19 June 2024

Darren Conway

fyi-request-20148-b782842f@requests.fyi.org.nz

Dear Darren Conway

Ombudsman Preliminary Inquiry

We refer to correspondence sent from the Office of the Ombudsman regarding our decision to refuse to release the Seaview Links Project Feasibility Report 2015 under section 17(g) of the Local Government Official Information and Meetings Act 1987 (the Act).

Response:

We have located this document and now release it to you. Some Information has been withheld under section 7(2)(a) of the Act to protect the Privacy of natural persons.

You have the right to seek an investigation and review by the Ombudsman of this decision. Information about how to make a complaint is available at www.ombudsman.parliament.nz or freephone 0800 802 602.

Please note that this response to your information request may be published on Hutt City Council's website. Please refer to the following link: www.huttcity.govt.nz/council/contactus/make-an-official-information-act-request/proactive-releases

Yours sincerely

Philip Rossiter

Senior Advisor, Official Information and Privacy

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HUTT CITY COUNCIL
10 NOV 2015

2 November 2015

Bruce Sherlock
Hutt City Council
531 High Street, 5040
Lower Hutt

Dear Bruce,

Seaview Links Project Feasibility Report

I am pleased to enclose the final Seaview Links Project Feasibility Report.

As you are aware, we have managed the development of this Report on behalf of Hutt City Council, and in accordance with the agreed terms of reference for its preparation. We believe the process of developing the Report has been highly collaborative, and would like to thank your staff for the time they have taken to help us finalise the Report.

We now consider the Report to be complete.

We would be happy to meet with you to discuss the Report, and the next steps in the investigation process for improving connections to Seaview, once you have had time to consider the findings of the Report.

We look forward to hearing from you. Please contact Selwyn Blackmore on (04) 894 5247 or by email to Selwyn.blackmore@nzta.govt.nz to discuss the Report in the first instance.

Yours sincerely

Neil Walker
State Highway Manager - Central Region

Encl.

cc. Ron Muir

Petone to Grenada

Seaview Links Project Feasibility Report

Petone to Grenada I&R

Petone to Grenada

Seaview Links

Project Feasibility Report

Petone to Grenada I&R

Prepared By

Reviewed By

Approved for Release By

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Revision Schedule					
Rev. No.	**Date**	**Description**	**Prepared**	**Reviewed**	**Approved**
Draft	August 2013	Draft issue for comment	[redacted]		
Issue 1	August 2014	Final issue addressing Comments			
Issue 2	June 2015	2015 update addressing additional comments			
Issue 3	September 2015	Update reference to Petone Esplanade Capacity Study (May 2012)			

Contents

Executive Summary

Opus International Consultants (Opus) has been commissioned by the Hutt City Council (HCC) and the NZ Transport Agency (Transport Agency) to complete a Project Feasibility Report (PFR) for a transportation link between Seaview and Petone, assuming that the Petone to Grenada project is in place.

Seaview is one of the logistic, industrial and commercial hubs in Wellington distributing freight across the region and this is forecast to grow. Employment in the Lower Hutt area is forecast to grow by 11%[1] by 2031 placing additional pressure on the transport network.

The Petone Esplanade is the primary road link between Seaview and the region, which as a result carries high traffic volumes, buses and freight movements.

The Petone Esplanade is subject to peak time congestion and delay with high proportions of freight traffic throughout the day. These problems result in inefficient freight movements, poor travel time reliability, severance between the Petone suburbs and the foreshore, increasing safety risk for vulnerable road users.

The aim of this PFR is to investigate alternative options to upgrade routes and transport options to serve Seaview and suburbs to the south and east.

There have been several studies completed in the last 10 years to consider options to connect the east and west sides of the Hutt Valley. Options previously identified which provide the appropriate outcomes for HCC and the community have not been considered economically viable. The following objectives were agreed at a workshop with representatives from the Transport Agency, HCC, Greater Wellington Regional Council (GWRC) and Opus:

- To improve safety and efficiency of the transport network including efficiency and connectivity of HCVs travelling between Seaview and the State Highway network. Demonstrate value for money;
- Support the economic growth and development of the Hutt Valley by improving connectivity within the region;
- Enhance resilience to the local road network within the Region;
- Reduce adverse environmental impacts; and
- Enhance the linkage between the sea and Petone for all users.

Multi-modal option concepts were developed following the stakeholder consultations during the 6th and 28th June 2013 with a view to address both the project objectives and the stakeholder inputs. Desktop analysis and discussions amongst the project team were conducted to assess the multi-modal option concepts and from this the list was shortened to include those that best achieved the project objectives and desired stakeholder outcomes. Following this process the following multi-modal options were evaluated in greater detail:

[1] table 4-2 http://www.gw.govt.nz/assets/Transport/Transport-models/TN29-Demographic-Inputs-to-WTSM-FINAL-with-Appendicies.pdf

- **MM1** – Reinstate Gracefield Rail Link,
- **MM2** – Enhance Bus Services,
- **MM3** – Weekday Ferry Service, and
- **MM4** – Improve Walking and Cycling Facilities

The table below outlines the findings of the multi-modal options assessment against the project objectives:

Objective	MM1	MM2	MM3	MM4
Maximise Value for money*	Likely positive (but dependent on funding)	Likely Negative (As requires significant modal shift)	Likely Negative	Likely Positive
Facilitate Economic Growth	Positive Effects as improves freight efficiency	Positive as, if successful, would relieve network congestion	Positive	No Change
Enhance Resilience	Positive Effects as provides alternative freight route	No Change	Positive - alternative transport route established	No Change
Minimise Environment Impacts	Positive	Positive	Positive	Positive
Enhance Linkage between Petone and the Sea	Positive as removes freight from the network	Positive	Positive	Positive

* Note that no economic analysis has been carried out

All of the multi-modal options align well with the project objectives, with the exception of the value for money objective where MM2 and MM3 are noted as likely negative.

In addition to the multi-modal options, a number of roading options were identified both from previous studies and by the project team with the aim of satisfying the project objectives. The following roading options were identified:

- **SV1** – Intersection and active mode / bus improvements as per GHD's Petone Esplanade Capacity Study, May 2012
- **SV2a** – Cross Valley Link along Whites Line East alignment
- **SV2b** – Cross Valley Link along Whites Line East alignment and Esplanade depowering
- **SV3a** – Cross Valley Link along Railway Line alignment
- **SV3b** – Cross Valley Link along Railway Line alignment and Esplanade depowering
- **SV4** – Esplanade depowering
- **SV5** – Four laning Esplanade – from Hutt Road to Estuary Bridge
- **SV6** – Four laning Esplanade – from Hutt Road to Victoria Street
- **SV7** – Four laning Esplanade – from Hutt Road to Seaview(including Estuary Bridge)
- **SV8a** – Cross Valley Link along Railway Line alignment and HCV restrictions on the Esplanade
- **SV8b** – Cross Valley Link along Railway Line alignment, HCV restrictions on the Esplanade and Esplanade depowering

These roading options have been assessed both in terms of the project objectives and economic benefits. A summary of this assessment is provided in the following table.

Option	Description	Cost ($M)	BCR[2]	Project Objective Rating				
				Maximise Value for money	Facilitate Economic Growth	Enhance Resilience	Minimise Environment Impacts	Enhance Linkage between Petone and the Sea
SV-1	Esplanade Improvements	30.4	0.0	Minimal	Minimal	None	Minimal	Positive
SV-2a	Whites Line CVL	57.6	1.9	Positive	Positive	Positive	Negative	Positive
SV-2b	Whites Line CVL with Esplanade Depowering	88.0	Negative*	Negative*	Positive	Positive	Negative	Positive
SV-3a	Railway Alignment CVL	63.6	1.7	Positive	Positive	Positive	Negative	Positive
SV-3b	Railway Alignment CVL with Esplanade Depowering	94.0	Negative*	Negative*	Positive	Positive	Negative	Positive
SV-4	Esplanade Depowering	30.4	-8.4	Negative	Negative	None	Minimal	Positive
SV-5	Full four-laning	35.4	2.1	Positive	Positive	None	Negative	Negative
SV-6	Partial four-laning	31.3	-0.1	Negative	Positive	None	Minimal	Positive
SV-7	Full four-laning including Estuary Bridge	54.4	2.0	Positive	Positive	None	Negative	Negative
SV-8a	Railway Alignment CVL with HCV restrictions	63.6	1.5	Positive	Positive	Positive	Negative	Positive
SV-8b	Railway Alignment CVL with HCV restrictions and Esplanade Depowering	94.0	Negative*	Negative*	Positive	Positive	Negative	Positive

* As determined by the EEM, the negative transport benefits of depowering are higher than the benefits of the CVL options; therefore the BCR and the Maximise Value For Money objective ratings are negative. Costs for these are calculated as the addition of the relevant CVL option and the SV4 depowering option; however there may be economies of scale through carrying out these works together.

Since the initial assessment, the SATURN model has been updated and the Cross Valley Link (CVL) options rerun. To give an idea of how these options perform under the updated model the following table presents the 2031 travel time costs (Travel time benefits typically form about 80% of overall benefits) between the earlier and updated modelling for the Do Min and CVL options.

[2] The BCRs are based on earlier modelling and they include agglomeration benefits. As per EEM, 40 year benefits at a 6% discount rate have been assumed.

Options	Travel Time Costs ($M Earlier Model)	Travel Time Costs ($M Updated Model)	Difference
Do Min	1,438.70	1,438.60	-0.1
SV2a	1,434.50	1,433.10	-1.4
SV2b	-	1,446.60	-
SV3a	1,434.40	1,434.40	0.0
SV3b	-	1,449.20	-
SV4	1,451.00	-	-
SV8a	1,434.90	1,435.00	0.1
SV8b	-	1,480.80	-

Based on the above updated model results, particularly the relatively small differences between the travel time costs for the earlier and updated model, SV2a, SV3a and SV8a options are likely to produce similar transport benefits to those of the earlier modelling economics.

Options SV2b and SV3b will likely produce greater benefits than SV4, however these options result in increased travel time costs compared to the do minimum (e.g. the travel time costs for SV3b are $1,449.2M, some $10.6M more than the Do Min costs of $1,438.6M), and therefore there are no forecast transport benefits for these options, in fact the transport benefits are negative. SV8b will likely produce fewer benefits compared to SV4.

Following this assessment it was determined that there are several economically viable options. Of these SV-3a (called SV-3 hence forward) was selected as the option that would be assessed at a greater detail in this report as it had a positive BCR, promoted economic growth and improved resilience. Although SV-2a (called SV-2 hence forward) has the highest BCR and lowest cost it also requires greater land acquisition, which carries a risk to the project. SV-2 also necessitates the removal of more greenspace so has the greater adverse environmental effects. Because of these issues SV-3 was selected over SV-2. SV-3 also diverted traffic away from The Esplanade so in turn enhancing the linkage between Petone and the sea. Additionally from an urban design perspective SV-3 was identified as the best solution.

Although the multi-modal options align well with the project objectives, the project team considered that, given the magnitude of modal-shift required to have a noticeable effect on network congestion, and the unlikelihood that this shift would be achieved, these options would be complementary to a road option rather than an option in their own right.

Following the more detailed evaluation, a Transport Agency Assessment profile was given to SV-3 based on the requirements of NZTA's Planning and Investment Knowledge Base. The following ratings were given:

Strategic Fit: **Medium**

Effectiveness: **High**

Efficiency: **Low**

This rating (MHL) classifies this option as a priority 6 project which is in the middle of the Transport Agency's priority range (1 to 11).

In summary this report proves that an improved link to Seaview is a feasible option. Going forward an optimal solution should be identified once the preferred Petone to Grenada (P2G) option has been selected. At this stage sensitivity testing around growth assumptions as well as further consideration for urban design, stakeholder and community inputs, and planning issues should be undertaken, while the option to restrict freight on certain roads should also be consideration further.

A decision to improve the east-west connectivity through a combination of a cross valley link and changes to the Esplanade should be a strategic planning response not a decision driven by cost benefit ratios.

Limitations of this report

This PFR has been undertaken using the best available information to hand. The assessment relied on the North Wellington SATURN Model (NWSM) which has been developed by Jacobs as part of the NZTA Petone to Grenada Project. This model has been subject to an on-going peer review process which has not been resolved at the time of publishing this document. In particular, travel speeds and delays in the base model around the Petone Interchange area do not replicate the travel times and speeds observed from the established Bluetooth-Wi-Fi detectors. Any future application for works in the area should utilise a more up-to-date model if available. It should be noted that the option assessment within this report incorporates the Petone to Grenada link road project as its do minimum scenario, which address the existing Petone Interchange issues with the provision of a new and improved interchange. Based on this any issues in the base model likely won't affect the comparative assessment or resulting option ranking contained within this report.

Note:

The NZ Transport Agency recognises that The Esplanade depowering option considered herein achieves one of the key project objectives to address the current severance issue experienced along this route. It is noted, however, that the option introduces significant delays resulting in transport dis-benefits as measured by the Transport Agency's Economic Evaluation Manual. If this depowering option were to be pursued along with another option the overall benefits (transport and other benefits such as those arising from increased amenity) will need to be considered as part of any future funding application which may be made to the Transport Agency.

1 Introduction

1.1 Overview

Opus International Consultants (Opus) has been commissioned by the Hutt City Council (HCC) and the New Zealand Transport Agency (NZTA) to complete a Project Feasibility Report (PFR) for a link between Seaview and the State Highway with the Petone to Grenada project in place. The local linkage along the Petone Esplanade provides the main access for high traffic volumes and freight movements, which also creates a severance between Petone and the harbour. The Esplanade is subject to peak time congestion and delay with high proportions of HCV traffic throughout the day. The aim of the PFR is to investigate the alternative options to upgrade routes and transport options to serve Seaview and suburbs to the south and east (Wainuiomata and Eastbourne).

Currently the Hutt City Council's long term plan is to de-power The Esplanade and to reassign vehicles to the Cross Valley Link. This PFR will investigate whether the Petone to Grenada link corresponds to this outcome while also improving the network's performance. If this goal is unattainable, HCC and the NZTA will be informed of other options that may better achieve the objectives sought. The position and connections between the Petone to Grenada link and the route between Petone and Seaview will ensure there is a robust and effective strategy for future transport needs in this area.

1.2 Background

The Government has identified seven essential State Highways as Roads of National Significance (RoNS) that are closely aligned to New Zealand's economic prosperity. In the Wellington Region the SH1 route from Wellington Airport to Levin (Wellington Northern Corridor) has been identified as having a key role to play in supporting economic transformation.

Although the Petone to Grenada (P2G) project does not officially form part of this RoNS package, it is being progressed by the RoNS team because it contributes to the benefits of the RoNS programme. It has subsequently been commissioned to proceed through an investigation and reporting (I&R) phase. The Petone to Grenada link will significantly alleviate congestion on the busiest part of the Wellington Northern Corridor, which is between Grenada and Wellington on SH1 and between Petone and Ngauranga on SH2. The link also plays an important role in optimising the Wellington Northern Corridor by ensuring that the full benefits of the different RoNS packages are realised.

In conjunction with the P2G I&R phase, three project feasibility studies have also been commissioned. These studies have been commissioned to investigate alternative options to ensure that the Petone to Grenada link is realising the greatest benefits possible. The subject of this PFR is the transport link between Seaview and Petone. Seaview is a major industrial hub in the Wellington Region and a large part of the economy of Hutt City. There are two main goals for this PFR, and they are to:

a. Investigate transport options and alternatives to improve the linkage between Seaview, Petone and the wider transport network, including the Petone to Grenada Link. Various options will be discussed in relation to the project objectives, detailed in Section 1.6; and
b. Identify the most suitable location for the connection of the Seaview area to the Petone to Grenada link.

Plans to provide an east-west link across the Hutt Valley have been considered since the 1960's. A number of different alignments have been considered over this time, and have included:

- Wakefield Street/Whites Line[3];
- Wakefield Street/Railway corridor;
- Udy Street; and
- The Esplanade.

These different alignments have their own positive and negative outcomes. The purpose of this report is to identify an alignment that optimises the positive benefits gained by private vehicles, vehicle freight, public transport, rail freight, pedestrians and cyclists.

The purpose of this PFR is to recommend a preferred outcome that will enable the Petone to Grenada link I&R to be developed with confidence that it will be able to connect to a Seaview to Petone transport link at some time in the future.

1.3 Previous Work

There have been several studies completed in the last 10 years to determine the best routes and options to proceed with in order to connect the east and west sides of the Hutt Valley.

This PFR builds on this work previously completed, including the:

- Valley Floor Connector Needs Analysis, October 2003
- Ngauranga Triangle Strategy Study, January 2010
- Cross Valley Link Options Council Briefing Paper, March 2011
- Petone Esplanade Capacity Study, May 2012
- Hutt Corridor Plan, October 2011

These different studies are summarised below.

1.3.1 Valley Floor Connector Needs Analysis, October 2003

The Valley Floor Connector Needs Analysis was completed by MWH in 2003. The objectives of this study were to evaluate the need for improved access in the Lower Hutt valley, summarise findings of previous reports, and recommend an action plan for the Hutt City Council to manage traffic demands.

The study found that a Cross Valley Link is needed to address the increasing congestion. The Wakefield/Railway option was recommended despite having a lower BCR than the Wakefield/ Whites Line option since the Railway option had less social and environmental impacts.

[3] The HCC removed a designation from the Wakefield Street/ Whites Line route in 1989 due to the social and environmental issues and the view that there were more beneficial options available.

1.3.2 Ngauranga Triangle Strategy Study, January 2010

The Ngauranga Triangle Strategy Study completed by SKM considered the whole Ngauranga Triangle area. As part of this strategy study there was considerable work done on the SH2 to Seaview / Gracefield component. This study included issue identification, option development, fatal flaw screening (long list option assessment), more detailed analysis of the options (short list option assessment), identification and evaluation of preferred strategy components, and finally an implementation plan.

The short listed options in the report included:

- Traffic Calming on The Esplanade
- Esplanade Multi Lane Efficient Arterial
- Wakefield Street to Rail Alignment
- Wakefield Street to Whites Line Alignment
- Gracefield Multi Modal Hub
- Udy Street "Wiggle"
- Two Way Pairs –Petone Esplanade and Udy Street "Wiggle"

For SH2 to Seaview/Gracefield the Ngauranga Triangle Study recommends a Cross Valley Link following the Wakefield Street/ Railway alignment, as shown schematically in Figure 1-1. Traffic calming along The Esplanade was also included in this option. Overall the direct transportation related benefits gave the recommended route a BCR of 0.5. This includes the negative travel benefits produced by the traffic calming. The report suggests that further work to quantify potential amenity and economic regeneration benefits associated with the link should be considered.

Figure 1-1: Wakefield Street/ Railway Alignment

The implementation plan contains short term (within 10 years) and long term (beyond 10 years) actions related to the Cross Valley Link. The short term actions are:

- HCC to undertake additional economic regeneration benefit analysis of the Cross Valley Link and supporting policy/planning frameworks, and
- HCC to undertake full investigation and reporting, design and gain consents for the Cross Valley Link.

The long term actions are:

- HCC to construct the Cross Valley Link.

The implementation plan also notes that if the additional work that HCC is undertaking further justifies the Cross Valley Link road then bringing the construction of the Cross Valley Link forward should be considered.

1.3.3 Cross Valley Link Options Council Briefing Paper, March 2011

Three options were discussed in the council briefing paper:

- Option A: Do nothing;
- Option B: Build the Cross Valley Link; and
- Option C: Develop options for a staged upgrade of The Esplanade to maximise traffic efficiency and foreshore amenity.

These options are schematically shown in Figure 1-2, below.

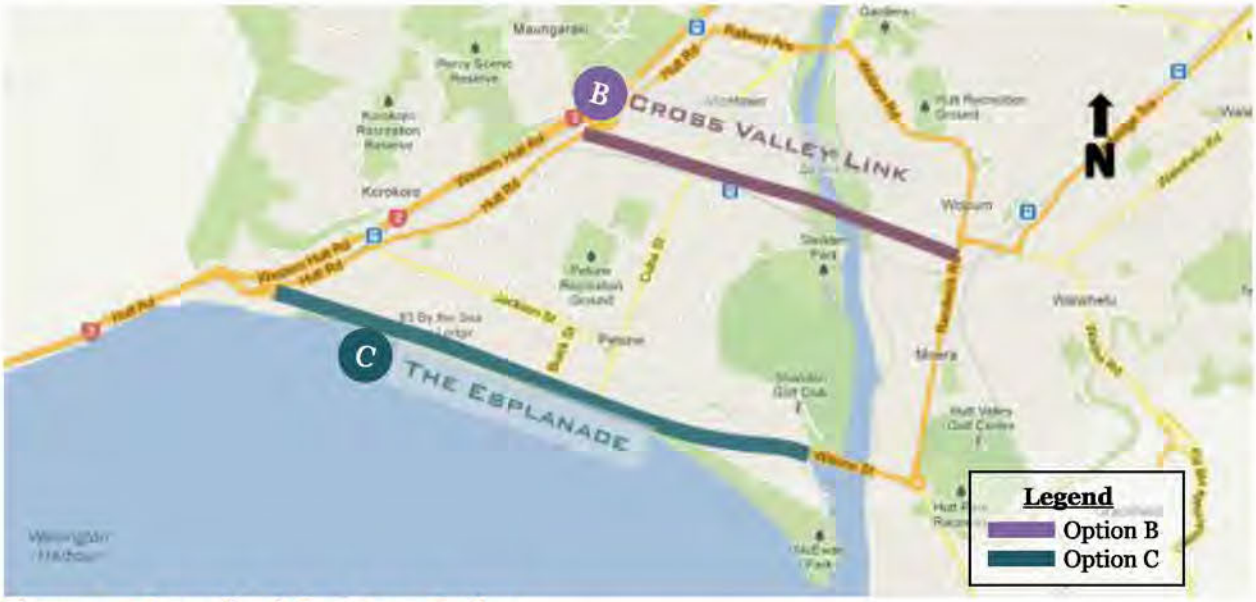

Figure 1-2: Council Briefing Paper Options

The council officers considered Option A (do nothing) not a feasible option since it does not address increasing congestion, community severance, Petone foreshore amenity, or economic development issues.

Option B, Cross Valley Link would provide significant benefits to the city, but it has a low BCR and the assessment profile based on NZTA's Planning Programming and Funding manual for the Cross Valley Link is low strategic fit, low effectiveness, and low efficiency (LLL). This is the lowest possible rating and means the project is unlikely to be eligible for a NZTA subsidy.

Officers feel that Option B is not a realistic option, despite the benefits to the city, since Council would need to meet the full cost of construction.

Option C involves developing a range of improvements that would optimise traffic efficiency of The Esplanade by minimising congestion and travel time variability, improve pedestrian access to the foreshore, enhance the recreational amenity of the foreshore and provide dedicated pedestrian and cycle facilities to form part of the "Great Harbour Way". The council officers consider this to be a pragmatic approach to addressing the objectives of the Cross Valley Link.

1.3.4 Petone Esplanade Capacity Study, May 2012

GHD completed a study of The Esplanade for HCC. This study found that:

- The proportion of heavy vehicles on The Esplanade is high for an urban road;
- The two-lane Estuary Bridge has a structural life span of at least another 25 years provided that continued maintenance is undertaken;
- With the Petone to Grenada link, the traffic flow on The Esplanade will increase by about 3,000 vehicles per day due to induced traffic;
- The capacity of The Esplanade is limited by the intersections along it and the SH2 on-ramps;
- Currently vehicles use Jackson Street and Te Puni Street as a rat-run to avoid the queuing in the morning peak to get onto SH2;
- The proposed Cross Valley Link will reduce the traffic volumes on The Esplanade by around 10,000 vpd. Based on the economic evaluation, construction of the Cross Valley Link is not warranted.
- Upgrading The Esplanade to maintain and improve the level of service required for access to the region's industrial hub in Seaview can generate many of the same benefits as the Cross Valley Link. The cost of upgrading The Esplanade was not included in the economic analysis for the do-minimum scenario.

Short term capacity improvements are possible by changing some signals and the lane allocation, as shown in Figure 1-3. However, these changes may make it more difficult for traffic on the side road to access The Esplanade.

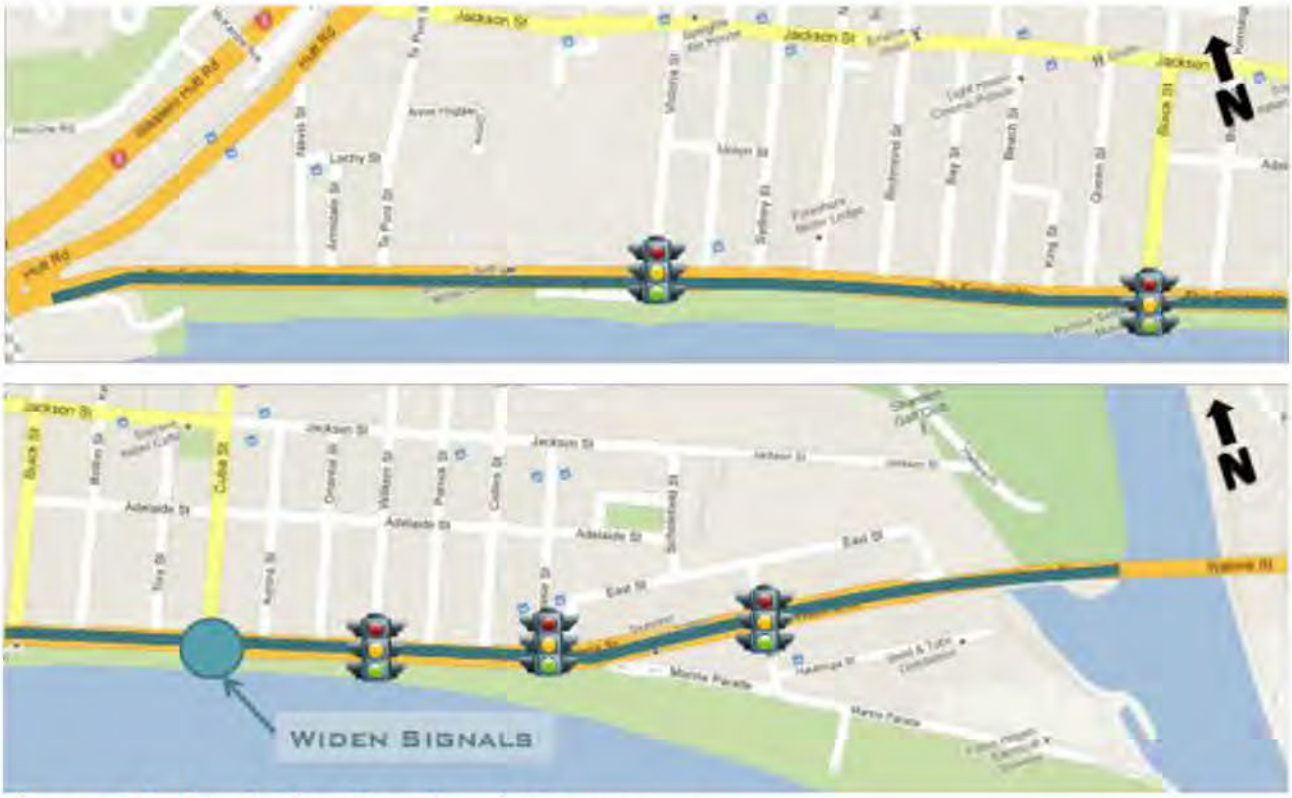

Figure 1-3: Esplanade Short Term Capacity Improvements

1.4 Land Use Policy

1.4.1 Hutt Corridor Plan, October 2011

The Hutt Corridor Plan identifies a number of significant issues on the transport network for Seaview/Gracefield to SH2. These issues include:

- Seaview/Gracefield has around 6000 employees in about 700 businesses;
- Large companies have growth plans for the Seaview/Gracefield area;
- Severe congestion on The Esplanade during peak times makes access between Seaview and key freight destinations/markets difficult. Part of the issue is the need to merge with SH2 traffic at the western end and the way the current Petone Interchange functions;
- Capacity/delay issues with intersections along The Esplanade; and
- High volumes and large trucks are not consistent with the community vision for the area, including desires to enhance the amenity values and increase walking, cycling and other recreational uses.

The Hutt Corridor Plan then identifies the priority projects for the strategic road network. The Gracefield package includes:

- Short term plans by HCC to investigate options for optimising traffic efficiency as well as pedestrian and cycling access along and across The Esplanade;
- Further work to investigate the wider economic benefits and finding a way to fund the preferred long term solution (Cross Valley Link); and
- Advocating for the retention of the Gracefield rail corridor. CentrePort and KiwiRail both have key roles in investigating the feasibility of reinstating the Gracefield rail line.

1.4.2 Petone Vision Statement

The Petone Vision Statement Element 2 is, "Growth in Petone will be managed in an economically and environmentally sustainable manner". One of the identified means of achieving this is through changed roading networks that improve the movement of residential and business traffic and add amenity value to areas such as the foreshore.

Element 4 is, "An attractive and vibrant village culture at the heart of Petone". Part of this element acknowledges that more should be done to face and better connect with the harbour. A key consideration in this is whether the Cross Valley Link is established.

1.4.3 Vision Seaview Gracefield 2030

Seaview Gracefield has approximately 700 businesses employing around 6000 people. Since the adoption of the Council's Economic Development Strategy in 2002 the number of businesses in the area has increased by 25 percent compared to 20 percent for Hutt City.

One of the key outcomes identified in the vision is improving traffic efficiency for commercial vehicles including over-weight and over-dimension trucks. Traffic congestion along The Esplanade results in loss of trade, costs for businesses, costs for employees, and a lack of competitiveness of Seaview Gracefield as a location.

Another outcome is to provide safer roads for pedestrians and cyclists to encourage people to walk or cycle to work. The Esplanade has heavy mixed traffic and there is a lack of space for cyclists on the Hutt Estuary Bridge.

1.4.4 Hutt City Urban Growth Strategy

Hutt City Council has drafted a growth strategy for the city to help achieve the desired economic and population growth outcomes. The Statistics NZ median forecast is for a population of 105,000 by the year 2031. The focus of the strategy is on providing more housing to address the needs of the ageing population, provide economically feasible options for residents of Hutt City and encourage migration to the city. This growth in housing is proposed to be achieved through intensification with some Greenfield development and subsequently, changes to the District Plan. The 'moderate intensification' strategy would be achieved through infill housing and growth in apartments to a total growth of 5,000 homes for a population of 107,000 by 2031. The 'proactive intensification' strategy enhances the moderate strategy with a wider range of smaller dwellings through infill homes and multi-unit developments with a total growth of 7,500 homes for a population of 113,000 by 2031. This forecasted growth will increase traffic demand in the region and will subsequently require an increase in the Hutt River crossing capacity as well as improved access to SH2.

1.4.5 Great Harbour Way

The Great Harbour Way (GHW) concept is to provide a shared use path around the coastline of Wellington Harbour from Pencarrow Head in the east to Red Rocks in the west. The link between Seaview and SH2 along The Esplanade is part of the GHW. This idea was first developed in 2002 and further progressed through Wellington City Council to the GHW coalition group that champions the concept today. This coalition consists of members from Living Streets Aotearoa, Cycle Aware Wellington, Wellington Waterfront, and Hutt Valley and Wellington Rotary clubs. While the GHW mainly focuses on recreational path use, it also aims to connect communities as

part of a wider network and promote the history and cultural aspects of the harbour. The objectives of the GHW are to:

- Provide a safe continuous walking and cycling route for both transport and recreation movement around the perimeter of the harbour between Pencarrow Head and Red Rocks;
- Be predominantly designed to accommodate a continuous 2-way path;
- Provide a safe cycling commuter route between the communities along the route;
- Be located immediately along the harbour edge as far as is practicable;
- Be planned and designed in such a way as to avoid adverse effects on environmentally sensitive areas;
- Highlight Māori cultural history and values and other historical values;
- Recognise the opportunities of this route to act as a catalyst for new ancillary or development opportunities within the corridor of land it traverses;
- Enhance knowledge and awareness of the Wellington Harbour environment and immediate environs through interpretation, storytelling and art;
- Become a nationally recognised cycleway / walkway, and a key part of the National Cycleway project promoted by the Government; and
- Be developed and upgraded over time and in stages as resources allow. The initial focus is providing at least a basic level of access along the entire length.

1.5 Stakeholders

Hutt City Council and NZTA have been identified as the key stakeholders. The proposed changes would occur on roads within HCC's jurisdiction. The recommended option is also likely to affect the State Highway network and may influence current and future projects that NZTA may be considering, such as the Petone to Grenada project. Both NZTA and HCC have been involved in a workshop discussing the problem, project objectives, opportunities and constraints. Greater Wellington Regional Council (GWRC) has also been included to provide transport policy advice and input from a land use, transport and public transport integration perspective.

Other stakeholders that have been consulted are KiwiRail and CentrePort. CentrePort runs the port off of Seaview and KiwiRail owns property in the Seaview / Gracefield area and has a currently disused rail corridor; therefore, their input regarding growth aspirations in the study area as well as current issues and restraints was sought. In addition to these stakeholders, consultation was undertaken with various freight groups that operate in the Seaview / Gracefield area, including the New Zealand Heavy Haulage Association, Road Transport Association of New Zealand, and individual freight companies to understand their concerns regarding the existing situation in Hutt City and proposed options and to identify opportunities for improvement. A summary of the dates and attendees at each meeting is provided in Appendix A.

Some consistent themes came out of these discussions:

- The Seaview area is the main freight service area in the Wellington Region;
    - 2.5Mt of CentrePort's cargo travel via The Esplanade
    - 3Mt are from the fuel industry
    - There are a large number of freight operators in the area and even if they don't have a depot in Seaview, they move large quantities of freight to and from this area.

- Congestion on The Esplanade during both AM and PM peaks is a significant concern for businesses with regard to development and investment in the Seaview / Gracefield area;
    - The port aims to have efficient cargo movement therefore congestion influences their business decisions.
    - Port has a large amount of developable land in Seaview but its growth will be influenced by congestion
- Consideration needs to be given for a heavy haulage and/or dangerous goods route through the Hutt Valley;
    - Need to maintain the driveable width of The Esplanade
    - Stopping and starting at traffic lights adds to repairs and maintenance. A more continuous route is preferable, even if it is slightly longer
    - Dimensions under the Petone Bridge are too small
- There is potential for fuel / oil related growth in the area
    - There is speculation that Seaview will house the centralised lower North Island operations for a major oil company.
    - The airport extension may well require further fuel to be transported form Seaview.
- Freight companies prefer routes that don't cater to cyclists or school children.
    - Freight companies try to avoid routes near schools
    - There is a road conflict between cyclists and trucks. There is a preference for them to not share a road.

Overall, the various freight operators in the Seaview area have identified congestion along The Esplanade as a major risk to the future development of their business. Their desire is that the outcome from this project will provide them with a safe and efficient route that will help their business grow.

1.6 Project Objectives

The project objectives were refined and agreed at a workshop, on 29 January 2013, with representatives from the NZTA HCC, GWRC and Opus. The agreed objectives and their performance measures are presented in Table 1-1.

Table 1-1: Agreed Project Objectives and Performance Measures

	Objective	Performance Measure
1	To improve safety and efficiency of the transport network including efficiency and connectivity of HCVs travelling between Seaview and the State Highway network. Demonstrate value for money.	Achieve an acceptable BCR to receive project funding.
2	Support the economic growth and development of the Hutt Valley by improving connectivity within the region.	Wider economic benefits. Strategic Fit.
3	Enhance resilience to the local road network within the Region.	Assessment of the reduction of risk against each potential hazard affecting the resilience of the study area.
4	Reduce adverse environmental impacts.	Specialist's subjective assessment of effects.
5	Enhance the linkage between the sea and Petone for all users.	Either through less traffic on The Esplanade or better connectivity, with less congestion.

Also of relevance to this assessment, the Petone to Grenada (P2G) Project Objectives were considered, to determine how the Seaview Links options may complement and/or support the outcomes of that project. The P2G Project Objectives (as of May 2015) are:

- *enhance local, regional and national economic growth and productivity for people and freight;*
- *improve connectivity between the lower Hutt Valley and Johnsonville and Porirua;*
- *reduce journey times and improve journey time reliability between the lower Hutt Valley, Ngauranga and Porirua, and on the Wellington State Highway network;*
- *enhance safety of travel on the Wellington State Highway network;*
- *enhance resilience of the Wellington State Highway network; and*
- *manage the immediate and long term social, cultural, land use and other environmental impacts of the Project on the Wellington region and its communities by, so far as practicable, avoiding, remedying or mitigating any such effects through route and alignment selection, expressway design and conditions;*

  by developing and constructing a cost efficient new road alignment to expressway standards between SH2 in the lower Hutt Valley and SH1 north of Ngauranga.

2 Problem Definition

The Esplanade is a major arterial which provides access from Seaview to SH2. It also provides access to Gracefield, Eastbourne and Wainuiomata. Seaview is an industrial hub for the region and a good transport connection to the wider network is required for the efficient movement of freight and economic growth of the area. Currently The Esplanade carries a high number of HCVs. Approximately 10 percent of the ADT on The Esplanade is HCVs.

Listed below are some of the key transportation issues between Seaview and SH2:

- The high traffic volumes result in severance and decreased amenity for users of the Petone foreshore.
    - » There is a desire from HCC and the community to enhance the amenity of the Petone foreshore, reduce severance and improve connections for pedestrians and cyclists which is a competing function with the high volume of traffic and HCVs currently using The Esplanade.
    - » Traffic volumes on The Esplanade are expected to increase as a result of the construction of a link from Petone to Grenada.
- Queues along The Esplanade in the westbound direction mainly occur due to insufficient capacity at the Petone on-ramp.
    - » In the morning queues often extend to around the Petone Wharf (GHD, 2011) as shown in Figure 2-1. This results in traffic rat-running along Jackson Street and then using the streets closest to the western end such as Te Puni Street to access The Esplanade.
- In the eastbound direction, queuing occurs at The Esplanade and Cuba Street intersection.
    - » This is due to the capacity constraints at the signal lights and typically occurs in the afternoon between 3pm and 6pm. This situation is worsening and also starting to occur outside of the peak periods.
- Seismic strengthening of both the Cuba Street Rail over-bridge is needed in the future. Its locations is shown in Figure 2-1.
    - » The Cuba Street rail over-bridge has a remaining life of approximately 40 - 45 years;

Figure 2-1: Site plan with queue locations and bridges with seismic strengthening requirements

3 Site Description

3.1 Study Area

The study area considered by the PFR is shown in Figure 3-1. It mainly consists of the Lower Hutt Valley bounded by SH2 in the west, Wainui Road in the east, The Esplanade in the south to north of Wakefield Street. Most of the focus and analysis of traffic volumes will centre on the key roads in the study area as these roads are most heavily impacted by options discussed in Section 7: The Esplanade, Waione Street, Randwick Road, Wakefield Street and Whites Line East. Any improvements to this network could also give benefits to zones outside the study area. However these are beyond the scope of this project and have therefore not been considered in this report.

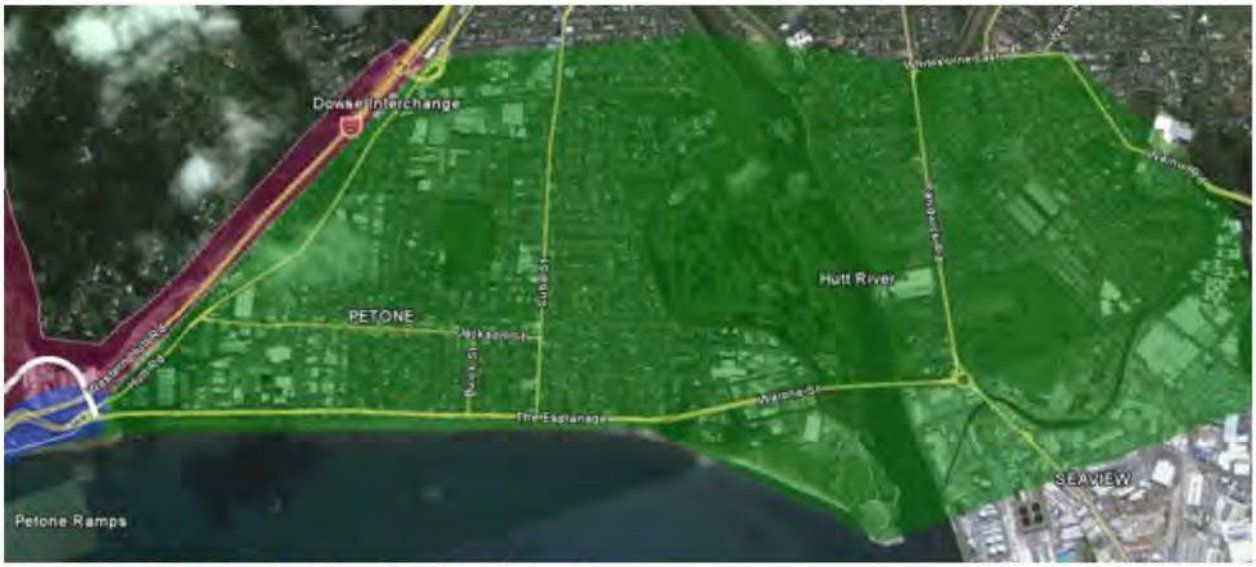

Figure 3-1: Petone to Seaview PFR Area (green)

3.2 Traffic volumes

The traffic volumes, based on annual HCC count data, collected between 2007 and 2012, is shown in Figure 3-2, below. The Estuary Bridge and Randwick Road both carry 27,000 and 17,000 vehicles per day, respectively.

Figure 3-2: Current Traffic Volumes (HCC Count Data)

3.3 Road Network

The road network in the Lower Hutt Valley mainly consists of two way roads with one lane in each direction. Most of the intersections are priority controlled. Some traffic signals are present, generally on Cuba Street and Jackson Streets at various locations.

The roading hierarchy for the study area from the City of Lower Hutt District Plan is shown in Figure 3-3. All unmarked roads are classified as Access Roads.

Note currently congestion regularly forms on SH2, The Esplanade and Hutt Road in both the AM and PM peak periods.

Figure 3-3: Road Hierarchy (Hutt City Council, 2004)

3.4 Resilience

Resilience is the ability to recover readily and return to its original form from adversity. In a transportation context, resilience comes from:

- Resilience to natural hazard events;
- Resilience to technological hazards; and
- Resilience to operation incidents or maintenance.

Resilience of access depends on:

- Route security – less vulnerable to failures in natural hazards;
- Redundancy – availability of alternate routes in hazards, accidents or maintenance; and
- Connectivity – trip diversity and ability to move from one link to other to avoid blockage.

3.4.1 Importance of Resilience

Resilience is important to avoid loss of access in the routine operation of the network (e.g. allow people to get to the hospital), as well as to respond and recover after major hazard events (e.g. allow for rescue after a significant earthquake or provide access for essential services).

The Petone/Seaview region is also identified by the National Infrastructure Unit as a 'hotspot'. A hotspot is defined as a "geographic area where the presence of multiple elements of infrastructure lead to interdependency vulnerabilities" meaning that this region deserves particular attention to ensure on-going operations. Damage to this area will impact key lifeline utilities including the fuel terminals at Seaview, 33kV fluid-filled buried power cables and buried water and wastewater pipes.

3.4.2 Current Regional Resilience in Wellington

The Wellington Region is very vulnerable to failures of the transport links in large hazard events. It also has very limited redundancy and connectivity and has poor operational resilience.

The situation after a major earthquake (M7.5 which is the commonly used for assessment in the Wellington Region) is illustrated in Figure 3-4. Wellington will be cut off from the North (SH1 and North Island Main Trunk railway) by failures along the Pukerua Bay to Paekakariki section in particular, and along the Porirua Harbour; and from the East by failures along the Rimutaka Hill Road (SH2). Transmission Gully expressway will substantially improve this scenario.

Also Wellington, Hutt Valley, Upper Hutt and Porirua will be cut off from each other, due to major failures along SH 58; between Ngauranga and Petone (SH2): and moderate failures in Silverstream (SH2), Eastern Hutt Road (Stokes Valley) and SH1 between Porirua and Wellington (SH1). This will NOT be improved by Transmission Gully.

In particular SH2 Ngauranga to Petone and SH 58 will be cut off for a number of months after a major earthquake. There is also vulnerability along SH1 between Porirua and Ngauranga which can close the link for days. The Petone to Grenada link will improve access into the Hutt Valley.

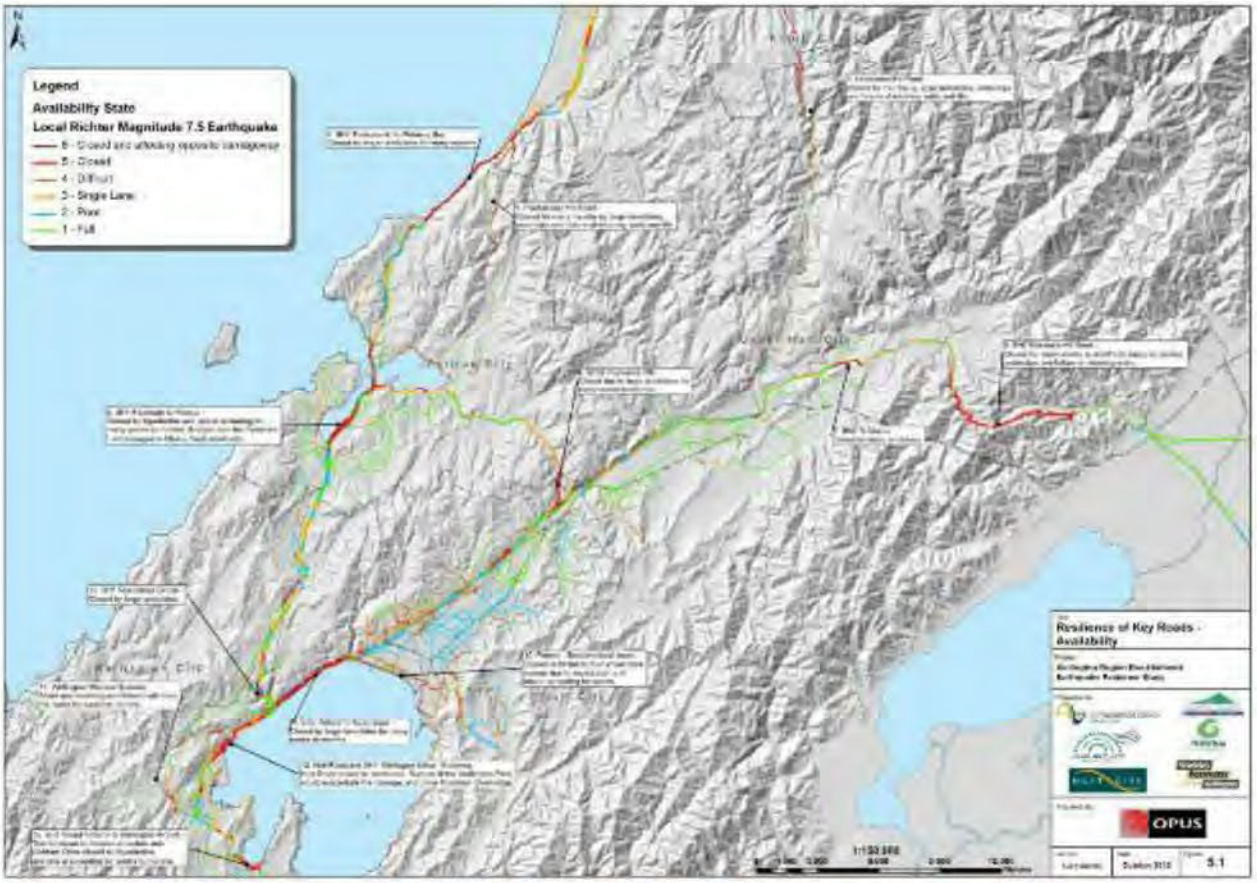

Figure 3-4: Road closures in the Wellington Region that will occur after a major earthquake

3.4.3 Resilience within the southern part of Hutt Valley

Resilience within the Hutt Valley is influenced by the limited number of crossings of the Hutt River and the railway corridor. Between Petone and the lower part of the Hutt Valley area, there are only two road river crossings at Ewen Bridge and Waione Street Bridge.

The Waione Street Bridge is one of the few places where a river crossing is provided. In the event of a crash during routine operation, or even routine maintenance, significant congestion issues can arise. Its approaches are vulnerable to liquefaction and lateral spreading towards the harbour as well as the Hutt River.

The bridges between Moera / Gracefield and Seaview are also vulnerable to failure due in earthquakes and associated liquefaction and lateral spreading. Such liquefaction and lateral spreading caused extensive damage to bridges in the Canterbury earthquakes of 2010-2011.

The Esplanade is susceptible to natural hazards such as winds, storm surge, earthquakes and tsunami. Being located adjacent to the sea, on the southern side, this section of road is exposed to high winds and leaves the roadway vulnerable to storm events such as the event experienced in late July 2013. The Esplanade is mainly one lane in both the eastbound and westbound directions, although the bus lane in the westbound direction may be utilised in the event of an emergency or to divert around a crash. These low duration hazards are likely to become frequent as a result of climate change.

The Esplanade road is also vulnerable to earthquake induced liquefaction. Although the western part of the route is only likely to be vulnerable in larger earthquakes, the consequences of liquefaction are more severe because of its location adjacent to the harbour making it vulnerable to lateral spreading. The route is particularly vulnerable because of the high potential for liquefaction and lateral spreading vulnerability of the eastern section adjacent to the Hutt River as identified by Brabhaharan et al (1994)[4].

3.5 Pedestrians and Cyclists

Footpaths for pedestrians are generally provided throughout Lower Hutt. Pedestrian phases are provided at all signalised intersections.

HCC has provided shared use paths along the Hutt River and the waterfront adjacent to The Esplanade, as well as other locations not located within the study area. Pedestrians and cyclists are able to cross the Estuary Bridge via a barrier separated lane on the south side of the bridge. Where the railway crosses the river and at Ewen Bridge the path travels underneath the structures.

There are also several on road cycle lanes provided in Hutt City. Many of the cycle lanes are short sections that provide access / egress to the shared use paths. Within the study area there are two main on road cycle lanes: Waione Street between East Street west and East Street east and Randwick Road from York Street south to Seaview Road at Gough Street. A map of the existing cycle lanes and shared use paths in Hutt City has been provided in Appendix B. A map showing the cycle lanes in the study area is provided as Figure 3-5. Designated routes such as the Hutt River Trail and NZ Cycle Trail are also identified.

[4] Brabhaharan, P, Hastie, WJ and Kingsbury, PA (1994). Liquefaction Hazard Mapping Techniques Developed for the Wellington Region, New Zealand. Annual NZNSEE Conference, Wairakei, 18-20 March 1994.

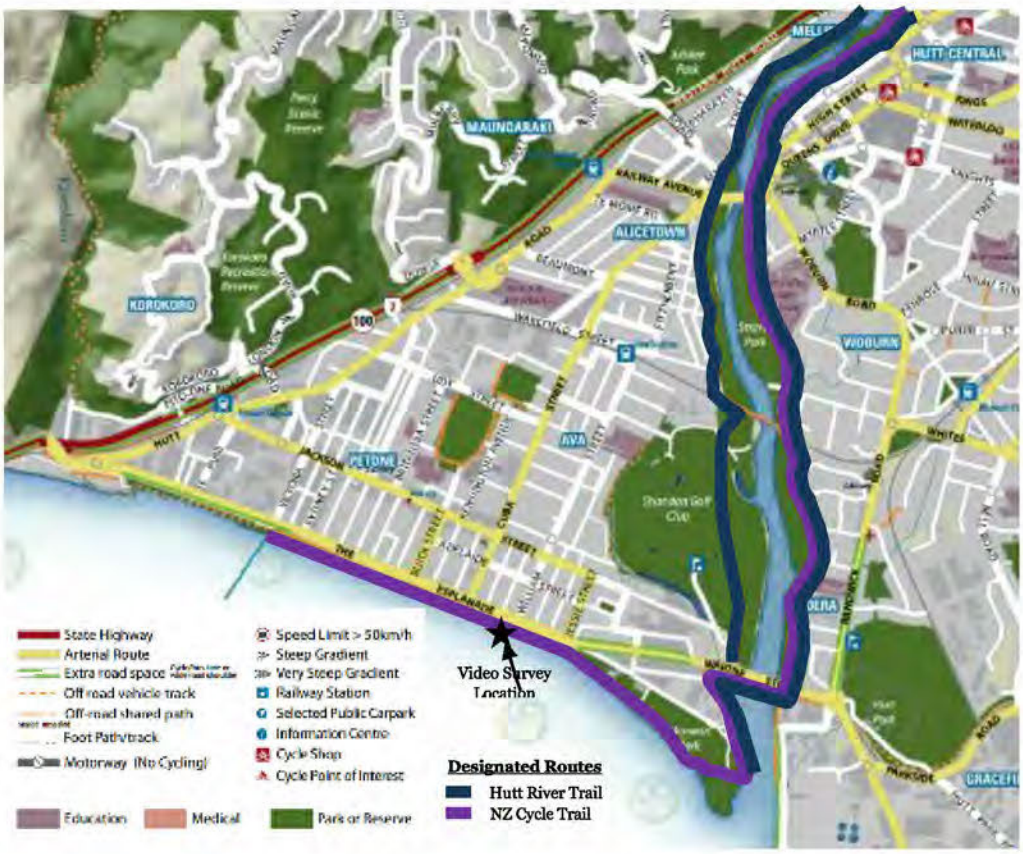

Figure 3-5: Excerpt from HCC Map of Existing Cycle Lanes and Shared Paths

Hutt City has collected video footage of the cyclist and pedestrian movements at the intersection of The Esplanade and Cuba Street (reference 6819), see Figure 3-5. Six hours of video was recorded: from 7.30am to 10.30am and 3.30pm to 6.30pm. This footage was reviewed for Wednesday, 27 March 2013 which was a sunny summer day prior to the Easter weekend (Good Friday was 29 March 2013).

At this location there are pedestrian crosswalks in both the north-south and east-west directions. A wide footpath is also provided on the shore side of The Esplanade that is often used by cyclists. The majority of cyclists and pedestrians that travelled through the intersection were travelling either eastbound or westbound on this footpath (approximately 60%). A summary of the total cyclists and pedestrians recorded, and the peak flow hours, is provided in Table 3-1. A summary of all the recorded movements has been provided in Appendix C.

Table 3-1: Pedestrian and Cyclist Counts on The Esplanade

Time Period	Cyclists	Time Period	Pedestrians
AM Total – 7.30-10.30	41	AM Total – 7.30-10.30	59
AM Peak – 7.45-8.45	20	AM Peak – 8.45-9.45	27
PM Total – 15.30-18.30	45	PM Total – 15.30-18.30	134
PM Peak – 17.30-18.30	29	PM Peak – 17.30-18.30	66

Figure 3-6 and Figure 3-7 provide an illustration of the cycling and pedestrian movements during both the total AM and PM periods, respectively.

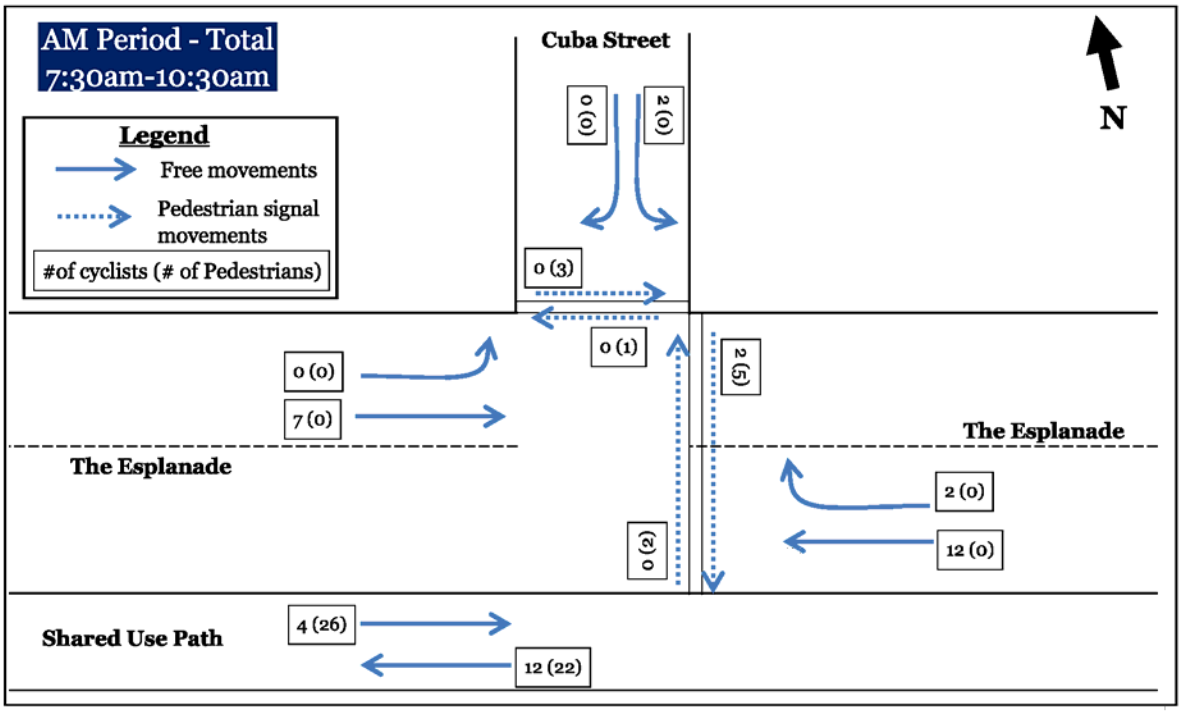

Figure 3-6: AM period movement diagram - Total

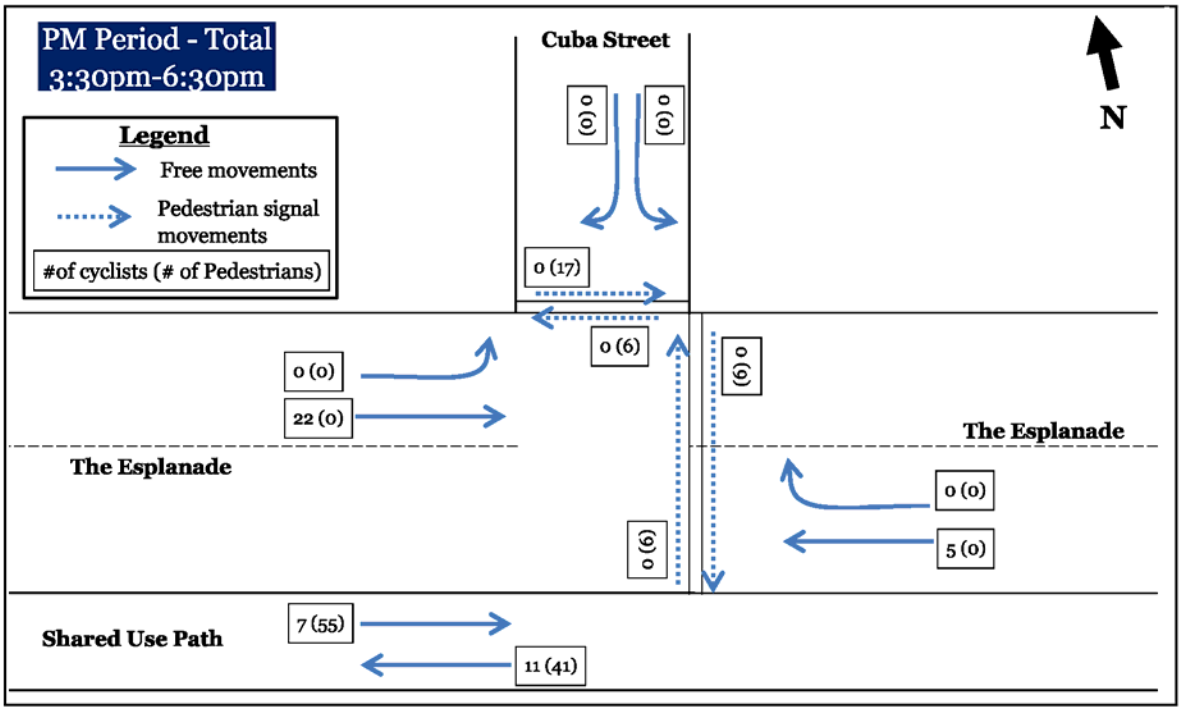

Figure 3-7: PM period movement diagram - Total

This information indicates that the number of active transportation mode users are fairly small especially relative to the number of vehicles. This supports the present notion that the high traffic volume along The Esplanade is negatively impacting on the amenity of the foreshore particularly

for pedestrians and cyclists. However there is a desire among the Hutt City population to use the foreshore as a means of travelling using active transportation modes and for recreational purposes, so the options identified in this report will have provisions for this. Additionally the inclusion of cycling facilities along The Esplanade will support the current Ngauranga to Petone cycleway project as well as help achieve the aspirations set out in the Great Harbour Way.

Between May and August 2012 NZTA conducted user surveys and focus groups as part of the consultation for the Ngauranga to Petone cycleway upgrade project. Results from the survey were published October 2012[5]. A key finding was that *"35% of respondents do not currently cycle between Wellington and the Hutt Valley. The most common reason was that the journey was too dangerous"*. This suggests that providing safer cycle facilities would increase the cyclist mode share. The economics for the project at the time assumed cyclist growth of 4.75% per annum by providing improved facilities. Findings from the focus groups suggested the actual cyclist growth achieved could be much higher, provided the option of using the SH2 shoulder remained. This indicates that there is latent cyclist demand for which the mode share could be improved by providing improved cyclist facilities.

Travel to work data for collected in the 2013 census data is shown in Table 3-2 at both a Lower Hutt regional and overall national level. Mode share for cycling was 2% which is consistent with the national figure. Walking to work was 4% in the Lower Hutt area, 1% below the national figure of 5%.

Table 3-2: 2013 Census Travel to Work Statistics

Main means of travel to work	Lower Hutt City Users	NZ Wide Users	Lower Hutt mode share	NZ Wide mode share
Worked at home	2,256	169,674	5%	8%
Did not go to work today	4,794	207,141	10%	10%
Drove a private car, truck or van	20,304	971,730	43%	49%
Drove a company car, truck or van	4,887	217,407	10%	11%
Passenger in a car, truck, van or company bus	2,283	76,437	5%	4%
Public bus	2,352	64,380	5%	3%
Train	4,602	24,639	10%	1%
Motor cycle or power cycle	414	26,205	1%	1%
Bicycle	849	44,184	2%	2%
Walked or jogged	1,785	106,119	4%	5%
Other	522	18,333	1%	1%
Not elsewhere included	1,779	74,757	4%	4%
Total people	**46,824**	**2,001,006**	**100%**	**100%**

Source: Statistics New Zealand

[5] http://nzta.govt.nz/network/projects/ngauranga-to-petone-cycleway/docs/n2p-executive-summary-cycle-groups.pdf

3.6 Freight Movements

3.6.1 HCV Movements

Several data sources were reviewed to try to get an accurate representation of the HCV flows in the Hutt Valley and the HCV movements to and from the Seaview / Gracefield area. These include the Wellington Transport Strategic Model (WTSM), the Northern Wellington SATURN Model (NWSM) and HCC traffic data. In addition to these data sources, a survey of businesses in the Seaview / Gracefield area undertaken for the Valley Floor Connector Needs Analysis (see Section 1.3.1) was reviewed.

The WTSM transport model suggests that 75 percent of HCVs travelling on Seaview Road have an origin or destination within Hutt City or Upper Hutt City. The remaining 25 percent are distributed between Wellington City, northern SH1 and northern SH2. Knowledge of the area and consultation of other data sources indicates that this does not accurately reflect the actual HCV movements in the region. The HCV trip generation in the current WTSM model is a known weakness and GWRC are currently working on a project to improve this part of the model. For this reason, the new NWSM used electronic Road User Charges (eRUC) data in addition to the HCV demands from WTSM in order to more accurately reflect the commercial vehicle movements. However, the origin / destination results produced by NWSM are similar to those provided by WTSM in that a large proportion of HCVs remain in the Hutt Valley.

In the Valley Floor Connector Needs Analysis contract in 2003, a survey of Seaview/ Gracefield businesses found that 50 percent of HCVs remained in the Hutt Valley while the remaining 50 percent travelled to destinations on the wider state highway network as shown in Figure 3-8. Almost all HCVs that travel south towards Ngauranga and north to Porirua will access SH2 via The Esplanade. Anecdotal information collected during meetings, on the 6th and 28th June 2013, with stakeholders from the freight industry during this project confirms that the survey results are a better reflection of the HCV activity in the area than WTSM, despite the age of the survey.

Figure 3-8: HCV Origins and Destinations for Seaview/Gracefield

HCC traffic count data collected between 2003 and 2012 was also reviewed. While this data does not provide origin / destination information, it does provide data for different user classes. This data indicates that approximately 10 percent of traffic on The Esplanade are HCVs. Randwick Road carries approximately 7 percent HCVs.

3.6.2 Rail Freight

KiwiRail operates freight trains to and from Wellington. The freight trains follow the same rail line as the Hutt Valley Line. Previously KiwiRail operated a rail line that travelled south from the Woburn Station through Gracefield and into Seaview. This line has been decommissioned and as a result portions of the rail have been removed and other sections are no longer present or are in very poor condition. Sections of land have also been leased to other businesses that operate in the area. As an input to this project KiwiRail produced a high level estimate to refurbish and reinstate the rail line. The costs are estimated at $3M, including the necessary replacement of the bridge over Waiwhetu Stream. This high level estimate along with notes following consultation with KiwiRail are provided in Appendix F. KiwiRail have identified the following operational issues associated the Gracefield rail line making it an unlikely reinstatement candidate:

- Shunting of cars to split off the main rail line;
- The short distance to Wellington Port means that freight companies are unlikely to utilise it to avoid additional handling of the cargo and associated costs of that handling; and
- Conflicts with the public transport rail that uses the same lines.

KiwiRail currently has no plans to refurbish the rail line and proposals have been made to convert the decommissioned line into a trail for walking and cycling. This would allow the land to become useable and provide an additional 3.75km of shared paths for Hutt City. During consultation with

other stakeholders, it was also suggested that this rail corridor could be converted to a road for HCV use, thus allowing easier access to any Cross Valley Link options while avoiding busier urban roads such as Randwick Road.

3.7 Public Transport

Hutt City has freight rail, passenger rail and bus services available. The freight rail is privately owned and operated by KiwiRail. Passenger rail and bus services are operated by Metlink. The public transport volumes have been modelled in the Wellington Public Transport Model (WPTM) which is a facet of WTSM that can model the public transport movements in more detail. WPTM provides peak two hour flows for the AM and inter peak periods only. PM public transport flows are assumed to be the reverse of AM flows.

Table 3-3 summarises the volume of people travelling by bus on key roads in Hutt City from the Base 2011 and future 2031 WPTM/WTSM models. The assumptions used in this model are reported in Section 4.3.1. Screenshots of the WPTM outputs are provided in Appendix D. Passenger rail volumes are discussed later in this section.

Table 3-3: Public Transport Passenger Volumes in the AM and Inter Peak Periods

		Number of Passengers			
Road	**Direction**	**2011**		**2031[6]**	
		AM	**IP**	**AM**	**IP**
The Esplanade* (West of Fitzherbert Street)	Westbound	400	10	700	140
Estuary Bridge	Westbound	310	40	380	20
	Eastbound	80	30	60	30
Jackson Street* (West of Richmond Street)	Westbound	420	290	370	70
	Eastbound	220	200	320	350
Randwick Road	Northbound	60	80	50	50
	Southbound	80	80	50	80
Cuba Street	Northbound	180	210	230	340
	Southbound	200	260	370	210
Hutt Road (South of Jackson Street)	Northbound	210	180	280	330
	Southbound	160	250	70	40

*Peak flows on this road

[6] 2031 volumes taken from the P2G-2 WTSM model which includes the RoNS projects and P2G.

Generally, the number of passengers on public transport has increased by 24% in the AM peak in 2031. Overall the inter peak volumes are relatively stagnant. Some decreases are shown on specific corridors; however, this may be due to the proposed bus route and frequency changes that have been incorporated into the future WTSM/WPTM models. It is evident that bus patronage on The Esplanade is predicted to increase significantly.

3.7.1 Bus Routes

There are several bus routes that pass through the study area. Most of the bus routes travel along Cuba and Jackson Streets, however, three routes use at least a portion of The Esplanade. One route travels via Randwick Road while five use the Estuary Bridge. A summary of the bus routes and the key roads they travel is provided in Table 3-4. Additionally, maps illustrating the route taken by each bus service through the study area is provided in Appendix E.

Table 3-4: Summary of Bus Routes in the Study Area

Route No.	Route Name	Key Roads
80	Wainuiomata Commuter (to Wellington)	Waione Street The Esplanade from Cuba St to Hutt Rd
81	Eastbourne – Wellington	Waione Street
83	Eastbourne – Lower Hutt – Wellington	Randwick Road
84	Gracefield – Wellington	Waione Street
85	Eastbourne Express	Waione Street The Esplanade
91	Airport Flyer (Lower Hutt – Airport)	The Esplanade from Fitzherbert Street to Hutt Road
130	Petone – Naenae	Randwick Road Waione Street

3.7.2 Passenger Rail

The Hutt Valley Line (Wellington – Upper Hutt) travels through the study area. From the north, the railway line follows Cambridge Terrace under Whites Line East and Randwick Road and crosses the river south of Wakefield Street. It then travels west meeting up with Wakefield Street before diverting south again under Hutt Road to follow Western Hutt Road.

There are three train stations in the study area:

- Woburn Station at Cambridge Terrace north of Whites Line East;
- Ava Station at North Street; and
- Petone Station at Western Hutt Road near Jackson Street.

The Melling Line travels adjacent to Western Hutt Road from the north and joins up with the Hutt Valley Line just north of the Petone Station. Rail passenger volumes from WTSM/WPTM are provided in Table 3-4. The table indicates that rail volumes will decrease in the future by approximately 300 people in the AM peak travelling westbound and southbound (the main AM peak direction of travel). However, passenger volumes in the opposite direction will increase. The number of people utilising the train system in both directions during the inter peak will also increase by 740 people in the year 2031.

Table 3-5: Rail Passenger Volumes in the AM and Inter Peak Periods

Road	Direction	Number of Passengers			
		2011		2031	
		AM	IP	AM	IP
East of Ava Station (Hutt Valley Line)	Westbound	4500	230	4200	310
	Eastbound	120	80	300	360
South of Petone Station (Hutt Valley Line and Melling Line)	Southbound	4900	230	4600	330
	Northbound	150	90	370	370

3.8 Existing Urban Situation

An assessment of the current urban situation in the study area was undertaken in conjunction with an assessment of the options, provided in Section 12 of this report. The full urban design assessment is provided in Appendix G. Figure 3-9 shows the key land use patterns and topographical features that influence this assessment.

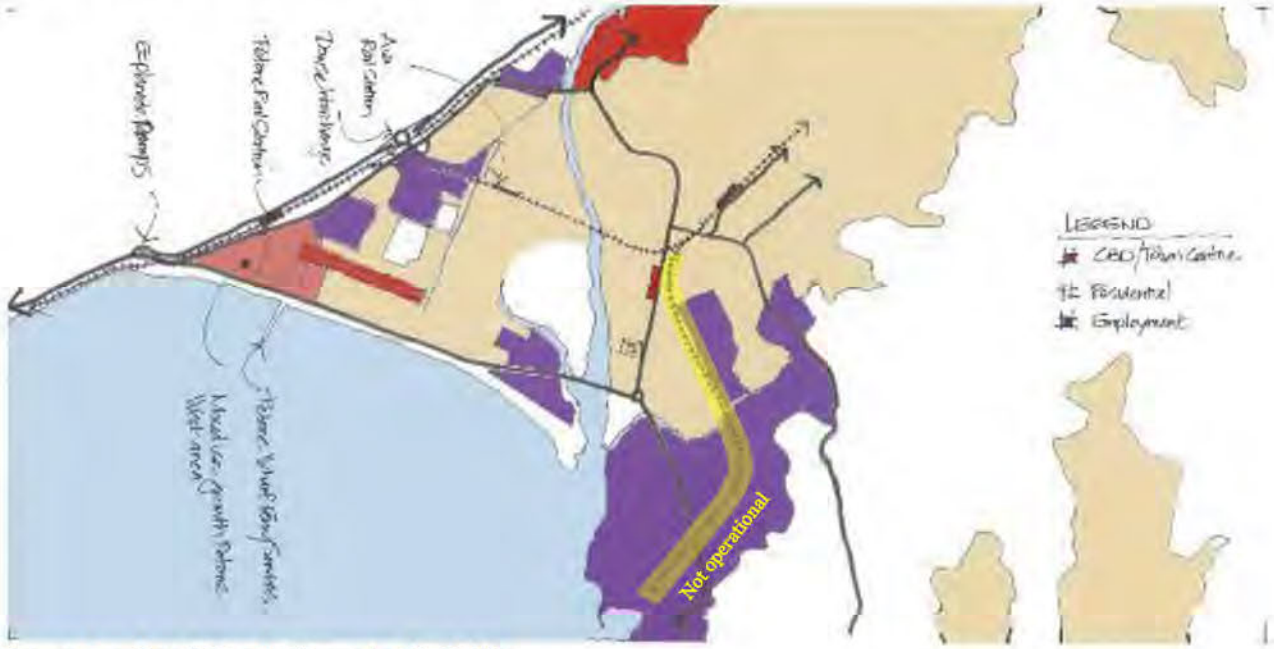

Figure 3-9: Land Use Patterns in Hutt City

3.8.1 Town Centres

Hutt CBD, Petone Town Centre (Jackson Street) and Moera Village are shown in red fill in Figure 3-9. Petone has become a desirable residential and small business address, and encouragement of this change is significant given the lower population growth rates in other areas of the Hutt Valley. Transport options are one important factor in this existing growth including direct access to SH2 and Petone Railway Station, and to a lesser extent ferry services from Petone Wharf. Access to open space is another key attractor so linkages to The Esplanade foreshore and Hutt River Trails will continue to grow in importance.

Moera Village shops, Randwick Primary School, churches and a marae are located along Randwick Road. While smaller in size, it remains an important neighbourhood centre. Mature trees make an attractive walking route along Randwick Road which is important for the primary school children.

Hutt City Council's (HCC) Plan Change 29 seeks to capitalize on this population and employment growth by encouraging mixed use intensification in Petone West. This area and the 'trade retail' area of Petone are shown in a lighter red fill in Figure 3-9. HCC's Plan Change 29 will achieve this by rezoning this area to allow a greater range of activities. Additionally under this change taller buildings as well as larger retail and commercial developments are now permitted in the area.

3.8.1.1 Future Town Centre Predictions

As property values increase many of the larger light industrial and trade retail sites will be subdivided for smaller commercial, retail and residential activities. This will lead to new streets, discouragement of front yard parking and a larger reliance on street parking to increase streetscape amenity. The Esplanade road frontage will transform from front yard car parking and industrial buildings to buildings with active frontages built on front boundaries. Kerbside parking and a high quality footpath on The Esplanade are important to encourage small commercial, retail and hospitality businesses in accordance with a desire to reduce severance issues.

3.8.2 Employment Areas

The industrial employment areas are shown in purple fill on Figure 3-9. Seaview is the dominant area, with 700 businesses employing around 6000 people, and is the largest heavy industrial precinct in the Wellington / Hutt Valley area. The other significant areas are Waione Street (west of the Hutt River), Petone North, Wakefield Street and Cornish Street.

In addition to predominantly industrial employment, the Seaview and Gracefield areas also has retail and food services employment types.

3.8.3 Transport Linkages

There are two rail stations in the project area, as shown in Figure 3-9. Petone is the most important station as it serves an existing town centre. Employment and residential intensification is occurring in Petone West and will be encouraged by Plan Change 29. Therefore, the walk to the station across Hutt Road is an important linkage to encourage rail patronage.

Ava Rail Station is located south of Wakefield Street alongside the Cross Valley Link route. The Ava Rail station is less utilised compare to other stations on the line and is located in a lower density employment and residential area. WTSM figures indicate that 400 passengers utilise the both Petone and Ava stations during the peak period.

The key roading elements are the SH2 interchange locations and the Hutt River bridges as they constrain options. Petone has south facing ramps only, with Hutt Road and The Esplanade providing the local arterial access roads. Dowse Interchange was upgraded in 2009 and has north and south facing ramps to SH2. The Estuary Bridge provides a direct access along The Esplanade to the Petone Interchange for Seaview, Moera and other eastern suburbs. Whereas for Dowse, access to central Lower Hutt and the eastern suburbs is available via Railway Avenue and Ewen Bridge.

3.8.4 Hutt River

The Hutt River is being developed, as detailed in the Hutt Corridor Plan, into an attractive green corridor with improved cycling/walking trails.

3.8.5 Esplanade Foreshore

For a country of two islands New Zealand has remarkably few cities that have foreshore roads close to major urban centres. New Plymouth's Molesworth Street, Auckland's Tamaki Drive, Mount Maunganui's Marine Parade, Napier's Marine Parade, Taupo's Lake Terrace, Queenstown's Marine Parade / Beach Street, Wanaka's Ardmore Street and perhaps most importantly Oriental Parade in Wellington are examples of such foreshore roads.

The Esplanade and Petone Beach important for the area as they are the only major seafront connection for the Hutt Valley. As evidenced by the scarcity of foreshores near urban centres it represents an important relationship between city and sea. The enhancement of the linkage between the sea and Petone is also listed as a project objective in section 1.6 so is important to consider when assessing options.

4 Network Characteristics

The following sections detail the traffic related characteristics of the study area under Do Minimum and future year forecast traffic flow conditions. The analysis undertaken provides a quantified measure of performance thus allowing comparisons to be made against potential improvement options and against the Project objectives. All traffic data utilised for this assessment has been obtained from HCC or the Northern Wellington SATURN Model (NWSM).

Results from two versions of the NWSM model have been presented, the earlier version which was completed in 2013 and used for the initial Seaview Links option investigation, and the updated version which was completed late 2014 and used for further option refinement of the Cross Valley Link (CVL) options (with and without The Esplanade depowering). As the underlying base model has been completely recalibrated and used different base assumptions the earlier NWSM and the updated NWSM results are not directly comparable. Both sets of results have been included as some option scenarios were not rerun with the new models.

4.1 Existing Traffic Volumes and Historic Growth

HCC collects data at different locations on their network every year. They also retain several permanent count sites that collect data throughout the year. Annual Daily Traffic (ADT) volumes on key roads in the study area have been estimated using this count data. As this data is generally only collected for one or two weeks out of the year, the counts do not necessarily represent an average for the year, nor have seasonal adjustment factors been applied. The permanent count sites have been used to calculate a traffic growth rate for Hutt City.

Since July 2009, Hutt City has had a traffic growth rate of -1%. This negative growth rate is consistent with the trends in the region and reflects the negative net migration and falling employment base in Hutt City as reported in the Draft Urban Growth Strategy (see Section 1.4.4).

The most recent traffic flows collected by HCC's data collection programme are presented in Table 4-1.

Table 4-1: ADT from HCC Count Sites

Road	Current ADT	% of HCV
The Esplanade	24,000	11
Wakefield Street West*	1,500	4
Wakefield Street East**	700	n/a
Randwick Road	17,000	7
Whites Line East	20,000	4

*Count taken between Rush Grove and Victoria Street
**Count taken between Cuba Street and Fitzherbert Street

4.2 Travel Time Surveys

On Tuesday 5th March 2013 SKM carried a journey time survey along The Esplanade. Runs were made in both the eastbound and westbound direction during all peak periods. A summary of the survey results are provided in Table 4-2.

Table 4-2: Summary of the SKM Journey Time Survey on The Esplanade

Peak Period	Direction	# Runs	Avg. Speed (km/h)	Travel Time (sec)	Coefficient of Variation
AM	EB	6	42	310	0.09
AM	WB	7	23	573	0.46
IP	EB	18	42	308	0.11
IP	WB	17	48	274	0.06
PM	EB	9	25	515	0.18
PM	WB	8	48	275	0.07

From Table 4-2 it is evident that travel times are higher in the westbound direction during the AM peak period and eastbound direction during the PM peak period. These directions and times are consistent with the principal commuter flow directions and are due to the congestion that occurs along The Esplanade. When there is no congestion the 3.62km route along Esplanade takes around 300 sec (5 min) at an average speed of over 40 km/h. Comparatively, when there is congestion the travel time increases to over 500 sec (8.5 min) at an average speed of around 25 km/h.

The coefficient of variation reported in Table 4-2 represents the travel time reliability of the trip. The highest level of variability is observed in the AM peak in the westbound direction. This is largely due to the high level of congestion on the road and the relatively large proportion of HCVs on the road. The next highest level of variation occurs in the eastbound direction during the PM peak. Again this is most likely caused by the level of congestion in that direction during the peak period. The coefficient of variation for other periods and directions are relatively stable and suggests that their travel time is more reliable.

4.3 Forecast Future Year Traffic Volumes

The NWSM has been utilised for the modelling of this project. The SATURN model has been used for the quantitative assessment, including economic assessment, of the 'Do Minimum' and proposed options. Due to the size of the study area and the impact that the Petone to Grenada project has on the Seaview Links project, the SATURN model has also been used for the operational assessment of the intersections and links instead of a micro-simulation modelling tool. This information is documented in later sections of this report.

4.3.1 Do-Minimum Modelling Assumptions

The models have a base year of 2011 with forecast years of 2021 and 2031. Medium growth trip matrices from WTSM 2011 have been used as the basis for the NWSM matrices. The medium growth assumption is used because it is consistent with the growth occurring in the region as a whole, which is included in the model.

The other Do-Minimum assumptions for the transportation modelling of the Seaview Links PFR include:

- Wellington Northern RoNS as per the RoNS construction programme, See Table 4.3;
- Passenger Transport Improvements as per the Wellington Regional Rail Plan 2010-2035;
- SH58 improvements (SH2/SH58 grade separation, uphill passing lane extension on SH58); and
- Petone to Grenada as per the PFR alignment but with an 80 km/h speed environment.

These assumptions are included in the Do-Minimum because they are either identified in the current Wellington Regional Land Transport Programme 2012-2015 or it is reasonable to expect them to be completed in the forecast years. Additionally no peak spreading has been predicted in the Do-Minimum model for the purposes of this assessment.

Since one of the aims of this investigation is to determine what effect the Petone to Grenada (P2G) link will have on Hutt City, P2G has been included in the Do-Minimum modelling with the assumption it will be constructed before 2021 and therefore is included in the 2021 model network. The P2G modelling arrangement is based on the PFR alignment as a preferred option for the P2G Scoping Report had not been chosen at the time of preparing the models. The P2G PFR alignment is modelled with a full interchange at the Petone end, north facing ramps only at the Tawa end and six lanes of SH1 between the Tawa Interchange and Transmission Gully. As the P2G project is currently at the scoping stage, the preferred arrangement is subject to change. It should be noted that an option to link P2G with the Dowse Interchange, with north facing ramps only at SH2, was considered (as part of the 2013 P2G Scoping phase works) but resulted in significantly less benefits, accessibility and network resilience. For these reasons it has been assumed that the main Hutt Valley Interchange with P2G will be at the western end of Petone (as per the P2G PFR).

Table 4-3 provides a detailed list of all the roading projects that have been included in the Do-Minimum model, including the years which they will be constructed.

Throughout the development of this PFR the NWSM has been refined. Results from the initial version of the model were delivered in July 2013 and are referred to as the "earlier model" throughout this report. NWSM was then recalibrated following the collection of additional data, results from which were delivered in April 2015. Results from this recalibrated NWSM version are referred to throughout this report as the "updated model".

Table 4-3: List of Roading Infrastructure Projects Included in the Do-Minimum Models

Wellington Northern Corridor RoNS	Construction Finish Date	2021	2031
Airport to Mt. Victoria Tunnel	2022	No	WTSM
Tunnel to Tunnel	2017	WTSM	WTSM
Terrace Tunnel Duplication	2024	No	WTSM
Ngauranga to Aotea Quay	2021	Included	Included
Transmission Gully	2020	Included	Included
MacKays to PekaPeka	2018	WTSM	WTSM
Peka Peka to Otaki	2020	WTSM	WTSM
Otaki to north of Levin	2024	No	WTSM
Other Schemes			
Petone to Grenada PFR Alignment	2021	WTSM	WTSM
PT Improvements as per the Rail Plan		WTSM	WTSM
SH2/SH58 Grade Separation		Included	Included
Uphill passing lane extension (SH58)		Included	Included

No =Not built, therefore not included in WTSM or SATURN modelling
WTSM = Project built but located beyond SATURN model extents, therefore only in the WTSM modelling
Included= Project operational and included in both WTSM and SATURN modelling

The ADT factors listed in Table 4-4 have been used to convert the peak hour models into ADT's. The ADT factors have been calculated using TMS counts from NZTA and the NWSM 2011 base model. These factors are derived from weekdays only as this is the most critical period with regards to traffic demand on the network.

Table 4-4: ADT Factors

Peak Hour	ADT Factor
AM	2
IP	11.3
PM	2

4.3.2 Do-Minimum Traffic Volumes

Table 4-5 summarises the 2011 Base traffic volumes in addition to the 2021 and 2031 forecast Do-Minimum volumes from NWSM for various locations in Hutt City using the earlier NWSM model and Table 4-6 shows this for the updated NWSM model. This forecast shows that demands in Hutt City are expected to grow in the future Do-Minimum scenario despite the negative growth rate given in Section 4.1. This is partially due to the demand matrices provided by WTSM as growth is expected in the Wellington Region as a whole. The extent of the growth predicted, however, is likely a product of the Petone to Grenada project that is included in the Do Minimum. This project is expected to create economic growth in Hutt City and change origin and destination patterns in the region.

Table 4-5: Forecast ADT from SATURN Actual Flows with P2G (Earlier Model)

Road	ADT (vpd)		
	Base 2011	2021	2031
The Esplanade West (West of Nevis Street)	20,100	25,100	26,800
The Esplanade East (West of Cuba Street)	18,600	22,200	23,400
Estuary Bridge	23,100	25,300	26,900
Randwick Road	15,600	15,500	16,300
Whites Line East	17,600	19,100	20,300
Wakefield Street West (East of Hutt Road)	1,100	1,300	1,600
Wakefield Street East (East of Cuba Street)	410	470	510

Table 4-6: Forecast ADT from SATURN Actual Flows with P2G (Updated Model)

Road	ADT (vpd)		
	Base 2011	2021	2031
The Esplanade West (West of Nevis Street)	21,000	23,500	24,700
The Esplanade East (West of Cuba Street)	20,700	22,400	23,800
Estuary Bridge	25,500	27,000	28,500
Randwick Road	17,000	16,900	17,700
Whites Line East	18,300	19,600	20,500
Wakefield Street West (East of Hutt Road)	1,100	1,300	1,500
Wakefield Street East (East of Cuba Street)	550	660	770

NWSM has also been run without P2G in place. Table 4-7 shows the predicted traffic volumes for this scenario as per the earlier model and Table 4-8 shows this for the updated model. Traffic volumes are generally lower under this scenario, with volumes on Wakefield Street West actually decreasing from the Base year model. Of note is that traffic flows on Randwick Road are greater without P2G than with it.

Table 4-7: Forecast ADT from SATURN Actual Flows without P2G (Earlier Model)

Road	ADT (vpd)		
	Base 2011	2021	2031
The Esplanade West (West of Nevis Street)	20,100	23,000	24,500
The Esplanade East (West of Cuba Street)	18,600	20,000	21,000
Estuary Bridge	23,100	23,500	24,600
Randwick Road	15,600	16,100	17,000
Whites Line East	17,600	18,200	19,600
Wakefield Street West (East of Hutt Road)	1,100	900	1,000
Wakefield Street East (East of Cuba Street)	410	450	480

Table 4-8: Forecast ADT from SATURN Actual Flows without P2G (Updated Model)

Road	ADT (vpd)		
	Base 2011	2021	2031
The Esplanade West (West of Nevis Street)	21,000	21,500	22,100
The Esplanade East (West of Cuba Street)	20,700	20,900	21,800
Estuary Bridge	25,500	25,600	26,600
Randwick Road	17,000	17,600	18,400
Whites Line East	18,300	18,900	19,900
Wakefield Street West (East of Hutt Road)	1,100	850	900
Wakefield Street East (East of Cuba Street)	550	600	690

Together these four tables show that the Hutt Valley road network will be put under additional strain if P2G is built, however these changes are relatively small. P2G more directly connects two business districts, Hutt City and Porirua, and subsequently promotes economic growth. This growth will result in increased employment and improved network connectivity and is the primary cause of the increased vehicle flow.

There are some discrepancies between the 2011 base results and those mentioned in Section 3.2. Notably, the current observed flow on The Esplanade (24,000 ADT is recorded at 20,100 ADT in the model). This model discrepancy is significant, but the slightly higher assumption of medium growth should convert this into more reliable future volumes. Nevertheless, the model is most useful as a tool for comparison and should be treated as such. Subsequently, in this report the difference between results are of more importance than the actual results. These lower than actual recorded demands and forecast demands are being investigated further by the Transport Agency. As such, options, designs and outputs have been mindful of the impact increased demands may have as a result of these issues being resolved in subsequent versions of the NWSM.

Generally the updated NWSM is showing higher flows than the previous NWSM version. The exception to this is the west end of The Esplanade which is showing a decrease of 1600 and 1500 vehicles with P2G included and excluded respectively in 2021 and a decrease of 2100 and 2400 respectively in 2031.

4.3.3 Forecast Land Use

Hutt City Council has aspirations to grow the Seaview / Gracefield area and has outlined this aspiration in many of the plans discussed in Section 1.4. However, it was deemed necessary to determine how the future models change with respect to land use. In order to do this, a brief sector based analysis was completed using the NWSM matrices. The model area was split into 10 different geographical areas and the origin and destination pairs within these areas were then determined and graphed. Maps and graphs of this work have been provided as Appendix H.

The results of this sector analysis indicate that the overall growth in trips from the 2011 Base model to the 2031 forecast model (without Petone to Grenada) is 20% overall. The Seaview and Gracefield sector experiences a growth of approximately 23% greater than the average of 20%. When these results are compared to the matrices that include the Petone to Grenada project, there are negligible differences (i.e. minimal additional growth in Seaview and Gracefield as a result of the Petone to Grenada project is modelled). The number of business in the Seaview/Gracefield area has however grown by 25% since 2002. This is higher than the 20% average growth experienced in other parts Hutt Valley. This supports the findings from the sector analysis which indicates that slightly more trips can be expected in the Seaview/Gracefield area than for the rest of the Hutt Valley.

This information indicates that the forecasted trip growth in the area is higher than the overall model. While this is consistent with HCC's growth aspirations for the Seaview / Gracefield area, the actual growth in the area may not achieve these aspirations. The Hutt City Urban Growth Strategy, discussed in Section 1.4.4, quotes Statistics New Zealand forecasts of 2% population growth over the next 20 years in Hutt City while Wellington is expected to grow by 10%.

The growth in the Seaview / Gracefield area is not wholly dependent on the population growth of Hutt City, however, should the population growth in the region be this low, the growth in Seaview is likely to be similarly low. Thus, the land use predicted in the model may not be considered a conservative estimation of the growth in the Seaview / Gracefield area.

4.4 Do Minimum Network Operations

The performance of the Do Minimum network has been assessed using outputs from the NWSM. The model outputs provide measurable comparisons for the network as a whole under a number of key criteria. The following data has formed the basis of the Do Minimum network analysis:

- General network statistics;
- Level of service that is currently provided on The Esplanade, Randwick Road and Whites Line East; and
- Journey times along The Esplanade and Waione Street from the Petone Interchange in the west to the Randwick Road roundabout in the east (and vice versa).

4.4.1 Network Statistics

The NWSM provides network statistics that indicate the overall network performance. Network statistics with and without P2G have been included in Table 4-9 show the effect that the Petone to Grenada project has on the network in the earlier model and Table 4-10 shows this effect in the updated model. It is of note that the 2011 base, 2031 with no P2G and 2031 with P2G models have not been run with the same matrix.

Table 4-9: Network Statistics for 2011 Base, 2031 (No P2G) and 2031 (P2G) (Earlier Model)

Peak	Network / Matrix	Average Speed (km/h)	Travel Time (pcu hrs/hr)	Total Delay (pcu hrs/hr)	Network Queue (pcu hrs/hr)	Travel Distance (pcu kms/hr)	Total Trips (pcus)
AM	2011	49	9,510	910	1,930	465,000	81,500
	2031 (No P2G)	48	11,170	1,420	2,190	541,000	97,200
	2031 (P2G)	53	10,620	1,140	1,590	556,000	97,700
IP	2011	59	5,070	70	595	298,000	72,900
	2031 (No P2G)	62	5,590	120	484	347,000	86,200
	2031 (P2G)	62	5,700	110	490	351,000	86,300
PM	2011	46	11,200	1,630	2,110	516,000	95,900
	2031 (No P2G)	47	12,690	2,080	2,230	594,000	112,300
	2031 (P2G)	50	12,540	1,690	2,060	620,000	112,900

Table 4-10: Network Statistics for 2011 Base, 2031 (No P2G) and 2031 (P2G) (Updated Model)

Peak	Option	Average Speed (km/h)	Travel Time (pcu hrs/hr)	Total Delay (pcu hrs/hr)	Network Queue (pcu hrs/hr)	Travel Distance (pcu kms/hr)	Total Trips (pcus)
AM	2011	50	9,160	900	1,550	455,000	82,200
	2031 (No P2G)	46	11,500	1,450	1,980	530,000	96,500
	2031 (P2G)	51	10,710	1,090	1,730	549,000	96,900
IP	2011	58	5,100	75	660	290,000	73,000
	2031 (No P2G)	59	6,040	135	890	354,000	85,900
	2031 (P2G)	58	6,080	110	805	355,000	85,900
PM	2011	45	11,300	1,530	1,960	510,000	96,400
	2031 (No P2G)	44	13,370	1,920	2,260	590,000	111,600
	2031 (P2G)	47	13,000	1,430	2,250	611,000	112,100

It is observed that in the AM and PM peaks, more trips are observed on the P2G network than on the network without P2G. This increase is largely due to the improved connectivity between Tawa/Porirua and the Hutt Valley. The P2G scoping report indicates that there will be a 40% increase in trips between the two areas, suggesting an increase in economic growth in both locations. To a lesser extent the removal of congestion will also increase the number of trips as more people may switch from public transport to private vehicles. Further discussion is available in the P2G Scoping Report.

Even though the number of trips have increased in both AM and PM peak instances the total travel time decreases by 7% and 3%, respectively but the total travel distance increases by 4% in both the AM and PM periods. Consequently the overall Average Speed increases by 1% in both the AM and PM periods. This is indicative of the reduction of congestion that will occur along the network as a result of P2G.

Conversely, the average speed during the Inter peak has decreased in the P2G option relative to the without P2G network. This is due to lower levels of congestion during the inter peak. As there is less congestion the relative increase in the travel distance in the P2G model is not offset by the relative reduction in total delays, therefore the average speed in the P2G model is lower.

4.4.2 Level of Service

The following tables will show the changing Level of Service (LOS) along three of main corridors in Hutt City. The LOS represents the quality of performance by a road. LOS A is given to the best operating roads and LOS F given to the worst. In this instance, the LOS is derived using the travel speed for through vehicles in addition to the volume to capacity ratio (V/C). However, the V/C only becomes a contributing factor if greater than one. This is the suggested method for analysing urban road segments by the Highway Capacity Manual (2010). The criteria are outlined in Table 4-11.

Table 4-11: Level of Service Criteria Based on Travel Speed and Volume to Capacity Ratio[7]

Travel Speed as a Percentage of Free Flow Speed (%)	LOS by V/C	
	≤1	>1
>85	A	F
>67-85	B	F
>50-67	C	F
>40-50	D	F
>30-40	E	F
≤30	F	F

To determine the LOS, the modelled speeds from the 2031 Do Minimum SATURN model are compared to the free flow speeds (FFS) identified by the model link. The AM and PM peak flow volumes are also compared to the SATURN modelled capacity to determine if the volume to capacity ratio is 1 or greater. The capacity used for comparison is obtained from the link capacities

[7] Adapted from Exhibit 17-2 from the Highway Capacity Manual (2010)

stated in the Do Minimum model and are is generally 1600 pcu/hr, with the exception of Wakefield Street, which is modelled with a capacity of 1200 pcu/hr.

Using these criteria with the existing average speeds from the travel time surveys conducted by SKM (March 2013), and average free flow speed of 50km/h[8] from the Do Minimum model, the current LOS on The Esplanade in 2013 is displayed in Table 4-12. As would be expected, the lowest Levels of Service are experienced westbound in the AM peak and eastbound in the PM peak.

Table 4-12: 2013 Travel Time Survey LOS on Petone Esplanade

Peak Period	Direction	Avg. Speed (km/h)	% of FFS	LOS
AM	EB	42.04	84%	B
AM	WB	23.43	47%	D
IP	EB	42.37	85%	B
IP	WB	48.11	96%	A
PM	EB	25.37	51%	C
PM	WB	47.61	95%	A

Table 4-13 shows the same criteria applied to the modelled free flow speeds in the 2011 Base model and 2031 Do Minimum model for the AM and PM peaks in the earlier NWSM model. This same table is included showing outputs from the updated NWSM as Table 4-14.

Table 4-13: 2011 Base and 2031 Do Minimum AM and PM Peak Link LOS (Earlier Model)

Link	Direction	AM LOS		PM LOS	
		2011	2031	2011	2031
The Esplanade (approaching Victoria Street)	EB	A	B	B	B
	WB	A	B	B	C
The Esplanade (approaching Cuba Street)	EB	B	B	B	B
	WB	A	A	B	B
Estuary Bridge	EB	A	B	B	C
	WB	B	C	B	C
Wakefield Street (approaching Cuba Street)	EB	A	A	A	A
	WB	A	A	A	A
Randwick Road (south end)	NB	A	A	A	A
	SB	A	A	A	A
Randwick Road (north end)	NB	A	A	A	A
	SB	B	B	A	A
Whites Line East (approaching Cambridge Terrace)	EB	A	B	A	A
	WB	A	A	B	C

[8] In the Do Minimum model the east and west sections of The Esplanade have 48km/h and 52km/h FFS. Subsequently an average of 50km/h is used.

Table 4-14: 2011 Base and 2031 Do Minimum AM and PM Peak Link LOS (Updated Model)

Link	Direction	AM LOS		PM LOS	
		2011	2031	2011	2031
The Esplanade (approaching Victoria Street)	EB	A	B	A	B
	WB	A	B	B	B
The Esplanade (approaching Cuba Street)	EB	B	B	A	B
	WB	A	A	A	B
Estuary Bridge	EB	A	B	B	C
	WB	B	C	B	B
Wakefield Street (approaching Cuba Street)	EB	A	A	A	A
	WB	A	A	A	A
Randwick Road (south end)	NB	A	A	A	A
	SB	A	A	A	A
Randwick Road (north end)	NB	A	A	B	B
	SB	B	B	B	B
Whites Line East (approaching Cambridge Terrace)	EB	A	A	A	A
	WB	A	A	A	A

While the levels of service shown in Table 4-13 may seem acceptable, these are not necessarily representative of the actual LOS experienced by road users. When comparing the results in Table 4-13 to those in Table 4-12, LOS based on actual travel time surveys, we can see that the model may be overestimating the cruise speeds along The Esplanade, and likely in the rest of the model as well. When reviewing these results we should consider the change in LOS between years (and in latter sections of this report, options) rather than the LOS itself as the main indicator of network operation.

Table 4-13 shows that The Esplanade and the Estuary Bridge generally have the poorest LOS than the other modelled roads assessed, particularly in the PM peak. The LOS on the Estuary Bridge also gets consistently worse in the future year.

Whites Line East also has a worsening LOS in the eastbound direction during the AM peak and in the westbound direction during the PM peak. This is consistent with increased traffic on the network and indicates that effects of congestion will be increasingly felt on Whites Line East in the future.

In the 2031 Do Minimum model the LOS has still deteriorated slightly even though improvements have been made to Petone Interchange. This is due to the increase in traffic volumes offsetting some of the congestion relief provided by the new interchange.

Table 4-14 shows a similar comparison between 2011 and 2031 as indicated by the earlier model. Generally the LOS is the same or better in the updated model. Of note is the Whites Line East LOS which is performing much better in the updated model, achieving LOS of A in all periods and assessment years, whereas previously the PM eastbound indicated a LOS of B and C in 2011 and 2031 respectively.

4.4.3 Journey Times

The route used to analyse the modelled journey times has been taken along The Esplanade and Waione Street from east of the Petone Interchange to west of Randwick Road, as depicted in Figure 4-1.

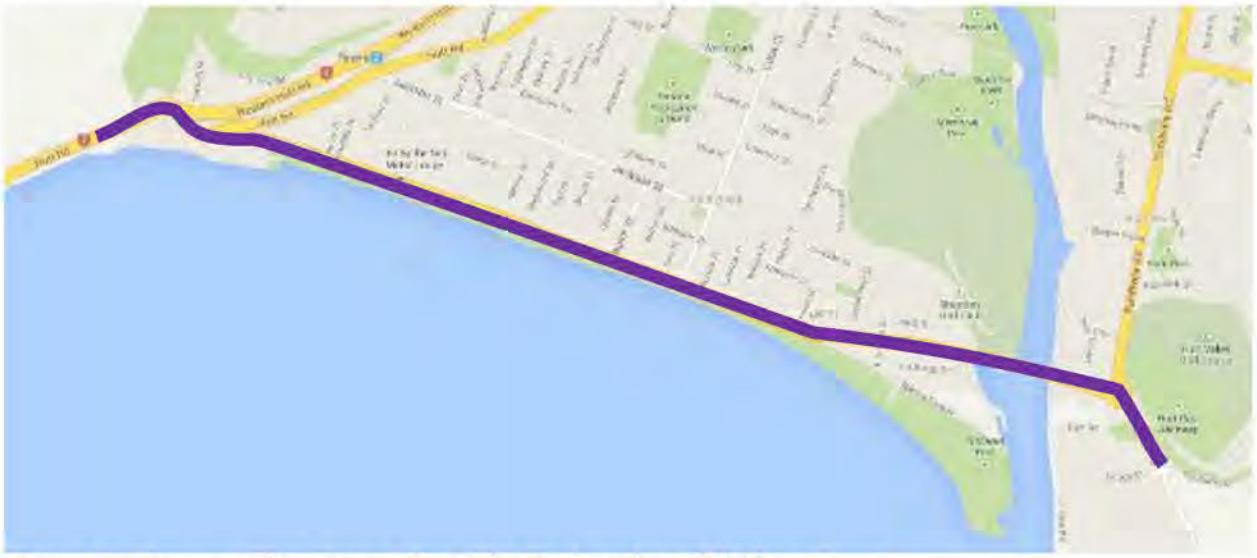

Figure 4-1: Journey Time Route along The Esplanade and Waione Street

The modelled time taken for the trip in the 2031 Do Minimum models has been plotted in Figure 4-2 and Figure 4-4 for the earlier model and Figure 4-3 and Figure 4-5 for the updated model. Journey times over the same route in the Base model have also been plotted for comparison. Various road names have also been plotted on the x axis of the diagrams as a reference.

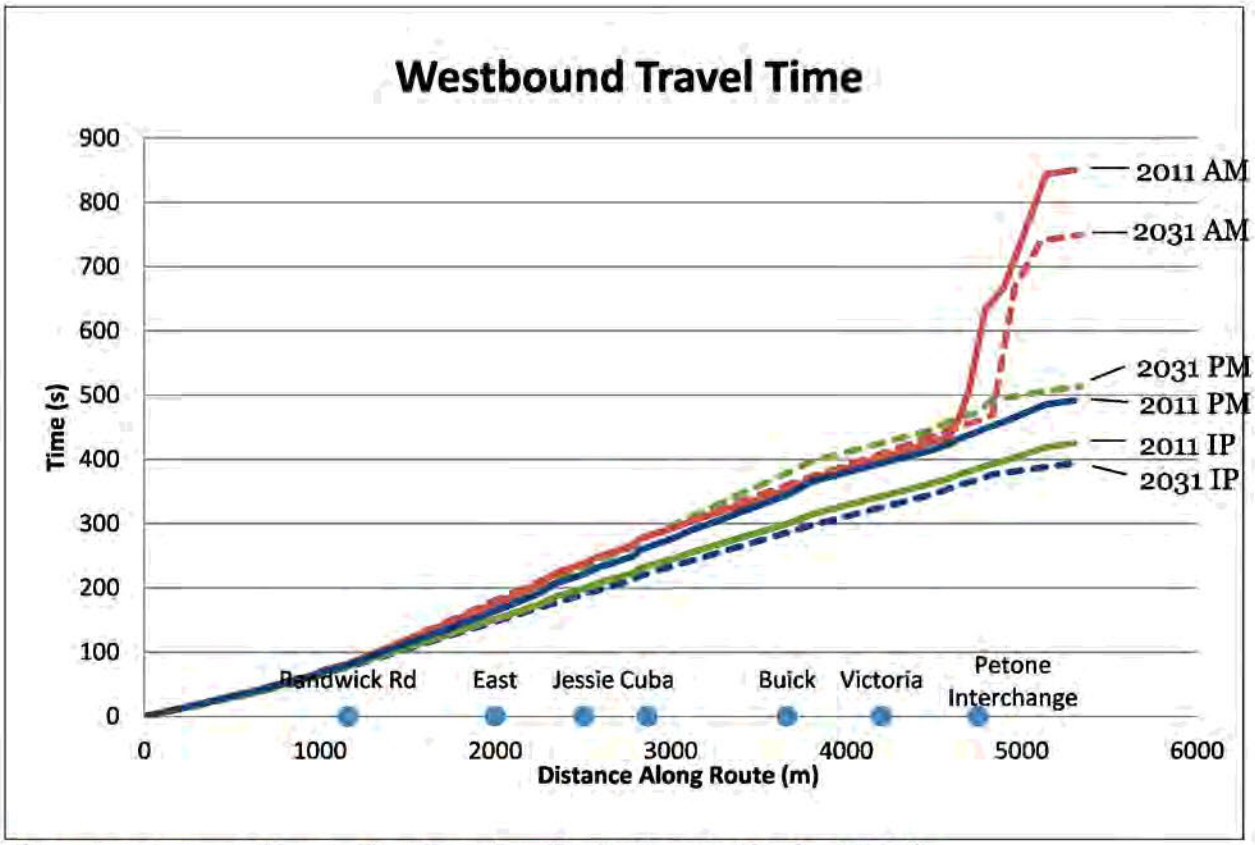

Figure 4-2: Journey Times – Westbound on The Esplanade (Earlier Model)

The westbound journey times in the AM peak are very consistent prior to reaching the Petone Interchange. After this point, both AM peak lines spike indicating the congestion faced at this location. The new interchange incorporated with the Petone to Grenada project, however, appears to improve the overall journey time in 2031 by approximately 100 seconds despite having more volume in the later model year.

The differences between the AM peak and inter peak journey times are less pronounced and follow a pretty steady progression. The 2031 inter peak journey time is approximately 30 seconds less than that of the Base model while the 2031 PM peak time is about 20 seconds greater than the Base model.

Figure 4-2 also suggests an improvement in travel time variability. This notion is supported by the size of the difference between the longest trip (AM) and the shortest trip (IP) decreasing from 2011 to 2031. This improvement will largely be due to the new Petone Interchange.

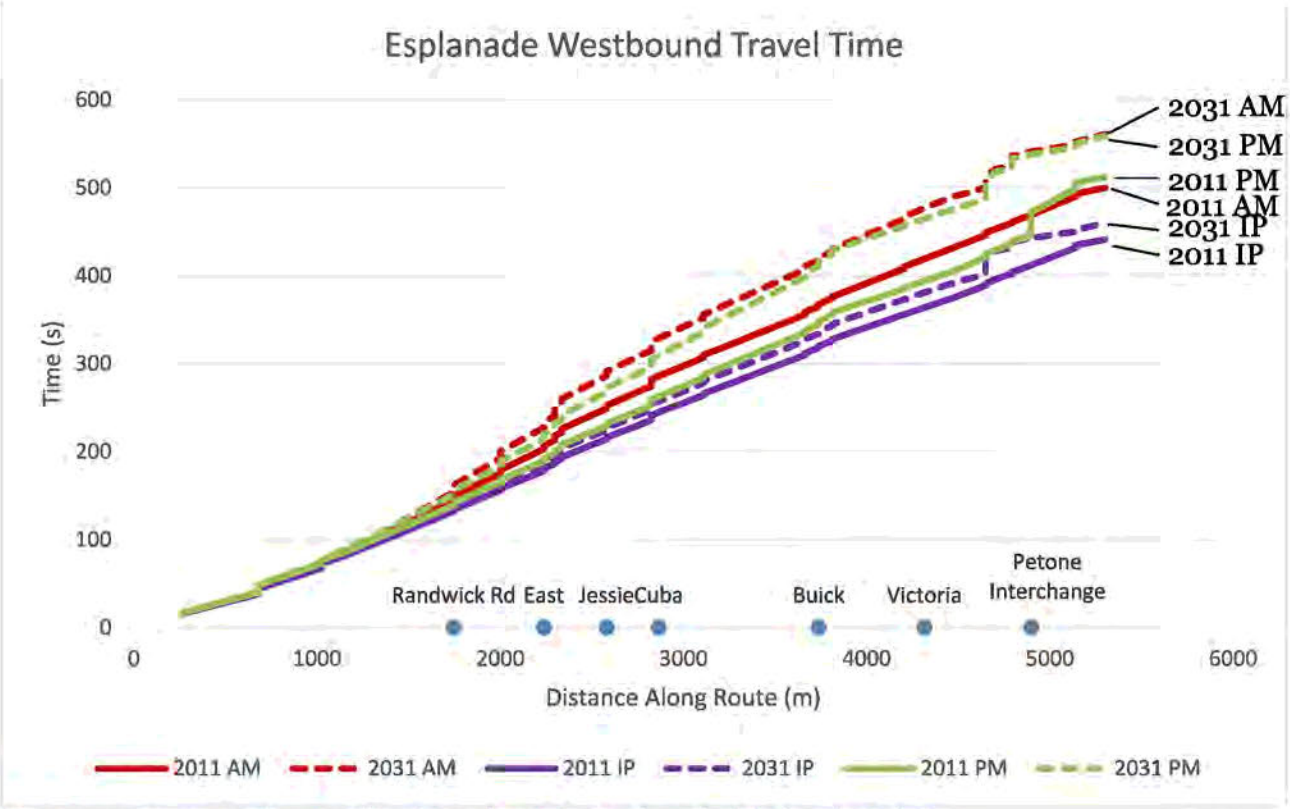

Figure 4-3: Journey Times – Westbound on The Esplanade (Updated Model)

The updated model is showing a significant reduction in journey times in the AM period along The Esplanade compared to the earlier model. This AM reduction is seen in both the 2011 and 2031 models and is in the order of five minutes and two minutes respectively and appears to occur in the approach to the Petone interchange.

Conversely, the IP and PM peaks are showing a higher journey time in both the IP and PM in the updated model. For the 2011 PM, 2031 IP and 2031 PM this is in the order of 60 sections.

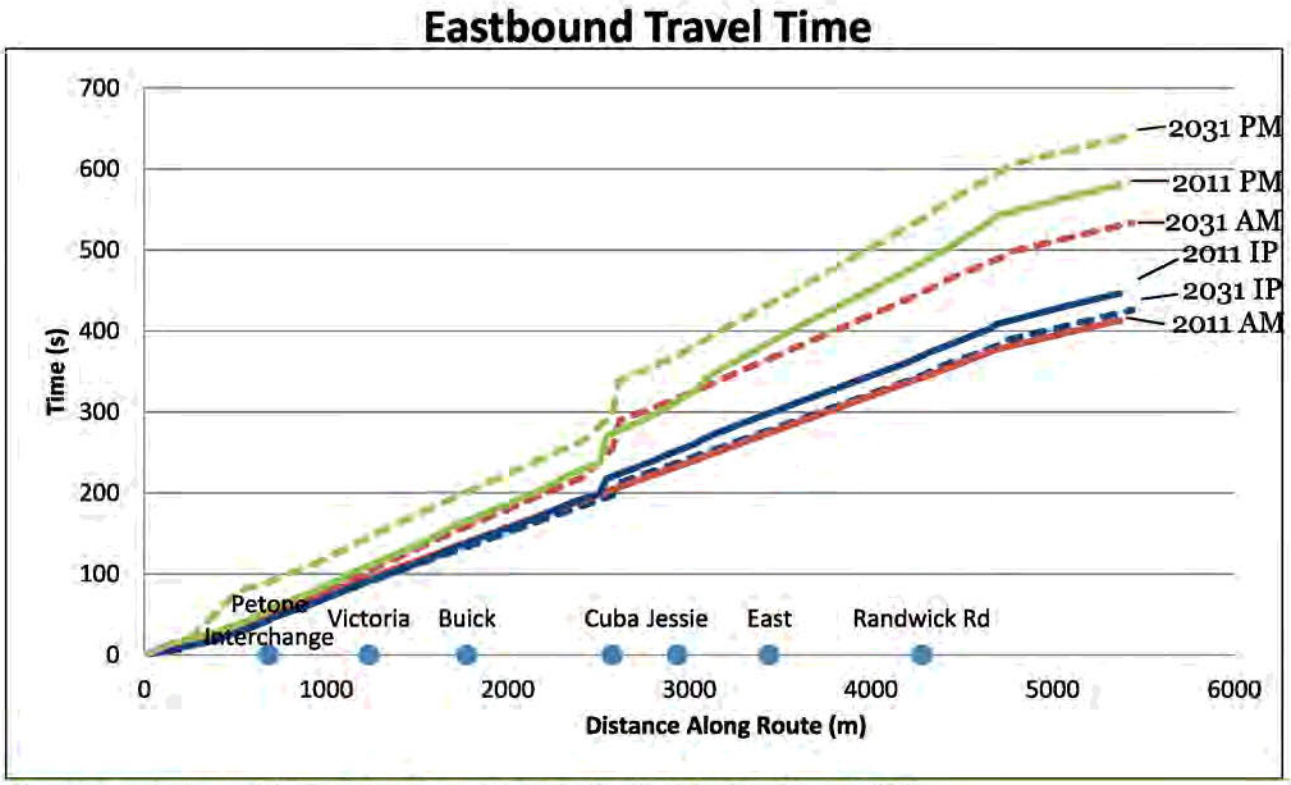

Figure 4-4: Journey Times – Eastbound on The Esplanade (Earlier Model)

As in the westbound direction, the AM journey times in the eastbound direction show the greatest difference between 2031 and 2011, however, in this instance travel in 2031 takes approximately 120 seconds longer than in the Base model. The overall travel time is greater but the journey also seems to be affected by a 10sec delay due to congestion near the Cuba Street intersection.

The eastbound PM peak has the highest travel time with the 2031 journey taking about 60 seconds longer than it did in 2011. Again the 2031 inter peak journey time is lower than that of 2011 by approximately 20 seconds despite having greater volumes on the road network. This is likely due to the overall travel time benefits provided by the new Petone Interchange linking to Petone to Grenada.

In contrast to the westbound direction the travel time variability appears to worsen in the eastbound direction. This is shown by the increase in the difference between the longest and shortest trips.

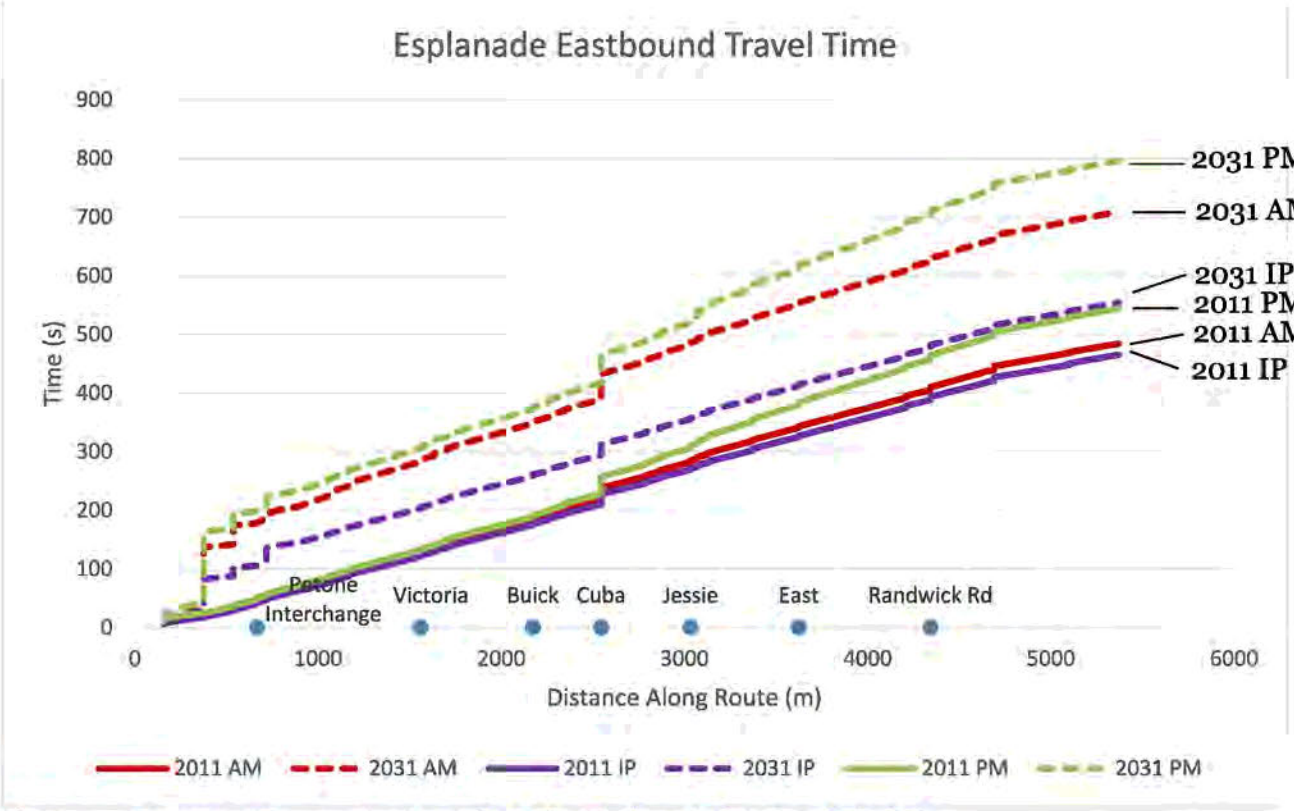

Figure 4-5: Journey Times – Eastbound on The Esplanade (Updated Model)

The updated model is showing higher overall travel times in all comparisons except for the 2011 PM. In 2011, journey times in the updated model have increased by 70 seconds in the AM, 18 seconds in the interpeak and reduced by 35 sections in the PM when compared to the earlier model. This same comparison in between the 2031 forecast models shows an increase of in the AM of 190 second (over 3 minutes), in the IP of 140 seconds (over 2 minutes) and in the PM 170 seconds (just under 3 minutes).

This shows a significant increase in travel times in the updated model over the earlier model. In 2031 this increase appears to occur at the Petone interchange. This can likely be attributed to the addition of signals on the upgraded Petone interchange however the magnitude of the increase suggests that the new signals could be further coordinated.

5 Crash History

The NZTA Crash Analysis System (CAS) was used to analyse the crash history of three road corridors in Lower Hutt from 1/01/2008 to 31/12/2012. This study period represented the most recent full-five year period at the time of the initial PFR development. An updated comparison accident for the 5-year period to 2014 is included later in this section. The corridors chosen were based on the options previously assessed as well as the options considered in this study, identified in Sections 6 and 7. Those corridors are listed below and presented in Figure 5-1.

a. The Esplanade / Waione Street;
b. Randwick Road; and
c. Wakefield Street / Whites Line West.

The study area has been selected using a 10m offset around midblock sections and 35m radii around intersections. Only police reported crashes have been included in this analysis. Throughout this section the crash history of the corridors will be compared to the national averages obtained from CAS for all non-state highway roads in New Zealand. The crash summary reports from CAS have been included in Appendix I.

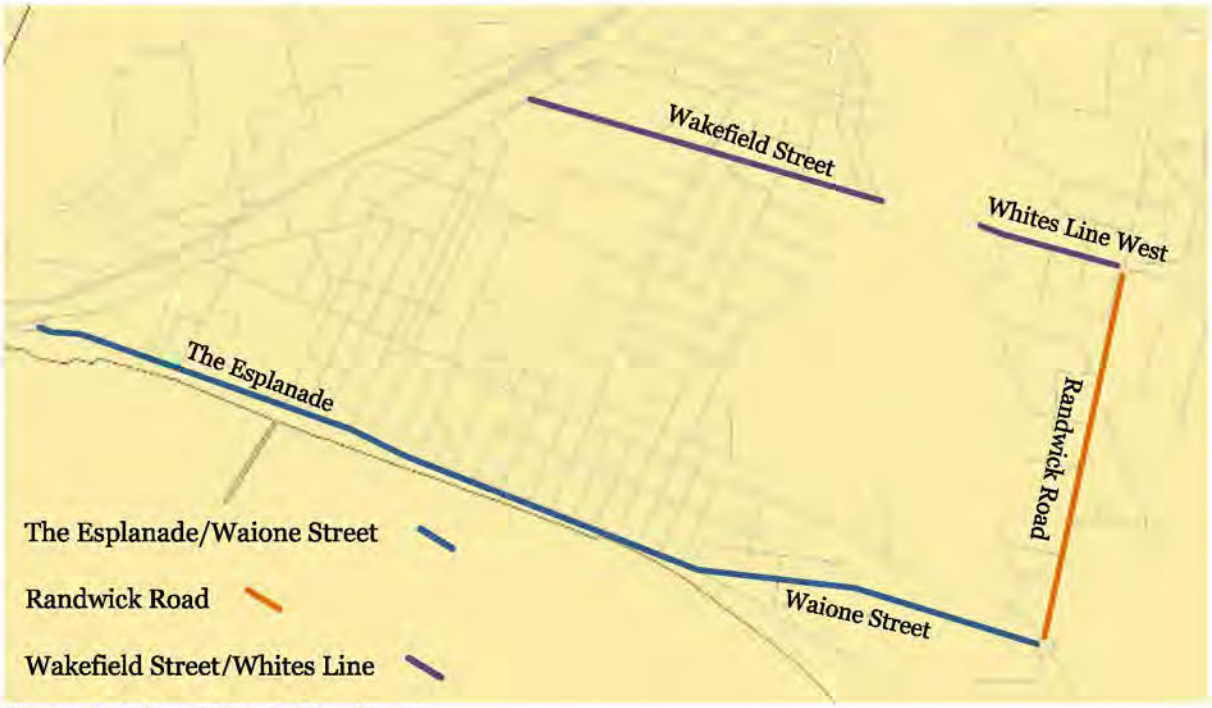

Figure 5-1: Crash Study Corridors

Updated crash history outputs covering the three corridors from 1/01/2010 to 31/12/2014 are included in Section 5.4. These are included to determine if the crash trends identified in the original analysis have changed significantly.

5.1 The Esplanade / Waione Street

Over the defined five year period analysed, a total of 150 crashes were recorded along The Esplanade / Waione Street corridor. Two of these crashes resulted in serious injury, 33 in minor injury and 115 were non-injury. The injury classification is based on the most severe injury sustained by any party involved in the crash. Table 5-1 summarises the crash severity by year. The average number of crashes per year over the study period is 30. The number of collisions in 2011 and 2012 is less than that average at 24 and 25 crashes, respectively.

Table 5-1: The Esplanade/ Waione Street Crash History 2008-2012

Year	Serious	Minor	Non-Injury	Total
2008	0	7	31	38
2009	2	6	21	29
2010	0	7	27	34
2011	0	6	18	24
2012	0	7	18	25
Total	2	33	115	150

Figure 5-2 shows the locations of the crashes on The Esplanade and Waione Street.

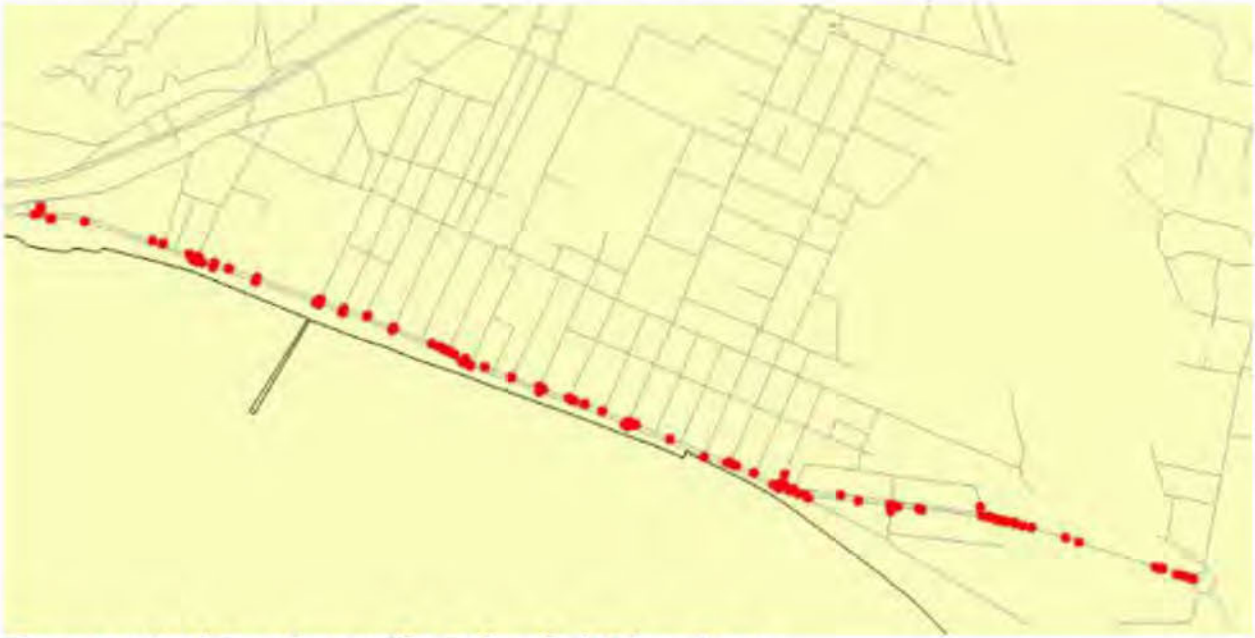

Figure 5-2: Crash Locations on The Esplanade / Waione Street

Based on the quantity of crashes the following intersections along The Esplanade/Waione Street Corridor were identified as having a notably poor crash history:

1. Waione Street at Kirkcaldy Street: There were nine crashes recorded at this intersection, all of which involved right turning vehicles out of Kirkcaldy Street.
2. Waione Street at the Randwick Road / Seaview Road roundabout: There were five crashes recorded at the Waione Street entrance/exit to the roundabout. Four of the crashes were rear ends due to the car ahead slowing or stopping for traffic in the roundabout. The remaining crash was caused by failure to give way to traffic in the roundabout.

5.1.1 Road User Groups

Table 5-2 summarises the road user type and crash severity. Since most crashes involve more than one road user type, the total number of road users (323) is greater than the total number of crashes (150). Approximately 55% of the road users involved in crashes were cars or station wagons.

Table 5-2: Road User/Vehicle Type by Crash Severity

Road User	Serious	Minor	Non-Injury	Total	% of Total	National Average (%)
Bus	0	0	8	8	2	1
Car/Station Wagon	0	47	131	178	55	74
Cyclist	0	7	1	8	2	2
Moped	0	0	2	2	1	1
Motorcycle	0	3	7	10	3	2
Pedestrian	1	3	0	4	1	2
School Bus	0	0	1	1	<1	<1
SUV	0	5	28	33	10	7
Taxi	0	0	1	1	<1	1
Truck	0	9	21	30	9	3
Van or Utility	3	10	35	48	15	7
Total	4	84	235	323	100	100

There were four pedestrians and eight cyclists involved in crashes. Unsurprisingly, due to their vulnerability, the injury rate for pedestrians and cyclists is significantly higher than the overall injury rate (92% vs. 27%). Failure to give way by motorists was noted as a factor in over half of the pedestrian and cyclist crashes (7 of 12).

Compared to the national averages by road user types, there are higher rates of crashes involving vans/ utility vehicles, SUVs and trucks on The Esplanade. While the proportion of truck crashes are higher than the national average for non-state highway roads it is still representative of the traffic profile along this corridor as The Esplanade is made up of 10% HCVs. All other road users with the

exception of cars have similar crash proportions to the national average. Car crashes along this corridor are well below the national average.

5.1.2 Intersection/Midblock Comparison

Table 5-3 summarises the crash severity by location type.

Table 5-3: Crash Severity by Location Type

Location	Serious	Minor	Non-Injury	Total	% of Total	National Average (%)
Intersection	0	24	55	79	53	47
Midblock	2	9	60	71	47	53
Total	2	33	115	150	100	100

The proportion of crashes occurring at midblock locations versus intersections is approximately the same with 79 crashes occurring at intersections (53%) and 71 crashes occurring at midblock locations (47%). Whilst the two serious injury crashes occurred at midblock locations, the proportion of injury crashes is less for the midblock than for intersections crashes (15% vs. 30%). When compared to the New Zealand average there is a higher proportion of intersection crashes. This will most likely be due to the relatively higher number of intersections that are on this corridor.

5.1.3 Time of Day/Day of Week

The number of crashes occurring during each hour of the day is presented in Figure 5-3. This graph includes crashes that occurred on both weekdays and weekends. The number of crashes peaks three times, during the am and pm peaks and around noon. This is consistent with traffic and congestion peaking. Between 6pm and 7am there are five or fewer crashes per hour. The largest number of crashes per hour (15) occurs from noon to 1pm and from 5pm to 6pm.

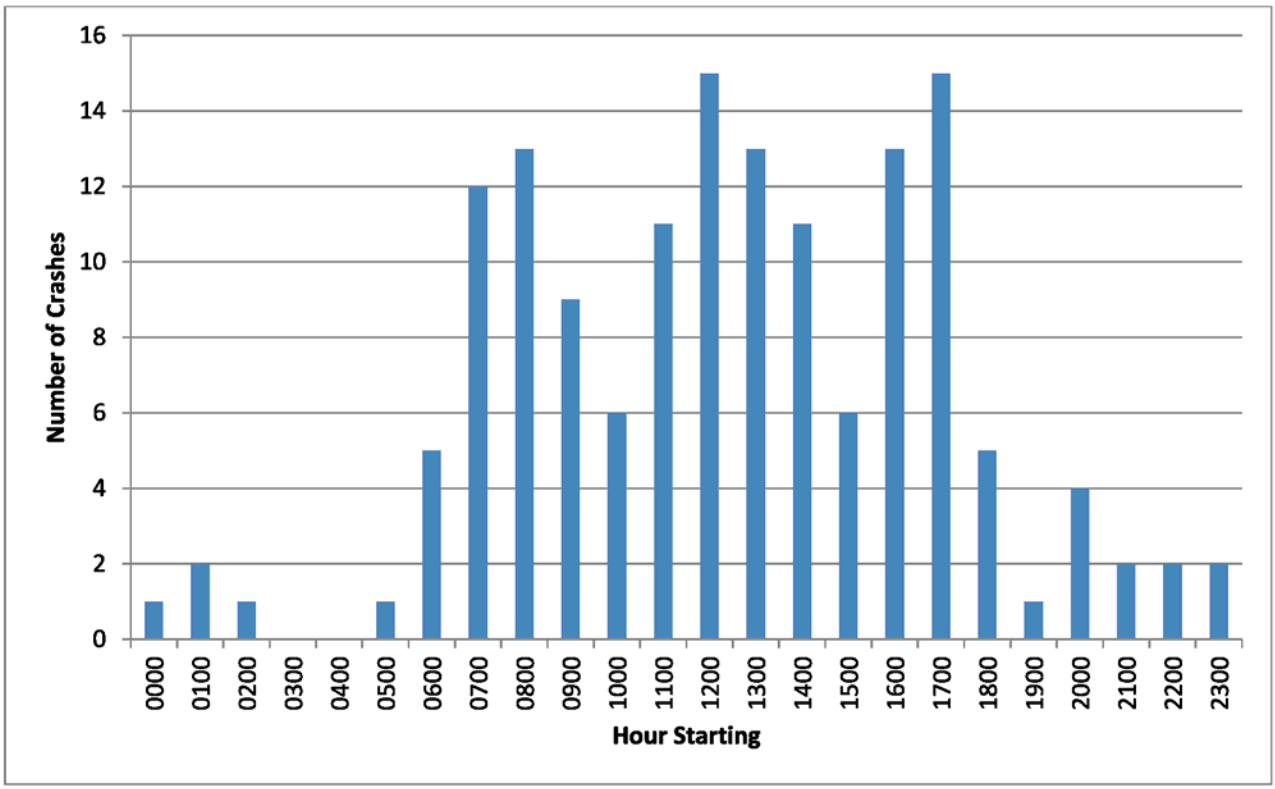

Figure 5-3: Number of Crashes by Time of Day

The number of crashes occurring during each day of the week, including severity of crash, has been presented in Figure 5-4.

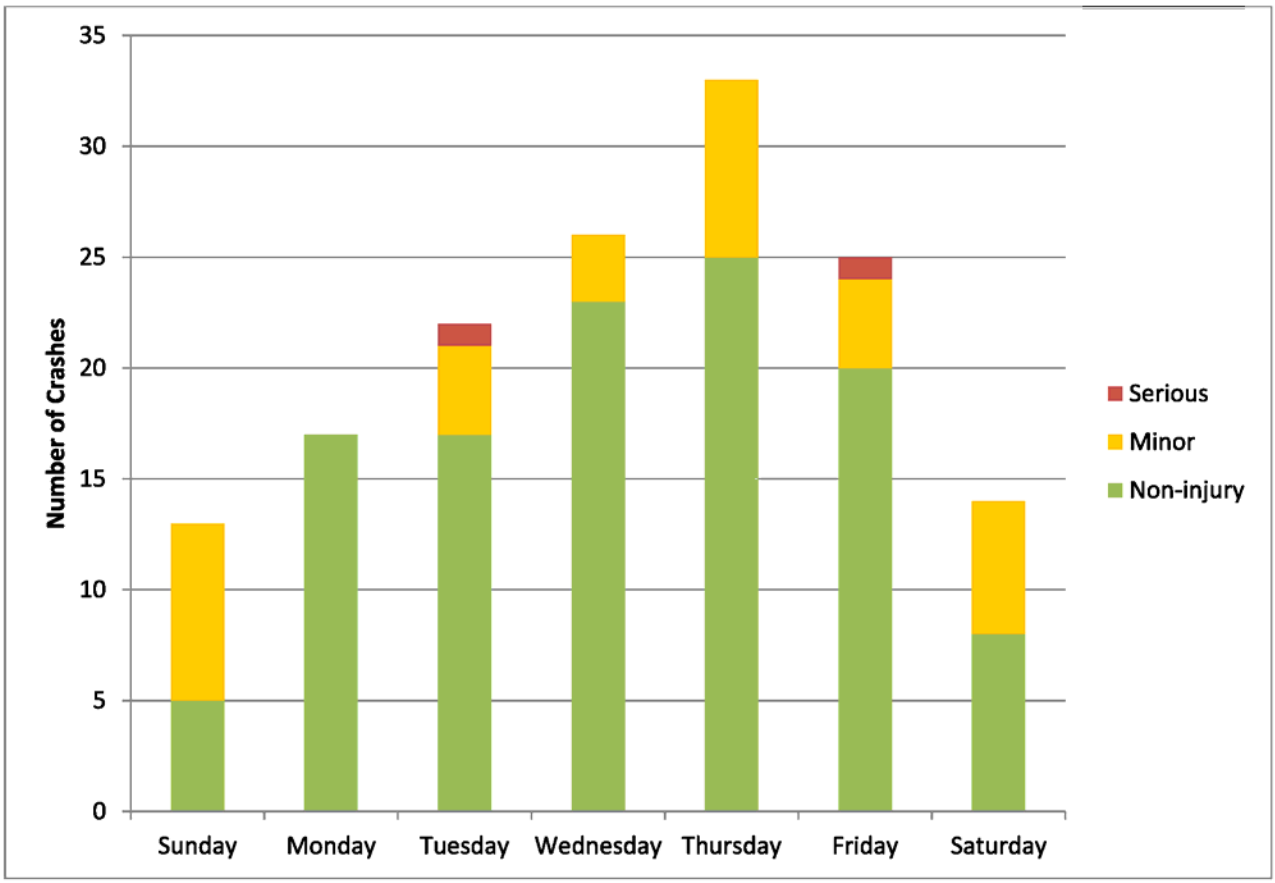

Figure 5-4: Number of Crashes by Day of the Week

The number of crashes occurring on Saturday and Sunday are 13 and 14, respectively. The number of crashes occurring on weekdays (Monday to Friday) range from 17 on Monday to 33 on Thursday. As expected more crashes occur during the weekdays as there is more traffic during the week than on weekends. Although there are fewer crashes on the weekend, the injury rate is higher with 52% of crashes resulting in injury on the weekend as opposed to an average injury rate of 16% on the weekdays.

5.1.4 Environmental Conditions

Analysis was undertaken to determine if environmental conditions were significant factors in crashes. Table 5-4 and Table 5-5 present the crash severity by road and light condition and environmental conditions, respectively.

Table 5-4: Crash Severity by Road and Light Conditions

	Dry	Wet	Light	Dark
Serious	2	0	2	0
Minor	24	9	28	5
Non-Injury	93	22	99	16
Total	119	31	129	21
Grand Total	150		150	

Table 5-5: Environmental Conditions

	Light	Dark	Total	% of total	National Average (%)
Dry	105	14	119	79	75
Wet	24	7	31	21	25
Total	129	21	150		
% of total	86	14			
National Average (%)	68	32			

The two serious injury crashes occurred during light and dry conditions. 79% of crashes occurred in dry conditions and 86% occurred during daylight with 70% during both light and dry conditions. Overall when compared against the national averages, wet and dark condition crashes are less common implying that environmental factors are not a major factor at this site.

5.1.5 Crash Movement Type

Table 5-6 presents the number of crashes by crash movement along The Esplanade/Waione Street corridor.

Table 5-6: Crash Movement Types

Crash Movement	Crashes	% of Total	National Average (%)
Overtaking	19	13	6
Straight Road - Lost Control/Head On	11	7	9
Bend – Lost Control/Head On	5	3	21
Rear End/Obstruction	85	57	35
Crossing/Turning	27	18	24
Pedestrian	3	2	4
Miscellaneous	0	0	1
Total	150	100	100

The most common crash movement type was rear end / obstruction accounting for 57% of crashes (85 of 150). This is significantly high proportion relative to the national average and is indicative of the large number of intersections in the area and does not necessarily indicate there is a crash problem along this road. Other notable crash movement types for The Esplanade / Waione Street are crossing / turning (18%) and overtaking (13%). These are common crash types in urban areas due to the congestion and close proximity of intersections to one another.

5.2 Randwick Road

Over the defined five year period analysed, a total of 49 crashes were recorded along the Randwick Road corridor. One of these crashes resulted in serious injury, 11 in minor injury and 37 were non-injury. Table 5-7 summarises the crash severity by year. The average number of crashes per year over the study period is 10. The number of collisions in 2011 and 2012 is less than that average at 5 and 7 crashes, respectively.

Table 5-7: Randwick Road Crash History 2008-2012

Year	Serious	Minor	Non-Injury	Total
2008	0	4	8	12
2009	0	2	12	14
2010	0	2	9	11
2011	0	2	3	5
2012	1	1	5	7
Total	1	11	37	49

Figure 5-5 shows the locations of the crashes on this corridor.

Figure 5-5: Crash Locations on Randwick Road

The three locations listed below have been identified on Randwick road as having markedly poor crash history:

1. Randwick Road at the Waione Street / Seaview Road roundabout: All five crashes recorded at the Randwick Road entrance / exit to the roundabout were rear end crashes.
2. Randwick Road at Randwick Crescent: There were six crashes recorded at this intersection. No overarching theme was determined.
3. Randwick Road at York Street: There were five crashes recorded at this intersection. Four of the crashes were rear ends due to the car ahead slowing or stopping for pedestrians, a queue or to turn. The remaining crash was due to a driver failing to give way to a pedestrian on the footpath.

5.2.1 Road User Groups

Table 5-8 summarises the road user type and crash severity. Since most crashes involve more than one road user type, the total number of road users (98) is greater than the total number of crashes (49). Approximately 78% of the road users involved in crashes were cars or station wagons.

Table 5-8: Road User/Vehicle Type by Crash Severity

Road User	Serious	Minor	Non-Injury	Total	% of Total	National Average (%)
Bus	0	0	1	1	1	1
Car/Station Wagon	1	14	61	76	78	74
Cyclist	0	2	0	2	2	2
Motorcycle	1	0	0	1	1	2
SUV	0	1	3	4	4	7
Taxi	0	0	1	1	1	1
Van or Utility	0	3	9	12	12	7
Wheeled Pedestrian	0	1	0	1	1	2
Other	0	0	0	0	0	4
Total	2	21	75	98	100	100

There were two cyclists and one wheeled pedestrian involved in crashes. All three collisions resulted in minor injury to one of the parties involved. There are no truck crashes along this corridor but the overall proportion of crashes by user type is approximately similar to the national average, implying there are no safety risk for any specific user group.

5.2.2 Intersection/Midblock Comparison

Table 5-9 summarises the crash severity by location type.

Table 5-9: Crash Severity by Location Type

Location	Serious	Minor	Non-Injury	Total	% of Total	National Average (%)
Intersection	0	5	19	24	49	47
Midblock	1	6	18	25	51	53
Total	1	11	37	49	100	100

The proportion of crashes occurring at midblock locations versus intersections is approximately the same with 24 crashes occurring at intersections (49%) and 25 crashes occurring at midblock locations (51%). This is very similar to the national averages. In this instance the proportion of midblock crashes with injuries is slightly greater than those at intersections. The results are representative of the fact that in this corridor there are larger midblock sections and fewer intersection.

5.2.3 Time of Day/Day of Week

The number of crashes occurring during each hour of the day is presented in Figure 5-6. This figure presents crashes that occurred during both weekdays and weekends. Between 7pm and 7am there are 2 or fewer crashes per hour. The largest number of crashes per hour (6) occurs from 6pm to 7pm.

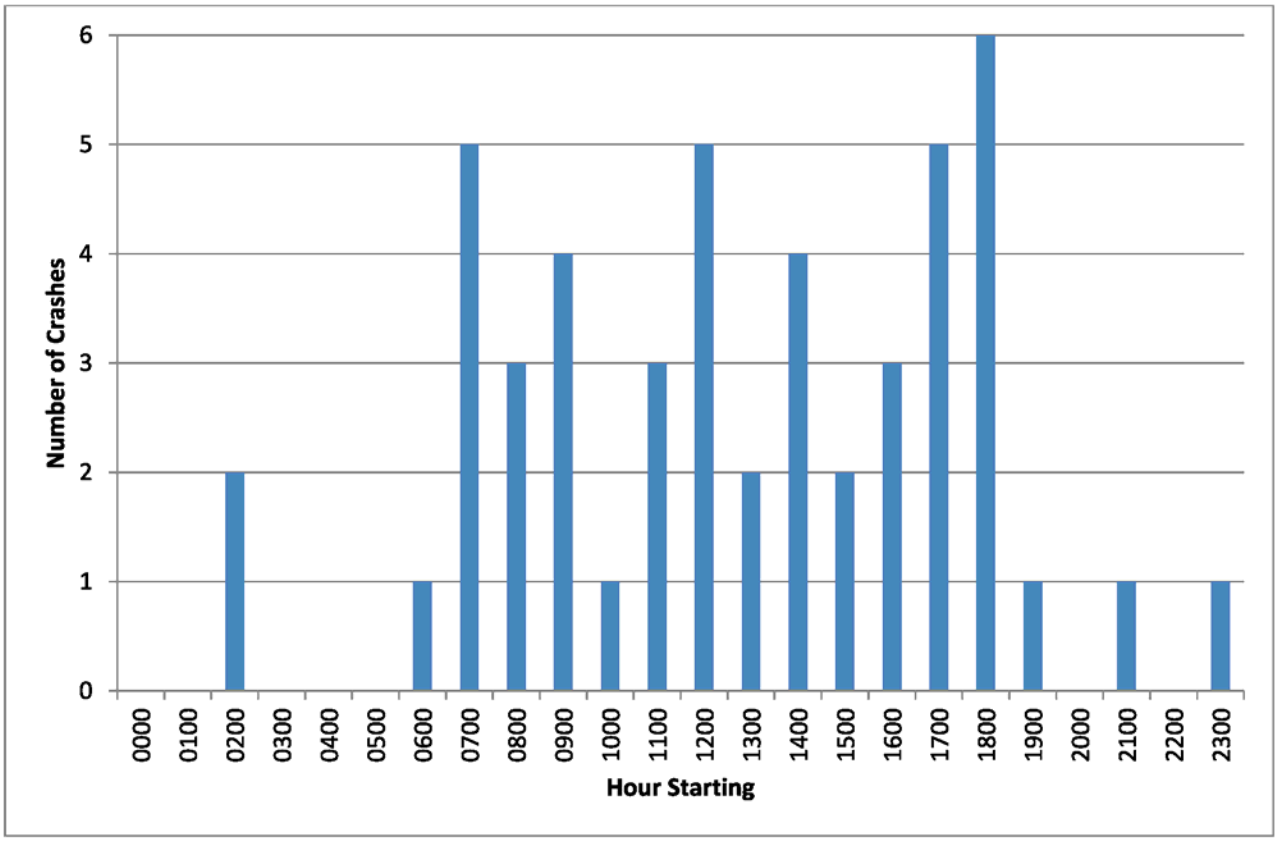

Figure 5-6: Number of Crashes by Time of Day

The number of crashes occurring during each day of the week, including severity of crash, has been presented in Figure 5-7.

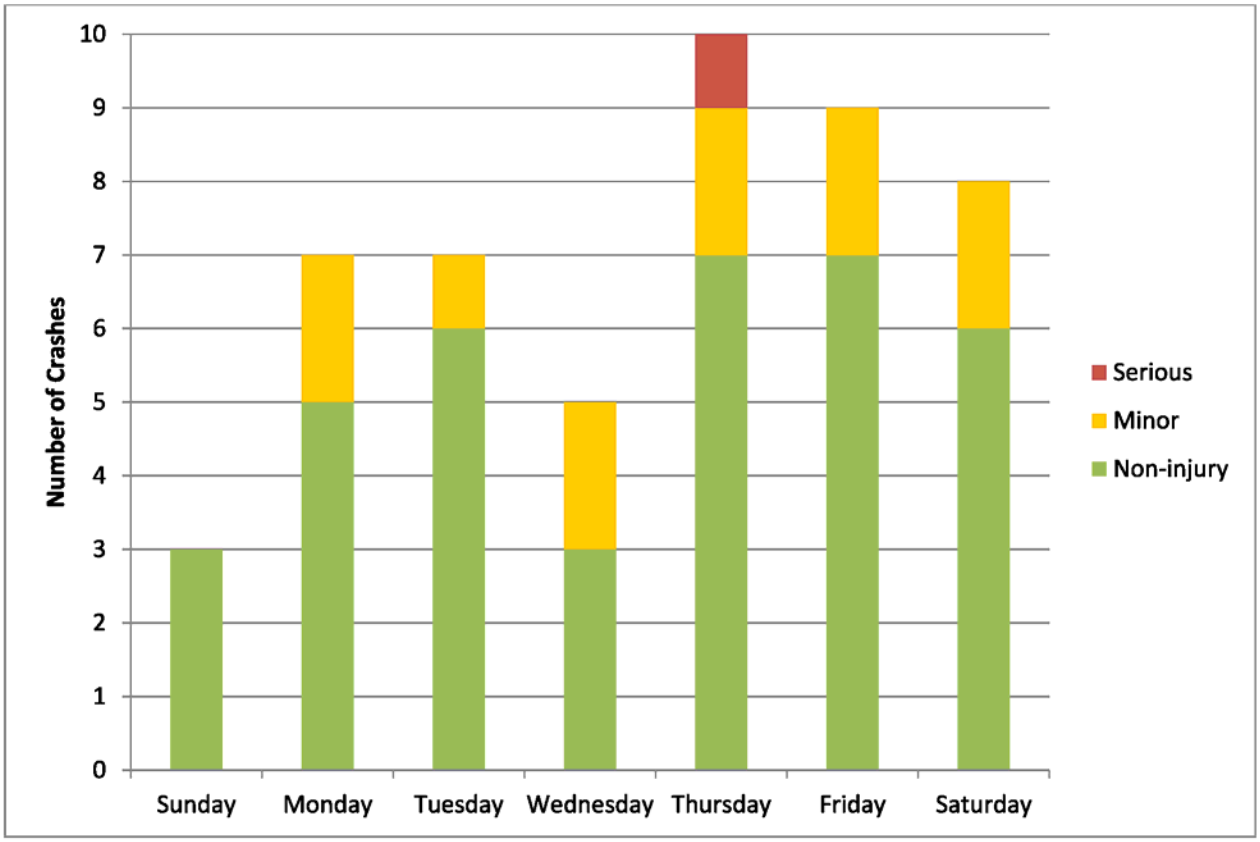

Figure 5-7: Number of Crashes by Day of the Week

The fewest number of crashes occur on Sundays (3) with no recorded injuries. The highest number of crashes occur between Thursday and Saturday of each week, with the highest number of crashes, 10, occurring on Thursday followed by 9 and 8 crashes on Friday and Saturday respectively. There is also 1 serious crash included in the 10 crashes which occur on Thursday. Most traffic occurs on weekdays and subsequently it is anticipated that most crashes will occur on these days too. However there are relatively crashes on Wednesday and comparatively more on Saturday. This indicates that Saturday crashes are overrepresented along this corridor.

5.2.4 Environmental Conditions

Table 5-10 and Table 5-11 present the crash severity by road and light condition and environmental conditions, respectively.

Table 5-10: Crash Severity by Road and Light Conditions

	Dry	Wet	Light	Dark
Serious	1	0	1	0
Minor	10	1	9	2
Non-Injury	34	3	30	7
Total	45	4	40	9
Grand Total	49		49	

Table 5-11: Environmental Conditions

	Light	Dark	Total	% of total	National Average (%)
Dry	38	7	45	92	75
Wet	2	2	4	8	25
Total	40	9	49		
% of total	82	18			
National Average (%)	68	32			

The serious injury crash occurred during light and dry conditions. 92% of crashes occurred in dry conditions and 82% occurred during daylight with 78% during both light and dry conditions. These proportions are relatively higher than the national averages. Overall, this indicates environmental factors are not a major concern along this corridor.

5.2.5 Crash Movement Type

Table 5-12 presents the number of crashes by crash movement along the Randwick Road corridor.

Table 5-12: Crash Movement Types

Crash Movement	Crashes	% of Total	National Average (%)
Overtaking	5	10	6
Straight Road - Lost Control/Head On	4	8	9
Bend – Lost Control/Head On	0	0	21
Rear End/Obstruction	32	65	35
Crossing/Turning	6	12	24
Pedestrian	2	4	4
Miscellaneous	0	0	1
Total	49	100	100

The most common crash movement type was rear end / obstruction accounting for 65% of crashes (32 of 49). Other notable crash movement types for Randwick Road are crossing / turning (12%) and overtaking (10%). In summary this corridor has similar crash type proportions to The Esplanade / Waione Street with the high proportion of rear end/obstruction crashes being indicative of a busy urban road with several intersections.

5.3 Wakefield Street / Whites Line West

Table 5-13 summarises the crash severity by year.

Table 5-13: Wakefield Street/ Whites Line West Crash History 2008-2012

Year	Serious	Minor	Non-Injury	Total
2008	0	0	0	0
2009	0	1	3	4
2010	2	1	2	5
2011	0	0	2	2
2012	0	0	2	2
Total	2	2	9	13

Over the defined five year period analysed, a total of 13 crashes were recorded along Wakefield Street. There were no reported crashes on Whites Line West during the analysis period. There were 2 serious injury and two minor injury crashes. The remaining nine were non-injury crashes. As with the previous two corridors assessed, Wakefield Street has seen a reduction in the number of crashes reported for 2011 and 2012 compared to the previous few years.

Figure 5-8 shows the locations of the crashes on this corridor.

Figure 5-8: Crash Locations on Wakefield Street

Along this corridor the Wakefield Street/Hutt Road intersection was identified has having a poor crash history. This intersection had six crashes over the five year study period. Three of these crashes were lost control on bend crashes. This indicates that there may be issues with the geometry of the intersection. Three of the four injury crashes reported on the Wakefield Street corridor occurred at this intersection.

5.3.1 Road User Groups

Table 5-14 summarises the road user type and crash severity.

Table 5-14: Road User/Vehicle Type by Crash Severity

Road User	Serious	Minor	Non-Injury	Total	% of Total	National Average (%)
Car/Station Wagon	0	3	10	13	57	74
Motorcycle	2	0	0	2	9	2
SUV	0	0	3	3	13	7
Truck	0	0	3	3	13	3
Van or Utility	0	0	2	2	9	7
Other	0	0	0	0	0	7
Total	2	3	18	23	100	100

There were 23 road users involved in the 13 crashes. The two serious injury crashes were single vehicle crashes involving motorcycles that lost control on a bend. There were no pedestrians or cyclists involved in any of the reported crashes on Wakefield Street during the study period. The proportion of car crashes are well below the national average and are underrepresented along this corridor. Additionally, truck crashes are overrepresented and are significantly higher than the national average.

5.3.2 Intersection/Midblock Comparison

Table 5-15 summarises the crash severity by location type.

Table 5-15: Crash Severity by Location Type

Location	Serious	Minor	Non-Injury	Total	% of Total	National Average (%)
Intersection	2	2	4	8	62	47
Midblock	0	0	5	5	38	53
Total	2	2	9	13	100	100

Eight of the crashes, including all of the reported injury crashes, occurred at intersections on Wakefield Street. Five crashes occurred at the midblock. This ratio is relatively higher than the national average but is still representative of the urban nature of the corridor and is not indicative of a serious crash problem.

5.3.3 Time of Day/Day of Week

The number of crashes occurring during each hour of the day is presented in Figure 5-9. The crashes presented in this charted occurred during both weekdays and weekends. The majority of crashes occur between 11am and 6pm (the afternoon). There are two or fewer crashes per hour for all hours of the day.

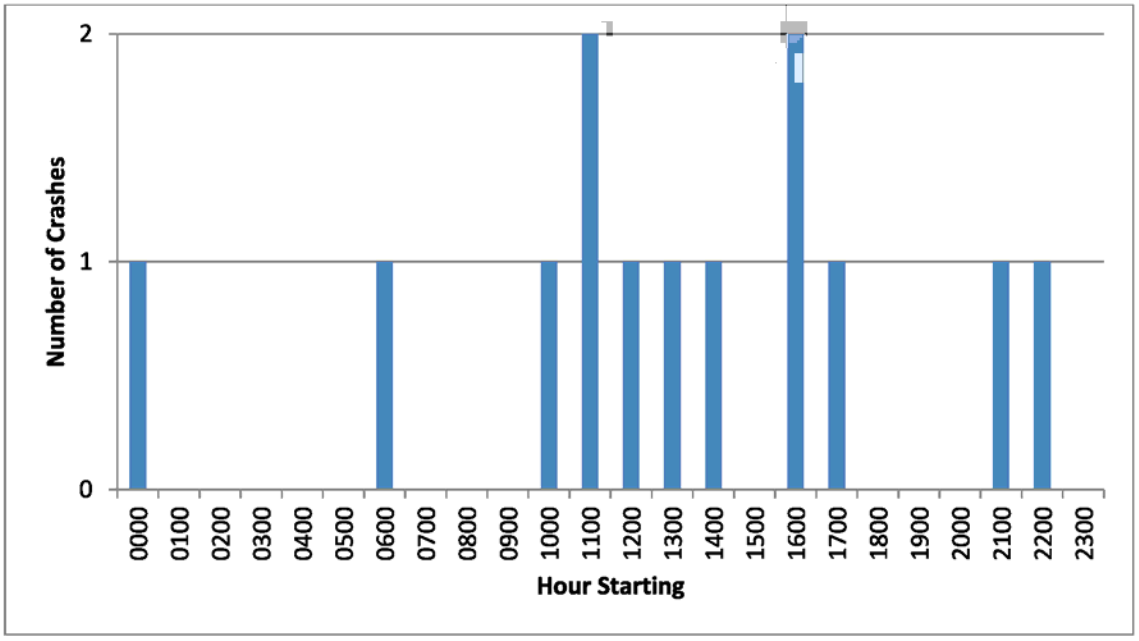

Figure 5-9: Number of Crashes by Time of Day

The number of crashes occurring during each day of the week, including severity of crash, has been presented in Figure 5-10. The highest number of crashes occurs on Mondays and Tuesdays with four recorded crashes.

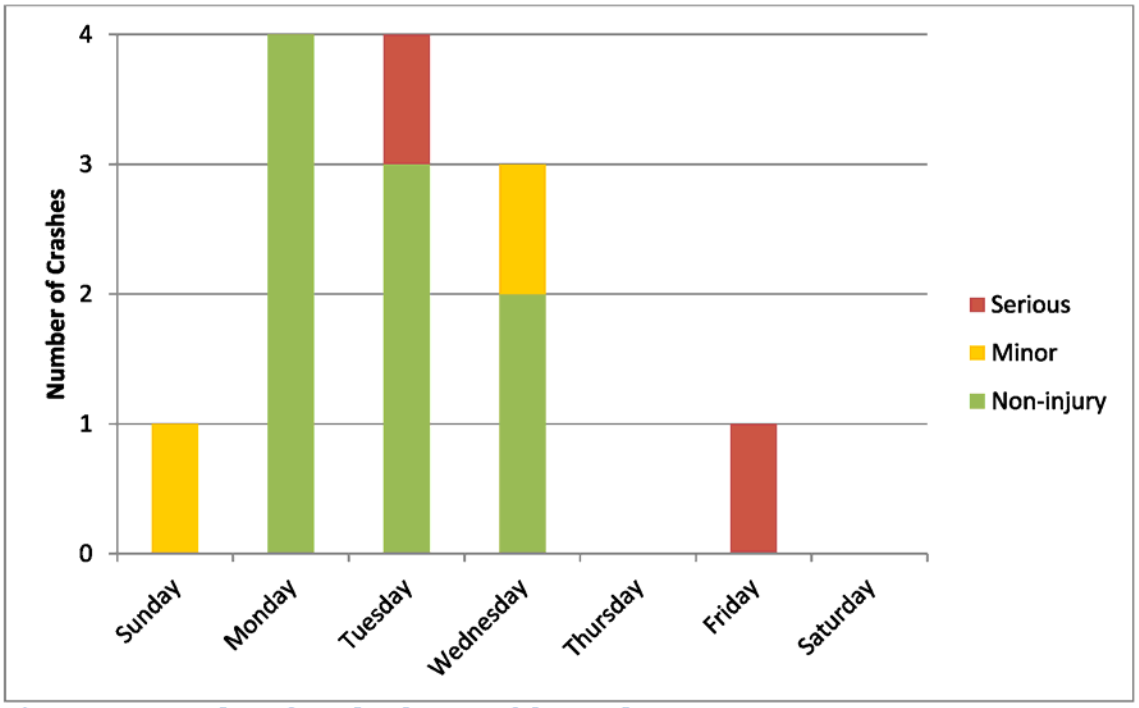

Figure 5-10: Number of Crashes by Day of the Week

5.3.4 Environmental Conditions

Table 5-16 and Table 5-17 present the crash severity by road and light condition and environmental conditions, respectively.

Table 5-16: Crash Severity by Road and Light Conditions

	Dry	Wet	Light	Dark
Serious	2	0	2	0
Minor	0	2	0	2
Non-Injury	8	1	7	2
Total	10	3	9	4
Grand Total	13		13	

Table 5-17: Environmental Conditions

	Light	Dark	Total	% of total	National Average (%)
Dry	8	2	10	77	75
Wet	1	2	3	23	25
Total	9	4	13		
% of total	69	31			
National Average (%)	68	32			

As with the previous two corridors assessed, the serious injury crashes occurred during light and dry conditions. The proportion of light and dry condition crashes are also similar to the national averages. Overall, Environmental conditions are not a significant factor in the cause of crashes along this corridor.

5.3.5 Crash Movement Type

Table 5-18 presents the number of crashes by crash movement along the Wakefield/White Line West corridor.

The most common crash movement type was rear end / obstruction accounting for seven of 13 crashes. The second most common crash movement type was lost control on a bend with four of 13. Alcohol and/or speed were factors in these four crashes.

Table 5-18: Crash Movement Types

Crash Movement	Crashes	% of Total	National Average (%)
Overtaking	1	8	6
Straight Road - Lost Control/Head On	0	0	9
Bend – Lost Control/Head On	4	31	21
Rear End/Obstruction	7	54	35
Crossing/Turning	1	8	24
Pedestrian	0	0	4
Miscellaneous	0	0	1
Total	13	100	100

The most common crash movement type was rear end / obstruction accounting for seven of 13 crashes. The second most common crash movement type was lost control on a bend with four of 13. Alcohol and/or speed were factors in these four crashes. With the exception of these the crash movements along this corridor is indicative of an urban environment.

5.4 Updated Crash History (2010 – 2014)

The initial data analysed from The Esplanade / Waione Street, Randwick Road and Whites Line / Wakefield Street corridors as shown above, has been updated in the following tables to reflect and the present crash history, and to identify any changes to the crash trends. As before the data has been obtained through the NZTA Crash Analysis System (CAS) with a 10m offset around midblock sections and 35m radii around intersections.

The three corridors analysed previously have been updated for the five year period between 1/01/2010 – 31/12/2014, inclusive. The following tables detail the updated analysis.

Table 5-19: The Esplanade/ Waione Street Crash History 2010-2014

Year	Serious	Minor	Non-Injury	Total
2010	0	7	26	33
2011	0	6	18	24
2012	0	7	18	25
2013	1	7	19	27
2014	1	6	13	20
Total	2	33	94	129

The Esplanade / Waione corridor shows an overall reduction in the number of crashes of 15% when compared to the previous study period. This overall reduction consisted entirely of a reduced number of non-injury crashes from 115 in the previous study period to 94 in the current study period, for a total of 18% reduction. As the number of serious and minor injuries have remained consistent, the crash trends long the Esplanade/Waione corridor have not significantly changed.

Table 5-20: Randwick Road Crash History 2010-2014

Year	Serious	Minor	Non-Injury	Total
2010	0	2	9	11
2011	0	2	3	5
2012	1	1	5	7
2013	0	2	7	9
2014	1	2	6	9
Total	2	9	30	44

Over the updated five year period analysed, the number of crashes along the Randwick Road corridor showed an overall reduction in total crashes by 11% when compared to the previous study period. Serious crashes decreased by 100% from 2 down to 1, while both minor and non-injury crashes showed a decrease of 20% and 19% respectively when compared to the previous study period. As serious injury crashes have only decreased by 1 and minor and non-injury crashes have both decreased, the crash trends along the Randwick road corridor are not considered to have significantly changed.

Table 5-21: Wakefield Street/ Whites Line West Crash History 2010-2014

Year	Serious	Minor	Non-Injury	Total
2010	2	1	2	5
2011	0	0	2	2
2012	0	0	2	2
2013	0	0	1	1
2014	0	0	2	2
Total	2	1	9	12

The Wakefield Street / White Line West corridor showed a reduction in minor crashes from 2 during the previous study period down to 1 during the current period, showing a 100% reduction in minor crashes and an overall reduction in total crashes of 8% when compared to the previous study period. Crash Trends on the Wakefield / White Line corridor have therefore not significantly changed.

The updated analysis has shown that injury crashes within the three corridors has not significantly changed since the initial crash analysis. While the total number of crashes appears to have reduced, this is largely due to a reduction in non-injury crashes. This reduction in non-injury incidents may indicated a safety improvement along the three corridors, it could also be that, as the analysis include police reported crashes only, less non-injury crashes involved the police and were therefore unreported.

5.5 Summary

The crash history along three corridors within the study area was reviewed for the five year period of 2008 to 2012, inclusive. A number of themes were evident in the crash assessment. Those are:

- Rear end crashes feature highly;
- Cars and station wagons are the main road users involved in crashes;
- Approximately half of crashes occur at the midblock and half at intersections;
- Between 2010 and 2012, total annual crashes have decreased by 32%; and
- This decrease is at a higher rate than the national average (19%);
- However there has been a slight increase in overall crashes along the corridors (3 crashes) between 2011 and 2012.

More similarities were observed between the Randwick Road and The Esplanade / Waione Street corridors:

- Crossing / turning and overtaking were the second and third most common crash movement types after rear end crashes;
- The proportion of crashes with pedestrians and cyclists is representative of the traffic composition along these corridors (3% are pedestrians and cyclists); and
- There is a correlation between the time of day that crashes are occurring and congestion peaks.

Many of these themes are consistent with an urban setting with many intersecting roads and thus crossing and turning movements. It is also important to note that no fatalities have occurred as a

result of the crashes over the five year study period and only five (of 222) resulted in serious injury. Environmental conditions have not been a major factor in the crash history.

Crashes by road users are also generally representative of the traffic profile along the corridors. The only exceptions to this are where car crashes are underrepresented along The Esplanade and Wakefield Street corridors and truck crashes are overrepresented along the Wakefield Street corridor only. Overall these corridors have crash histories that strongly support the fact that they are urban corridors, and no significant crash problems are present.

The updated analysis of all accidents within the 5-year period to 2014, as detailed in section 5.4 has shown that the number injury crashes within the three corridors has not significantly altered since the initial crash analysis. While the total number of crashes appears to have reduced, this is largely due to a reduction in non-injury crashes. This reduction in non-injury incidents may indicate safety improvements along the three corridors, it could also be that, as the analysis include police reported crashes only, less non-injury crashes were reported to the Police.

6 Multi-Modal Options

This section discusses active and sustainable mode options. Roading only options (which include those which enable multi modal options) are discussed in Section 7.

6.1 Options

Section 3 discussed many of the various modes of transportation that operate within the study area. Multi-modal option concepts were developed following the stakeholder consultations during the 6th and 28th June 2013 with a view to address both the project objectives and the stakeholder inputs. Attendance at the stakeholder consultation meetings are outlined in Appendix A.

Desktop analysis and discussions amongst the project team were conducted to assess the multi-modal option concepts and from this the list was shortened to include those options that conformed best to the project objective and desired stakeholder outcomes. Following this process the following multi-modal options were evaluated in greater detail:

- **MM1** – Reinstate Gracefield Rail Link,
- **MM2** – Enhance Bus Services,
- **MM3** – Weekday Ferry Service, and
- **MM4** – Improve Walking and Cycling Facilities

This section describes how multi-modal options compare to the project objective as well as the strengths and limitations of each option.

MM-1 Reinstate Gracefield Rail Link

This option involves repairing the existing Gracefield rail line and making it operational. This will provide an alternative method for freight companies based in Seaview to transport their goods to Wellington Port. Once the rail line is active the freight rail will be able to avoid the congestion along The Esplanade and travel directly to Wellington. Any freight service will have to share the existing rail corridor with the passenger rail services.

Implementing this option will help to address all the goals identified in the project objectives, through improved connectivity, enhanced resilience etc., however this would be dependent upon uptake of demand. In particular it will improve the efficiency of the transport network especially for freight movements. The resilience of the network would also improve as freight would have an alternative route that can be utilised in case another route is closed.

Limitations

Listed below are the issues surrounding this option:

- Existing business need to invest in capital that will allow them to use the rail, so the level of uptake and utilisation of the line isn't likely to be high;
- The existing rail link would require significant investment in order to make it operational;
- Wellington port is relatively close and freight companies have suggested they would prefer not to use rail as it involves additional handling of the cargo and many trips are over short distances (particularly Seaview to CentrePort Wellington); and

- Would need to work around the busy public transport schedule.

MM-2 Enhanced Bus Service

As identified in section 3.7.1 there are many services that travel through the study area. Of these all the Wellington bound buses use the Petone interchange to access SH2. The main element of this option is to increase the frequency of these buses. The aim is to provide a regular bus service that will promote a modal shift away from private vehicles to the bus. This will help achieve the project objectives of improving transport efficiency and minimising adverse environmental impacts.

Limitations

Listed below are the drawbacks of this option:

- Large sections of The Esplanade are still single lane therefore the buses will still be impacted by congestion;
- While patronage is expected to grow, a significant modal shift is required to achieve a noticeable difference in congestion. However this level of change is highly unlikely and well beyond the expected patronage increases as noted in section 3.7; and
- Without a significant modal shift the bus service will still be limited by the performance of the roading network.

Modal shift could be encouraged by various means. In WTSM, Wellington commuters are particularly sensitive to parking costs, which could be a measure to shift commuters onto bus services.

MM-3 Weekday Ferry Service

At present, during the peak weekday periods, the 'East by West' ferry service provides a direct link between Days Bay, Eastbourne and Queens Wharf, Wellington. The ferry runs at 25min intervals in both direction. Under this option the following changes are proposed:

- The ferry service will operate between Petone Wharf and Queens Wharf.
    - » This will implemented by either including Petone as a stop on the exiting Days Bay to Queens Wharf route or a direct trip to Queens Wharf will be provided.
    - » Additional ferries will need to be purchased to ensure that trip frequency is maintained.
- Additional parking facilities are provided near Petone Wharf
- The Esplanade/Victoria Street intersection will need be signalised to accommodate the increased flows that will be accessing parking near the wharf
- Amenities such as shelters and ticket booths will be erected on the wharf near the ferry dock.

The aim of this option is to promote a modal shift away from private vehicles to using the ferry. This would aid in achieving the project objectives of improving traffic efficiency and minimising adverse environmental impacts. A review of WTSM suggests that the ferry mode's sensitivity to factors such as price limit the uptake of ferry improvement options.

Limitations

Listed below are the shortcomings of this solution:

- The ferry is highly susceptible to poor weather as it is unsafe to operate during rough sea conditions;
- To access the ferry, the walk from residential area to the ferry is long and exposed and there is no shelter for waiting passengers, this would need to be improved;
- The catchment for users of the service is small and a number of other alternative options exist;
- A large modal shift is required to noticeably reduce congestion. However this is unlikely to be achieved, especially considering the ferry's route largely replicates that of the regular rail service which is less susceptible to the weather;
- The ferry trip takes approximately 30mins, between Petone Wharf and Queens Wharf. This is longer than the time taken to travel by train, bus or car; and
- A review of WTSM suggests that the ferry mode's sensitivity to factors such as price limit the uptake of ferry improvement options;

It is noted that the Greater Wellington Regional Council has previously trialled such a service in 2006 which ultimately failed due to lack of patronage. This previous trial should be investigated further should this option be progressed.

MM-4 Improve Walking/Cycling Facilities

This option will involve improving the existing walking and cycling facilities along The Esplanade. A designated cycling lane will be provided along the entire length of the road and will be connected to the Ngauranga to Petone cycleway. This will improve cycling safety and subsequently encourage road users to switch to cycling.

The wide seaside footpath at the eastern end of the road would also be extended to encompass the full length of the Petone foreshore. Additionally, traffic lights will replace the existing pedestrian crossings. This will help calm traffic speeds and improve the accessibility of the beach for pedestrians.

Overall this option will help achieve the project objectives of improving transport safety and efficiency, minimising adverse environmental impacts and enhancing the linkage between the sea and Petone.

Limitations

Listed below are the issues faced by this solution:

- The implementation of pedestrian friendly infrastructure will reduce the speed on the road and therefore worsen the transport efficiency of the network; and
- The size of the modal shift required to significantly reduce congestion is unlikely to occur.

6.2 Summary

The above mentioned multi-modal options could all provide solutions which may assist in the accomplishment of the project objectives. However, as identified there are some notable shortcomings that may affect the performance of these options. That does not mean that aspects of certain options should not be considered further in the future (e.g. increased bus provision and improvements to walking and cycling).

This conclusion was also supported by discussions held with stakeholders and interest groups, however it is acknowledged that wider public consultation and community engagement has not occurred. If this was to occur, this should be based upon an option which the HCC and the Transport Agency might be prepared to progress in order to meet the project objectives, at this time there is no evidence to suggest that such an option exists in isolation.

A summary of the preliminary assessment of the multi-modal options against the project objective is shown in Table 6-1 below.

Table 6-1: Preliminary Multi-Modal Option Assessment

Objective	MM1	MM2	MM3	MM4
Maximise Value for money*	Likely positive (but dependent on funding)	Likely Negative (As requires significant modal shift)	Likely Negative	Likely Positive
Facilitate Economic Growth	Positive Effects as improves freight efficiency	Positive as, if successful, would relieve network congestion	Positive	No Change
Enhance Resilience	Positive Effects as provides alternative freight route	No Change	Positive - alternative transport route established	No Change
Minimise Environment Impacts	Positive	Positive	Positive	Positive
Enhance Linkage between Petone and the Sea	Positive as removes freight from the network	Positive	Positive	Positive

In order to achieve a better outcome for all transport users, roading options will also be considered as they are more likely to significantly improve the network performance and subsequently more effectively accomplish the project objectives.

The roading options considered are discussed in Section 7. These options also contain multi-modal elements including on-road cycling facilities, improved pedestrian facilities and bus lanes.

7 Roading Options

7.1 Options

There have been many road options and alignments reviewed in the past. The results of those previous studies have indicated that a road link to Seaview with an alignment utilising Wakefield Street and/or changes to The Esplanade were the most desired options as they were most in line with the HCC's vision for the region and had the best economic value. For reporting purposes, The Esplanade depowering options have been included in this section with the roading options, despite these options providing amenity benefits rather than transportation benefits.

Initially options identified from previous work, stated in Section 1.3, were considered. Additional options were then created with the aim of satisfying the project objectives. The list was then shortened based on how likely they were to meet these goals. A long list of options that were not tested are included in Section 7.2. All options focus on vehicle traffic and freight movement, however public transport, walking and cycling modes have been considered in the design and assessment where appropriate. A schematic of all the options progressed is shown in Figure 7-1.

Figure 7-1: Schematic of all Roading Options

SV-1 Esplanade Improvements

This option has been modelled as per GHD's Petone Esplanade Capacity Study, May 2012. Drawings of the proposed layout have been provided in Appendix J. Features of The Esplanade Improvements include:

- Changes to intersections resulting in:
    - » New traffic signals at the Victoria Street intersection. The existing signalised pedestrian crossing east of Victoria Street would be removed, providing additional storage for the westbound right turn lane on The Esplanade. The existing roadway will be widened to accommodate an eastbound right turn lane. The existing westbound bus only lane will now begin approximately 40 metres west of the intersection.
    - » New traffic signals at the Buick Street intersection. The zebra crossing at Queen Street would be removed. Two through movements would be provided for westbound traffic and an additional eastbound through movement is provided by altering the left lane to a combined left and through. The two through lanes merge into one downstream of the intersection in both directions.
    - » Widening of traffic signals at the Cuba Street intersection. Additional changes include an additional eastbound through lane by altering the left lane to a combined left and through. Two through traffic lanes then merge into one lane downstream.
    - » New traffic signals at the Jessie Street intersection. The zebra crossing east of the intersection would be removed. Three approach lanes would be provided in the eastbound direction and two lanes would be in the westbound directions. Two lanes are also proposed immediately downstream in both direction but these will merge into a single lane after approximately 50m.
    - » New traffic signals at the Kirkcaldy Street intersection. The new intersection layout has two lanes in the northbound and southbound directions and three lanes in the east and westbound directions including two through movements that merge to one lane downstream.
- Removal of zebra crossings at Bay Street, Oriental Street and Patrick Street. The zebra crossing at Bay Street is proposed to be replaced with a signalised pedestrian crossing, however, this has not been modelled in NWSM as Bay Street has not been included in the model;
- A planted median barrier along the majority of The Esplanade, reducing the opportunities for right turning traffic;
- A westbound bus lane from west of the Victoria Street intersection to the Hutt Road roundabout; and
- On-road cycle lanes in both the eastbound and westbound directions.

SV-2 Whites Line Cross Valley Link

A Cross Valley Link route beginning at Wakefield Street in the west has been reviewed several times in the past, as summarised in Section 1.3. It is considered a good alternative route to The Esplanade as it is in close proximity to the existing interchange at Dowse Drive providing easy access to the State Highway network at this point. If this option was implemented vehicles wanting to travel on SH2 could avoid the congestion at the Petone interchange and access it via the Dowse interchange. Consequently, this would also reduce the demand the Petone interchange and improve its performance. It is also not too great of a distance to reroute for traffic travelling from Seaview and Gracefield, a major origin/destination for HCV traffic, as it is approximately 1.3 km north of The Esplanade. This route also provides good access to Wainuiomata. The route finishes at Whites Line East which is connected directly to Wainui Road, the main road to and from Wainuiomata.

The Whites Line Cross Valley Link would be a 50km/h, two lane road. It would follow Wakefield Street across a new bridge crossing the Hutt River and connecting with Whites Line West before tying into the Randwick Road/Whites Line East roundabout. The improvements associated with this route are based on those identified in the MWH Valley Floor Connector Needs Analysis Report (2003) with updates provided by GHD (2012). Drawings of the route are provided in Appendix K. The suggested improvements include:

- A two lane roundabout at Wakefield Street and Hutt Road incorporating an access to Percy Avenue, this in turn provides access from the proposed link into the Dowse interchange;
- Restriction of movements at the Rush Grove and Wakefield Street intersection (left-in/left-out only) and associated upgrades to the intersection;
- Upgrades to the Cuba Street rail overbridge;
- New traffic signals at the Fitzherbert Street and Wakefield Street intersection providing right turn lanes in both the eastbound and westbound directions.
- Closure of the Tama Street intersection due to the ramping up of the road prior to the new bridge;
- Restricted access from Mudie Street. Instead of a full closure as was suggested by the MWH report, local traffic and pedestrians from Mudie Street would be able to access westbound Wakefield Street via an underpass. Pedestrians will also have access provided to the north side of the bridge.
- New bridge structure of approximately 350 metres length connecting Wakefield Street to Whites Line West across the Hutt River;
- Modification to intersections at Richmond Grove and Fuller Grove to priority controlled intersections;
- New traffic signals at the Saulbrey Grove and Whites Line West intersection with two lanes at three out of four approaches; and
- Modification of the existing Ludlam Crescent/Whites Line East/Randwick Road roundabout to include Whites Line West as a fourth entry/exit point from the west.

Some land acquisition would be required to complete this option, particularly on either side of the new bridge structure and near the connection to the Randwick Road roundabout. Land requirements will be discussed in more detail in Section 11.

An alternative version of SV-2 has also been assessed where The Esplanade depowering and HCV restrictions, as detailed in SV-4, are included.

SV-3 Railway Alignment Cross Valley Link

The Railway Alignment Cross Valley Link starts at the Hutt Road/Wakefield Street roundabout and travels east along Wakefield Street to the Ava Railway Station. The route then follows the railway line to Randwick Road. It is a 60km/h, two lane road. The improvements associated with this route are broadly based on those identified in the MWH Valley Floor Connector Needs Analysis Report (2003). The eastern section of the route, up to the Cuba Street rail overbridge has been adopted from the GHD drawings completed in 2012. Drawings of the route are provided in Appendix L. The suggested improvements include:

- A two lane roundabout at Wakefield Street and Hutt Road incorporating an access to Percy Avenue, this in turn provides access from the proposed link into the Dowse interchange;
- Restriction of movements at the Rush Grove and Wakefield Street intersection (left-in/left-out only) and associated upgrades to the intersection;
- Upgrades to the Cuba Street rail overbridge;
- The link between Cuba Street and Fitzherbert Street will divide into two roads: a service lane following the Wakefield Street alignment to Fitzherbert Street and the other being the main link following the railway corridor. The service lane would provide access to the properties on the northern side of Wakefield Street and a suggested new Park and Ride facility for Ava Station. Westbound traffic on Wakefield Street east of the new link will not have access to it and would be directed up Fitzherbert Street;
- The Park and Ride facility has been suggested in response to the effect (i.e. reduced accessibility) the new alignment would have on the properties on the southern side of Wakefield Street. In this scenario these properties would be purchased and the land used for the parking facility;
- New bridge structure of approximately 270 metres length for vehicle traffic to cross the Hutt River. This new bridge would be adjacent to the current railway bridge (which would remain as a separate structure);
- As with the Whites Line Cross Valley Link option, the east end of the route would tie into the existing Ludlam Crescent/Whites Line East/Randwick Road roundabout. This option has extremely tight geometrics with the new link placed between Randwick Road and Whites Line East. It would also require realignment of Randwick Road and replacement of the Randwick Road rail overbridge.

The widening of the existing railway corridor requires a considerable amount of land acquisition, discussed in more detail in Section 11.

An alternative version of SV-3 has also been assessed where The Esplanade depowering and HCV restrictions, as detailed in SV-4, are included.

SV-4 Esplanade Depowering

This option uses traffic calming, likely through 30km/h speed restrictions, in addition to The Esplanade Improvements option discussed in Section 0. The Esplanade Depowering has been modelled by reducing the free flow speed on The Esplanade and on Jackson Street. The speed reduction on Jackson Street may or may not be included in the physical works of this option but is necessary for modelling to prevent 'rat-running' on the network. This option is being modelled individually for information purposes as it may be considered in conjunction with a Cross Valley Link option in the future.

This option is not intended to be built on its own. It will supplement another solution. However to understand the specific impact of this option this report will assess it as an independent project, as well as in conjunction with the three CVL options.

SV-5 – SV-7 Esplanade Four Laning

The four laning of The Esplanade would provide additional through capacity for eastbound and westbound traffic. These options have been modelled using The Esplanade Improvements option, as described in Section SV-1, as a base. The safety improvements at key intersections along The Esplanade provided in SV-1 complements the introduction of additional traffic lanes as turning traffic would otherwise be subjected to a larger conflict area, crossing two lanes instead of one as they do currently. There are three options considered, and are described below. Drawings are provided in Appendix M.

SV-5: Full Four Laning

Two through lanes in the westbound and eastbound directions from the Hutt Road roundabout in the west to Waione Street in the east.

SV-6: Partial Four Laning

Two through lanes in the westbound and eastbound directions from the Hutt Road roundabout in the west to Victoria Street in the east.

SV-7: Full Four Laning including Estuary Bridge

Two through lanes in the westbound and eastbound directions from the Hutt Road roundabout in the west to the Waione Street/Randwick Road roundabout in the east. This option has been modelled to determine the effects of four laning the Estuary Bridge (aka the Waione Street Bridge).

SV-8 Railway Alignment CVL with Restricted HCV Movements

This option uses the Railway Alignment Cross Valley Link in combination with restricting HCV movements on the Estuary Bridge. HCVs can still access The Esplanade as far as East Street but no further, forcing HCV traffic from Seaview and Gracefield to use the Cross Valley Link. Only authorised HCVs with destinations between Hutt Road and East Street will be allowed to access the restricted zone. This option could have been applied to the Whites Line Cross Valley Link (SV-2) also however the initial urban design assessment suggested that SV-3 would be preferred if it was to facilitate high HCV volumes.

An alternative version of SV-8 has also been assessed where The Esplanade depowering and HCV restrictions, as detailed in SV-4, are included.

7.2 Other Long List Options

There were several other options initially considered but then discounted for various reasons. Some of the options that were considered are described below. A schematic of these options are illustrated in Figure 7-2.

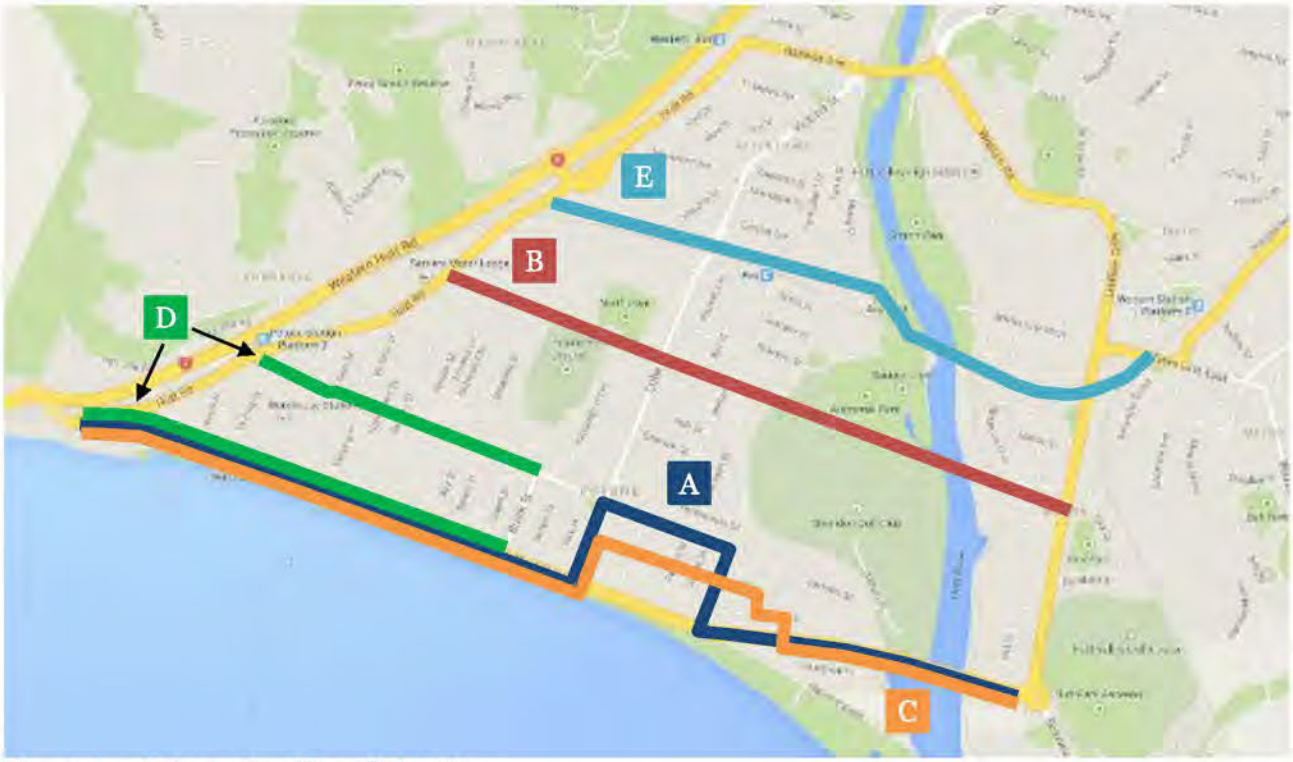

Figure 7-2: Schematic of long list options

A. Waione St, Jackson St to Cuba St then The Esplanade

This option reroutes the main traffic flow from Waione Street, onto Jessie Street, followed by Jackson Street, followed by Cuba Street and finally back along The Esplanade. It was considered to relieve the congestion on The Esplanade and make it a more desirable amenity. The specifics of enforcing the traffic redirection has not been developed but could be achieved in a number of ways including changing traffic priorities, directional signage and traffic calming measures.

Reason for omission:

The option mainly shifts the problem from The Esplanade to Jackson Street that has less capacity or room to handle it without removing parking. It also moves the severance problem from The Esplanade to Jackson Street which will likely only increase foreshore accessibility for the few residents that live between the two roads and only for those east of Cuba Street.

B. Cross Valley Link Udy Street to Golf Course.

This option creates a Cross Valley Link beginning at Udy Street and continuing over the golf course and over the Hutt River.

Reason for omission:

It is not possible to create a route through the golf course as this is a significant amenity for Hutt City. Udy Street would also require significant upgrading and a new bridge over the river. It is located further south of the Dowse Interchange and therefore the Wakefield Street options were deemed to be more effective at achieving the desired objectives of the project. In particular this option would have adverse environmental impacts through the removal of green space.

C. Waione St, East St, Adelaide St to Cuba St then The Esplanade

This option reroute the main traffic flow from Waione Street, into Kirkcaldy Street, then East Street, then onto Adelaide Street followed by Cuba Street and finally back along The Esplanade.

Reason for omission:

This option provided little benefit in terms of accessibility to the foreshore and resulted in a major diversion onto residential streets. Again, it would only be relocating the issues rather than solving them.

D. Jackson/Esplanade one way system

Between Buick Street and Hutt Road The Esplanade will only allow vehicles in the westbound direction and Jackson Street will only allow vehicles in the eastbound direction. The purpose of this change is to relieve congestion.

Reason for omission:

This option does not negate the severance issues and may even make it more difficult to reach the foreshore.

E. Cross Valley Link - Wakefield Street alignment to Railway Overbridge via Ava Park

This option is a Cross Valley Link that follow Wakefield Street and then connects onto the railway overbridge at Ava Park. It was originally considered as it used mostly existing infrastructure.

Reason for omission:

It would require the removal of a portion of green space in Ava Park which is not in line the project objective of minimising adverse environmental impacts. Considering that the railway bridge will require a clip on for vehicles or the construction of a second bridge, the cost savings are not substantial enough to make this a feasible option.

F. Travel Demand Management

This option increases bus and rail service frequencies in addition to implementing improved park and ride facilities and parking cost increases in the Wellington CBD. The idea of this option is to encourage a modal shift from cars and onto public transport services to relieve congestion and improve the performance of the network.

Reason for omission:

This option has implications well beyond the scope of this PFR and is thus instead being investigated as part of the Petone to Grenada project.

7.3 Updated Model Options

As noted in Section 4.4 throughout the development of this PFR the NWSM has been refined. Results from the initial version of the model were delivered in July 2013 and are referred to as the "earlier model" throughout this report. NWSM was then recalibrated following the collection of additional data, results from which were delivered in April 2015. Results from this recalibrated NWSM version are referred to throughout this report as the "updated model".

In conjunction with the updated model some additional options were tested. These options were effectively a combination of previous options (particularly combining options SV2, SV3 and SV8 with SV4 (Esplanade depowering). These additional tests have been denoted as SV2b, SV3b and SV8b respectively with the original tests annotated with an "a".

The results of these additional tests have not been assessed in detail in the following sections and only feature in the executive summary and the economic analysis in section 10 below.

8 Traffic Assessment and Modelling of Options

Traffic modelling was carried out using the Northern Wellington SATURN Model (NWSM) updated to a base year of 2011 by SKM. Modelling in NWSM is carried out using demands extracted from the Wellington Strategic Transportation Model (WTSM) which is a four stage EMME model covering the whole Wellington region.

To simplify the economic evaluation process, a fixed matrix approach has been taken, where the same WTSM demand matrices are used in both the option and Do Minimum models. This is consistent with the Economic Evaluation Manual (EEM). The P2G project is using a variable matrix approach to better reflect the wider regional impacts that project will have, whereas the effects of the options covered in this report are predominantly contained to the Lower Hutt region.

As noted in Section 4.4 throughout the development of this PFR the NWSM has been refined. Results from the initial version of the model were delivered in July 2013 and are referred to as the earlier model throughout this report. NWSM was then recalibrated following the collection of additional data, results from which were delivered in April 2015. Results from this recalibrated NWSM version are referred to throughout this report as the updated model. As the underlying base model has been completely recalibrated and used different base assumptions the earlier NWSM and the updated NWSM results are not directly comparable.

Using the earlier NWSM, eight different options were modelled, as detailed in Section 7, in addition to the Do Minimum. The Do Minimum assumptions, described in Section 4.3.1, have remained constant throughout the project. With the updated NWSM only the three Cross Valley Link (CVL) options were remodelled with and without depowering The Esplanade.

8.1 Option Performance

The performance of the options has been assessed using outputs from the NWSM. The assessment contained in this section is only for the 2031 horizon year as the trends are similar to the horizon year 2021, but escalated. As with the Do Minimum network, the following data has formed the basis of the option network analysis:

- General network statistics;
- Traffic volumes along key routes;
- Level of service that is currently provided on The Esplanade, Randwick Road and Whites Line East; and
- Journey times along The Esplanade and Waione Street from the Petone Interchange in the west to the Randwick Road roundabout in the east (and vice versa).

8.1.1 Network Statistics

The network statistics from Saturn, presented in Table 8-1 for the earlier model and in Table 8-2 for the updated model, are meant to provide an overall picture of the performance of the network. These results are also presented in a different format in Appendix N. All of the networks listed in this section have been run using the same matrix.

Note that in the updated model table, options denoted with 'a' represent the options as described and those with 'b' also include Esplanade depowering.

Table 8-1: Network Statistics for all options during all the peaks (Earlier Model)

Peak	Option	Average Speed (km/h	Travel Time (pcu hrs/hr)	Total Delay (pcu hrs/hr)	Network Queue (pcu hrs/hr)	Travel Distance (pcu kms/hr)	Total Trips (pcus)
AM	Do Min	53	10,620	1,140	1,590	560,000	97,700
	SV-1	53	10,640	1,130	1,610	560,000	97,700
	SV-2	53	10,500	1,070	1,550	559,000	97,700
	SV-3	53	10,500	1,070	1,550	560,000	97,700
	SV-4	51	10,910	1,240	1,710	560,000	97,700
	SV-5	53	10,560	1,090	1,590	560,000	97,700
	SV-6	53	10,610	1,120	1,600	560,000	97,700
	SV-7	53	10,520	1,060	1,580	560,000	97,700
	SV-8	53	10,510	1,070	1,550	560,000	97,700
IP	Do Min	62	5,700	110	490	351,000	86,300
	SV-1	62	5,710	120	500	351,000	86,300
	SV-2	62	5,680	100	490	351,000	86,300
	SV-3	62	5,680	100	490	351,000	86,300
	SV-4	61	5,780	140	510	352,000	86,300
	SV-5	62	5,700	110	500	351,000	86,300
	SV-6	62	5,710	110	500	351,000	86,300
	SV-7	62	5,700	110	500	351,000	86,300
	SV-8	62	5,690	110	490	352,000	86,300
PM	Do Min	50	12,540	1,690	2,060	620,000	112,900
	SV-1	50	12,500	1,660	2,060	620,000	112,900
	SV-2	50	12,420	1,620	2,030	619,000	112,900
	SV-3	50	12,410	1,610	2,030	620,000	112,900
	SV-4	48	12,900	1,760	2,320	619,000	112,900
	SV-5	50	12,400	1,600	2,050	619,000	112,900
	SV-6	50	12,500	1,650	2,060	620,000	112,900
	SV-7	50	12,360	1,550	2,050	619,000	112,900
	SV-8	50	12,420	1,610	2,040	620,000	112,900

Table 8-2: NWSM Network Statistics for Remodelled Options during All the Peaks (Updated Model)

Peak	Option	Average Speed (km/h)	Travel Time (pcu hrs/hr)	Total Delay (pcu hrs/hr)	Network Queue (pcu hrs/hr)	Travel Distance (pcu kms/hr)	Total Trips (pcus)
AM	Do Min	51	10,710	1,090	1,730	549,000	96,870
	SV-2a	52	10,590	1,040	1,690	548,000	96,870
	SV-2b	49	11,160	1,130	1,870	551,000	96,870
	SV-3a	52	10,580	1,040	1,690	548,000	96,870
	SV-3b	50	11,140	1,130	1,850	552,000	96,870
	SV-8a	52	10,590	1,040	1,680	549,000	96,870
	SV-8b	50	11,150	1,130	1,850	552,000	96,870
IP	Do Min	58	6,080	110	805	355,000	85,870
	SV-2a	59	6,060	98	805	354,000	85,870
	SV-2b	58	6,150	120	820	356,000	85,870
	SV-3a	59	6,060	97	805	355,000	85,870
	SV-3b	58	6,160	118	820	356,000	85,870
	SV-8a	59	6,080	100	805	355,000	85,870
	SV-8b	58	6,170	125	825	357,000	85,870
PM	Do Min	47	13,000	1,430	2,250	611,000	112,000
	SV-2a	48	12,800	1,370	2,200	610,000	112,000
	SV-2b	47	12,900	1,420	2,200	607,000	112,000
	SV-3a	48	12,800	1,360	2,190	610,000	112,000
	SV-3b	47	13,160	1,430	2,280	612,000	112,000
	SV-8a	48	12,800	1,370	2,200	610,000	112,000
	SV-8b	42	14,230	1,370	2,170	590,000	112,100

It is observed that all options except SV-4 have similar average speeds across all the peaks. As expected the 30km/h speed restrictions along The Esplanade in SV-4 have resulted in a lower average speed. In the AM and IP peaks, the Cross Valley Link (CVL) Options (SV-2, SV-3 and SV-8) have the least network travel time with Option SV-7, four laning The Esplanade including the Estuary Bridge the next shortest. In the PM peak, the CVL options still perform well, however SV-7 has the least travel time.

In addition to being the slowest option, SV-4 behaves the poorest in all the network statistics with the highest total delays and network queues throughout all three peak periods. This is to be expected considering the speed reduction on The Esplanade and on Jackson Street without providing an alternate route.

SV-7 has the least amount of total delay in the AM and PM peaks, followed closely by the CVL options. In the inter peak nearly all the options have identical delays. Only SV-1 and SV-4 have greater delays. For network queues, again the CVL options perform the best for all peaks followed by Option SV-5, full four laning of The Esplanade.

Overall, the network statistics seem to show that the CVL options perform the best overall in the AM and inter peaks while Option SV-7 performs the best in the PM peak.

The results of the updated models general show slower average speeds and higher travel times than the earlier model. Queues are similar in the AM and PM but slightly higher in the IP in the new NWSM. Travel Distance is comparable as are the total Trips.

8.1.2 Traffic Volumes

SATURN outputs showing the change in traffic volumes between the options and the Do Minimum scenarios are contained in Appendix O. Table 8-3 summarises the modelled flows predicted by NWSM for the options and Do Minimum in 2031 in the earlier model and Table 8-4 shows this for the updated model. Figure 8-1 and Figure 8-2 show the locations of where the counts were taken. These figures also show the extent of the difference between the options and the Do Minimum. The volumes presented are in vehicles and not pcus. A summary of the volumes in each peak period has been included in Appendix P. It should be noted that, in the updated model table, the three options denoted with 'a' represent the option as described, while those with 'b' also include Esplanade depowering.

The CVL options show a significant increase in flows on Wakefield Street with approximately 15,000 vehicles per day opting to use the Cross Valley Link. The CVL options consistently show a reduction of traffic on The Esplanade to approximately 17,000-18,000 vehicles per day, a reduction of approximately 5,000-6,000 vehicles per day. The difference plots in Appendix O indicate that the remaining vehicles are diverting from Railway Avenue, north of Wakefield Street. A concern regarding the CVL options is that the number of vehicles on Randwick Road increases significantly, increasing the exposure to the children who attend the primary school on this road. However, the modelled traffic volumes on Randwick Road only increase with the HCV restriction in Option SV-8.

The introduction of the traffic signals on The Esplanade in Option SV-1 cause modelled traffic volumes to decrease slightly on this road and on Randwick Road and the Estuary Bridge. The Esplanade depowering in Option SV-4 causes a significant reduction on these roads with over half of the traffic volumes being diverted elsewhere. Partial four laning of The Esplanade in Option SV-6 result in little to no change at these locations.

Full four laning of The Esplanade, Option SV-5, causes an increase of 1200 vehicles per day at the west end of The Esplanade, 400 more vehicles per day at the east end of The Esplanade and 600 fewer vehicles per day over the Estuary Bridge. This indicates that some vehicles are crossing the river at other locations and accessing The Esplanade from the side streets west of Cuba Street.

As expected, four laning of The Esplanade including the Estuary Bridge, Option SV-7, causes increases in traffic volumes on The Esplanade and Estuary Bridge ranging from 1,100 to 2,200 vehicles per day. Modelled volumes on Randwick Road also increase by approximately 600 vehicles.

Consistent with earlier volume comparisons in section 4.3, volumes produced by the updated model show that generally, with the exception of The Esplanade West, have increased over those produced by the earlier model.

The CVL with depowered esplanade options (those denoted with a 'b') show a significant volume reduction on The Esplanade when compared to the CVL only options (those denoted with an 'a') as is shown in Table 8-4. At the West end of The Esplanade, ADTs have reduced by 13,900, 13,400 and 13,200 vehicles (66%, 65% and 64%) in SV2b, SV3b and SV8b respectively. The east end of The Esplanade shows a similar flow reduction, 12,800 vehicles in SV2b (70%), 12,400 vehicles in SV3b (69%) and 11,900 vehicles in SV8b (68%). The Estuary Bridge shows less of a reduction, 10,700, 10,200 and 9,700 vehicles, which equates to 47%, 46% and 47% for options SV2b, SV3b and SV8b respectively. A corresponding increase in flows is seen on Wakefield Street where SV2b shows 9,200 additional vehicles (61%), SV3b shows 8,600 additional vehicles (53%) and SV8b shows 7,900 additional vehicles (46%). This in effect demonstrates that depowering The Esplanade would promote the use of a cross valley link option.

Table 8-3: Option ADT's from SATURN Actual Flows (Earlier Model)

No	Road	2031 Traffic Flows (vpd)								
		Do-Min	SV-1	SV-2	SV-3	SV-4	SV-5	SV-6	SV-7	SV-8
1	The Esplanade West	26,800	25,700	23,800	23,400	12,700	28,000	26,800	29,000	23,600
2	The Esplanade East	23,400	21,800	18,400	18,000	11,700	23,800	22,200	25,100	17,400
3	Estuary Bridge	26,900	25,100	21,100	20,600	18,400	26,300	25,400	28,000	19,600
4	Randwick Road	16,300	15,900	15,500	15,600	15,900	16,200	15,800	16,900	16,700
5	Whites Line East	20,300	21,300	25,600	26,200	25,000	20,800	21,100	20,200	26,000
6	Wakefield Street West	1,600	1,700	14,800	15,100	2,000	1,600	1,600	1,500	15,400
7	Wakefield Street East	500	510	14,300	510	530	510	510	510	510
8	Railway Corridor	N/A	N/A	N/A	14,900	N/A	N/A	N/A	N/A	15,700

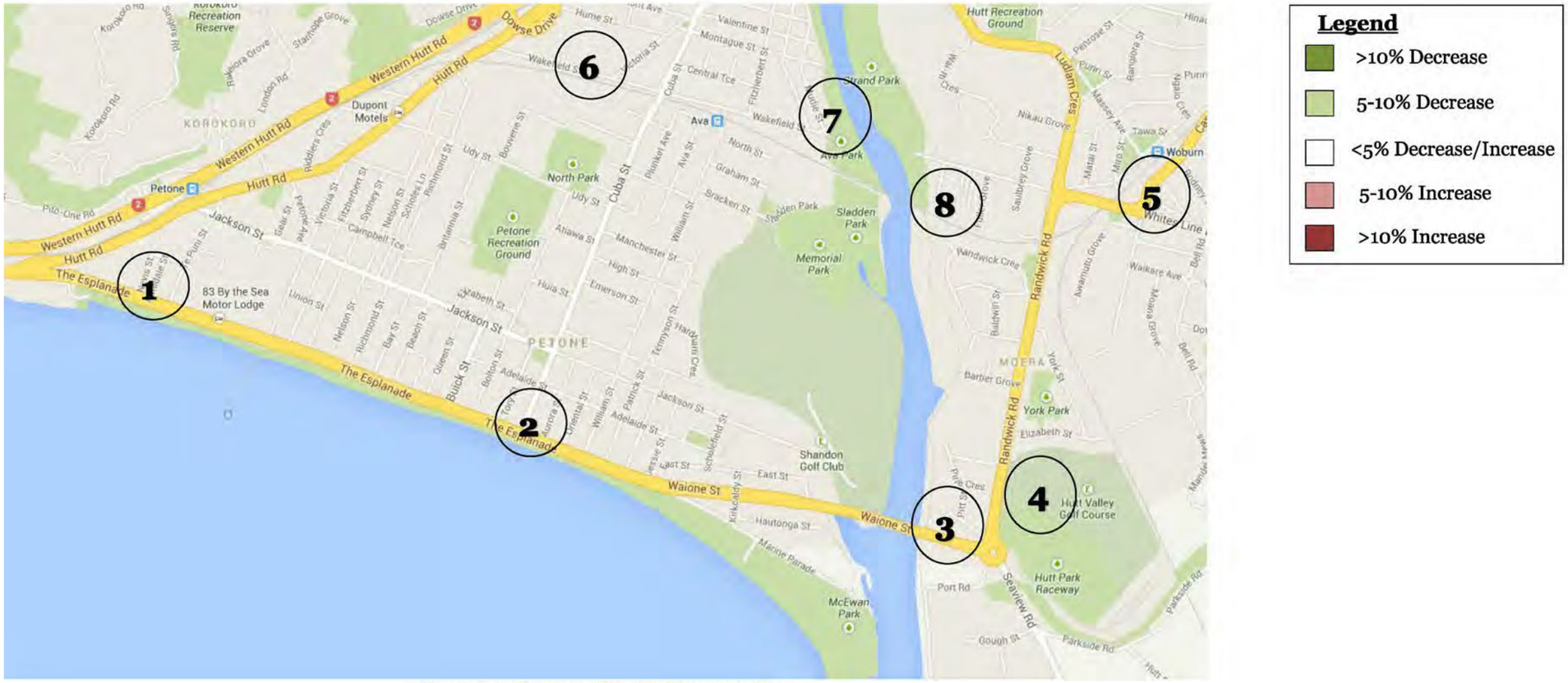

Figure 8-1: Diagram of Traffic Flow Locations

Table 8-4: Option ADT's from SATURN Actual Flows (Updated Model)

No.	Road	2031 Traffic Flows (vpd)						
		Do-Min	SV-2a	SV2b	SV-3a	SV3b	SV-8a	SV8-b
1	The Esplanade West	24,700	21,000	7,100	20,500	7,100	20,600	7,400
2	The Esplanade East	23,800	18,400	5,600	17,900	5,500	17,500	5,600
3	Estuary Bridge	28,500	22,900	12,200	22,200	12,000	20,800	11,100
4	Randwick Road	17,700	16,300	24,000	16,000	23,400	17,700	23,800
5	Whites Line East	20,500	25,400	25,200	16,200	21,800	17,500	22,200
6	Wakefield Street West	1,460	15,000	24,200	15,500	24,200	16,200	24,200
7	Wakefield Street East	770	15,200	24,400	16,200	24,800	17,200	25,100
8	Railway Corridor	N/A	N/A	N/A	16,200	24,800	17,200	25,100

Figure 8-2: Diagram of Traffic Flow Locations

8.1.3 Level of Service

Table 8-5 shows the changing Level of Service (LOS) produced from the earlier model along three of main corridors in Hutt City, as was provided for the Do Minimum in Section 4 and Table 8-6 shows this for the updated model. To maintain consistency and comparability, the modelled speeds from the 2031 option SATURN models are compared to the free flow speeds (FFS) identified in the Do Minimum[9]. However, capacities have been adjusted to account for the increase in lanes for Options SV-5 to SV-7 and the operational change to Wakefield Street in the Cross Valley Link options. In accordance with the SATURN model links with double lanes will have a capacity of 3,400 pcu/hr and when operational changes are made to Wakefield Street it will have an increased capacity of 1,600 pcu/hr. As with the levels of service provided for the Do Minimum, this information is best used when considering the change in LOS, not the LOS itself, due to modelled speeds generally being higher than actual speeds.

In general, the options perform at a higher level of service or remain the same as the Do Minimum network. The exceptions to this are:

- Option SV-3 has been given an automatic LOS of F along Whites Line East in the westbound direction during the PM peak because the volume has exceeded the capacity;
- Option SV-4 performs at a lesser level of service at five locations / directions in both the AM and PM peak periods. Of particular note is the performance shown at The Esplanade during both peak AM and PM peak periods which reduced to LOS E. Randwick Road also performs worse than the Do Minimum in the southbound and northbound directions during the AM and PM peaks, respectively;
- For SV-1 and SV-6 the westbound approach to Cuba Street on The Esplanade drops to a LOS of B in the AM peak; and
- In SV-8 the westbound approach to Cambridge Terrace on Whites Line East drops to a LOS of B in the AM peak.

Most of the applied options have a positive effect on the LOS of the Estuary Bridge.

As was noted in section 4.4.2, the updated model generally performs similarly or slightly better than the earlier model at the locations reported. This trend continues when comparing the updated options to those modelled earlier.

The depowered Esplanade options (those denoted with a 'b') show, in the AM peak, performance worsening in the eastbound direction reverting from LOS B to A, effectively reverting to the Do Minimum performance. Performance on Randwick Road and Wakefield Street both show a reduction, corresponding to the flow increase noted in section 8.1.2, particularly in the PM period where Randwick Road shows a LOS of C. While the depowered Esplanade options do show a reduction in performance, the worst LOS being C, these options still provide acceptable performance.

[9] The modelled free flow speed in Option SV-4 was reduced on The Esplanade as part of the option (to depower The Esplanade). Options SV-2, SV-3 and SV-8 also have changes to modelled free flow speeds; however, these changes increased the FFS. The Do-Minimum free flow speed was maintained for comparison to show the change in LOS perceived by the driver once the option is in place.

Table 8-5: 2031 Do Minimum and Option AM and PM Peak Link LOS (earlier SATURN Model)

	Link	Direction	Do-Min	SV-1	SV-2	SV-3	SV-4	SV-5	SV-6	SV-7	SV-8
AM Peak	**The Esplanade** (approaching Victoria St Intersection)	EB	B	B	B	B	E	A	A	A	B
		WB	B	A	A	A	C	A	A	A	A
	The Esplanade (approaching Cuba St Intersection)	EB	B	B	B	A	E	A	B	A	A
		WB	A	B	A	A	E	A	B	A	A
	Estuary Bridge	EB	B	B	A	A	A	B	B	A	A
		WB	C	C	B	B	B	C	C	A	B
	Wakefield Street (approaching Cuba St Intersection)	EB	A	A	A	A	A	A	A	A	A
		WB	A	A	A	A	A	A	A	A	A
	Randwick Road (south end)	NB	A	A	A	A	A	A	A	A	A
		SB	A	A	A	A	A	A	A	A	A
	Randwick Road (north end)	NB	A	A	A	A	A	A	A	A	A
		SB	B	B	A	A	C	B	B	B	A
	Whites Line East (approaching Cambridge Terrace Intersection)	EB	B	A	B	B	A	B	A	B	B
		WB	A	A	A	A	A	A	A	A	B
PM Peak	**The Esplanade** (approaching Victoria St Intersection)	EB	B	B	B	B	E	A	A	A	B
		WB	C	A	C	C	C	A	A	A	C
	The Esplanade (approaching Cuba St Intersection)	EB	B	B	B	B	E	A	B	A	B
		WB	B	B	B	B	E	A	B	A	B
	Estuary Bridge	EB	C	C	B	B	B	C	C	A	B
		WB	C	B	B	B	A	B	B	A	B
	Wakefield Street (approaching Cuba St Intersection)	EB	A	A	A	A	A	A	A	A	A
		WB	A	A	A	A	A	A	A	A	A
	Randwick Road (south end)	NB	A	A	A	A	B	A	A	A	A
		SB	A	A	A	A	A	A	A	A	A
	Randwick Road (north end)	NB	A	A	A	A	B	A	A	A	A
		SB	A	A	A	A	A	A	A	A	A
	Whites Line East (approaching Cambridge Terrace Intersection)	EB	A	A	A	A	A	A	A	A	A
		WB	C	C	C	F	C	B	C	C	A

Legend LOS Improves LOS Worsens

Table 8-6 :2031 Do Minimum and Option AM and PM Peak Link LOS (Updated SATURN Model)

	Link	Direction	Do Min	SV-2a	SV-2b	SV-3a	SV-3b	SV-8a	SV-8b
AM Peak	**The Esplanade** (approaching Victoria St Intersection)	EB	B	A	B	A	B	A	B
		WB	B	A	A	A	A	A	A
	The Esplanade (approaching Cuba St Intersection)	EB	B	A	A	A	A	A	A
		WB	A	A	A	A	A	A	A
	Estuary Bridge	EB	B	A	A	A	A	A	A
		WB	C	B	A	B	A	A	A
	Wakefield Street (approaching Cuba St Intersection)	EB	A	A	B	A	B	A	B
		WB	A	A	A	A	A	A	A
	Randwick Road (south end)	NB	A	A	A	A	A	A	A
		SB	A	A	A	A	A	A	A
	Randwick Road (north end)	NB	A	A	B	A	B	A	B
		SB	B	A	B	A	B	A	B
	Whites Line East (approaching Cambridge Terrace Intersection)	EB	B	B	B	A	A	A	A
		WB	A	A	A	A	A	A	A
PM Peak	**The Esplanade** (approaching Victoria St Intersection)	EB	B	A	A	A	A	A	A
		WB	B	A	A	A	A	A	A
	The Esplanade (approaching Cuba St Intersection)	EB	B	A	A	A	A	A	A
		WB	B	A	A	A	A	A	A
	Estuary Bridge	EB	C	B	A	B	A	B	A
		WB	B	B	A	B	A	B	A
	Wakefield Street (approaching Cuba St Intersection)	EB	A	A	A	A	A	A	A
		WB	A	A	A	A	B	A	B
	Randwick Road (south end)	NB	A	A	B	A	B	A	B
		SB	A	A	A	A	A	A	A
	Randwick Road (north end)	NB	B	B	C	B	C	B	C
		SB	B	B	B	B	B	B	B
	Whites Line East (approaching Cambridge Terrace Intersection)	EB	A	A	B	A	B	A	B
		WB	A	A	A	A	A	A	A

Legend LOS Improves LOS Worses

8.1.4 Journey Times

The route used to analyse the modelled journey times has been taken along The Esplanade and Waione Street from east of the Petone Interchange to west of Randwick Road, as depicted in Figure 8-3.

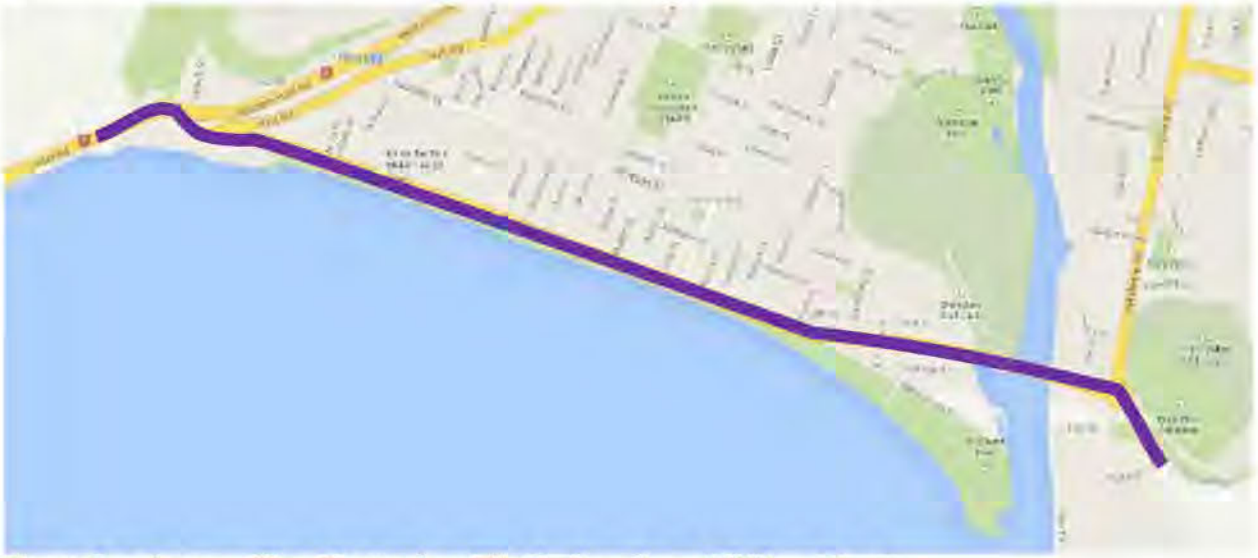

Figure 8-3: Journey Time Route along The Esplanade and Waione Street

Figure 8-4 to Figure 8-11 show modelled travel times along The Esplanade for the 2031 Do Minimum and option models in the AM and PM peaks for both the earlier and updated SATURN models. The Esplanade was selected as this route is common to all options, whereas the particular options vary in length so are difficult to compare. A4 size copies of these graphs, including graphs of the inter peak travel times, have been included as Appendix Q.

The westbound journey times in the AM and PM peaks are relatively consistent for all options, with the exception of SV-4, which has a 30km/h speed restriction on The Esplanade. In the PM peak, Option SV-4 has a large spike in travel time near the Petone Interchange indicating that there are significant delays at this point. Options SV-6 and SV-1 are slightly slower than the Do Minimum in the AM peak. In the PM peak SV-1, SV-6 and Do-Min consistently travel at the same speed. The fastest overall journey times are SV-8 and SV-3 in the AM peak, and SV-7 and SV-8 in the PM peak.

The updated model westbound travel time graphs show similar trends as noted in section 4.4.3. Compared to the earlier model, the AM peak period is significantly quicker (ranging from two to two and a half minutes) and the IP and PM periods are 50 to 70 seconds slower.

The depowered Esplanade options (those denoted with a 'b') show a similar journey time increase Westbound in the updated model, in comparison to the other options, to that of SV4 in the earlier modelling. As would be expected, the reduced speeds on The Esplanade have a significant impact on journey times along this route.

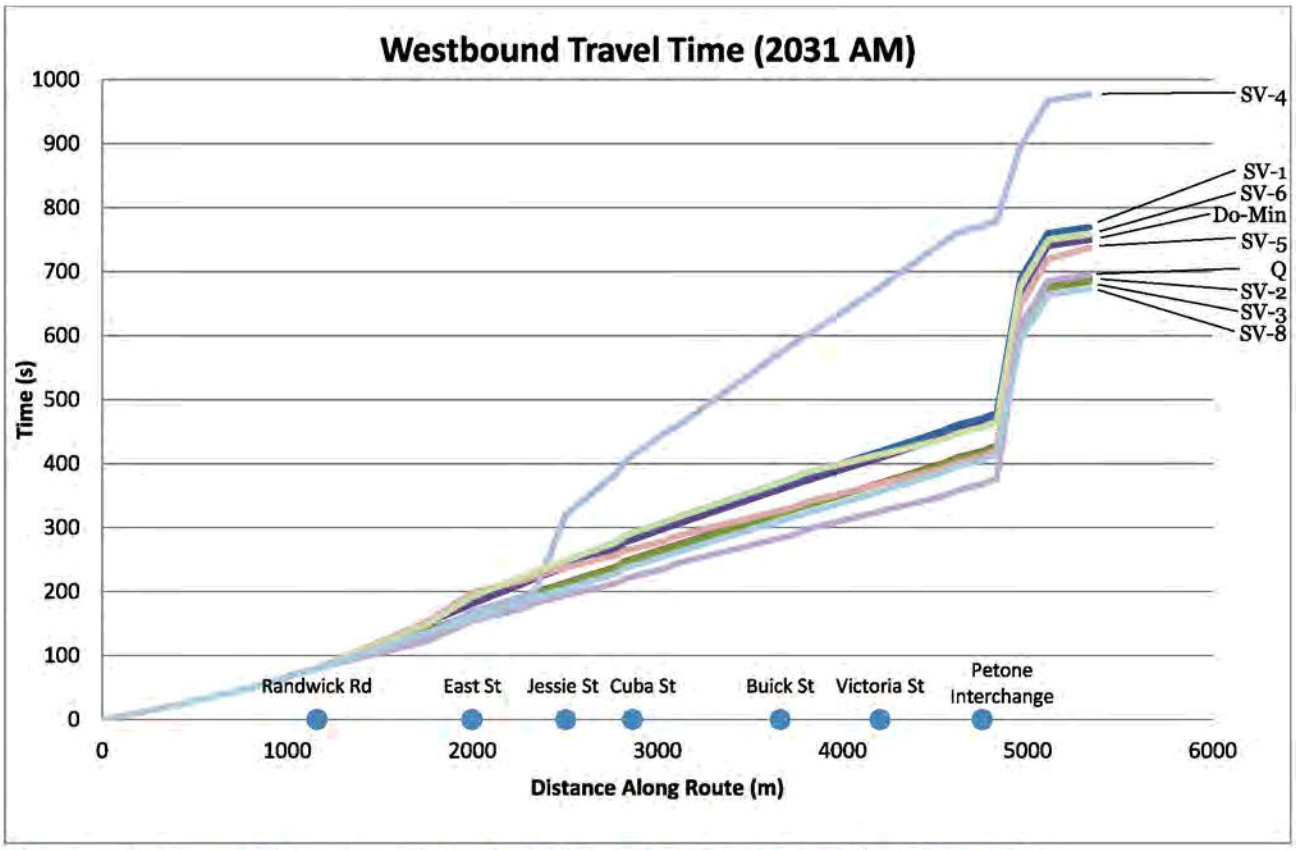

Figure 8-4: Journey Times – Westbound on The Esplanade, AM Peak (Earlier Model)

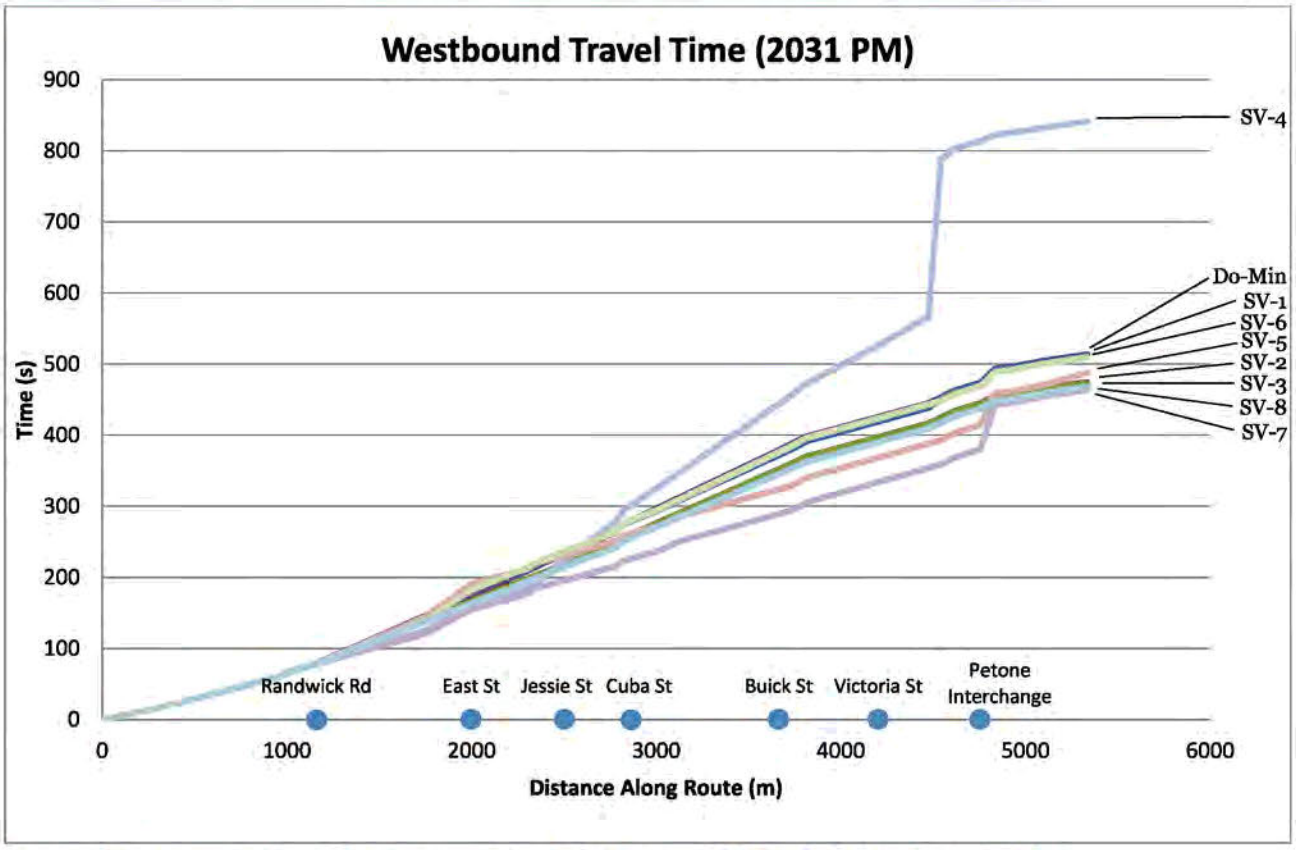

Figure 8-5: Journey Times – Westbound on The Esplanade, PM Peak (Earlier Model)

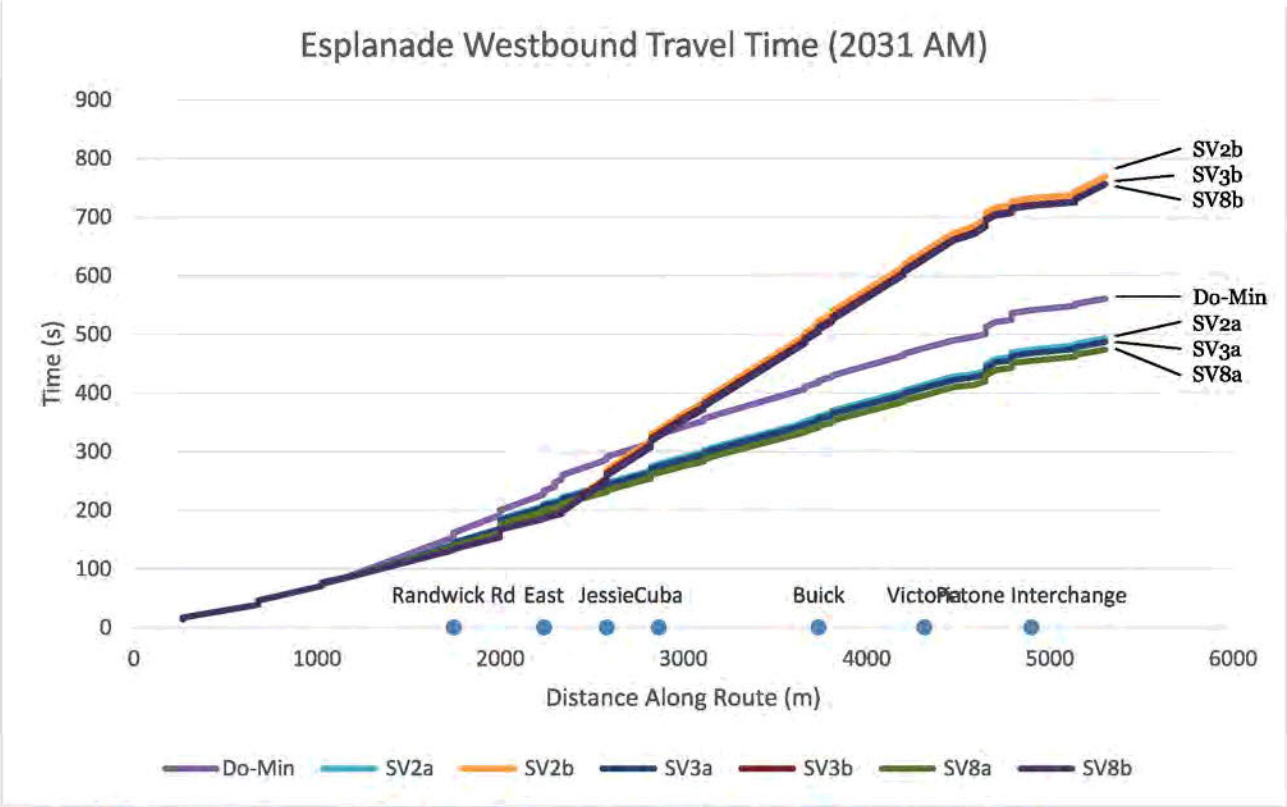

Figure 8-6: Journey Times – Westbound on The Esplanade, AM Peak (Updated Model)

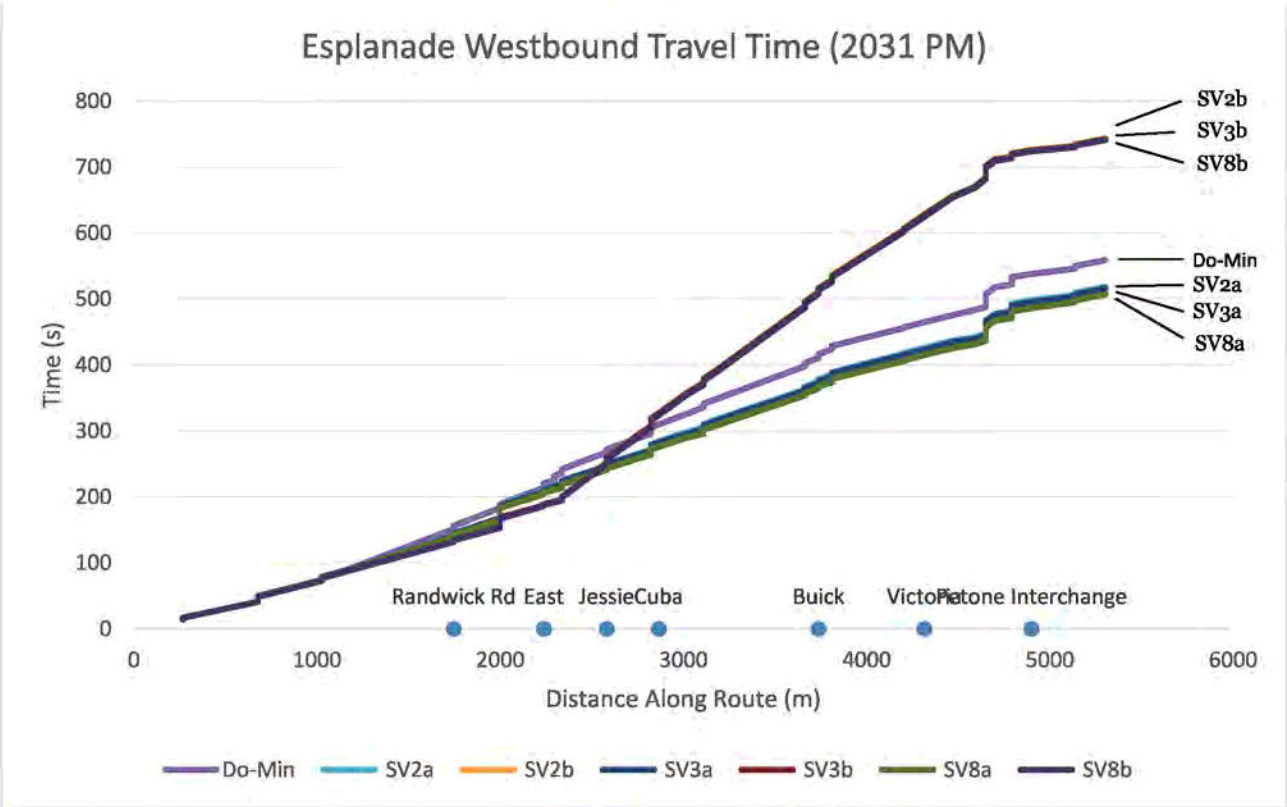

Figure 8-7: Journey Times – Westbound on The Esplanade, PM Peak (Updated Model)

As in the westbound direction, the Option SV-4 has the longest journey time in both the AM and PM peaks. Again Option SV-1 is slightly slower than the Do Minimum in the AM peak. In the PM peak SV-1 and SV-6 are both slower than the Do Minimum.

SV-7 and SV-8 have the fastest modelled travel times in the AM peak and the fastest overall journey times are SV-8 and SV-3 in the eastbound direction in the PM peak. This is a mirror image of what occurs in the westbound direction.

Overall, the fastest journey times along The Esplanade occur under SV-7 (the full double laning including the Estuary Bridge) and CVL (SV-2, SV-3 and SV-8) options. SV-7 is generally faster because the double laning has increased the capacity along The Esplanade whereas the CVL options are quicker because there are less flows along The Esplanade. For all options, major delays occur at the Petone interchange in the westbound direction, this is especially true during the AM peak. The signalised intersection at Cuba Street is also a point of delay in both directions. Additionally SV-4 experiences delays at Jessie Street because this is the location where the 30km/h speed restrictions begin. In general all options except SV-1, Sv-4 and SV-6 perform consistently better than the Do Minimum.

The updated model eastbound journey time graphs show similar trends as noted in section 4.4.3. Compared to the earlier model, the AM peak period is significantly slower (ranging from three to three and a half minutes) and the IP and PM periods are two and a half to three minutes seconds slower.

As with the westbound direction, the depowered Esplanade options (those denoted with a 'b') show a similar journey time increase eastbound in the updated model, in comparison to the other options, to that of SV4 in the earlier modelling. As would be expected, the reduced speeds on The Esplanade have a significant impact on journey times along this route.

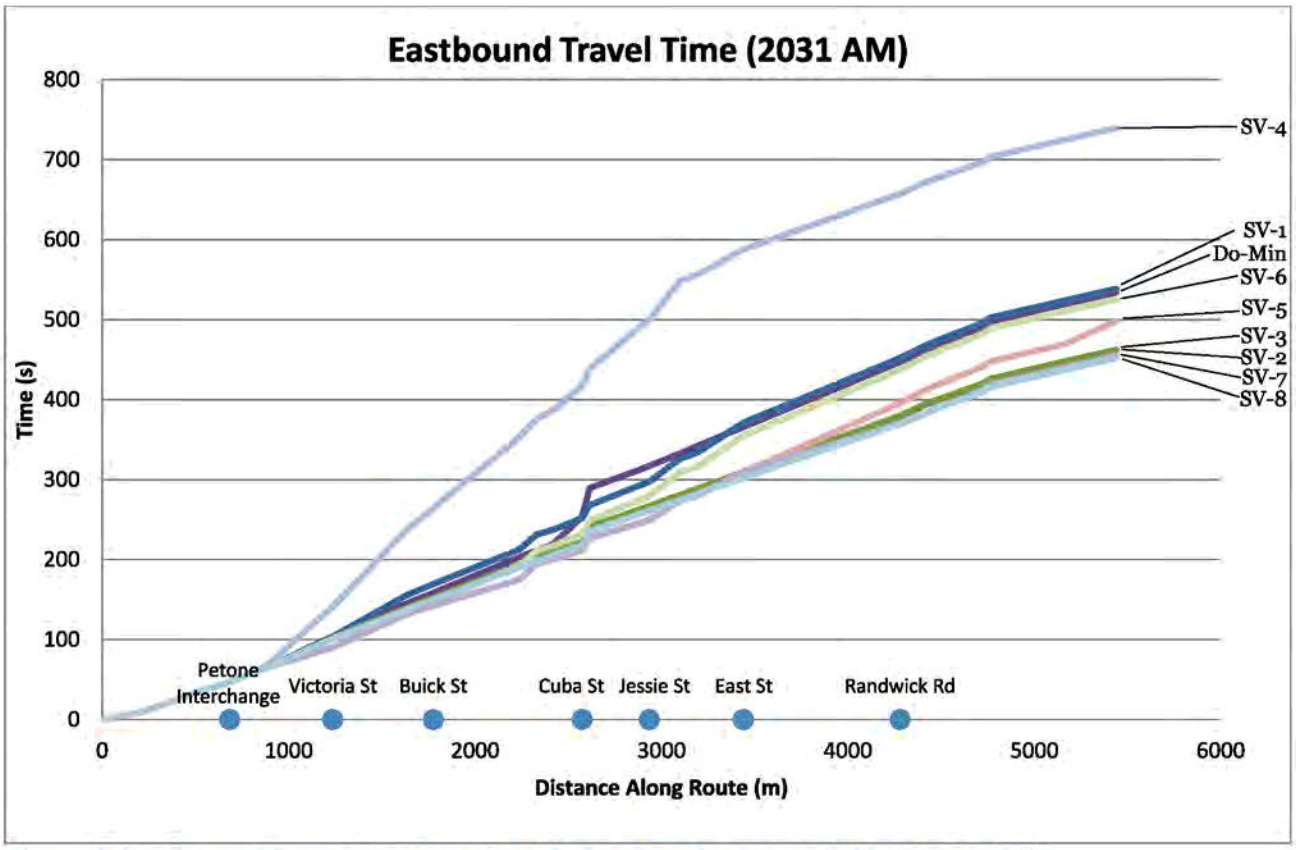

Figure 8-8: Journey Times – Eastbound on The Esplanade, AM Peak (Earlier Model)

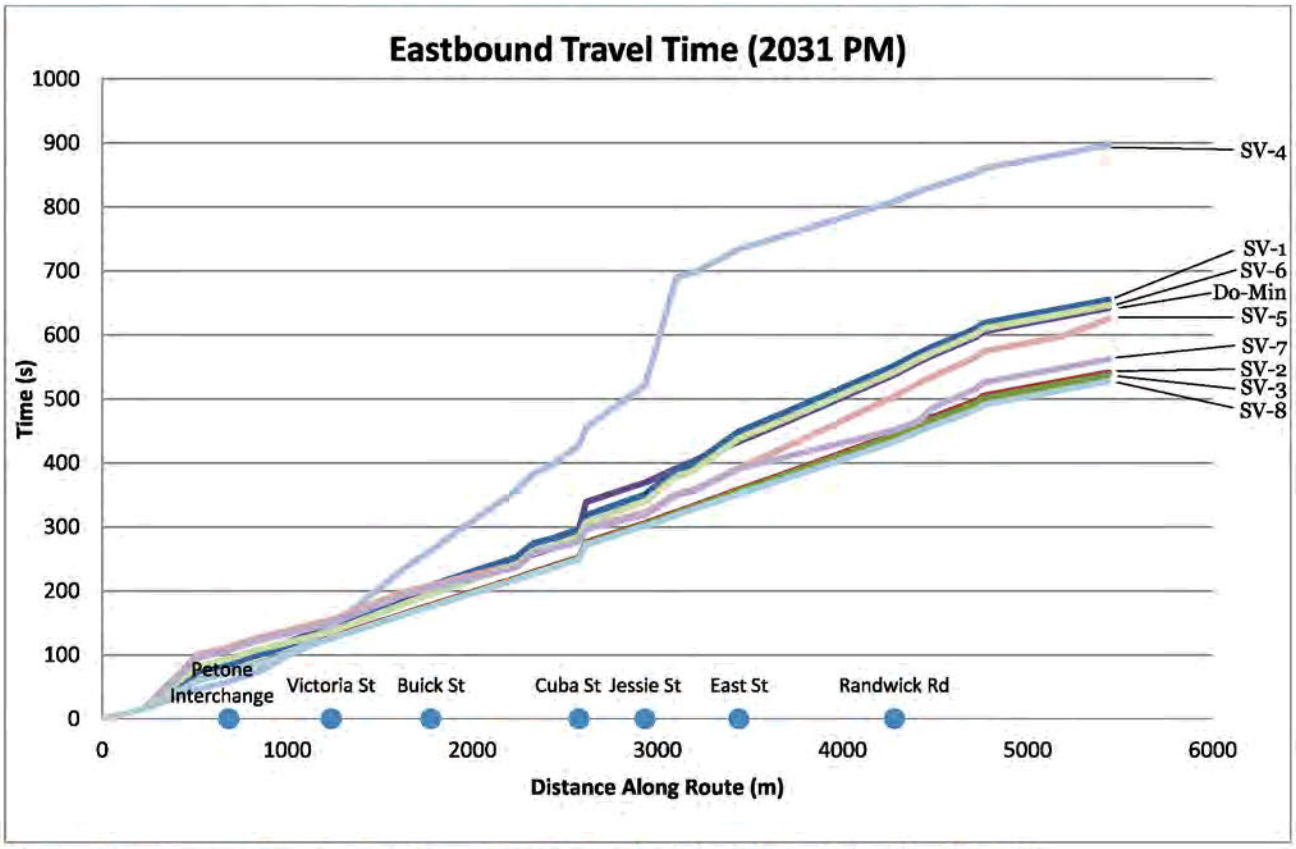

Figure 8-9: Journey Times – Eastbound on The Esplanade, PM Peak (Earlier Model)

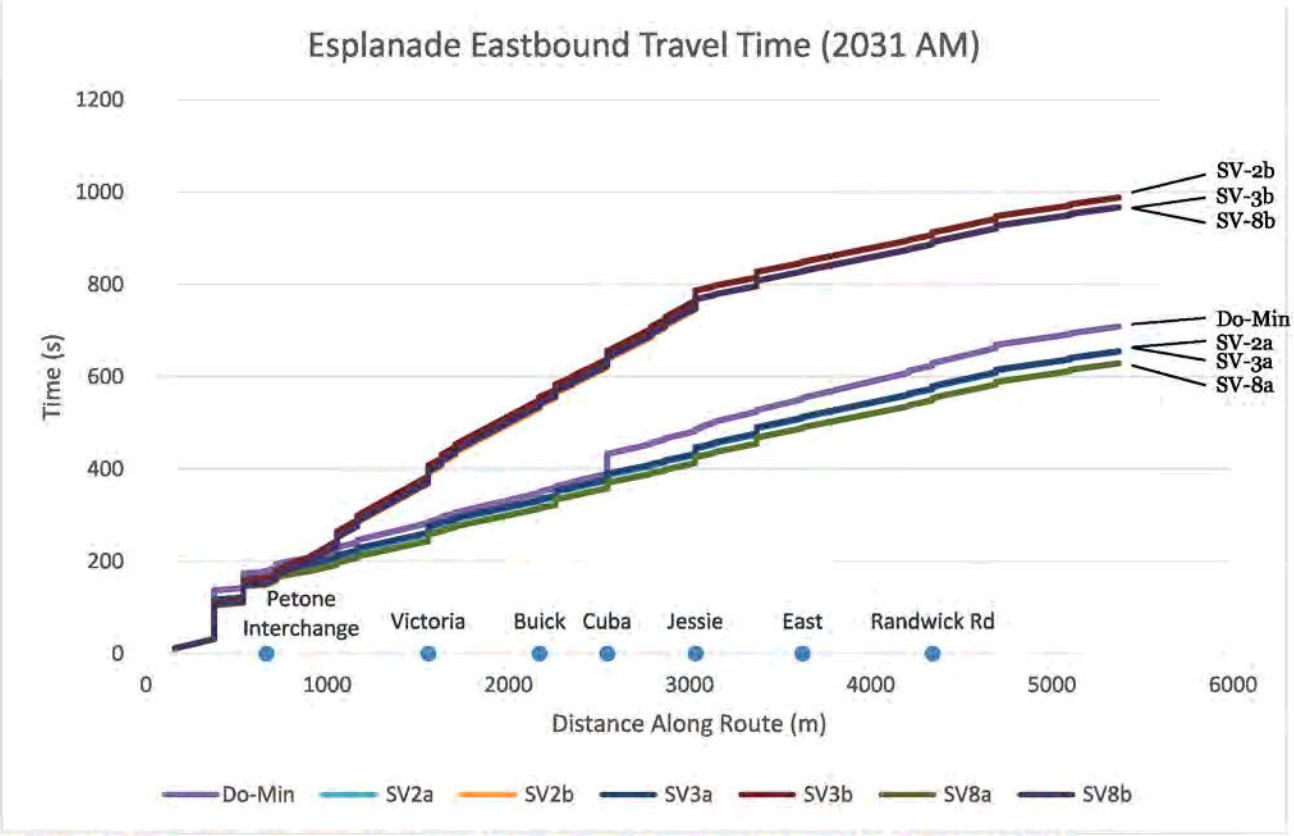

Figure 8-10: Journey Times – Eastbound on The Esplanade, AM Peak (Updated Model)

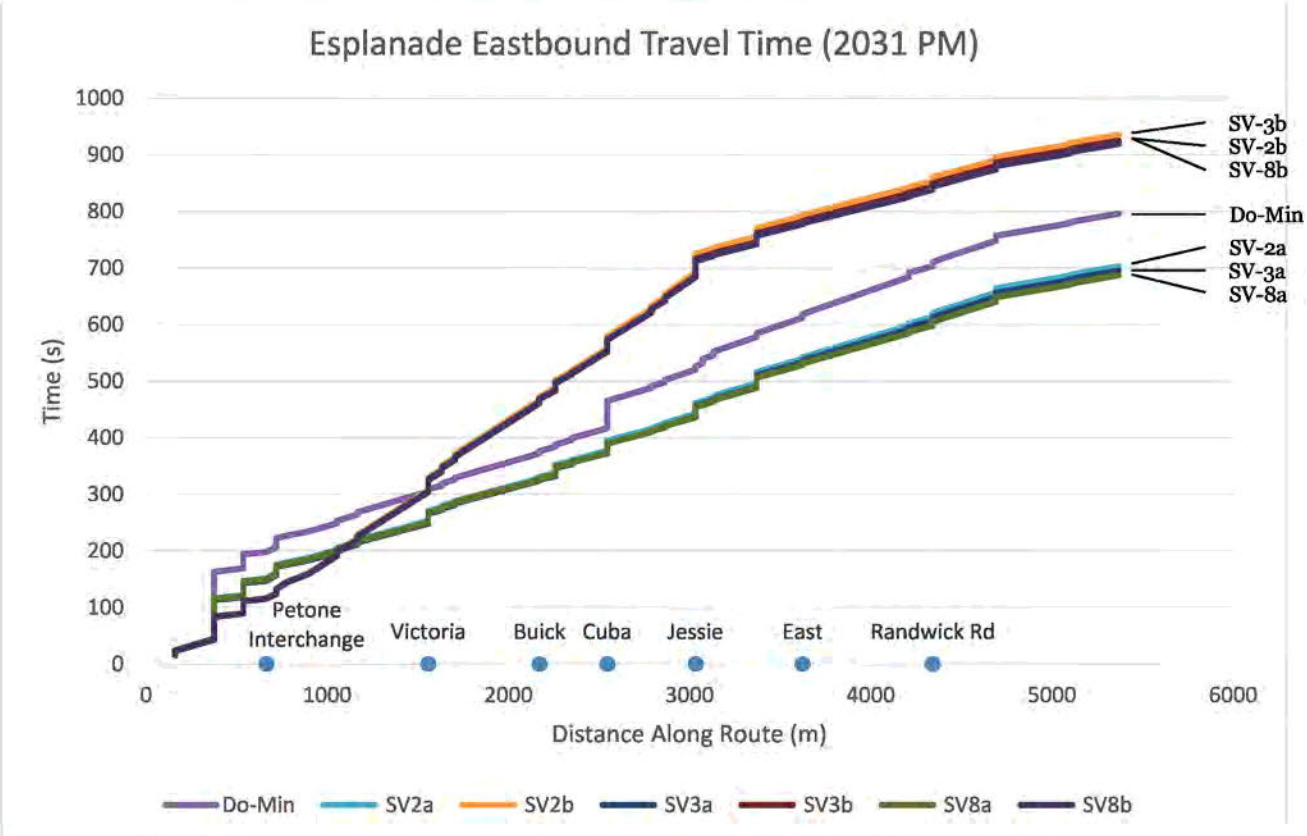

Figure 8-11: Journey Times – Eastbound on The Esplanade, PM Peak (Updated Model)

9 Cost Estimates

9.1 Cost Estimates

This section focuses on the methodology used to produce the Feasibility Estimate (FE) for the seven options. The estimates attached in Appendix R have been prepared and reviewed in accordance with NZTA's 'Cost Estimation Manual' (SM014).

9.2 Assumptions and Exclusions

The following section identifies the assumptions made during the estimating process. The cost estimates have developed based on preliminary designs, limited site information as well as general information about the type of construction and scope of work. The FE is formed using the design drawings contained within Appendices J through M.

In order to create a complete estimate it was necessary to make the following assumptions:

- NZTA managed costs have allowed for costs associated with the project (managed by NZTA) and are not part of the NZTA's administration costs such as partnering meetings. No provision has been made for extraordinary circumstances such as Environment Court appeals;
- Residential property estimates have been assumed by obtaining unit rates of affected land from the Quickmap database;
- The value of property currently owned by GWRC and KiwiRail have been derived based on their current land use as identified in the Hutt City District Plan. The relevant pages of the district plan are provided in Appendix S. The rates applied to each land use are provided below:
  - River Recreation = $10/m^2$
  - General Recreation = $27/m^2$
  - General residential = $115/m^2$
- All rates have been assumed to be at June 2013;
- A fixed percentage of the total construction cost has been assumed to estimate the investigation and design fees that might be required. In reality this could vary due to the size and scale of the schemes, particularly if programmed in isolation;
- Lump sum estimates have been included for service relocations. As no service investigation has been undertaken, there is a large degree of uncertainty associated with these costs at this point in the project;
- The design used as the basis for the cost estimate has not been subject to a safety audit. If there are any significant findings this could have a bearing on the estimate;
- A lump sum allowance for landscaping / urban design has been included. However, this does not allow for significant urban design mitigation since the potential scope of this work is unknown at this point;
- The options include a significant amount of new pavement markings. It has been assumed that an overlay on the existing pavement is required to allow for new pavement marking;
- In addition to new street lighting, a cost for upgrading all existing lanterns has been included in the estimates;
- For Options SV-1 and SV-4 to SV-7, where on-road cycle facilities have been provided, the Great Harbour Way cost has been excluded;

- Along with replacement fencing, a noise fence has been included between the road and rail for Option SV-3; and
- Costs for replacement of the Cuba Street overbridge for both SV-2 and SV-3 and replacement of the Randwick Road overbridge for SV-3 have been included in this project.

The following items have been excluded from the FE's

- GST;
- Escalation beyond the time the estimates were prepared;
- Sunk Costs; and
- Operational costs associated with the project outcome (i.e. maintenance costs).

9.3 Quantitative Risk Assessment

A quantitative risk assessment has been undertaken to derive the:

- Base or Expected Estimate to determine the NZTA managed contingency
- 95%ile estimate to determine the appropriate funding risk

The cost estimates consist of scoped work (the Base Estimate) and uncertainty (the risk element). At the beginning of a project, the level of knowledge is limited and there is a high level of uncertainty. With an increasing level of knowledge the uncertainty reduces.

The percentage range of uncertainty in the Base Estimate has been determined on a section-by-section basis (across the project by each line item in the estimate). Individual risks have not been quantified.

The option estimates are attached in Appendix R of this report and a summary has been presented below in Table 9-1.

Table 9-1: Summary of Cost Estimates

Options		Expected Estimate ($M)	95th Percentile Estimate
SV-1	Esplanade Improvements	30.4	42.1
SV-2a	White Lines Cross Valley Link	57.6	82.6
SV-2b	White Lines Cross Valley Link with Esplanade Depowering[11]	88.0[10]	124.7[10]
SV-3a	Railway Alignment Cross Valley Link	63.6	87.5
SV-3b	Railway Alignment Cross Valley Link with Esplanade Depowering[11]	94.0[10]	129.6[10]
SV-4	Esplanade Depowering[11]	30.4	42.1
SV-5	Esplanade Four Laning – Full	35.4	48.2
SV-6	Esplanade Four Laning – Partial	31.3	43.0
SV-7	Esplanade Four Laning including Bridge	54.4	74.1
SV-8a	Railway Alignment CVL with HCV Restriction[12]	63.6	87.5
SV-8b	Railway Alignment CVL with HCV Restriction[12] and Esplanade Depowering[11]	94.0[10]	129.6[10]

[10] These costs are based on the addition of cost from the relevant CVL option and SV-4, the Depowered Esplanade Option. This should be considered to be the worst case costs as there may be cost savings found due to economies of scale by carrying out these works together.
[11] No additional costs have been identified for traffic calming measures as the exact nature of these measures are unknown at this point.
[12] No additional costs have been identified for HCV restriction on the Estuary Bridge. It is assumed that this would be a low cost measure (e.g. signage) that would be enforced by local police initially to improve the uptake of the rule change. It is assumed that any advertising campaigns or marketing would come from existing budgets.

10 Economic Analysis

10.1 Assumptions

An economic analysis for each of the options has been carried out in accordance with the NZTA's Economic Evaluation Manual (EEM). The economic analysis calculation sheets are included for each option in Appendix T. The key assumptions used in the economic evaluation are:

- All costs and benefits have been discounted to 01/07/2013 (time zero);
- A 6% discount rate has been used to discount the costs and benefits to the time zero over a 40 year analysis period;
- The latest update factors and vehicle operating costs (July 2012 base date) have been applied in accordance with the EEM;
- SATURN outputs across the AM, inter peak and PM peak hours have been used to forecast the travel time, vehicle operating and CO_2 emission costs;
- CO_2 emission costs are assumed to be 4% of the vehicle operating costs;
- Crash cost benefits are assumed to be 5% of the total transportation benefits;
- A four year construction period has been assumed for all options with construction commencing 01/01/2020;
- Traffic disruption costs during construction have not been included; and
- No allowance for maintenance costs has been made.
- The annualisation factors used in this assessment are provided in Table 10-1

Table 10-1: Summary of annualisation factors

Peak Period	Days per year	Hours per day	Annualisation Factor (of Inter Peak)
AM Peak	240	2	Modelled
Inter Peak	240	7	Modelled
PM Peak	240	2	Modelled
Off-Peak	240	13	0.33(x IP)[13]
Weekend Peak	120	7	1.08(x IP)[7]
Weekend Off-Peak	120	7	0.32(x IP)[7]

[13] These are generic from previous modelling and should be updated at scheme assessment stage

10.2 BCR Values (Earlier Modelling)

The benefit cost ration (BCR) for each option, as per the earlier modelling results, is summarised in Table 10-2 below:

Table 10-2: Summary of construction costs and Payments used in the Economic Analysis

Options		Benefits (NPV) ($M)	Cost (NPV) ($M)	BCR
SV-1	Esplanade Improvements	-0.06	18.6	0.0
SV-2	White Lines Cross Valley Link	59.1	35.2	1.7
SV-3	Railway Alignment Cross Valley Link	58.1	38.8	1.5
SV-4	Esplanade Depowering	-155.7	18.6	-8.4
SV-5	Esplanade Four Laning – Full	36.8	21.6	1.7
SV-6	Esplanade Four Laning – Partial	-2.0	19.1	-0.1
SV-7	Esplanade Four Laning including Bridge	53.0	33.2	1.6
SV-8	Railway Alignment CVL with HCV Restriction	51.4	38.8	1.3

10.3 Wider Economic Impacts

A preliminary estimate of the possible Wider Economic Impacts (WEIs) which might be generated by the main alternative options was prepared. This appraisal has been provided in Appendix U. Because the appraisal is only at a preliminary stage the WEIs have not been calculated directly. Their estimation, which is intended to provide an initial indication of the possible scale of these benefits, is based on information derived from other projects. These percentages were only applied to those options that have positive benefits.

Traditionally WEIs are only considered for project with a capital value greater than $200 million. While the cost of this project is below this threshold it is envisaged that this project would be completed in conjunction with the P2G link road, which is valued above this constraint. Consequently these WEIs are based on cumulative benefits from the P2G project. Without building the Petone to Grenada link road, it will be difficult to realise these benefits.

The three elements of WEI's analysed are agglomeration benefits, impacts of imperfect competition and labour supply benefits. Following the approach set out in the NZTA Note General Circular– Funding: No 13/06, agglomeration benefits can be added to conventional economic benefits in estimating the base BCRs. The other two WEI components, imperfect competition benefits and labour supply benefits, are to be considered as a sensitivity test. As the P2G link is included in both the options and the do min, the agglomeration benefits are specific to the PFR options.

Table 10-3: Effect of Agglomeration Benefits

Options	Transportation Benefits ($M)	Agglomeration %	Agglomeration Benefits ($M)	Total Benefits for Base BCR ($M)	BCR
SV-2	59.1	16%	9.5	68.6	1.9
SV-3	58.1	16%	9.3	67.4	1.7
SV-5	36.8	25%	9.2	46.0	2.1
SV-7	53.0	25%	13.2	66.2	2.0
SV-8	51.4	16%	8.2	59.7	1.5

The imperfect competition benefits and labour supply benefits are 5% and 1% of the transportation benefits, respectively, for all options.

Table 10-4: Effect of Imperfect Competition and Labour Supply Benefits

Options	Transportation Benefits ($M)	Imperfect Competition ($M)	Labour Supply ($M)	Total Benefits ($M)	BCR
SV-2	68.6	3.0	0.6	72.1	2.0
SV-3	67.4	2.9	0.6	70.9	1.8
SV-5	46.0	1.8	0.4	48.2	2.2
SV-7	66.2	2.6	0.5	69.4	2.1
SV-8	59.6	2.6	0.5	62.8	1.6

10.4 Updated Economics

As described previously, the NWSM model has undergone a recalibration exercise and the Cross Valley Link (CVL) options have been rerun using this updated model. The CVL options have only been rerun in the 2031 forecast year and thus it is not possible to update the economic assessment. To provide some idea of the relative benefits generated from the updated modelling the 2031 costs are presented in this section.

Tables 10-5 and 10-7 show the 2031 year benefits in terms of travel time costs, congestion relief value, vehicle operating costs and CO2 emission costs for the earlier and updated models respectively. Tables 10-6 and 10-8 show the percentage difference of the options compared to the do min and give an idea of the benefits which are generated. The key comparison is that of the travel time costs as this produces the bulk (generally ~80%) of the benefits.

Table 10-5: 2031 Modelled Costs (Earlier Model)

Options	Travel Time Costs ($M)	Congestion Relief Value ($M)	Vehicle Operating Costs ($M)	CO2 Costs ($M)
Do Min	1,438.7	48.1	1,186	47.4
SV1	1,439.3	48.1	1,186.1	47.4
SV2	1,434.5	47.2	1,184.8	47.4
SV3	1,434.4	47.1	1,185.3	47.4
SV4	1,451	50.2	1,188.6	47.5
SV5	1,436.4	47.7	1,185.4	47.4
SV6	1,439	48.1	1,186	47.4
SV7	1,435.3	47.4	1,184.8	47.4
SV8	1,434.9	47.1	1,185.6	47.4

Table 10-6: 2031 Modelled Costs Percentage Difference (Earlier Model)

Options	Travel Time Costs	Congestion Relief Value	Vehicle Operating Costs	CO2 Costs
SV1	-0.04%	0.00%	-0.01%	0.00%
SV2	0.29%	1.87%	0.10%	0.00%
SV3	0.30%	2.08%	0.06%	0.00%
SV4	-0.85%	-4.37%	-0.22%	-0.21%
SV5	0.16%	0.83%	0.05%	0.00%
SV6	-0.02%	0.00%	0.00%	0.00%
SV7	0.24%	1.46%	0.10%	0.00%
SV8	0.26%	2.08%	0.03%	0.00%

Table 10-7: 2031 Modelled Costs (Updated Model)

Options	Travel Time Costs ($M)	Congestion Relief Value ($M)	Vehicle Operating Costs ($M)	CO2 Costs ($M)
Do Min	1,438.6	50.7	1,151.8	46.1
Option 2a	1,433.1	49.7	1,150.4	46
Option 2b	1,446.6	51.6	1,153.8	46.2
Option 3a	1,434.4	50	1,150.8	46
Option 3b	1,449.2	52.1	1,155.5	46.2
Option 8a	1,435	50	1,151.4	46.1
Option 8b	1,480.8	60	1,152.3	46.1

Table 10-8: 2031 Modelled Costs Percentage Difference (Updated Model)

Options	Travel Time Costs	Congestion Relief Value	Vehicle Operating Costs	CO2 Costs
Option 2a	0.38%	1.97%	0.12%	0.22%
Option 2b	-0.56%	-1.78%	-0.17%	-0.22%
Option 3a	0.29%	1.38%	0.09%	0.22%
Option 3b	-0.74%	-2.76%	-0.32%	-0.22%
Option 8a	0.25%	1.38%	0.03%	0.00%
Option 8b	-2.93%	-18.34%	-0.04%	0.00%

The CVL options in the updated model show travel time cost improvements ranging from 0.25% in option 8a to 0.38% in option 2a. This is in line with the same options as previously modelled. The Esplanade depowered options show negative travel time benefits as expected and in line with the earlier modelling of SV4 option which also had a depowered esplanade. Option 8b however performs significantly worse than the options 2b, 3b and the earlier SV4.

This analysis shows little variation in the benefits anticipated for each of the options when compared to the earlier assessment, and accordingly the BCR analysis is considered to remain valid. The only except to this is the congestion relief for Option 8b, where a difference of 18% is observed. As noted above, the majority of benefits are derived from travel time costs, and the congestion relief represents a much smaller portion of the combined benefits.

While BCR analysis was not able to be carried out using the updated modelling for options 2b, 3b and 8b, from the travel time costs it can be seen that these options would produce a negative BCR compared to the do minimum scenario. Option 2b and 3b would likely show greater benefits compared to the depowering alone in SV4. It should be noted that while the depowered esplanade options show negative transport benefits, these don't take into account other benefits such as improved amenity which may make such an option desirable despite the transport dis-benefits.

11 Land Requirements

Varying amounts of properties are required to implement the 8 options analysed. The identified land requirements in this section take into consideration the full road width including shoulders and central medians. The Cross Valley Link options (SV-2, SV-3 and SV-8) require the most property. The options considering four-laning of The Esplanade require less property or no property at all. No land acquisition has been assumed for construction of the Great Harbour Way as this occurs on the foreshore.

Options SV-1, SV-4 and SV-6 do not require acquisition of any property as these works occur within the apparent road reserve or existing carriageway.

Option SV-2 requires acquisition of several properties on either side of the new bridge and near the new connection to the roundabout at Randwick Road and Whites Line West:

- Approximately 10 square metres is required from the property on the southwest corner of Tama Street and Wakefield Street to create a cul-de-sac at the south end of Tama Street;
- Two properties at the east end of Wakefield Street (100 Wakefield Street and 2A Mudie Street) will need to be purchased and their buildings removed in order to accommodate the new bridge structure. Three properties at the west end of Whites Line West will also need to be purchased for this reason. Those are 1 and 3 Whites Line West and 37 Richmond Grove; and
- 51, 53 and 55 Whites Line West will also need to be acquired to build the connection between Whites Line West and the Randwick Road / Whites Line East roundabout.

Option SV-3 and SV-8 require the most property including private properties, frontages and a pump station.

- On the west side of the rail bridge along the rail corridor, the following properties would be required to create the roadway:
    - A pump station at 56 Wakefield Street;
    - 58, 60 and 62 Wakefield Street;
    - One unit at 64 Wakefield Street, a subdivided lot, would require removal of the building and purchase of the associated land;
    - Approximately 70 square metres of 66 Wakefield Street would be needed to build the roadway. This would require removal of some outbuildings on the property; and
    - Approximately 1.5 metres of the remaining properties that back onto the north of the railway line on the west side of the river would be required.
- On the east side of the rail bridge along the rail corridor, the following properties would be required to create the roadway:
    - Five properties of Housing NZ would need to be acquired: Units 2, 3 and 4 at 26 Richmond Grove and Units 5 and 6 at 22 Richmond Grove;
    - 1A and 2 Fuller Grove;
    - A small portion of 1 Fuller Grove that would result in the removal of an outbuilding.; and;
    - Approximately 50 square metres at 31 Trevethick Grove that would result in the removal of an outbuilding.

- The new road would also use some land that is currently used for Trevethick Grove, a local road accessing several properties. Thus, 13 Trevethick Grove and a portion of 14 Trevethick Grove would be required to realign the existing road.

The current design used for Options SV-5 and SV-7 requires that several buildings on the south side of The Esplanade may need to be removed between Fitzherbert Street and Richmond Street. These are the TS Tamatoa Sea Cadets building, the Jetty Café and Rowing Club and the Heretaunga Boating Club. Two of these buildings are heritage buildings and would their removal would be discouraged. However, this has been costed for as a 'worst case scenario'. As these buildings are on land owned by Hutt City Council, approximate costs of relocating the tenants of the buildings were assumed instead of land acquisition costs. There are opportunities in the design of these options to allow the buildings to remain; however, this would result in reduced traffic movements at several intersections and thus the benefits currently achieved may decrease, however costs would also decrease. Further discussion on the heritage buildings is provided in Section 14.

The property requirements noted above are based on the current designs. As the designs are refined the property requirements may change. Opportunities to minimise the amount of land required may be identified. Opportunities to improve the streetscape and enhance urban design of the desired option may also be identified as it progresses.

Property acquisition presents a risk where land has not previously been subject to designation.

Net property costs have been included in the cost estimates contained in Section 9 of this report.

12 Urban Design

A preliminary Urban Design Assessment has been completed on the eight options. This was a desktop based analysis identifying the issues and opportunities of the various options considered from an urban design perspective. The views and assessment presented in this section are those of Kevin Brewer, Registered Architect with Brewer Davidson and the Urban Designer for this and the Petone to Grenada project. In addition to the information presented in this section, the location of the Petone to Grenada connection with State Highway 2 was also discussed in the full assessment which been provided in Appendix G.

This urban design assessment covers the area from the SH2 Interchange in the west to Seaview in the east to a Preliminary Feasibility Report standard. The assessment compares The Esplanade and Cross Valley Link options against urban design best practice and the project objectives.

12.1 Cross Valley Link Options

The rail alignment option (SV-3) is preferred from an urban design perspective. Wakefield Street west of Cuba Street is low in amenity and can accommodate the arterial road.

The western footbridge to Ava Station can be linked directly to the replacement Cuba Street overbridge and avoid a pedestrian crossing on the CVL. The possibility of transfers to the busy bus routes on Cuba Street becomes a possibility. The Fitzherbert Street signalised intersection can provide access to the eastern rail footbridge.

From an urban design perspective the railway alignment is the preferred option between Hutt River and Randwick Road to avoid effects on a residential street. This can be confirmed and further developed if the CVL is taken to a Scheme Assessment stage.

Randwick Road can be used as a medium term solution to providing a cross valley link but the Railway/Elizabeth Street alignment is the preferable long term option to avoid Moera Village, Randwick Primary School and the church/marae at York Street corner.

12.2 Esplanade Options

The option preference is based on the desire to disperse traffic between The Esplanade and CVL to integrate land use and transport improvements.

If the CVL is not included then Option SV-1 is preferred as it retains parking on the northern kerb that supports mixed use intensification along The Esplanade. Options 5, 6 & 7 all remove parking on the northern kerb in the Plan Change 29 Petone West area. Connecting the existing westbound double lanes through to Hutt Road is supported as it increases capacity without compromising land use intensification. The general traffic lanes and Hutt Roundabout design in SV-6 is preferable to SV-1.

Dispersing traffic is also preferred to allow the SV-1 cross section east of Nelson Street with parking on the northern kerb and a single carriageway in each direction. The cycling lanes are a potential transport benefit. The more important urban design goals are to retain parking and a single lane in each direction to keep the road narrow and slow speeds.

The increase in signalised intersections with pedestrian crossings at Victoria Street, Buick Street, Cuba Street, Jessie Street and Kirkcaldy Street as well as pedestrian calls at Bay and Patrick Streets will dramatically improve connectivity to the foreshore. This pattern is consistent in all Esplanade options.

However, a crossing facility at the western end of the Plan Change 29 area is desired given the planned land use intensification and the desirability of Korokoro Gateway Park. Victoria Street is 855 metres from Hutt Road so allowance for a future pedestrian crossing near Hutt Road should be allowed for as part of wider transport improvements.

The existing balance of buildings, car parking and open space along the foreshore boardwalk is ideal so the retention of the T.S. Tamatoa and Jetty Café buildings is preferred. This is only an issue for the four laning in Options SV-5 and SV-7 which are not preferred from an urban design perspective.

12.3 Conclusion

Objectives 2 and 5, identified in Section 1.6, for the project read:

- Support the economic growth and development of the Hutt Valley by improving connectivity within the region; and
- Enhance the linkage between the sea and Petone for all users.

The important land use issues are the regional importance of Seaview as a heavy industrial and scientific research area, and mixed use intensification at Petone.

These two land use issues have contrasting transport requirements. Seaview will remain largely dependent on private vehicles especially to SH2 and P2G links. Petone will have a balance of private vehicle and public transport needs, but encouraging patronage of rail is a strategic goal. Therefore the walk or cycle route to Petone Rail Station and to a lesser degree Petone Wharf (no current commuter service operating) becomes important.

Petone's growth is different to fringe suburban growth. It is typically higher value, start up business growth and medium density urban residential development that is important to establish in the Hutt Valley. It is important to develop higher value employment where people live in the Hutt Valley. This reduces people having to travel to Wellington CBD for these job types so is a long term transport benefit.

Urban nodes with foreshore edges are rare in New Zealand cities, so this is one of the reasons for Petone's success. Connection to the amenity provided by The Esplanade foreshore is critical to attracting businesses and residents to higher density development.

There are land use and transport benefits of dispersing traffic to the Dowse and Petone interchanges along a combination of The Esplanade and CVL route upgrades.

Dowse Interchange is located between the Petone and Hutt urban nodes so is a better route for general traffic and HCVs in particular. This reduces traffic along The Esplanade and Hutt Road protecting walking and cycling linkages to the foreshore and Petone Rail Station. In addition, general eastern suburb growth will have a more direct link to SH2 along the CVL route reducing traffic along Randwick Road.

Conversely the full Petone Interchange will pull traffic along The Esplanade and Hutt Road severely affecting the growth potential of Petone. These are the same issues faced with Customhouse Quay severing the city and waterfront in Wellington's CBD. The response has been to form an inland state highway and encourage buses as an extension of the rail route along the 'growth spine'. A four lane road with no parking to slow vehicles severing a growth node and foreshore could become a bigger and bigger mistake as time goes by. A combination of CVL and The Esplanade routes should be a strategic planning response not a decision driven by cost benefit ratios.

Therefore the preferred option(s) from an urban design perspective are:

- In Stage 1 of development, Option SV-1 should be implemented with two general vehicle westbound lanes at Petone West. Also pedestrian connections across The Esplanade at Petone West be included;
- This should be followed by Option SV-3 CVL railway alignment (with a caveat that the best linkage to a future Elizabeth Street link may alter that choice);
- Directly linking the Dowse Interchange to the CVL should be Stage 2 of development as it provides direct access to SH2.
- The Elizabeth Street connection should be addressed in the final stage (Stage 3). This will divert the Seaview HCV flows away from the Moera Village, Randwick Primary School and the church/marae on York Street;
- Options for the Grenada link to Dowse Interchange or ramps north of Petone Interchange be investigated further to direct through traffic away from Petone West;
- Options to connect Ava Rail Station to the replacement Cuba Street overbridge be investigated for pedestrian access and possible bus/rail transfers; and
- Confirmation that the Great Harbour Way will be the route for all cyclists travelling south to Ngauranga so that linkages to The Esplanade and Hutt Road can be planned.

13 Geotechnical Requirements

Opus has undertaken a review of available literature, interpretation of aerial photographs, and engineering geological reconnaissance mapping. The preliminary geotechnical appraisal has involved the following:

- A desk study of regional geology and hazard maps.
- A review of past relevant geological and geotechnical reports, and the results of previous investigations.
- A desk study of the potential for contamination along the route.
- Site reconnaissance visits by our engineering geologist, Doug Mason, and our principal geotechnical engineer, P. Brabhaharan.
- Appraisal of the geotechnical issues that may influence the development of route alignments.
- Recommendations for development of the route.
- Consideration of a strategy for carrying out geotechnical investigations.

13.1 Geomorphology and Geology

Within the Hutt Valley, the geomorphology is characterised by flat, low-lying coastal and alluvial terrace surfaces. The urban areas of Petone, Lower Hutt, Gracefield and Seaview have been developed on this land. The Cross Valley Link (CVL) route is proposed to cross the Hutt River near the Ava Rail Bridge. In this area, the river is approximately 120m wide and consists of a gravel channel that grades downstream into finer grained deposits (marine sands and estuarine muds) near its mouth between Petone and Seaview.

The geology of the Wellington region has been mapped by the Institute of Geological and Nuclear Sciences at 1:50,000 scale (IGNS, 1996) and 1:250,000 scale (IGNS, 2000). These maps indicate that the proposed CVL route crosses land that is underlain by marginal marine sediments and alluvium of the Holocene age.

13.2 Hazards

13.2.1 Contaminated Land

Contaminated site information for sites in the vicinity was obtained through Greater Wellington Regional Council's selected land use register (SLUR). The SLUR is a database of sites that have, or may have, been used for activities and industries from the Hazardous Activities and Industries List (HAIL) established by the Ministry for the Environment. The information provided is indicative only of the levels of contamination and expected contaminants.

A summary of contaminated sites in close proximity to the CVL route is provided in Table 13-1 and a map of these sites are provided in Appendix V.

Table 13-1: Contaminated Site Summary

Site (GWRC File No.)	Proximity to Route	Age / Closure	Nature of Land Use	Identified/Potential Contaminants
Ex Ados Chemical Co Ltd (SN/03/090/02)	0 m	-	Resins/synthetics manufacture	Hydrocarbons, solvents
Ex General Motors / Mitre 10 Mega (SN/03/115/02)	20 m	1984	Motor vehicle workshops	Hydrocarbons
Ex Turnbull and Jones Ltd; Currently Acme Engineering (SN/03/091/02)	0 m	1940s-1978; Current	Electrical manufacturing, iron and steel works	Asbestos, metals
Ex Turnbull and Jones Ltd; Currently Hutt Valley Polytech (SN/03/092/02)	0 m	1940s-1978; Current	Electrical manufacturing, iron and steel works	Asbestos, metals
Pacific Container Park (SN/03/127/02)	170 m	Current	Transport depot: storage/use/disposal of hazardous substances	Hydrocarbons, solvents
Ava Park landfill (SN/03/151/02)	0 m	1940s – unknown	Refuse landfill	Hydrocarbons, metals, landfill gas
Mobil Ludlam (SN/03/119/02)	0 m	1995 – current	Service station	Hydrocarbons

Records of asbestos are only held for 2 of the sites listed in Table 13-1 above (the ex-Turnbull and Jones factory buildings on Wakefield Street). However, given the age and nature of land use at the remaining sites in the project area, asbestos may be present at a number of these sites.

The 2011 National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES), sets out a framework for assessing the risks associated with land contamination. The NES requires a Preliminary Site Investigation (PSI), comprising a detailed desk study, to be undertaken in the first instance to classify the nature and distribution of potentially hazardous land uses in the project area and to develop the scope of necessary intrusive investigations and laboratory chemical testing to quantify the hazard posed by soil contaminants. The distribution of potentially contaminated sites in the project area shows that land contamination could pose significant issues for the route options under consideration, and therefore we recommend a PSI be undertaken in conjunction with developing concepts for the P2G and CVL routes should they be progressed. This will be followed at a later stage by detailed site investigations and laboratory testing, when the preferred alignments have been selected.

13.2.2 Seismicity

The project area lies within the Wellington region, which is exposed to a high level of seismicity. The region has a number of major active faults and a subduction zone associated with the active

plate boundary between the Pacific and Australian plates. These structures are capable of generating large earthquakes of magnitude 7.5 to 8+, and together these represent earthquake sources that contribute significantly to the seismic hazard in the Wellington region. The principal active faults within 20km of the site are the Wellington Fault, Moonshine Fault, Wairarapa Fault and Ohariu Fault. The characteristics of these faults are provided in Table 13-2.

Table 13-2: Active faults in the vicinity of the site

Fault Name	Direction from site	Expected Magnitude - Mw	Recurrence Interval (years)
Wellington Fault	West	7.5	840
Moonshine Fault	West	7.1	2,000
Wairarapa Fault	East	8.2	1,200
Ohariu Fault	West	7.5	2,500

In addition, the subduction interface between the Pacific and Australian plates has the potential to generate very large magnitude earthquakes (M_w 8.2-8.6) that would generate strong ground shaking in the Wellington region (Holden and Zhao, 2011).

13.2.3 Liquefaction

A liquefaction hazard study for the Wellington Region was carried out by Works Consultancy Services (now Opus) in 1992 and the results of the study were published by the Wellington Regional Council (WRC, 1993). This study indicates a variable liquefaction potential across the site, from low to high, which reflects the variable compositions of the alluvial, marine and fan deposits.

Liquefaction will occur when submerged loose to medium dense granular materials and silt are subjected to ground shaking. Liquefiable materials such as loose to medium dense silt, sand and gravel are likely to be present in the area, particularly around the Petone foreshore and along the Hutt River.

The groundwater table at Petone is likely to be about 2 m deep (Works Consultancy Services, 1996a) and this part of the site may therefore be susceptible to liquefaction. The Cross Valley Link being considered is located in areas of variable potential for liquefaction, ground subsidence and lateral spreading.

13.2.4 Tsunami

The Petone Interchange area, The Esplanade and the Cross Valley Link are exposed to tsunami hazards according to the Wellington Regional Council tsunami evacuation zones. The Cross Valley Link would be exposed a lower height tsunami inundation than The Esplanade.

13.3 Engineering Issues and Solutions

If the Cross Valley Link progresses it is likely to involve at grade or low height embankments along Wakefield Street, embankments and a bridge across the Hutt River flood plain and low height embankments to the east of the river.

Key engineering features of the CVL routes are:

- Large areas of road pavement at present ground level along Wakefield St and Whites Line West;
- New bridge over Hutt River, upstream of or alongside the Ava Rail Bridge; and
- Small embankments and retaining walls at the approaches and abutments to the new bridge.

The principal issues for the Cross Valley Link route are summarised in Table 13-3.

Table 13-3: Key Geotechnical Issues for the Cross Valley Link Route

Location	Road Form	Key Geotechnical Engineering Issues	Risk Management Measures and Possible Concepts
At-grade along Wakefield St and Whites Line West	» Road on existing ground	» Proximity to active Wellington Fault. » Variable ground conditions. » High groundwater levels, including artesian groundwater. » Liquefaction hazard in earthquakes and impact on embankments and structures. » Potentially contaminated ground.	» Geotechnical investigations to confirm ground and groundwater conditions and liquefaction hazard. » Geological investigations to confirm location, width, characteristics and form of the Wellington Fault zone. » Locate structures away from fault zone. » Undercut of soft ground and drainage measures.
Hutt River crossing	» Bridge » Retaining walls » Embankments	» Foundation conditions for bridge and retaining walls on alluvial deposits. » Artesian groundwater pressures. » Instability of bridge abutments and embankments due to liquefaction and lateral spreading in earthquake events.	» Geotechnical investigations to confirm ground and groundwater conditions and liquefaction hazard. » Pile foundations to support bridge structure. » Pile construction to resist artesian groundwater pressure and prevent aquifer contamination.

The geotechnical issues described above in Table 13-3 can be resolved through:

- An appropriate level of geotechnical investigations;
- Early consideration of issues during concept development and preliminary design; and
- Integrated consideration of the geotechnical issues with the development of the project, to achieve an appropriate road form, reduce construction costs, reduce potential hazards and improve the overall performance and resilience of the new road.

14 Resource Management Issues

A preliminary assessment of the planning restraints associated with the eight options has been completed and provided in Appendix W. The assessment considers:

- Affected land uses;
- Physical and environmental constraints;
- Zoning requirements;
- Heritage buildings and trees;
- District council plan requirements; and
- Regional council plan requirements.

From a planning perspective, it is considered that there are two main options with variations within these options. Those are Esplanade Improvements options and Cross Valley Link options. These are discussed in the following sections. A summary of the various possible consents necessary has also been provided.

14.1 Esplanade Improvement (SV-1, Sv-4, SV-5, SV-6, SV-7)

Option SV-1 is currently planned as upgrading The Esplanade predominantly within the legal road reserve. This option will impact on a small section of land in front of the War Memorial, a heritage building. For this reason, a heritage building consent may be required. The works will occur adjacent to a Special Recreation Activity Area zone (Petone Beach) and encroach slightly into the recreational space. This type of zone has a number of applicable rules that relate to Option SV-1 including changes to utilities, transport and earthworks. The encroachment of works into the Special Recreation Activity Area is the main trigger for resource consent.

Options SV-4, depowering The Esplanade, and SV-6, four laning The Esplanade to Victoria Street, have the same resource consenting issues as SV-1. However, SV-6 does encroach further into the Special Recreation Activity zone than SV-1.

Option SV-5 provides four lanes along the full length of The Esplanade to the Estuary Bridge. In addition to the requirements for SV-1, this option would require additional heritage building consents and demolition consents as it would require the removal or relocation of the TS Tamatoa Sea Cadets Building and the Jetty Café and Rowing Club.

Option SV-7, four laning of The Esplanade and the Estuary Bridge, shares all of the same planning requirements as SV-5 and SV-1. The bridge construction would likely trigger additional resource and demolition consents and is not likely to be a permitted activity under GWRC Regional Plans.

14.2 Cross Valley Link (SV-2, Sv-3, SV-8)

Option SV-2, the Whites Line alignment, mainly follows the existing roads that have a wide legal corridor. Most of the improvements will be located within the legal road which is the responsibility of the Hutt City Council. There are sites outside of the legal road, approximately eight residential properties, which would be affected as buildings on those sites would need to be removed. The construction of a bridge across the Hutt River would also require consents from GWRC in terms of not being permitted under various Regional Plans. These consents would largely be a discretionary activity and the likelihood of full public notification is very high.

Options SV-3 and SV-8 follow the railway alignment to create a Cross Valley Link. Some of the improvements will be performed within the legal road area that is the responsibility of the Hutt City Council. The rest of the alignment will require the construction of a new road that will impact on existing housing and recreational activity areas. Resource consent will be required as well as changes to the existing railway designation. There are a number of sites affected that will need to be purchased and houses/housing demolished. The construction of a bridge across the Hutt River will also require consents from GWRC.

14.3 Summary

Table 14-1 provides a quick overview of what kind of approval or consent applications might be required for each of the proposed options.

Table 14-1: Overview of the required approval or consent applications for each option

Option	Planning Requirements						
	Public Works Act	Designation	Resource Consent	Outline Plan	Certificate of Compliance	Heritage Building Consents	Demolition permits
SV-1	No	No	**Yes**	No	No	**Yes**	No
SV-2	**Yes**	No	**Yes**	No	No	No	**Yes**
SV-3	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**
SV-4	No	No	**Yes**	No	No	**Yes**	No
SV-5	No	No	**Yes**	No	No	**Yes**	**Yes**
SV-6	No	No	**Yes**	No	No	**Yes**	No
SV-7	**Yes**	No	**Yes**	No	No	**Yes**	**Yes**
SV-8	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	**Yes**

15 Maintenance Issues

Only concept designs have been prepared to date, current and future maintenance issues have not been considered in detail. However, the options that propose additional traffic lanes will make maintenance easier as lanes can be closed and opened to maintain traffic flow. This is not currently possible in some sections due to the single lane configuration. A general list of maintenance issues that will arise from each option is provided below in Table 15-1. It should be noted that this list is not comprehensive it is just to provide an indication of the types of maintenance issues that will arise.

Table 15-1: General List of Possible Maintenance Issues

Maintenance Issues		Option							
		1	2	3	4	5	6	7	8
Extra maintenance cost	Additional traffic lanes					✓	✓	✓	
	New specialised lanes e.g. cycle, bus	✓			✓				
	Widening road					✓	✓	✓	
	New road			✓					✓
	New bridge structure		✓	✓					✓
	Widening existing bridge structure							✓	
	New traffic lights	✓	✓		✓	✓	✓	✓	
	Modified road marking and signage	✓	✓	✓	✓	✓	✓	✓	✓
	New roundabout		✓	✓					✓
	Road layout changes	✓	✓	✓	✓	✓	✓	✓	✓
	New parking provisions[14]			✓					✓
	Off-road shared use path (GHW)					✓	✓	✓	
Additional lane allows for easier maintenance			✓			✓	✓	✓	

Future development and refinement of the designs during the scheme assessment/design stages should consider maintenances issues in further detail. It is anticipated that the project improvements will be maintained as part of the existing Hutt City Council maintenance programme.

[14] Parking provisions have not been quantified. May need to provide parking at another site to account for parking removed from four laning options (SV-5 and SV-7).

16 Option Evaluation

A high level assessment has been undertaken in order to combine the various assessment elements of the project in order to illustrate the relative differences between the various options and the existing situation. The evaluation was based on the project objectives provided in Section 1.6. Each objective is comprised of sub-sections which allows for a more detailed assessment of the options against the objectives. Where possible the assessment has been expressed in monetary terms however most criteria can only be evaluated in a qualitative manner.

It must be noted that this evaluation has been carried out by transport engineers and planning specialists, not individual specialists from each discipline. The full results from this assessment are attached in Appendix X and a summary of its outcomes are shown in Table 16-1.

Table 16-1: Summary of Options Analysis

Option	Maximise Value for Money	Facilitate Economic Growth	Enhance Resilience	Minimise Environmental Impacts	Enhance Linkage between Sea and Petone
SV-1	Minimal effects. Negative BCR	Little to no effect	No change	Minimal effects	Improves access
SV-2a	Positive effects and BCR	Positive effects	Enhanced resilience	New bridge has impacts	Reduces severance
SV-2b	Negative effects and likely negative BCR	Positive effects	Enhanced resilience	New bridge has impacts. Positive for access to the seafront	Reduces severance
SV-3a	Positive effects and BCR	Positive effects	Enhanced resilience	New bridge has impacts while new road may have social effects	Reduces severance
SV-3b	Negative effects and likely negative BCR	Positive effects	Enhanced resilience	New bridge has impacts while new road may have social effects. Positive for access to the seafront	Reduces severance
SV-4	Negative effects and BCR	Negative effect	No change	Minimal effects. Positive for access to the seafront	Greatly improves access
SV-5	Overall positive effects and BCR	Some positive effects	No change	More pavement and heritage effects	Worsens severance
SV-6	Minimal effects. Negative BCR	Overall positive effects	No change	Minimal effects	Improves access
SV-7	Overall positive effects and BCR	Some positive effects	No change	Improved bridge has impacts. More pavement and heritage effects	Worsens severance
SV-8a	Overall positive effects and BCR	Overall positive effects	Enhanced resilience	New bridge has impacts while new road may have social effects. Positive for The Esplanade	Reduces severance
SV-8b	Negative effects and likely negative BCR	Overall positive effects	Enhanced resilience	New bridge has impacts while new road may have social effects. Positive for The Esplanade and positive for access to the seafront	Reduces severance

16.1 Maximise Value for Money

This assessment shows the CVL options (SV-2, SV-3 and SV-8) as well as the options that involve double laning the whole length of The Esplanade (SV-5 and SV-7) all achieve the objective of maximising value for money. This is because these are the options that give a positive BCR. The other options all have negative BCRs and subsequently do not meet this objective.

16.2 Facilitate Economic Growth

The improved network capacity and additional cross corridor connection also help CVL options achieve the second objective of facilitating economic growth. The full double laning options have a smaller effect on facilitating economic growth. They do provide an improved connection to the P2G link road but they also negatively impact on the availability of street parking. This may lead to growth in Petone but may negatively impact growth elsewhere due to reduced accessibility. SV-5 which is only partially double laned has minimal impact on street parking and maintains accessibility. Consequently it has a positive influence on economic growth. SV-1 has improved accessibility but its ability to enable economic growth is limited. The depowering in SV-4 has a significant negative impact on growth and subsequently does not meet this goal.

16.3 Enhance Resilience

The additional cross corridor connection provided by the CVL options give them a high rating in the enhance resilience objective. The additional capacity provided on The Esplanade by SV-5, SV-6 and SV-7 does improve the networks resilience slightly. All other options do not improve the networks resilience and subsequently don't satisfy this objective.

16.4 Minimise Environmental Impacts

The CVL options and SV-7, which involve constructing a new or wider bridge, will impact the waterways, Iwi and ecology. The full double laning options also encroach on the Petone Settlers Museum, which is a heritage building. Overall The Esplanade improvement options, except SV-7, tend to have lower environmental impacts than the others.

16.5 Enhance Linkage between the Sea and Petone

The double laning options increase the flow along The Esplanade and subsequently have the potential to increase severance and congestion. In contrast the CVL options divert traffic away from the water front and reduce congestion. Additionally the new signals in SV-1 and SV-4 improve the accessibility of the sea. Overall the CVL options best satisfy this objective as the lower volumes help reduce severance between Petone and the sea.

16.6 Comparison with Petone to Grenada Project Objectives

P2G is a related, but separate transportation project. The relationship between the Seaview Links options and the P2G project objectives is shown below:

Enhance local, regional and national economic growth and productivity for people and freight;

Improve connectivity between the lower Hutt Valley and Johnsonville and Porirua

Reduce journey times and improve journey time reliability between the lower Hutt Valley, Ngauranga and Porirua, and on the Wellington State Highway network;

The CVL options could all be considered to support these three objectives, through the provision of an upgraded connection across the lower valley floor. The Esplanade depowering option does not achieve these objectives, as it introduced increased travel times between Seaview and the P2G project.

Enhance safety of travel on the Wellington State Highway network;

Enhance resilience of the Wellington State Highway network;

No options under consideration support these objectives, as the projects are focused on the Hutt City local road network.

Manage the immediate and long term social, cultural, land use and other environmental impacts of the Project on the Wellington region and its communities by, so far as practicable, avoiding, remedying or mitigating any such effects through route and alignment selection, expressway design and conditions;

This objective is considered not relevant to the CVL options.

By developing and constructing a cost efficient new road alignment to expressway standards between SH2 in the lower Hutt Valley and SH1 north of Ngauranga

This overarching objective is not met by any of the improvements.

This analysis shows that the Seaview to Petone options can partially support the P2G project objectives, but do not meet the overall project requirement for a new link road.

17 Assessed Options

NZTA standards for feasibility studies require that a preferred option is selected. In this case there are several options that have the potential to be progressed and may be taken forward for more detailed investigation depending upon the aspirations of HCC and NZTA.

The economically feasible options include the two full Esplanade four laning options (SV-5 and SV-7) as well as the CVL options (SV-2, SV-3 and SV-8). Of these options, the CVL options were considered to better meet the project objectives due to the positive effects of enhancing resilience and improving access between Petone and the sea. These options also facilitate economic growth. However it must be noted that the provision of a new bridge structure may have environmental and cultural impacts.

SV-3a (called SV-3 hence forward) was selected as the option that would be assessed at a greater detail in this report as it had a positive BCR, promoted economic growth and improved resilience. Although SV-2a (called SV-2 hence forward) has the highest BCR and lowest cost it also requires greater land acquisition, which carries a risk to the project. SV-2 also necessitates the removal of more greenspace so has the greater adverse environmental effects. Because of these issues SV-3 was selected over SV-2. SV-3 also diverted traffic away from The Esplanade so in turn enhancing the linkage between Petone and the sea. Additionally from an urban design perspective SV-3 was identified as the best solution.

The following sections of the report therefore use SV-3 in assessing the social and environmental effects, LTMA assessment and the NZTA profile assessment. While SV-3 has been selected in this report, in the future all economically feasible options should be considered in the future stages of this project.

18 Social and Environmental Assessment

This section documents the assessment of the potential social and environmental effects of the assessed option, SV-3. Consideration has been given to effects both during construction and on completion of the improvements. The assessment subjectively identifies the magnitude of the potential effects before mitigation. This assessment completed using the Transit NZ PSF/13 form, and populated according to the accompanying Transit NZ PSG/13.

The *Degree of Effect* is intended to describe the potential magnitude of the effects of each option. The four categories are as follows:

- High (**H**): Permanent, serious and widespread adverse effects and/or opportunities for social and environmental improvement. Adverse effects to be avoided; opportunities to be actively pursued.
- Medium (**M**): Major, medium-term adverse effects and/or opportunities for social and environmental improvement. Where cost-effective, adverse effects to be avoided and opportunities pursued (significant mitigation may be required).
- Low (**L**): Limited, short-term adverse effects and/or opportunities for social and environmental improvement. Where cost effective, adverse effects to be avoided or mitigated and opportunities pursued (mitigation may be required).
- Irrelevant (**NA**): No effect and/or opportunity. No action required.

The following tables should be updated as the project progresses.

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Noise Construction noise, traffic noise, maintenance noise, presence of sensitive receivers (homes, schools, hospitals etc.)	• Construction noise may disturb local communities. • Additional bridge maintenance (and possibly paving) noise from existing. • Should be minimal change in overall traffic noise. Some locations might get busier but other locations will have less traffic to offset this.	L L L			
Air Quality Dust, air pollution, greenhouse gas emissions, odour.	• Dust and air pollution from construction will need to be mitigated. • CO2 emissions may reduce as a result of the improvements due to the easing of congestion.	L L (+ve)			

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Water resources Sedimentation, contaminants in road run off, climate change impacts (sea level rise and changing rainfall patterns), impacts on sensitive water bodies, changing hydrological cycles and water flow patterns.	• Requires new bridge structure. Construction effects will require mitigation. • Additional paving of road near rail line. Road run off will require mitigation.	M M			
Erosion and sediment control Soil slips, landslides, water erosion (raindrop, sheet, rill gully, tunnel, channel) and wind erosion (dust)	• As above.	M			
Social Responsibility Social severance, social interaction, connectivity	• Improved connectivity through the provision of additional routes. • Reduced social severance.	M (+ve) M (+ve)			

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Culture and Heritage Wahi tapu, and Statements of Identified Maori Interests, archaeological sites, historic buildings, places, trees and special features	• Cultural effects due to bridge over Hutt River may be present.	L			
Ecological Resources Significant vegetation, fauna passage, habitat protection, special trees, reinstatement of vegetation, slope stabilisation, use of low-growth vegetation to reduce maintenance costs.	• No ecological effects are expected.	N/A			

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Spill response and contamination Spills from vehicle accidents, on-site storage of fuels, excavations of contaminated soils/ clean fill	• Possible contamination effects further investigation required. • Mitigation measures should be in place for possible construction effects.	L L			
Resource efficiency In situ pavement recycling, energy efficiency, initiatives to reduce waste to landfill, use of local materials.	• Use of local quarry material may be possible.	L (+ve)			
Climate Change: adaptation and mitigation Sea level rise, greenhouse gas emissions, increase incidence of flooding and coastal storms	• A more efficient road will reduce congestion and greenhouse gas emissions.	L (+ve)			

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Visual quality Landscaping, retaining walls, noise walls, views from roads and neighbouring properties, use of plants to reduce maintenance costs.	• New bridge structure over Hutt River may effect visual quality	L			
Vibration Construction and maintenance vibration, pavement surface, heavy traffic vibration, presence of sensitive features including historic buildings and features.	• Should be minimal change in overall vibration. Some locations might get busier but other locations will have less traffic to offset this.	L			

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Land use and transportation integration Integration of land use and development with transport networks, reverse sensitivity, access management.	• Provides more direct link for eastern suburb growth • Reduced congestion on The Esplanade encourages growth in Petone and on foreshore	M (+ve) M (+ve)			
Urban design Context sensitive design, including aesthetics of structures (refer to PSG/12).	• Urban Design assessment has been completed which identifies a range of effects and opportunities for mitigation.	M			
Public health Stress to individuals and community, personal security, cycling and walking opportunities.	• Reduced congestion is likely to reduce stress to individuals and the community. • Footpath to be provided along the new road and bridge increasing the pedestrian facility network.	L (+ve) L(+ve)			

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Cycling Infrastructure On highway cycle lanes, segregated cycle path adjacent to SH, links to local cycling network.	• No change to cycle specific infrastructure however provides the opportunity to provide improved cycle facilities.	N/A			
Cycle Crossing Facilities Shared cycle/pedestrian crossing at traffic signals, widened traffic island to accommodate cyclists where cycle route crosses SH, dropped crossings.	• No change to cycle specific infrastructure.	N/A			
Walking Infrastructure New or widened footway, connections to local road footways.	• Footpath to be provided along the new road and bridge increasing the pedestrian facility network.	M (+ve)			

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Pedestrian Crossing Facilities Signalised crossings, traffic islands, dropped crossings, pedestrian desire lines	• Existing pedestrian crossing facilities to be maintained. Improvements possible on The Esplanade.	N/A			
Bus Related Infrastructure Bus laybys, hard standings, build-outs into carriageway at bus stop.	• No bus stops are present on the route however new crossing opportunity provides additional options for the future • Reduced congestion on The Esplanade will improve bus journey times and level of service	L(+ve) L(+ve)			

Social and Environmental Screen			Social and Environmental Assessment		
Issue Social and environmental issues	**Effects** Describe the potential social and environmental effects of the opinion, including where the option may improve social and environmental outcomes.	**Degree of effect** H/M/L/ NA	**Requirements** List all legal requirements and relevant social and environmental objectives	**Addressing effects and meeting requirements** List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.	
				Specific Actions	Estimated cost ($)
Priority Lanes Potential to include bus, freight, HOV lane either through the reallocation of existing road space or new construction to make certain modes more efficient and widen travel choice.	• No opportunity at present as it is not currently a bus route, however, provides additional route options for freight.	L(+ve)			
Traffic Management Potential for ITS, variable message signing, variable speed management, ramp signalling.	• ITS signage could be implemented if necessary to better manage flows, movements, etc.	L (+ve)			

19 Resilience Assessment

The assessed option (SV-3) which includes the CVL will enhance resilience during operation by providing an additional link across the river in the southern part of Hutt Valley. This will provide an alternate route in the event of an emergency, crashes or during maintenance.

The link would also enhance resilience in natural hazards. Being away from the coast, the route will be less vulnerable to tsunami, and particularly storm surge and high winds. In earthquake events, the route will still be susceptible to liquefaction. However, the route will be more resilient because:

1. The route will be predominantly located on flat ground, and therefore the effects of liquefaction will be predominantly sand boils and subsidence of the ground. These are far less damaging to road links than lateral spreading towards the river and harbour as in the case of The Esplanade / Waione Street link. This was evident in Christchurch in the Canterbury earthquakes. The performance of the road could be further enhanced by reinforcing the road subgrade with geogrids. The road will continue to provide access, although may be uneven, and can be quickly restored by reinstating the pavement.

2. The link across the Hutt River will still be vulnerable to liquefaction and lateral spreading, but because the bridge will be newly built, the abutments and approaches can be strengthened by a stronger structure or by ground improvement to make the link across the river resilient to earthquakes (Brabhaharan, 2014). This has been used on bridges on the Christchurch Southern Motorway as well as the current reconstruction of the Ferrymead Bridge in Christchurch.

3. The SV-3 would be designed follow current standards and engineering best practice including the provision of adequate drainage to mitigate flood risk.

In summary, the new cross valley link would substantially enhance resilience of access in the southern part of the Hutt Valley.

20 Land Transport Management Act Assessment

20.1 Policy Context

The Land Transport Management Act 2003 (LTMA) is the main statute for New Zealand's land transport planning and funding system. The purpose of this act is "to contribute to an effective, efficient and safe land transport system in the public interest". It aims to achieve this by supporting the objectives of the Government Policy Statement (GPS) by making specific requirements for the preparation of Regional Land Transport Strategies.

The LTMA requires the Minister of Transport to issue a GPS every three years. This enables the Minister to guide the NZTA and the land transport sector on the short-midterm outcomes and objectives that the crown wishes to achieve. The LTMA requires NZTA to assess all potential projects against the GPS and the relevant Regional Land Transport Strategy (RLTS).

Proving that a project that aligns well with the objectives stated in the GPS and RLTS is important in ensuring that projects such as this progress. This project will also be assessed against the Hutt Corridor Plan, which is a derivative of the RLTS that is directly linked to the aim of this project. The following chapters outline how the preferred option supports the vision and objectives presented in these documents.

20.2 Government Policy Statement

The Government Policy Statement on Land Transport Funding 2012/13-2017/18 (July 2011) details the government's aspiration and funding priorities in the short to midterm period. At the present time economic growth and productivity is a major priority for the government. Subsequently there are three areas focus listed in the GPS:

- Economic Growth and Productivity
- Value for Money
- Road Safety

The GPS also highlights the need to improve the local road network by addressing opportunities to ease congestion and capacity constraints as well as improving journey time reliability and improve safety. To achieve this the GPS proposes "improving the condition and/or operation of key routes that are important in providing access to areas of employment or economic growth, and routes that carry significant amounts of freight". This description accurately describes many of the roads discussed in the project area, especially The Esplanade.

20.3 Wellington Regional Land Transport Plan

The Regional Land Transport Plan 2015 (RLTP) for the Wellington Region has been developed by Greater Wellington Regional Council to set out the strategic direction for land transport in the Wellington region for the next 10 to 30 years. It is a statutory document, which replaces the earlier Regional Land Transport Strategy 2010-40. The RLTP outlines a number of strategic objectives for transport projects in the region with respect to economic growth safety, resilience and liveability. The key actions which are implemented out by this project are also presented. Consequently this demonstrates that the Seaview Links project will contribute towards achieving many of the objectives detailed in the RLTP as shown in Table 20-1.

Table 20-1: List of Regional Land Transport Outcomes that are Satisfied by the Preferred Option

Strategic Objective	Key Action
Economic Growth	
A high quality, reliable public transport network	• Bus priority measures and other supporting road network improvements
A reliable and effective strategic road network	• Build safety improvements on roads • Improved pedestrian and cycling safety • Measures to reduce congestion • Advocate for mode shift
An effective network for the movement of freight	• Advocate and provide commuter mode shift • Advocate for infrastructure improvements along regionally significant priorities
Safety	
A safe system for all users of the regional transport network	• Build safety improvements on roads • Improved pedestrian and cycling safety
Resilience	
An increasingly resilient transport network	• Advocate for mode shift
Liveability	
A well planned, connected and integrated transport network	• Advocate for infrastructure improvements along regionally significant priorities • Advocate and provide commuter mode shift • Bus priority measures and other supporting road network improvements
An attractive and safe walking and cycling network	• Improved pedestrian and cycling facilities • Improved pedestrian and cycling safety
An efficient and optimised transport system that minimizes the impact on the environment	• Advocate and provide commuter mode shift • Measures to reduce congestion • Improved pedestrian and cycling facilities

20.4 Hutt Corridor Plan 2011

The Hutt Corridor Plan 2011 (HCP) was developed to be consistent with the RLTS. The Hutt Corridor is the transport corridor formed by State Highway 2 (SH2) between Ngauranga and Te Marua, Upper Hutt. The HCP sets the long term vision for this section and includes major connecting arterial routes and key public transport, walking and cycling connections.

One of the significant issues identified in the HCP is the future capacity concerns along the link between SH2 and Seaview/Gracefield. It also proposes the P2G link road which will add further strain on the existing connection along The Esplanade. To counter this, the HCP has indicated that improvements will need to be carried out. The P2G project will largely address these problems through the redesign of the linkage with SH2 in Petone, however the preferred option for this project will addresses the proposed infrastructure improvements and will in turn help achieve the HCP objectives which are listed below:

- Provide for current and future growth pressures (population/employment/freight) in the Hutt Corridor;
- Reduce severe congestion on the road network, including the Petone Esplanade/SH2 intersection;
- Improve the mode share of walking, cycling and public transport;
- Improve accessibility for all modes;
- Improve route security and network resilience; and
- Improve road safety throughout the corridor.

21 NZTA Assessment Profile

The assessment profile associated with the project has been evaluated in accordance with the requirements of NZTA's Planning & Investment Knowledge Base. This appraisal will assist the projecting being included in the Regional Land Transport Programme. NZTA currently considers funding based on how well the project aligns with the following three areas:

- Strategic Fit of the problem, issue or opportunity that is being addressed;
- Effectiveness of the proposed solutions; and
- Economic efficiency of the proposed solution.

The project has been assessed against the above three criteria by assigning a rating of high, medium or low. The strategic fit evaluation considers how well the project aligns with the NZTA's strategic investment direction and the effectiveness assessment looks at the extent to which the project will achieve the potential identified in the strategic fit. The efficiency rating refers to the BCR.

The following sections set out ratings given to the assessed option.

Strategic Fit: **Medium**

Improvements to this corridor will contribute to economic growth and productivity in the region by improving travel time, reliability and reducing congestion. However, as this corridor is not directly part of the RoNS programme and only affects connectivity between the Hutt area and SH2, this project only achieves a medium strategic fit.

Effectiveness: **High**

This project increases the effectiveness of a strategic component of the region's transportation system. In particular the project improves travel time and reliability for motorists.

Efficiency: **Low**

At this early stage in the project development, and without consideration of WEIs, the BCR including agglomeration benefits for this option is 1.7. Thus the economic efficiency rating is low. There is some uncertainty surrounding the population growth, employment and forecasted land use in the area. Therefore in the next stage of the project a sensitivity analysis should be carried to understand the impact any variations will have on the option's BCR (e.g. low and high growth scenarios).

This rating (MHL) classifies the option as a priority 6 project. NZTA awards funding to projects based on their evaluated priority (1 to 11) thus this project is in the middle of that range.

22 Opportunities and Risks

Through the development of this PFR, a range of opportunities and risks which should be considered going forward have been identified. The following list highlights the key items which should be considered further in the next stages of the project:

- The NWSM used in evaluating the options was calibrated but at this stage is yet to be validated[15], due to lack of count data and the tight timeframes around the associated studies. This is a risk in that it leaves uncertainty around the results which have been produced out of this model. This has since been resolved with the update to NWSM but only the CVL options have been rerun;
- Sensitivity tests should be performed to further evaluate any identified preferred options and the assumptions that have been taken forward in this work. For example, the modelled outputs were completed using the medium growth scenario in WTSM. As the projected land use around Hutt City could have large variance in growth in the future, it would be prudent to assess the outputs using the low and high growth scenarios;
- This project has assumed that the Petone to Grenada project will be built in the base modelling and economic assumptions. A particular alignment has also been assumed from the Petone to Grenada PFR. It may be necessary to assess the preferred option(s) with and without P2G and using the most up to date information from the Scoping Report, or Scheme Assessment Report once completed;
- A link from Seaview to any Cross Valley Link option through the decommissioned railway line to remove HCVs from Randwick Road and encourage the use of the CVL may require further consideration and/or modelling;
- Staging of options to best achieve the project objectives may be considered. If one of the CVL options was chosen to be progressed, The Esplanade Improvements option (SV-1) may be implemented first to improve accessibility to the foreshore. This would require a longer term commitment to the scheme by Hutt City Council;
- The modelling of options SV5 and SV-7 (four laning of The Esplanade) has been completed with the assumption that several foreshore buildings affected (TS Tamatoa Sea Cadets building, Jetty Café and Rowing Club and Heretaunga Boating Club) could be removed or relocated. There have been variations to these options developed that do not require the removal of these buildings but turning movements from Fitzherbert, Sydney and Nelson Streets would be restricted (left-in / left-out only). These variations will reduce project cost estimate by $3.5M but may also reduce benefits. If one of these options was identified to be progressed, modelling and assessment of the option without removing the buildings could be performed;
- Potential contaminated land sites identified in Appendix V may require preliminary site investigations to determine whether or not this is a risk and should be considered in the next stages of the project;
- Provide a direct link from the Dowse Interchange to Wakefield Street for any CVL options that may be progressed so as to enable benefits to be realised sooner;
- The impact on SH2 has not been considered and subsequent changes to the interchanges have not been included in the cost estimate. Therefore possible changes to interchanges should be identified and have costs quantified if they were progressed as part of this project;

[15] Northern Wellington SATURN Model Update Model Calibration and Validation Report, SKM 2013

- Even with CVL the flows along The Esplanade are around the threshold for double laning (ADT >17,000). Therefore in conjunction with the CVL double laning The Esplanade or flow reduction measures should be considered; and
- A safety review should be carried out on the project to identify any significant safety concerns.

23 Conclusions and Recommendations

The feasibility assessment undertaken for a link to Seaview builds on previous work completed for NZTA and HCC.

Traffic modelling has been carried out with the P2G link road and found that this project will likely increase traffic on The Esplanade by approximately ten percent in the year 2031. This additional volume may require changes to the Hutt City transport network in order for them to achieve operational efficiency. The predicted traffic increase on The Esplanade also suggests that The Esplanade cannot be depowered without some other scheme in place to alleviate traffic volumes. While the forecast numbers with and without the P2G link road may not be excessive, it should be noted that the modelled volumes in the base year for 2011 are less than the existing volumes identified by the HCC traffic counting programme. While the HCC volumes may be more recent (from 2012 or 2013) and have not been seasonally adjusted, they are consistently higher than those in the model. Should this project progress to scheme assessment, further assessment and refinement around the traffic modelling should be undertaken.

Eight options were developed and modelled to address the demands of the future traffic volumes with the P2G link road and to address the project objectives agreed by HCC and NZTA. Of these options five have positive benefit cost ratios greater than one. However, several of the options with positive BCRs do not address, or worsen, some of the other intentions for the project such as reducing severance and improving access to the foreshore. A number of these options meet or exceed the other criteria set forth and there is potential for elements of options to be combined to find the best solution.

The urban design assessment identified Esplanade Improvements and the Railway Alignment for a Cross Valley Link as preferred options depending on the alignment of the P2G link road and the resulting interchanges with SH2 and the Petone/Hutt Valley.

If this project is progressed it is recommended that the preferred option(s) are determined and clear, consistent objectives identified. Further work should include:

- Modelling with varying growth assumptions to determine economic risk associated with the project;
- Detailed analysis of WEI's for the options once the preferred option for P2G has been identified; and
- Investigation of staged solutions on The Esplanade and CVL corridor.

Progressing the project to the scheme assessment stage once the P2G preferred option has been identified will enable HCC to continue to develop the design and identify an optimal solution. During the next stage of work, further consideration of the urban design issues, stakeholder and community inputs, and planning issues should be undertaken.

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Appendix A – Stakeholder Engagements

Appendix B – HCC Cycle Lanes and Shared Paths

Appendix C – Pedestrian and Cyclist Counts at Cuba Street

Appendix D – WPTM/WTSM Screenshots

Appendix E – Bus Routes through the Study Area

Appendix F – Gracefield Rail Line Cost Estimate

Appendix G – Urban Design Assessment

Appendix H – NWSM Sector Analysis

Appendix I – CAS Outputs

Appendix J – Option Drawings: SV-1 and SV-4

Appendix K – Option Drawings: SV-2

Appendix L – Option Drawings: SV-3 and SV-8

Appendix M – Option Drawings: SV-5, SV-6 and SV-7

Appendix N – Options' Network Statistics

Appendix O – SATURN Flow Plots

Appendix P – Traffic Volumes for each Peak Period

Appendix Q – Journey Time Graphs

Appendix R – Cost Estimates

Appendix S – Hutt City District Plan

Appendix T – Economic Analysis

Appendix U – Assessment of WEI's

Appendix V – Map of Contaminated Land

Appendix W – Planning Assessment

Appendix X – Options Assessment Matrix

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