowledged that the designation has some permeability for non-motorised transport users. Additional locations for pedestrian / cyclist bridges over the expressway would therefore need to be identified in order to maintain this permeability.

Properties

Much of the land within the WLR designation is owned by KCDC or NZTA. For this reason a small number of privately owned land parcels will be required. Depending on the outcomes of any future detailed design, this option is expected to affect between 20 and 50 privately owned land parcels.

Local Access

In Option 2, the expressway is provided on greenfield land. This means that existing access patterns are completely unaffected. Journeys to Paraparaumu and Waikanae using the old state highway alignment are likely to improve because inter-regional traffic will now use the expressway.

A major advantage of Option 2 is that the expressway bypasses Waikanae town centre. Traffic reductions in Waikanae would improve the amenity of the town centre and could make it a more attractive place for businesses, and for pedestrians who need to cross SH1.

Conversely Option 2 may impact on the proposal to develop an accessible, high quality town centre in Paraparaumu west of Rimu Road. Development at the town centre site and at Paraparaumu Aerodrome is highly dependent on the provision of the WLR. This option would force KCDC to re-visit existing land-use plans and focus the town centre on what is now SH1.

Considerations

The following issues should be considered in more detail if Option 2 is progressed:

- The depowered old SH1 in Waikanae is more appropriate for a town centre environment.
- Allows future provision of high quality transit orientated developments close to Waikanae and Paraparaumu railway station.
- Constrains planned development in Paraparaumu (town centre and airport) that is dependent on WLR.
- This option impacts on the smallest number of private land owners
- Existing designation requires alteration to reflect the altered function of the road.
- KCDC must agree to transfer the land designation to NZTA.
- An Urupa may be affected where the expressway extends outside the WLR designation north of the Waikanae River.
- It is likely that the WLR designations will need to be extended at three locations.
- Minimal improvement for motorists making local trips.
- Difficult to provide east-west pedestrian / cyclist links needed in an urban area.
- The distance between the expressway and adjacent properties will be sufficient to avoid adverse noise effects in most cases. Any increase in traffic noise is likely to be easily mitigated.

Option 2 provides most benefits to inter regional traffic by providing a high speed through route. Because it does not affect existing roading network, local trips are not adversely affected. Nevertheless, it still will be necessary to improve the roading network for local trips in future years. Since this option uses the land set aside for the WLR for the SH1 expressway, additional initiatives will be required to improve capacity for local vehicles. One idea could be to provide additional west-east connections to the old SH1 by linking Arawhata Road with the old SH1 at Lindale, as shown in Figure 3.2. It may also be feasible to provide an additional local crossing of the Waikanae River to the west of the present WLR designation.

5.3 Option 3 - Expressway Follows Rail Corridor

Constructing the SH1 expressway adjacent to the NIMT railway would not introduce any additional severance. Through Raumati and north of the Waikanae River, SH1 is currently located immediately to the west of rail. It would be reasonable for the expressway to follow the western side of the railway between these two town centres. Figure 5.3 shows a SH1 expressway following the western side of the railway.

Figure 5.3 – Option 3 - Expressway Follows Rail Corridor

Interchanges

Interchanges are again proposed at the northern and southern ends of the study area with a grade separated interchange between SH1 and Otaihanga Road. There are two locations where an interchange could be constructed south of Paraparaumu. There are also three locations where an interchange could be constructed north of Waikanae. The factors that will influence decisions regarding the location of Interchanges are similar to those for upgrading the existing SH1 alignment (Option 1) described in chapter 6. No other interchanges are proposed.

Other Structures

Grade separated east-west links below the expressway would be provided in both Paraparaumu (at Kapiti Road) and in Waikanae (at Te Moana Road). These links would maintain a connection between each side of the expressway.

It would be necessary to demolish Paraparaumu rail overbridge in order to accommodate Option 3. This would be necessary whichever side of the NIMT railway the expressway were to follow. Reconstruction of the bridge is not proposed. Motorists wishing to cross between the east and west sides of Paraparaumu could instead use the underpass at Kapiti Road.

A new four lane Waikanae River crossing would be needed. The route north of Kebbel Drive would be the same as if the existing alignment was upgraded. The new bridge would be located to the west of the existing river crossing.

Considerations

The following issues should be considered in more detail if Option 3 is progressed:

- Removing connections to the SH1 expressway within Paraparaumu town centre and along Raumati straights results in severe congestion and delays within Paraparaumu town centre. The WLR between Poplar Avenue and Kapiti Road would fully mitigate this.
- Likely to be lengthy disruption to SH1 traffic during construction of expressway between Raumati and Paraparaumu unless WLR Stage 3 is constructed first.
- Creates an eastern arterial for north-south trips within the district.
- Accommodates the construction of the WLR (north-south local arterial) and a new western river crossing.
- Creates a coherent road hierarchy.
- It is possible to avoid Paraparaumu Domain with local rail re-alignment north of the rail overbridge. If the expressway avoids the domain, properties on Buckley Grove would be affected.
- Any increase in traffic noise is expected to be small and may be easily mitigated.
- The SH1 expressway is likely to affect the amenity of Waikanae town centre.
- Improving the connection between SH1 and Otaihanga Road will create opportunities for future land development close to Otaihanga Road.

Variation: SH1 Expressway Follows Eastern Side of the Expressway

North of Waikanae and south of Paraparaumu, SH1 follows the western side of the NIMT railway. Between the two towns it is possible to construct the expressway on either side of the railway. Both variations are feasible and the transport economic efficiency benefits would be similar for each.

Fewer structures are needed if the expressway follows the western side. If the expressway follows the east of the NIMT railway a rail overbridge would be required to connect with a new Waikanae River bridge. Another bridge would be needed to carry the expressway over the railway somewhere south of Paraparaumu. Although the property impacts differ according to the alignment relative to rail, the number of private land owners affected would be similar.

The preferred alignment will need to be confirmed through a scheme assessment if this option is progressed.

5.4 Option 4 - Expressway Avoids Future Town Centres

Option 4 is a hybrid of the three previous options. It was developed in an attempt to use the best aspects of the other options. In Paraparaumu the SH1 expressway would be constructed along the existing alignment immediately to the west of the NIMT railway. This option will allow the town centre to develop in accordance with KCDC's land-use plans. The WLR between Poplar Avenue and Kapiti Road would be essential to provide adequate access to the town centre and Paraparaumu aerodrome.

From Otaihanga Road to the north, SH1 would follow the WLR alignment allowing the expressway to avoid Waikanae town centre. This is shown in Figure 5.4. Not only would this avoid the negative effects associated with high capacity roads passing through urban areas, it would also reduce the number of property acquisitions that would be necessary.

The considerations for Option 4 can mostly be drawn from the other options. This option also has the potential to affect an Urupa unless the designation close to the Waikanae River is revised. Where it differs from the other options is between Paraparaumu Domain and Otaihanga Road. Constructing a new road across the landfill site is unlikely to be feasible. Instead it has been possible to bypass the landfill site with a 110kmph design speed and avoid Paraparaumu Domain. This is however at the expense of land parcels on Bluewater Place.

Interchanges

As with other options, three interchanges are proposed. The interchange south of Paraparaumu would be the same as that proposed for Options 1 and 3. The interchange at Otaihanga Road would be similar to that proposed for Option 2. It would be adjusted to accommodate the different alignment between Otaihanga Road and Paraparaumu. An Interchange at Peka Peka could be exactly the same as that proposed for Option 2.

Figure 5.4 – Option 4 - Expressway Avoids Future Town Centres

Other Structures

Several structures would be needed to allow connections between the east and west sides of the expressway. A four lane bridge across the Waikanae River would also be constructed.

To maintain connections between the east and west sides of Paraparaumu, an underpass is proposed at Kapiti Road. The underpass could be used by motorists travelling between Paraparaumu and Waikanae using the old SH1 which will function as an eastern arterial. The underpass will provide the only connection across the expressway in Paraparaumu because the rail overbridge has to be demolished for the expressway to follow the western side of the railway.

It would also be necessary to create a grade separated connection across the expressway at Te Moana Road. This would maintain the connection between Waikanae and the coast.

Local Access

Option 4 maintains existing levels of local access and protects the amenity of the Waikanae Town Centre. Unlike alignments that follow the rail corridor, the local road network remains unchanged from the existing. In other words, there are no improvements to the road network for local trips. Using the WLR designation from north of Otaihanga Road will prevent KCDC from realising current plans for a local river crossing at this location. This may mitigated by providing a river crossing for the west of the district at another location.

Considerations

The following issues should be considered in more detail if this option is progressed:

- Improving the connection between SH1 and Otaihanga Road will create opportunities for future land development close to Otaihanga Road.
- Removing connections to the SH1 expressway within Paraparaumu town centre and along Raumati straights results in severe congestion and delays within Paraparaumu town centre. The WLR between Poplar Avenue and Kapiti Road would fully mitigate this.
- Likely to be lengthy disruption to SH1 traffic during construction of expressway between Raumati and Paraparaumu unless WLR Stage 3 is constructed first.
- Motorists can use an eastern arterial (old SH1) for north-south trips between Waikanae and Paraparaumu
- The depowered old SH1 in Waikanae is more appropriate for a town centre environment.
- Prevents the construction of a local road river crossing at the WLR designation.
- WLR designation requires alteration to reflect the different function of the road.
- KCDC must agree to transfer the land designation to NZTA.
- An Urupa would be affected if the expressway cannot be accommodated within the designated alignment north of the Waikanae River.

- It is possible to avoid Paraparaumu Domain with local rail re-alignment north of the rail overbridge. If the expressway avoids the domain, properties on Buckley Grove would be affected.
- Properties on Bluewater Place would be affected to enable the landfill to be avoided.
- Any increase in traffic noise is expected to be small.

5.5 Cost Estimates

Indicative costs for each option were estimated using the same methodology and parameters that were applied to the route section between Pukehou Bridge and Peka Peka. The assumptions on which these estimates are based are documented in Appendix B.

Table 5.1, below presents indicative cost estimate for each option. Costs for Options 1, 3 and 4 include the WLR between Kapiti Road and Poplar Avenue (between $60M & $80M).

Table 5.1 – Indicative Cost Estimates

Option[5]	Cost Indication ($ Millions)	
	Expected	95%ile
1. Upgrade the Existing SH1 Alignment	560	700
2. Expressway Follows WLR Designation	380	500
3. Expressway Follows Rail Corridor	500	610[6]
4. Expressway Avoids Future Town Centres	410	590[7]

The table shows that upgrading the existing SH1 alignment is likely to be the most expensive option. This is because a large number of privately owned land parcels are required. Subdivided land adjacent to the SH1 is also more expensive than other less accessible sections.

The least expensive option would be to construct a SH1 expressway within the WLR designation. NZTA and KCDC already own a significant number of the land parcels that would be needed for this option. The costs are also reduced because approximately half of the length would pass over greenfield that is currently used for agricultural purposes.

5.6 Construction Timetable

Table 5.2 shows a possible construction timeline for each option. For options that have not been previously investigated, it has been assumed that at least two years would be needed prior to construction. This assumes that detailed design would progress in parallel with designations, consenting and property acquisitions. Options that follow all or part of the WLR designation are expected to progress more quickly because fewer land parcels would need to be acquired. Road building outside urban areas is also less constrained and is therefore often faster.

[5] Costs for Options 1, 3 & 4 include WLR from Poplar Avenue to Kapiti Road.
[6] If this option was built in several stages, each of these stages would have their own 95th percentile estimate. If we were to sum all of these 95th percentiles, the total cost would be $770 Million.
[7]. The sum of 95th percentiles for each stage of this option would be $680 Million.

Table 5.2 – Possible Construction Programme

Option	Earliest Start to Construction	Possible Duration
1. Upgrade the Existing SH1 Alignment	2012	9 Years
2. Expressway Follows WLR Designation	2011	5 years
3. Expressway Follows Rail Corridor	2012	9 years
4. Expressway Avoids Future Town Centres	2012	6 years

5.7 Summary

Work to date indicates that upgrading the existing SH1 alignment (Option 1) would be disproportionally expensive compared to the other options. Option 1 would also affect a large number of landowners because land adjacent to SH1 has been subdivided more than other less accessible sections. Upgrading the existing SH1 alignment would also affect the amenity of Waikanae town centre more than other options. It is reliant on construction of the WLR river crossing or provision of a full diamond interchange in the centre of Waikanae or both.

The three other options are able to consolidate the road and rail corridors to minimise severance or avoid future town centres with varying degrees of success. None are able to fulfil both aspirations completely.

Following the WLR designation (Option 2) is the cheapest option because NZTA and KCDC already own much of the land. This option would however limit development of Paraparaumu town centre and aerodrome, forcing KCDC to revisit land-use plans for the District. Option 2 introduces a further severance within the district, although it is accepted that the designation for the WLR has, in many respects, already created this severance. It is also possible that an Urupa on the northern side of the Waikanae River may be affected.

Following the rail corridor (Option 3) is relatively expensive because of the number and value of land parcels in the Paraparaumu and Waikanae urban areas. Constructing an expressway in Waikanae town centre and limiting connections to the road would impact on the amenity of Waikanae town centre. Option 3 does, however, enable development of Paraparaumu town centre and aerodrome. Locating the expressway adjacent to the NIMT railway avoids adding further severance in the district.

The hybrid option 4 avoids both of the future town centres and follows the rail corridor for a good proportion of its length. It is also expected to be the second least expensive option. Design challenges associated with the Urupa and avoiding the landfill will need to be resolved. Option 4 would also require the support of KCDC who would need to agree to transfer the designation to NZTA.

6 Expressway Interchange Options and Local Access in Kapiti

The options for providing an interchange south of Paraparaumu are the same for Options 1, 3 and 4. There are also a number of common issues and themes associated with providing an interchange north of Waikanae for Options 1 and 3. Option 2 and 4 would have the same interchange configuration at their northern interchange. This chapter describes the available options for creating a grade separated interchanges connecting a SH1 expressway with the local road network at each location.

6.1 South of Paraparaumu

Option 1, 3 & 4: An interchange could be constructed at Poplar Avenue or on land at 200 Main Road (see Figure 6.1). The designated connection between the WLR and SH1 is presently at Poplar Avenue although the land designated would only be sufficient for an at-grade intersection. It is likely that land outside the designation would be needed to allow an interchange to be built. A small area of Queen Elizabeth Park would be needed to provide a northbound exit ramp. This could be avoided by realigning the railway further to the east, closer to the hills or moving the interchange to the north.

Figure 6.1 – Options for an Interchange South of Paraparaumu

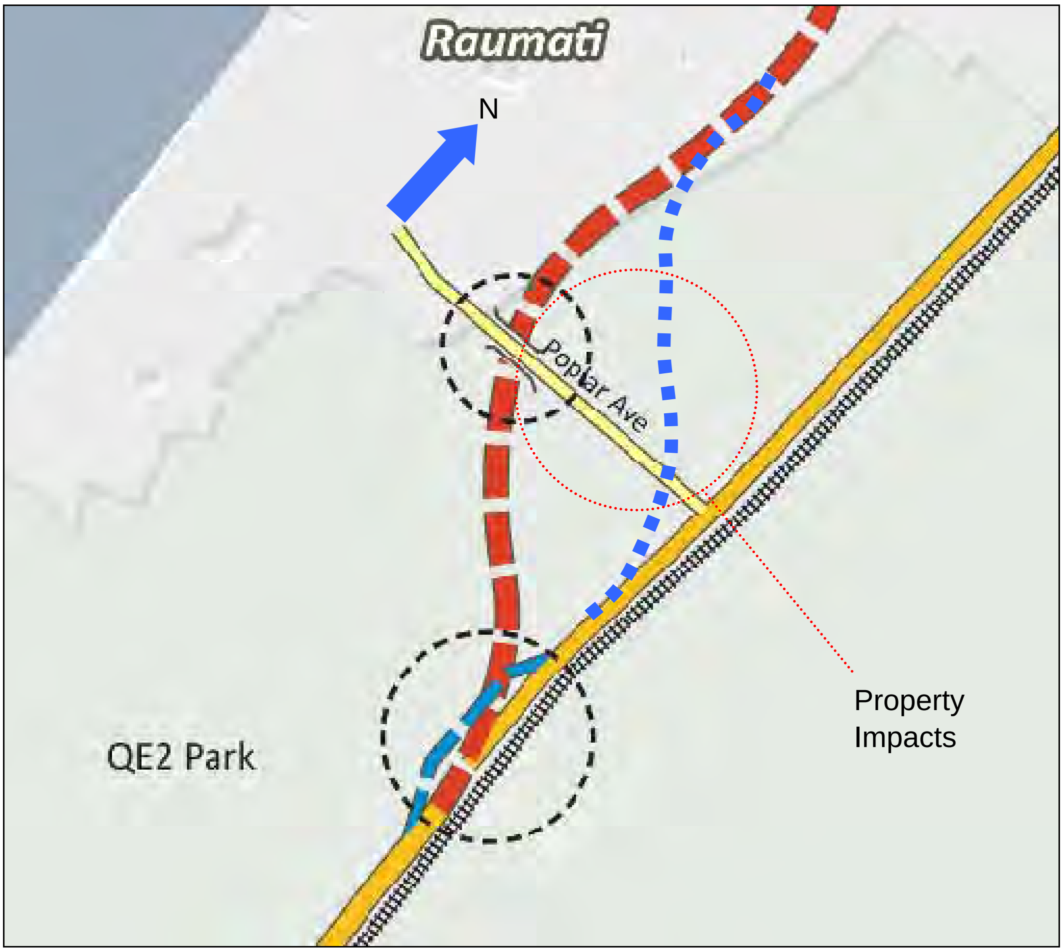
Currently there is no designation for an interchange at 200 Main Road. More private properties would be affected by this option than if the interchange were built at Poplar Avenue.

It is proposed that the interchange south of Paraparaumu have only south facing ramps. This would reinforce the district road hierarchy, making it more attractive for motorists to use local roads for local trips. If the WLR south of Kapiti Road is not built, a full diamond interchange would be required to provide for local trips.

A full diamond interchange with both north and south facing ramps, could be built at either location, increasing the number of affected properties. It would also allow motorists travelling between Raumati Beach and Waikanae to use the SH1 expressway rather than local roads.

Option 2: In order to provide a horizontal alignment that is safe for a 110km/h design speed it is necessary to build outside the WLR designation at the southern interchange. An interchange could be constructed immediately south of Poplar Avenue as shown in Figure 6.2, below.

Figure 6.2 – Interchange South of Paraparaumu - Option 2



Motorists travelling north from Paekakariki to Paraparaumu would leave the expressway and travel on a bridge over the expressway to the old SH1. Motorists travelling south from Paraparaumu would join the expressway at an at-grade merge.

The interchange configuration shown above would require a significant area of Queen Elizabeth Park. The park could be avoided by moving the whole interchange further to the north closer to Paraparaumu. This would however impact on a far greater number of residential properties on Leinster Avenue and adjacent to SH1.

6.2 Otaihanga Road

All four options include a grade separated intersection at Otaihanga Road. A grade separated roundabout with both north and south facing ramps is proposed. This will provide full connectivity allowing motorists travelling from Levin to leave the expressway and join a local arterial for the final part of a journey to Paraparaumu. Similarly motorists driving from Wellington would be able to leave an expressway at Otaihanga Road before joining the local road network for the final part of their journey to Waikanae. Each option has a different alignment in this part of the study area. A slightly different interchange design would therefore be required for each.

Constructing an interchange on the existing alignment (Option 1) would require a large quantity of earthworks. It is also anticipated that substantial amount of horizontal realignment would be required to enable motorists to travel at speed safely. Motorists driving between the interchange and areas in the west of the district would need to cross the NIMT railway. Currently an Otaihanga Road rail crossing is provided at grade. Following the service frequency increases for services between Paekakariki and Waikanae, it may be necessary to create a grade separated rail crossing.

A grade separated roundabout can be accommodated within the WLR designation at Otaihanga Road for Option 2. The interchange would be built at a similar location for Option 4. A slightly different design would be needed to accommodate the different alignment to bypass the land fill site. Again it may be necessary to build an Otaihanga Road rail overbridge following the service frequency increases.

By constructing a SH1 expressway adjacent to the rail corridor (Option 3) it is possible to incorporate a rail overbridge within the interchange structure. If SH1 follows the western side, the eastern arm of Otaihanga Road would need to be carried over the railway.

6.3 North of Waikanae

A workshop organised by KCDC highlighted desire from some parts of the community for a grade separated intersection in the middle of Waikanae town centre. This would be possible for Options 1 and 3 with some land acquisition and rail re-alignment. Where the expressway follows the WLR designation between Otaihanga Road and Peka Peka (i.e. Options 2 & 4) this is not required as part of an expressway project.

Constructing a grade separated interchange in the heart of a town is likely to result in a number of negative effects. The large land footprint required to build an interchange would be car dominated and would affect the amenity of Waikanae. It would also be difficult to provide pedestrian or cycle-friendly routes between the east and west sides of Waikanae at such an interchange.

Constructing an interchange outside the Waikanae urban area would reduce the negative effects associated with passing the expressway through the town. Figure 6.3 shows three locations where a grade separated interchange could be constructed for Options 1 and 3.

The KCDC District Plan includes a designation for an intersection between SH1 and the WLR approximately 600m south of Peka Peka Road (Variation 1). A grade separated interchange with north facing ramps could be constructed within the designation. Alternatively the interchange could be located at Peka Peka Road (Variation 2) or further to the south as part of the Waikanae North Development (Variation 3).

Figure 6.3 – Options for an Interchange North of Waikanae

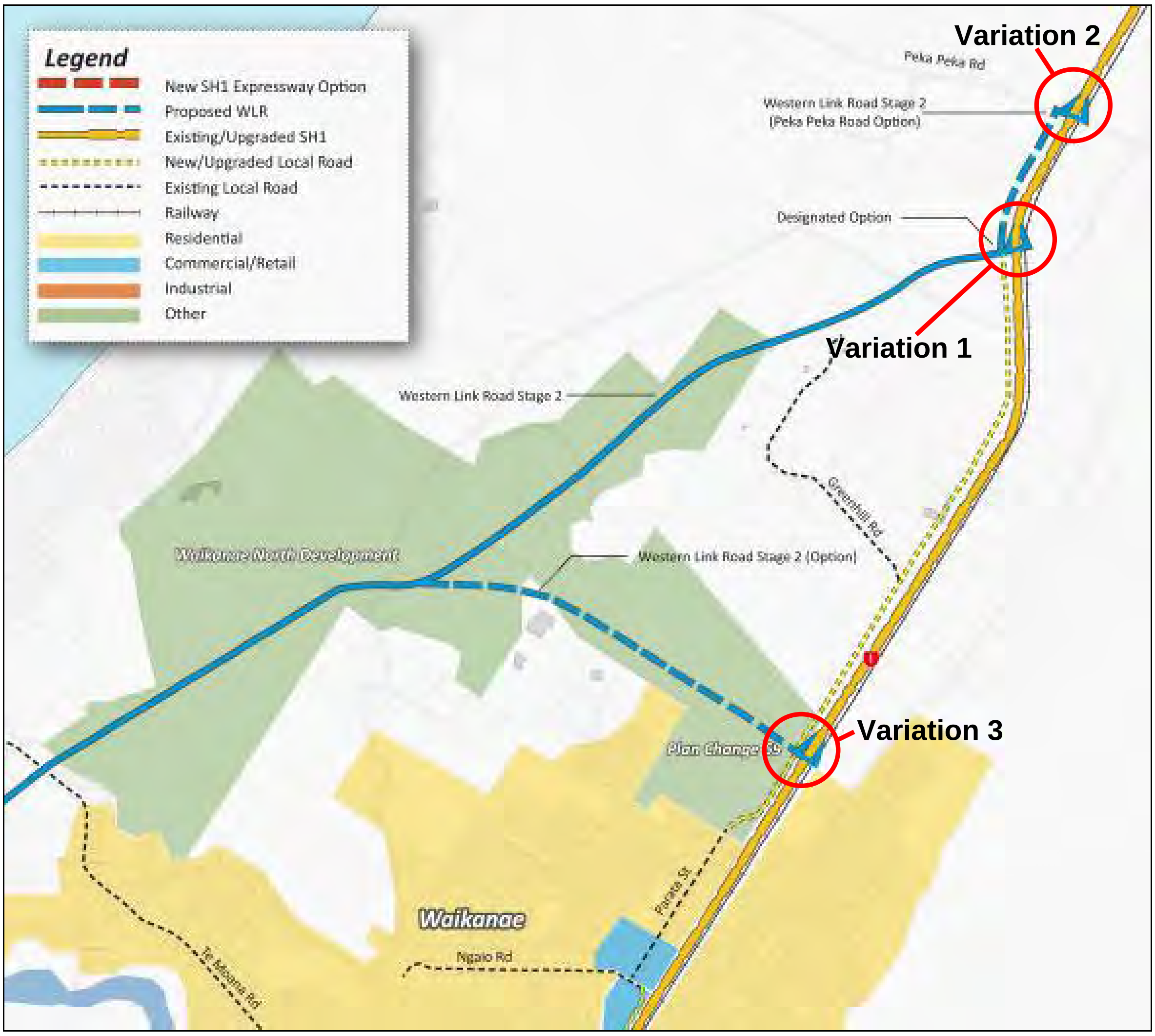


Figure 6.3 shows for Options 1 and 3, how these intersections could connect to the northern part of the WLR. It would still be possible to provide an intersection outside the

Waikanae urban area if this part of the WLR did not progress. Motorists travelling to and from the intersection would instead use the parallel service road that is provided to maintain access to properties already adjacent to SH1.

In options 2 and 4, a grade separated roundabout with north facing ramps and connections to the local road network is required to maintain current levels of access. Motorists travelling between Waikanae and Levin would use this roundabout interchange. The existing designation would need to be extended to allow enable this interchange to be constructed.

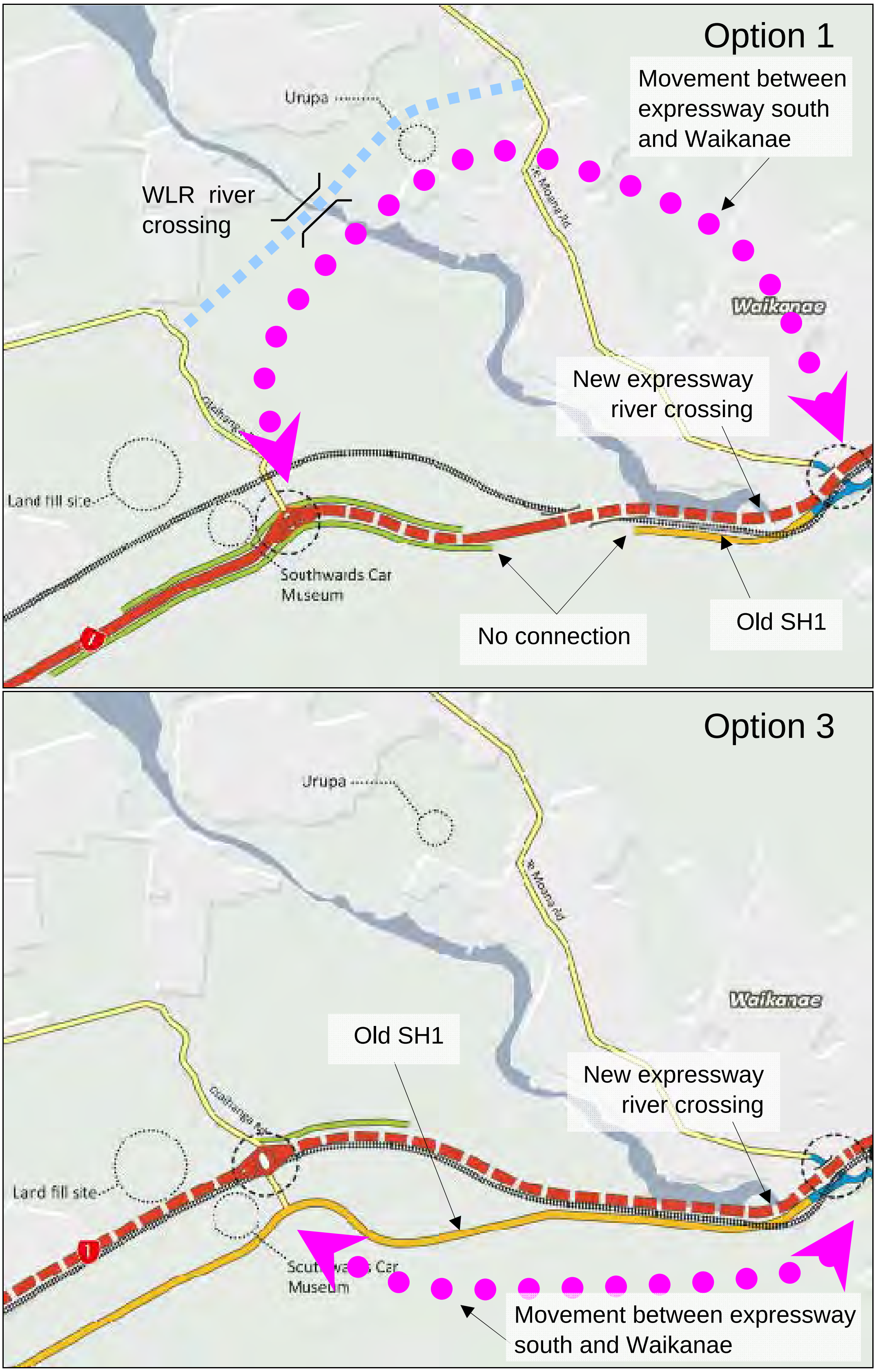
If an expressway is constructed between Pukehou Bridge and Peka Peka, it will be necessary to also provide south facing ramps for all options. These will allow people travelling between Peka Peka or Te Horo and Paraparaumu or Wellington to use the SH1 expressway. The Otaki to Peka Peka alignment approved by the Transit NZ board included south facing ramps. If south facing ramps are not provided, the first opportunity motorists driving from the north would have to access the expressway would be at the Otaihanga interchange. South Facing Ramps would also be needed if Option 1 were constructed without the WLR river crossing.

WLR River Crossing

In Options 1 and 3 a new expressway river crossing would be constructed west of the existing bridge (as shown in Figure 6.4). In Option 3 the old SH1 would function as a local arterial connecting Waikanae and Otaihanga (and to the south). In Option 1 however, the old SH1 river crossing would only connect to Kebbel Drive. It would not allow motorists to drive between Waikanae and Otaihanga. Instead vehicles making this movement must make the journey via the WLR crossing over the Waikanae River.

In Options 1 & 3, the WLR river crossing would provide an alternative route for motorists, cyclists and pedestrians to travel between Waikanae and Paraparaumu. Motorists travelling to Wellington from Waikanae would use the WLR river crossing to join the expressway at the Otaihanga interchange. Building the WLR river crossing would avoid the need to provide a grade separated intersection in Waikanae. Instead a grade separated link between Te Moana Road and Elizabeth Street could be provided to connect the east and west sides of the town. Connections to the expressway would be provided at an interchange north of Waikanae, outside the urban area.

Figure 6.4 - Requirement for WLR River Crossing or Town Centre Interchange



7 Transport Assessment

SH1 expressway options between Peka Peka and Poplar Avenue were tested using the calibrated Kapiti SATURN model. The traffic model is validated for a 2006 base year. 2016 and 2026 forecast year trip matrices are based upon information extracted from the Wellington (Region) Transport Strategy Model (WTSM). The matrices also reflect the additional traffic expected to be generated by permitted future developments. The do minimum scenario, used for tests presented in this chapter, does not include any element of the WLR.

7.1 Do Minimum Forecast

The Paraparaumu airport and town centre developments are expected to be complete before 2016. The additional traffic generated by these developments is forecast to have a significant impact on the traffic operations in Kapiti, particularly Paraparaumu. This is one of the reasons KCDC have been progressing plans for a WLR. Without this additional local arterial, motorists will continue to rely on the existing SH1 and local routes such as:

- Poplar Avenue,
- Raumati Road,
- Ihakara Street, and
- Kapiti Road

In 2016, with development, the Kapiti Road / SH1 intersection is expected to be over capacity in both the morning and evening peaks. Motorists that currently pass through this intersection already suffer congestion and delays. Queuing at this intersection not only impacts on the safe and efficient operation of SH1 but also impacts on the local road network that serves the existing Paraparaumu town centre (i.e. coastlands and municipal buildings). Motorists passing through the Kapiti / Rimu Road and Kapiti / Arawhata Road intersections are forecast to continue experiencing congestion and severe delays in 2016 if no improvements are introduced.

The main cause for this congestion is the volume of traffic using SH1. Motorists wishing to turn right from or into roads that intersect with SH1 will be delayed waiting because there will be fewer gaps in the traffic. Long queues of motorists waiting to turn right onto SH1 interfere with the operation of local roads such as Rimu Road. The volume to capacity (V/C) ratio for the worst turns at the SH1 intersections are forecast to be between 97% and 126% in every time period modelled for 2016[8].

Existing congestion problems in Waikanae are also forecast to worsen. The V/C ratios for right turns at Te Moana Road are between 97% and 111% in the 2016 AM and PM peaks. The worst performing turns at Elizabeth Street are forecast to operate with V/C of between 71% and 91%.

[8] A turn is considered to have a Level of Service D or worse when V/C ratios exceed 85%. At level of service D, motorists may be delayed by up to a minute.

The network summary statistics presented in Appendix C show that total intersection delays (i.e. queuing) more than triple between 2006 and 2016. Delay associated with congestion on links (i.e. between intersections) more than doubles over the same time period. By 2026, traffic volumes are forecast to have increased, exacerbating existing problems further. The network average peak hour travel speeds are forecast to decrease from about 50km/h (2006) to about 40km/h in 2016. By 2026 the network average travel speed is forecast to be as low as 33km/h in the PM peak hour.

7.2 Option Performance

The primary function of a SH1 expressway is to create a safe and efficient inter-regional connection providing a high quality route to Wellington. Table 7.1 shows the forecast travel time saving for a motorist travelling on the SH1 expressway. The forecasts were extracted from the Kapiti Saturn model and therefore include any delays associated with congestion. No delays are forecast for the SH1 expressway. Table 7.1 also shows forecast travel times between MacKays Crossing and Paraparaumu Airport. The travel times are for the route forecast to be used by the majority of motorists. In Options 1, 3 and 4 most motorists are forecast to use the southern part of the WLR. For Option 2 the most motorists use the existing SH1 to Kapiti Road, and then cut through the Town Centre[9] and use Ihakara Street.

Option 2 results in a smaller reduction in travel times between MacKays Crossing and Paraparaumu Airport than the other three options. This is because Options 1, 3 & 4 all include the WLR between Poplar Avenue and Kapiti Road. Building this part of the WLR improves access to this area.

Table 7.1 – Forecast Travel Time Savings (Minutes) for 2026

Option	SH1	Local Roads
	MacKays - Peka Peka	MacKays – Airport
Option 1 - Upgrade the Existing SH1 Alignment	11:32	07:58
Option 2 - Expressway Follows WLR Designation	11:22	05:59
Option 3 - Expressway Follows Rail Corridor	12:36	07:40
Option 4 - Expressway Avoids Future Town Centres	11:44	08:16

The table shows that travel time reductions are similar for each of the expressway options. The smallest reduction is where the expressway follows the WLR designation (Option 2). This is because it is the longest of the four options. Option 4 is the second longest route because of the deviation around Waikanae. This additional length appears to add approximately 45 seconds to a journey between MacKays Crossing and Peka Peka.

Appendix C presents the network summary statistics for each of the options.

[9] via Raumati, Rimu, Town Centre spine, Arawhata and Kapiti Roads

7.3 Forecast Transport Economic Efficiency Benefits

The forecast benefits and indicative BCR's for each option are shown in Table 7.2. The economic benefits are derived from forecast travel time savings and reduced vehicle operating costs. For the purposes of this assessment crash cost savings have been assumed as an additional 5% of the total benefits. This is likely to be conservative and crash savings could be as much as an additional 35% of the total benefits.

Table 7.2 – Benefit Indication

Option	NPV Tangible Benefits ($M)	Indicative BCR
Option 1 - Upgrade the Existing SH1 Alignment	160	0.4 – 0.6
Option 2 - Expressway Follows WLR Designation	230	0.6 – 1.0
Option 3 - Expressway Follows Rail Corridor	140	0.4 – 0.6
Option 4 - Expressway Avoids Future Town Centres	180	0.5 – 0.8

Initial forecasts of transport economic efficiency benefits were based on the assumption that no benefits would be realised until the scheme was complete. Whilst this is realistic for Option 2, there is potential to increase the tangible benefits for Options 3 and 4 by more accurately reflecting potential staging. Whilst it is likely that Option 1 would be built in stages, any incremental benefits are likely to be countered by traffic disruption during construction.

The highest total benefits are forecast for Options 2 and 4. The benefits of Option 2 are higher because journeys on SH1 would be improved without affecting users of the local road network. The relatively swift construction period will also increase the number of years in which benefits are accrued. Option 4 is also expected to have a relatively fast construction period thereby increasing the number of years over which benefits are accrued.

Table 7.3 shows the first year rates of return for each option. It shows the return on investment as a proportion of the total cost. The results indicate that Option 2 is likely to generate a faster return than the other three options. There is little difference between Options 3 and 4.

Table 7.3 – First Year Rates of Return

Option	FYRR
Option 1 - Upgrade the Existing SH1 Alignment	2.0%
Option 2 - Expressway Follows WLR Designation	4.1%
Option 3 - Expressway Follows Rail Corridor	3.3%
Option 4 - Expressway Avoids Future Town Centres	3.1%

7.4 Summary

This section summarises the preceding technical assessment. Table 7.4 is a summary table presenting the key features of each option.

Option 1 – Upgrade the Existing SH1 Alignment

Upgrading the existing SH1 alignment is not inconsistent with KCDC's plans for developing Paraparaumu town centre. It would also allow the Council to progress plans for the WLR between Poplar Avenue and Waikanae.

This option is expected to be the most expensive to build and is likely to have a major impact on the efficiency of SH1 traffic flows during construction. It requires the demolition and re-construction of several structures. Of the four options, this has one of the latest opening dates. A significant drawback is that this option may restrict local movement since it does not create an eastern arterial for motorists, pedestrians and cyclists wanting to make local trips within the district. Unless a full diamond interchange is provided as close as possible to Waikanae, Option 1 will significantly impact on vehicles travelling between Waikanae and Otaihanga or between Waikanae and Wellington.

Option 2 - Expressway Follows WLR Designation

This option is expected to be the cheapest and the fastest to build. Early completion relative to the other options means that the transport economic efficiency benefits are realised earlier. This results in the accrual of more benefits within the return period than options with longer construction periods.

If this option were to progress, KCDC would need to revise land use plans for Paraparaumu. Instead of mixed-use employment, retail and light industrial uses, it would be necessary to plan for land-uses that result in lower trip generation because the local road network would be unable to accommodate additional traffic. Although this option creates an eastern arterial, it limits the potential for a future western arterial providing for north south movements in the west of the district.

Option 3 - Expressway Follows Rail Corridor

This is one of the options with a later opening date. Despite this it has a BCR comparable to the other options. Staging for this option is likely to increase the return on investment (BCR). Parts of this alignment option are located on greenfield land and could therefore be constructed without disrupting SH1 traffic.

This is the only option that allows the existing SH1 to become an eastern arterial without limiting options for a future local arterial to the west of the district thereby providing two north-south arterials. This option is likely to affect amenity of Waikanae Town Centre.

Option 4 - Expressway Avoids Future Town Centres

This option is a hybrid of Options 1 – 3. Costs and benefits are comparable to those associated with Option 3. Although approximately half of this alignment option is on greenfield land, options for staging to increase return on investment are more limited than for Option 3.

In the southern part of the district Option 4 follows the NIMT railway and the existing SH1 alignment minimising any increase in east-west severance. In the north the expressway follows the WLR designation in order to avoid Waikanae Town Centre. However by avoiding the Waikanae Town Centre, a new element of severance is introduced into the northern part of the district.

Table 7.4 – Option Summary Table

	Option 1	Option 2	Option 3	Option 4
Cost Range ($Millions)	560 – 920	380 – 580	500 – 770	450 – 740
Indicative BCR	0.4 – 0.6	0.6 – 1.0	0.4 – 0.6	0.5 – 0.8
First Year Rate of Return	2.0%	4.1%	3.3%	3.1%
Earliest Expected Opening Date	2021	2016	2021	2018
Inter-regional Travel Time Savings (Minutes)	11:32	11:22	12:36	11:44
Impact on East-West Severance	Moderate -ve	Significant -ve	Moderate -ve	Moderate -ve
Impact on Future Town Centres	Impact in Waikanae	Impact in Paraparaumu	Impact in Waikanae	None
Creates Eastern Arterial for Local Trips	No	Yes	Yes	Yes
Allows Future Western Arterial for Local Trips	Yes	No	Yes	Yes – south of Kapiti Rd

8 LTMA Assessment

It is a requirement that transport proposals are assessed against the objectives and purpose of the Land Transport Management Act (LTMA) 2008. The Act also requires the Government to periodically issue a Government Policy Statement on Land Transport Funding (GPS). The LTMA and the GPS have provided direction to the project team during the formulation of options.

A new GPS was released as this project was being progressed. The most recent GPS places a heavy emphasis on the generation of national economic growth and productivity. All of the options have been developed in accordance with the requirements of the LTMA. There is unlikely to be any significant differences between options in their ability to achieve the objectives of the GPS. This chapter presents an assessment of the project rather than of options.

8.1 Land Transport Management Act Compliance

The LTMA requires that the GPS and NZTS contribute to an affordable, integrated, safe, responsive and sustainable land transport system, and more specifically to its five objectives. The most recent GPS means that “assisting economic growth” will now be given more weighting when projects are evaluated.

Economic Development

The SH1 expressway project has high potential to stimulate economic activity in the region. The expressway could contribute to economic growth both by providing a fast, reliable route to and from Wellington and by enabling KCDC to capitalise on land development opportunities.

Assist Safety and Personal Security

Providing a SH1 expressway with superior horizontal and vertical alignments would reduce the number of fatal and serious crashes for motorists making inter-regional trips. Removing at-grade intersections and eliminating queuing on SH1 would also reduce the likelihood of, often minor, nose-to-tail crashes.

Improve Access and Mobility

The SH1 expressway is intended to improve inter-regional connectivity. The project is therefore unlikely to have a significant impact on access and mobility at a local level.

Protect and Promote Public Health

Options that avoid town centres will lead to reduced noise and air pollution in urban areas. The use of measures such as noise bunds, noise walls and noise minimisation surfacing is expected to be sufficient to maintain or reduce noise levels from their current levels.

Ensure Environmental Sustainability

Work completed during this scoping stage has not identified any significant environmental effects. The double tracking and electrification of the NIMT railway in Kapiti will help to create an integrated inter-urban transport system, providing alternatives to single occupancy vehicle trips.

8.2 Government Policy Statement Assessment Criteria

The GPS outlines specific short to medium term "impacts" the government expects to be achieved through the use of the National Land Transport Fund. These can be seen in Figure 8.1.

Figure 8.1 – Desired Short to Medium Term Impacts (GPS, May 2009, Page 11)

Impacts that contribute to economic growth and productivity

- Improvements in the provision of infrastructure and services that enhance transport efficiency and lower the cost of transportation through:
  - improvements in journey time reliability
  - easing of severe congestion
  - more efficient freight supply chains
  - better use of existing transport capacity.
- Better access to markets, employment and areas that contribute to economic growth.
- A secure and resilient transport network.

Other impacts

- Reductions in deaths and serious injuries as a result of road crashes.
- More transport choices, particularly for those with limited access to a car where appropriate.
- Reductions in adverse environmental effects from land transport.
- Contributions to positive health outcomes.

Journey Time Reliability & Congestion Relief: Limiting the number of connections between the SH1 expressway and the local road network will reduce interruption to traffic flow reducing the likelihood of congestion for motorists making inter-regional trips. Eliminating at-grade intersections will eliminate traffic congestion on SH1 in Kapiti.

Providing two lanes in each direction will allow motorists to overtake slow moving vehicles. This will improve journey time reliability allowing the efficiency of freight supply chains to be improved. It is anticipated that improvements to travel times will also result in faster movement of freight.

Access to Areas that Contribute to Economic Growth: Kapiti Coast District Council has identified Paraparaumu Town Centre and Airport developments as stimulus for economic growth in the district. Options that restrict or do not provide access to these areas are likely to reduce the potential of these developments.

Network Resilience: Options that provide additional Waikanae River crossings will improve route security by providing an alternative river crossing to the existing SH1 bridge.

8.3 National Land Transport Programme Criteria

The NZTA has developed a draft funding assessment framework for use as a tool for allocating funding. Once finalised the assessment framework will be published as an amendment to the NZTA Planning, Programming and Funding Manual (PPFM). The draft framework indicates three criteria against which options must be assessed:

- Strategic fit assessment;
- Effectiveness assessment; and
- Economic efficiency assessment.

Strategic Fit

SH1 between Levin and Wellington (through Kapiti Coast) is identified in the GPS as a Route of National Significance. Any Kapiti SH1 expressway is therefore well aligned with the national transport strategy and will achieve a 'high' strategic fit rating.

Effectiveness Assessment

The 2005 Western Corridor Study considered a variety of multi-modal enhancements to the corridor and recommended the creation of a four-lane expressway from MacKays Crossing to north of Otaki. This, combined with rail enhancements will provide an integrated transport improvement. The strategic function of SH1 in Kapiti means that highway improvements will be beneficial to all of New Zealand.

The Wellington Region was consulted as part of the Western Corridor Study about the provision of an expressway through Kapiti Coast District. Improvements to SH1 in Kapiti are already included in the Regional Land Transport Plan. Any Kapiti SH1 expressway will therefore effectively meet the regional objectives for the project. Any Kapiti SH1 expressway will achieve a 'high' effectiveness rating.

Economic Efficiency

The benefit to cost ratios for all of the options are reported in Chapters 4 and 6 . Options that have a BCR of less than 2 should be classified as having a low economic efficiency rating, while a BCR between 2 and 4 corresponds to a medium economic efficiency rating and projects with a BCR over 4 are rated as having a high economic efficiency.

9 Conclusions and Options for Public Consultation

A key feature of the existing road network in Kapiti is that SH1 currently provides for both local and inter-regional movements. The additional demand from motorists making short, local trips results in congestion and delays, particularly at the SH1 intersections. The additional traffic associated with permitted development within the district is forecast to exacerbate this situation.

This study has found that it would be possible to build an expressway from north of Otaki to MacKays Crossing and that there are four options for doing so. Although limiting access to the expressway improves travel conditions for those making inter-regional trips, it would also result in more congestion and longer trips for Kapiti residents wishing to drive within the district. The provision of additional local arterials is therefore a necessity for some options in order to mitigate negative impacts. This study has also found that where additional arterials are provided, they not only mitigate the negative effects of an expressway but add additional value.

9.1 Conclusions

(a) SH1 is currently the only north-south route within the study area, serving local and inter-regional trips. In future years, SH1 is predicted to attract 40,000 vpd, which is well above its theoretical capacity for a two lane road, parts of which pass through urban areas. Furthermore, this shared use requires SH1 to connect with the local arterials, and these intersections are predicted to operate well over capacity in future years. Travel times along SH1 between Waikanae and Paraparaumu are predicted to increase by 25% in the morning peak and 75% in the evening peak in future years.

(b) The Western Link Road, being a local north south arterial that provides an additional crossing over the Waikanae River provides an alternative route for north-south trips, has been shown to significantly reduce the number of vehicles using the SH and hence reduce congestion both now and in future years.

(c) In terms of staging road building, the section of the Western Link Road between Te Moana and Otaihanga has the highest benefit cost ratio of all elements being considered, including those elements forming part of the expressway.

(d) Starting at the top of the study area. NZTA Board have considered a four lane expressway from Poteau Bridge (just north of Otaki) to Peka Peka (just north of Waikanae). At a cost of $215M to $355M, this section of the expressway has a BCR between 0.5 and 0.9. We concluded that the interchange originally proposed at Te Horo is unlikely to be justified and consideration should be given to not including it the final scheme. We also concluded that the some of the ‘on and off ramps’ around Otaki could be simplified – with some cost savings. Ideally, the final design should seek to provide north-facing ramps north of Otaki and south-facing ramps south of the Otaki River.

(e) We concluded that the four lane expressway from Pukehou Bridge (just north of Otaki) to Peka Peka (just north of Waikanae) must be constructed as one section.

(f) The long term plan for that part of the study between Peka Peka (just north of Waikanae) and Popular Avenue (south of Paraparaumu) is to have a single high speed expressway supported with one or more north-south arterials and numerous west-east arterial. Multiple arterials will distribute traffic throughout the district. This will avoid concentrating traffic along a limited number of key arterials and prevent congestion at a limited number of intersections. We concluded that building the expressway so as to allow for both a western arterial (the proposed Western Link Road) and an eastern arterial (the Old SH) was desirable.

(g) The strategy is built around creating a strong roading hierarchy. It will provide a 4 lane high speed expressway for inter-regional traffic providing no property access and limited access to key local arterials with high speed interchanges. It will provide several local arterials for local traffic, passenger transport and cyclists. These local arterials will provide access to properties, key activities and trip generators. Arterials will connect and link to local residential streets. By developing this hierarchy, we accept that roads have different functions and that all roads are not necessarily for all modes.

(h) Given the need to serve both inter-regional and local trips, both the SH1 expressway and parts of the Western Link Road are required to be built. Other sections of the Western Link Road are desirable. We can draw several conclusions from our work: -

(i) The economic benefits of - $230M for the SH1 expressway are negative because, when constructed as a stand alone project, it removes a number of key connections which create longer travel distances and journey times for local trips within the district. The cost of these longer journey times for local vehicles is significant, and is greater than the benefits of reduced journey time for inter-regional vehicles using the expressway. This means that some elements of the Western Link Road must be built at the same time as (or even before) the expressway.

(ii) The economic benefit of $470M from having both the expressway and the Western Link Road operating is much greater than the sum of the economic benefits of the two individual projects ($390M - $230M = $160M). The reason for this is synergy. The two projects need each other. They work together: one delivering significantly reduced travel time for inter-regional vehicles and the other delivering reduced travel distance and travel time for local trips. The cost of providing both is, however substantially more than providing one or the other.

9.2 Options for Public Consultation

Four alignment options for the SH1 expressway were investigated between Peka Peka (just north of Waikanae) and Popular Avenue (south of Paraparaumu). The project team decided that two of these were worthy of further investigation and discussion with the community.

Option 1 was seen as inferior to the other options because of its higher cost and likely difficulties during construction. Its negative impact on trips between Waikanae and Paraparaumu was also seen as a serious failing. It was therefore decided that this option should not be progressed further. Although Option 2 is inexpensive compared to the other three options, its impact on future developments in Paraparaumu was considered a serious flaw.

The options the project team decided to progress to public consultation are: -

- Option 3: - Expressway located along the NIMT railway.
- Option 4: - Expressway located along the NIMT railway from Paraparaumu to Otaihanga and then following the Western Link Road designation between Otaihanga and Peka Peka.

The key benefit of Option 3 is that it allows the construction of the Western Link Road as a local arterial serving the west of the district. This is an important function in the roading hierarchy. The key benefits of Option 4 is that it by-passes the Waikanae Town Centre, allowing its amenity, walkability and sense of place to be retained.

Preliminary analysis of staging for the WLR found that the river crossing between Te Moana Road and Otaihanga Road would have the highest BCR of between of between 4 and 7. The project team therefore concluded that although not a necessity for creating a SH1 expressway through Kapiti, this part of the WLR would significantly improve transport economic efficiency. In the longer term, building the full WLR would improve the route coherence of the district and local accessibility. The options that will be consulted on are shown in Figure 9.1 and Figure 9.2, below.

9.3 Recommendations

(a) That a four lane expressway be built as part of the Government's Road of National Significance for Wellington between MacKays Crossing to Pukehou Bridge. As part of this work, key elements of the Western Link Road also need to be constructed to mitigate the effects that an expressway will have on local trips.

(b) Further work is undertaken during the next phase of the project to rationalise and simplify the on and off ramps around Otaki.

(c) Consideration is given to not providing the interchange at Te Horo.

(d) That the expressway is one component of the roading network within the study area, and that this expressway needs to build in conjunction with a number of key north-south and west-east arterials, including the Western Link Road.

(e) That NZTA consult with the public on the proposal to provide a four lane expressway from MacKays Crossing to Pukehou Bridge. As part of this consultation, seek views on two options that remain between Peka Peka and Popular Avenue: one that avoid the Western Link Road Designation and the other that avoids Waikanae Town Centre.

(f) While the expressway would not ban access by cyclists, it is recommended that the north-south arterials should be designed to accommodate cyclists, and provide a cycling route for recreational cyclists and tourists through the study area.

(g) If Option 4 is selected, it is recommended that road improvements still be undertaken at Waikanae to mitigate the effects of delays at Elizabeth Street caused by the new passenger rail service to Wellington.

(h) The section of the study area between Poplar Avenue (south of Paraparaumu) and MacKays Crossing is already a four lane expressway. The only remaining impediment is intersection between SH1 and Waterfall Road. There are plans to extend Waterfall Road to MacKays Crossing interchange. This would remove the rail crossing. However, the BCR for this would be very low. As an interim measure, providing a left in, left out to Waterfall Road as well as removing right turns is worth considering.

MacKays Crossing to Peka Peka - Concept Map

Option: SH1 Expressway with local supporting roads

MacKays Crossing to Peka Peka - Concept Map

Option: SH1 Expressway that avoids town centres

Appendix A

Alignments Between North of Otaki and Peka Peka Road

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Date: August 2009
Reference: 5C1333.02

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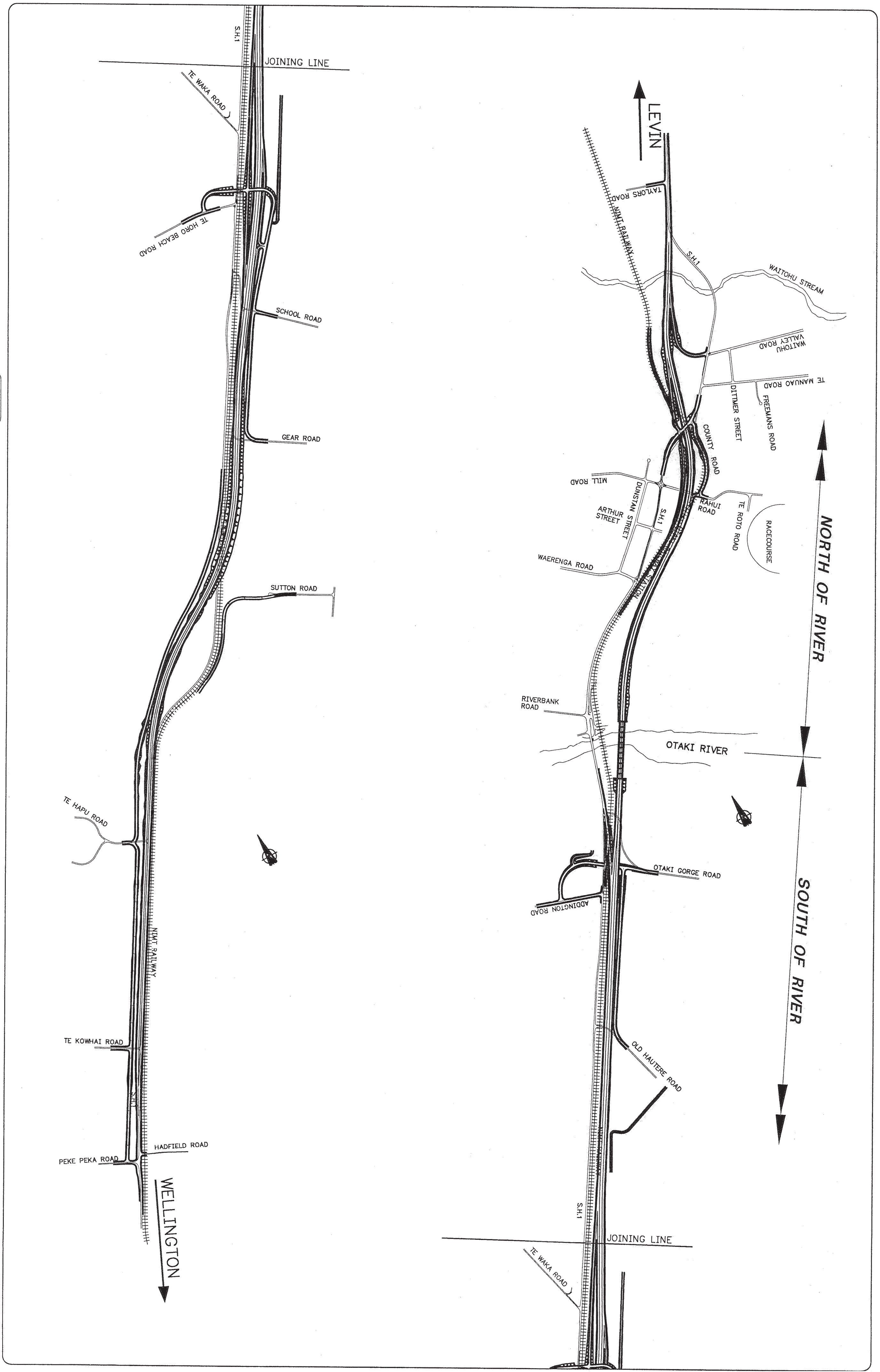
Plotted by: dobsong on Fri, 26 July 2002 @ 09:15:59.812 AM



Issue	Description	Date	App'd

Verify all dimensions before commencing work.

		Checked	Date
Design	GPD		5.7.2002
Drawn	GPD		
Approved		Status	SAR

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WANGANUI REGIONAL OFFICE

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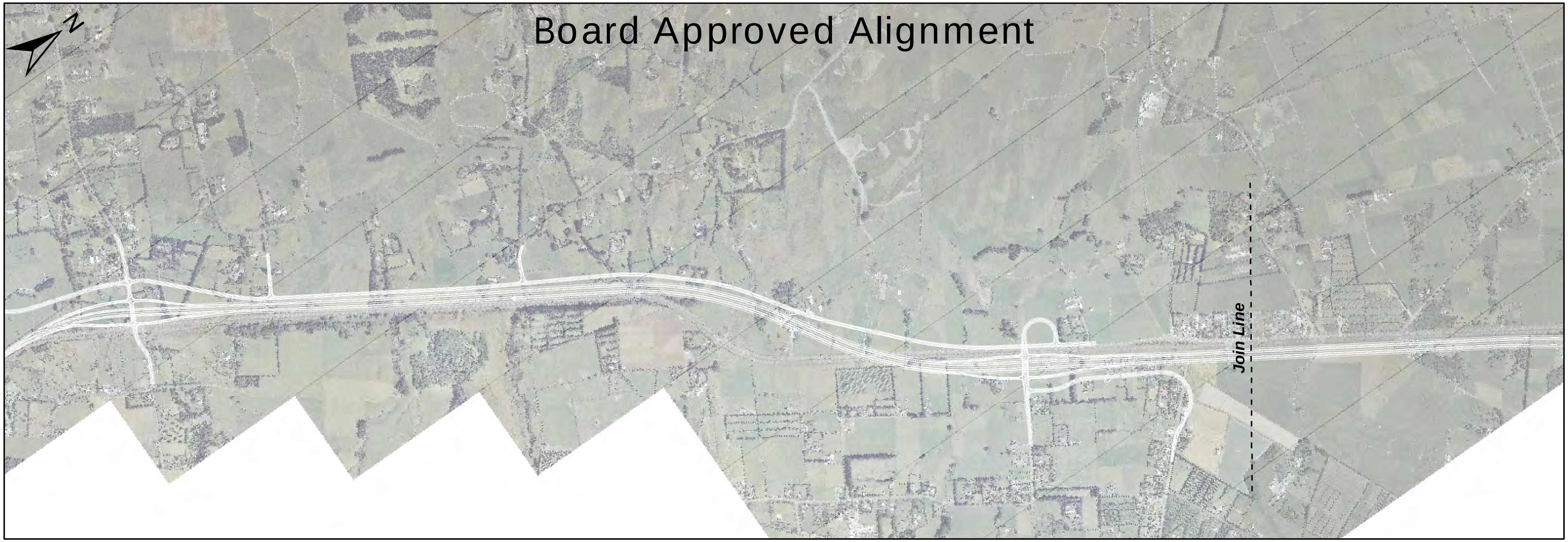
RP. 915/3.03 to RP. 915/15.70

SCHEME PHASE
EASTERN IMPROVED ROUTE PLAN

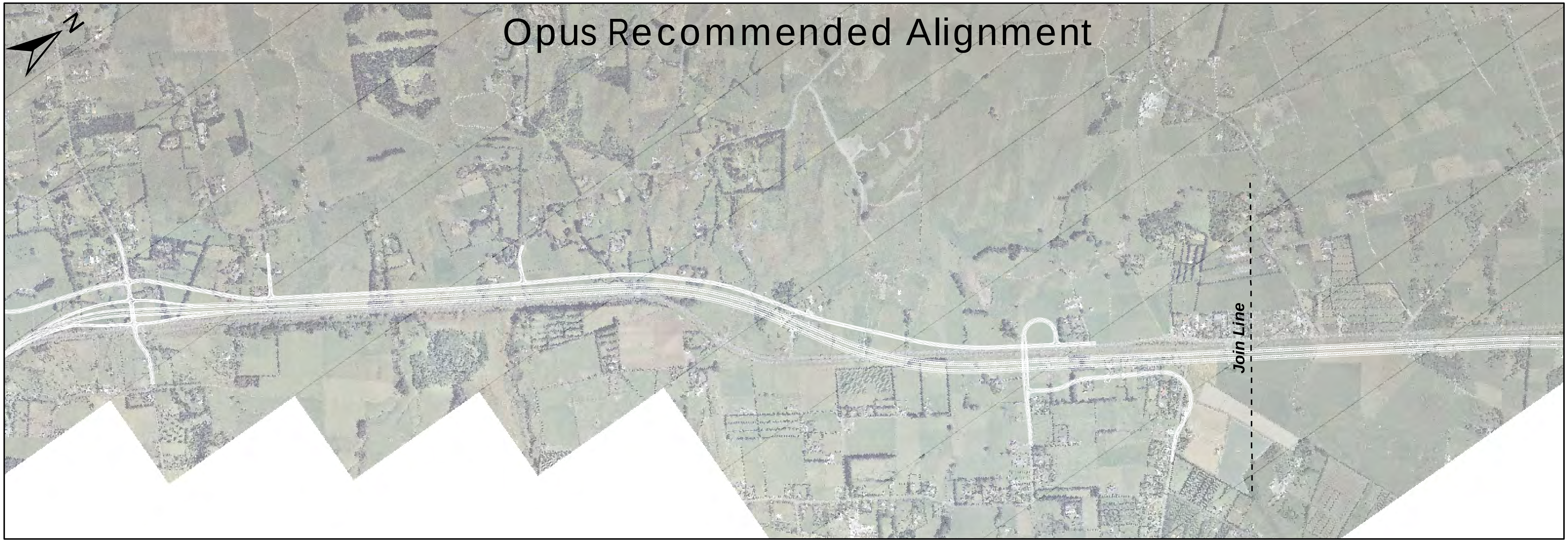
A1 Scale NOT TO SCALE

Project No. 5981718 | Drawing No. SP70-6 | Issue -

Board Approved Alignment



Opus Recommended Alignment



Appendix B

Parameter Based Estimate Assumptions

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1.0 Parameters

The parameters developed for this estimate are listed below and have been built up from a database compiled from past projects:

Parameter	Parameter Cost ($M)
Two lane rural road	**4.0** /km
Four lane rural road	**8.0** /km
Two lane urban road	**20.0** /km
Four lane urban road	**25.0** /km
Widening 2 lane to 4 lane, rural	**3.0** /km
Widening 2 lane to 4 lane, urban	**15.0** /km
Grade separated intersection	**15.0** per intersection
Two lane bridge	**4.5** each
Four lane bridge	**8.5** each
Double track rail re-alignment	**5** /km
Single track rail re-alignment	**3** /km

These parameters have been used to build up a physical works cost by measuring the length of road (from drawings) and multiplying that by the associated parameter rate.

2.0 Professional Services

The proposed professional services fee (I&R, D&PD and MSQA) has been taken to be 15% of the physical works cost.

3.0 Property Costs

Property costs have been estimated by using land values (rates) extracted from the land valuation component of the 2008 State Highway valuation and multiplying this rate by the measured area (from AutoCAD). The land values vary depending on the land use adjacent to the state highway. The measured area extends from the existing state highway designation to the toe of the earthworks footprint. An allowance has then been made to purchase additional land in areas where the remaining area of a parcel becomes unusable. This has been accounted for by multiplying the measured area by a factor representative of any additional land take required (i.e. more in urban cases). This methodology has been used to develop an indicative property purchase cost for each stage.

4.0 Exclusions and Assumptions

The following is a list of exclusions and assumptions that should be noted with these figures:

1. We have used the cost index of March 2009.

2. No specific design has been undertaken for any aspects of the works. Therefore a parameter cost approach has been adopted. Parameter rates should be used with caution.

3. No information is available on existing services, but parameter costs include some allowance (based on previous projects)

4. The measured property purchase area is the earthworks footprint in both rural and urban cases. An allowance has been made for addition land purchase (see above).

Appendix C

Transport Economic Efficiency Forecasts -North of Otaki to Peka Peka Road

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Introduction

The New Zealand Transport Agency (NZTA) has commissioned Opus to undertake a strategy study for the upgrading of State Highway 1 (SH1) in the Kapiti Coast District. SH1 in this area is currently an undivided single carriageway highway which is proposed to be upgraded to a four lane (two in each direction) expressway.

This appendix outlines our preliminary assessment of the economic benefits of the scheme between Peka Peka and north of Otaki. This incorporates two sections as shown in Figure 1, being:

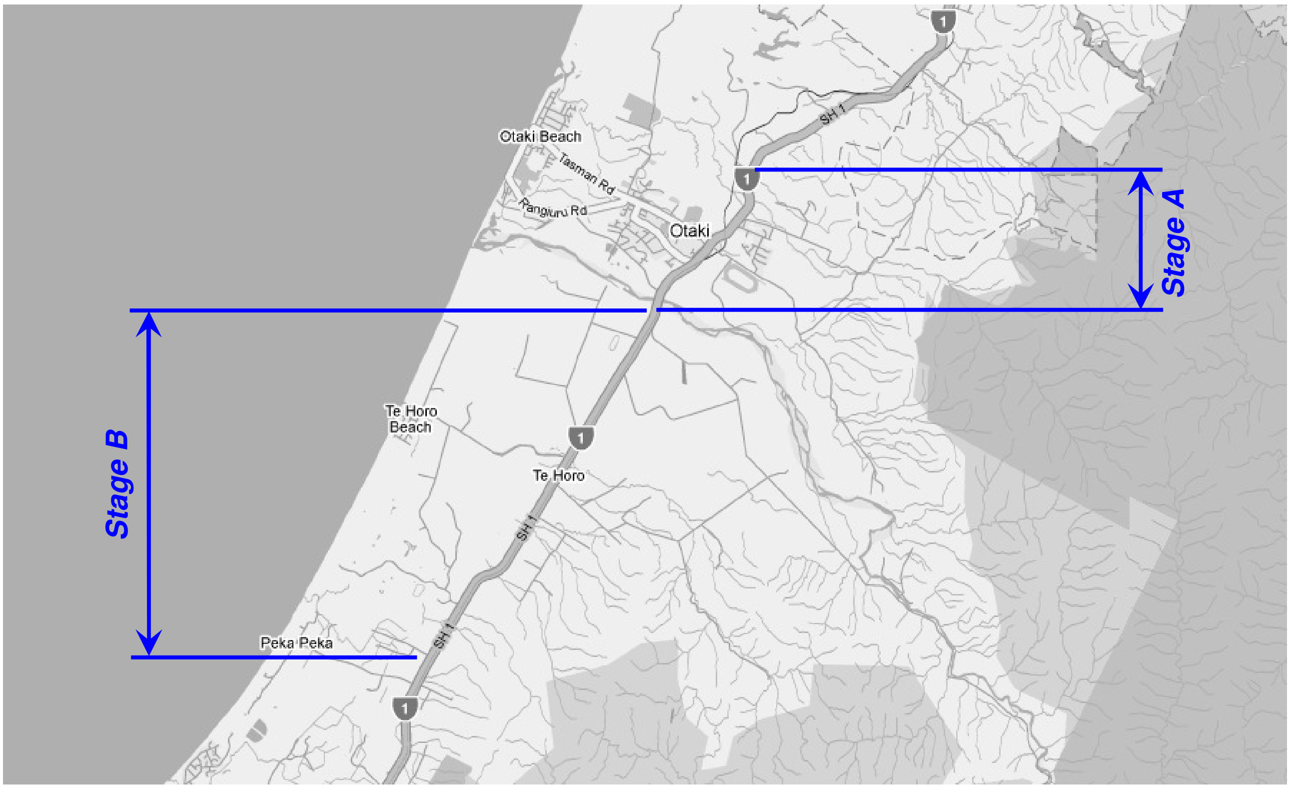
- Stage A: North of Otaki to Addingon / Otaki Gorge Road – This 4.3km section includes a lower speed zone through Otaki township; and
- Stage B: Addington Road to Peka Peka – A rural section of 8.4km.

Input Data

Input data collated for this evaluation includes:

- Classified, directional and hourly traffic count information from the NZTA's monitoring database;
- Base and forecast year traffic demands, modelled speeds and capacities from the Wellington Transport Strategy Model (WSTM) and Kapiti Coast SATURN Model;
- Feasibility cost estimates and construction timeline for the scheme from the Opus project team;
- Five years of crash history for the existing highway from the NZTA Crash Analysis System;
- Weekend peak period journey time surveys; and
- Journey time surveys along the study area in the AM, Inter and PM Peak periods.

Figure 1 – Peka Peka to North of Otaki Location Plan



Development of Spreadsheet Model

There is very little traffic model information for the study area that can be used to forecast any benefits from the scheme. The study area does lie on the edge of WSTM, however as advised by Greater Wellington Regional Council the model would not be suitable as a detailed forecasting tool.

As a result, Opus developed a spreadsheet model to assess relevant performance statistics as a result of the scheme based on journey time surveys and other available data. As viable alternative routes to SH1 are not feasible in this area, this approach was considered to be acceptable for this assessment. The spreadsheet model is detailed in the following sections.

Modelled Periods

Stage A and B costs were calculated for the Do Minimum (existing) and Option 1 (four lane expressway) models based on the journey time surveys, measured distances and available count data. Specifically, costs were developed for travel time, congestion relief and vehicle operating costs for 2009, 2016 and 2026 for the following model periods:

- AM Peak (average hour 07:00 to 09:00);
- Inter Peak (average hour 12:00 to 14:00);
- PM Peak (average hour 16:00 to 18:00);
- Thursday/Friday Holiday PM Peak Northbound (average hour 14:00 to 18:00); and

- Sunday/Monday Holiday PM Peak Southbound (average hour 13:00 to 17:00).

The following performance statistics were calculated:

- Traffic Flow (Veh/h);
- Journey Time (seconds);
- Speed (km/h);
- Travel Time (Veh-hrs/h);
- Congestion Relief (Veh-hrs/h); and
- Travel Distance (Veh-km/h).

Congestion relief costs were estimated based on observed variation from Inter Peak journey times, on the assumed basis that any additional travel time from 'normal' conditions would be a source of frustration. This is a crude assumption, but only a small proportion of benefits were produced using this methodology (approximately 2% of travel time benefits for the combined Stages A and B).

The performance results for 2009, 2016 and 2026 for Stages A and B are included in Addendum A for reference.

Demand Growth Assumptions

Average forecast traffic demand growth was assessed from the WSTM and recently re-forecast Kapiti Coast SATURN Model for Sections A and B as shown in Table 1. The Kapiti Coast Model runs north to Peka Peka, being the southernmost portion of Stage B.

Table 1 – Annual Growth Forecasts on State Highway 1

Section Description	Annual Growth Forecasts	
	2006 to 2016 (%)	2016 to 2026 (%)
WTSM Stage A	1.3	0.7
WTSM Stage B	1.2	0.6
Kapiti SATURN Stage B	2.2	0.9

Following the advice of GWRC, the SATURN forecasts were considered to be the most appropriate and based on the most up to date information. These forecasts at Peka Peka were adopted for both Sections A and B for this assessment, based on the assumption that traffic growth north of Otaki will be proportional to south of Otaki.

To put this into context, Table A2.5 of the EEM recommends the use of 2% per annum for a rural strategic highway in the Wellington Region. The effect of this assumption on the economic efficiency of the project is examined in sensitivity test 3.

The full calculations are included in Addendum B for reference.

Journey Time Estimation

2009 Do Minimum (existing) performance statistics were based on the observed average journey time surveys (October 2008 and June 2009) and NZTA counts from April 2009. The journey times include all current delays to traffic as a result of slow moving Heavy Commercial Vehicles (HCV), speed limits and traffic congestion etc. Average operating speeds were calculated from measured distances. The April 2009 NZTA counts were the most recent representative period of available data on both sections, which also included HCV counts. The counts are also the most reflective of the journey time survey operating conditions.

Vehicle speeds and corresponding journey times are commonly related to vehicle flow in strategic modelling software such as SATURN for highway link sections. Observed levels of flow and average speed were plotted for each of the two modelled sections. Rough empirical approximations of this speed-flow relationship were developed from the plots as included in Addendum C using SATURN based formulae.

It should be noted that the relationships developed represent average speed and flow over the whole highway section. These forecasts were then used to predict average operating speeds in the forecast years of 2016 and 2026 based on the predicted traffic flows. This works reasonably well for Section B where intersection delays are minimal, but is not very accurate for Section A due to the presence of lower speed limits, side friction due to development accesses, and intersection delays within Otaki. Therefore the assumed curve for Stage A is more conservative (predicts a higher speed) than would be expected in reality, as the capacity of the intersections / accesses / side friction and the delay due to turning interactions are more complex than can be accurately reflected using this method. This is particularly apparent for the holiday peak southbound journey times, which show a significantly slower travel time than is explained by the speed/flow relationship – in this instance a correction offset was applied to the predicted speed.

All forecast Option 1 performance statistics were based on assumed average operating speeds for the expressway of 105km/h. This makes the assumption that the new expressway will be well within capacity in all time periods and years, and that vehicles will travel at their desired speeds and overtake slower vehicles at will. The travel distance for Option 1 was assumed to be the same as for the existing highway, which is another source of conservatism in the analysis.

Crash History

Five years (2004-2008) of crash history for the existing highway was obtained from the NZTA Crash Analysis System (CAS) for each of the two sections. Addington Road crashes have been assumed to reside in Stage A for the purposes of this assessment. A summary of the accident history is presented in Table 2.

Table 2 – Accident History 2004 to 2008

Crash Severity	CAS Accident History	
	Stage A	Stage B
Fatal	2	2
Serious	15	28
Minor	14	12
Non-Injury	41	36
Total	**72**	**78**

Table 2 shows that there is a significant crash history for the study area with a number of serious and fatal accidents. Each section has had two fatal accidents in the last five years.

The CAS coded accident listings and collision diagrams are included in Addendum D for reference.

Economic Evaluation

Economic benefits for Option 1 have been calculated in accordance with NZTA Economic Evaluation Manual procedures to generate a Benefit / Cost Ratio (BCR) and First Year Rate of Return (FYRR). This assessment has been based on the spreadsheet model estimates of travel time, congestion relief, vehicle operating costs, CO_2 emissions and accident benefits.

Evaluation Assumptions

Evaluation assumptions for this assessment are as follows:

- Base Date: 1 July 2009;
- Time Zero: 1 July 2009;
- Construction: Commences 1 July 2012 for a duration of four years completing 1 July 2016;
- First Year of Benefits: 1 July 2016 to 1 July 2017 (Midpoint Year 7.5);
- Benefit Period: 26 Years (Year 7 to Year 33); and
- Discount Rate: 8%.

All update factors, base value of travel times, and values of travel cost are based on estimates for a Rural Strategic Highway from NZTA's EEM Vol 1 Amendment 2 (Updated on September 2008).

All cost and benefit estimations have been based on an extrapolation of the peak traffic models, using the following annualisation factors:

- AM Peak: 245 days at 2 hours per day (07:00-09:00);
- Inter Peak: 245 days at 8 hours per day (09:00-16:00 & 18:00-19:00);
- PM Peak: 240 days at 2 hours per day (16:00-18:00);
- Off Peak: 245 days at 10 hours per day (19:00-07:00) at 0.193 (Stage A) or 0.204 (Stage B) x Inter Peak;
- Weekend Inter Peak: 118 days at 10 hours per day (10:00-20:00) at 1.162 (Stage A) or 1.168 (Stage B) x Inter Peak;
- Thursday/Friday Holiday PM Peak Northbound: 5 days at 4 hours per day (14:00-18:00); and
- Sunday/Monday Holiday PM Peak Southbound: 5 days at 4 hours per day (13:00-17:00).

Weekend Off Peak costs have not been assessed – this is a slightly conservative assumption.

The above factors are based on profiles developed from the NZTA count database as shown in Addendum E for reference.

Accident Analysis

A simplified accident analysis was undertaken for the two sections, based on the available accident history outlined above. As this is only a very high level assessment of the benefits of the scheme, it was considered inappropriate to perform a detailed crash analysis. The two sections have a high accident history, which qualifies for an accident by accident assessment of the Do Minimum in the EEM as opposed to an accident rate analysis.

For the Option crash costs, applying an accident rate for a four lane expressway is not conservative as this is mid-block only and ignores any intersection crashes. Therefore the proposed methodology was to apply a range of crash reduction percentages on an accident by accident basis to estimate crash benefits. Conservative accident reduction assumptions applied to both Stages A and B of the scheme are as follows, based on the assumption of a limited access rural expressway standard road for Option 1:

- 100% Head On;
- 100% U-Turn;
- 40% Fatal, 30% Serious, 10% Minor, 10% Non-Injury for Loss of Control, Changing Lanes, Overtaking;
- 100% Pedestrian (only 1 minor pedestrian crash observed);
- 100% Train Related;
- 100% Parking Related;
- 25% Reduction for miscellaneous (trailer loss of control/hitting misc. objects) due to improved geometrics; and
- 50% Manoeuvring, Turning, Rear-End.

The annual accident costs for the Do Minimum and Option 1 are shown below in Table 3.

Table 3 – Annual Accident Costs

Description	Annual Accident Costs		
	Stage A	Stage B	Both
Do Minimum Costs	$3.4m	$10.2m	$13.6m
Option 1 Costs	$1.2m	$4.4m	$5.6m
Total Annual Benefits	**$2.2m**	**$5.8m**	**$8.0m**

Table 3 shows that significant accident benefits can be attributed to the scheme using the conservative reductions assumed. If accident rates were used, the benefits would be considerably higher as shown in Table 4.

Table 4 – Accident Rate Annual Accident Costs

Description	Annual Accident Costs		
	Stage A	Stage B	Both
Do Minimum Costs	$3.4m	$10.2m	$13.6m
Option 1 Accident Rate Costs	$0.46m	$1.2m	$1.7m
Total Annual Benefits	**$2.9m**	**$9.0m**	**$11.9m**

Therefore Table 4 shows that using the accident by accident methodology for Option 1 is conservative by around $3m per annum on the combined scheme.

Costs

Construction has been assumed to commence on 1 July 2012 for a duration of four years completing on 1 July 2016, and costs have been assumed to be incurred evenly over this period. Table 5 shows the construction and discounted (NPV) costs for each stage.

Table 5 – Peka Peka to North of Otaki Construction Costs

Description	NPV Construction Costs		
	Stage A	Stage B	Both
Construction Costs	$105m	$110m	$215m
Net Present Value Costs	**$71.8m**	**$75.2m**	**$147m**

Table 5 shows that the NPV cost for the entire Option 1 scheme is $147m.

No maintenance costs have been assumed for this assessment.

Benefits

Economic benefits for Option 1 have been calculated for travel time, congestion relief, vehicle operating costs, CO_2 emissions and accident benefits.

Net present value (NPV) benefits for the project are shown in Table 6.

Table 6 – Peka Peka to North of Otaki NPV Benefits

Description	NPV Benefits		
	Stage A	Stage B	Both
Travel Time	$37.5m	$23.0m	$60.5m
Congestion Relief	$0.5m	$0.8m	$1.3m
Vehicle Operating	-$11.3m	-$14.0m	-$25.3m
Accidents	$15.1m	$40.9m	$56.0m
Carbon Dioxide (4% of VOC)	-$0.45m	-$0.56m	-$1.0m
Total NPV Benefits	**$41.4m**	**$50.2m**	**$91.5m**

Table 6 shows that the NPV benefits for the Option 1 scheme are $92m.

The majority of benefits for Stage A come from improving travel times through the corridor around Otaki to the desired operating speed. In Stage B this is not so pronounced as the average speed for the Do Minimum is higher. A significant benefit is forecast for accident benefits for both sections, but this makes up the bulk of benefits for Stage B.

Dis-benefits for vehicle operating costs are expected for both sections in this situation as a result of high speed travel costing more than low speed travel.

Evaluation Results

Benefit / Cost Ratio (BCR) and First Year Rate of Return (FYRR) results are presented in Table 7.

Table 7 – Peka Peka to North of Otaki BCR and FYRR Results

Results	Evaluation Results		
	Stage A	Stage B	Both
Benefit / Cost Ratio (BCR)	0.6	0.9	0.7
First Year Rate of Return (FYRR)	5%	7%	6%

The overall BCR result of 0.7 forecast significant benefits for the scheme, but not enough to cover the high expected costs. Stage B is forecast to have a higher economic efficiency than Stage A.

Full EEM worksheets for all BCR results are documented within Addendum F.

Sensitivity Tests

Three sensitivity tests were undertaken to examine how volatile the BCR is to changing assumptions in the assessment as follows:

- Test 1: This test assumes that only the stated accident reductions for Head On, U Turns, and Loss of Control/Lane Changing/Overtaking were applied. This gives a very conservative accident reduction for the scheme;
- Test 2: The assumed desire speed of the expressway has been reduced to 95km/h instead of 105km/h; and
- Test 3: Traffic growth has been assumed to be the EEM default of 2% per annum for Wellington Region highways. This is lower than the 2.2% assumed in the early years to 2016, but greater than the 0.9% assumed thereafter in the main assessment.

The BCR results for these tests are presented in Table 8.

Table 8 – Peka Peka to North of Otaki BCR Sensitivity Tests

Benefit / Cost Ratio (BCR)	Sensitivity Test Results		
	Stage A	Stage B	Both
Test 1: Low Crash Reductions	0.6	0.7	0.6
Test 2: 95km/h Desired Speed	0.6	0.8	0.7
Test 3: EEM 2% Growth	0.7	0.9	0.8

The sensitivity tests show that the modification of assumptions in the modelling has a limited effect on the economic viability of the scheme, although Stage B comes very close to having a 'low' economic efficiency of 1.

Summary

The main conclusions from the assessment are as follows:

- Both sections have a significant crash record, including two fatal crashes each;
- Significant crash benefits can be attributed to the scheme using the conservative reductions assumed. In particular, most of the benefits for Stage B come from crash savings;
- The overall BCR result of 0.7 forecasts significant benefits for the scheme, but not enough to cover the high expected costs;

- The FYRR of 6% shows that the project will provide a significant benefit in the opening year; and
- The presented sensitivity tests show that the modification of assumptions in the modelling has a limited effect on the economic viability of the scheme.

1 Addendum A – Performance Calculations

1.1 Stage A: North of Otaki to Addingon / Otaki Gorge Road

Stage A North of Otaki to Addingon / Otaki Gorge Road

Do Minimum

		2009							2016							2026						
		Flow (Vehs/hr)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)	Flow (Vehs)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)	Flow (Vehs)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)
NB	AM Peak	453	4335	252	62	31.7	0.0	1965	523	4335	251	62	36.4	0.0	2268	570	4335	253	62	40.0	0.0	2472
	Inter Peak	510	4335	269	58	38.0	0.0	2209	588	4335	271	58	44.3	0.5	2550	641	4335	274	57	48.9	1.1	2779
	PM Peak	644	4335	248	63	44.4	0.0	2790	743	4335	263	59	54.3	0.0	3220	810	4335	269	58	60.6	0.2	3510
	Holiday PM	821	4335	268	58	61.1	0.0	3561	948	4335	285	55	75.0	4.3	4109	1033	4335	296	53	85.0	8.0	4479
SB	AM Peak	439	4335	251	62	30.6	0.2	1903	507	4335	250	62	35.2	0.1	2196	552	4335	252	62	38.6	0.4	2394
	Inter Peak	492	4335	249	63	34.1	0.0	2134	568	4335	253	62	39.9	0.5	2462	619	4335	255	61	43.9	1.0	2684
	PM Peak	665	4335	252	62	46.6	0.5	2883	768	4335	266	59	56.7	3.5	3328	837	4335	272	57	63.3	5.3	3627
	Holiday PM	901	4335	595	26	148.9	86.5	3905	1040	4335	697	22	201.2	129.2	4507	1133	4335	786	20	247.5	169.1	4913
Both	AM Peak	892			62	62.4	0.2	3868	1030			62	71.6	0.1	4464	1122			62	78.7	0.4	4866
	Inter Peak	1002			60	72.1	0.0	4343	1156			60	84.2	1.0	5012	1260			59	92.8	2.1	5463
	PM Peak	1309			62	91.0	0.5	5674	1510			59	111.0	3.5	6548	1646			58	123.9	5.5	7137
	Holiday PM	1722			42	210.0	86.5	7466	1987			38	276.2	133.5	8616	2166			36	332.6	177.0	9391

Option 1

		2009		105 km/h					2016							2026						
		Flow (Vehs/hr)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)	Flow (Vehs)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)	Flow (Vehs)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)
NB	AM Peak	453	4335	149	105	18.7	0.0	1965	523	4335	149	105	21.6	0.0	2268	570	4335	149	105	23.5	0.0	2472
	Inter Peak	510	4335	149	105	21.0	0.0	2209	588	4335	149	105	24.3	0.0	2550	641	4335	149	105	26.5	0.0	2779
	PM Peak	644	4335	149	105	26.6	0.0	2790	743	4335	149	105	30.7	0.0	3220	810	4335	149	105	33.4	0.0	3510
	Holiday PM	821	4335	149	105	33.9	0.0	3561	948	4335	149	105	39.1	0.0	4109	1033	4335	149	105	42.7	0.0	4479
SB	AM Peak	439	4335	149	105	18.1	0.0	1903	507	4335	149	105	20.9	0.0	2196	552	4335	149	105	22.8	0.0	2394
	Inter Peak	492	4335	149	105	20.3	0.0	2134	568	4335	149	105	23.4	0.0	2462	619	4335	149	105	25.6	0.0	2684
	PM Peak	665	4335	149	105	27.5	0.0	2883	768	4335	149	105	31.7	0.0	3328	837	4335	149	105	34.5	0.0	3627
	Holiday PM	901	4335	149	105	37.2	0.0	3905	1040	4335	149	105	42.9	0.0	4507	1133	4335	149	105	46.8	0.0	4913
Both	AM Peak	892			105	36.8	0.0	3868	1030			105	42.5	0.0	4464	1122			105	46.3	0.0	4866
	Inter Peak	1002			105	41.4	0.0	4343	1156			105	47.7	0.0	5012	1260			105	52.0	0.0	5463
	PM Peak	1309			105	54.0	0.0	5674	1510			105	62.4	0.0	6548	1646			105	68.0	0.0	7137
	Holiday PM	1722			105	71.1	0.0	7466	1987			105	82.1	0.0	8616	2166			105	89.4	0.0	9391

1.2 Stage B: Addington Road to Peka Peka

Stage B Addington Road to Peka Peka

Do Minimum

		2009 Flow (Vehs/hr)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)	2016 Flow (Vehs)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)	2026 Flow (Vehs)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)
NB	AM Peak	598	8408	344	88	57.2	1.4	5024	690	8408	342	88	65.5	1.2	5797	752	8408	346	87	72.3	2.2	6319
	Inter Peak	560	8408	336	90	52.3	0.0	4711	647	8408	340	89	61.0	0.7	5437	705	8408	343	88	67.1	1.4	5926
	PM Peak	775	8408	353	86	76.0	3.7	6513	894	8408	361	84	89.6	6.2	7516	974	8408	372	81	100.7	9.8	8193
	Holiday PM	960	8408	353	86	94.1	4.6	8068	1107	8408	398	76	122.4	19.1	9311	1207	8408	422	72	141.5	29.0	10149
SB	AM Peak	511	8408	340	89	48.2	0.2	4296	590	8408	340	89	55.7	0.3	4958	643	8408	343	88	61.2	0.7	5404
	Inter Peak	599	8408	339	89	56.3	0.0	5035	691	8408	342	88	65.7	0.6	5810	753	8408	346	87	72.5	1.6	6333
	PM Peak	828	8408	348	87	80.0	2.0	6965	956	8408	370	82	98.4	8.4	8038	1042	8408	384	79	111.1	13.1	8761
	Holiday PM	736	8408	348	87	71.1	1.8	6187	849	8408	356	85	84.0	4.1	7140	926	8408	366	83	94.1	7.0	7783
Both	AM Peak	1109			88	105.4	1.6	9320	1279			89	121.3	1.5	10756	1394			88	133.6	3.0	11724
	Inter Peak	1159			90	108.6	0.0	9746	1338			89	126.7	1.3	11247	1458			88	139.6	3.0	12259
	PM Peak	1603			86	156.0	5.8	13478	1850			83	188.0	14.6	15554	2016			80	211.8	22.9	16954
	Holiday PM	1695			86	165.2	6.4	14256	1957			80	206.4	23.2	16451	2133			76	235.7	36.0	17932

Option 1 105 km/h

		2009 Flow (Vehs/hr)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)	2016 Flow (Vehs)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)	2026 Flow (Vehs)	Distance (m)	JT (s)	Speed (km/h)	TT (Veh-hrs/hr)	CRV (Veh-hrs/hr)	Distance (Veh-km/hr)
NB	AM Peak	598	8408	288	105	47.8	0.0	5024	690	8408	288	105	55.2	0.0	5797	752	8408	288	105	60.2	0.0	6319
	Inter Peak	560	8408	288	105	44.9	0.0	4711	647	8408	288	105	51.8	0.0	5437	705	8408	288	105	56.4	0.0	5926
	PM Peak	775	8408	288	105	62.0	0.0	6513	894	8408	288	105	71.6	0.0	7516	974	8408	288	105	78.0	0.0	8193
	Holiday PM	960	8408	288	105	76.8	0.0	8068	1107	8408	288	105	88.7	0.0	9311	1207	8408	288	105	96.7	0.0	10149
SB	AM Peak	511	8408	288	105	40.9	0.0	4296	590	8408	288	105	47.2	0.0	4958	643	8408	288	105	51.5	0.0	5404
	Inter Peak	599	8408	288	105	48.0	0.0	5035	691	8408	288	105	55.3	0.0	5810	753	8408	288	105	60.3	0.0	6333
	PM Peak	828	8408	288	105	66.3	0.0	6965	956	8408	288	105	76.5	0.0	8038	1042	8408	288	105	83.4	0.0	8761
	Holiday PM	736	8408	288	105	58.9	0.0	6187	849	8408	288	105	68.0	0.0	7140	926	8408	288	105	74.1	0.0	7783
Both	AM Peak	1109			105	88.8	0.0	9320	1279			105	102.4	0.0	10756	1394			105	111.7	0.0	11724
	Inter Peak	1159			105	92.8	0.0	9746	1338			105	107.1	0.0	11247	1458			105	116.8	0.0	12259
	PM Peak	1603			105	128.4	0.0	13478	1850			105	148.1	0.0	15554	2016			105	161.5	0.0	16954
	Holiday PM	1695			105	135.8	0.0	14256	1957			105	156.7	0.0	16451	2133			105	170.8	0.0	17932

2 Addendum B – Forecast Growth Analysis

WTSM Stage A: North of Otaki

		AM Peak			Rate	Rate	Inter Peak			Rate	Rate	PM Peak			Rate	Rate
		2006	2016	2026	06-16 %	16-26%	2006	2016	2026	06-16 %	16-26%	2006	2016	2026	06-16 %	16-26%
NB	Cars	484	538	577	1.1%	0.7%	403	445	478	1.0%	0.7%	645	704	742	0.9%	0.5%
	HCVs	55	76	81	3.9%	0.7%	55	77	83	3.9%	0.8%	48	67	70	4.0%	0.4%
	Total	**539**	**614**	**658**	**1.4%**	**0.7%**	**458**	**522**	**560**	**1.4%**	**0.7%**	**693**	**771**	**812**	**1.1%**	**0.5%**
SB	Cars	590	645	681	0.9%	0.6%	403	444	477	1.0%	0.7%	557	614	660	1.0%	0.7%
	HCVs	56	78	82	4.0%	0.6%	56	78	82	4.0%	0.6%	49	69	71	4.0%	0.4%
	Total	**646**	**722**	**763**	**1.2%**	**0.6%**	**459**	**522**	**559**	**1.4%**	**0.7%**	**606**	**683**	**730**	**1.3%**	**0.7%**

	Rate 06-16 %	Rate 16-26%
Cars	1.0%	0.7%
HCVs	4.0%	0.6%
Total	**1.3%**	**0.7%**

WTSM Stage B: North of Peka Peka

		AM Peak			Rate	Rate	Inter Peak			Rate	Rate	PM Peak			Rate	Rate
		2006	2016	2026	06-16 %	16-26%	2006	2016	2026	06-16 %	16-26%	2006	2016	2026	06-16 %	16-26%
NB	Cars	405	397	431	-0.2%	0.8%	376	383	412	0.2%	0.8%	649	658	692	0.1%	0.5%
	HCVs	169	243	260	4.4%	0.7%	179	258	278	4.4%	0.8%	143	207	215	4.4%	0.4%
	Total	**573**	**640**	**691**	**1.2%**	**0.8%**	**555**	**640**	**690**	**1.5%**	**0.8%**	**792**	**865**	**907**	**0.9%**	**0.5%**
SB	Cars	571	570	596	0.0%	0.4%	369	374	403	0.1%	0.8%	456	451	484	-0.1%	0.7%
	HCVs	165	238	252	4.4%	0.6%	163	234	248	4.4%	0.6%	128	184	190	4.4%	0.4%
	Total	**735**	**808**	**848**	**1.0%**	**0.5%**	**531**	**608**	**651**	**1.4%**	**0.7%**	**584**	**635**	**674**	**0.9%**	**0.6%**

	Rate 06-16 %	Rate 16-26%
Cars	0.0%	0.7%
HCVs	4.4%	0.6%
Total	**1.2%**	**0.6%**

Kapiti SATURN Model Stage B: North of Peka Peka

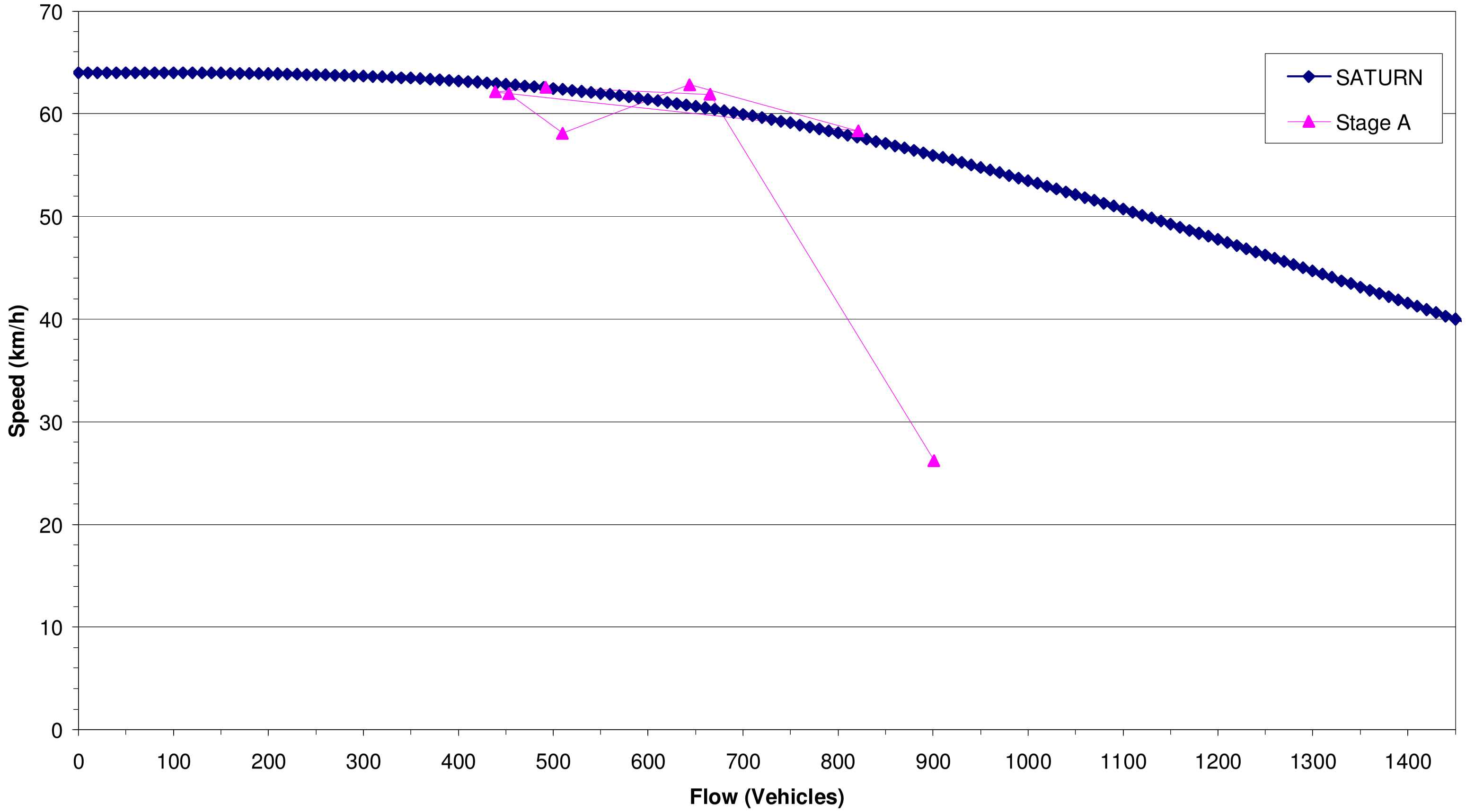
		AM Peak			Rate	Rate	Inter Peak			Rate	Rate	PM Peak			Rate	Rate
		2006	2016	2026	06-16 %	16-26%	2006	2016	2026	06-16 %	16-26%	2006	2016	2026	06-16 %	16-26%
NB	Cars	642	724	773	1.3%	0.7%	541	618	672	1.4%	0.9%	736	876	954	1.9%	0.9%
	HCVs	24	57	65	14.0%	1.5%	30	66	74	11.8%	1.2%	49	96	110	9.8%	1.4%
	Total	**666**	**781**	**838**	**1.7%**	**0.7%**	**571**	**684**	**746**	**2.0%**	**0.9%**	**785**	**972**	**1064**	**2.4%**	**0.9%**
SB	Cars	604	705	765	1.7%	0.9%	536	601	647	1.2%	0.8%	526	618	656	1.7%	0.6%
	HCVs	65	123	143	8.9%	1.6%	32	68	76	11.6%	1.2%	25	89	117	26.1%	3.2%
	Total	**669**	**828**	**908**	**2.4%**	**1.0%**	**568**	**669**	**723**	**1.8%**	**0.8%**	**551**	**707**	**773**	**2.8%**	**0.9%**

	Rate 06-16 %	Rate 16-26%
Cars	1.5%	0.8%
HCVs	13.7%	1.7%
Total	**2.2%**	**0.9%**

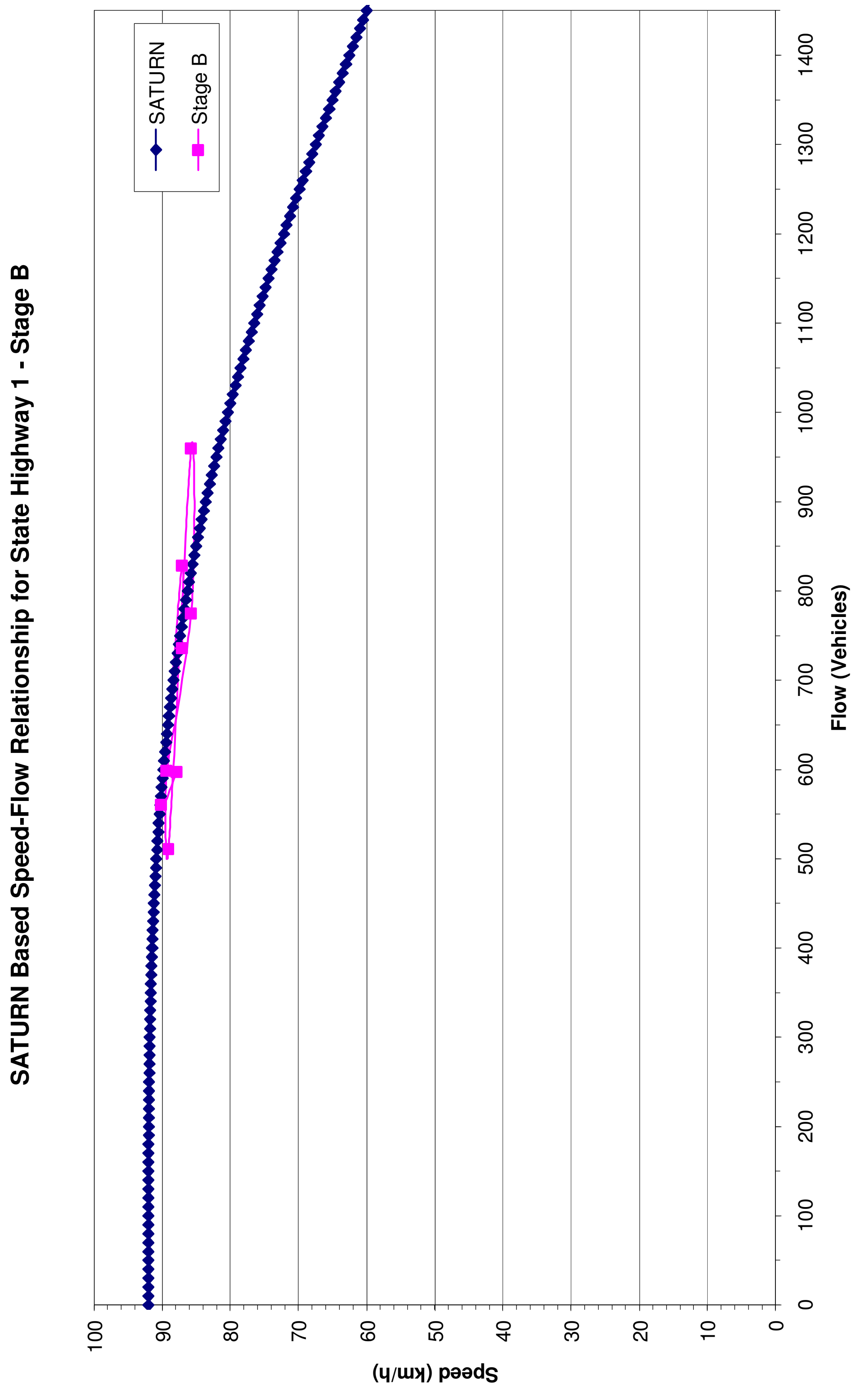
3 Addendum C – Speed-Flow Relationships

3.1 Stage A: North of Otaki to Addingon / Otaki Gorge Road

SATURN Based Speed-Flow Relationship for State Highway 1 - Stage A



3.2 Stage B: Addington Road to Peka Peka



4 Addendum D – CAS Outputs

4.1 Stage A: North of Otaki to Addingon / Otaki Gorge Road

NZ TRANSPORT AGENCY
WAKA KOTAHI

Coded Crash report, run on 24-06-2009, Page 1

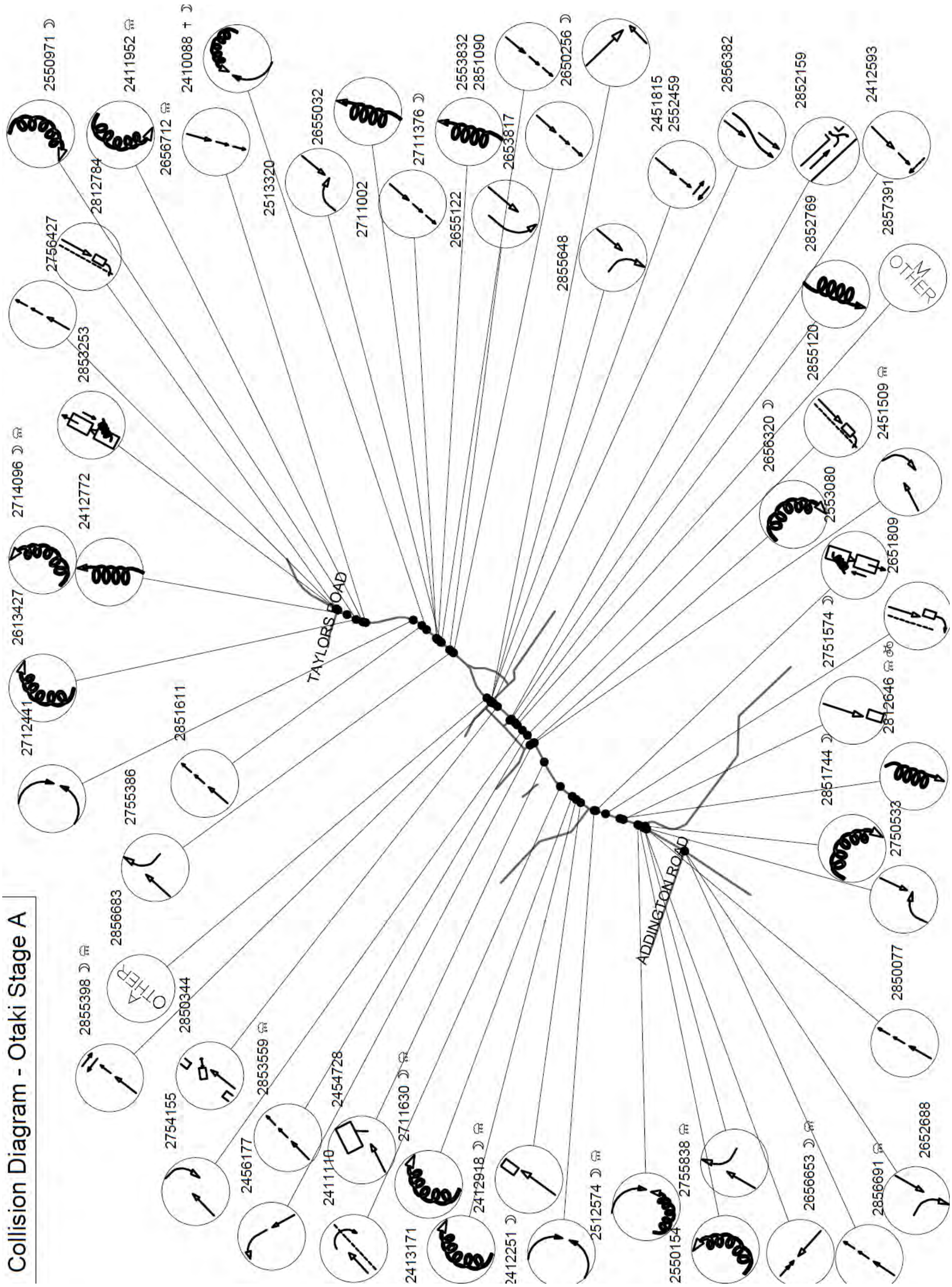
First street	Distance / DIR	Second street or landmark	Crash Number	Date DD/MM/YYYY	Day DDD	Time HHMM	MVMT	DVR VN 1 VVV 234	Factors and Roles (A is for vehicle 1, B is for veh 2 etc)	OBJECT	CURVE	WETNESS	LIGHT	WEATHER	JUNCTION	CONTROL	MARKS	SPD LMT	Total Inj FAT	SER	MIN	PED age	CYC age
1N/995/7.643	I	ADDINGTON ROAD	2856691	30/12/2008	Tue	1143	FD	CN1C	331A 351A		R	W	O	L	T	N	C	100					
1N/995/5.135	50N	MILL ROAD	2856683	19/12/2008	Fri	1100	AO	CN1T	150A		E	D	O	F		N	C	050					
1N/995/5.538	80S	ARTHUR ST	2857391	21/11/2008	Fri	1730	MO	CS1C	387A		R	D	B	F		N	C	050					
1N/995/5.223	15S	MILL ROAD	2856382	28/09/2008	Sun	1530	AA	TS1C	387A		E	D	B	F	R	G	C	050					
1N/995/5.185	I	RAHUI ROAD	2855648	07/09/2008	Sun	1400	KB	CS1M	302A 375A		E	D	B	F	R	G	C	050					
1N/995/5.676	100N	WAERENGA ROAD	2855120	15/08/2008	Fri	0820	GD	TS14	101A 386A 927		R	D	B	F	D	N	C	050					
1N/995/5.208	I	MILL ROAD	2855398	11/08/2008	Mon	1815	FB	CN1C	331A		R	W	TO	L	R	G	R	050					
1N/995/3.302	I	TAYLORS ROAD	2812784	10/08/2008	Sun	1610	GD	CS1C	333A 360A 902		R	D	B	F	T	G	C	100		1	1		
1N/995/6.939	20S	OTAKI RIV BR S	2812646	30/07/2008	Wed	1623	CA	SS1	105A		R	W	O	H		N	C	100			1		49
1N/995/5.676	100N	WAERENGA ROAD	2853559	12/06/2008	Thu	1035	FD	CN1C	331A		R	W	O	H		N	C	050					
1N/995/5.508	50S	ARTHUR ST	2852769	29/05/2008	Thu	1200	CB	CS1CCC	129A	MMM	R	D	B	F		N	R	050					
1N/995/3.302	I	TAYLORS ROAD	2853253	02/05/2008	Fri	1040	QG	CN1C	682A	D	R	D	O	F	T	G	L	100					
ARTHUR ST	20W	SH 1N	2852159	29/04/2008	Tue	1100	MD	TE1C	371A 920		R	D	B	F	D	N	C	050					
OTAKI GORGE ROAD	20E	SH 1N	2851744	07/04/2008	Mon	2130	DA	CS1	101A 101	C	M	D	DN	F		N	N	100					
1N/995/4.423	50S	WAITOHU VALLEY ROAD	2851090	29/02/2008	Fri	1720	FD	CS1CCC	181A		R	D	B	F		N	C	050					
1N/995/5.276	500N	WAERENGA ROAD	2850344	31/01/2008	Thu	1450	MA	CN1C	181A		R	D	B	F		N	C	050					
1N/995/7.22	30S	OTAKI GORGE ROAD	2850077	22/01/2008	Tue	0856	FD	CN1C	181A		R	D	B	F		N	L	100					
1N/995/4.173	200N	WAITOHU VALLEY ROAD	2851611	16/01/2008	Wed	1340	FD	4N1CC	181A		R	D	B	F		N	L	100					
1N/995/3.402	100S	TAYLORS ROAD	2714096	01/10/2007	Mon	0320	DB	CN1	134A 402A 800	GV	M	W	DN	L		N	C	100			1		
1N/995/7.19	I	OTAKI GORGE ROAD	2755838	30/09/2007	Sun	1800	KB	4N1C	176B 301B		R	W	O	H	T	S	C	100					
1N/995/3.282	20N	TAYLORS ROAD	2756427	30/09/2007	Sun	1500	FD	VN1CC	181A		R	D	O	F		N	L	100					
1N/995/4.559	I	TE MANUAO ROAD	2755386	22/09/2007	Sat	1400	KB	VN14	176B 302B 375B		R	D	B	F	T	G	C	050					
1N/995/5.608	150S	ARTHUR ST	2754155	25/07/2007	Wed	1240	JA	CN1C	308B 423B 922		R	D	O	F	D	N	C	050					
Z FCT MOBIL	50N	SH 1N/ARTHUR	2712907	13/07/2007	Fri	1900	MO	4N1C	103A 517A 512B	IP	R	D	DO	F		N	R	050			1		
1N/995/4.073	300N	WAITOHU VALLEY ROAD	2712441	18/06/2007	Mon	0810	BC	VN1C	121A 410A		E	D	B	F		N	L	100		2			
1N/995/6.973	350S	RIVERBANK ROAD	2751574	24/03/2007	Sat	0415	EA	TS1V	386A	Q	R	D	DF	F		N	L	100					
1N/995/6.423	200N	RIVERBANK ROAD	2711630	21/03/2007	Wed	2200	DA	VN1	410A	P	E	W	DO	L		N	C	070		1	1		
1N/995/4.383	10S	WAITOHU VALLEY ROAD	2711376	26/02/2007	Mon	0534	CB	CN1	410A	P	R	D	DO	F	T	N	C	050			1		
1N/995/7.19	I	OTAKI GORGE ROAD	2750533	11/02/2007	Sun	1445	LB	CS1C	303B 404B		R	D	B	F	T	N	C	100					
1N/995/4.363	10N	WAITOHU VALLEY ROAD	2711002	03/01/2007	Wed	1614	FD	CS1CC	331A 351A		R	D	B	F	T	N		050			1		
1N/995/3.602	300S	TAYLORS ROAD	2656712	27/12/2006	Wed	1639	FD	CS1C	112A 331A 337A		R	W	O	L		N	L	100					
WAERENGA ROAD	50W	SH 1N	2656320	02/12/2006	Sat	0400	DA	CE1	103A 111A	P	E	D	DO	F		N	C	050					
1N/995/3.502	200S	TAYLORS ROAD	2613427	19/11/2006	Sun	1140	DA	CN1C	372A 501A		E	D	O	F		N	L	100		2			
OTAKI GORGE ROAD	I	1N/995/7.19	2656653	18/11/2006	Sat	1910	MG	4W1V	512B		R	W	TN		T	G	C	100					
1N/995/4.373	I	WAITOHU VALLEY ROAD	2655032	14/10/2006	Sat	1507	CB	VN1	410A	P	R	D	O	F	T	N	L	050					
1N/995/4.529	30N	TE MANUAO ROAD	2655122	06/10/2006	Fri	1750	GB	4S1C	112A 158A 175B 929	F	R	D	B	F	D	N	P	050					
1N/995/4.579	20S	TE MANUAO ROAD	2653817	04/08/2006	Fri	1500	FD	CS14	359A		R	D	B	F	M	N	P	050					

NZ TRANSPORT AGENCY
WAKA KOTAHI

Coded Crash report, run on 24-06-2009, Page 2

First Street	Distance / DIR	Second street or landmark	Crash Number	Date DD/MM/YYYY	Day DDD	Time HHMM	MVMT	DVR VN 1 VVV 234	Factors and Roles (A is for vehicle 1, B is for veh 2 etc)	OBJECT	CURVE	WETNESS	LIGHT	WEATHER	JUNCTION	CONTROL	MARKS	SPD LMT	Total Inj FAT	SER	MIN	PED age	CYC age
1N/995/7.642	I	ADDINGTON ROAD	2652688	17/05/2006	Wed	0840	KB	CS14	125A 302B 382B		R	D	B	F	T	G	C	100					
1N/995/6.793	170S	RIVERBANK ROAD	2651809	19/04/2006	Wed	1315	GC	CS1C	145B 300B 372B 920		R	D	B	F	D	N	L	100					
1N/995/5.196	I	MILL ROAD	2650256	23/01/2006	Mon	2235	HA	CE2C	103A 205A 302A		R	D	DO	F	R	G	R	050					
Z DWAY SH 1N	130W	WAERENGA ROAD	2513697	13/12/2005	Tue	0855	QC	4S1	370A	NT	R	D	B	F		N	N	070		1			
1N/995/4.413	40S	WAITOHU VALLEY ROAD	2513320	27/11/2005	Sun	1745	LB	MS1C	303A 377A 151B 929		R	D	B	F	D	N	P	050			1		
Z FCT CALTEX OTAKI	A	SH 1N	2512385	21/07/2005	Thu	1220	DA	CE1C	504A 923	MX	R	D	B	F	D	N	C	050			1		
1N/995/4.423	50S	WAITOHU VALLEY ROAD	2553832	10/07/2005	Sun	1549	FD	VS1CV	331A 353A		R	D	B	F		N	C	050					
1N/995/6.693	70S	RIVERBANK ROAD	2553080	01/07/2005	Fri	0905	QG	VS1	660A	B	E	D	B	F		N	C	100					
1N/995/5.184	I	RAHUI ROAD	2552459	27/05/2005	Fri	1250	FB	CS1C	181A		R	D	O	F	R	G	R	050					
1N/995/3.502	200S	TAYLORS ROAD	2550971	02/03/2005	Wed	0625	DA	CS1	410A 504A	CF	E	D	TN	F		N	L	100					
1N/995/7.123	500S	RIVERBANK ROAD	2512574	11/02/2005	Fri	1927	BF	CN1C	137A 407A	G	M	W	TF	L		N	C	100			1		
1N/995/7.14	50N	OTAKI GORGE ROAD	2550154	26/01/2005	Wed	0830	DB	VN1	130A 410A	FJ	M	D	B	F		N	C	100					
WAERENGA ROAD	10W	SH 1N	2456177	12/12/2004	Sun	0920	GA	VW1C	331A 350A 930		R	D	B	F	D	N	C	050					
1N/995/6.465	150N	RIVERBANK ROAD	2413171	12/11/2004	Fri	2015	DA	CN1	129A 330A	P	E	D	B	F		N	C	070		1			
1N/995/4.233	140N	WAITOHU VALLEY ROAD	2410088	25/10/2004	Mon	2150	BF	CS1V	106A 120A 410A		E	D	DO	F		N	L	100	1	1			
1N/995/6.515	100N	RIVERBANK ROAD	2412918	18/10/2004	Mon	0445	EA	VN1V	129A 359A	HMF	R	W	DO	L		N	C	070			1		
1N/995/5.196	I	MILL ROAD	2455003	06/10/2004	Wed	2138	JA	CN1C	103B 302B 375B		R	D	DO	F	R	G	R	050					
1N/995/5.978	210S	WAERENGA ROAD	2454728	03/10/2004	Sun	0715	EE	CN1C	374B	M	R	D	B	F		N	P	070					
1N/995/3.402	100S	TAYLORS ROAD	2412772	29/08/2004	Sun	1425	CB	MN1	104A 330A	F	R	D	O	F		N	C	100			2		
1N/995/5.458	I	ARTHUR ST	2412593	12/08/2004	Thu	1400	FC	CW1CE	331A		R	D	O	F	X	G	X	050			1	74	
1N/995/5.184	I	RAHUI ROAD	2451815	06/05/2004	Thu	1200	FB	CS1C	101A 331A		R	D	B	F	R	G	R	050					
1N/995/5.768	I	WAERENGA ROAD	2451509	27/04/2004	Tue	1420	JA	VN1C	302B 375B 901		R	W	O	H	T	G	P	050					
1N/995/3.573	800N	WAITOHU VALLEY ROAD	2411952	02/04/2004	Fri	0910	DB	CS1	103A 332A	CF	E	W	O	L		N	L	100			1		
1N/995/6.677	40N	OTAKI RIV BR N	2412251	04/03/2004	Thu	2140	BC	CN1C	103A		M	D	DN	F		N	L	100		1	4		
1N/995/6.265	350N	RIVERBANK ROAD	2411110	17/01/2004	Sat	1020	MC	MN1C	151A 372B		E	D	B	F		N	P	070			2		

Collision Diagram - Otaki Stage A



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4.2 Stage B: Addington Road to Peka Peka

NZ TRANSPORT AGENCY
WAKA KOTAHI

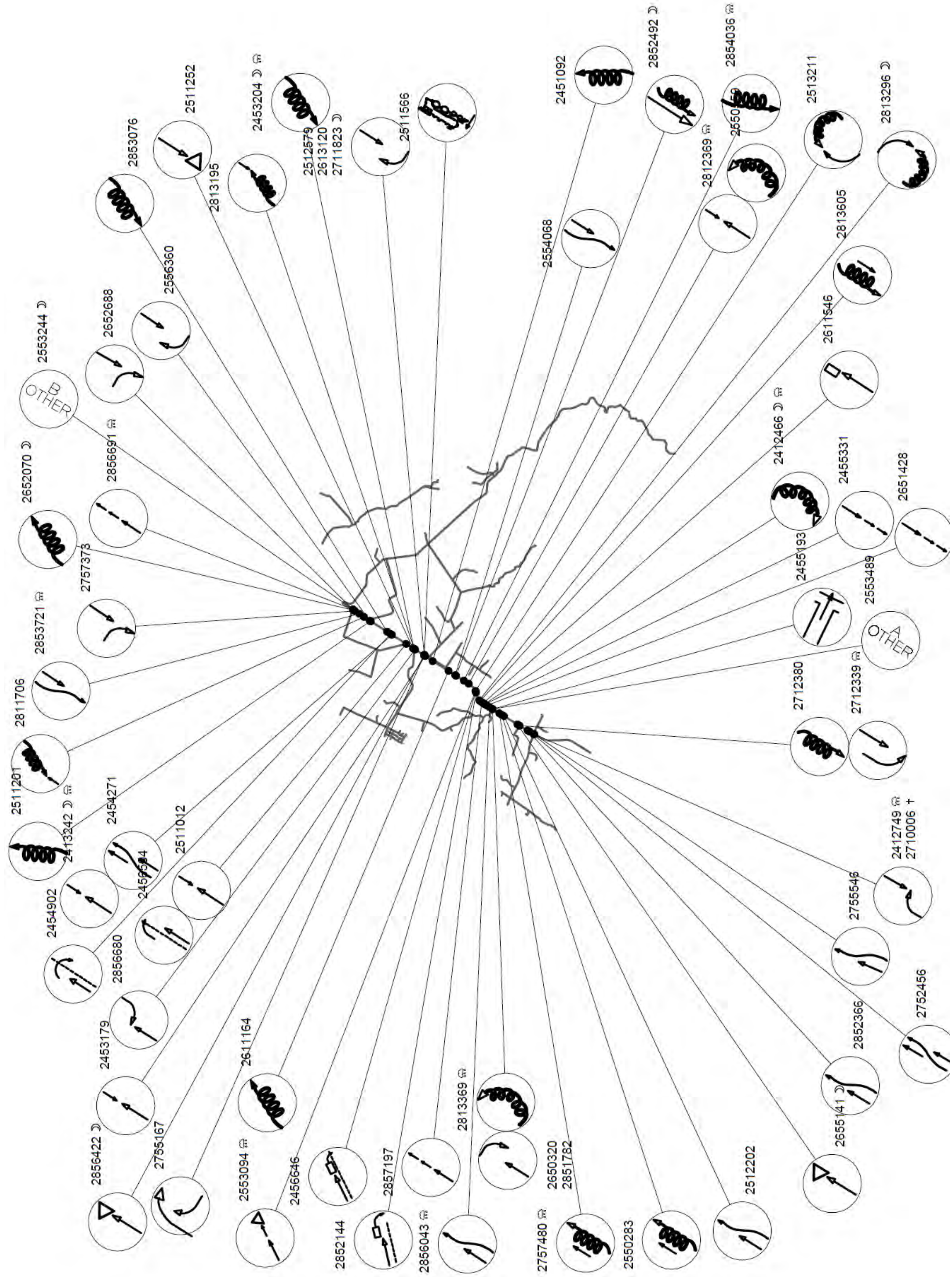
Stage B - Coded Crash Report (Date)
Coded Crash report, run on 24-06-2009, Page 1

First Street	DIR / Distance	Second street or landmark	Crash Number	Date DD/MM/YYYY	Day DDD	Time HHMM	MVT DIR / VN VVV (T 1 234)	Factors and Roles (A is for vehicle 1, B is for veh 2 etc)	OBJECT	CURVE	WETNES	LIGHT	WETHER	JUNCT	CONTRL	MARKS	SPDLMT	Total Inj FAT	SER	MIN	PED age	CYC age
1N/995/7.643	I	ADDINGTON ROAD	2856691	30/12/2008	Tue	1143	FD CN1C	331A 351A		R	W	O	L	T	N	C	100					
1N/995/13.734	500N	TE HAPUA ROAD	2857197	26/12/2008	Fri	1235	FD CN1CC	181A		R	D	B	F		N	C	100					
1N/995/10.446	I	TE HORO BEACH ROAD	2856680	26/12/2008	Fri	1114	LB MN1C	157A 158A 377A		R	D	B	F	T	G	P	080					
1N/995/13.674	560N	TE HAPUA ROAD	2813605	22/11/2008	Sat	1803	AD MS1C	104A 132A 156A		E	D	B	F		N	C	100		1			
1N/995/10.853	I	SCHOOL ROAD	2856422	18/11/2008	Tue	2300	EC TN1	911	W	R	D	DO	F	T	S	C	080					
1N/995/14.084	150N	TE HAPUA ROAD	2856043	06/11/2008	Thu	1821	AC TN1T	159A 381A 137B	G	R	W	O	L		N	C	100					
1N/995/14.234	I	TE HAPUA ROAD	2813369	01/11/2008	Sat	1340	DB CN1C	111A		R	W	O	L	T	S	C	100			1		
1N/995/13.634	600N	TE HAPUA ROAD	2813296	30/10/2008	Thu	2153	BF CN1C	101A 111A 514A		M	D	DN	F		N	C	100		2	1		
1N/995/10.406	40N	TE HORO BEACH ROAD	2813195	10/10/2008	Fri	1150	BE CN1C	500A		R	D	B	F		N	L	080			2		
1N/995/12.634	1600N	TE HAPUA ROAD	2854036	06/08/2008	Wed	1210	CB TS1	137A 197A	V	R	W	B	F		N	L	100					
1N/995/12.853	2000S	SCHOOL ROAD	2812369	27/06/2008	Fri	0800	BA CN1C	125A 150A		R	W	O	H		N	C	100			1		
1N/995/7.942	300S	ADDINGTON ROAD	2853721	07/06/2008	Sat	1025	AC CS1C	145A 372A 387B 927		R	W	O	L	D	N	L	100					
1N/995/15.777	300N	PEKA PEKA ROAD	2852366	22/05/2008	Thu	1555	AC CN1C	103A 381A		R	D	O	F		N	L	100					
1N/995/9.19	2000S	OTAKI GORGE ROAD	2853076	18/05/2008	Sun	1630	CC CS1	410A	F	R	D	B	F		N	L	100					
1N/995/12.293	1440S	SCHOOL ROAD	2852492	08/05/2008	Thu	2121	AF CS1C	197A 400A 632A 156B	V	R	D	DN	F		N	L	100					
1N/995/13.304	930N	TE HAPUA ROAD	2852144	26/04/2008	Sat	1035	GC CN1C	372B 929	G	E	D	B	F	D	N	C	100					
1N/995/14.234	I	TE HAPUA ROAD	2851782	25/04/2008	Fri	1200	JA CN1C	301B 382B		R	D	B	F	T	S	C	100					
1N/995/8.152	510S	ADDINGTON ROAD	2811706	27/03/2008	Thu	1615	BE CS1C	137A 331A 927		R	D	B	F	D	N	L	100		1	3		
1N/995/14.534	300S	TE HAPUA ROAD	2757480	25/12/2007	Tue	1755	AD CN1	135A 402A	G	R	W	O	L		N	L	100					
1N/995/7.742	100S	ADDINGTON ROAD	2757373	13/12/2007	Thu	1148	KB CS1C	308B 375B 929		R	D	O	F	D	N	L	100					
1N/1012/0	I	PEKA PEKA ROAD	2755546	12/09/2007	Wed	1643	AC CN1C	159A 173A		R	D	O	F	X	N	P	100					
1N/995/10.852	I	SCHOOL ROAD	2755167	28/08/2007	Tue	1725	JC CW2C	302A 360A 375A		R	D	B	F	T	G	P	100					
1N/995/15.429	I	TE KOWHAI ROAD	2712380	07/07/2007	Sat	1200	CA MS1	136A 610A		R	D	O	F	T	G	C	100			1		
1N/995/15.429	I	TE KOWHAI ROAD	2712339	21/06/2007	Thu	1104	GB TS1VC	145B 372B		R	W	O	H	T	G	L	100		4			
1N/995/10.852	I	SCHOOL ROAD	2711823	27/04/2007	Fri	1708	JA CS1C	302B 377B		R	D	TO	F	T	G	C	080			1		
1N/995/15.877	200N	PEKA PEKA ROAD	2752456	05/04/2007	Thu	1600	AA CN1C	372A	F	R	D	B	F		N	L	100					
1N/995/16.041	I	HADFIELD ROAD	2710006	16/01/2007	Tue	1620	LB 4S1CO	303B 532B	M	R	D	B	F	T	G	P	100	1		1		
1N/995/10.852	I	SCHOOL ROAD	2613120	06/10/2006	Fri	0918	JA CS1C	302B 377B		R	D	O	F	T	G	L	080			2		
1N/995/15.341	700N	HADFIELD ROAD	2655141	25/09/2006	Mon	2010	EC TN1	912	W	R	D	DN	F		N	L	100					
1N/995/7.642	I	ADDINGTON ROAD	2652688	17/05/2006	Wed	0840	KB CS14	125A 302B 382B		R	D	B	F	T	G	C	100					
1N/995/7.684	50S	ADDINGTON ROAD	2652070	06/05/2006	Sat	0416	CC VN1	101A 517A 524A		R	D	DN	F		N	C	100					
1N/995/13.814	420N	TE HAPUA ROAD	2611546	30/03/2006	Thu	1300	EA VN10	330A 443B 668B	M	E	D	B	F		N	L	100			1		
1N/995/13.974	260N	TE HAPUA ROAD	2651428	26/03/2006	Sun	0820	FD CS14	181A 378A 831		R	D	B	F		N	C	100					
1N/995/11.953	1100S	SCHOOL ROAD	2611164	22/02/2006	Wed	0918	CC CN1	125A 504A	F	R	D	B	F		N	L	100			1		
1N/995/14.226	I	TE HAPUA ROAD	2650320	04/02/2006	Sat	1315	JA CN1C	301B 375B		R	D	B	F	T	S	L	100					
1N/995/8.403	I	OLD HAUTERE ROAD	2556360	18/11/2005	Fri	1235	JA CS1V	303B 375B		R	D	B	F	T	N	L	100					
1N/995/13.234	1000N	TE HAPUA ROAD	2513211	08/11/2005	Tue	1400	BF VS14	137A 170A 410A		E	D	B	F		N	C	100		1	1		

NZ TRANSPORT AGENCY
WAKA KOTAHI

Stage B - Coded Crash Report (Date)
Coded Crash report, run on 24-06-2009, Page 2

First Street	DIR / Distance	Second street or landmark	Crash Number	Date DD/MM/YYYY	Day DDD	Time HHMM	MVT DIR / VN VVV (T 1 234)	Factors and Roles (A is for vehicle 1, B is for veh 2 etc)	OBJECT	CURVE	WETNES	LIGHT	WETHER	JUNCT	CONTRL	MARKS	SPDLMT	Total Inj FAT	SER	MIN	PED age	CYC age
1N/995/10.844	I	SCHOOL ROAD	2512579	03/08/2005	Wed	0753	JA VS1C	302B 360B 377B		R	D	B	F	T	G	P	100			1		
1N/995/13.234	1000N	TE HAPUA ROAD	2553094	22/06/2005	Wed	1020	FF VN1C	181A		R	W	O	F		N	C	100					
1N/995/12.253	1400S	SCHOOL ROAD	2554068	22/06/2005	Wed	1000	AC CS1T	381A 386A		R	D	O	F		N	L	100					
1N/995/14.234	I	TE HAPUA ROAD	2553489	18/06/2005	Sat	1125	AO CS1C	156A 157A		R	D	O	F	T	S	P	100					
1N/995/8.453	50S	OLD HAUTERE ROAD	2553244	09/06/2005	Thu	2025	BO CS1C	120A 197B	P	R	D	DN	F		N	L	100					
1N/995/12.853	2000S	SCHOOL ROAD	2550559	03/03/2005	Thu	1722	DB CN1	136A 622A	F	E	D	O	F		N	C	100					
1N/995/14.726	500S	TE HAPUA ROAD	2512202	27/02/2005	Sun	0724	AC CN1T	103A 159A 386A 532B		R	D	O	F		N	C	100		1			
1N/995/10.344	500N	SCHOOL ROAD	2511252	26/02/2005	Sat	1059	EC CS1	158A 178A 357A	V	R	D	B	F		N	C	080		2			
SCHOOL ROAD	20E	SH 1N	2511566	26/02/2005	Sat	1004	QC CW1	300A 326A	NP	R	D	B	F		T	N	080		2			
1N/995/8.438	2000N	TE HORO BEACH ROAD	2511201	17/02/2005	Thu	1730	CB MN1	130A 682A		R	D	O	F		N	C	100			1		
1N/995/14.626	400S	TE HAPUA ROAD	2550283	31/01/2005	Mon	0900	AD CN1T	150A 386A		R	D	B	F		N	L	100					
1N/995/10.043	I	TE WAKA ROAD	2511012	09/01/2005	Sun	1245	BA CN1CC	125A 410A		R	D	B	F	X	N	C	100		1	1		
1N/995/10.043	I	TE WAKA ROAD	2456504	24/12/2004	Fri	0915	GE CN1C	155A 160A 929		R	D	B	F	D	G	L	100					
1N/995/9.403	1000S	OLD HAUTERE ROAD	2413242	29/11/2004	Mon	0600	BA CN1V	412A		R	W	TN	L		N	L	100		1	1		
1N/995/13.253	2400S	SCHOOL ROAD	2456646	16/11/2004	Tue	1350	GD CN1C	333A 370A 929		E	D	B	F	D	N	C	100					
1N/995/13.884	350N	TE HAPUA ROAD	2455331	30/10/2004	Sat	1650	FD CS1V	331A 353A		R	D	B	F		N	C	100					
1N/995/14.234	I	TE HAPUA ROAD	2455193	19/10/2004	Tue	0815	DC CE2	335A 354A	C	R	D	B	F	T	G	C	100					
1N/995/16.033	I	HADFIELD ROAD	2412749	16/09/2004	Thu	1541	LB TS1V	692A 303B 387B		R	W	O	F	T	G	R	100		1	2		
1N/995/9.403	1000S	OLD HAUTERE ROAD	2454271	11/09/2004	Sat	1915	AA CN1C	372B		R	D	O	F		N	P	100					
1N/995/9.343	700N	TE WAKA ROAD	2454902	14/08/2004	Sat	1345	MC CN1V	372B		R	D	O	F		N	L	100					
1N/995/10.388	50N	TE HORO BEACH ROAD	2453204	15/07/2004	Thu	0240	CC CS1	112A	F	R	W	DO	L		N	C	100					
1N/995/10.903	50S	SCHOOL ROAD	2453179	04/07/2004	Sun	1230	BA VN1C	129A 370A 927		R	D	B	F	D	N	P	080					
1N/995/13.864	370N	TE HAPUA ROAD	2412466	02/04/2004	Fri	0335	DA VS1	359A	EFV	E	W	DN	L		N	C	100		2			
1N/995/11.253	400S	SCHOOL ROAD	2451092	17/03/2004	Wed	1800	CB CN1	410A	FV	R	D	O	F		N	L	100					



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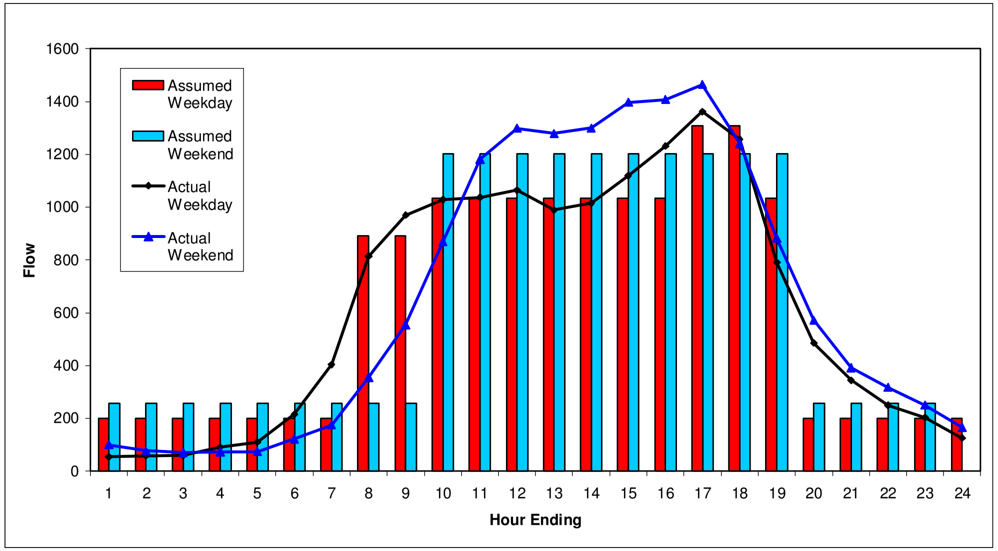
5 Addendum E – Annualisation Factors

5.1 Stage A: North of Otaki to Addingon / Otaki Gorge Road

Otaki Stage A 01N00998 - Economic Flow Profile April 2009

5 Day ADT			Weekend		
Time	Actual Weekday	Assumed Weekday	Time	Actual Weekend	Assumed Weekend
01:00	**54**	200	01:00	**100**	257
02:00	**58**	200	02:00	**77**	257
03:00	**59**	200	03:00	**71**	257
04:00	**90**	200	04:00	**73**	257
05:00	**110**	200	05:00	**74**	257
06:00	**214**	200	06:00	**122**	257
07:00	**404**	200	07:00	**175**	257
08:00	**815**	893	08:00	**355**	257
09:00	**970**	893	09:00	**554**	257
10:00	**1028**	1,034	10:00	**871**	257
11:00	**1037**	1,034	11:00	**1181**	1,202
12:00	**1064**	1,034	12:00	**1298**	1,202
13:00	**989**	1,034	13:00	**1279**	1,202
14:00	**1015**	1,034	14:00	**1299**	1,202
15:00	**1119**	1,034	15:00	**1397**	1,202
16:00	**1231**	1,034	16:00	**1407**	1,202
17:00	**1361**	1,309	17:00	**1464**	1,202
18:00	**1257**	1,309	18:00	**1240**	1,202
19:00	**791**	1,034	19:00	**882**	1,202
20:00	**485**	200	20:00	**572**	1,202
21:00	**344**	200	21:00	**391**	257
22:00	**249**	200	22:00	**317**	257
23:00	**204**	200	23:00	**250**	257
00:00	**126**	200	00:00	**166**	257
Total	15,074	15,074	Total	15,615	15,615



Economic Hour Summary

	Hours	Volume	veh/hr
AM Peak	2	1,785	893
Inter Peak	8	8,274	1034
PM Peak	2	2,618	1309
Off Peak	12	2,397	200
Weekend 10 - 20	10	12,019	1202
Weekend 20 - 10	14	3,596	257

Off Peak Proportion of the Inter Peak

Interpeak	8	8,274	1034
Offpeak	12	2,397	200
% of interpeak	12		19.3%

Weekend Proportion of the Inter Peak

Inter Peak	8	8274	1034
Weekend 10 - 20	10	12019	1202
% of interpeak	10		116.2%

Weekend Off Peak Proportion of the Inter Peak

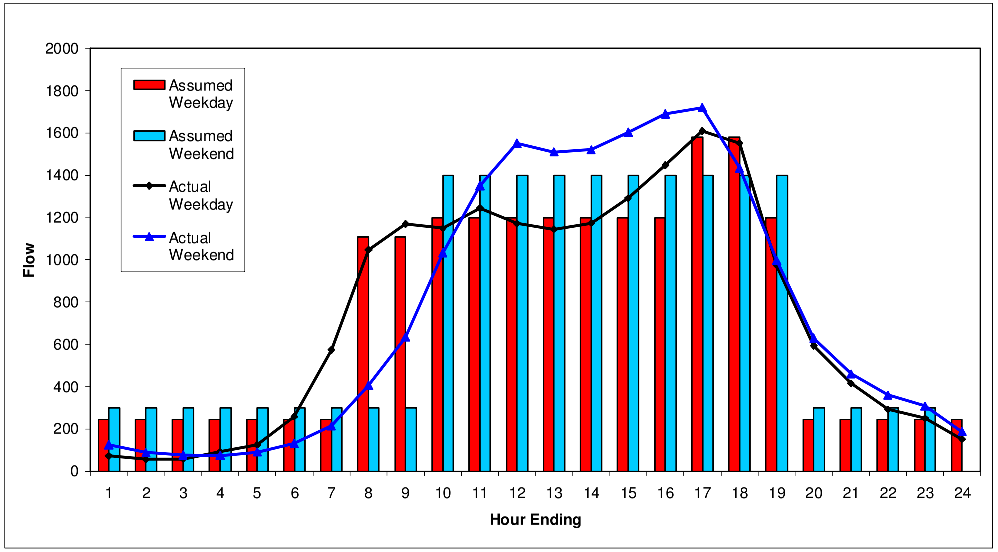
Interpeak	8	8,274	1034
Weekend 20 - 10	14	3,596	257
% of interpeak	14		24.8%

C:\Work\Otaki Bypass\Kapiti SH1 Strategy - Otaki Economics\[2008 traffic data Ohau.xls]Summary Sunday

5.2 Stage B: Addington Road to Peka Peka

Otaki Stage B 01N01011 - Economic Flow Profile April 2009

5 Day ADT			Weekend		
Time	Actual Weekday	Assumed Weekday	Time	Actual Weekend	Assumed Weekend
01:00	72	245	01:00	125	299
02:00	56	245	02:00	88	299
03:00	59	245	03:00	76	299
04:00	92	245	04:00	74	299
05:00	125	245	05:00	90	299
06:00	259	245	06:00	131	299
07:00	575	245	07:00	214	299
08:00	1047	1,109	08:00	407	299
09:00	1170	1,109	09:00	633	299
10:00	1150	1,200	10:00	1034	299
11:00	1244	1,200	11:00	1351	1,401
12:00	1172	1,200	12:00	1551	1,401
13:00	1144	1,200	13:00	1511	1,401
14:00	1174	1,200	14:00	1521	1,401
15:00	1292	1,200	15:00	1604	1,401
16:00	1448	1,200	16:00	1690	1,401
17:00	1610	1,582	17:00	1721	1,401
18:00	1553	1,582	18:00	1434	1,401
19:00	974	1,200	19:00	997	1,401
20:00	594	245	20:00	630	1,401
21:00	416	245	21:00	460	299
22:00	292	245	22:00	360	299
23:00	250	245	23:00	308	299
00:00	152	245	00:00	187	299
Total	17,920	17,920	Total	18,197	18,197



Economic Hour Summary

	Hours	Volume	veh/hr
AM Peak	2	2,217	1109
Inter Peak	8	9,598	1200
PM Peak	2	3,163	1582
Off Peak	12	2,942	245
Weekend 10 - 20	10	14,010	1401
Weekend 20 - 10	14	4,187	299

Off Peak Proportion of the Inter Peak

Interpeak	8	9,598	1200
Offpeak	12	2,942	245
% of interpeak	12		20.4%

Weekend Proportion of the Inter Peak

Inter Peak	8	9598	1200
Weekend 10 - 20	10	14010	1401
% of interpeak	10		116.8%

Weekend Off Peak Proportion of the Inter Peak

Interpeak	8	9,598	1200
Weekend 20 - 10	14	4,187	299
% of interpeak	14		24.9%

C:\Work\Otaki Bypass\Kapiti SH1 Strategy - Otaki Economics\[2008 traffic data Ohau.xls]Summary Sunday

6 Addendum F – BCR and FYRR Results

6.1 Stage A: North of Otaki to Addingon / Otaki Gorge Road

COST-BENEFIT ANALYSIS

WORKSHEET 3

1. Project Options	Do Minimum	Option 1 - Expressway	Option 1 - Expressway
DISCOUNTED COSTS:			Net Costs of the Project Options ($)
2. Construction Costs	$0.00	$71,779,154.86	$71,779,154.86
3. Maintenance Costs	$0.00	$0.00	$0.00
4. Design Costs (7% of Construction)	$0.00	$0.00	$0.00
5. Total Costs (2) to (4)	**$0.00**	**$71,779,154.86**	**$71,779,154.86**
DISCOUNTED BENEFITS:			Net Benefits of the Project Options ($)
6. Travel Time Costs	$85,464,919.03	$47,492,610.69	$37,972,308.34
7. Vehicle Operating Costs	$63,031,503.77	$74,318,275.69	-$11,286,771.92
8. Accident Costs	$23,790,398.66	$5,726,325.56	$18,064,073.10
9. Seal Ext. / Passing Lane			$0.00
10. Carbon Dioxide (4% of VOC)	$2,521,260.15	$2,972,731.03	-$451,470.88
11. Total Benefits (6) to (10)	**$174,808,081.61**	**$130,509,942.96**	**$44,298,138.65**
12. B/C Ratio (11) / (5)			0.6

FIRST YEAR RATE OF RETURN

WORKSHEET 5

1	Preferred Project Option	Option 1 - Expressway
2	Present Value of Total Net Costs	71,779,155
3	Mid Point of First Year of Benefits (Relative to Time Zero)	7.50
4	Discount Factor (SPPWF) for First Year of Benefits	0.5615

	Net Annual Benefit (at Time Zero) (5)	Growth Rate (as a decimal) (6)	PV of Benefits in First Year (1.0 + (3)*(6))*(4)*(5) (7)
Travel Time Savings			$2,935,566.12
Vehicle Operating Costs			-$900,045.35
Accident Costs			$1,486,826.31
Seal Extn Benefits			$0.00
Passing Lane Benefits			$0.00
Carbon Dioxide (@ 4% of VOC)			-$36,001.81
Other Monetised Factors			$0.00
9 Present Value of Tangible Benefits in First Year			$3,486,345.26

10 First Year Rate of Return (9)/(2)	5%

6.2 Stage B: Addington Road to Peka Peka

Page 1

COST-BENEFIT ANALYSIS **WORKSHEET 3**

	Do Minimum	Option 1 - Expressway	Option 1 - Expressway
1. Project Options			
DISCOUNTED COSTS:			Net Costs of the Project Options ($)
2. Construction Costs	$0.00	$75,197,209.86	$75,197,209.86
3. Maintenance Costs	$0.00	$0.00	$0.00
4. Design Costs (7% of Construction)	$0.00	$0.00	$0.00
5. Total Costs (2) to (4)	**$0.00**	**$75,197,209.86**	**$75,197,209.86**
DISCOUNTED BENEFITS:			Net Benefits of the Project Options ($)
6. Travel Time Costs	$132,726,566.15	$108,931,109.50	$23,795,456.65
7. Vehicle Operating Costs	$156,304,591.15	$170,291,376.66	-$13,986,785.51
8. Accident Costs	$72,366,783.41	$16,926,763.74	$55,440,019.67
9. Seal Ext. / Passing Lane			$0.00
10. Carbon Dioxide (4% of VOC)	$6,252,183.65	$6,811,655.07	-$559,471.42
11. Total Benefits (6) to (10)	**$367,650,124.36**	**$302,960,904.97**	**$64,689,219.39**
12. B/C Ratio (11) / (5)			0.9

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FIRST YEAR RATE OF RETURN

WORKSHEET 5

1	Preferred Project Option	Option 1 - Expressway
2	Present Value of Total Net Costs	75,197,210
3	Mid Point of First Year of Benefits (Relative to Time Zero)	7.50
4	Discount Factor (SPPWF) for First Year of Benefits	0.5615

	Net Annual Benefit (at Time Zero) (5)	Growth Rate (as a decimal) (6)	PV of Benefits in First Year (1.0 + (3)*(6))*(4)*(5) (7)
Travel Time Savings			$1,742,813.56
Vehicle Operating Costs			-$1,058,039.60
Accident Costs			$4,563,183.46
Seal Extn Benefits			$0.00
Passing Lane Benefits			$0.00
Carbon Dioxide (@ 4% of VOC)			-$42,321.58
Other Monetised Factors			$0.00
9 Present Value of Tangible Benefits in First Year			$5,205,635.84

10 First Year Rate of Return (9)/(2)	7%

6.3 Stages A & B: North of Otaki to Peka Peka

Page 1

COST-BENEFIT ANALYSIS **WORKSHEET 3**

	Do Minimum	Option 1 - Expressway	Option 1 - Expressway
1. Project Options	**Do Minimum**	**Option 1 - Expressway**	**Option 1 - Expressway**
DISCOUNTED COSTS:			Net Costs of the Project Options ($)
2. Construction Costs	$0.00	$146,976,364.72	$146,976,364.72
3. Maintenance Costs	$0.00	$0.00	$0.00
4. Design Costs (7% of Construction)	$0.00	$0.00	$0.00
5. Total Costs (2) to (4)	**$0.00**	**$146,976,364.72**	**$146,976,364.72**
DISCOUNTED BENEFITS:			Net Benefits of the Project Options ($)
6. Travel Time Costs	$218,191,485.18	$156,423,720.19	$61,767,764.99
7. Vehicle Operating Costs	$219,336,094.92	$244,609,652.35	-$25,273,557.42
8. Accident Costs	$96,157,182.07	$22,653,089.30	$73,504,092.77
9. Seal Ext. / Passing Lane			$0.00
10. Carbon Dioxide (4% of VOC)	$8,773,443.80	$9,784,386.09	-$1,010,942.30
11. Total Benefits (6) to (10)	**$542,458,205.97**	**$433,470,847.93**	**$108,987,358.04**
12. B/C Ratio (11) / (5)			0.7

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FIRST YEAR RATE OF RETURN

WORKSHEET 5

1	Preferred Project Option	Option 1 - Expressway
2	Present Value of Total Net Costs	146,976,365
3	Mid Point of First Year of Benefits (Relative to Time Zero)	7.50
4	Discount Factor (SPPWF) for First Year of Benefits	0.5615

	Net Annual Benefit (at Time Zero) (5)	Growth Rate (as a decimal) (6)	PV of Benefits in First Year (1.0 + (3)*(6))*(4)*(5) (7)
Travel Time Savings			$4,678,379.68
Vehicle Operating Costs			-$1,958,084.95
Accident Costs			$6,050,009.77
Seal Extn Benefits			$0.00
Passing Lane Benefits			$0.00
Carbon Dioxide (@ 4% of VOC)			-$78,323.40
Other Monetised Factors			$0.00
9 Present Value of Tangible Benefits in First Year			$8,691,981.10

10 First Year Rate of Return (9)/(2)	6%

Appendix D

Network Summary Statistics

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Date: August 2009
Reference: 5C1333.02

Level	Performance Measure	Units	2006 - Based			Do Minimum			Option 1 Upgrade the Existing SH1 Alignment			Option 2 Expressway Follows WLR Designation			Option 3 Expressway Follows Rail Corridor			Option 4 Expressway Avoids Future Town Centres		
	Forecast year 2016		AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
Network	Network average travel speed	kms/hr	53.1	53.2	50.0	42.8	45.5	38.8	54.2	51.1	47.4	53.4	51.5	48.7	53.4	50.3	47.6	51.5	50.8	46.7
	Total trips assigned	pcus	8437	9114	10909	12089	12604	15948	12089	12604	15948	12089	12604	15948	12089	12604	15948	12089	12604	15948
	total vehicle distance	pcu-kms	46049.4	42105.8	53888.6	65557.7	60237.5	78531.8	66934.4	60957.5	80022.9	68414.4	61614.5	81522.7	66478.3	60312.8	79677.6	67228.9	61855.4	81232.0
	total travel time	pcu-hrs	867.1	790.9	1077.8	1533.3	1323.8	2024.0	1235.2	1191.8	1687.5	1281.6	1196.8	1673.1	1244.3	1198.7	1675.3	1306.0	1218.3	1738.8
	total delayed time	pcu-hrs	35.7	25.7	59.0	88.0	56.9	107.8	17.6	11.1	24.4	25.8	18.2	34.3	16.3	10.8	24.4	16.4	8.1	17.5
	total queued time	pcu-hrs	109.7	99.0	158.0	394.6	287.8	612.3	154.2	174.2	339.4	198.9	198.1	338.3	150.2	174.7	313.6	236.1	202.4	387.8
Intersections	Overall volume/capacity ratios (worst turning movement)	node no.																		
	1 SH1/Poplar Avenue	1002	101%	50%	68%	126%	101%	97%	61%	49%	77%	69%	39%	44%	58%	47%	70%	59%	46%	82%
	2 SH1/Raumati Road	1021	96%	81%	82%	120%	107%	102%	11%	13%	16%	61%	70%	55%	11%	12%	15%	12%	12%	18%
	3 SH1/Ihakara Street	1023	73%	78%	76%	110%	106%	102%				67%	79%	47%						
	4 SH1/Kapiti Road	1037	105%	103%	104%	113%	112%	118%	39%	39%	38%	84%	104%	104%	35%	35%	33%	52%	41%	45%
	5 SH1/Otaihanga Road	2002	60%	44%	67%	116%	112%	135%				83%	64%	80%				107%	92%	106%
	6 SH1/Te Moana Road	2008	69%	46%	88%	97%	58%	111%				40%	49%	104%				41%	29%	41%
	7 SH1/Elizabeth Street	2009	86%	74%	73%	74%	91%	81%				61%	83%	83%				62%	64%	87%
	8 Kapiti Road/Rimu Road	1038	55%	76%	101%	80%	101%	100%	91%	101%	102%	81%	100%	101%	89%	102%	102%	100%	102%	104%
	9 Kapiti Road/Arawhata Road	1043	61%	77%	91%	102%	103%	109%	82%	90%	102%	101%	103%	106%	73%	89%	104%	76%	89%	104%
	10 Kapiti Road/Te Roto Dr	1061	39%	61%	85%	60%	88%	100%	82%	91%	106%	64%	81%	101%	68%	91%	101%	78%	92%	102%
	11 Kapiti Road/Airport accesses (Aerodrome)	8061				57%	64%	71%	54%	59%	81%	53%	63%	72%	56%	58%	77%	52%	59%	82%
	12 Kapiti Road/Airport accesses (Langdale)	1067				50%	56%	58%	51%	62%	82%	44%	75%	94%	42%	39%	85%	47%	43%	85%
	13 Kapiti Road/Airport accesses (Hurley)	1078				9%	13%	40%	8%	8%	12%	9%	13%	19%	8%	9%	11%	9%	9%	12%
	14 WLR/Poplar Avenue	8070							31%	24%	38%	39%	24%	49%	30%	22%	34%	27%	21%	37%
	15 WLR/Raumati Road (S)	4001							71%	76%	102%				71%	80%	102%	69%	76%	102%
	16 WLR/Raumati Road (N)	9502							96%	99%	104%				93%	94%	104%	88%	100%	104%
	17 WLR/Ihakara street (T-Signal)	5101							38%	43%	85%				38%	41%	82%	31%	41%	83%
	18 WLR/Ihakara street (Roundabout)	9520							9%	15%	30%				8%	14%	30%	8%	15%	31%
	19 WLR/Kapiti Road	4002							62%	79%	94%				59%	76%	95%	57%	77%	97%
	20 WLR/Te Roto	5104																		
	21 WLR/Mazengarb Road	4003																		
	22 WLR/Otaihanga Road	4004										86%	40%	64%				112%	103%	117%
	23 WLR/Te Moana Road	4005																		
	24 WLR/SH1 (Peka Peka)	2073										37%	32%	52%				39%	27%	43%
	25 Expressway/Poplar Avenue	1002							34%	27%	44%				33%	26%	41%	32%	26%	45%
	26 Expressway/Otaihanga Road	2002							58%	40%	59%				29%	21%	33%			
	27 Expressway/Te Moana	3022							91%	67%	90%				91%	67%	90%			
	28 Expressway/Elizabeth	2009							20%	21%	25%				20%	21%	27%			
	29 Rimu Road/Ihakara Road	1022	21%	30%	32%	42%	94%	101%	41%	49%	68%	58%	60%	85%	41%	51%	83%	42%	48%	85%
	30 Rimu Road/Raumati Road	1020	21%	52%	104%	21%	33%	100%	28%	26%	41%	24%	27%	72%	28%	26%	41%	27%	26%	46%
	31 Mazengarb Road/Guildford	2000	20%	12%	19%	32%	20%	24%	33%	24%	34%	34%	21%	30%	35%	24%	46%	33%	24%	34%
Intersections	Overall volume/capacity ratios (intersection average VC ratio)	node no.																		
	1 SH1/Poplar Avenue	1002	30%	26%	38%	31%	28%	37%	36%	28%	37%	39%	30%	41%	34%	27%	35%	33%	26%	37%
	2 SH1/Raumati Road	1021	25%	23%	32%	33%	27%	37%	8%	10%	12%	19%	20%	24%	8%	10%	11%	9%	10%	12%
	3 SH1/Ihakara Street	1023	30%	28%	39%	46%	39%	40%				22%	27%	28%						
	4 SH1/Kapiti Road	1037	64%	60%	67%	101%	81%	86%	38%	39%	38%	61%	59%	58%	32%	33%	31%	46%	40%	44%
	5 SH1/Otaihanga Road	2002	46%	37%	50%	78%	62%	81%				44%	38%	50%				43%	33%	45%
	6 SH1/Te Moana Road	2008	27%	25%	30%	43%	37%	45%				33%	26%	31%				32%	25%	31%
	7 SH1/Elizabeth Street	2009	51%	51%	55%	66%	61%	69%	21%	19%	23%	45%	44%	48%	23%	20%	25%	45%	40%	42%
	8 Kapiti Road/Rimu Road	1038	50%	76%	87%	43%	47%	51%	47%	47%	44%	44%	38%	40%	40%	42%	36%	48%	48%	46%
	9 Kapiti Road/Arawhata Road	1043	28%	36%	42%	94%	92%	103%	70%	76%	89%	82%	82%	100%	66%	74%	84%	69%	74%	81%
	10 Kapiti Road/Te Roto Dr	1061	21%	29%	34%	34%	40%	40%	39%	44%	55%	34%	39%	48%	36%	43%	51%	38%	44%	54%
	11 Kapiti Road/Airport accesses (Aerodrome)	8061				32%	39%	47%	30%	38%	55%	29%	35%	46%	29%	36%	53%	31%	37%	55%
	12 Kapiti Road/Airport accesses (Langdale)	1067				28%	35%	41%	28%	37%	60%	28%	33%	45%	26%	28%	58%	29%	33%	59%
	13 Kapiti Road/Airport accesses (Hurley)	1078				7%	9%	15%	5%	6%	9%	6%	9%	12%	5%	6%	8%	6%	6%	8%
	14 WLR/Poplar Avenue	8070							28%	23%	39%	34%	22%	39%	27%	22%	36%	25%	21%	37%
	15 WLR/Raumati Road (S)	4001							35%	36%	51%				35%	37%	51%	34%	36%	51%
	16 WLR/Raumati Road (N)	9502							38%	38%	50%				37%	37%	50%	35%	36%	49%
	17 WLR/Ihakara street (T-Signal)	5101							34%	33%	72%				34%	32%	67%	30%	31%	71%
	18 WLR/Ihakara street (Roundabout)	9520							6%	10%	25%				6%	10%	24%	6%	10%	25%
	19 WLR/Kapiti Road	4002							39%	44%	57%				36%	42%	55%	39%	42%	57%
	20 WLR/Te Roto	5104																		
	21 WLR/Mazengarb Road	4003																		
	22 WLR/Otaihanga Road	4004										29%	21%	33%				39%	33%	38%
	23 WLR/Te Moana Road	4005																		
	24 WLR/SH1 (Peka Peka)	2073										39%	32%	44%				25%	21%	27%
	25 Expressway/Poplar Avenue	1002							34%	27%	36%				33%	26%	34%	30%	25%	35%
	26 Expressway/Otaihanga Road	2002							32%	26%	36%				22%	15%	21%			
	27 Expressway/Te Moana	3022							34%	24%	32%				34%	24%	29%			
	28 Expressway/Elizabeth	2009							21%	19%	23%				23%	20%	25%			
	29 Rimu Road/Ihakara Road	1022	18%	27%	24%	43%	76%	96%	27%	45%	75%	40%	55%	77%	27%	47%	78%	28%	44%	81%
	30 Rimu Road/Raumati Road	1020	16%	19%	27%	22%	32%	91%	19%	26%	39%	21%	27%	62%	19%	28%	38%	21%	27%	41%
	31 Mazengarb Road/Guildford	2000	18%	12%	16%	25%	17%	25%	28%	20%	34%	27%	18%	29%	30%	21%	42%	28%	20%	33%

Prepared by: Bob Hu
Reviewed by: Roger Burra
11/08/2009

Forecast year 2026			2006 - Based			Do Minimum			Option 1 Upgrade the Existing SH1 Alignment			Option 2 Expressway Follows WLR Designation			Option 3 Expressway Follows Rail Corridor			Option 4 Expressway Avoids Future Town Centres		
Level	Performance Measure	Units	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
Network	Network average travel speed	kms/hr	53.1	53.2	50.0	39.2	41.0	33.4	52.0	50.0	45.9	52.3	50.9	47.2	51.9	49.3	45.2	47.0	49.1	43.7
	Total trips assigned	pcus	8437	9114	10909	13141	13814	17298	13141	13814	17298	13141	13814	17298	13141	13814	17298	13141	13814	17298
	total vehicle distance	pcu-kms	46049.4	42105.8	53888.6	71494.0	65298.5	84137.5	73352.6	67607.4	88284.2	74397.1	68128.5	89560.3	72862.7	66978.0	87556.9	72699.4	68447.8	89087.6
	total travel time	pcu-hrs	867.1	790.9	1077.8	1825.5	1593.1	2516.4	1409.9	1351.7	1924.9	1423.4	1337.5	1898.8	1403.2	1358.1	1938.5	1545.5	1394.4	2038.0
	total delayed time	pcu-hrs	35.7	25.7	59.0	109.8	71.1	126.9	23.9	14.1	32.7	38.7	24.2	47.7	21.1	13.9	31.8	19.8	11.4	24.2
	total queued time	pcu-hrs	109.7	99.0	158.0	560.5	457.5	979.0	221.4	220.2	427.1	242.8	231.8	425.1	203.2	216.7	433.0	391.0	264.2	550.1
Intersections	Overall volume/capacity ratios (worst turning movement)	node no.																		
	1 SH1/Poplar Avenue	1002	101%	50%	68%	130%	104%	103%	65%	51%	79%	51%	38%	54%	63%	50%	71%	67%	54%	86%
	2 SH1/Raumati Road	1021	96%	81%	82%	123%	108%	108%	11%	13%	17%	102%	94%	84%	11%	13%	15%	13%	14%	18%
	3 SH1/Ihakara Street	1023	73%	78%	76%	114%	104%	107%				85%	89%	69%						
	4 SH1/Kapiti Road	1037	105%	103%	104%	117%	109%	121%	47%	42%	46%	100%	104%	105%	41%	40%	43%	54%	47%	53%
	5 SH1/Otaihanga Road	2002	60%	44%	67%	123%	116%	163%				103%	84%	97%				109%	104%	114%
	6 SH1/Te Moana Road	2008	69%	46%	88%	64%	55%	68%				48%	57%	109%				45%	35%	47%
	7 SH1/Elizabeth Street	2009	86%	74%	73%	84%	80%	83%				71%	100%	95%				70%	73%	62%
	8 Kapiti Road/Rimu Road	1038	55%	76%	101%	82%	100%	109%	100%	103%	104%	98%	100%	101%	100%	103%	103%	102%	104%	104%
	9 Kapiti Road/Arawhata Road	1043	61%	77%	91%	103%	104%	110%	83%	100%	105%	101%	103%	108%	78%	99%	106%	76%	95%	105%
	10 Kapiti Road/Te Roto Dr	1061	39%	61%	85%	64%	86%	96%	87%	94%	104%	68%	87%	101%	76%	94%	102%	82%	92%	103%
	11 Kapiti Road/Airport accesses (Aerodrome)	8061				53%	61%	82%	52%	60%	95%	50%	62%	72%	52%	59%	83%	50%	60%	93%
	12 Kapiti Road/Airport accesses (Langdale)	1067				49%	50%	49%	51%	60%	101%	35%	82%	95%	47%	46%	100%	48%	60%	100%
	13 Kapiti Road/Airport accesses (Hurley)	1078				10%	13%	31%	9%	9%	14%	10%	14%	22%	8%	9%	13%	9%	9%	15%
	14 WLR/Poplar Avenue	8070							35%	25%	39%	13%	10%	18%	33%	24%	41%	30%	23%	39%
	15 WLR/Raumati Road (S)	4001							78%	83%	102%				75%	82%	103%	71%	81%	102%
	16 WLR/Raumati Road (N)	9502							99%	101%	104%				96%	100%	104%	95%	101%	104%
	17 WLR/Ihakara street (T-Signal)	5101							40%	48%	89%				40%	47%	92%	33%	46%	93%
	18 WLR/Ihakara street (Roundabout)	9520							9%	17%	34%				9%	17%	35%	8%	16%	31%
	19 WLR/Kapiti Road	4002							70%	80%	99%				66%	78%	100%	63%	79%	97%
	20 WLR/Te Roto	5104																		
	21 WLR/Mazengarb Road	4003																		
	22 WLR/Otaihanga Road	4004										102%	55%	84%				125%	111%	117%
	23 WLR/Te Moana Road	4005																		
	24 WLR/SH1 (Peka Peka)	2073										44%	31%	34%				43%	31%	49%
	25 Expressway/Poplar Avenue	1002							37%	28%	45%				37%	27%	44%	34%	28%	46%
	26 Expressway/Otaihanga Road	2002							65%	46%	66%				33%	24%	37%			
	27 Expressway/Te Moana	3022							103%	99%	104%				102%	95%	97%			
	28 Expressway/Elizabeth	2009							22%	22%	29%				23%	23%	31%			
	29 Rimu Road/Ihakara Road	1022	21%	30%	32%	47%	97%	115%	44%	70%	111%	79%	71%	100%	45%	73%	118%	46%	74%	127%
	30 Rimu Road/Raumati Road	1020	21%	52%	104%	24%	37%	101%	29%	28%	41%	35%	37%	101%	29%	28%	43%	29%	29%	45%
	31 Mazengarb Road/Guildford	2000	20%	12%	19%	33%	22%	26%	33%	26%	36%	38%	22%	32%	36%	26%	54%	36%	26%	36%
Intersections	Overall volume/capacity ratios (intersection average VC ratio)	node no.																		
	1 SH1/Poplar Avenue	1002	30%	26%	38%	32%	29%	37%	38%	29%	38%	38%	33%	41%	37%	28%	36%	36%	28%	38%
	2 SH1/Raumati Road	1021	25%	23%	32%	33%	31%	40%	8%	10%	12%	22%	22%	28%	9%	10%	11%	9%	11%	13%
	3 SH1/Ihakara Street	1023	30%	28%	39%	46%	44%	42%				26%	29%	32%						
	4 SH1/Kapiti Road	1037	64%	60%	67%	109%	96%	81%	43%	41%	45%	72%	65%	67%	37%	37%	39%	49%	47%	51%
	5 SH1/Otaihanga Road	2002	46%	37%	50%	88%	70%	87%				53%	44%	57%				44%	39%	53%
	6 SH1/Te Moana Road	2008	27%	25%	30%	50%	40%	50%				39%	29%	35%				36%	30%	35%
	7 SH1/Elizabeth Street	2009	51%	51%	55%	72%	69%	74%	24%	21%	27%	53%	49%	53%	25%	22%	29%	50%	47%	51%
	8 Kapiti Road/Rimu Road	1038	50%	76%	87%	45%	50%	55%	50%	50%	47%	48%	42%	46%	46%	42%	39%	51%	51%	52%
	9 Kapiti Road/Arawhata Road	1043	28%	36%	42%	94%	96%	104%	73%	83%	86%	83%	87%	102%	68%	81%	84%	67%	76%	86%
	10 Kapiti Road/Te Roto Dr	1061	21%	29%	34%	36%	37%	39%	42%	46%	59%	33%	42%	48%	39%	45%	56%	40%	45%	61%
	11 Kapiti Road/Airport accesses (Aerodrome)	8061				31%	37%	46%	31%	39%	60%	27%	36%	46%	31%	37%	58%	31%	39%	61%
	12 Kapiti Road/Airport accesses (Langdale)	1067				29%	34%	40%	29%	39%	72%	27%	34%	46%	28%	32%	71%	29%	38%	71%
	13 Kapiti Road/Airport accesses (Hurley)	1078				7%	8%	20%	6%	7%	10%	6%	9%	16%	6%	6%	9%	6%	7%	10%
	14 WLR/Poplar Avenue	8070							31%	25%	41%	12%	9%	13%	29%	24%	41%	28%	23%	40%
	15 WLR/Raumati Road (S)	4001							38%	40%	52%				37%	40%	52%	36%	38%	52%
	16 WLR/Raumati Road (N)	9502							39%	40%	51%				39%	40%	51%	37%	39%	50%
	17 WLR/Ihakara street (T-Signal)	5101							35%	36%	74%				35%	36%	76%	32%	35%	78%
	18 WLR/Ihakara street (Roundabout)	9520							6%	12%	29%				6%	12%	29%	6%	12%	29%
	19 WLR/Kapiti Road	4002							43%	46%	59%				40%	44%	59%	40%	44%	59%
	20 WLR/Te Roto	5104																		
	21 WLR/Mazengarb Road	4003																		
	22 WLR/Otaihanga Road	4004										33%	24%	35%				40%	36%	38%
	23 WLR/Te Moana Road	4005																		
	24 WLR/SH1 (Peka Peka)	2073										27%	23%	30%				28%	23%	30%
	25 Expressway/Poplar Avenue	1002							36%	27%	36%				35%	27%	35%	33%	27%	36%
	26 Expressway/Otaihanga Road	2002							36%	30%	40%				25%	17%	23%			
	27 Expressway/Te Moana	3022							41%	29%	36%				41%	30%	35%			
	28 Expressway/Elizabeth	2009							24%	21%	27%				25%	22%	29%			
	29 Rimu Road/Ihakara Road	1022	18%	27%	24%	50%	81%	97%	30%	64%	86%	46%	68%	84%	31%	67%	84%	31%	65%	92%
	30 Rimu Road/Raumati Road	1020	16%	19%	27%	25%	39%	98%	20%	28%	40%	32%	39%	79%	20%	29%	40%	21%	29%	41%
	31 Mazengarb Road/Guildford	2000	18%	12%	16%	28%	19%	26%	31%	22%	35%	31%	19%	33%	33%	23%	45%	31%	22%	33%

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Reviewed by: Roger Burra
11/08/2009

	Option 1	Option 2	Option 3	Option 4
Description	**NPV Benefits ($ Millions)**	**NPV Benefits ($ Millions)**	**NPV Benefits ($ Millions)**	**NPV Benefits ($ Millions)**
Travel Time	107.0	166.1	131.5	131.8
Congestion Relief	28.2	40.5	34.7	34.2
Vehicle Operating	12.8	11.2	20.1	4.7
Accidents (5%)	7.4	10.9	9.4	8.5
Carbon Dioxide (4% of VOC)	0.5	0.4	0.8	0.2
Total NPV Benefits	**155.9**	**229.2**	**196.5**	**179.4**

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