NZ TRANSPORT AGENCY
WAKA KOTAHI

Petone to Grenada Transportation Link

Investigation and Reporting

Scoping Report

April 2014



NZ TRANSPORT AGENCY
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Scoping Report
April 2014

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Contents

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In preparing this report we acknowledge the material developed in previous reports for NZTA

Glossary

The following terms and abbreviations are used throughout this report:

Abbreviation / Term	Description
AADT	Average Annual Daily Traffic
ArchSite	New Zealand Archaeological Association Recorded Site database
BCR	Benefit to Cost Ratio
BRP	Belmont Regional Park
CAS	NZTA Crash Analysis System
CBD	Central Business District
Change 29	Petone West Plan Change
Change 45	Plan Change 45
CO_2	Carbon dioxide
CVL	Cross Valley Link
DP	District Plan
EEM	Economic Evaluation Manual
FYRR	First Year Rate of Return
GATS	Greater Wellington Land Use and Transport Strategic Review
GPS	Government Policy Statement on Land Transport Funding
GWRC	Greater Wellington Regional Council
HAIL	Hazardous Activities and Industries List
HCC	Hutt City Council
HCM	Highway Capacity Manual
HCP	Hutt Corridor Plan
HCV	Heavy Commercial Vehicle
HPA	Historic Places Act
HPT	Historical Places Trust
HQL	Horokiwi Quarries Ltd
LFSP	Lincolnshire Farm Structure Plan
LOS	Level of Service
LTA	Land Transport Act
LTMA	Land Transport Management Act
LTP	Long Term Plan
NES	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health
NGMF	Northern Growth Mangement Framework
NLTP	National Land Tranport Programme
NOR	Notice of Requirement
NSHS	National State Highway Strategy
NWSM	Northern Wellington SATURN Model
NZAA	New Zealand Archaeological Association
NZTA	New Zealand Transport Agency
NZTS	New Zealand Transport Strategy
P2G	Petone to Grenada Link Road
PFR	Project Feasibility Report
PIKB	Planning and Investment Knowledge Base
PSI	Preliminary Site Investigation
RLTP	Regional Land Transport Programme
RLTS	Regional Land Transport Strategy
RMA	Resource Management Act
RoNS	Roads of National Significance
RPS	Regional Policy Statement
RPTP	Regional Public Transport Plan
SAR	Scheme Assessment Report
SH	State Highway
SKM	Sinclair Knight Merz
SLUR	GWRC Selected Land Use Register
SMA	Stone Mastic Asphalt
TDM	Traffic Demand Management
TG	Transmission Gully
TMS	Traffic Management System
TPPM	Transit Planning Policy Manual
VOC	Vehicle Operating Costs
WCC	Wellington City Council
WCP	Western Corridor Plan
WRC	Wellington Regional Council (former name for GWRC)
WRLUTS	Wellington Regional Land Use and Transport Strategy
WRS	Wellington Regional Strategy
WTSM	Wellington Transport Strategic Model

Executive Summary

Executive Summary

The Project

The New Zealand Transport Agency (NZTA) is investigating a transportation link between the Hutt Valley and Porirua, identified as the Petone to Grenada Link Road (P2G). P2G aims to address severe congestion and improve resilience on the State Highway (SH) network as well as improving connectivity between the Hutt Valley and Porirua.

This report will lead to a Scheme Assessment Report which will recommend and provide details of a preferred option. In addition to the Scoping Report, three Project Feasibility Reports (PFRs) have also been completed to inform future decisions made by NZTA.

The P2G link will be designed to provide a safe and efficient route between the Hutt Valley and SH1 to the north, as well as an alternate route between Porirua and the Ngauranga Gorge. As part of the planning and assessment for the project, an alternative link, providing an additional connection to Transmission Gully (TG), has been identified.

The study area comprises SH1 from Ngauranga to SH58, the length of SH58, SH2 from Ngauranga to SH58 and the land between these State Highways. The main focus for this project is toward Petone and Grenada. The future TG Route has also been included in the project area for assessment.

Within the Wellington Region, significant volumes of goods flow between Wellington City, Seaview / Gracefield, Petone and Porirua. Seaview is a major industrial hub in Wellington and as such is the origin and destination for many heavy commercial vehicles (HCVs). The CentrePort dock at Seaview is also a major distribution point in the Wellington Region and there is potential growth in this area for fuel distribution. Most sea freight becomes road freight at this point. Currently HCV trips from Seaview to Porirua generally travel south on SH2 to Ngauranga before turning north on SH1, extending their trip length. Road freight contributes to the traffic congestion and travel time delays on SH2 between Petone and Ngauranga.

Project Objectives

The Petone to Grenada Link Road aims to address severe congestion and resilience issues on the State Highway network as well as improving connectivity between the Hutt Valley and Porirua. Creating a more efficient State Highway network will allow for future growth, while improving connectivity will provide additional areas for that growth.

The project objectives, following the Design Surgery Workshop 1, were identified as follows:

1. Improve safety and efficiency of the transport network including efficiency of HCVs travelling between Seaview and SH1 to the north and maximise value for money;
2. Support the economic growth and development of the region by improving connectivity within the region;
3. Enhance resilience of the State Highway network within the region; and
4. Minimise adverse environmental impacts.

Existing Situation

Traffic

Within the project area both SH1 and SH2 experience significant congestion southbound during the morning peak and northbound during the afternoon peak. In particular, SH2 southbound has significant delays during both AM and PM peaks. The peak hour flows are over 3200 veh/hr[1] in each direction on both SH1 and SH2; which indicates both of the state highways (which have 2 lanes in each direction) are reaching capacity during peak periods.

Community

The project area is large and currently includes the residential areas east of SH1 in Porirua and all of Newlands, Woodridge, Paparangi and Grenada. The key community infrastructure or community uses associated with the project area include the Petone foreshore, the Korokoro industrial area, Belmont Regional Park, Horokiwi community, Horokiwi Quarry, Lincolnshire Farm and the residential areas of Horokiwi, Grenada and Grenada North. The P2G link can supplement the existing social and cultural facilities and values by improving connectivity within Wellington and providing complimentary activities.

Ecology

The ecology of the project area has been substantially impacted by human activity. Much of the project area is in pasture with sub-division encroaching from the west, while industrial activity is present in the south. The Horokiwi Quarry has had a substantial impact on the southern part of the project area. There are several landfill / contaminated sites in this location. The hills in the eastern part of the project area are less intensively managed and covered in exotic scrub with regenerating native trees and shrubs forming part of the cover. The Belmont Regional Park contains a number of forest remnants as well as areas of regenerating bush. There are three main stream catchments namely, the Korokoro Stream in the east, Porirua Stream in the west and Takapu Stream in the north. The other main habitat type within the project area is the coastal zone around the mouth of the Korokoro Stream. This location is a highly modified section of coastline with the coast frontage and is managed as public open space. There are opportunities which need to be considered to mitigate and reduce potential effects which may arise from the P2G link.

Landscape

The study area comprises three distinct sections in terms of landscape. At the northern end, between Tawa and TG, the project area includes the north-south valley of the Takapu Stream. The top of the ridge at the eastern side of Takapu Valley is identified as visually significant in the District Plan, though not specifically identified as regionally significant in landscape terms. The grassed slopes and vegetated gullies provide a simple broad scale framework where the vegetation cover echoes the land form. The central section continues this hill and valley formation, but differs in having a higher density of built and future built development occurring from Grenada North to the proposed Lincolnshire Farms Structure Plan area. The southern section ranges from the steep sided bush clad area of the Belmont Regional Park centred on the Korokoro Stream, to the strongly defined coastal edge facing the Wellington Harbour and finally to Petone itself. Any assessment of effects will need to consider the changes to the landscape, changes to views and the viewing audience, together with the ability of the landscape to absorb change.

1 When considering the 15 minute peak, flows are as high as 4000 vehicles per hour

Key Considerations

The following factors were considered when the options for the P2G Link Road were developed:

- Creating options that are economically efficient to construct, operate and maintain;
- The objectives and requirements of the PFRs which form part of this project namely the Seaview Links, SH58 and SH2 Petone to Ngauranga and their relationship to this project;
- Recognising the relationship to other projects including TG and Petone to Ngauranga Cycling and Pedestrian Improvements;
- Recognising natural features in the surrounding environment e.g. the urban coastal edge, ridgelines and hilltops and the Petone foreshore;
- Recognising areas of ecological and cultural significance e.g. Korokoro Stream valley within Belmont Regional Park and the Honiana Te Puni Reserve;
- The impact of the Petone West Plan Change (Change 29) which provides for future land intensification in terms of additional residential and commercial occupants;
- Enabling the Lincolnshire Farm Development to connect to the P2G Link Road as required in the Lincolnshire Farm Structure Plan;
- Ensuring that urban design and landscaping is integrated into option development particularly at Petone and Lincolnshire Farm. For example, investigating a "Beach to Bush" link as part of the option development at Petone;
- Archaeological impacts;
- Geotechnical issues such as the proximity to the active Wellington Fault and liquefaction hazard at Petone, the stability of high cuttings in fractured Wellington greywacke and contaminated material from landfill sites;
- Resilience in the context of the Hutt Valley and the greater Wellington area given the limited number of routes and their poor resilience; and
- Selecting an appropriate design speed based on design criteria including: terrain, horizontal and vertical alignment, compatibility with adjacent routes, comparable roads, traffic volumes and crash risks.

Option Development

The option development process was initiated at a one day Design Surgery Workshop held with the project team and key stakeholders from NZTA, HCC, WCC and GWRC. At the workshop early assumptions were challenged while issues and opportunities were explored. By the conclusion of the workshop the project objectives were ratified and the basis of design was established.

In addition to developing options between Petone and Tawa, early economics were employed to test a connection between Petone and Transmission Gully (TG). Alignments between Petone and SH1 in the vicinity of Tawa traverse very steep terrain and will include steep gradients. Steep gradients reduce travel speeds, increase travel time and therefore increase vehicle operating costs for Heavy Commercial Vehicles (HCVs). Given vehicle operating costs are a significant contribution to economic benefits, particularly for HCVs, we developed a simple economic model to analyse the impact of steep gradients on vehicle operating costs and travel time for HCVs in particular. A connection between Petone and TG route was estimated to be around 20% more efficient than a route between Petone and Tawa and around 40% more efficient than the existing route for HCVs along SH1 and SH2. The results indicated clearly that a shorter and steeper route is favoured, based on HCV travel costs, over a longer and shallower route.

To assist with identifying and assessing options we have utilised a rapid geometric route option software tool, known as Quantm. Quantm was used to test the difference in cost between alignments with design speeds of 60km/hr, 80km/hr and 100km/hr. The results of Quantm indicated that an 80km/hr design speed should be adopted for this project. Adopting an 80km/hr design speed was also supported by the findings of the safety report. Quantm was also used to test alternative options to the Project Feasibility Report (PFR) option between Petone and Tawa as well as alternative southern connections such as Dowse, Horokiwi Road and Korokoro Crescent. The results of Quantm indicated firstly that there are several alignments between Petone and Tawa which are significantly more cost effective than the PFR alignment. Secondly Quantm indicated that the most cost effective southern connection point for the interchange is at Petone. Four options were eventually selected for the development process as follows:

1. Option A – Petone to Grenada;
2. Option B – Petone to Tawa (with north facing ramps to SH1);
3. Option C – Petone to Tawa (with a full interchange to SH1 and local road network); and
4. Option D – Petone to TG (with connections to Grenada and Tawa).

Option A provides full connectivity to SH2, The Esplanade and Hutt Road in Petone as well as full connectivity to SH1 and the local road network at Grenada. This option provides a link to Lincolnshire Farms and maintains the form of Grenada Drive and the Grenada Interchange on SH1 but both require upgrades to increase capacity. This option will increase traffic along SH1 north of the Grenada Interchange. To provide additional capacity, SH1 will need to increase from 4 lanes to 6 lanes between the Grenada Interchange and the proposed interchange at TG.

Option B, which is similar to the PFR alignment, provides full connectivity to SH2, The Esplanade and Hutt Road in Petone, and full connectivity to SH1 with north facing ramps at Tawa and a connection to the existing Grenada Interchange. This option provides a link to Lincolnshire Farms and Grenada. This option will increase traffic along SH1 north of Tawa. As a result SH1 will need to increase from 4 lanes to 6 lanes between this new connection and the proposed interchange at TG to provide additional capacity. In addition to increasing SH1 from 4 lanes to 6 lanes, SH1 will require modifications to accommodate the north facing ramps while meeting the requirements of geometric and safety design standards. These include modifications to the alignment (to the north and south of the north facing ramps) and removing the interchange at Tawa.

Option C provides full connectivity to SH2, The Esplanade and Hutt Road in Petone and full connectivity to SH1 and the local road network at Tawa. This option also provides a link to Lincolnshire Farms and Grenada. Like Option B this option will increase traffic on along SH1 north of Tawa and will need to increase from 4 lanes to 6 lanes between Tawa and TG to provide additional capacity.

Option D also provides full connectivity to SH2, The Esplanade and Hutt Road in Petone and full connectivity to TG at Takapu. This option also provides full connectivity to SH1 and the local road network at Tawa as well as a link to Lincolnshire Farms and Grenada. Unlike the other options, Option D does not require upgrading SH1 from 4 to 6 lanes up to the proposed interchange at TG.

Options A to D described above share a common alignment between Petone and the eastern section of Lincolnshire Farms. Over this portion of the route four sub-options were developed identified as P1, P2, P3 and P4.

The main differences between these four sub-options are the alignments they follow to traverse the steep hill slopes just north of Petone to reach the broad undulating hill tops of Lincolnshire Farms. Sub-option P1 traverses the coastal escarpment in a large sidling cut to wind its way to Lincolnshire Farms while Sub-options P2 and P3 run directly up the Korokoro valley in large cuts

and fills. Sub-option P4, on the other hand, avoids both the coastal escarpment and Korokoro valley but involves large cuts over a long distance resulting in greater earthworks than Sub-options P1 to P3.

Transportation Assessment

The four options were modelled in the Northern Wellington SATURN Model (NWSM) and the results were compared for network performance, local intersection performance, travel time savings on key routes and traffic redistribution impacts. Option A provided the best network wide performance results while Option B provided the worst. Options A and C provided the best travel time savings as a whole while again Option B provided the worst travel time savings on key routes. Option D was found to have minimal impact on the TG route itself and would require only a new 2 lane carriageway link between Tawa and TG to accommodate traffic connecting to the Petone to Grenada route.

Option Evaluation

The options were evaluated following a structured process to arrive at a preferred option to be taken forward to the consultation phase. As part of the option evaluation process, a second workshop was held with all specialists that had undertaken the assessment of feasible options, the project team and key stakeholders from NZTA, HCC, WCC and GWRC. The aim of this workshop was to provide an opportunity to challenge and discuss the specialists' ideas in a group forum, following their limited investigations at this point. From this workshop a number of specialists could then make alterations to their evaluations which reflected a better understanding of the options or in this case.

Conclusions and Recommendations

Our project team considered options at Petone and came to a view that Option P4 is the preferred option because it avoids the significant ecological effects associated with P2 and P3, whilst also avoiding the negative resilience effects of P1.

Having selected Option P4, the project team considered Options A, B, C and D, each incorporating Option P4 at Petone. This analysis showed that Options C or D are better than Options A or B. Therefore, Option C and D are our preferred options. Both Option C and D have similar costs and benefit to cost ratios. If more weight is given to resilience, then Option D is preferred to Option C. If more weight is given to ecology than resilience, then Option C is better than Option D. Ecological effects can be mitigated. At this stage in the process, both options are considered feasible and should be taken forward to the public engagement phase.

1

Introduction

1 Introduction

The New Zealand Transport Agency (NZTA) is investigating a transportation link between the Hutt Valley and Porirua, identified as the Petone to Grenada Link Road (P2G). P2G aims to address severe congestion and resilience issues on the State Highway (SH) network as well as improving connectivity between the Hutt Valley and Porirua.

Opus International Consultants (Opus) has been engaged by the NZTA to assist in the investigation of this link road by completing a Scoping Report. This report builds on the Project Feasibility Report (PFR) previously completed for P2G by Sinclair Knight Merz (SKM) in January 2010. This report will lead to a Scheme Assessment Report which will recommend and provide details of a preferred option. Opus is collaborating with Brewer Davidson regarding Urban Design and Environmental Management Services Ltd for planning.

The P2G Link Road will be designed to provide a safe and efficient route between the Hutt Valley and SH1 to the north, as well as an alternate route between Porirua and the Ngauranga Gorge. As part of the planning and assessment for the project, an alternative link, providing an additional connection to Transmission Gully, has been identified.

In addition to the Scoping Report, Opus has also completed three PFRs that are listed in Section 1.4 of this report.

1.1 Project Area

The study area is shown in Figure 1-1. It comprises SH1 from Ngauranga to SH58, the length of SH58, SH2 from Ngauranga to SH58 and the land between these State Highways. The main focus for this project is at the lower end of this map toward Petone and Grenada. The future Transmission Gully Route has also been included in the project area for assessment. Further description of the road network is provided in Section 4 of this report.

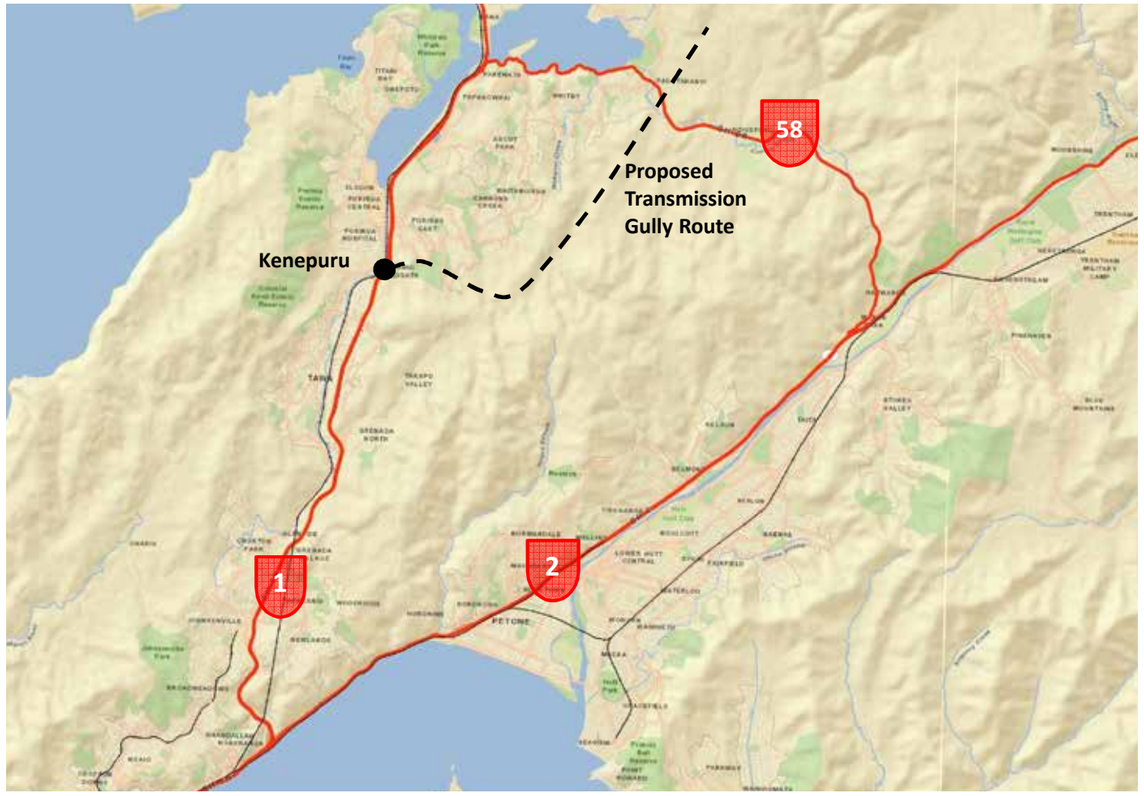

Figure 1-1: Petone to Grenada Link Road Study Area

1.1.1 Public Transport Services

In addition to the road transport network, there are other transport modes that operate on SH1 and SH2 including rail and bus services. SH58 has no public transport services.

Rail

The Kāpiti Line provides rail passenger service from Waikanae to Wellington City via the rail line that roughly follows SH1. The Capital Connection and the Northern Explorer services also use this section of line; however, they are express routes and make no stops in the project area.

Three passenger rail services operate along SH2 in the project area.

- Melling Line follows SH2 in to Wellington from the Melling Station, near Melling Link;
- Hutt Valley Line begins north of the project area in Upper Hutt. It mostly travels through the Hutt Valley, meeting up with

SH2 at Manor Park Station near the intersection with SH58 and at Petone Station near Jackson Street before travelling into Wellington; and

- Wairarapa Line which starts further north, in Masterton, and follows the same line as the Hutt Valley Line in the project area.

Bus

There is a network of bus services that follow SH1 and SH2 or adjacent roads. Origins / destinations of these buses range from Wairarapa, Porirua, Kāpiti, Johnsonville, Lower Hutt, Upper Hutt and Wellington City. Any buses from the Hutt Valley use SH2 between Petone and Ngauranga. They generally get on the highway at Jackson Street or at the Petone Interchange. The buses using SH1 follow many varying routes, with some being express buses making few stops along the route, and others servicing the suburbs adjacent to SH1 and thus only accessing the highway briefly between community stops.

1.1.2 Cyclist and Pedestrian Facilities

SH2

Currently there is no separate continuous cycle link between Petone and Ngauranga. There is, however, one main off road cycling facility on SH2 within the project area. This facility runs parallel to SH2, adjacent to the southbound lane between the Ngauranga Interchange and approximately 250m south of the Horokiwi Road intersection. This cycleway is basically a southbound facility only and most commuter cyclists, travelling between Petone and Ngauranga, use the adjacent southbound shoulder[1] . Between the Horokiwi Road intersection and Petone there is no separate cycle track and a cycleway has been marked within the highway shoulder.

There is no northbound separate cyclist facility along SH2 between Ngauranga and Petone. Consequently northbound cyclists use the SH2 northbound shoulder. To access the northbound SH2 shoulder at Ngauranga cyclists typically follow the two way parallel cycle track on the eastern side of the Hutt Road and cross at the Ngauranga signalised intersection under the Ngauranga over-bridges.

At Petone there is provision for northbound cyclists to access Hutt Road from SH2 via the Petone off ramp, as shown in blue in Figure 1-2. At the northern end of the route, users can choose to follow Hutt Road northbound, or to access a shared path. Both options are shown in blue. Cyclists heading southbound on Hutt Road can access SH2 using a new access route implemented in 2010. This ramp facility was provided to improve safety for cyclists and pedestrians by reducing conflict points for those accessing SH2 and allowing them to avoid the Hutt Rd roundabout. This route is represented on Figure 1-2 in green. Survey work by NZTA indicates that the vast majority of cyclists do not use these routes and instead favour the SH2 shoulder.

Figure 1-2: SH2 Northbound and Southbound Cycle Routes at Petone

In addition to the facilities mentioned above NZTA has currently commissioned consultant AECOM to prepare a Detailed Business Case (DBC) for the Petone to Ngauranga Cycling and Pedestrian Improvements project. The purpose of this project is to identify a preferred cyclist and pedestrian facility option which includes the area along SH2 between Petone and Ngauranga and between Ngauranga and Melling.

SH1

There is also no separate continuous cycle link between Grenada North and Ngauranga. Cyclists travelling between the two generally use lower volume roads adjacent to SH1 up to Johnsonville, such as Middleton Road and Johnsonville Road. Sealed shared paths are then provided on both sides of SH1 (Centennial Highway) from Corlett Street in Johnsonville to Ngauranga which are generally used by cyclists. The cycle route is shown in Figure 1-3.

1 The Ngauranga to Petone Cycleway – Executive summary of cyclist survey findings (NZTA, October 2012), states that video footage undertaken by NZTA demonstrated that 97% of cyclists ride on the SH2 southbound shoulder rather than using the cycleway during peaks on weekdays.

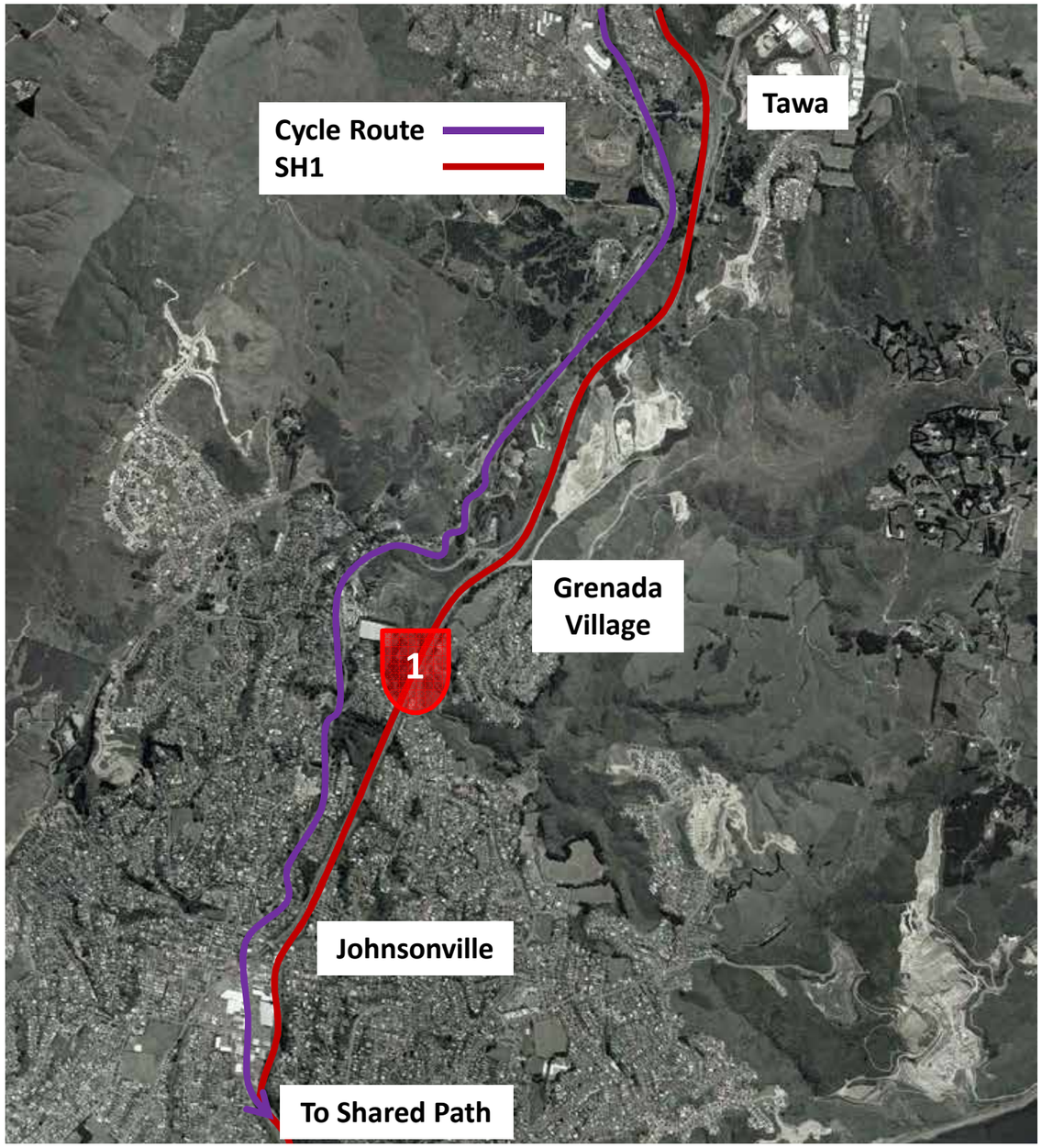

Figure 1-3: SH1 Cycle Route between Tawa and Shared Path on Centennial Highway

South of the Ngauranga interchange SH1 and SH2 combine to form the Wellington Urban Motorway. This section of state highway is designated motorway and banned for cyclists. To avoid travelling along the motorway, cyclists travelling south along SH2 follow the SH2 off ramp to Hutt Road via the subway under the motorway. This allows southbound cyclists to connect to the two way parallel cycle track on the eastern side of the Hutt Road. Cyclists travelling southbound on SH1 also meet up with the Hutt Road cycle track via the Centennial Highway.

There are no pedestrian footpaths provided along the State Highways.

1.1.3 Freight Movement

Within the Wellington Region, significant volumes of goods flow between Wellington City, Seaview / Gracefield, Petone and Porirua. Seaview is a major industrial hub in Wellington and as such is the origin and destination for many heavy commercial vehicles (HCVs). The CentrePort dock at Seaview is also a major distribution point in the Wellington Region and there is potential growth in this area for fuel distribution. Most sea freight becomes road freight at this point. Currently HCV trips from Seaview to Porirua generally travel south on SH2 to Ngauranga before turning north on SH1, extending their trip length. Road freight contributes to the traffic congestion and travel time delays on SH2 between Petone and Ngauranga.

There are also many oversized and overweight loads that are forced to reroute around the Petone Interchange and other locations on the State Highway network.

1.2 Problem Description

The key stakeholders of the project, including Wellington City Council (WCC), Hutt City Council (HCC), Greater Wellington Regional Council (GWRC) and NZTA identified the following problem statement:

- Economic: Limited capacity of the current road network contributes to congestion and restricts growth and development.
- Economic: Inefficient routes cause freight to be carried over longer distances.
- Resilience: Any disruption to existing routes risks isolating Wellington from its neighbouring communities and restricts State Highway north access.
- Utilisation: Current network precludes efficient public transport links between areas of common interest, e.g. Hutt Valley and Porirua.

1.3 Project Objectives

The Petone to Grenada Link Road aims to address severe congestion and resilience issues on the State Highway network as well as improving connectivity between the Hutt Valley and Porirua. Creating a more efficient State Highway network will allow for future growth, while improving connectivity will provide additional areas for that growth.

The project objectives, following the Design Surgery Workshop 1, were identified as follows:

1. Improve safety and efficiency of the transport network including efficiency of HCVs travelling between Seaview and SH1 to the north and maximise value for money;
2. Support the economic growth and development of the region by improving connectivity within the region;
3. Enhance resilience of the State Highway network within the region; and
4. Minimise adverse environmental impacts.

Factors that the project team must have due regard to:

1. Creating options that are economically efficient to construct, operate and maintain;
2. The objectives and requirements of the PFRs which form part of this project namely the Seaview Links, SH58 and SH2 Petone to Ngauranga and their relationship to this project;
3. Recognising the relationship to other projects including Transmission Gully and Petone to Ngauranga Cycling and Pedestrian Improvements;
4. Recognising natural features in the surrounding environment e.g. the Urban Coastal Edge, Ridgelines and Hilltops and the Petone foreshore;
5. Recognising areas of ecological and cultural significance e.g. Korokoro Stream valley within Belmont Regional Park;
6. The impact of the Petone West Plan Change (Change 29) which provides for future land intensification in terms of additional residential and commercial occupants;
7. Enabling the Lincolnshire Farm Development to connect to the P2G Link Road as required in the Lincolnshire Farm Structure Plan;
8. Ensuring that urban design and landscaping is integrated into option development particularly at Petone and Lincolnshire Farm. For example creating a "Beach to Bush" link as part of the option development at Petone; and
9. Recognise relationship with Ngauranga to Aotea project.

1.4 Purpose and Structure of Report

This purpose of this report is fourfold:

- Provide a baseline of the facts and information that we are aware of at this stage of the process. The facts and information presented will form the basis of the decision making process as the project is developed. Examples of this include current and forecast traffic demands and the current national, regional and local policies that apply to transportation projects;
- Present an analysis of the existing situation in the project area. This covers a wide range of topics from current traffic demands to landscape and ecological considerations;
- Summarise the data that is available as the options are developed and document why specific data has influenced the development of the options; and
- Document the existing issues and environment in the project area. This will allow robust decisions to be made in the future about the most appropriate option to develop further.

The report is structured as follows:

- Chapter 1 introduces the project area and objectives;
- Chapter 2 provides the strategic and planning context in which the options have been developed – at a national, regional and local level to ensure that all of the major stakeholders are represented;
- Chapter 3 outlines the previous work produced and assessment of the options to date;
- Chapters 4 to 11 present analysis of the existing issues in terms of transportation demand and performance, social considerations, environmental conditions and visual context as well as archaeological, geotechnical and physical design considerations;
- Chapters 12 and 13 present the options being considered and the option development process;
- Chapter 14 provides a transportation assessment and description of the modelling inputs and outputs used for that assessment;
- Chapters 15 to 21 present the individual options and their economic performance where applicable; and
- Chapters 22 and 23 evaluate the options and provide conclusions and recommendations for further work and the options to be considered for the Scheme Assessment Reporting stage.

Additional reports that have been prepared as part of this project include:

- Draft Engagement Plan, July 2013;
- Preliminary Geotechnical Appraisal Report, August 2013;
- Draft State Highway 58 Scoping/PFR Report, August 2013;
- Draft SH 2 Preliminary Feasibility Report, August 2013; and
- Draft Seaview Links Project Feasibility Report, August 2013.

2

National, Regional and Local Policy Context

2 National, Regional and Local Policy Context

2.1 Introduction

This section provides a brief review of what are considered to be the key central and local government policy and regulatory documents to understand how they might support a Petone to Grenada Link Road. It will also identify key considerations that may act as a constraint upon a link road route and design that will need to be addressed.

2.2 National Policy and Legislation

2.2.1 Land Transport Management Act 2003 (Statutory)

The Land Transport Management Act (LTMA) builds upon legislation contained within the Land Transport Act (LTA), which was predominantly focused upon the development of transport infrastructure rather than its use and management. The LTMA requires the preparation of Regional Land Transport Strategies (RLTS) by regional councils in each of New Zealand's regions. It requires NZTA to take into account each region's RLTS. Similarly, the LTMA requires that local authorities' plans and decisions not be inconsistent with the relevant RLTS.


Reprint
as at 1 January 2009

Land Transport Management Act 2003

Public Act 2003 No 118
Date of assent 12 November 2003
Commencement see section 2

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Preliminary provisions

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Note
Changes authorised by section 17C of the Acts and Regulations Publication Act 1989 have been made in this reprint.

The objective of the LTMA is to operate the transport network in a way that contributes to an integrated, safe, responsive and sustainable land transport system.

The LTMA specifies that when considering a transport proposal it should be assessed:

- In relation to other development proposals within the region, rather than in isolation;
- To demonstrate the degree to which it will contribute towards achieving community outcomes (defined in the Regional Land Transport Strategy);
- To demonstrate how it will contribute to managing the demand for travel; and
- To determine affordability given the likely availability of funding for the region.

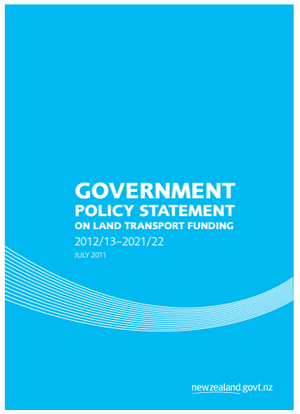
The Petone to Grenada project is required to contribute to the objectives of the LTMA in that it aims to improve the efficiency of the roading network, to encourage a mode shift to passenger transport, and to improve safety. This project is required to contribute to the objectives of the RLTS (see Section 2.3.2), and has been identified by the Regional Transport Committee as a project of priority.

The Petone to Grenada project must also consider other significant projects taking place within the region, including the Transmission Gully highway, and other RoNS projects.

Recognising and providing for these matters within the overall scheme of the project will ensure that the project maximises its return on investment.

2.2.2 Government Policy Statement on Land Transport Funding 2012/13-2021/22 (Statutory)

The Government Policy Statement on Land Transport Funding (GPS) issued by the Minister of Transport sets out the Government's priorities for expenditure from the National Land Transport Fund over the next 10 years. The GPS is the main Government document for influencing the planning and funding of land transport and is a requirement of the LTMA.



The three main areas of focus under the current GPS are:

- Economic growth and productivity
  - » The GPS has an expectation that land transport funding is directed into high quality projects and activities.
- Value for money
  - » Achieving value for money will determine the level of benefits realised from land transport investment.
- Road safety
  - » The safety priority acknowledges the substantial burden road crashes place on the economy and the health sector each year.

The GPS must be given effect by the NZ Transport Authority (NZTA) and through the Land Transport Management Act in developing the National Land Transport Programme. Regional Land Transport Strategies and programmes must also take into account the GPS.

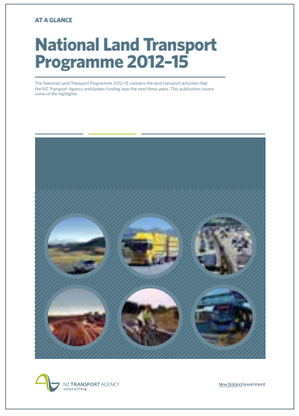
The Government's priority is for land transport investment to support national economic growth and productivity. The GPS ensures that land transport funding will direct investment into high quality infrastructure projects and transport services that encourage the efficient movement of freight and people.

The GPS is the primary piece of policy which introduced the RoNS, and escalated the priority of projects under the current government so as to provide some further context about the timing of RoNS projects.

There is no specific reference in the GPS to the Petone to Grenada project although it is funded through the RoNS programme. It is discussed that increased funding for State Highway construction will bring benefits for national economic growth and productivity, particularly given that State Highways carry most inter-regional freight and link major ports, airports and urban areas. Also that improving the safety of the State Highway will also see a reduction in accidents and injuries, which will have social and economic cost savings.

2.2.3 National Land Transport Programme 2012-2015 (Statutory)

The National Land Transport Programme (NLTP) is a planning and investment partnership between local authorities and the NZ Transport Agency (NZTA). The NLTP is required to contribute to the outcomes and objectives of the GPS, and sets out the key expectations and priorities for transport funding over the next three years.



Four key themes underpin the activities within the NLTP:

- Ensuring value for money;
- Supporting economic growth and productivity;
- Improving safety; and
- Providing a range of travel choices.

The investigation of the Petone to Grenada Link Road project is listed in the NLTP as part of 'Other Strategic Roading Improvements'.

The NLTP considers that the link road would:

- Become the major network link from the industrial areas in Wellington's Hutt Valley and the port to SH1 North;
- Enhance the connections between the three main urban areas within the Wellington region;
- Provide better inter-regional connections for people and freight;
- Provide a more direct route for freight and is also expected to improve the efficiency of the network and relieve congestion on State Highways 1 and 2; and,
- Increase the resilience of the Wellington network by providing an alternative to the coastal section of SH2 between Ngauranga Gorge and Petone.

Approximately $6 million is expected to be invested for this under this NLTP. The SH1/SH2 Petone to Grenada Link Road is likely to be considered for development or construction funding in the years 2015-2018.

2.2.4 NZ Transport Strategy 2008 (Non-statutory)

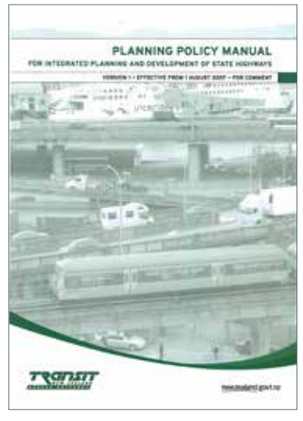
The New Zealand Transport Strategy (NZTS) is a national policy for developing and using transport infrastructure. It does not specifically mention the Petone to Grenada project. The strategy seeks to achieve integration between transport modes, and between transport and land use. The vision for transport is "By 2040 New Zealand will have an affordable, integrated, safe, responsive and sustainable transport system".

The key objectives of the NZTS (based on the LTMA) are as follows:

- Ensuring environmental sustainability;
- Assisting economic development;
- Assisting safety and personal security;
- Improving access and mobility; and
- Protecting and promoting public health.

It is considered that the Petone to Grenada project can promote economic development and improve access and mobility by providing for an alternative regional main connector route for freight and passenger vehicles.

2.2.5 Transit Planning Policy Manual 2007 (Non-statutory)



The Transit NZ Planning Policy Manual (TPPM) was published in 2007. The TPPM sets out policies, standards and guidelines on transport planning, land-use planning and the integration of the two. The manual is still in use although there are more recent NZTA technical documents which address specific environmental interests such as landscaping, stormwater or erosion/sediment control. The TPPM includes a statement of commitment to sustainable development and defines its objectives for the state highway network. It specifies planning outcomes which seek to ensure state highways:

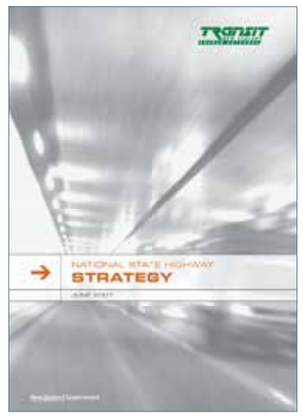
- Provide safe, efficient and pleasant links between cities, towns, airports, ports, transport hubs and places of interest;
- Balance the needs of national productivity and through traffic with the needs and aspirations of surrounding communities and local economies;
- Support well-planned local transport networks that in turn service sustainable land use patterns;
- Support the provision of travel choices and accessibility while encouraging low impact travel behaviours; and
- Are a legacy to be proud of.

The manual also defines supporting policies which explain how the organisation will support walking and cycling, provision for passenger transport services and development control.

The Petone to Grenada project seeks to achieve the above outcomes through developing options designed to:

- Mitigate traffic congestion and delays; and
- Improve the overall efficiency and safety of SH1 (and SH58) and local traffic flows.

2.2.6 National State Highway Strategy 2007 (Non-statutory)



The National State Highway Strategy (NSHS) takes a 30-year view and provides a link between the New Zealand Transport Strategy, the Land Transport Management Act, NZTA's (formerly Transit) plans and policies, and the State Highway Forecast.

The NSHS addresses the need for integration between state highway planning and local land use and multi-modal transport planning. It recognises that highways must respond to differing and sometimes conflicting expectations.

The NSHS sets out eight key principles for the planning, building, operating and maintaining of an integrated transport system:

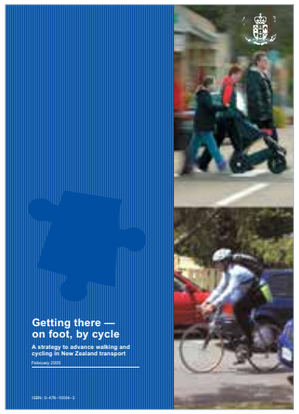
- Safety;
- Operating the network;
- Asset management;
- Managing demand;
- Environment and communities;
- Integrated planning;
- Education; and
- Continual improvement.

2.2.7 Getting There - On Foot, By Cycle 2005 (Non-statutory)

Getting There - On Foot, By Cycle is a national strategy to advance walking and cycling in New Zealand transport. Its vision is "a New Zealand where people from all sectors of the community walk and cycle for transport and enjoyment". This vision is supported by three goals:

- Community environments and transport systems that support walking and cycling;
- More people choosing to walk and cycle, more often; and
- Improved safety for pedestrians and cyclists.

By including pedestrian and cyclist infrastructure in the design options, and improving pedestrian and cyclist access and safety, the Petone to Grenada Link Road project would support the three goals listed above.



2.3 Regional Policy and Strategy

2.3.1 Greater Wellington Regional Policy Statement (Statutory)

The Regional Policy Statement (RPS) identifies the regionally significant issues around management of the region's natural and physical resources. A second generation RPS for the Wellington Region was made operative on 24 April 2013.

The RPS is arranged into themes that cross reference various objectives, policies, and methods. The 'Urban Design' theme incorporates the issue of a 'Strategic Transport Network'. Other themes - Air, Biodiversity, Climate change, Coastal, Hazardous substances, Historic heritage, Infrastructure, Landscapes, Natural hazards, Open space, Public access, Rivers and lakes, Tangata whenua, Vegetation disturbance, Water quality, and Wetlands would all potentially influence the project. Key policies are arranged into two tables in terms of whether they support (Table 2-1) or are a potential constraint (Table 2-2) upon the proposed Petone to Grenada Link Road.

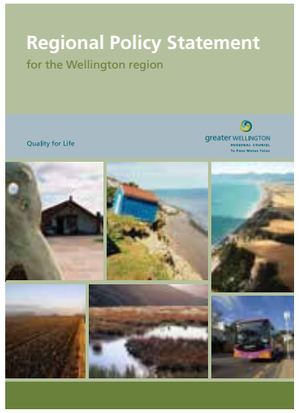


Table 2-1: Key RPS Policies that Support the Petone to Grenada Link Road

RPS Policy	Significance
Policy 8: Protecting regionally significant infrastructure – regional and district plans	Supports a P2G Link Road in terms of recognition as regionally significant
Policy 9: Reducing the use and consumption of non-renewable transport fuels and carbon dioxide emissions from transportation – Regional Land Transport Strategy	Supports a P2G Link Road in terms of being prioritised through the RLTS
Policy 30: Maintaining and enhancing the viability and vibrancy of regionally significant centres – district plans	Supports a P2G Link Road in terms of enhancing east-west connections
Policy 39: Recognising the benefits from renewable energy and regionally significant infrastructure – consideration	Supports a P2G Link Road in terms of improving efficiency of highway network as regionally significant infrastructure
Policy 51: Minimising the risks and consequences of natural hazards – consideration	Supports a P2G Link Road in terms of resilience for regionally significant transport network
Policy 57: Integrating land use and transportation - consideration	Supports a P2G Link Road in terms of a multi-mode and multi-use corridor
Policy 58: Co-ordinating land use with development and operation of infrastructure – consideration	Supports a P2G Link Road in terms of a multi-mode and multi-use corridor

Table 2-2: Key RPS Policies that Constrain the Petone to Grenada Link Road

RPS Policy	Significance
Policy 28: Managing special amenity landscape values – district and regional plans	Impacts upon the design of P2G Link Road through the WCC Ridgeline / Hilltop overlay zone, Belmont Regional Park, and Harbour coastal escarpment.
Policy 35: Preserving the natural character of the coastal environment – consideration	Impacts upon the design of P2G Link Road through the Harbour coastal escarpment
Policy 36: Managing effects on natural character in the coastal environment – consideration	Impacts upon the design and construction of P2G Link Road through the Harbour coastal escarpment
Policy 37: Safeguarding life supporting capacity of coastal ecosystems – consideration	Impacts upon the design and construction of P2G Link Road through the Harbour coastal escarpment
Policy 40: Safeguarding aquatic ecosystem health in water bodies – consideration	Impacts upon the design and construction of P2G Link Road adjacent to Korokoro Stream and other watercourses
Policy 41: Minimising the effects of earthworks and vegetation disturbance – consideration	Impacts upon the design and construction of P2G Link Road
Policy 42: Minimising contamination in stormwater from development – consideration	Impacts upon the design, construction, and future maintenance of P2G Link Road
Policy 43: Protecting aquatic ecological function of water bodies – consideration	Impacts upon the design and construction of P2G Link Road adjacent to Korokoro Stream and other watercourses
Policy 46: Managing effects on historic heritage values – consideration	Impacts upon the design of P2G Link Road through the Belmont Regional Park, or other archaeological sites along link route.
Policy 47: Managing effects on indigenous ecosystems and habitats with significant indigenous biodiversity values – consideration	Impacts upon the design and construction of P2G Link Road adjacent to Korokoro Stream, and terrestrial habitats (e.g. Belmont Regional Park, Harbour coastal escarpment)
Policy 49: Recognising and providing for matters of significance to tangata whenua – consideration	Impacts upon the design and construction of P2G Link Road adjacent to Korokoro Stream, archaeological sites, or other places of interest to tangata whenua
Policy 52: Minimising adverse effects of hazard mitigation measures – consideration	Impacts upon the design and construction of P2G Link Road
Policy 53: Public access to and along the coastal marine area, lakes and rivers – consideration	Impacts upon the design and construction of P2G Link Road adjacent to Korokoro Stream, and the Harbour coastal escarpment
Policy 56: Managing development in rural areas – consideration	Impacts upon the design and construction of P2G Link Road through rural areas.

The RPS lists the Korokoro Stream under Appendix 1, Table 15 in relation to being a river or lake with significant amenity and recreational values (walking, running & mountain biking). The threshold of significance for the Korokoro Stream is:

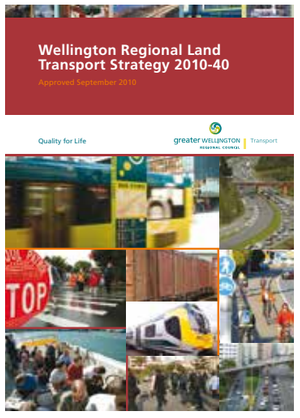
- Regarded as especially valuable by two or more recreational groups because of the quality of the opportunity and experience it affords, and
- Used for two or more recreational activities by people from throughout the region or beyond.

The RPS also lists the Korokoro Stream under Table 16 as a river or lake with significant indigenous ecosystem values. The threshold of significance for the Korokoro Stream is based upon the criteria:

- Habitat for threatened indigenous fish species; and
- Habitat for six or more migratory indigenous fish species.

The criterion for habitat of threatened native fish species is based upon numbers of shortjaw kokopu (Galaxias postvectis), giant kokopu (galaxias argenteus) and dwarf galaxias (Galaxias divergens) as recorded in the New Zealand freshwater fish database.

The key action for the proposed Petone to Grenada Link Road project in terms of the RPS is to ensure that environmental positives are highlighted such as the new road promoting resilience to minimise natural hazards disruption, integration of public transport and alternative (non-vehicle) users for the route alignment, and minimising adverse impacts upon those values listed for Policies under Table 2-2.



2.3.2 Wellington Regional Land Transport Strategy 2010-2040 (Statutory)

The Regional Land Transport Strategy (RLTS) is a statutory document prepared under the LTMA 2003). The RLTS is the strategic transport document that guides the development of the region's transport system including public transport, roads, walking, cycling and freight for the next ten years and beyond. A RLTS prepared under the LTMA must contribute to the overall aim of achieving an integrated, safe, responsive and sustainable land transport system.

The RLTS provides the strategic direction for developing the region's transport network over the next 30 years. The Strategy's vision is "to deliver an integrated land transport network that supports the region's people and prosperity in a way that is economically, environmentally and socially sustainable".

The RLTS objectives are:

- Assist economic and regional development;
- Assist safety and personal security;
- Improve access, mobility and reliability;
- Protect and promote public health;
- Ensure environmental sustainability; and
- Ensure that the Regional Transport Programme is affordable for the regional community.

The objectives reflect the provisions set out in the LTA and the LTMA, while also taking account of regional issues and objectives. The objectives form an important component of the strategic framework which is aligned with Greater Wellington's Long Term Council Community Plan and the Wellington Regional Strategy, to ensure the strategy contributes to the community outcomes identified by these documents.

The RLTS has identified strategic targets for the region with key actions to achieve by 2020. These are:

1.1 *Increased peak period public transport mode share*

2.1 Increased mode share for pedestrians and cyclists

3.1 Reduced greenhouse gas emissions

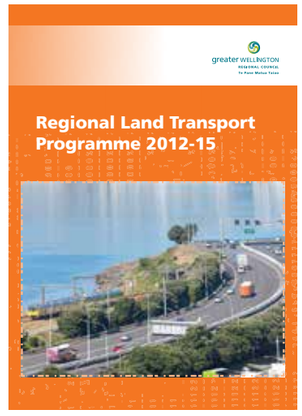
4.1 Reduced severe road congestion

5.1 Improved regional road safety

6.1 Improved land use and transport integration

7.1 Improved regional freight efficiency

8.1 Improved safety, efficiency and reliability of strategic road, public transport and freight links to the north of the region



Targets 3.1 to 8.1 are applicable to a Petone to Grenada Link Road, and the future route and design should assess the compatibility of key actions under those targets.

The strengthening of east-west connections is a regional transport network issue (3.3.8) in terms of improving access, efficiency and reliability for trips between the Hutt Valley, Wellington and Porirua.

2.3.3 Regional Land Transport Programme 2012-2015 (Statutory)

The Regional Land Transport Programme (RLTP) sets out the region's expectations for new capital expenditure on strategic roading and funding for passenger transport, active modes travel and demand management over a 10 year period.

The RLTP includes a set of prioritisation policies which guide this process and the matters to be taken into account in the prioritisation methodology. These policies ensure projects which contribute towards key outcomes are given top priority, ensuring priority decisions reflect seriousness, urgency, economic efficiency, effectiveness, volumes, affordability, and perceived safety benefits. The key objectives (from the RLTS) recognised in the programme are to:

- Assist economic and regional development;
- Assist safety and personal security;
- Improve access, mobility and reliability;
- Protect and promote public health;
- Ensure environmental sustainability; and
- Ensure the Regional Transport Programme is affordable for the regional community.

The Petone to Grenada Project is recognised as a 'committed' project, and is automatically included in the RLTP list for 2012-2015. It is acknowledged that the objectives for the project are to:

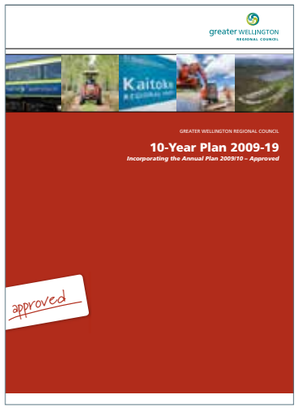
- Alleviate congestion, improve journey times and trip reliability on SH1 and SH2;
- Improve east/west journey times between SH1 (Grenada) and SH2 (Petone);
- Improve road network resilience; and
- Improve access to existing and new land use developments (i.e. Lincolnshire Farm).

2.3.4 Wellington Regional Strategy 2012 (Non Statutory)

The Wellington Regional Strategy (WRS) 2012 has been revised from the original 2007 document. The strategy has been developed by the nine local authorities in conjunction with a range of local stakeholders. The aim of the WRS is to build a resilient, diverse economy –one that retains and creates jobs (especially high value jobs), supports the growth of high value companies and improves the region's position in relation to the national GDP and national employment.

The WRS is centred around six focus areas to achieve its aim with actions for supporting economic growth, and building a resilient and diverse economy for the Wellington region. The focus areas that are relevant to the P2G Link Road are:

- *Focus area 2 - Investment mechanisms for growth.*
  - » This is about attracting international investment, making more of existing investment networks (such as angel investment networks) and ensuring businesses are in a position to realise investment opportunities.
- *Focus area 3 - Building world-class infrastructure.*
  - » Regional economic prosperity is heavily dependent on the region's level of connectedness and resilience at local, national and international levels. This is in turn dependent on the quality of our foundation infrastructure and transport systems.
- *Focus area 4 - Attracting business, investment and talent to the region.*
  - » This focus area is about having a targeted approach to attracting businesses, potential investors, skilled migrants and students to the region.



2.3.5 Greater Wellington 10 Year Plan 2009-19 (Statutory)

Greater Wellington's 10-Year Plan is a requirement of the Local Government Act 2002. It contains information about Greater Wellington's planned activities for the next 10 years and shows how these contribute to 10 agreed community outcomes.

The main community outcome which the Transportation section of the plan contributes to is "Connected Community - Access is quick and easy - locally, nationally and internationally. Our communication networks, air and sea ports, roads and public transport systems enable us to link well with others, both within and outside the region".

The Transport section also contributes to the following community outcomes; Prosperous Community, Healthy Environment, Essential Services, Healthy Community, and Quality Lifestyle.

The plan sets out a number of objectives as listed below:

- Increase peak period passenger transport mode share;
- Increase mode share for pedestrians and cyclists;
- Reduce greenhouse gas emissions;
- Reduce severe road congestion;
- Improve regional road safety;
- Improve land use and transport integration (in line with the WRS and local authority urban development strategies); and
- Improve regional freight efficiency.

A Petone to Grenada Link Road project has the potential to contribute to the objectives of the Greater Wellington 10-Year Plan as listed above. A key consideration for the P2G project to fit in with the plan would be to address road congestion on SH1 and SH2, and road safety for those who use SH58.

2.3.6 Wellington Regional Public Transport Plan 2011-2021 (Non-statutory)

The Regional Public Transport Plan (RPTP) was adopted on 1/11/2011, and sets out Greater Wellington's intentions for the regional public transport system over the next 10 years and includes objectives, policies and targets.

The vision for passenger transport is "a sustainable passenger transport system that....is integrated, accessible and increasingly the mode of choice for a greater number of journeys".

Key outcomes for passenger transport are identified as:

- Increased off-peak period passenger transport use and community connectedness;
- Improved passenger transport accessibility for all, including people with disabilities or from low income groups;
- Reduced passenger transport journey times compared to travel by private car; and
- Increased passenger transport reliability.

The Petone to Grenada Link Road project is not specifically referenced in the RPTP. A consideration for the P2G Link Road design in terms of being influenced by the RPTP is the network coverage area. The RPTP Network Plan diagram (page 10) identifies future connections between Johnsonville, Lincolnshire Farms, and Petone (via Melling, Lower Hutt). The potential for an east-west public transport connection is shown on the RPTP's network plan and a public transport network is also shown in the Wellington City Council development strategy for Lincolnshire Farm (see Section 2.4.3).

Section 5.1 of the RPTP sets out policy for the Network and services, some of which (as listed below) could be considered as a 'broad policy influence' on the design of the P2G Link Road.

Policy 1.2	*Deliver an integrated and interconnected network of public transport services that is simple and layered according to the following hierarchy of network service layers:* *a) Rapid transit network: supports high capacity services along high demand corridors connecting regionally significant centres, with measures to avoid the impacts of traffic congestion.*
Policy 1.7	*Encourage developments that maximise integration with walking, cycling and public transport services and which support the delivery of an effective and efficient public transport network.*
Policy 2.3	*Ensure the provision of well-designed transport interchanges on the rapid transit network and quality transit network.*
Policy 2.4	*Maintain existing park and ride and passenger drop-off facilities and identify opportunities for additional facilities.*

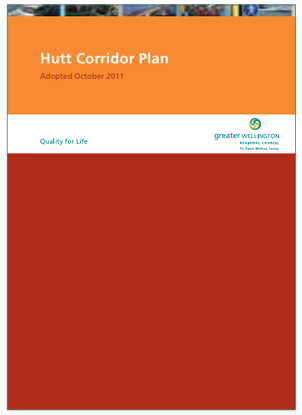
The Petone to Grenada Link Road would be considered as a strategic route for the regions road network. Therefore the P2G Link Road design should consider whether opportunities exist to fit in with the RPTP policies as identified above, and would also support objectives and outcomes for the RLTS as discussed in Section 2.3.2.

2.3.7 Corridor Plans (Non-statutory)

2.3.7.1 Hutt Corridor Plan 2011

A Corridor Plan for the Hutt Valley (HCP) was adopted on 27 October 2011. The HCP has been developed to be consistent with the strategic policy framework provided by the RLTS 2010 – 2040. The HCP is one of 3 corridor plans that include actions and improvements to move towards the long term vision for the region's transport network in the Wellington RLTS.

Corridor plans contain a range of walking, cycling, public transport and roading projects to make it easier for people and freight to travel within the corridor and from there to other parts of the region. Corridor plans are the only place where the development of the region's strategic road network is considered in regional planning. Proposed roading improvements are a significant aspect of these.



The objectives of the corridor plan are to:

- Prepare for current and future population, employment and freight growth;
- Reduce severe congestion on the road network;
- Increase trips made by walking, cycling and public transport;
- Improve accessibility for, and between, all forms of transport;
- Improve route security and resilience; and
- Improve road safety throughout the corridor.

The Hutt transport corridor follows State Highway 2 and the railway line from Ngauranga to Upper Hutt. It includes east-west connections between State Highways 1 and 2 such as State Highway 58.

The Petone to Grenada Link Road project is described as a 'Strategic Road Network Project' on page 6 of the HCP as reprinted below;

A new road is proposed to connect SH2 at Petone and SH1 at Grenada North – known as the Petone to Grenada Link Road. This project has benefit across multiple objectives and issues including:

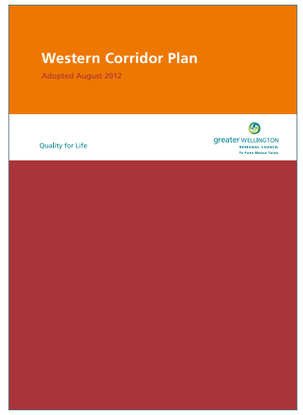
- *A direct connection for freight, commuters and other trips between Lower Hutt and Porirua / North Wellington providing for more efficient freight trips (expected to accommodate around 2,500 freight vehicles per day) and improved access between employment and markets (with trip length saving of about 7 km and travel time saving of around 8 minutes).*
- *Reduced congestion on SH2 south of Petone, and SH1 south of Tawa – by attracting around 25,000 vehicles per day to the new link road.*
- *Significantly improved transport network resilience through provision of a new alternative east-west connection that can be used in the event of a traffic accident or natural hazard / earthquake event affecting SH2 between Ngauranga and Petone.*
- *Potential to create a new direct east-west bus service between Porirua / Johnsonville and Lower Hutt.*
- *Integrating land use and transport by supporting proposed development at Lincolnshire Farm, Petone west and Seaview / Gracefield.*

Other elements of the Petone package include a new Petone interchange and measures such as ramp metering which will help to smooth the flow of merging traffic – these will help to reduce congestion around Petone and get more efficiency out of the existing road network. The Petone interchange upgrade will enable the creation of a 'beach to bush' walk and cycle link between Belmont Regional Park and the Petone foreshore.

Investigation of the Petone package of improvements will start in the 2011/12 financial year and will continue through the 2012 – 2015 Regional Land Transport Programme. Construction is likely to be substantially completed during the 2015 – 2018 Programme.

East to west connections are identified as a significant issue in the HCP in terms of congestion and resilience. The reduction of congestion and the improvement of network resilience are key objectives which would be supported by the Petone to Grenada Link Road project.

2.3.7.2 Western Corridor Plan 2012



The Western Corridor Plan (WCP) was adopted on 15 August 2012. The WCP has been developed to be consistent with the strategic policy framework provided by the RLTS 2010 – 2040.

East to West connections are identified as a significant issue in the WCP in terms of reducing congestion and improving resilience. The reduction of congestion and improving network resilience are key objectives which would be supported by the Petone to Grenada Link Road project. The P2G Link Road project is described on page 12 of the WCP as part of its 'Plan of Action' in terms of being prioritised immediately after the Roads of National Significance projects.

2.3.8 Belmont Regional Park

Belmont Regional Park (BRP) is located in the hill country between Porirua, the Hutt Valley and Wellington City, encompassing 3,500 hectares, with ridge-tops visible from the surrounding urban areas. The BRP is located mostly within the territorial boundaries of Hutt City Council (HCC), and is managed and/or owned by GWRC or HCC. The Department of Conservation, and the Porirua and Wellington City Councils also own small parcels of land managed by GWRC.

The park offers panoramic hilltop views with many opportunities for walkers, cyclists and horse riders. Multisport events are held in the park. A number of community groups have interest in the park, including Friends of Belmont, Belmont Area Mountain Bike Association, Korokoro Environmental Group, and Friends of Maara Roa (involved in forest restoration).

The closest road access into BRP relative to the Petone to Grenada link project is via Cornish Street (off SH2) in Petone which provides walking access along the Korokoro Stream.

BRP is managed by GWRC, under a 'Parks Network Plan' (covers all Regional Parks) released in July 2011. A management plan is required under the Reserves Act 1977.

BRP is covered under Part 6.3 of the management plan, as well as being discussed under 'Rules for use and development' (Part 7).

The focus for Belmont Regional Park is to:

- Protect the geological landscape of the boulder block fields;
- Provide extensive open space for outdoor recreation by retaining farming of the open tops;
- Conserve and enhance native forest in the valleys;
- Maintain examples of the historic munitions bunkers;
- Implement a sustainable farm management plan; and
- Re-evaluate future land management of areas that are separated by the Transmission Gully project from the main park body.

Policies in the BRP management plan are set out in section 6.3.5. Of interest for the Petone to Grenada Link Road project are:

- Biodiversity and ecosystems

a. To have particular regard for the high priority indigenous areas when determining ecosystem protection and enhancement priorities (included in Table 4).

The Korokoro Valley is included under Table 4.

- Landscape and geological features

b. To protect the park's key landscape features and values listed below from inappropriate use and development:

» Grassed open hill tops (generally above the 250 metre contour)

» "Fossil gullies" (filled with soil and associated materials from surrounding hills).

c. To advocate for the protection of the park's key geological features and values listed below from inappropriate use and development:

» The peneplain remnants of Boulder Hill (442 m), Belmont (456 metres), Cannons Head (390 metres), Belmont Road Trig (382 metres), Round Knob (410 metres), northeast of Hill Road (362 metres) and ITA (362 metres)

» Remnants of greywacke of Belmont Block Field (part) and Hill Road Block Field (part)

» The glacial feature of the solifluction debris tongue (Hill Road area)

» The fault-related features of Korokoro Stream, Dry Creek and Takapu Stream, as well as the notched ridges and spurs along the western hills of Lower Hutt.

The key landscape feature in terms of the P2G Link Road would relate to the last bullet point (Korokoro Stream).

- Cultural heritage

d. To manage the key sites of cultural heritage significance in the park, which include:

» The lower dam in Korokoro Valley

» The upper reservoir and dam in Korokoro Valley

» That portion of the Belmont –Pauatahanui Old Coach Road and associated early settler homestead sites within the park

» The Belmont historic munitions bunkers and associated facilities.

The key cultural heritage features would likely be those within the Korokoro Valley.

BRP also includes various Department of Conservation ecosites within the Park, including some in the Korokoro Stream valley. The Korokoro Stream ecosite is also recorded in the Hutt City District Plan (reference SNR 26 Hutt City DP). The ecological values for the site are listed under;

Table 4 - Protected and managed natural areas - Belmont Regional Park;

"Korokoro Stream Bush (400 hectares)

Rimu-rata/tawa-kohekohe forest remnant. Broadleaf regenerating forest, Nikau regeneration. Species: Forest gecko, New Zealand pigeon. Banded kokopu, inanga, koaro and long finned eel.

Korokoro Stream is noted in the RPS as an important habitat for at least 6 species of indigenous fish.

The BRP section 6.3.2 notes that Korokoro Stream has a cultural significance as it is known as "Te Korokoro o te Mana - the throat of "Te Mana" - meaning the food supply of Te Mana (the stream was an important food supply source).

The Transmission Gully route designation as well as the main gas pipeline and power transmission line routes are recognised in the BRP management plan.

The BRP Management Plan under section 6.3.6 also makes reference to future 'projected changes' of which some are of interest for the P2G Link Road project. These are:

- Develop walking and biking tracks that link the park's track network to complement, and where possible connect to other open space areas, for instance, the Hutt River Trail, the Eastern Hills and Wellington city's 'Outer Green Belt';
- Encourage and provide public access tracks and recreational corridors into the park from adjacent land, e.g. Lincolnshire Farm, Porirua East and Warspite Avenue, Whitby, Brady Road and Cornish Street; and
- Work with the New Zealand Transport Agency with regards to the Transmission Gully route and with other agencies to ensure recreational and management access links across the park from Porirua to Hutt City are maintained.

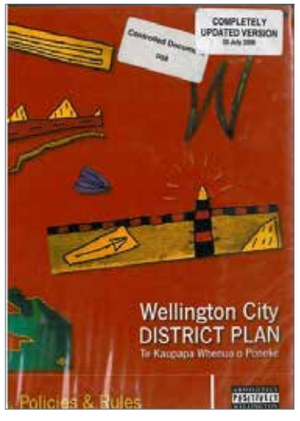
The BRP management plan includes a map of projected future changes which shows the Transmission Gully route designation. The map also identifies advocating for improved links between the BRP and Lincolnshire Farm, Petone at Cornish Street and Lower Hutt.

The implications of the BRP management plan for the Petone to Grenada project is that the alignment and corridor design should consider the ecological, cultural, and recreational access / future integration issues raised. The actual or potential effects upon the Korokoro Stream and catchment are likely to be a key consideration. Integration of recreation access and ecological corridors from the top of BRP down to Petone and the Hutt Valley is also a key issue for investigating. Promoting access aligns with a desire as stated in the HCP (Section 2.3.7.1) to create a walk and cycle link from the 'beach to the bush' in conjunction with the Petone to Grenada project. Also of interest for Petone to Grenada Link Road project is the inclusion of the Transmission Gully route designation into the BRP management plan.

2.4 District Policy and Strategy

2.4.1 Wellington City District Plan 2000 (Statutory)

The likely route for a Petone to Grenada Link Road would pass through a predominantly Rural and potentially Open Space B (Natural Environment) activity areas (zones) of the current Wellington City Council District Plan (WCC DP) . There are also 2 landscape overlays – the Urban Coastal Edge (refer Figure 2-1), and the Ridgeline and Hilltop that a route would pass over. A route for P2G is not currently designated in the WCC DP.



Transport policies relevant to a P2G Link found in the WCC DP include:

Objective 14.2.9 *To enable efficient, convenient and safe access for people and goods within the Rural Area.*

Policy 14.2.9.1 *Manage the road network to avoid, remedy or mitigate any adverse effects of road traffic on Rural Areas.*

Policy 14.2.9.2 *Manage the road system in accordance with a defined road hierarchy.*

Policy 14.2.9.3 *Provide for, and in certain circumstances require, extensions to the existing road network. In particular the actual development or potential for future development of the following connector routes is sought:*

- *from Jamaica Drive in the north to Mark Avenue in the south with a connection to the Grenada interchange x.*

A P2G Link project would require significant earthworks which are specifically managed by the WCC DP with objectives and policies (Chapter 29) and rules (Chapter 30). Of relevance to a P2G Link Road is:

Policy 29.2.1.9 *Control earthworks in the Urban Coastal Edge, areas within the Ridgelines and Hilltops Overlay, Open Space B Areas Conservation Sites, Heritage Areas and on sites containing listed Heritage Items to protect the character, visual amenity or heritage value these areas provide to their immediate surrounds and the City...*

...Matters to consider within the Urban Coastal Edge:

- *Whether the proposed earthworks and any associated structures will have a negative visual impact on the appearance and character of areas along coastal roads.*
- *The extent to which the natural characteristics of the site will be altered or modified by the earthworks.*
- *Whether mitigation will be effective in addressing the visual effects of the earthworks and associated structures.*
- *The extent that indigenous or naturalised species are used in landscaping.*
- *All relevant matters listed for assessment under Policy 29.2.1.7.*

In terms of the WCC Urban Coastal Edge, earthworks undertaken for the P2G Link Road would exceed permitted thresholds in relation to cut/fill height, and area, or slope angle of disturbance. The activity would require consent as discretionary restricted under the WCC DP Rule 30.2.1. Council's discretion is restricted to earthworks stability, erosion/dust/sediment control, visual amenity, proximity to water courses or the coastal marine area (20m), and the transport of material exceeding 200m3.

In terms of the WCC Ridgeline and Hilltop overlay, earthworks undertaken for the P2G Link Road would exceed permitted thresholds and would be assessed as discretionary unrestricted under the WCC DP Rule 30.3.2. The criteria for decision making are broader and would involve an assessment against the relevant GWRC RPS and WCC DP objectives and policies.

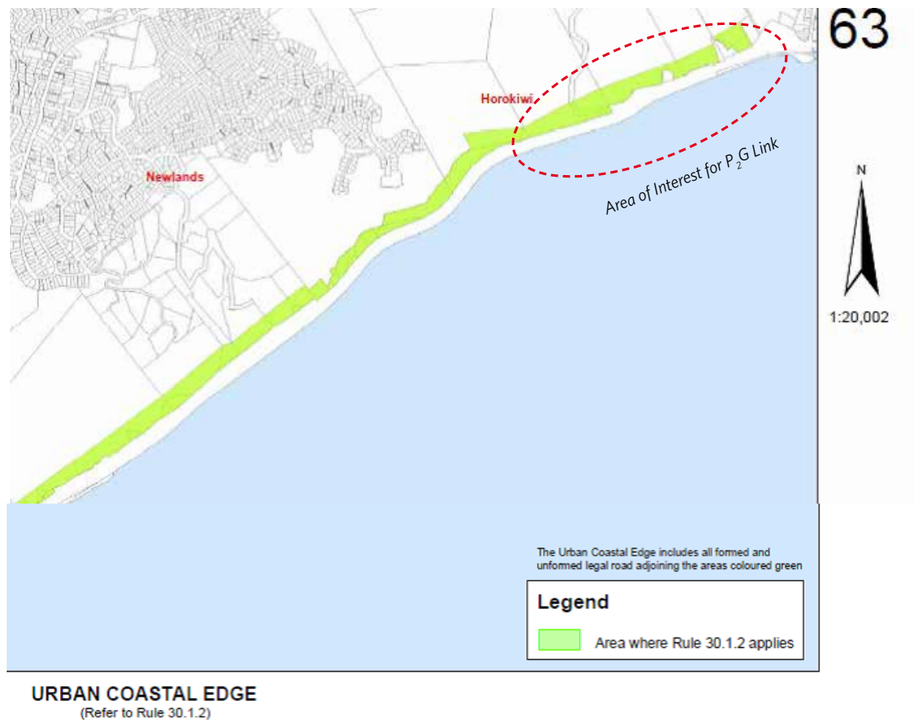


Figure 2-1: Excerpt of WCC DP Map 63 Urban Coastal Edge

The Petone to Grenada project will need to respond to issues about avoiding or mitigating impacts upon the urban coastal edge, the ridgeline and hilltop overlay, rural character, and Open Space B values. A P2G Link Road route and design would need to demonstrate how it can integrate with the landscape and amenity values of these activity areas.

2.4.2 Northern Growth Management Framework 2009 (Non-statutory)

The Northern Growth Management Framework (NGMF) is a strategic document articulating Wellington City Council's vision for land use and development in Wellington's northern suburbs. The NGMF has five themes:

- Liveability – supporting existing communities and ensuring a quality urban form for a quality lifestyle;
- Sustainability – managing growth in a sustainable way and responding to our environment;
- Accessibility – making it easy to access services and amenities – for work, pleasure, support;
- Connectivity – integrating the movement network and enhancing linkages within and between communities and to the city and region; and
- Prosperity – providing a climate for commercial enterprises and local businesses to thrive.

A Petone to Grenada Link Road is referenced under the NGMF in;

Transport issues

The northern area of Wellington City straddles two key transport links for the region: State Highway 1 and the main trunk railway. A review of transport infrastructure in this area offers the opportunity to improve the links between Porirua, Wellington and the Hutt cities.

Wellington City Council is keen to help address these regional transport issues as part of its land use planning in the area.

And;

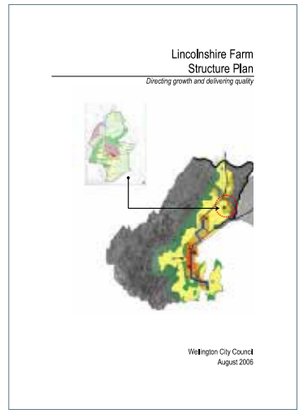
Growth management Principle 5:

Complete or develop cohesive and efficient transport modes and networks; and

Support further investigation of the Grenada Village – Petone road link, as appropriate, in the context of the Regional Land Transport Strategy.

The NGMF serves as a broad policy influence for a Petone to Grenada Link Road. It has led to Plan Change 45 (discussed in Section 2.4.3) which includes an indicative P2G Link Road corridor.

2.4.3 Lincolnshire Farm Structure Plan (Statutory)



Plan Change 45 (Change 45), which includes the Lincolnshire Farm Structure Plan (LFSP), was notified in 2006. It follows on from the Northern Growth Management Framework discussed previously. A decision on Change 45 was released in 2008 and appealed however it is understood that all appeals are resolved and confirmation of Change 45 is awaiting an order from the Environment Court.

The LFSP identifies an indicative route for a main arterial between SH1 at Tawa and SH2 up to Lincolnshire Road at Horokiwi. Section 1.1.3 Proposed development describes a link road as;

> *"A 4-lane link road from State Highway 1 between Tawa and Grenada interchange connecting to State Highway 2 between the Petone and Dowse interchanges in the Hutt Valley Under section 2.4 Regional Transport Connectivity'*

P2G Link Road design criteria are referenced under section 2.4 Regional Transport Connectivity:

> *"A key issue for the structure plan is to make provision for a link road that is designed:*

- *To accommodate at least 25,000 VPD*
- *To allow high average vehicle speeds (70-80km/hr)*
- *To have a minimum number of intersections to maintain traffic speeds*
- *To provide connections to the structure plan area"*

Potential locations for the link road corridor are discussed under Section 5 of the LFSP as follows:

> *"Link road / Arterial – providing regional connectivity between State Highway 1 / Grenada and State Highway 2 / Hutt Valley. At present principal access to the structure plan area is via the Grenada exit of State Highway 1. This interchange may require upgrade if it were to provide the main point of access to and from the completed Link road. The alternate preferred option to this is the construction of a new link from SH1 approximately 400m south of the existing Tawa interchange to the Link road as shown on Map 4. The Link road will be a limited access road meaning that there will be no direct property access onto or off the road in the structure plan area (including to the Employment Area). Access will instead be provided from the major intersections identified."*

The provision of funding and the implementation of a Link road are discussed at section 9.7:

> *"The majority of funding for the Link road will need to come from Transit New Zealand or the Crown. A decision on when and how to fund the Link road will depend on the Regional Land Transport Strategy and the priority that is given to other projects in the region in relation to available funding. As such, detailed investigations are unlikely to proceed until funding has been identified.*
>
> *Once funding is secured. Identification of the alignment, detailed design and implementation of the Link road will require a partnership approach between the Council, the developer, Transit and Hutt City."*

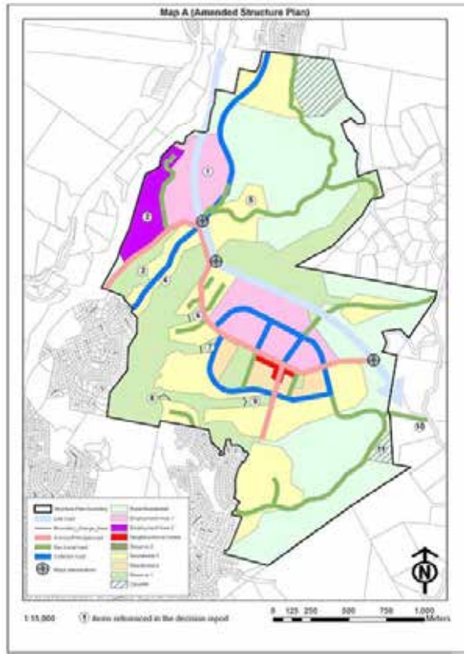


Figure 2-2: Excerpt from Change 45 Decision – Revised LFSP

WCC consultation on the LFSP included a questionnaire for which there were 110 responses. The questionnaire indicated almost 65% support for the statement "It is important to build a strategic link road between SH1/Grenada and SH2/Hutt Valley". The questionnaire responses indicated strong support from respondents for a LFSP road connection link, recreation and ecological links, and the protection of landscape and ecological features (Lincolnshire Farm Structure Plan: Background Report on Consultation). However submissions on Change 45 also included specific comments in relation to a P2G Link Road. These included a request that Horokiwi Road did not connect to a P2G Link Road (thereby providing a connection between the P2G Link Road and SH2), and that the construction of the P2G was managed to avoid effects on Horokiwi road.

Figure 2-2 provides an excerpt from the decision indicating the proposed link road route.

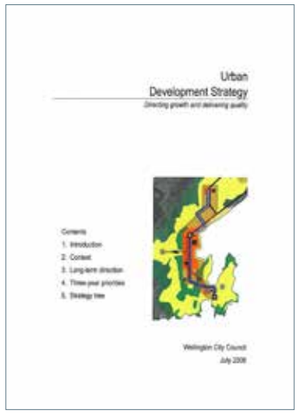
The LFSP therefore anticipates a P2G Link Road and has identified an indicative route to connect with the Lincolnshire development. A future design for a P2G Link Road will require engagement with WCC and the LFSP proponents to consider the relationship of LFSP and more recent options for the Petone to Grenada project.

2.4.4 Wellington City Council Long Term Plan 2012-2022 (Statutory)

The Council adopted the final version of the plan at its meeting on 27 June 2012. The Wellington City Long Term Plan (LTP) explains what WCC plans to do over the next decade, why they plan to do it, how much it will cost, and who will pay. It recognises key areas and strategies for the development of Wellington City over the next 10 years. Significant growth is expected in Wellington creating challenges in sustaining and preserving the city's character. A key priority is to improve land use and transport by focusing development in keys centres or 'hubs'. There are also challenges in ensuring the transport network can keep up with growing demand while aiming to reduce harmful environmental effects such as noise, water and air pollution.

Transport is one of seven activity areas covered under the LTP. The provision of an efficient and safe vehicle network is important to the city's economy and for residents' quality of life. It is also important for the environment. An inefficient transport network that is congested results in cars spending more time in transit consuming fuel and emitting carbon monoxide - a negative consequence of the roading network that we are seeking to minimise.

The overall aim is to manage and maintain the network to ensure it remains efficient. To achieve this, the key focus will be planning for improvements to the transport network to ensure it develops in ways that meet future needs. There is no specific mention of a Petone to Grenada Link Road project in the LTP.



2.4.5 WCC Transport Strategy 2006-16 (Non-statutory)

Wellington City Council has prepared a Transport Strategy to ensure that Wellington's transport system supports the city's vision for its future growth and function. The overall goal is for Wellington's transport network to support the economic, social, cultural and environmental aspirations of its citizens. To achieve this, the state highway system and arterial roads will need to provide efficient access to the city and to key transport hubs, while

also encouraging public transport and walking as ways to get around the areas of high-density development. It will also mean promoting developments that increase the energy efficiency of the transport system.

A Petone to Grenada Link Road is not prioritised in the strategy but is identified as a 'roading investment'.

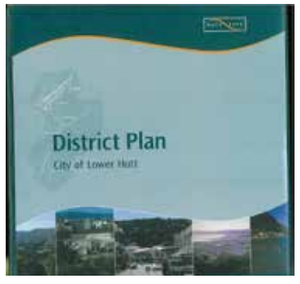
The strategy identifies six long term outcomes which are relevant to a Petone to Grenada Link project. They are:

- More liveable: Wellington will be easy to get around, pedestrian-friendly and offer quality transport choices;
- More prosperous: Wellington will have a coherent and efficient transport system that aids economic development;
- More sustainable: Wellington will minimise the environmental effects of transport and support the environmental strategy;
- Better connected: Wellington will have a highly interconnected public transport, road and street system that supports its urban development and social strategies;
- Healthier: Wellington's transport system will contribute to healthy communities and social interaction; and
- Safer: Wellington will seek to improve the safety and security of its citizens as they move around the city and region.

The strategy also identifies actions (things to do) which might be considerations relevant to the design of Petone to Grenada Link. These are:

- Develop the state highways and main arterial roads as the primary means of moving large volumes of traffic and freight to and through the city;
- Ensure continued access to the CBD for commuters; and
- Develop the port and airport as major contributors to the city and regional economy.

In summary the strategy should be considered as providing a broad policy support for a Petone to Grenada Link Road based upon the potential to increase transport efficiency, to reduce congestion and delay, and improving linkages to CentrePort and Wellington International Airport.



2.4.6 Hutt City Council District Plan (Statutory)

The current HCC DP contains broad policy influences such as Chapter 14A Transport with a roading hierarchy referring to state highways under policy 14A(i) 1.1.1. There is no specific mention of the Petone to Grenada project however improvements to SH2/SH58 are listed under Designations TNZ3 and TNZ4 (Chapter 15) and shown on Plan Map G1.

The HCC DP also includes Chapter 14E 'Significant Natural, Cultural & Archaeological Resources' which is likely to constrain P2G route selection. A list of relevant policies from *14E 1.1 Protection of Significant Natural, Cultural and Archaeological Resources is given below:*

> (b) That it be recognised that new significant natural, cultural and archaeological resources may be discovered, and added to the schedule of significant resources;
>
> (c) That any activity or site development shall not modify, damage or destroy a significant natural, cultural or archaeological resource;
>
> (d) That any activity or site development shall not compromise the natural character or visual amenity values of a significant natural, cultural or archaeological resource;
>
> (e) All buildings, structures and activities shall preserve the natural character, visual amenity values and landscape values of the significant natural, cultural or archaeological resources including the identified coastal environment;
>
> (f) The scale, height, location and design of all buildings and structures shall protect the amenity values, especially landscape values, of the identified coastal environment;
>
> (g) That any activity or site development will take into account new findings of significant natural, cultural or archaeological resources;
>
> (h) That the cultural significance of these natural resources be recognised and protected; and
>
> (i) That any activity or site development shall not modify, damage or destroy the intrinsic values of the ecosystems of a significant natural, cultural or archaeological resource.

Under Chapter 14E the Korokoro Stream Valley is identified as containing sites of significant natural or cultural resources. Sites relevant to a P2G Link Road include;

> *Chapter 14E Significant Natural Resources;*
>
> *25. Korokoro Bush: Lowland forest on hill country.*
>
> *26. Korokoro Stream Bush: The only large stand of lowland Rimu-Rata-Tawa-Kohekohe forest in the south west Wellington region. Possibly the most southern North Island Kohekohe-Karaka forest. Rare Giant Kokopu. Only area outside the Hutt Valley flats which contains the rifleman. Forest Gecko's.*
>
> *Chapter 14E Significant Cultural Resources*
>
> *27. Korokoro: (located on a ridge west of the mouth of the Korokoro Stream. Te-Raho-o-te Kapowai (hills).*

Figure 2-3 below show the locations of the identified sites. A P2G Link Road crossing through the Korokoro Stream Valley would

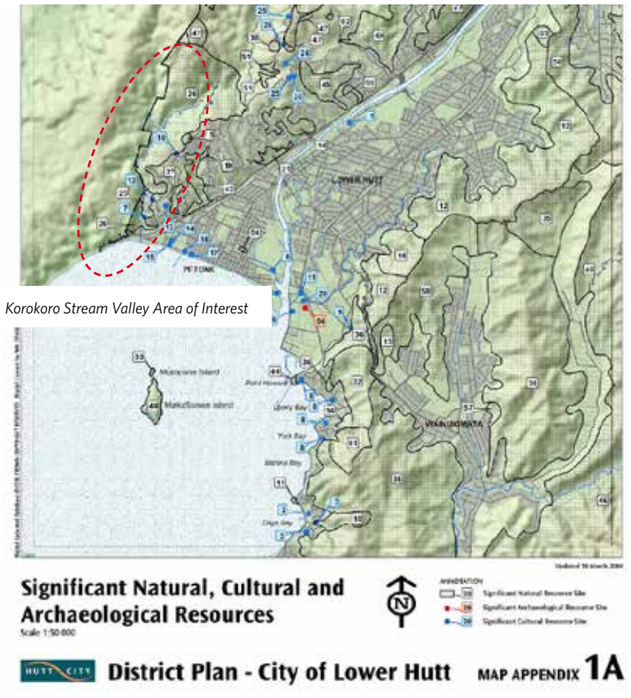


Figure 2-3: Excerpt from the HCC DP Plan Map 1A Showing Natural and Cultural Features

require a resource consent under HCC DP rule 14E 2.2 in terms of effects upon the listed sites. Factors for assessment are:

- The extent to which the resource is to be modified, damaged or destroyed;
- The extent to which the proposal may compromise natural character, visual amenities and landscape values;
- The impact on the coastal environment; and
- The recognition and protection of cultural significance.

The implications of the HCC DP for a P2G Link Road is that there are ecological and cultural values of significance recognised in the DP which should be thoroughly taken into consideration for a future alignment and design of the road corridor.

2.4.7 Change 29: Petone West 2012 (Statutory)

The Petone West Plan Change (Change 29) is a change to the HCC DP which could impact upon a P2G Link Road both in terms of traffic demand, route selection and design at the Petone interchange. Change 29 has undergone hearings in April and there is currently an additional consultation period (until 21 June) relating to a revised Petone Mixed Use Activity Area Design Guide before a final decision is released. The Officers report recommended approval, as did the Officer's Right of Reply after the presentation of oral submissions.

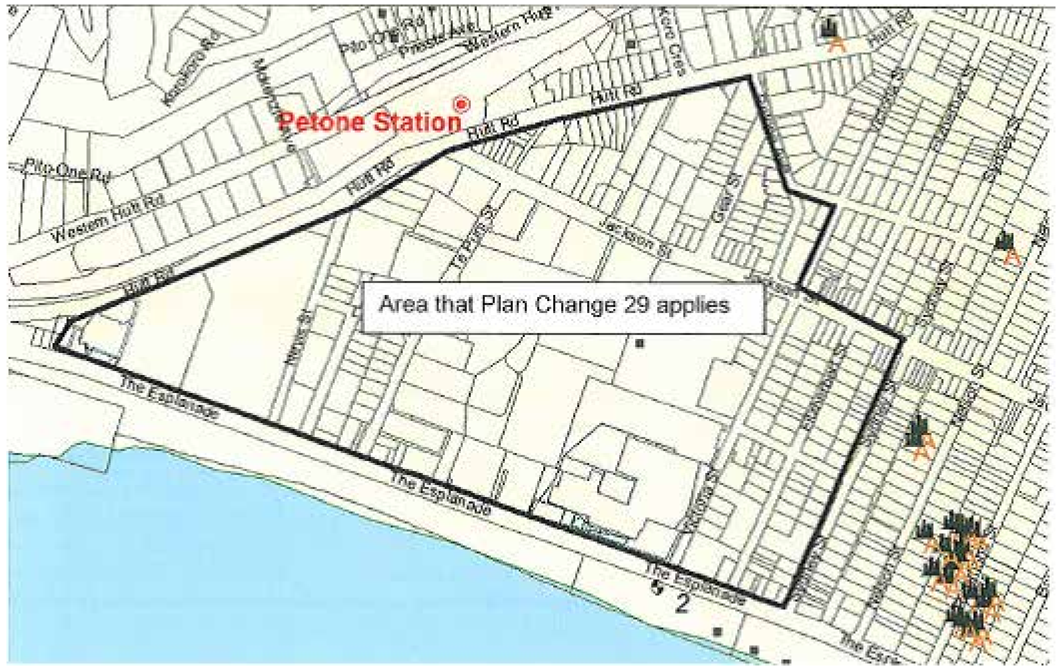


Figure 2-4: Petone West Plan Change Area

Figure 2-4 shows the location area of Change 29. In summary Change 29 would;

- Rezone the western part of Petone from a mixture of 'Petone Commercial Activity Area - Area 2', and 'General Business Activity Area' to 'Petone Commercial Activity Area - Area 2';
- Provide for a maximum permitted building height of 30m throughout the area, with any building over 12m requiring a wind assessment. Along Jackson Street, Hutt Road and The Esplanade the maximum permitted building height will be 15m and a 45-degree recession plane sloping inwards from this 15m height up to the maximum permitted height of 30m;
- New design guidelines for buildings along Jackson Street, Hutt Road and The Esplanade;
- Retail developments permitted up to a maximum of 10,000m2 of floor space, subject to compliance with the permitted activity conditions;
- Residential development permitted, subject to compliance with the permitted activity conditions;
- Commercial development permitted everywhere, subject to compliance with the permitted activity conditions, along with some light industrial uses;
- Retaining the present permitted maximum site coverage of 100%. Provision for extra rules relating to side and rear yard setbacks and recession planes would have the effect of lowering maximum coverage on sites abutting the General Residential Activity Area;
- Retaining current requirements to address risk of building within the Wellington Fault Area; and
- Three Properties in Victoria Street currently zoned 'General Business Activity Area' will be rezoned to 'Petone Commercial Activity Area – Area 1'.

Change 29 would provide for future intensification of the land use within the change area in terms of additional residential and commercial land uses. A further detailed assessment of the change area would be needed to provide information for identifying transportation effects in terms of modelling the traffic demand over the route or in terms of demand for public transport.

2.4.8 Long Term Plan 2012-22 (Statutory)

Hutt City Council has a current Long Term Plan (LTP) covering the period 2012-2022. The LTP has nine goals or outcomes to measure performance of the Council and two of these are relevant to the Petone to Grenada Link project and are listed as follows:

1. *Outcome: A Safe Community*

This outcome is relevant in terms of road safety and reducing harm caused by accidents to people and property.

2. *Outcome: An Accessible and Connected City*

A city that is easy to move about with well-designed roads, cycleways and footpaths. Members of our community are connected to the digital world. This outcome is relevant in terms of maintaining a quality transport network and passenger transport services.

The HCC LTP also makes references to roading and traffic issues such as:

Infrastructure opportunities include:

- Improving transport, roading and pedestrian connections, access and safety across the city.

Roading and Traffic

- It is expected that freight volumes will double over the next few decades. As the Seaview Gracefield area is the Wellington regions primary industrial and logistics centre, investigations into improved linkages with SH2 continue.

The implication of the HCC LTP for the Petone to Grenada Link Road is it provides broad support but no specific reference for a future proposal.

2.5 Summary

National, regional and local government policy has been reviewed to determine their level of influence or constraint upon the Petone to Grenada Link Road project.

It is considered that overall the policy framework supports the development of a Petone to Grenada connection. This is provided that the design and location of a P2G Link Road recognises the significant natural and cultural features and associated values located in Belmont Regional Park, the Korokoro Stream and the Wellington harbour coastal escarpment and that the form of the route provides for freight and other modes of transport.

A summary of main points grouped into 'Broad Policy Influences' and 'Constraints' is presented in the following sections. Figure 2-5 provides a diagram of the interrelationship of the assessed policy documents.

2.5.1 Broad Policy Influences

2.5.1.1 Central Government Policy Documents Support a P2G Link Road

- Stating objectives which a P2G Link Road can align with (E.g. LTMA – a safe, responsive and sustainable land transport system', or the GPS – economic growth and productivity, value for money, and road safety), or,
- Setting out specific reasons and implementation actions (E.g. the NLTP states a P2G Link would be a major network link, enhance inter region connections, relieve congestion on SH1/SH2, and increase resilience ; and proposes to spend $6million in 2015-2018 on P2G Link investigations).
- Identifying the potential for a Link route and referencing data that identifies problems with the existing network (NSHS lists SH58 as the 7th worst (of 10) highways for fatalities and serious crashes).

2.5.1.2 Regional and Local Government Policy Documents Support a P2G Link Road

- The RLTS expresses support for a P2G Link with recognition of an east-west connection as a regional transport issue, and specific targets for reducing congestion, improved road safety, freight efficiency and the integration of land use and transport.
- The RLTP recognises funding for a P2G Link Road and set out objectives for a route.
- The WRS has 3 areas (Investment mechanisms for growth, Building world class infrastructure, and Attracting business, investment and talent) that a P2G Link can align with.
- The GWRC LTP has objectives (i.e. reduce sever road congestion, improve regional road safety, improve regional freight efficiency) which a P2G Link can align with.
- The HCP has objectives (prepare for future population and freight growth, reduce congestion, improve route security and resilience, and improve road safety) which a P2G Link can align with.
- The NGMF supports the investigation of a P2G Link Road as a regional transport issue.

2.5.2 Constraints

2.5.2.1 Route Selection

- The WCC NGMF and LFSP documents provide an indicative plan for future development in the central part of a P2G Link Road. Although the LFSP is only indicative, a major deviation of route or design from the Change 45 LFSP may not be considered as consistent or favourable by the WCC.
- The GWRC RPS has an emphasis on integrating land use and transport which may impact upon considering a deviation from the LFSP in terms of not providing an east – west link.

2.5.2.2 Environmental Effects

- A P2G Link Road would have a potentially significant impact upon the amenity, landscape, and natural values of Wellington Harbour coastal escarpment, Korokoro Stream Valley, Belmont Regional Park, and elevated rural areas. Regional and local government policy (RPS, BRP, HCC DP and WCC DP) requires consideration in the protection of these values. Route selection and design of components for a P2G Link Road needs to consider how these values can be reflected in the location and design of the corridor.

2.5.2.3 Multi Modal

- Central Government policy may define constraints for a P2G Link Road project (E.g. Getting There - On Foot, By Cycle is a national strategy to advance walking and cycling in New Zealand transport, and an objective of the TTPM 'Support the provision of travel choices and accessibility while encouraging low impact travel behaviours). A P2G Link Road should consider how local communities and non-vehicle users can be integrated.
- Local Government statutory and non-statutory documents consider that a Petone to Grenada link route needs to investigate integrating non-vehicle users in terms of a recreation access link at Horokiwi and for the adjacent Belmont Regional Park through to the Petone foreshore (HCP, BRP, NGMF and LFSP).
- The Petone interchange upgrade will enable the creation of a 'beach to bush' walk and cycle link between Belmont Regional Park and the Petone foreshore (HCP, HCC LTP).

2.5.2.4 Public Transport

- Regional and local policy documents suggest that a P2G Link Road has the potential to create a new high quality, high capacity, fast and reliable passenger transport east-west bus service between Porirua/Johnsonville and Lower Hutt. Consideration should also be given to providing a dedicated space for buses along the route and passenger stops for bus passenger system in the future. The bus lanes will also improve the legibility of passenger transport, making it more permanent and create a perception of high quality (GW Public Transport Plan, WCC Transport Strategy, NGMF, and LFSP).

2.5.2.5 Freight Efficient

- Providing a route for more efficient freight trips (expected to accommodate around 2,500 freight vehicles per day) particularly a link from Porirua to the Seaview industrial and port facilities (Hutt Corridor Plan, WRS, & HCC LTP). This will influence design in terms of a location and form suitable to accommodate freight vehicles.

2.5.2.6 Reduce Congestion on Existing State Highway Network

- A key design driver for a P2G Link Road is reducing vehicle congestion and improving access between employment and markets (with trip length saving of about 7 km and travel time saving of around 8 minutes) particularly to the airport to improve economic growth and transport efficiency (RLTS, RLTP, HCP).
- Relieving pressure on SH1 through offering traffic a direct connection for freight, commuters and other trips between Lower Hutt to North Wellington and Porirua. Reduced congestion on SH2 south of Petone, and SH1 south of Tawa – by attracting around 25,000 vehicles per day to the new link road (NLTP, RLTS, RLTP, LFSP).
- A new Petone interchange will smooth the flow of merging traffic and reduce congestion around Petone and gain efficiency from the existing road network (HCP, HCC LTP).

2.5.2.7 Resilience from Natural Hazards

- Improved transport network resilience through provision of an alternative east-west connection that can be used in the event of a traffic accident or natural hazard event affecting SH2 between Ngauranga and Petone (PRPS, RLTS, RLTP).

Land Transport Planning & Funding Documents

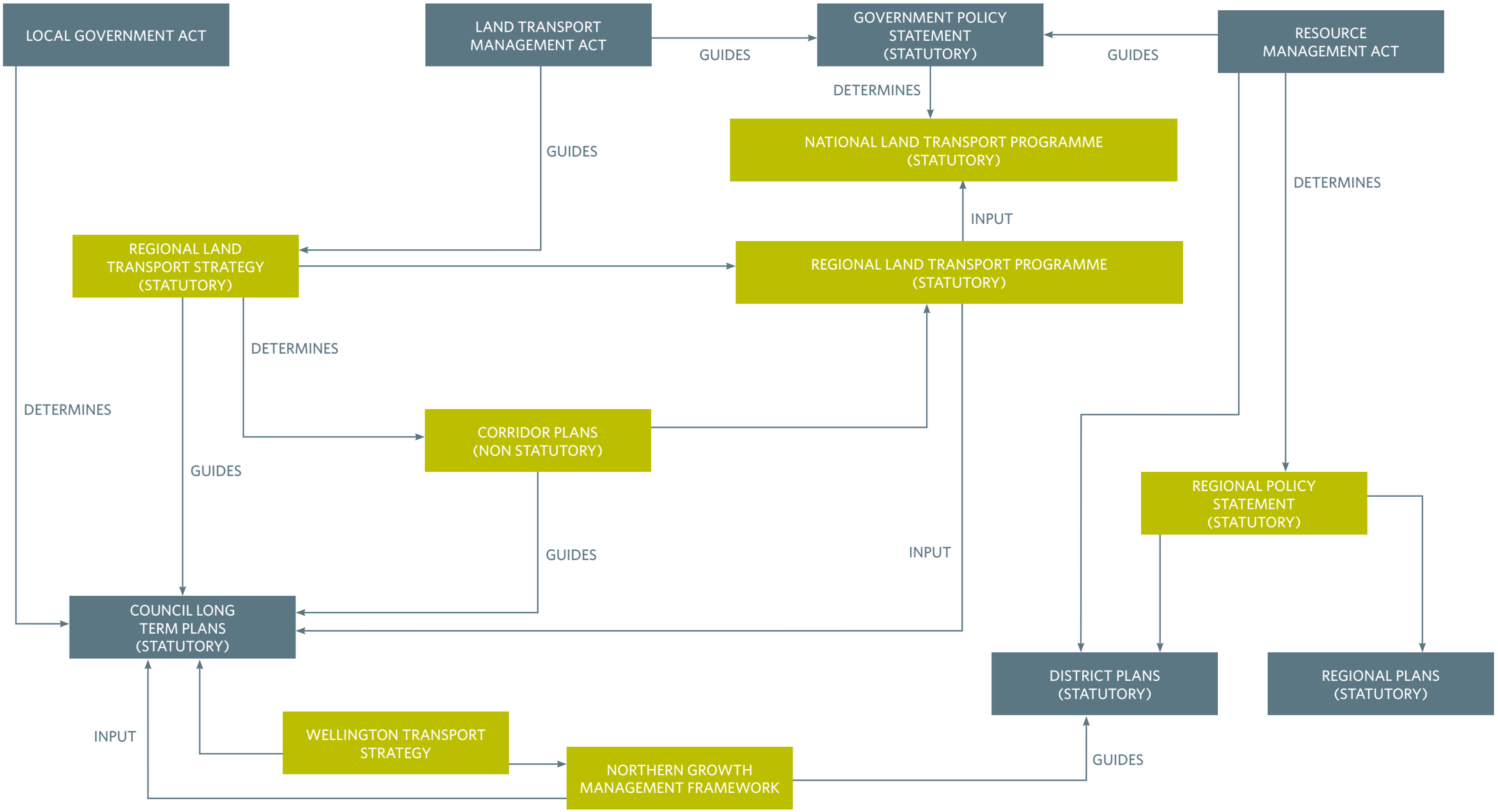


Figure 2-5: Chart Identifying Hierarchy of Planning and Transport Policy Documents with Reference to the Petone to Grenada Project

3

Background to Option Development

3 Background to Option Development

There have been several studies completed in the past with an aim to developing a link road solution between SH1 and SH2. We will draw on this information and facts to help identify key issues and develop potential options that may lead to possible future solutions.

3.1 Review of Previous Work

A link between Petone and Grenada has been planned for a number of years. This link appears to have been first identified in the 1975 Wellington Region Land Use and Transport Study (WRLUTS). As a consequence the Greater Wellington Land Use and Transport Strategic Review (GATS) identified this route as meriting further study in 1988. This led to the first detailed study of this link in 1991 described in Section 3.1.1.

3.1.1 SH1 Inland Route Review of Southern Section Report 2 – Petone to Grenada North Link 1991 (Works Consultancy Services)

Background

Works Consultancy Services was commissioned by Wellington Regional Council (WRC) to review the merits and comment on the scope of issues associated with a link road between Petone and Grenada. The review of a link between Petone and Grenada was ancillary to the primary purpose of this study which focused on reviewing links between Porirua and the Hutt Valley. There were two main link options considered in this study. One option, identified as the Belmont Variant, proposed a new link between Belmont, commencing from SH2 at the Kennedy Good Bridge, to Porirua. The other option, identified as the Takapu Road Option, proposed a new link between SH2 at Petone to Transmission Gully at Cannons Creek in Porirua.

Option Development

The proposed Petone to Grenada link was approximately 5.5km long with a maximum grade of 8%. The preliminary design was based on 70km/hr speed comprising two lanes plus crawling lanes. This report proposed connecting to SH2 via a new interchange at Petone including north facing ramps to SH2 north and indirect connections to SH2 south, via the Western Hutt Road and The Esplanade. An alternative connection to SH2, close to Horokiwi Road, was ruled out due to complex topography and the proximity of the harbour, rail and the coastal escarpment. The proposed link route traversed north from Petone through the Korokoro Valley then headed northwest to Grenada North while crossing Horokiwi Road near the summit. At Grenada, two connection options were considered. The first option was to connect directly to SH1 at a proposed mid-Grenada interchange. The second option was to connect to the southern section of the former Transmission Gully route (also known as the Takapu Valley Inland Route) at North Grenada. The first option was considered more feasible as it would not only provide direct access to SH1 but also direct connections to local links such as Middleton Road, Mark Avenue and Jamaica Drive. This link showing the two connection options considered at Grenada is shown in Figure 3-1.

Traffic and Economics

The study estimated 13,000 vehicles per day (vpd) on this route in year 2011 and the removal of approximately 10,000 vpd from both SH1 and SH2. The estimated cost of this route was approximately $30 million with a cost benefit ratio of 4.0 based on travel distance savings and vehicle operating costs.

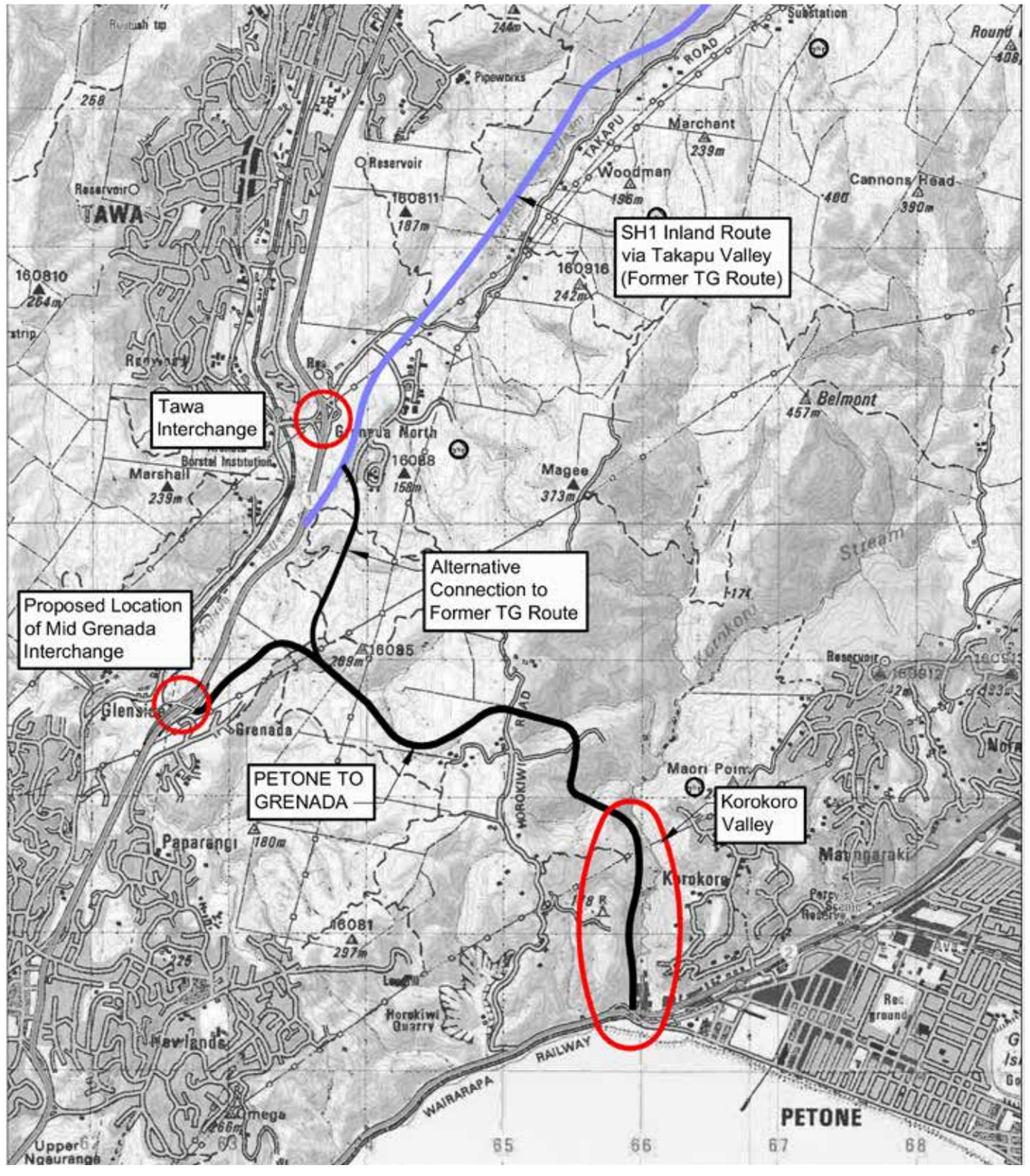


Figure 3-1: Proposed Petone to Grenada Link (1991)

Issues and Constraints

The issues and constraints identified in this study included:

i. Potentially significant ecological impact on Korokoro Valley;

ii. Significant visual impact of route at southern end from cuts in steep terrain and intrusion into areas of regenerating bush;

iii. Noise impacts on rural residential properties;

iv. Recreational impact within Korokoro Valley;

v. Iwi impacts on walking track in Korokoro Valley; and

vi. Property impacts from severance of large farm holdings.

Conclusions

The study concluded that this link road had potential to provide long term traffic relief to SH1 and SH2 and provide connectivity between Grenada and the Hutt Valley. The study indicated that the predicted future traffic volumes this link attracts may require a four lane highway (crawling lanes) rather than the two lanes (plus crawling lanes) proposed.

3.1.2 Petone-Grenada Link Study 1995 (BECA)

Background

This study was commissioned by Transit New Zealand in response to the study completed by Works Consultancy described in Section 3.1.1. Transit New Zealand defined the objectives of the link as follows:

i. To reduce severe congestion on SH1 south of Glenside and SH2 south of Petone;

ii. To provide a better linkage in the region and reduce travel times between the Hutt Valley and Porirua; and

iii. To provide an alternative route to Wellington from the Hutt Valley to mitigate the risk of an earthquake closing SH2 south of Petone.

Option Development

This study considered six options between Petone and Grenada. All options adopted a 12.7m formation width comprising two 3.5m wide lanes, shoulders and 2m wide grass verges. Climbing lanes were provided within this formation at the Petone and Grenada sections by shoulder running. The speed environment for all options was typically 75km/hr at Petone and 90km/hr at Grenada.

At Petone, five of the six options traversed north through the Korokoro Valley while four of these crossed the southern section of the Korokoro Stream with a bridge or culvert. Only one of the six options avoided the Korokoro Valley. This option commenced at the intersection of Horokiwi Road and SH2 and generally followed the alignment of Horokiwi Road.

All options shared the same alignment at the approach to SH1 at the Grenada Interchange. The major differences between the options were through the mid-section of each route at Horokiwi and the Lincolnshire Farm development.

Preferred Option

The preferred option commenced at Petone on the western side of the Korokoro Stream. From this location it crossed the stream and traversed north through the Korokoro Valley on its eastern side. Through the mid-section this option followed an alignment shaped by consultation with the Horokiwi Residents Association and Lincolnshire Farms Ltd together with an assessment of landscape effects. As a result the route passed through the south of the Horokiwi settlement to minimise impacts to the local communities in this area. The route also passed through the southern section of the Lincolnshire Farms development. The preferred option recommended in this study is shown in Figure 3-2.

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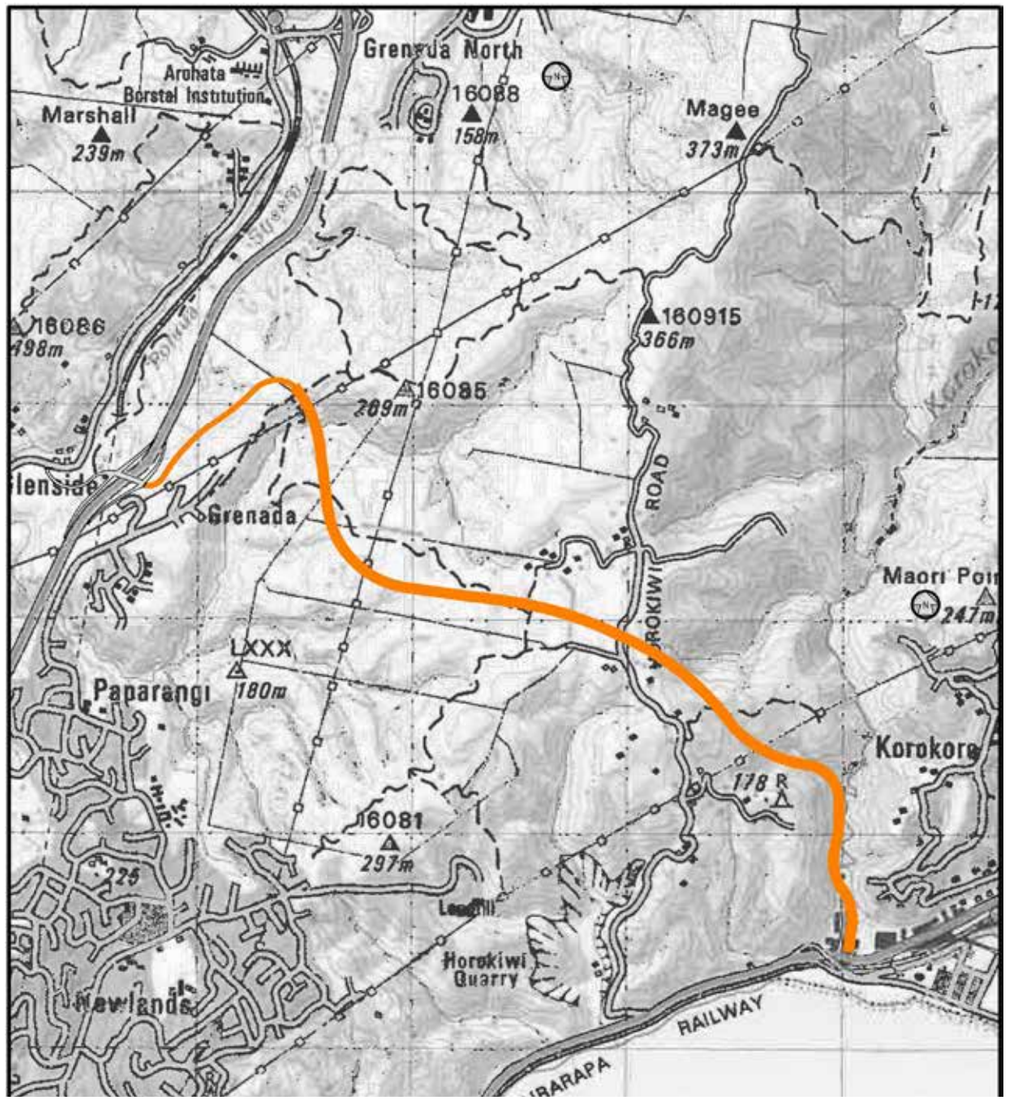


Figure 3-2: Proposed Petone to Grenada Link (1995)

At Petone complex interchanges were ruled out in favour of less intrusive options. Like the previous study by Works Consultancy Services, this report proposed a connection to SH2 via a new interchange at Petone which comprised north facing ramps to SH2 north and indirect connections to SH2 south, the Western Hutt Road and The Esplanade. This is shown in Figure 3-3.

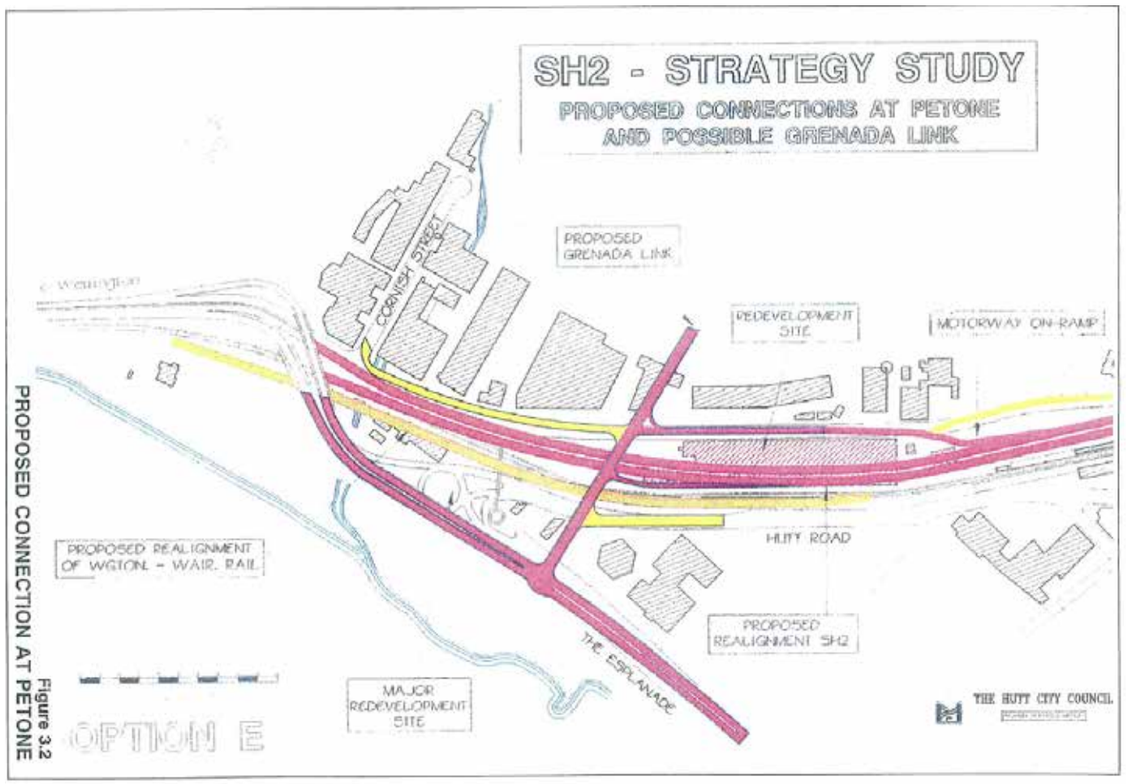


Figure 3-3: Interchange at Petone (1995)

The option which commenced at the intersection of Horokiwi Road and SH2 was ruled out due to costly and complex interchange requirements and because it does not provide a direct link between Petone and Grenada.

Traffic and Project Economics

The cost of the project was estimated at $31 million with a benefit to cost ratio between 1.0 and 1.9

Issues and Constraints

The issues and constraints identified in this study included:

i. Serious ecological impacts on the lower Korokoro Valley ecosystem;

ii. Visual impact of route through Korokoro Valley from Petone and houses on west side of Korokoro;

iii. Potential impacts on historic mill at the entrance to Belmont Regional Park and a Maori walking track both located in the lower Korokoro Valley;

iv. Moderate to serious noise impact on Horokiwi community residents and residents on Lincolnshire Road; and

v. GWRC policy unclear on how to accommodate this project within a regional park (Belmont Regional Park) given policy advocates a road linkage between the Hutt Valley and Porirua.

Conclusions

This study concluded that a link from Petone to Grenada was technically feasible and could be designed to avoid or minimise adverse impacts. However this study also concluded that the extremely challenging terrain at the Petone end of the alignment together with the interchange requirements at Petone incur significant costs which result in a benefit to cost ratio below the minimum level required for funding. As a result of the findings of this report no further actions were proposed by Transit at the time.

3.1.3 Hutt Valley - Porirua Link Initial Appraisal of Possible Links Working Paper for Steering Committee Consideration 1996 (Works Consultancy Services)

Background

This study was commissioned by Wellington Regional Council. The purpose of this study was to investigate the feasibility of a link route between the Hutt Valley and the Tawa–Porirua Basins that would meet travel demands and relieve congestion on SH1 and SH2. The study area was bounded by SH1, SH2 and SH58. The main objective of this study was to present an evaluation of a range of options to the Steering Committee to get direction on which schemes to investigate in more detail.

Option Development

Various options were considered with and without Transmission Gully. The main corridors examined were between:

i. SH2 Belmont (Kennedy Good Bridge) and Porirua/Whitby;

ii. SH2 Belmont (Kennedy Good Bridge) and SH58;

iii. SH2 Melling and Porirua/Whitby;

iv. SH2 Petone (Horokiwi Road) and Grenada

Preferred Option

The preferred route recommended in this working paper was between SH2 Belmont (Kennedy Good Bridge) and Porirua/Whitby and Transmission Gully if Transmission Gully was in place. Another option recommended was between SH2 Belmont (Kennedy Good Bridge) and James Cook Drive in Whitby with and without Transmission Gully.

The SH2 Petone (Horokiwi Road) to Grenada route was not recommended for further investigation in this working paper. Although this route provided the greatest traffic relief on SH1 and SH2 and lowest environmental impact compared to other options it was evaluated as offering low economic benefits and low ability to meet traffic objectives. This option was deemed to provide the least lateral displacement resulting in the least economic benefits compared to the other options. This working paper also noted that this option would likely require a major new interchange at Petone with intrusion into the harbour. The options considered with the preferred options highlighted are shown in Figure 3-4.

Conclusions

This working paper concluded that the routes recommended above should be investigated in more detail.

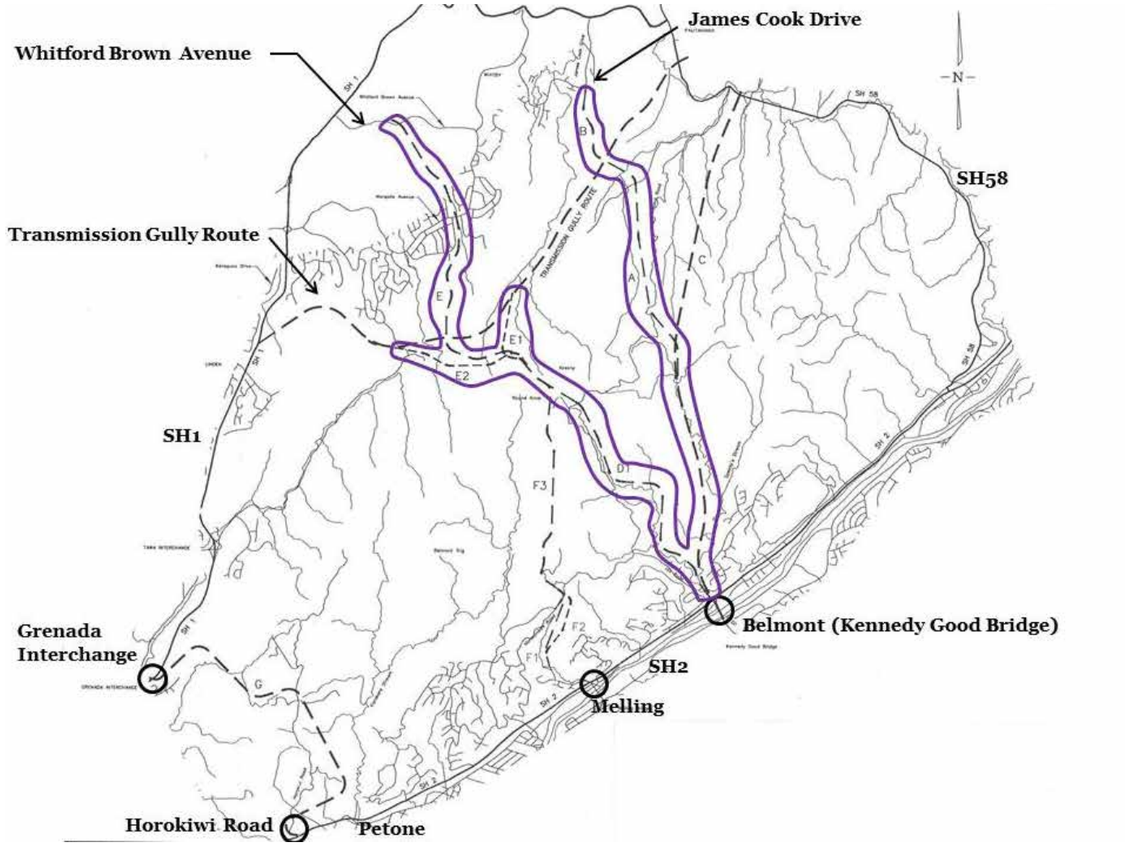


Figure 3-4: Options Considered in Hutt Valley Porirua Link Study

3.1.4 Hutt Valley – Porirua Road Link Study Feasibility Investigation Report 1997 (Opus)

Background

This study was commissioned by Wellington Regional Council and investigated the options recommended in the previous study in more detail. The Petone to Grenada link route was ruled out for further investigation in the previous study and is not discussed in this document.

Option Development

The preferred options, namely between SH2 Belmont (Kennedy Good Bridge) and Porirua and SH2 Belmont (Kennedy Good Bridge) and Whitby, were developed further and included calculating benefits based on traffic modelling and costs based on geometric design.

Preferred Options

The benefit and cost calculations indicated that the route between SH2 Belmont (Kennedy Good Bridge) and Porirua, identified as routes D and E in Figure 3-4 were technically feasible and potentially economically viable.

Conclusions

This study concluded that the preferred option should be investigated further to scheme plan stage.

3.1.5 Ngauranga Triangle Strategy Study – Detailed Technical Report 2009 (SKM)

Background

The purpose of this study, commissioned by NZTA, was to develop an integrated long-term transport strategy for the "triangle" between SH1 (Ngauranga Gorge to Tawa), SH2 (Ngauranga Gorge to Dowse) and a possible link between these two corridors. The study was also extended to consider links from the SH2 corridor to Gracefield and the surrounding areas. The study was a direct result of specific actions identified in the Hutt Corridor Plan (2003) and the Western Corridor Plan (2006) for NZTA, HCC and WCC to investigate projects within this study area.

Option Development

The option development process involved preparing a long list of options which addressed the strategic drivers and objectives developed for this study. The long list of options was then assessed against key performance indicators and functional goals and reviewed by the Study Governance Group comprising members from NZTA, WCC, HCC and GWRC. Following this review a short list of options was produced and further refined following a short list option assessment.

Preferred Options

A Petone to Grenada link road was identified as a significant project and chosen as a component of the preferred Ngauranga Triangle strategy. Other projects identified as components of the preferred strategy included the Cross Valley Link option and a "Beach to Bush" option which connects Belmont Regional Park on the western side of SH2 to Petone and the foreshore on the eastern side SH2. An implementation plan for the preferred strategy was then determined by reviewing the economic benefits, operational issues and statutory requirements of these projects.

Conclusions

A Petone to Grenada link road together with the Cross Valley Link option and a "Beach to Bush" option were proposed as part of a package of projects to go forward for implementation. These projects were subject to further stakeholder discussions and consideration by Council and the NZTA Board.

3.1.6 Ngauranga Triangle Strategy Study – Petone to Grenada Link Road PFR 2010 (SKM)

Background

This PFR proposed a 70km/hr four lane expressway linking SH1 just south of the Tawa Interchange to SH2 at Petone as part of a package of improvement projects identified in the Ngauranga Triangle Strategy Study. This link was proposed to assist in solving the following problems:

i. Poor regional connectivity;
ii. Congestion on SH1 and SH2 during peak times; and
iii. Travel times between Petone/Seaview and Grenada.

This PFR emphasised that the proposed link was part of a balanced strategy to solve these problems. Other projects and traffic demand management (TDM) proposals formed part of the balanced strategy including:

i. Cross Valley Link Road;

ii. Ramp metering at the southbound Petone on ramp to SH2;

iii. Ramp metering at the northbound Ngauranga on ramp to SH1;

iv. Middleton Road cycleway;

v. Ngauranga to Petone cycleway completion and upgrade; and

vi. Helston Road ramps.

Options Development

A number of options were initially considered against an evaluation framework developed by the Ngauranga Triangle Governance Group which comprised representatives from NZTA, WCC, HCC, GWRC and SKM. Options were developed further by this group over a number of workshops including inputs from the Horokiwi community. Integrating with and providing access to the Lincolnshire Farm development and Horokiwi was a key consideration in arriving at the preferred option.

Preferred Option

Figure 3-5 shows the preferred option links to SH1 south of Tawa Interchange with south facing ramps. From this location it travelled south for approximately 1.5km passing through the northern landfill before it traversed southeast through the Lincolnshire Farm development along the route proposed in the Lincolnshire Farm Structure Plan. At approximately 3km from its connection to SH1, a grade separated connection to the Lincolnshire Farm development is provided. The location of this connection aligned with one of the major intersections proposed in the Lincolnshire Farm Structure Plan (identified as Major Intersection 3 in this plan). Beyond this connection the preferred option travelled southeast traversing across the northern tip of the Horokiwi Quarry to SH2 at Petone. Between the Quarry and Petone the route avoids the Belmont Regional Park and Korokoro Stream by cutting through the coastal escarpment as it descends to a new grade separated, full interchange at Petone. This interchange connects to SH2 with direct links to The Esplanade and Hutt Road.

Alternative options were considered but ruled out in favour of the preferred option. Alternative options included:

i. Traversing through the Korokoro Valley which links to the Dowse Interchange ;

ii. Passing across the Maungaraki and Korokoro communities linking directly to the Dowse Interchange;

iii. Traversing through the Horokiwi Quarry linking to SH2; and

iv. Connecting to SH1 at the Grenada Interchange (Westchester Drive).

Traffic and Project Economics

Significant travel time and vehicle operating cost benefits were predicted south of Ngauranga Gorge on SH1, at MacKay's Crossing on SH1 and on SH2 north of SH58 based on a modelling and economic analysis. However, the analysis also predicted additional traffic into and out of Wellington in the AM and PM peaks induced by this new link resulting in dis-benefits. These traffic induced dis-benefits were also included in the economic analysis resulting in a predicted benefit to cost ratio of 1.1 for a project cost of approximately $250 million.

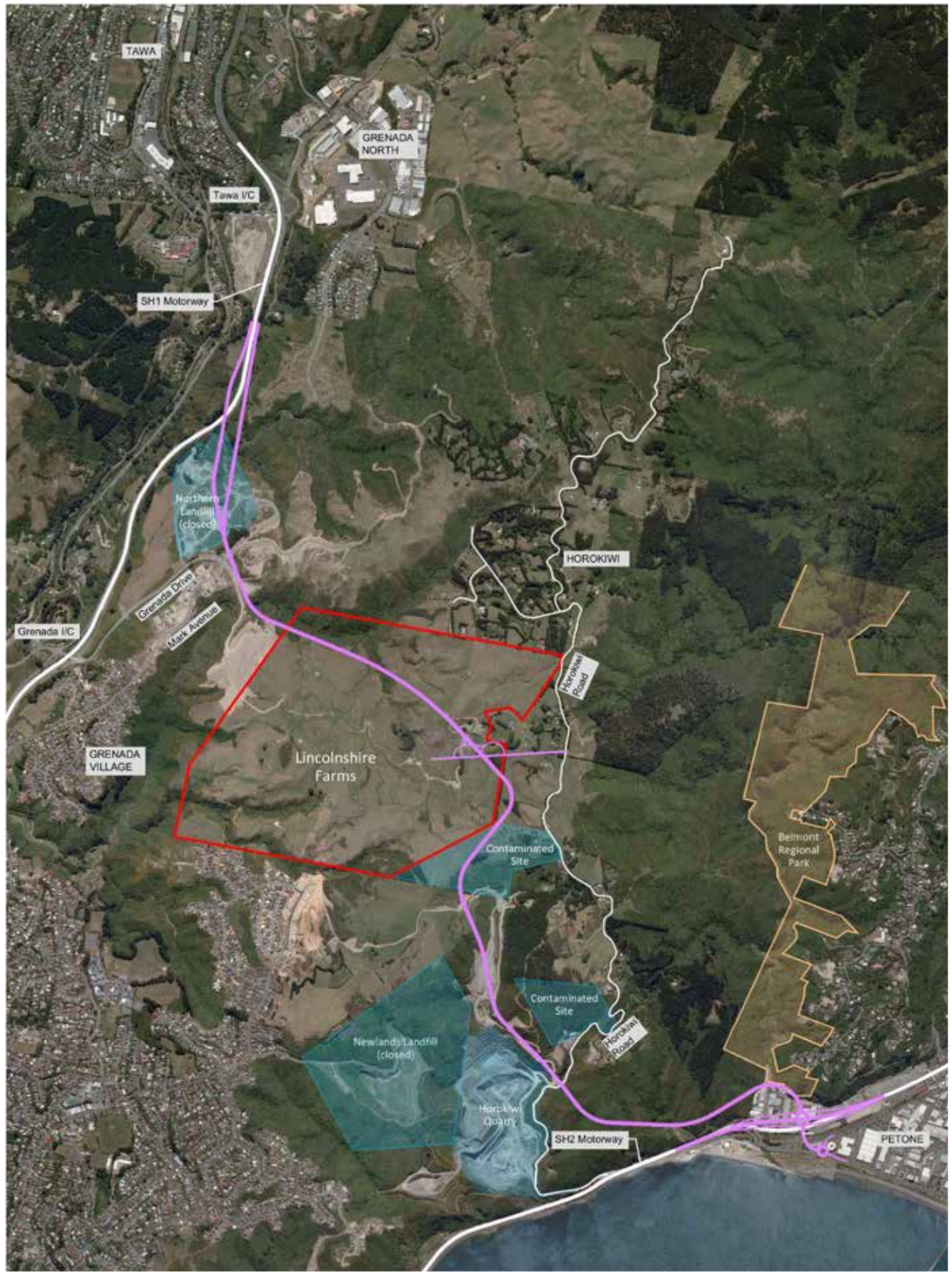


Figure 3-5: Proposed Petone to Grenada Link (2010)

Issues and Constraints

The issues and constraints identified in this PFR include:

i. Ecological issues associated with the southern section of the route where it passes through areas identified as Open Spaces B in the WCC District Plan and where it crosses the Horokiwi Stream. The Horokiwi Stream is identified as a Significant Natural Area in the District Plan;

ii. Geotechnical risks associated with the stability of the large cuts and road embankment fills required to form a link road in complex terrain;

iii. Ecological and consenting risks with earthworks through contaminated landfill sites;

iv. Geotechnical risks associated with road cuts and road embankment fills through landfills, particularly risks with differential settlement of road embankment fills;

v. Geometric constraints, particularly with respect to horizontal curvature and gradient, as a result of difficult terrain;

vi. Local community resistance particularly from the Horokiwi and Korokoro residents;

vii. Land acquisition issues as the route passes through various properties; and

viii. Visual impacts associated with changes in landform with areas of cut and fill and removal of vegetation.

Conclusions

This PFR concluded that this project was technically feasible, provided a benefit to cost ratio of 1.1 and rated medium under the criteria for strategic fit in accordance with NZTA's Planning Programming and Funding Manual therefore demonstrating that it aligns with NZTA's strategic objectives. On this basis SKM recommended that this PFR should proceed to the scoping and scheme assessment phase.

3.2 Summary

A link between Petone and Grenada has been planned for a number of years. All the previous studies have identified the need to relieve congestion on SH1 and SH2 north of Ngauranga Gorge and improve regional connectivity between the Hutt Valley and areas north of Grenada. Various alignments have been considered between Petone and Grenada including a link to the former Transmission Gully route in the vicinity of Tawa in the 1991 study. The early studies proposed alignments which traversed north from SH2 at Petone through the Korokoro Valley in Belmont Regional Park. The most recent study avoided this area by traversing west across the coastal escarpment from Petone at SH2. The most recent study also proposed a full interchange at Petone, south facing ramps at its connection to SH1 at Tawa and a connection midway to provide access to the Lincolnshire Farm Development and Horokiwi Road.

4

Existing Traffic Context

4 Existing Traffic Context

The study area is shown in Figure 4-1 and the key corridors and their posted speed limits have been identified as follows:

- State Highway 1 (SH1), 100km/hr, apart from the variable speed section (maximum 80km/hr) between Johnsonville and Ngauranga Gorge;
- State Highway 2 (SH2), 100 km/hr apart from the 80km/hr section between Petone off-ramp and Korokoro Crescent;
- State Highway 58 (SH58), posted speed limits varies from 50km/hr to 100km/hr; and
- The proposed Transmission Gully Link (TG), 100km/hr.

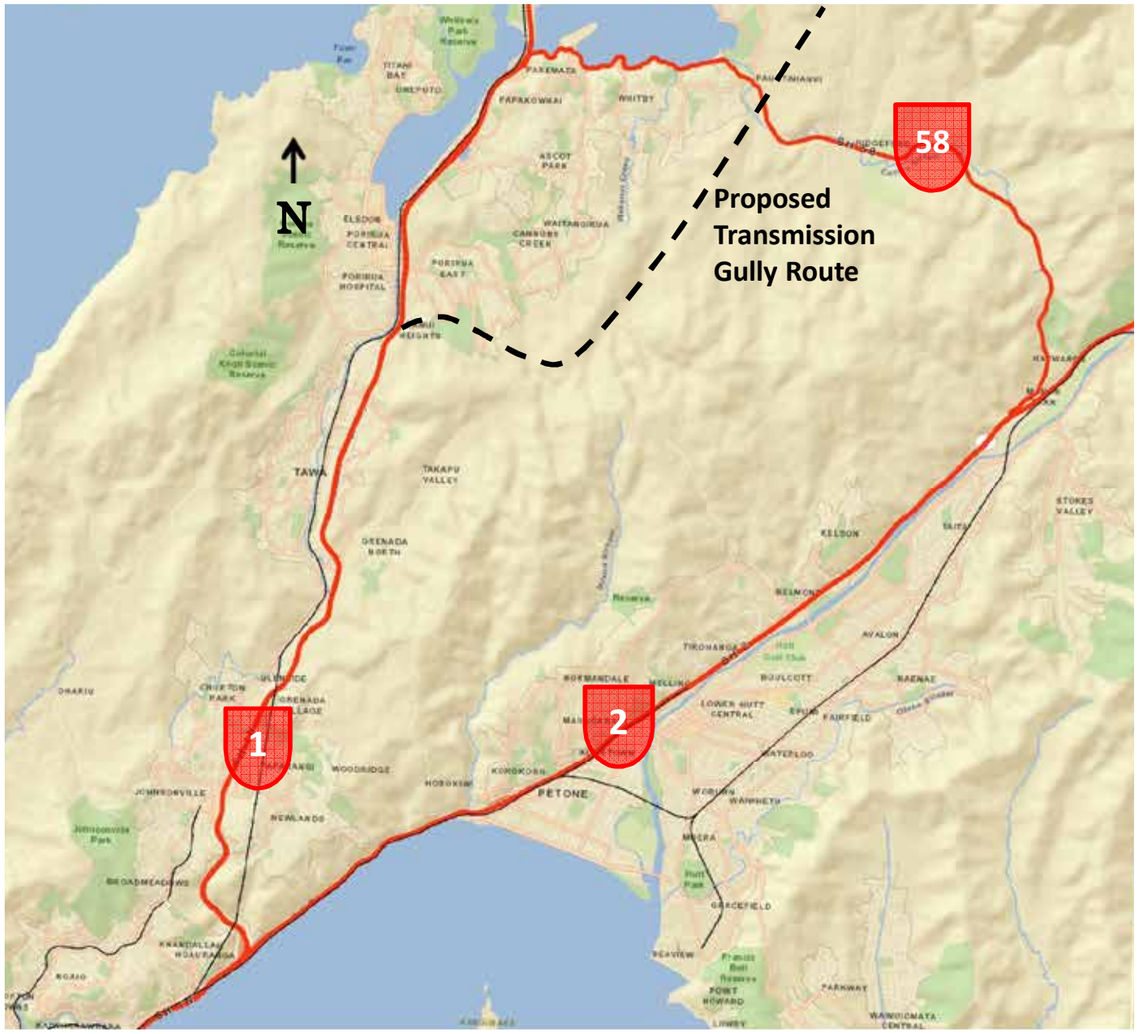


Figure 4-1: Petone to Grenada Study Area

4.1 Data Source

The following data has been sourced and analysed in this memo.

TMS – State Highway data are sourced from the NZTA Traffic Management System (TMS) at three locations as shown in Table 4-1. A week of data between 2nd July 2012 and 8th July 2012 has been analysed.

Table 4-1: TMS Reference Site Number

Location	Description	Site Reference
SH1	Between Grenada and Tawa	01N11061/01N21061
SH2	North of Ngauranga Interchange	00210978/00220978
SH58	West of SH2 near Haywards	05800000

WTSM

The Greater Wellington Regional council owned Wellington Transportation Strategic Model (WTSM) has been used for analysing local roads for the 2011 Base year. Table 4-2 records the WTSM model runs that have been adopted.

Table 4-2: WTSM Reference Run Number

Scenario	Peak	Run#
2011 Base	AM	99111
	IP	99112
	PM	99113

Travel Time

BECA is commissioned by NZTA to carry out journey times on the SH network twice a year. The March 2013 data has been obtained and the current project related travel time data have been analysed. The analysed routes are presented in Table 4-3.

Table 4-3: BECA Travel Time for Selected Routes

Travel time routes	Distance
Route 1 (SH1) SB- Johnsonville SBD off ramp to SH1 / SH2 merge;	4.2 km
Route 1 (SH1) NB - SH1 / SH2 diverge to Johnsonville NBD on ramp;	3.9 km
Route 2 (SH2) SB - Petone SBD on ramp to Ngauranga Gorge SBD off ramp;	4.3 km
Route 2 (SH2) NB - Ngauranga Gorge SBD off ramp to Petone SBD on ramp;	3.8 km
Route 3 (SH58) EB - Paremata RAB to SH2 intersection; and	15.1 km
Route 3 (SH58) WB - SH2 intersection to Paremata RAB.	15.1 km
Additional Route 2 (SH1/2) SB Mungavin Ave on ramp SBD to Petone SBD on ramp	17.6km
Additional Route 2 (SH1/2) NB Petone SBD on ramp to Mungavin Ave off ramp NBD	17.7km

4.2 Traffic Demand

The existing SH traffic demand has been sourced from the NZTA State Highway Traffic Data Booklet 2007-2011. The local street traffic data has been produced using WTSM predicted traffic demands. Figure 4-2 shows the 2011 Annual Average Daily Traffic on the key corridors within the study area.

The directional AADT is very balanced for each location, i.e. one-way AADT is equal to half of the two-way AADT displayed in Figure 4-2 .

There are very high traffic demands in the study area. The current 2011 traffic demands at key locations are discussed here:

- SH1 north of Tawa has a two-way AADT of 42,000 and the demand increases to 53,000 south of Grenada. Heavy Commercial Vehicles (HCVs) contribute to 5% of the demand;
- SH2 north of Petone has a two-way AADT of 39,000 and the demand increases to 66,000 north of Ngauranga Gorge. Due to the industrial nature of areas in Petone and Seaview,, the HCV contribution raises from 5% to 7% between Petone and the city;
- SH58 west of Haywards has a two-way AADT of 14,000 with a HCV contribution of 5%; and
- The Esplanade in Petone has two-way AADT of 21,000 with a HCV contribution of 7%.

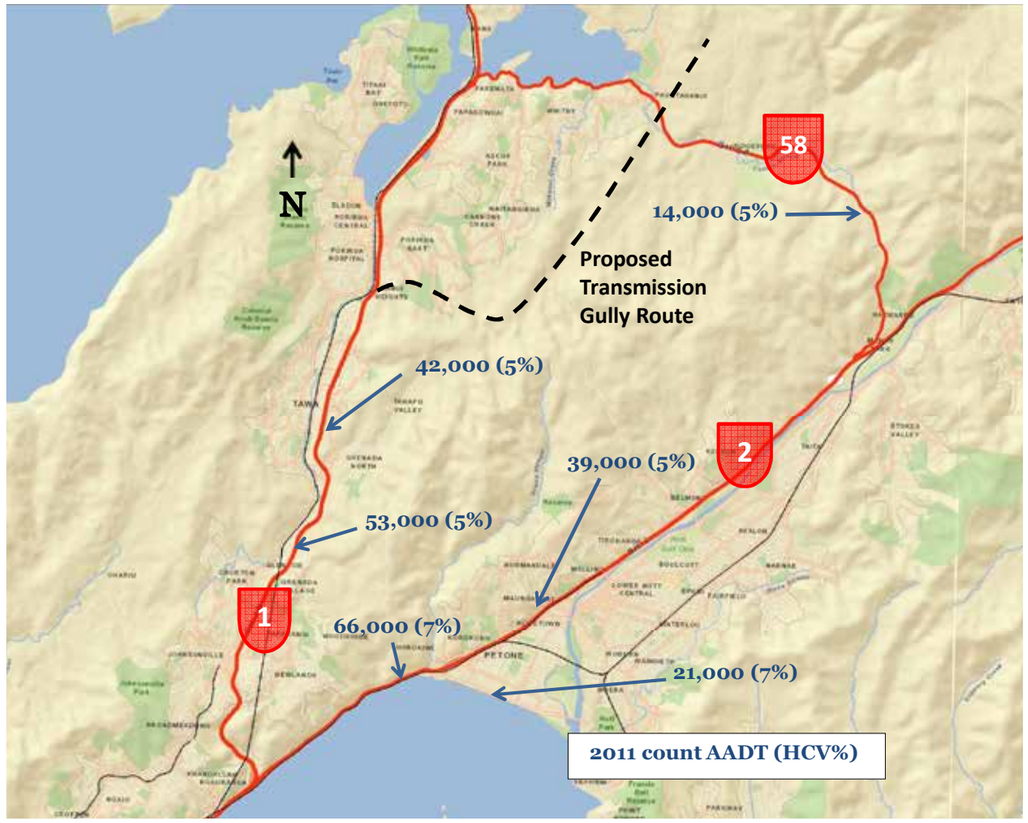


Figure 4-2: P2G Study Area Traffic Demand, Two-way AADT

4.3 Flow Profile

TMS state highway data for 2012 has been analysed. Figure 4-3, Figure 4-4 and Figure 4-5 illustrate the hourly traffic flow profiles through a typical weekday on SH1, SH2 and SH58, respectively. Vehicles have been separated into two user classes (light and HCV) for the analysis.

A clear tidal flow traffic pattern can be seen in the study area especially for SH1 and SH2. The dominant southbound movement in the morning peak is towards Wellington City, while the dominant northbound movement in the afternoon peak is towards Hutt Valley and Porirua. SH58 does not have clear tidal peaks when compared with SH1 and SH2, however it has more eastbound traffic demand in the AM peak and more westbound demand in the PM peak suggesting that greater employment opportunities exist in the Hutt Valley.

The three typical peak hours of the study area have been identified as follows:

- AM peak 07:00 to 08:00;
- Inter peak 12:00 to 13:00; and
- PM peak 17:00 to 18:00.

The peak hour flows are over 3200 veh/hr[1] in each direction on both SH1 and SH2; which indicates both of the state highways (which have 2 lanes each direction) are reaching capacity during peak periods. SH58 has a peak hour flow of 760 veh/hr, which is indicates that it has spare capacity remaining for future demand.

HCV traffic flows do not display clear peaks; the HCV traffic demands are very steady throughout business hours of operation on each of the state highways.

The weekend flow profile for all three highways has a peak from 12pm to 5pm which is higher than the weekday inter-peak period flows. SH58 has the highest relative weekend peak flow profile compared with weekday flows.

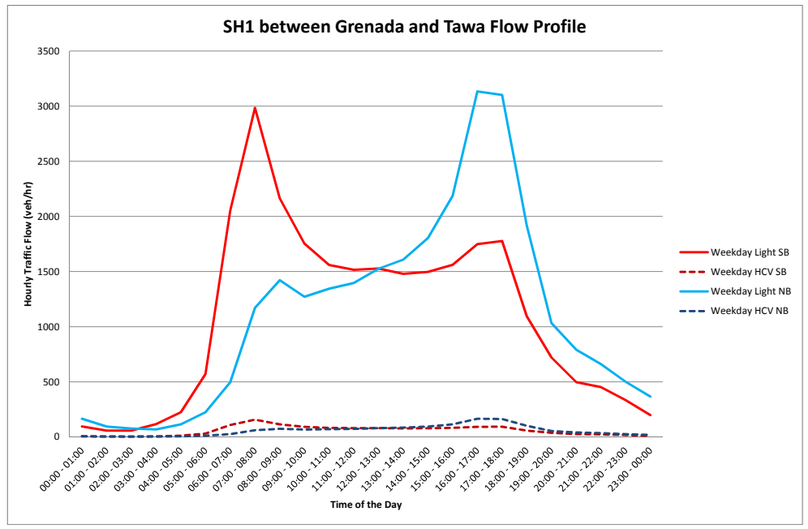


Figure 4-3: SH1 Traffic Flow Profile

1 When considering the 15 minute peak, flows are as high as 4000 vehicles per hour

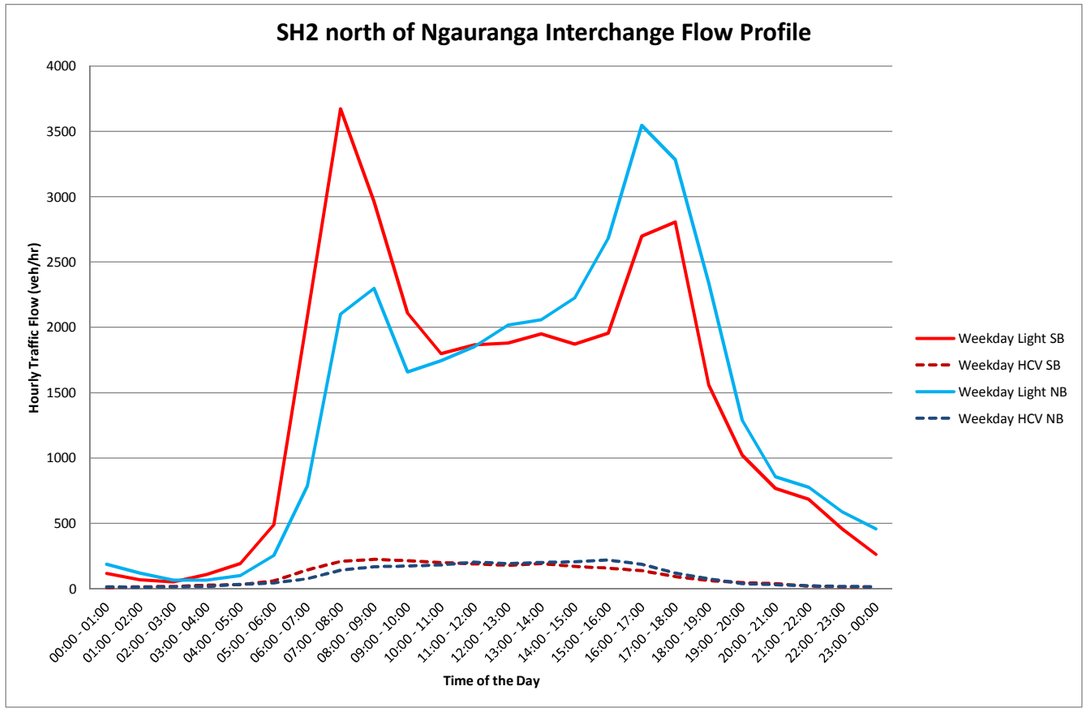


Figure 4-4: SH2 Traffic Flow Profile

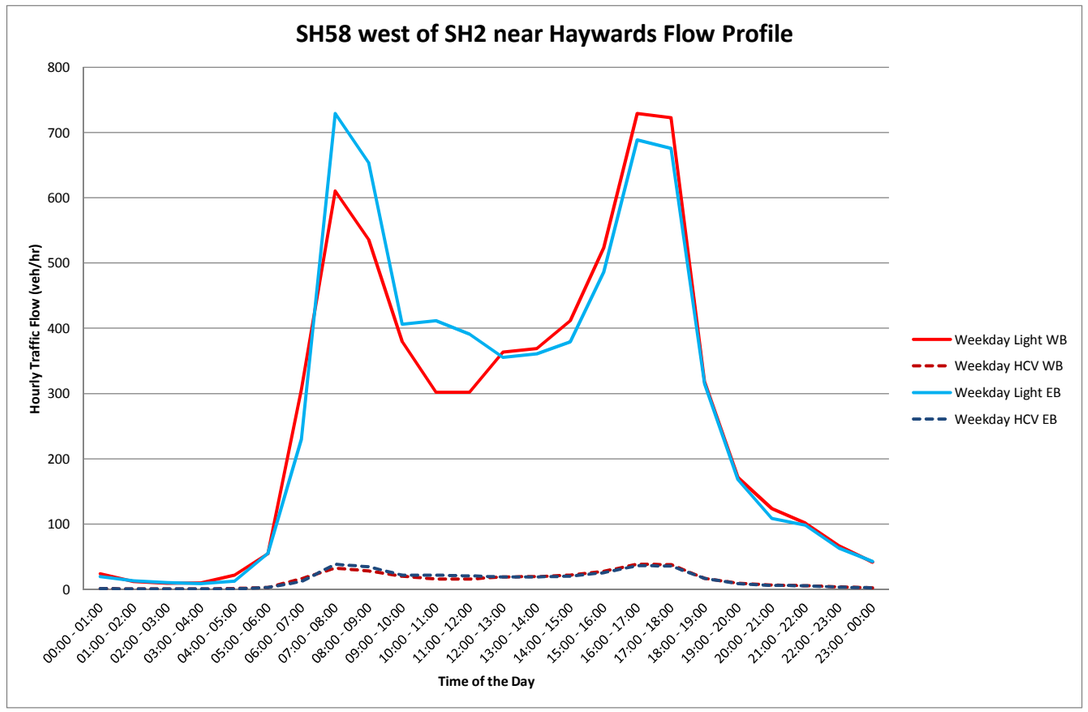


Figure 4-5: SH58 Traffic Flow Profile

4.4 Traffic Distribution

Table 4-4 shows the origins and destinations for journeys to work on census day in 2006. It includes all modes of travel (i.e. car, bus, train, bike and pedestrians).

In all of the districts except Porirua, most people lived and worked in the same district, indicated on the matrix by the diagonal red cells. For people that worked outside the district, Wellington was the most popular destination. Trips between Hutt Valley and Porirua / Kapiti Coast (highlighted in green) have been identified as potential users of the proposed Petone to Grenada Link Road.

Table 4-4: 2006 Census – Travel Origins to Destinations (Origin on the leftmost column)

Origin	Kāpiti Coast District	Porirua City	Wellington City	Upper Hutt City	Lower Hutt City	Sum
Kāpiti Coast District	10488	882	3768	174	756	**16068**
Porirua City	255	7779	8193	303	1449	**17979**
Wellington City	279	2619	79149	633	5259	**87939**
Upper Hutt City	45	399	3993	7317	4050	**15804**
Lower Hutt City	111	684	13521	1482	24597	**40395**
Sum	**11178**	**12363**	**108624**	**9909**	**36111**	**178185**

4.5 Travel Time

Travel time data obtained from the NZTA state highway monitoring survey has been analysed. The average travel time and speeds on each section are estimated in Table 4-5. The travel time routes have been provided in Figure 4-6.

The survey shows both SH1 and SH2 experience significant congestion southbound during the morning peak and northbound during the afternoon peak when compared against the interpeak. It is worth noting that SH2 southbound has significant delays during both AM and PM peaks.

On both SH1 and SH2, the traffic condition during the AM peak is considered to be worse than the PM peak. This is understood to be due to possible peak spreading during the PM peak, as the PM is less 'peaky' than the AM peak, and for the fact that the departure from Wellington City is less constrained than the approach.

Traffic conditions on SH58 experience small changes during peak periods; however they are generally acceptable for the current situation.

Table 4-5: Surveyed Travel time and Speed in Study Area

Travel Time in Seconds (Average Speed in km/hr)	AM	IP	PM
Route 1 (SH1) SB	593	183	187
	(25)	(83)	(81)
Route 1 (SH1) NB	175	180	204
	(80)	(78)	(69)
Route 2 (SH2) SB	354	166	205
	(44)	(93)	(76)
Route 2 (SH2) NB	149	172	194
	(92)	(80)	(71)
Route 3 (SH58) EB	876	881	872
	(62)	(62)	(62)
Route 3 (SH58) WB	861	875	795
	(63)	(62)	(68)
Additional Route 2 (SH1/2) SB	1163	712	924
	(54)	(89)	(69)
Additional Route 2 (SH1/2) NB	924	942	741
	(69)	(68)	(86)

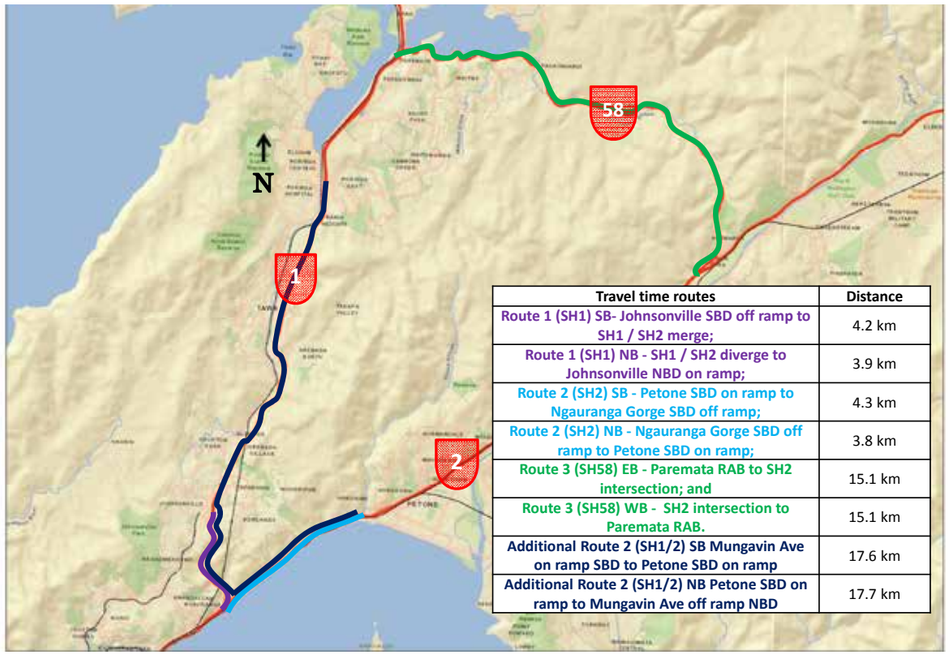


Figure 4-6: Travel Time Routes and Distances from Surveys

The travel time between the origin / destination pair of Petone and Porirua has been analysed using the 2011 Base WTSM. Travel time between Petone and Porirua for vehicles using Ngauranga Gorge and those using SH58 has been analysed and compared in Table 4-6. The travel time routes have been provided in Figure 4-7.

Travel between Petone and Porirua via Ngauranga Gorge is always faster than via SH58 due to its shorter distance. However, travel on SH58 has much less travel time variability than the Ngauranga route. The average travel speeds from Petone to Porirua during the AM peak and Porirua to Petone during the PM peak are approximately 70km/hr via the Ngauranga route.

Table 4-6: WTSM Predicted 2011 Travel Ttime between Petone and Porirua

Travel Time in Seconds (Average Speed in km/hr)	AM	IP	PM
Petone to Porirua via Ngauranga	1481 (50)	955 (78)	1027 (73)
Petone to Porirua via SH58	1987 (59)	1797 (66)	1875 (63)
Porirua to Petone via Ngauranga	978 (74)	889 (82)	1484 (49)
Porirua to Petone via SH58	1883 (62)	1854 (63)	2189 (54)

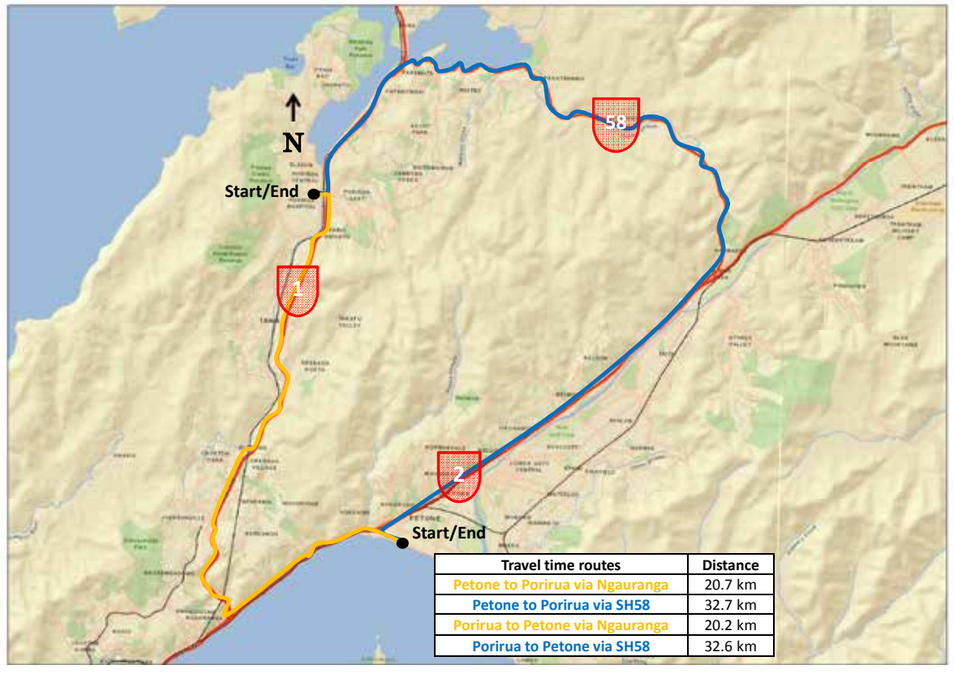


Figure 4-7: Travel Time Routes and Distances from 2011 WTSM

5

Crash Data

5 Crash Data

The crash history for Petone to Grenada has been obtained from NZTA's Crash Analysis System (CAS) for the five year period between 2008 and 2012, inclusive. This system catalogues all fatal, serious and minor injury crashes. However not all non-injury crashes are recorded as there is no legal requirement to report them to the police therefore the number of crashes could be understated.

5.1 Study Area

The collective risk is defined by the number of fatal and serious injury crashes per km, and the personal risk is defined by the number of fatal and serious injury crashes per 100 million vehicle-km. Both of the risk types have been extracted from the KiwiRAP risk analysis for 2012 as following:

- SH1 from Wellington to Paremata Roundabout has Medium-high collective risk but low personal risk;
- SH2 from Wellington to Upper Hutt has Medium-high collective risk but low personal risk; and
- SH58 from Porirua to SH2 has High collective risk (third highest in the region) but low-medium personal risk.

For this assessment, the study area is from SH1 south of Ngauranga Gorge to SH58 then SH2 near Manor Park and back around to Ngauranga Gorge. All ramps of the state highways have also been included. Some local roads in Johnsonville and the Lower Hutt have also been encompassed in the analysis to identify crash rates on these key routes which could be effected by redistribution of traffic following the implementation of the proposed P2G link. For simplicity the sites have been divided into the following sections (refer to Figure 5-1):

1. SH1 between the four lane section south of Ngauranga Interchange (incl.) and the slip lane to SH58 north of Porirua (incl.);
2. SH2 between Ngauranga Interchange and the signalised intersection with SH58 (incl.);
3. SH58 between SH1 and SH2;
4. Johnsonville Road between Fraser Avenue (incl.) and Middleton Road roundabout (incl.);
5. The Esplanade/Waione Street/Seaview Road between Barnes Street (excl.) and SH2 Petone Interchange (excl.);
6. Hutt Road/Railway Avenue/Woburn Road/Ludlam Crescent/Randwick Road between The Esplanade and Seaview Road;
7. Whites Line East/Cambridge Terrace between Randwick Road and Naenae Road (excl.).

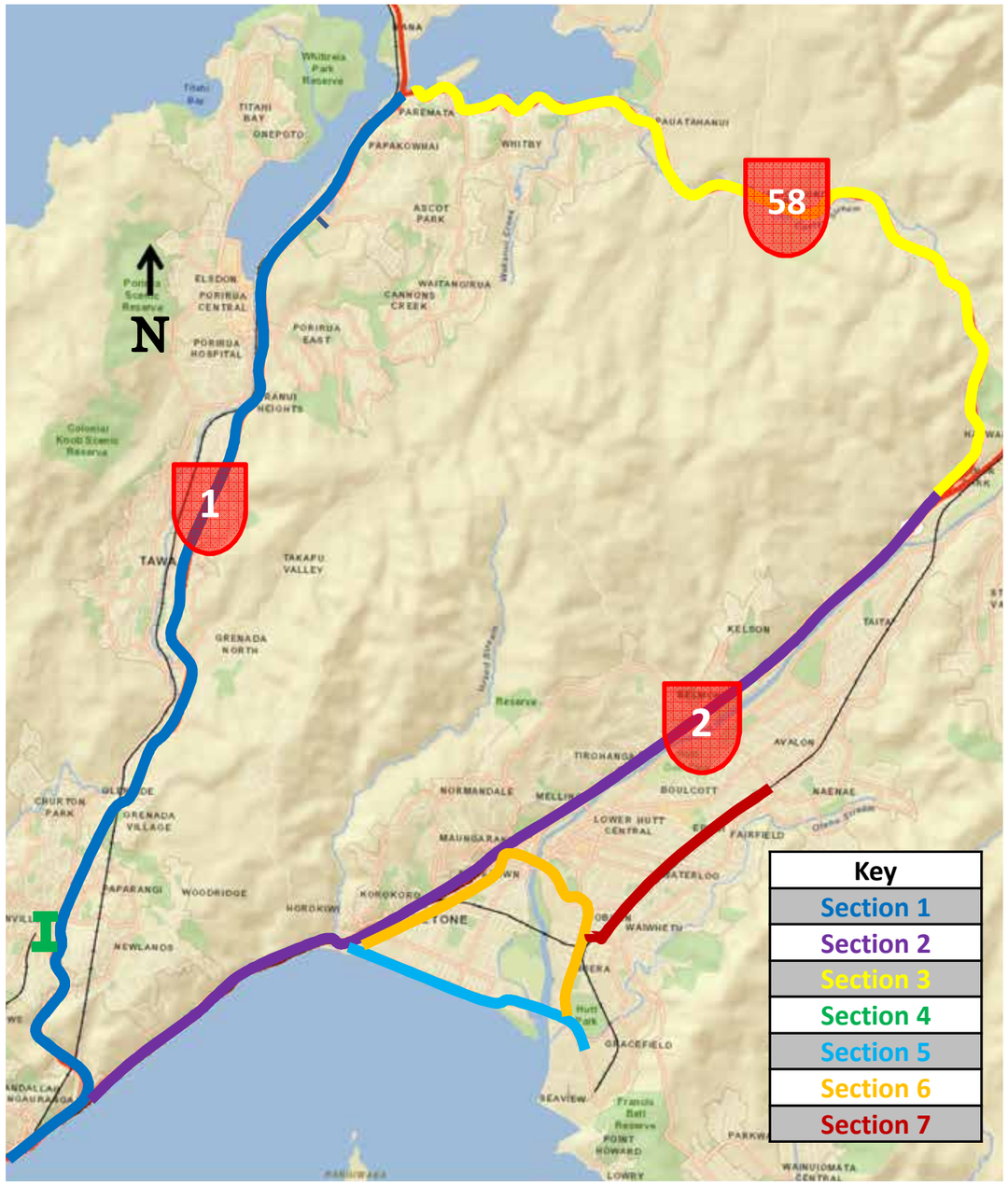


Figure 5-1: Map Identifying Crash Data Sections

5.2 Total Crashes

A total of 2,078 crashes have occurred on the identified roads in the last five years. Table 5-1 presents the crashes based on severity and location within the sections described in Section 5.1.

Table 5-1: Crash Severity by Section

Section	Length (km)	Fatal	Serious	Minor	Non-Injury	Total
1	46.9	2	25	165	705	897
2	35.4	1	30	193	596	820
3	30.1	2	23	80	224	329
4	0.7	0	2	35	88	125
5	5.5	1	2	49	162	214
6	6.3	0	5	48	253	306
7	3.1	0	3	13	50	66
Total	**128.7**	**6**	**90**	**583**	**2078**	**2757**

As most of the study area is comprised of State Highways (Sections 1 to 3) over 70 percent of the crashes identified occurred in these three sections. There have been six fatal crashes in the five year analysis period, five of which occurred on State Highways. Twenty five percent of crashes recorded resulted in death or injury. Relative to its length and volume, SH58 (Section 3) has a larger proportion of fatal and serious crashes than the other State Highways.

5.3 Considerations for Option Development

Our analysis of the crash history of the project area identified the following trends that should be considered when developing options:

- Since 2008, the total number of crashes per year has been decreasing. This is due to a decrease in minor injury and non-injury crashes, as serious injury and fatal crashes have stayed relatively consistent. Between 2008 and 2012, total crashes has decreased by approximately 35 percent;
- The most prevalent vehicle type involved in crashes in the project area is Car/Taxi (71 percent). The next most common are SUV/Van (18 percent) and Truck (6 percent);
- Crashes involving pedestrians and cyclists make up two percent of all crashes;
- Crashes involving motorcycles, mopeds and cyclists have a higher proportion of serious injury or fatality, which is expected considering these modes are higher risk and the high speeds of many of the roads in the study area;
- Fatal crashes are likely to result in more than one fatality;
- Rear end / obstruction was the most common 'movement' resulting in crashes (44 percent). Loss of control/ head-on and overtaking were the next most common movements with 25 percent and 16 percent, respectively;
- The most common object struck is a guard rail, accounting for 35 percent of struck object crashes. This is followed by "cliff bank" and "post or pole" which account for 14 percent and 10 percent of struck object crashes, respectively. None of the crashes involving striking a guard rail resulted in fatality;
- The majority of crashes occur under light conditions (76 percent). 67 percent of crashes also occur during dry conditions. This information does not seem to indicate specific environmental factors are having a significant effect on crash patterns; and
- The number of crashes on a weekend day is approximately 75% of a weekday which reflects the reduced traffic volumes during the weekend.

6

Community and Social Considerations

6 Community and Social Considerations

6.1 Social and Community Infrastructure

The project area is comprised of predominantly rural and conservation land uses with little pockets of residential and industrial uses on the fringes. The project area is large and currently includes the residential areas east of SH1 in Porirua and all of Newlands, Woodridge, Paparangi and Grenada.

The following are excluded from this scoping exercise:

a. Detailed listing of social and community services in the suburbs east of SH1 in Porirua.

b. Detailed listing of social and community services in Newlands, Woodridge and Paparangi.

Social and community services include schools, community halls, churches and parks. An assessment of the impact on these services has not been included as it is viewed that currently any of the roading options do not directly impact on these services or areas. The impacts on residents and housing are also briefly touched on.

The key community infrastructure or community uses associated with the project area are discussed in the following sections.

6.1.1 The Petone Foreshore

The Petone foreshore area is adjacent to the Petone Interchange and has important amenity and recreational value. The foreshore area is currently an important point of access to the harbour.



Figure 6-1: Petone Foreshore, Honiana Te Puni Reserve and the entrance to Petone and Grenada Link Road

Figure 6-2: Korokoro Industrial Area

6.1.2 Korokoro Industrial Area

A small pocket of industrial land exists immediately north of SH2 and adjacent to the Belmont Regional Park and is currently used by a number of businesses. This site provides employment opportunities for the Hutt Valley and the Wellington Region. The area is highly accessible from the road and rail network. An enforced relocation of these business occupancies would have socio economic implications for the landowners, business owners, and those employed at the various premises.

6.1.3 Belmont Regional Park

Belmont Regional Park has cultural, ecological, heritage, landscape and recreational values of regional and national significance. Adjacent to the project area the park is accessible from SH2 via Cornish Street, along the Korokoro Stream Walkway. The Korokoro Stream is traditionally a source of food for tangata whenua. Within the Regional Park is the historic Korokoro Dam, World War II ammunition stores and the original coach road from Wellington. Recreational values include a variety of trails used by walkers, runners, cyclists and horse riders, as well as picnic spaces and camping facilities.6.1.4 Horokiwi Quarry

Horokiwi Quarry is located south of the project area. It provides hard aggregate for roading and construction and has existed as an economic activity for the Wellington area since the 1960's. Any impacts on the quarry can represent socio economic impacts on the quarry employees and contractors who utilise material from the site.


Figure 6-3: Belmont Regional Park

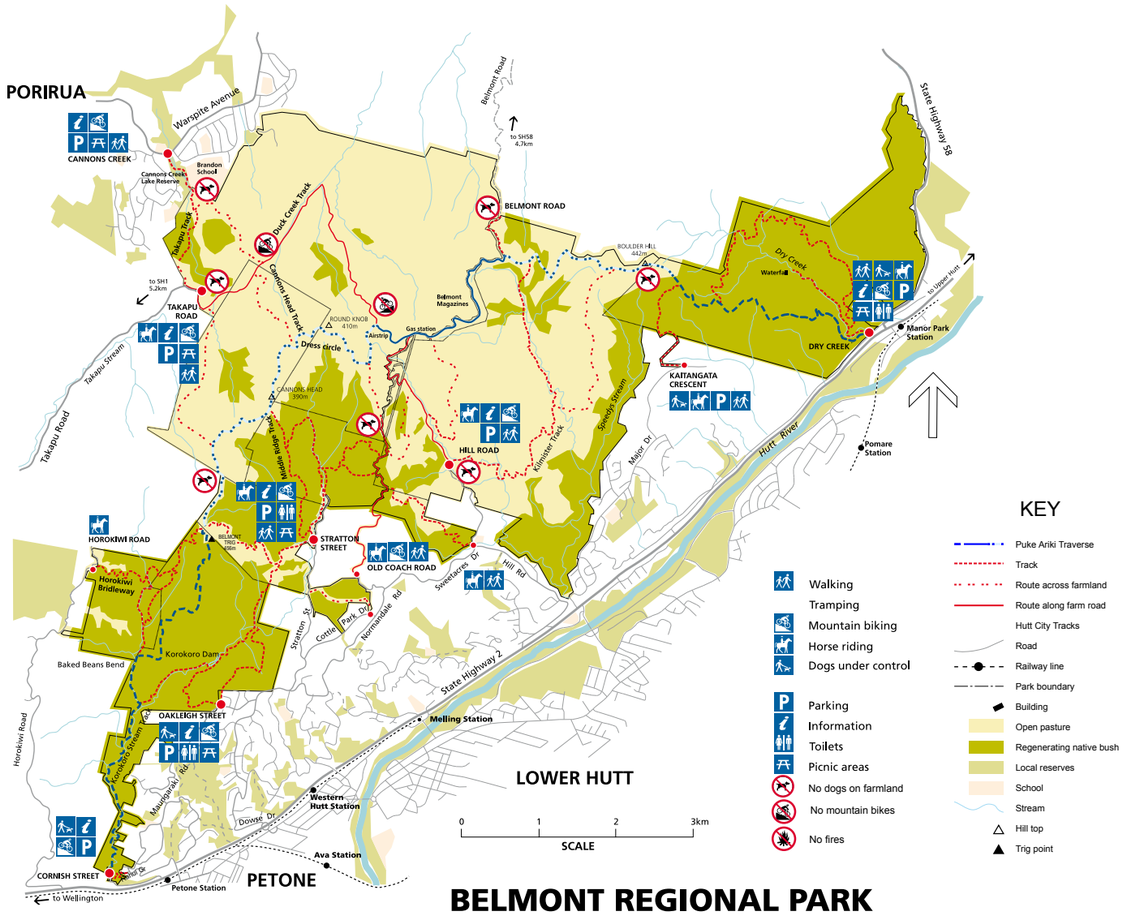


Figure 6-4: Map Indicating the Extent of the Belmont Regional Park (image sourced from Greater Wellington Regional Council website)

6.1.5 Horokiwi Rural Residential Area

To the west of Belmont Regional Park is the Horokiwi community that consists of lifestyle blocks and a small reserve. Horokiwi lifestyle block land uses typically include small scale farming and equestrian activities. The Horokiwi community is within commute driving proximity to the Wellington CBD and represents a component of lifestyle variety and housing choice that is beneficial to the quality of living for Wellington and the Hutt Valley.

The Horokiwi Reserve is used by the community for horse riding and dog walking. The Reserve is a community initiative with indigenous plants being established at a rate of approximately 1000 individual trees per year.

The Horokiwi area has a strong sense of community and the new road could impact on this. Connectivity will be an important consideration as any potential route will sever the community.

Figure 6-5: Horokiwi Lifestyle Block Area

6.1.6 Horokiwi Road

Horokiwi road serves the Horokiwi Quarry and Horokiwi community. This road provides direct access to the northbound section of SH2 just south of Petone. A P2G route will intersect with Horokiwi Road at some point north of Horokiwi Quarry. Any option will need to consider either maintaining Horokiwi Road (by a bridge for instance) or providing connections to the P2G Link Road.

6.1.7 Lincolnshire Farm Residential Growth Area

West of Horokiwi, the P2G Link Road may cross a planned residential expansion area (within the Wellington City Council local government boundary) known as the Lincolnshire Farm area. WCC has undergone a recent District Plan change, with support from land owners, to implement a Structure Plan for future development of the Lincolnshire Farm area. This is considered to be significant community infrastructure as it has been through a community consultation and agreement process, of which NZTA has been part of. The project area / alignment would have a major impact as to how future development within this growth area will proceed, although as discussed in section 2.4.3 a four lane link road is incorporated into the structure plan for Lincolnshire Farm

6.1.8 Grenada and Grenada North

On the western edge of the project area there are mainly residential areas with limited community services such as developed sports fields (Grenada North Park and Grenada Ground) that might be affected by the project. At Tawa there is also an industrial area that provides job opportunities and represents socio economic health for the area. Any option should try and limit any impacts on this industrial area.

6.1.9 North of the Tawa Interchange

North of Tawa interchange there is mainly effects on residents of both Tawa and Takapu Valley. The effected Tawa community is situated on both sides of SH1 and the effected residents of the Takapu Valley are situated east of Takapu Road.

The following issues are associated with each community;

Tawa Residents next to SH1:

- Increased noise.
- Further loss of amenity.
- Loss of houses.
- Due to densities the number of people affected in this community could be greater than the number of people affected in the more rural Takapu Valley.

Takapu Valley Residents

- New noise corridor.
- Loss of amenity.
- Loss of houses.
- Impact of economic viability of farms.

Any options should try to limit effects on these residential/rural residential areas.

6.2 Regional Social and Cultural Consideration

From a regional perspective the following aspects are very important:

- Improved resilience for all communities in Wellington;
- Belmont Regional Park and its associated recreational and quality of life values; and
- The possible socio economic improvements that can be associated with the construction of this road.

6.3 Early Iwi Engagement

Consultation with iwi has been initiated at an early stage to ensure that iwi are fully aware of the project and that the project can consider their concerns at the earliest point possible. The first meeting was held on the 16th of July 2013.

Iwi was represented by Hone Mahara Okeroa (Port Nicholson Settlement Block Trust), Morrie Love (Tenths Trust) and Richard TeOne (Tenths Trust). The purpose of the meeting was to:

- Introduce the team;
- Inform them on the progress of the project;
- Understand how they would like to be consulted; and
- Understand their areas of concern about the project.

The main points that came out of the meeting were:

a. Their preference would be for an option that avoids the Belmont Regional Park and the Korokoro Stream as they are used for food collection. The Korokoro Stream is one of the few remaining catchments that are protected and provides the following values:
    i. Recreation;
    ii. Flora and fauna; and
    iii. Source of food.
b. Options may fall under the Port Nicholson Settlement Block Trust area.
c. The Harbour is important to them especially the Petone foreshore area that is situated where the new road will link into SH2. This land has good commercial potential in the long run.
d. The coastal escarpment is not that important as it has already been modified.
e. They are very interested in getting a pedestrian connection between the coast and the Belmont Regional Park.

It was agreed that the project team will provide regular updates. The project team are also compiling a framework for future iwi engagement.

6.4 Other Early Engagement

6.4.1 Horokiwi Quarries Ltd

An engagement meeting with Horokiwi Quarries Ltd (HQL) was held on the 20th of June 2013. Discussions at the meeting were around:

- Expansion plans for Horokiwi Quarry; and
- Contaminated land in the area.

HQL indicated that they:

- Prefer a route away from the quarry;
- Are not interested in any surplus fill; and
- Would like access to the P2G Link Road as the current access to SH2 is very difficult.

Figure 6-6: Horokiwi Quarry

6.4.2 Lincolnshire Farm

As mentioned in Section 6.1.6, the Lincolnshire Farm residential area falls within the project area and has been rezoned for development (mainly residential). A meeting was held with the landowner, Rodney Callendar, on the 20th of June 2013.

The meeting informed the project team as follows:

- The Lincolnshire Farm residential development is not dependent on the P2G road and has access from the south in Woodridge and from Grenada Drive;
- They will be interested in fill for low areas within the development; and
- They do not have plans to develop this area in the next 5 years but have some consented sites nearby, particularly to the north which could potentially clash with the project alignment.

6.5 Considerations for Option Development

When developing / finalising options, the following factors have been identified as being important from a social impact perspective:

- Maintain or enhance (where possible) access to all community / social facilities, industries / jobs and residential areas;
- From a regional perspective it is critical to improve resilience; and
- Road safety for all users (including cyclists and pedestrians) is very important.
- Reduce impacts on existing residential areas and loss of houses.

The P2G project can supplement the existing social and cultural facilities and values by improving connectivity within Wellington and providing complimentary activities.

7

Environment / Ecology

7 Environment / Ecology

7.1 Introduction

This section of the report describes the ecology of the Study Area and sets out the issues, constraints, risks and mitigation opportunities in relation to the potential impacts on the ecological values in and around the Study Area. It is based on desktop review of available information of the ecology of the wider Wellington Area.

7.2 Terrestrial Habitat

The landscape within the Study Area comprises a series of hills and valleys, the terrain being steep in many places. It is a landscape that has been substantially impacted by human activity. The original forest has been cleared for a considerable period of time and much of the Study Area is in pasture. Sub-division is encroaching into the Study Area from the west and there is also industrial activity particularly at the southern extremity of the Study Area. The Horokiwi Quarry has also had a substantial impact on the landscape in the southern part of the Study Area and there are several landfill / contaminated sites in that location.

The hills in the eastern part of the Study Area are less intensively managed. These areas are covered in exotic scrub (gorse and broom dominant) with varying amounts of regenerating native trees and shrubs forming part of the cover. Part of this area of vegetation, along the Korokoro Stream Valley, is located within the Belmont Regional Park. The Belmont Regional Park (encompassing 3500 hectares) contains a number of forest remnants as well as areas of regenerating bush. The park contains a number of significant stream catchments including the Korokoro Stream, shown in Figure 7-1. It is not just a constraint on account of its ecological value but also recreational and amenity value. The Korokoro Stream is listed in Table 15 of the Regional Policy Statement as a stream with significant amenity and recreational values, specifically citing walking, running and mountain biking.

Within the eastern part of the Study Area (but outside the Regional Park) there are also pine plantations. These also occur elsewhere within the Study Area. As well as the large blocks of mixed exotic/native scrub and pine plantation, there are small stands of mainly exotic trees and shrubs within the landscape that may be affected by the project.

Birds species present within the Study Area are likely to be mainly common introduced or native species typical of modified landscapes. Although, it is possible that “At Risk” or “Threatened” species may be present, at least periodically. However, based on this preliminary assessment of the habitats affected it is unlikely that “At Risk” or “Threatened” species will be significantly affected by the Project, at least not to the extent that it is a major consideration in route selection.

Long-tailed bats (classified as Nationally Vulnerable - Threatened) may potentially be associated with the stands of mature trees (exotics included) within the Study Area. Long-tailed bats were found in the Karori Sanctuary, located to the west of the Study Area, until 2008 but have not been recorded since. There is the potential for loss of roost trees and feeding habitat, if present. Mature trees in the vicinity of Cornish Street and Lincolnshire Road have the highest potential as bat habitat, although pine plantations may also provide habitat.

Non-threatened lizard species are likely to be present along any option. “At Risk” or “Threatened” species may also be present. It is difficult to factor in effects of lizards without detailed survey information. However, based on an assessment of the habitats affected it is unlikely that the presence / absence of lizards would be a significant determining factor for route selection.

7.3 Aquatic Habitat

There are three main stream catchments within the Study Area: the Korokoro Stream in the east, Porirua Stream in the west and Takapu Stream in the north. As well as the main stream channels there are many smaller tributaries within the Study Area that could be impacted to varying degrees by any option.

Figure 7-1: Korokoro Stream

The streams within the Study Area have either been confirmed as supporting native fish or are likely to support native fish. This will include species classified as “At Risk” and could also potentially “Threatened” species. The small stream tributaries may provide habitat for fish as well as the main channels.

7.4 Marine Habitat

The other main habitat type that may be impacted by this project is the coastal zone around the mouth of the Korokoro Stream. This location is a highly modified section of coastline with the coast frontage and is managed as public open space. Any options that impact on this area are unlikely to have significant ecological effects in terms of habitat loss. Sediment discharge into the marine environment in this location is potentially a significant issue and will need to be addressed but is not a major consideration for option selection.

7.5 Issues and Constraints

The key ecological issues and potential constraints identified from the available information and limited field reconnaissance can be summarised as follows:

- Areas of exotic/native scrub in the vicinity of, and within, the Belmont Regional Park and around the Korokoro Stream. Vegetation along the Korokoro Valley within the Belmont Regional Park is identified in the Hutt District Plan as Significant Natural Resource Sites (Sites 25 and 26, Map Appendix 1A). The vegetation at least to the west of the stream does not appear to match the description provided in the District Plan i.e. lowland forest. The aerial images suggest the vegetation to the east of the stream is of higher quality and closer to the description provided in the District Plan. There is potential habitat loss to the project footprint from these areas;
- Wilf Mexted Reserve Site 5C, Wellington District Planning Map 29, immediately to west of Woodman Drive. Native bush - will likely be avoided;
- Two species of reptile have been recorded in Belmont Regional Park: Wellington Green Gecko (classified as At Risk – Declining) and Southern North Island Forest Gecko (Not threatened). Other species may also be present. These lizards may potentially be affected by habitat loss along the alignment but this is unlikely to be a major issue for route selection;
- The mouth of the Korokoro Stream is potentially a sensitive area. It may be habitat for spotted skink (classified as At Risk - Relict) and possibly inanga (classified as At Risk – Declining) spawning habitat. The actual mouth of the stream is likely to be avoided by the works;
- Korokoro Stream supports a number of native fish species. It is listed in Table 16 of the Regional Policy Statement as a stream requiring protection due to it meeting criteria as a significant indigenous ecosystem. The listing applies to all tributaries too. Fish passage, habitat loss to footprint, and habitat degradation, due to sedimentation, are all potentially significant impacts;
- Porirua Stream and tributaries recorded as supporting native fish. It is listed in Table 16 of the Regional Policy Statement as a stream requiring protection due to it meeting criteria as a significant indigenous ecosystem. The listing applies to all tributaries too. Fish passage, habitat loss to footprint, and habitat degradation, due to sedimentation, are all potentially significant impacts;
- Takapu Stream and tributaries recorded as supporting native fish. Takapu is a tributary of the Porirua Stream and therefore is covered by Porirua's listing in Table 16 of the Regional Policy Statement as a stream requiring protection due to it meeting criteria as a significant indigenous ecosystem. Fish passage, habitat loss to footprint, and habitat degradation, due to sedimentation, are all potentially significant impacts;
- Currently available information suggests a low risk of finding significant concentrations of long-tailed bats (classified as Nationally Vulnerable – Threatened) within the Study Area. However, the occurrence of this species cannot be discounted until field surveys have been undertaken;
- Coastal zone – potential little blue penguin (At Risk –Declining) nesting habitat but not likely to be significantly impacted based on current information; and
- Erosion and sediment discharge will require very careful management given the steep terrain.

7.6 Risks

Specific relative values of parts of the affected exotic/native scrub and streams are not known. There is a risk that field surveys will find habitats and potentially plant and animal species that may alter the effects rating of a particular option. For example field investigation may find pockets of vegetation with exotic/native scrub that are of significantly higher value than the majority. Furthermore field investigations may identify concentrated lizard and bat habitats at particular locations. Although the available information suggests this is unlikely it cannot be discounted until field investigations are completed.

Erosion and sediment discharges to streams and the marine environment are potential risks as highlighted earlier in this section. Erosion and sediment discharges will need to be carefully managed and controlled to mitigate potential adverse environmental effects.

7.7 Opportunities

There is potential to integrate indigenous bush planting into landscape design and provide enhanced ecological values in parts of the Study Area where values are currently low.

There are also several opportunities for mitigation of the possible issues identified which can substantially reduce effects. With regard to this project, the following are the key mitigation options that need to be considered / adopted:

- Bridging streams wherever possible;
- Provision of fish passage in all culverts on permanent or intermittent streams; and
- Habitat creation and/or enhancement to compensate for stream and scrub habitat loss.

8

Landscape and Visual Assessment

8 Landscape and Visual Assessment

8.1 Introduction

This section of the report describes the physical landscape of the project area, the visual catchment and viewpoints together with the issues, constraints, risks and opportunities in relation to the potential impacts on the landscape values in and around the project area. This section also considers mitigation opportunities and the issues which have implications for option selection.

8.2 Physical Landscape

Northern Section

At the northern end, between Tawa and Transmission Gully, the project area includes the north-south valley of the Takapu Stream. The top of the ridge at the eastern side of Takapu Valley is identified as visually significant in the District Plan, though not specifically identified as regionally significant in landscape terms.

There is integrity in the landscape, though it is heavily modified from the original land cover. The grassed slopes and vegetated gullies provide a simple broad scale framework where the vegetation cover echoes the land form.

Figure 8-1: Northern Section – Series of drainage gullies on eastern side of valley

Central Section

The central section continues this hill and valley formation, but differs in having a higher density of built and future built development occurring, being from the Grenada North to the proposed Lincolnshire Farms Structure Plan area.

Both build form and vegetation patterning are less consistent in this area, and will continue to change, in part at least, to a built environment. This will make the integrity of the surrounding ridgeline and hill form to the east of greater importance for both the outlook for development and the interface with the rural area.

Figure 8-2: Central Section – Showing major gully

This area is partially divided by an east west running ridge of higher ground, which forms a division between the Lincolnshire Farms area and the developing Grenada North area. Thus the Lincolnshire Farms area is visually separated from the valley north of Grenada North, though the physical ridge and valley form continues to run north-south. The east-west ridge becomes of more significance as a back drop to the ongoing development. The settlement of Horokiwi has a contrasting character to its surroundings with a smaller scale, finer patterned character in contrast to the more open hillsides.

Figure 8-3: Typical landscape in vicinity of Lincolnshire Farms

Southern Section

The southern section is comprised of three sub elements. Those being:

- The steep sided bush clad and vegetated area of the Regional Park, centred on the Korokoro Stream;
- The strongly defined coastal edge / foreshore / scarp face on the fault line uplift of the Wellington Fault; and
- The edge of Petone itself.

All three sub sections have distinct landscape qualities and values based around their natural attributes. The Korokoro Valley is seen as a natural vegetated valley despite industrial development at its mouth; the integrity of the cliff line is sufficiently large scale and strong to be dominant over the transport corridor at its base. The edge of Petone is a distinctly different mix of residential activity set on the vegetated upper slopes above the town with extensive infrastructure at the base of the slopes. This separates the town from the foreshore and the mix of built development between cliff foot and foreshore.

Significant landscape elements in the project area include The Esplanade and coastal edge, the coastal cliffs of Wellington Harbour, the Korokoro Valley, both in isolation and in juxtaposition with each other; the main gully in the location of the Lincolnshire Farms Structure Plan area; the sequence of side streams draining the slopes to the Takapu Stream; and the ridgelines which separate the Grenada / Tawa area from the Hutt Valley.

Figure 8-4: Southern Section – Typical Wellington Harbour coastal landscape

Figure 8-5: Southern Section – Korokoro Valley, Belmont Regional Park

8.3 Visual Catchment

The landscape and visual envelopes are similar, in that the visual catchment is determined by the physical land form with the major ridgelines providing the key structural element of the landscape. These also align with the stream catchments.

Ridges and slopes are a distinct boundary element for communities in Wellington. This has been recognised by their inclusion in the WCC District Plan of Ridgelines and Hilltops Maps. These ridges are seen as both containing and separating different communities and providing a backdrop to settlement. Views within these valleys are modified by vegetation and land use patterns.

Any proposal is likely to run along the side of hill slopes and cross through ridgelines. As a result there will be a high degree of inter-visibility between any proposed route and the surrounding land, particularly on the central and northern sections of the project area.

At the southern end, the steep cliff face of the Wellington Harbour is a key element in the harbour landscape. Any proposal affecting the cliff face will be visible not only from adjacent settlements, Korokoro and Petone, but also from the Petone foreshore, from the surrounding hills, including the Eastbourne / Wainuiomata hills, and from the harbour waters and users of transport, such as the Cook Strait Ferries, SH2 and the Hutt Valley rail line. In contrast, the incised valley of Horokiwi and Korokoro have a limited visual catchment.

Figure 8-6: Southern Section – Petone Esplanade with a view to Wainuiomata hills

Figure 8-7: Southern Section – Wellington Harbour cliff face showing Horokiwi Road and typical vegetation

8.4 Viewpoints

With a transportation proposal, the views are often a sequence with different vistas opening up with travel and are generally orientated along the line of travel.

From the surrounding landscape, the main viewpoints will be from high ground, in particular where there is public access, from any tall buildings or elevated areas of settlement. Initially all ridgelines should be considered key features, with viewpoints from public roads and tracks, within and adjacent to the corridor.

For the southern cliff face, there are sequential views for people moving on the water, on public transport or on the public road network. The Petone Esplanade is another viewpoint with extensive views to the proposal experienced for longer periods of time, particularly any intersection or alignment across the cliff face.

There are also viewpoints on the eastern hills on the opposite side of the Hutt Valley with views of the proposal as it affects the cliff face. Changes in colour, movement and light are elements which are picked up at a distance. Similarly there will be views from the island reserve of Matiu / Somes Island. It is from these points that the bigger picture of the harbour is experienced.

Figure 8-8: View of Wellington Harbour and Matiu / Somes Island

8.5 Issues, Constraints and Opportunities

There are a number of issues, constraints, risks and opportunities in relation to the potential impacts on the landscape values in and around the project area. The ecological, geotechnical and heritage issues, while all being an integral part of the landscape, are not considered here.

8.5.1 Issues

There does not appear to be a consistent level of landscape information and analysis across the local authority areas, being at various levels of development. The level of planning documentation in identifying areas of importance and the degree to which communities value their landscapes may therefore be variable, with assessment based on different parameters. GWRC has commenced an inventory and HCC has commissioned work to complement this. There will need to be interpretation of information but most plans have identified the importance of the coastline, landform and ridgelines.

Any assessment of effects will take account of changes to the landscape, changes to views and the viewing audience, but also the ability of the landscape to absorb change. The latter can increase or decrease the level of effect, prior to any consideration of remedy or mitigation.

8.5.2 Constraints

There are a number of constraints, the most significant being the location of the connection to SH2 in the vicinity of the narrow coastal strip at the mouth of the Korokoro Valley, due to geometric and transportation parameters.

Other constraints centred around this location relate to economic, social and political factors. For example, options are likely to be restricted due to perceived factors such as the expense of tunnels and structures, public reaction and buy in, and finally difficulty of processing consents (if intrusion into parkland and coastal areas is required). The extent to which these factors may be negotiated needs to be confirmed.

The most significant landform on the route is the coastal cliff line facing the Wellington Harbour. Allied to this is the steeply sided Korokoro Valley; the constraints here are also those of ecology and amenity value, as well as extensive earthworks fill narrowing the valley form.

The relationship of the coast with the hills provides an uninterrupted vegetation and recreational sequence from hill tops to sea, presently affected by the existing SH2 and the railway line. The climatic conditions in the coastal area affect the ability to restore a “natural appearance” to earthworks and minimise visual effects.

Belmont Regional Park and the Petone foreshore are significant recreational features in the region and community, recognised in District and Regional planning documents by their open space designation or zoning. Importance of both areas individually and their connection, particularly in terms of the regional Beach to Bush and Great Harbour Way routes, is affected.

The ridgeline between the Korokoro Valley and the Lincolnshire Farms area is a significant physical and visual element dividing these two catchments. Any alignment which crosses this ridge will require a significant cut.

In the central section of the route, the Lincolnshire Structure Plan area had potential to constrain or facilitate benefits of the proposal, and the effect it may have on the landscape. Locating an alignment which is parallel, or connecting, to the existing corridor, may fragment land into unviable parcels, which could affect functionality and amenity of areas adjacent to the route.

In the northern section, the drainage pattern of the eastern slopes of the Tapaku Valley is a constraint on how any transportation route is designed to maintain both their effectiveness and amenity.

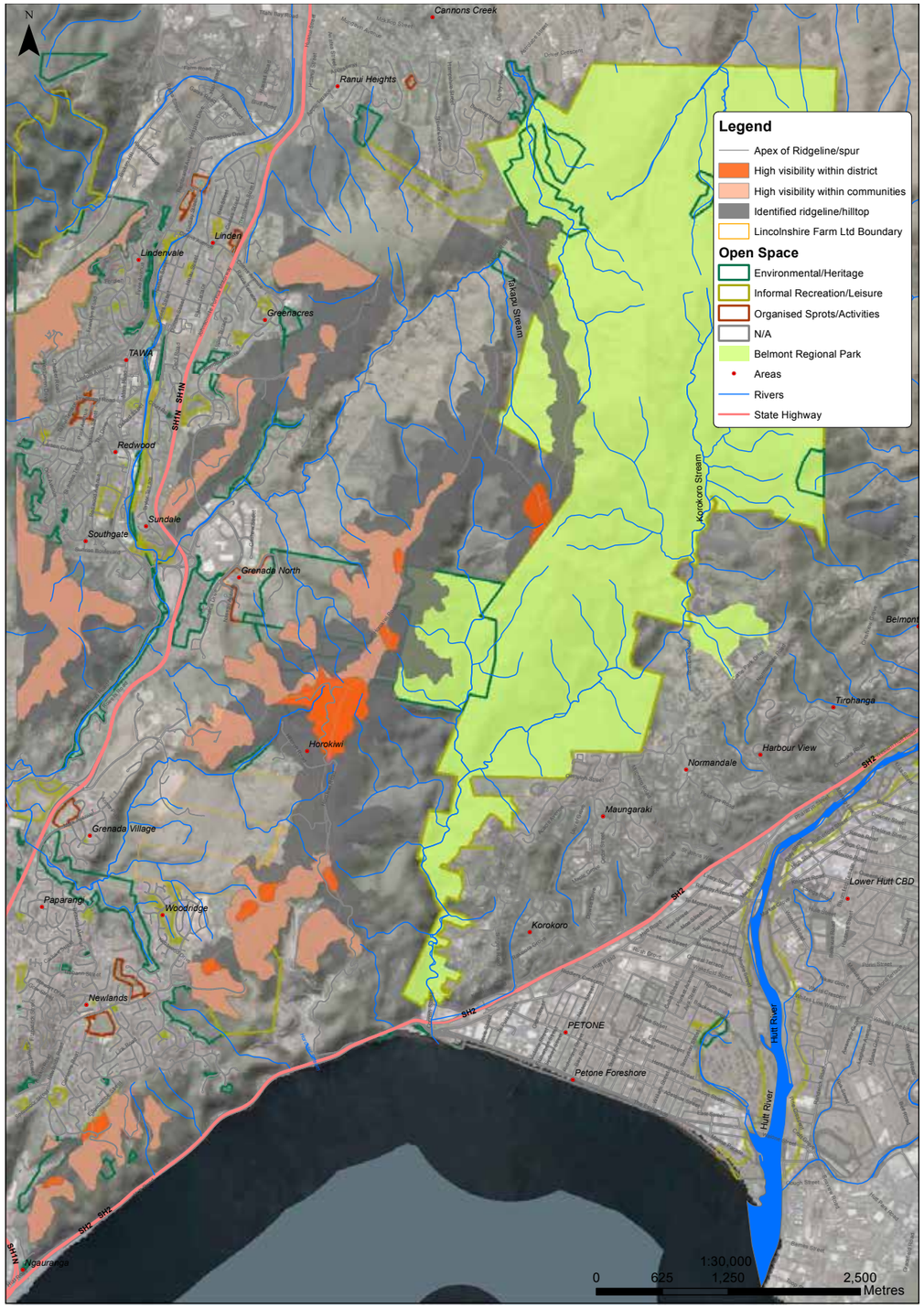


Figure 8-9: Map showing constraints, areas of high visibility and Belmont Regional Park

8.5.3 Mitigation Opportunities

The best solution is to avoid significant features, or to design in a way which is compatible with the essential characteristics of that element, and in a way that maintains character and connectedness of the surrounding landscape.

Southern Section (Including the Wellington Harbour Urban Coastal Edge)

Cutting into the hill faces along the coastal edge is likely to have a significant impact which is not easily mitigated. The best way to mitigate effects is to avoid any cut into the cliff face. However if this cannot be avoided then some options to minimise these effects should be considered.

One way to minimise the effect on this element would be to locate the intersection with SH2 at the mouth of the Horokiwi Valley on extended fill into the coastal marine area. This would allow access directly into the valley in the present break in the cliff line. There would be impact on the coastal area but this is not natural foreshore, and widening would also benefit the Great Harbour Way.

A second option would be to tunnel into the Korokoro spur, provided the approach to the tunnel is on a structure that does not narrow the stream valley. However, tunnels are very expensive and this would only be a viable option if the tunnel extended the full length of the project, making it unaffordable.

A third way would be to provide a separate elevated structure across the face of the slope, avoiding cut into the slope, and seen as a free standing sculptural element.

If these alternatives are not possible then treating retaining wall faces and batter slope surfaces (including benching batter slopes) will be necessary to reduce the impact of these cuts. However treating the cuts in this way will take a long period to be effective and will not match the existing coastal face. Omitting structures such as signage and lighting on this section is recommended to reduce road dominance, but the major effect to the Wellington harbour coastal landscape remains.

Figure 8-10: Southern Section – Location of alignment across cliff face to Petone intersection

The Korokoro Valley and Belmont Regional Park

Two factors need to be considered, one being the retention of the natural stream character and the second the recreational value of the Regional Park. Both of these also relate to the connection between the park and the foreshore and The Esplanade.

There is potential to minimise some effects by locating the intersection away from the mouth of the valley and by bridging across the valley mouth where structure is required. This could provide potential for extensive revegetation and planted parkland toward the foreshore over the full width of the valley floor and to daylight the stream in some places, achieving a better approach to the Regional Park.

Redesign of the Petone Interchange to remove traffic from The Esplanade would increase the accessibility and amenity of the foreshore area. The potential to link the foreshore with the Korokoro Valley on an extended pedestrian / cyclist bridge would benefit the aims of both the Beach to Bush track and Great Harbour Way cycle routes.

Streams and Ridges

For the numerous stream crossings along the route, maintaining stream profile and provision of broad and open span bridges, with clear parapet views along valleys will provide benefits.

The effect of earthwork excavation may be lessened by aligning the route with the contour along the slope of a hill, avoiding vertical cuts seen as notches in the ridgeline, and grading slopes to match the surrounding land form. The possibility of tunnelling or cut and cover should only be considered where significant cuts in ridges occur as there is minimal potential to reverse effects.

One of the key visually dominant aspects of road construction in a landscape is the difference in land cover and colour due to earthworks, which results from contrast of bare ground. Potential to mitigate this change relies on the ability to achieve a comparable vegetation cover to the surrounding land.

The potential to minimise lighting, movement and noise effects by ground shaping may not be possible on this route, but these changes to landscape character and amenity require consideration.

8.6 Key Design Criteria

The scale of this project, and the mix of landscapes through which it passes, requires a bold and simple approach, which minimises intrusion into the land form as far as possible. Use of structures and broad clear spans which lie over but do not cut into the land wherever possible will have less impact both physically and visually. However, in terms of resilience, such structures are not favoured.

Avoidance, retention of existing vegetation and enhancement of riparian corridors will help enhance natural patterns and the integration of the route.

Northern Section

The quality and amenity of the northern section will be affected but there is potential to work within this discrete valley to mitigate effects.

Central Section

The central section is already a landscape in change and effects of earthworks can be resolved to a large extent, with opportunity for a framework of positive landscape change through the proposed transport corridors.

Southern Section

The location and design of an intersection with SH2 is the most significant issue to be resolved on the route, along with the extent of cuts which result. Challenges include maintaining the integrity of the harbour cliff face, achieving direct recreational connection between the valley and the foreshore, and minimising the impact on the Korokoro Stream. Ideally this would also allow for reduction in roading affecting both the urban areas of Petone and The Esplanade.

8.7 Other Matters

Issues and constraints have been identified at a high level in terms of the route corridor. Effects and the ability to avoid, remedy or mitigate these depend very much on the actual alignment, rather than generalised corridor.

There are a large number of factors which make up the physical landscape, its character and amenity, how it is perceived and how people react to it. The interplay of ecology, recreation, heritage, settlement and urban design as well as land use and physical factors all contribute to the landscape.

Important implications for option selection will be based on how options respond to avoiding or mitigating the impact on:

- Changes to the form of the landscape and the integrity of the coastline and coastal edge; and
- Amenity values, environmental quality and character of the Korokoro Valley.

The effects range from regional to local issues. Factors which need further consideration are the urban design implications of the Lincolnshire Farm Structure Plan and also Plan Change 29 which affects route selection and design at the Petone Interchange. There may also be issues related to the impact on views from urban areas of the Hutt Valley and of structures in that vicinity.

As the project progresses, how the community values the broader landscape values, as well as their local issues will need to be considered.

9

Archaeology

9 Archaeology

A desktop archaeological assessment of the project area was completed. No fieldwork to identify the location or nature of the archaeological resource within the project area has been carried out. No statements in relation to the significance of sites or the area to tangata whenua have been provided. These are statements that only they can provide.

9.1 Methodology

This assessment was limited to a desktop review of information in order to determine the nature and potential extent of the archaeological resource within the project area. The following resources were reviewed as part of this work:

- New Zealand Archaeological Association Recorded Site database (ArchSite);
- Historic survey plans and titles;
- Published and unpublished historic accounts;
- Historic photographs; and
- Archaeological reports and assessments for the area.

Information provided in reports and databases identified above were examined in order to identify past land use within the area of the proposed works, and to identify the location and nature of formally recorded, or unrecorded archaeological sites that may be impacted by the works. The resultant information was then compared with plans of the proposed route options in order to identify potential physical impact. Based on the result of this review, statements are provided in this report in regard to the potential impact of the project on the archaeological resource. In determining the potential impact of the route or an option on the value of the resource or site, consideration is made of the known or reported condition of the site, the severity or level of potential impact and any potential cumulative effects. The assessment of impact or level of impact has been made against a "do minimum" baseline.

9.2 Legislation

There are several pieces of national legislation that assist with the protection and management of heritage sites, in conjunction with the objectives, rules and policies of district plans. These must be considered in regard to any development or land use proposal that may affect heritage or archaeological sites within an area. These are the Historic Places Act 1993 (HPA), Resource Management Act 1991 (RMA) and the Protected Objects Act 1975. In relation to NZTA projects, it is also necessary to consider the provisions of the Land Transport Management Act 2003.

9.2.1 The Historic Places Act 1993

Under the Historic Places Act 1993 (HPA) all archaeological sites, whether recorded or not, are protected and it is illegal to destroy, damage or modify an archaeological site without an Authority to do so from the Historic Places Trust (HPT).

An archaeological site is defined in the HPA 1993 as any place in New Zealand that:

a. *Either*

   i. *was associated with human activity before 1900; or*

   ii. *is the site of the wreck of any vessel where the wreck occurred before 1900; and*

b. *is or may be able through investigation by archaeological methods to provide evidence relating to the history of New Zealand.*

The HPT maintains a register of all recorded historical buildings, which is intended to assist in their identification and to assist in their protection by local bodies once identified. Historic Places are divided into two categories: Category I status is given to places of 'special or outstanding historical or cultural heritage significance or value', Category II status to places of 'historical or cultural heritage significance or value'.

Places may be significant because they possess aesthetic, archaeological, architectural, cultural, historical, scientific, social, spiritual, technological or traditional significance or value.

9.2.2 The Resource Management Act 1991

The Resource Management Act 1991 (RMA) provides guidelines and regulations for the sustainable management protection of the natural and cultural environment. In 2003 amendments to the RMA elevated historic heritage to a Matter of National Importance under Section 6 (f) which identifies the need for "the protection of historic heritage from inappropriate subdivision, use, and development."

A definition of Historic Heritage has also been added with the amendments to the RMA. This defines Historic Heritage as:

Those natural and physical resources that contribute to an understanding and appreciation of New Zealand's history and cultures deriving from any of the following qualities:

   i. Archaeological

   ii. Architectural

   iii. Cultural

   iv. Historic

   v. Technological

Includes

   i. Historic sites, structures, places, and areas; and

   ii. Archaeological sites; and

   iii. Sites of significance to Maori, including waahi tapu; and

   iv. Surroundings associated with the natural and physical resources.

9.2.3 Land Transport Management Act 2003

The Land Transport Management Act 2003 (LTMA) requires the NZTA to:

> *"exhibit a sense of social and environmental responsibility, which includes … avoiding, to the extent reasonable in the circumstances, adverse effects on the environment; and ensuring … that persons or organisations preparing regional land transport programmes … give land transport options and alternatives an early and full consideration… and provide early and full opportunities to the persons and organisations who are required to be consulted in order to contribute to the development of regional land transport programmes; and [establishing and maintaining processes to provide opportunities for Maori to contribute to decision making]…"*

9.2.4 Lower Hutt City Council District Plan

The Heritage Objectives and Policies of the Lower Hutt City Council District Plan, identify the importance of archaeological values and sites and the requirement under the RMA to protect them from inappropriate subdivision, use and development (Chapter 14 E). The District Plan identifies sites of natural, cultural and archaeological significance on planning maps to enable the implementation of rules to control the effects on such sites. It is important to note however that a number, though not all, of the sites listed in the District Plan as sites of significance to tangata whenua may also meet the definition of an archaeological site under the provisions of the HPA, but may not formally be recorded as site in the NZAA database.

9.2.5 Wellington City Council District Plan

The Heritage Objectives and Policies of the Wellington City Council District Plan, identify the importance of archaeological values and sites and the requirement under the RMA to protect them from inappropriate subdivision, use and development. The District Plan does not identify particular archaeological sites to enable the implementation of rules to control the effects on such sites (similar to the heritage rules for buildings, objects, trees and sites of significance to tangata whenua). As with the Hutt City Council District Plan, it is important to note that a number, though not all, of the sites listed in the District Plan as sites of significance to tangata whenua meet the definition of an archaeological site under the provisions of the HPA.

Within the District Plan, Council have provided a list of significant heritage items, and identified these on planning maps. Consideration of sites for listing on the District Plan is based on established criteria, outlined in Section 20.1.1 of the Plan. Under the rules of the plan, the total or partial demolition, destruction or removal of any listed site of significance to tangata whenua or other Maori is considered to be a Discretionary Activity (unrestricted).

In considering whether to grant a consent and what conditions, if any, to impose in relation to impacts on identified sites of significance to Maori, Council will have regard to the following: the degree to which the activity will detract from the heritage significance of the site, the effect of the activity on associated sites, and the outcome of consultation with tangata whenua and other Maori (Rule 21E.1.1). As an unrestricted discretionary activity, Council may also consider matters other than those identified in the plan rule.

9.2.6 Greater Wellington Regional Council Regional Policy Statement

The Greater Wellington Regional Council Regional Policy Statement contains several objectives and policies specific to historic heritage, and these must be considered in relation to any consent application. Relevant items in the proposed RPS are:

- *Objective 15 – Historic Heritage is identified and protected from inappropriate modification, use and development;*
- *Policy 20 – Identifying places, sites and areas with significant historic heritage values;*
- *Policy 21 – Protecting historic heritage values – through the use of district and regional plans; and*
- *Policy 45 – Managing effects on historic heritage values.*

A guide provided by the Regional Council contains a set of criteria for assessing historic heritage values and the significance of places. These criteria in many ways overlap with those of the HPT.

The guide separates criteria under a group of values:

a. Historic Values: themes, events, people, social;

b. Physical values: archaeological, architectural, technological, integrity, age, group or townscape; and

c. Social values: sentiment; recognition.

No specific sites of cultural or archaeological significance are identified in the Regional Policy Statement in the project area.

9.3 Historic Background

9.3.1 District

According to Carkeek (1966), Rangitane traditional history states that the earliest Maori to occupy the Wellington District were descendants of Whatonga, and in particular his son Tara who settled on the shores of Wellington Harbour. Ngai Tara, descended from Tara, were later joined by Ngati Ira. One of Tara's brothers, Tautoki was taken by Whatonga to Paekakariki, where he was shown the boundary of land which was to become the land of his descendants, named after his son, Rangitane (ibid.2). In an account of the early settlement of the harbour, it is noted that the land was the scene of a number of battles during the pre-European period, and in the 1820s and 1830s several major battles were fought in the district, resulting in Ngati Mutunga and Atiawa establishing a foothold in the area.

The location around the head of the large sheltered harbour would have provided pre-European Maori a rich source of resources. The hills and surrounding bush would have provided not only timber for building, but food. Maori would have fished in the sea, and gathered shellfish along the beaches and coastal streams and wetlands would have been a source of eels, water fowl and flax.

As well as Pito-one Pa, located at the eastern end of the long beach, there were other kainga (villages) and pa in the area, along with associated urupa (Maori cemeteries). These were mainly clustered around the mouth of Te Awa Kairangi or Heretaunga (Hutt River), and the density of these settlements is indicative of a strong Maori community in the district. Te Upoko o Te Poaka was situated on a hill behind Pito-one Pa, and Te Tatau o te po pa lay approximately 400 metres west of Pito-one Pa. There was an extensive urupa at Pito-one which was named Te Puni (Adkin 1959:126).

The original European settlement of Port Nicholson was located at the head of Te Whanganui a Tara or Wellington Harbour, adjacent to a Maori village called Pito-one. The land for the settlement was reportedly purchased by the New Zealand Company from the Te Puni, chief of the settlement at Pito One. Originally named Britannia, the settlement was located on land purchased by Wakefield and the representatives of the New Zealand Company in September 1839. They described a substantial, Maori village (Pito-one) located at the western end of the sandy beach, close to the mouth of the Korokoro Stream. This site was soon found to be subjected to regular flooding, and was considered to be unsuitable by the European settlers, and in 1840 the settlement was re-established on more solid ground at the opposite end of the harbour, where present day Wellington City stands (N Z Gazette 19/09/1840).

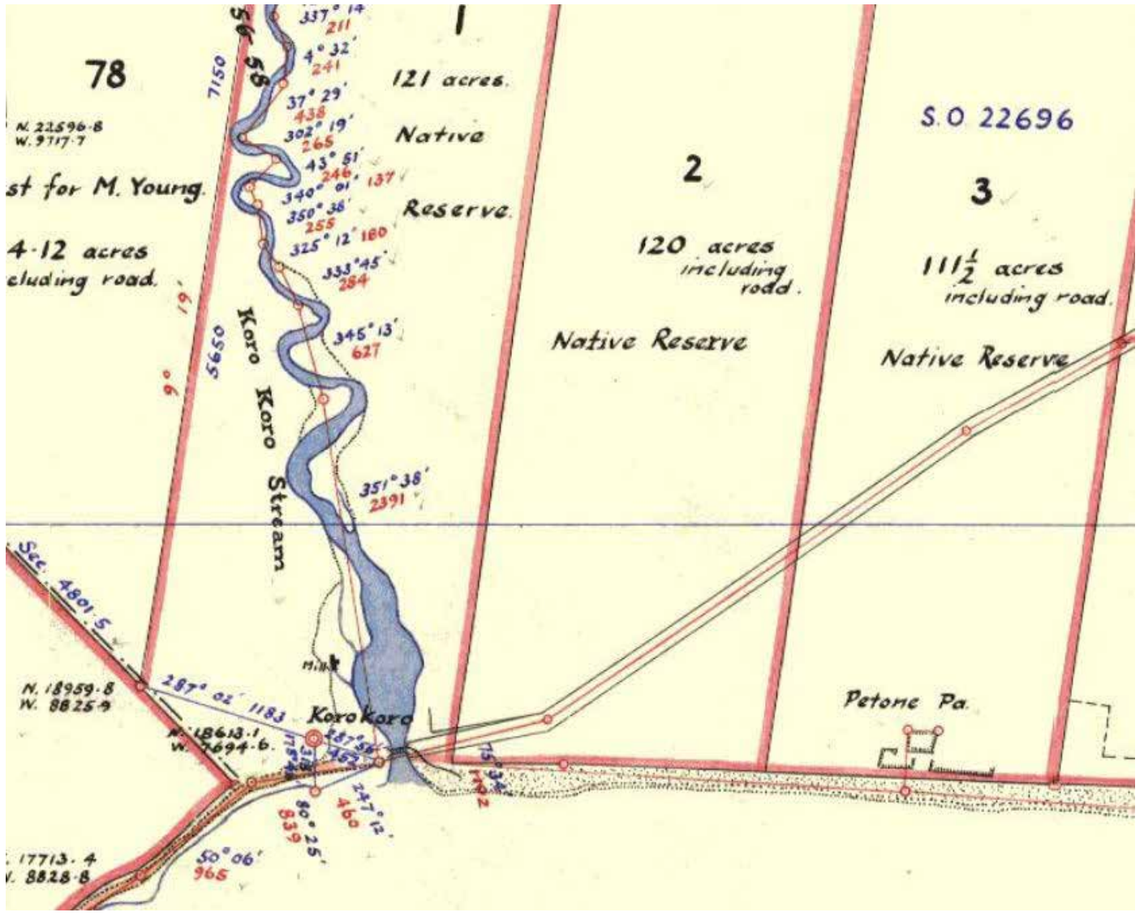


Figure 9-1: SO 11031 dated possibly 1867, redrawn 1963. Caption states Native Reserves Ngauranga W Snowden AS 10th Oct '76. Pito-one (Petone) Pa is marked. The original track to Porirua ran up from Korokoro Stream.

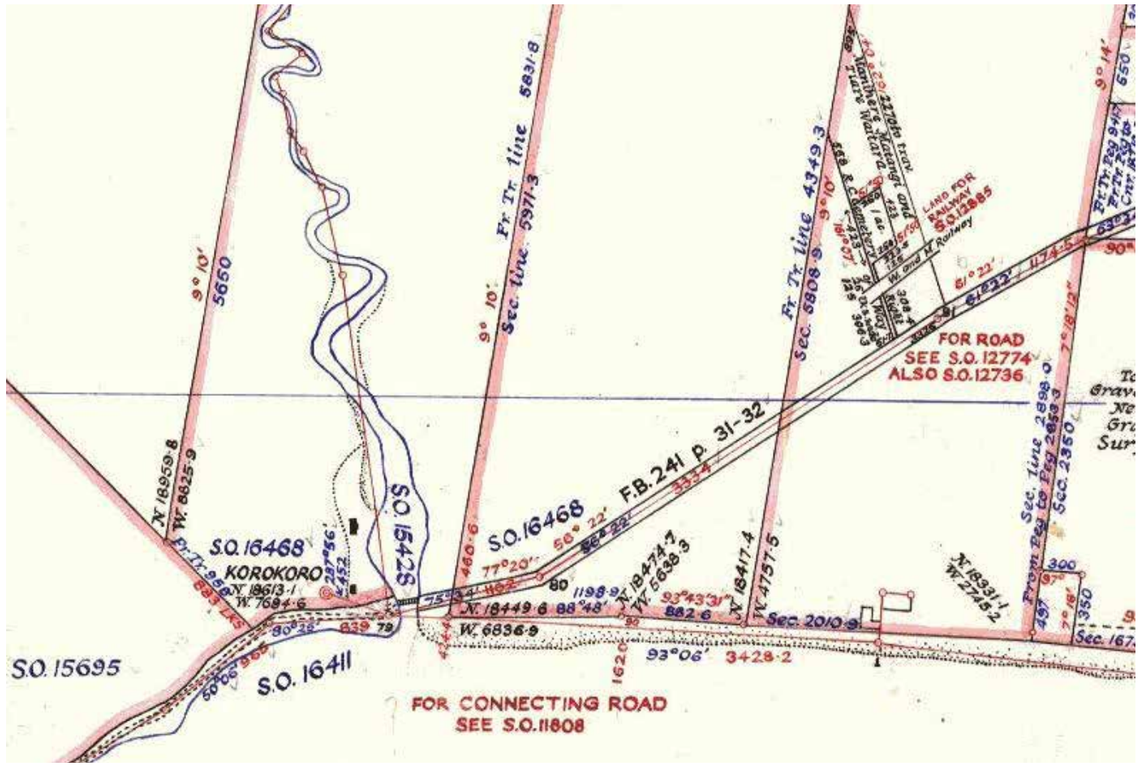


Figure 9-2: SO 11066 drawn 1880s showing land taken for roads. Note buildings on the western side of the Korokoro Stream (identified on Figure 9-1 as mill)

Early European settlers in the district provide accounts of travel in the early part of the 19th century, particularly the traverse between Port Nicholson (Wellington Harbour) at Petone to the coastal settlements at Porirua and Titahi Bay. For the most part these journeys were made using tracks that had been used by Maori for many years. In the 1880s, prominent Wellington settler James Coutts Crawford provided an account of his journey from Korohewa (sic) on the Kāpiti Coast to Port Nicholson following his arrival in New Zealand in late 1839.

> *"Passing Titahi Bay, and the pretty shores of Porirua, we entered the main bush, and travelled up the stream, in a line with whose course the present road stretches. We crossed and re-crossed the stream about seventy times, until at length the path ascended and led us over the summit of the range overlooking Korokoro. The whole distance traversed, with the exception of some few patches of cultivation at Porirua, was through dense and uncleared forest. ... The Hutt Valley presented a dense forest of gigantic trees, and a large pa was visible at Pitone. As we descended the hill, our advance was hindered by a mass of newly-felled forest, which was cleared and ready for burning off. Our escort now commenced firing guns to attract the attention of the fishermen; and as we descended the hill the canoes approached the shore, so that when we reached it, they were there to meet us."*
>
> (Coutts 1880: pp 27 -28)

Elsdon Best (quoted in Carman) also reports that many of the first journeys by Europeans through the district were made using the "old Maori trails", with the main one being that running over the hills from the Korokoro Stream to Tawa Flat and on to Porirua. Following the removal of the settlement from Petone to the current site of Wellington City, the track from Kaiwharawhara across Paerau hill became more used. This track joined with the Korokoro track at Takapu and then on to Porirua.

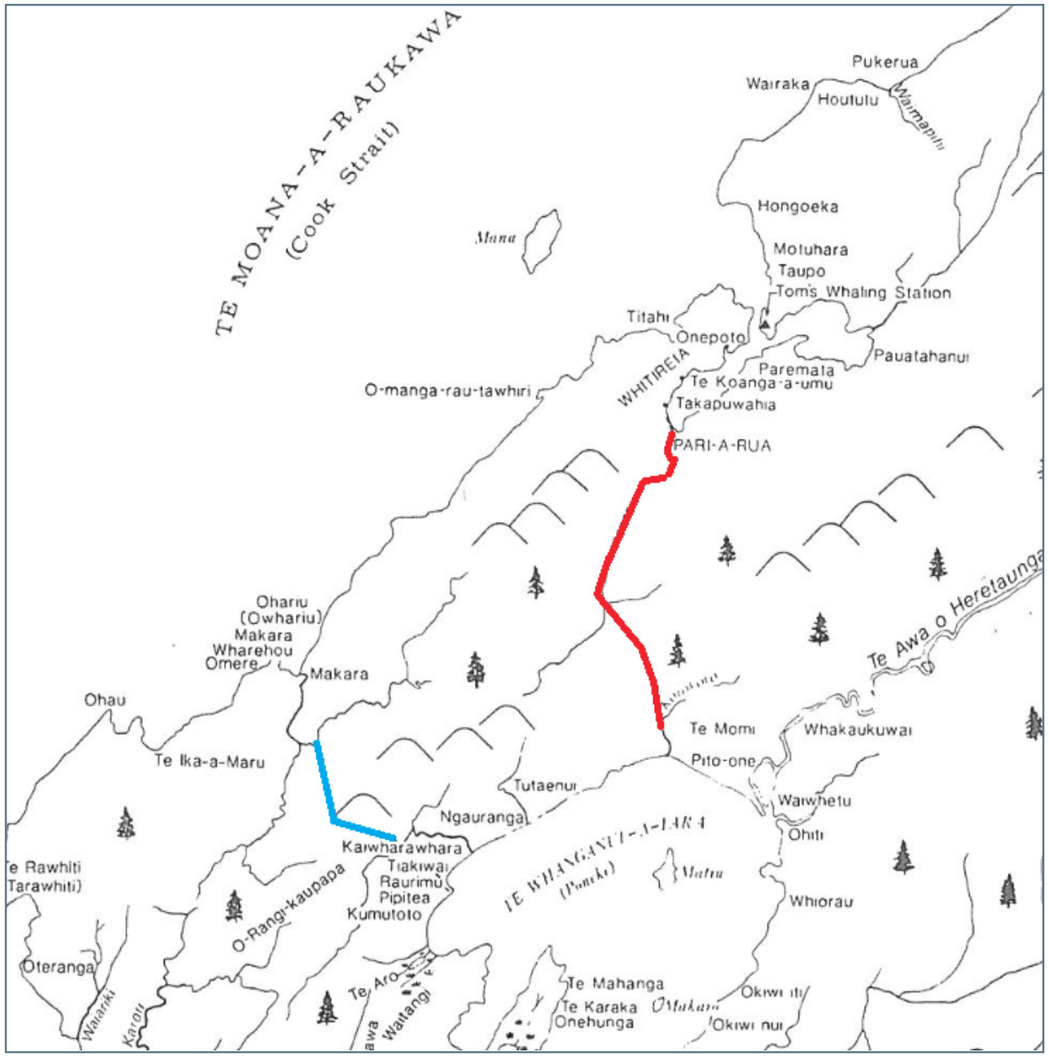


Figure 9-3: The Tracks to Porirua. Te Korokoro is marked in red and Kaiwharawhara in blue. (Map from Hamer and Nicholls 1990:14).

Best describes the Korokoro track as beginning on the south side of the Korokoro Stream, close to the mouth. It then ascended through bush up a steep hill and followed the ridge line to the Takapu Valley to the Kenepuru Stream and on to Porirua (marked in red, Figure 9-3).

During increased hostilities between Maori and the European settlers in the mid-1840s it was identified that the settlement of Porirua, and the Porirua Road was key to the protection of Wellington. Military stockades were established along the Kenepuru Stream to protect the Porirua Road as well as in part along the route of the Korokoro to Porirua track. Stockades were erected to provide protection for the transport routes, as well as for the increasing number of settlers in the district. The chain of defences ran from Porirua (Fort Elliot or Elliot's Stockade) alongside the Kenepuru Stream (Leigh's Stockade) to the junction with the Takapu Stream (McCoys Stockade) then south towards Johnsonville (Middleton's Stockade, located "about half a mile" north of the old Half-Way House) to Johnsonville (Clifford's Stockade). A similar line of defensive positions was also established along the Heretaunga or Hutt River.

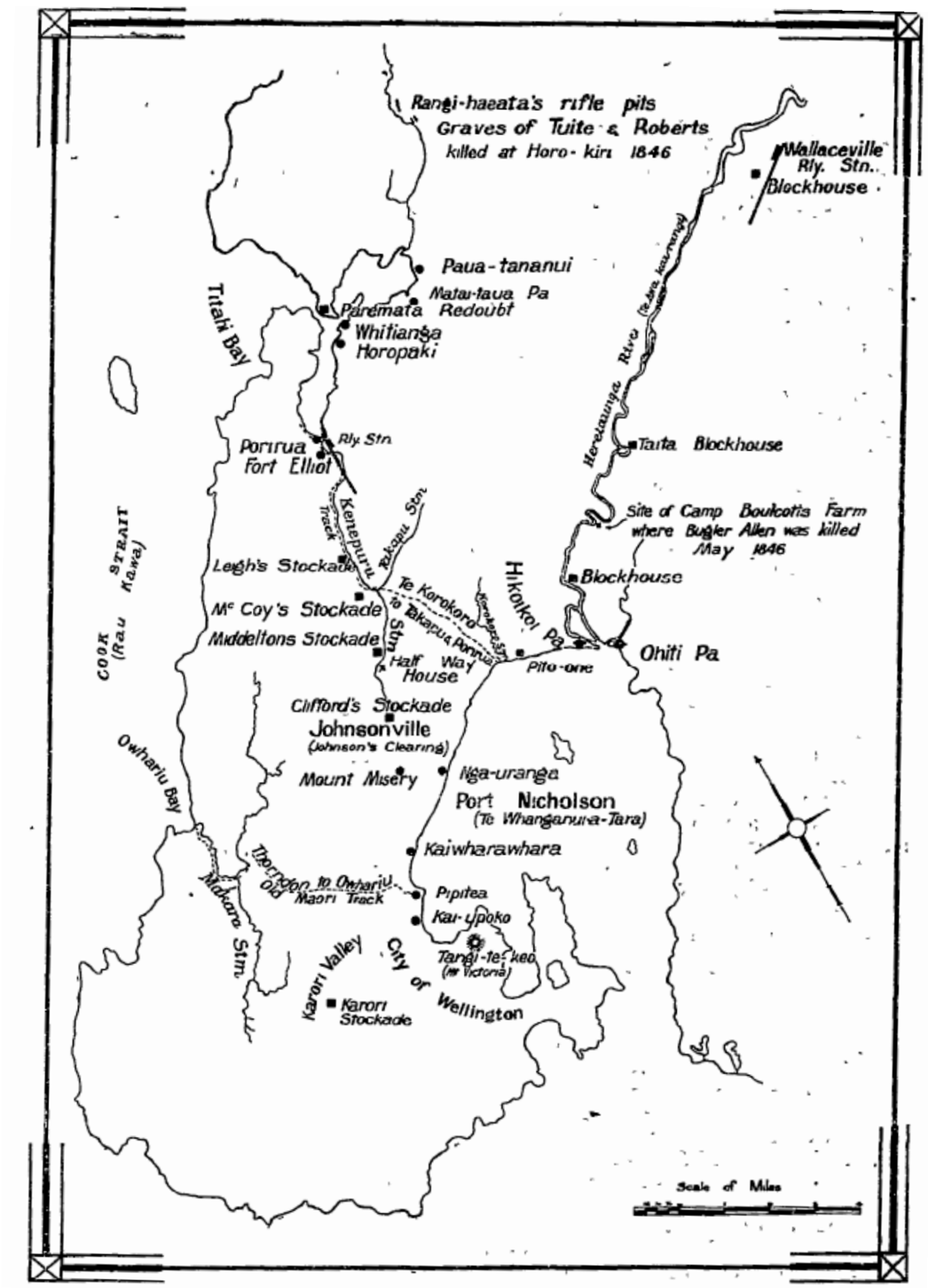


Figure 9-4: Best's plan of the District showing the location of military stockades between Porirua and Johnsonville (from Best 1921:15)

9.3.2 Petone

Following the early settlement and development of small farms in the Petone and Hutt Valley, the establishment of the Railways workshop at Petone in 1878 was instrumental in the district becoming a manufacturing and development centre. The railways workshops were soon followed by the establishment of the Gear Meatworks and the Wellington Woollen Mills, two large industrial complexes located at the western end of the sandy bay.

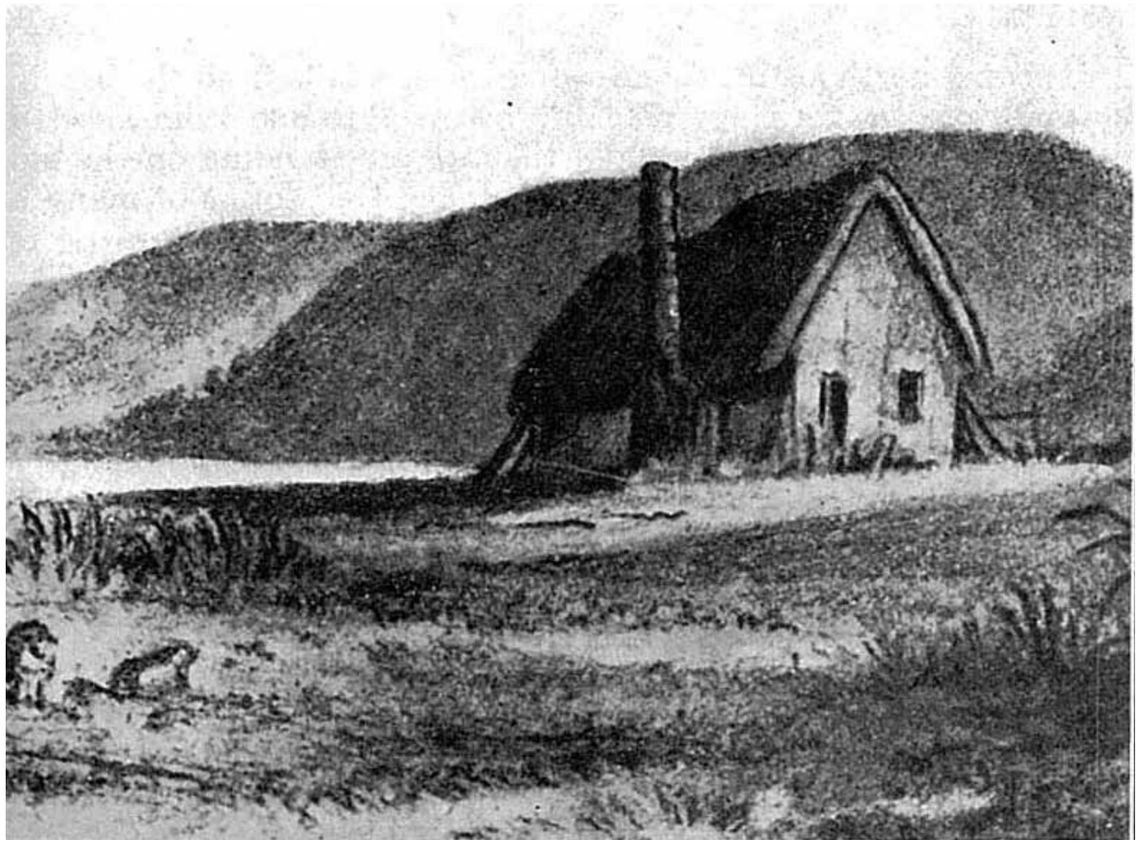


Figure 9-5: A Settler's House, Pito-one Flat, near the Korokoro Stream and Mill (Sketch by William Swainson, Esq., F.R.S.) image IN Petone's First 100 years page 51

Gear Meatworks

The Gear Meat Processing Company was established in Petone in 1882. While the area was not a prime stock farming district, the works were in an ideal transport location, close to the railway line and the Wellington port. The works were built up to become at one point the largest freezing works in the southern hemisphere, employing up to 600 at its peak. Operations were to remain on the site until 1981. During their operations in Petone, Gears also acquired grazing land in the surrounding district but were also responsible for building the first jetty at Petone, which enabled ships to load and unload in Petone, rather than at Wellington proper.

A review of historic plans and photographs indicated that the Gear works were located outside the project area.

Figure 9-6: The Gear Meat Processing Company circa 1880s. Image by Burton Brothers 1880-1889, courtesy of Te Papa Tongawera museum of New Zealand c 0.009827.

The Wellington Woollen Mills

Construction of the woollen mills at Petone began in November 1885, with manufacturing at the extensive plant commencing the following year. The mills occupied a large site (5.2 ha) on the flat alongside the Korokoro Stream, until they closed in 1968. Associated with the mill was a small dam constructed in the Korokoro Stream, to supply water for the dyeing and washing process as well as to power the steam engines in the complex.

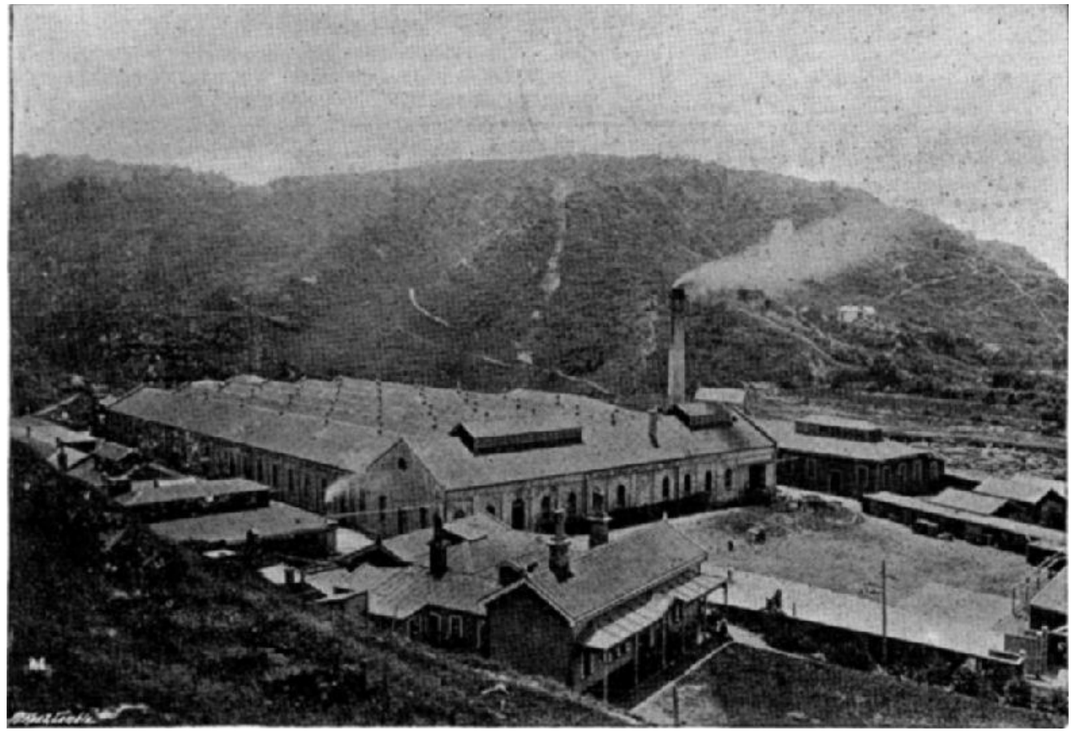


Figure 9-7: Cyclopaedia of New Zealand (Wellington Provincial District) 1897 page 829

Figure 9-8: Petone Looking East from the Hill Above the Woollen Mill 1906. Image by A.P. Godber P A Coll 0123-1.

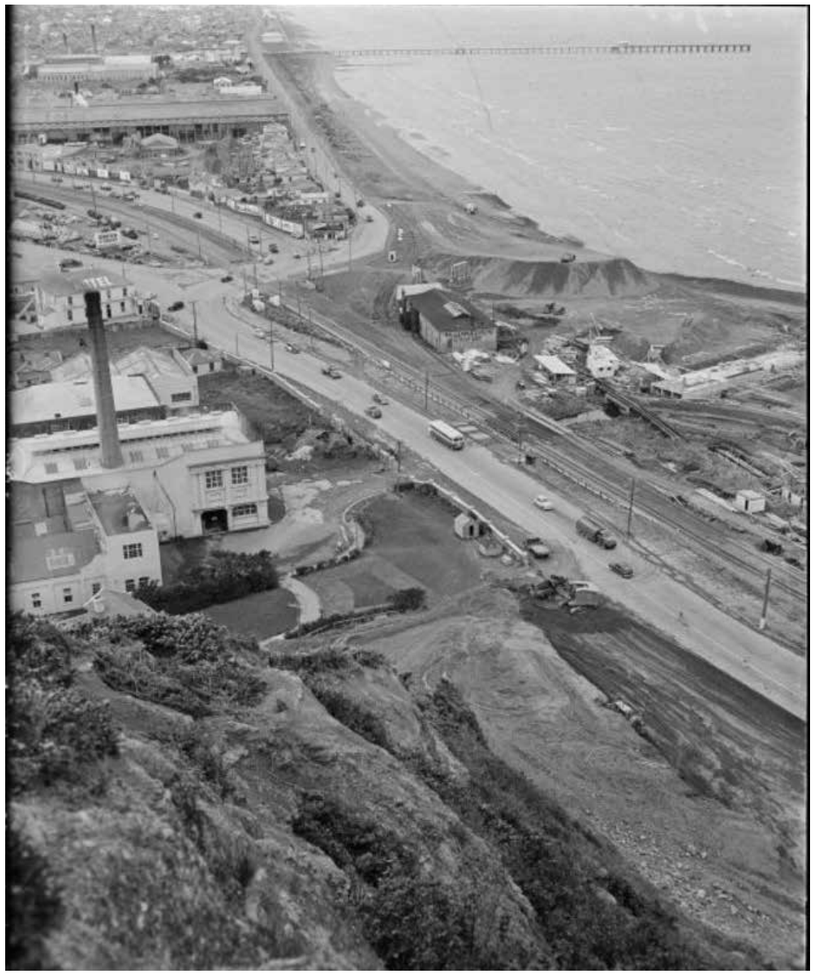


Figure 9-9: Site for the New Petone Overbridge circa 7 Sept 1951. Evening Post 7 September 1951. Wellington Woollen Mill is the building in the fore ground and the Petone jetty is visible in the background.

9.4 Research Results

9.4.1 Recorded Archaeological Sites

The New Zealand Archaeological Association (NZAA) "ArchSite" digital database contains details on all recorded archaeological sites throughout New Zealand. Individuals, professional archaeologists and iwi groups have contributed files in the database over almost sixty years and the quality and detail on records varies. The database is a useful management tool for understanding the distribution of archaeological sites within an area and past land use patterns. Although some areas of New Zealand have been intensively surveyed and large numbers of archaeological sites recorded, there are still large areas where no archaeological surveying has been carried out and few sites, if any, have been recorded. A lack of recorded sites does not necessarily equate with an absence of sites in some regions.

Each site is represented within the database as a single data point. Site location information is only considered accurate to within 100 metres. This is because sites are recorded using grid references on NZMS-260 topographical maps. Many sites were originally recorded on Imperial NZMS-1 maps, and later transferred onto the metric NZMS-260 maps, introducing additional inaccuracies through the conversion process.

A search of the New Zealand Archaeological Association (NZAA) national database (ArchSite) identified relatively few recorded archaeological sites in the Petone area or along the route of the proposed project (Figure 9-10).

Within a 100 metre buffer of the project footprint there are eight recorded archaeological sites. Information on these is summarised on Table 9-1. Of note, neither the site of the Gear Meatworks, nor the Wellington Woollen Mills are recorded in the database, however the location of both could be considered as meeting the definition of an archaeological site. The weir associated with the mill is however recorded as a site.

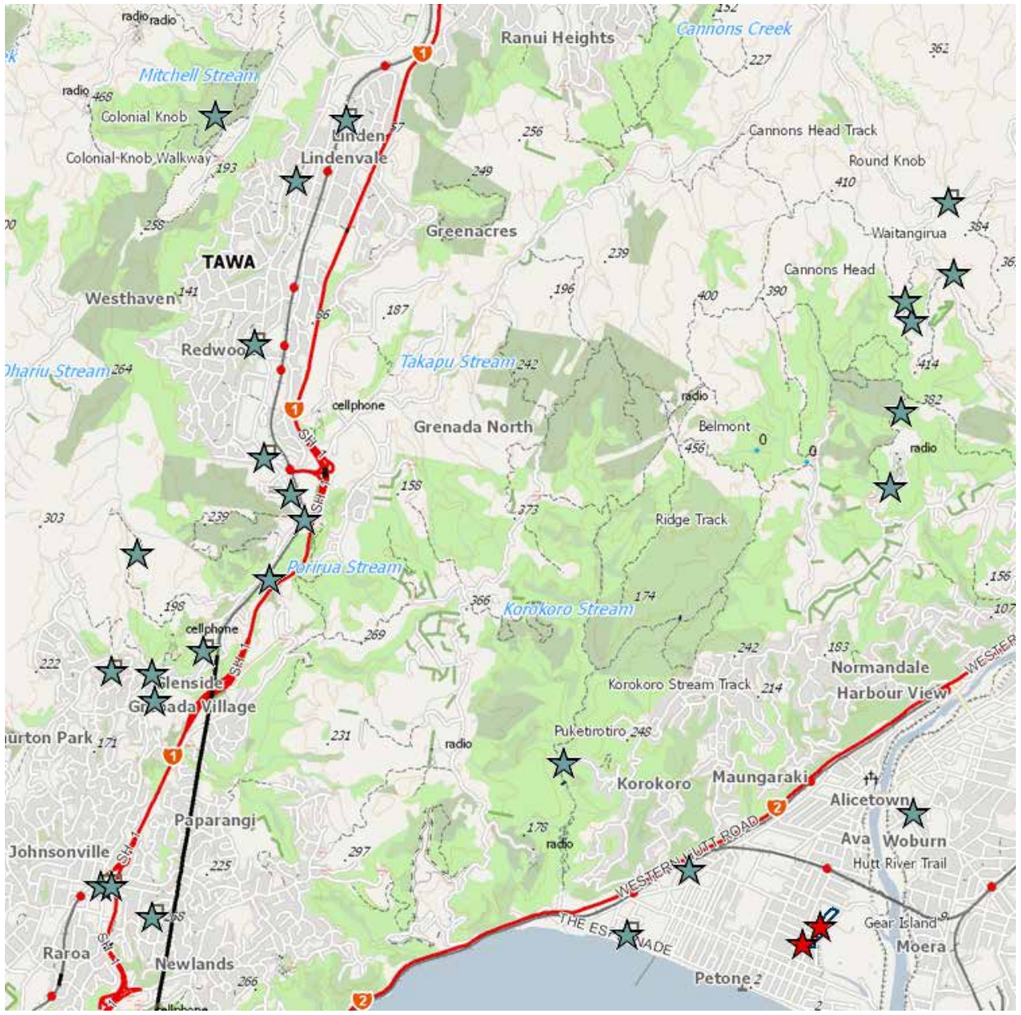


Figure 9-10: Screen shot of NZAA database ArchSite showing the location of recorded archaeological sites in the project area (captured 10 June 2013)

Table 9-1: Recorded Archaeological Sites within 100m of Project Footprint

NZAA Site Number	Grid Reference (NZTM)	Brief Description
R27/268	1756639 / 5434517	Pito-one Pa site
R27/248	1756020 / 5436195	Concrete weir and spillway in Korokoro Stream. Built late 1880s to provide water for the Wellington Woollen Mills
R27/491	1753124 / 5437992	Historic 19th century house (Nott House)
R27/492	1753479 / 5438575	Historic 19th century house (Greer House)
R27/445	1753344 / 5438828	Cottage built c. 1855 for Harrison family
R27/236	1753079 / 5439187	McCoy's stockade built 1846
R27/238	1752979 / 5440287	Leigh's stockade built 1846
R27/242	1754580 / 5444086	Fort Elliot / Elliot's stockade built 1846

9.4.2 Historic Survey Plans

A number of historic survey plans were consulted as part of this work. Early survey plans often identify the location of old settlements, cultivations, urupa and early European structures. In addition to those plans discussed in Section 9.3 of this report, other plans consulted provide information on the change of road and rail alignment in the vicinity of the Korokoro Stream since the late 1880s and the historic location of buildings (Figure 9-11).

Along the route of the proposed road survey plans indicate that much of the land was subdivided early in the 1800s, with the Lot boundaries and owners clearly indicated (for example SO 10983). The plans also indicate the route of the track from Petone to Porirua via Takapu. Few features of potentially archaeological interest are indicated however.

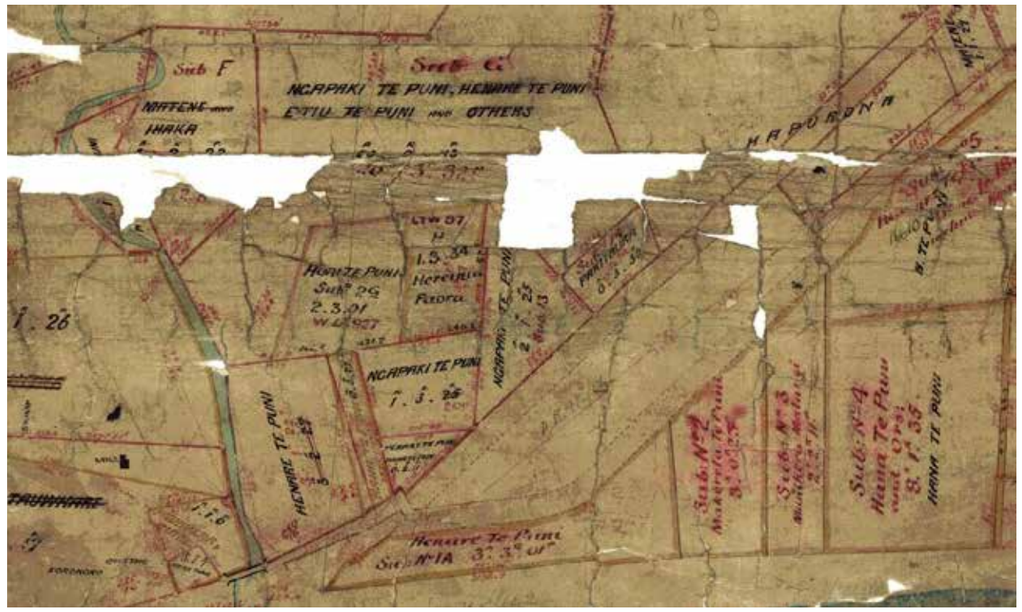


Figure 9-11: ML 842 – Possibly 1870s (date not clear) showing subdivision of land around the mouth of the Korokoro Stream

9.4.3 Hutt City District Plan

Within Chapter 14 E of the District Plan, Council have provided a list of significant heritage items (natural, cultural and archaeological). Of relevance to this project are those sites identified on Planning Map Appendix 1A. This map identifies Belmont Bush as a significant natural resource, and within this, close to the mouth of the Korokoro Stream are two identified sites of cultural significance, marked as sites 7 and 13. Nearby is the location of Te Puni Pa (14) and associated urupa (15) and Pito-one Pa (16) and urupa (17). While several of these sites are identified as cultural rather than archaeological features in the plan, they are included in consideration at the desktop phase of assessment as there is no indication of an archaeological assessment of the features, and there is potential that they may be sites of both cultural and archaeological value. These sites are identified below in Figure 9-12 and are:

7. Te Raho o te Kapowai – a cultural site located on a ridge west of the mouth of the Korokoro Stream;

12. Te upoko-o-te Poaka – identified as a cultural hill top site located on the western hills north of Petone Railway Station, on or near Singers Road;

13. Te Ahi-parera – located on a spur up the rugged gully of the Korokoro Stream; possibly an old earthworks pa;

14. Te Puni Pa – located in Te Puni Street;

15. Urupa – associated with the Te Puni family, located on the eastern side of Te Puni Street;

16. Pito-one Pa – a former stockade village, located near Te Puni Street; and

17. Urupa – located on the Esplanade, close to Te Puni Street.

9.4.4 Wellington City Council District Plan

Within the Wellington City District Plan the location of the Korokoro – Takau track is identified as a site of significance to tangata whenua (Schedule item M1; Map 27) and is considered to be of Medium significance.

It is noted that the route of the track indicated on planning Map 27 (Figure 9-13) ends abruptly at the edge of the map and does not extend on to the neighbouring map to the northwest (Map 30). Following the projected trajectory of the track through to Takapu, the historic track route may be affected by construction in the project area.

9.5 Potential for Archaeology in Project Area

With the exception of the weir and spillway in the Korokoro Stream, associated with the Wellington Woollen Mills, there are no recorded archaeological sites within the project footprint, based on plans considered for this assessment. There are several sites of cultural significance located close to the footprint identified in the Hutt City District Plan, and consideration must be given to the impact of the project on these. It is possible that these sites may also be archaeological; however this cannot be confirmed without a field inspection.

There is potential for currently unknown and unrecorded archaeological sites along the alignment of the proposed road. These may be either Maori or European in origin, and will be associated with early travel through the area, early European settlement and the exploitation of resources in the bush. This potential is however considered to be low based on the topography of the area, and historic descriptions of the area in the early 19th century that indicate that the area was covered in dense bush.

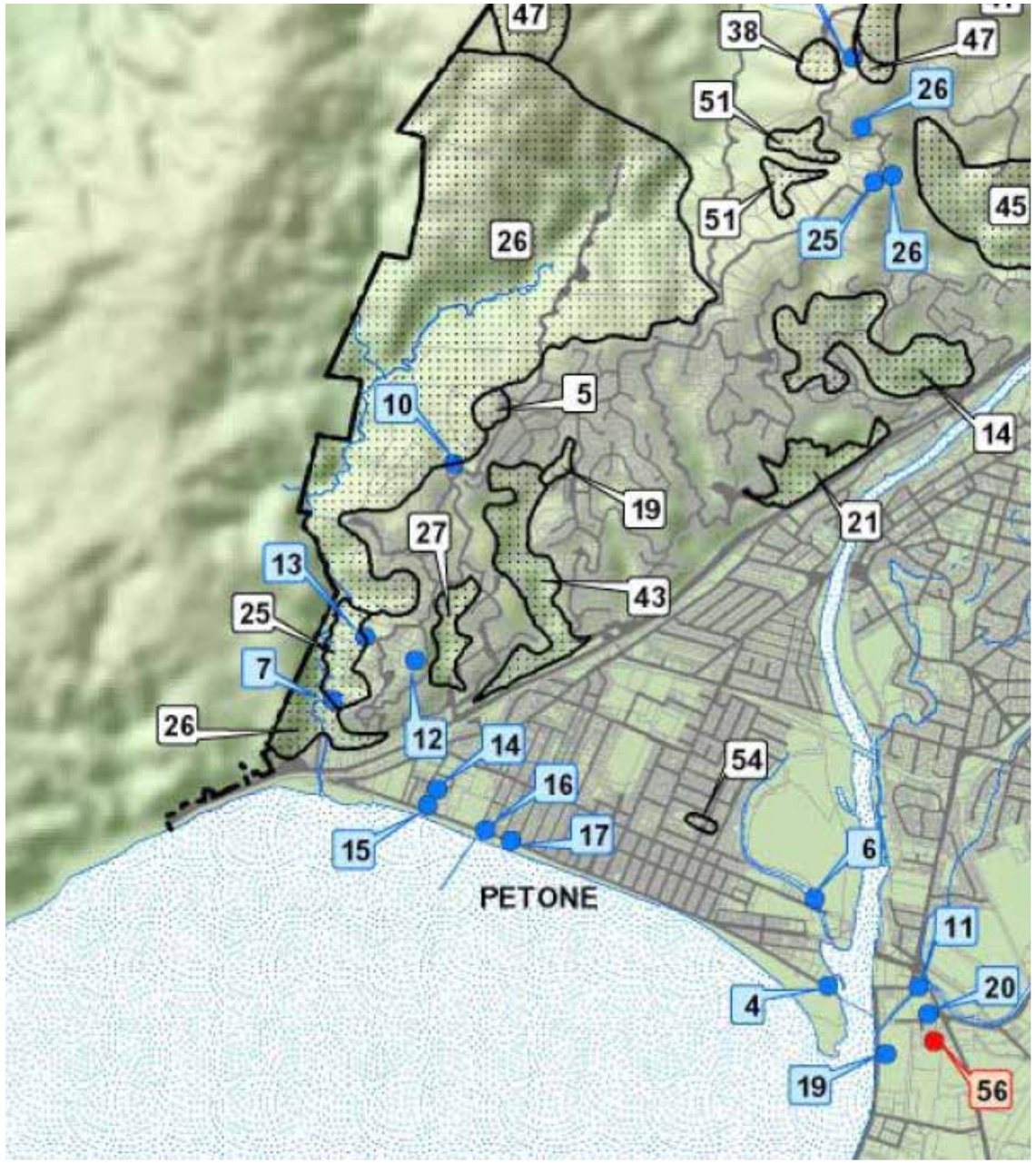


Figure 9-12: Part of Lower Hutt District Plan Map Appendix 1 A showing location of Significant Natural (white boxes), Cultural (blue boxes) and Archaeological (pink boxes) Resources. Note location of cultural sites 7 and 13 discussed above in text.

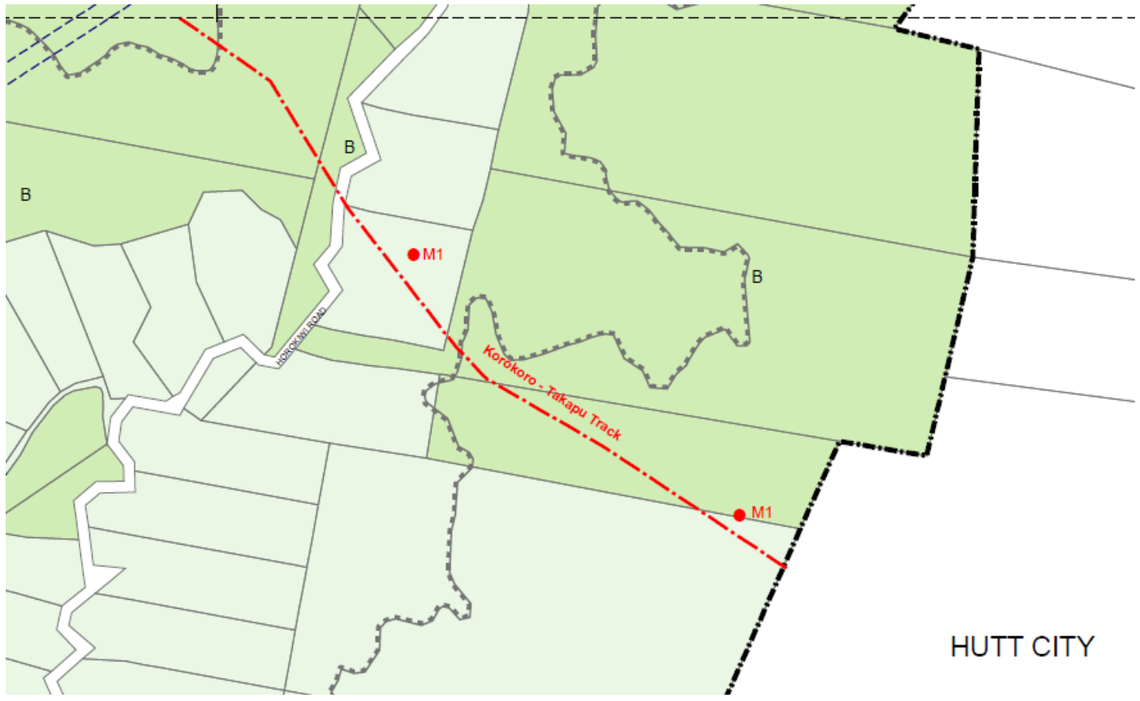


Figure 9-13: Part of Planning Map 27, Wellington City Council District Plan. Showing the location of Korokoro – Takapu track.

10

Geotechnical Considerations

10 Geotechnical Considerations

10.1 Introduction

Opus has undertaken a review of available literature, interpretation of aerial photographs, and engineering geological reconnaissance mapping. The full Petone to Grenada – Preliminary Geotechnical Appraisal Report (Opus, 2013) presents an appraisal of the salient geotechnical issues for the P2G project based on the results of this preliminary assessment, to help inform the selection of road form and alignment for the wider scoping study.

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;
- Appraisal of the geotechnical issues that may influence the development of route alignments;
- Recommendations for development of the route; and
- Consideration of a strategy for carrying out geotechnical investigations.

This section provides a summary of the full report provided to NZTA.

10.2 Regional Setting

10.2.1 Geomorphology

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 mouth of the Korokoro Stream in Wellington Harbour has been used as industrial land since deforestation in the 1840s.

To the southwest of Petone, around the western margin of Wellington Harbour, is a narrow bench of land that was uplifted in the 1855 Wairarapa Earthquake. SH2 and the Wairarapa Line railway have been constructed on this uplifted platform, which is underlain by variable reclamation fill, with rip rap protection, concrete rubble and a masonry seawall (rock held together with cement mortar) providing protection from coastal erosion.

Immediately adjacent to this area, on the western side of SH2, are steep hillslopes and deeply incised gullies of the uplifted block to the northwest of the Wellington Fault, shown in Figure 10-1. The hills rise from sea level at the SH2 Petone Interchange up to 290m elevation on the hilltops near Horokiwi. This area consists of bush-covered hillslopes, the active cut slopes of Horokiwi Quarry, and rural-residential land on the ridge tops.

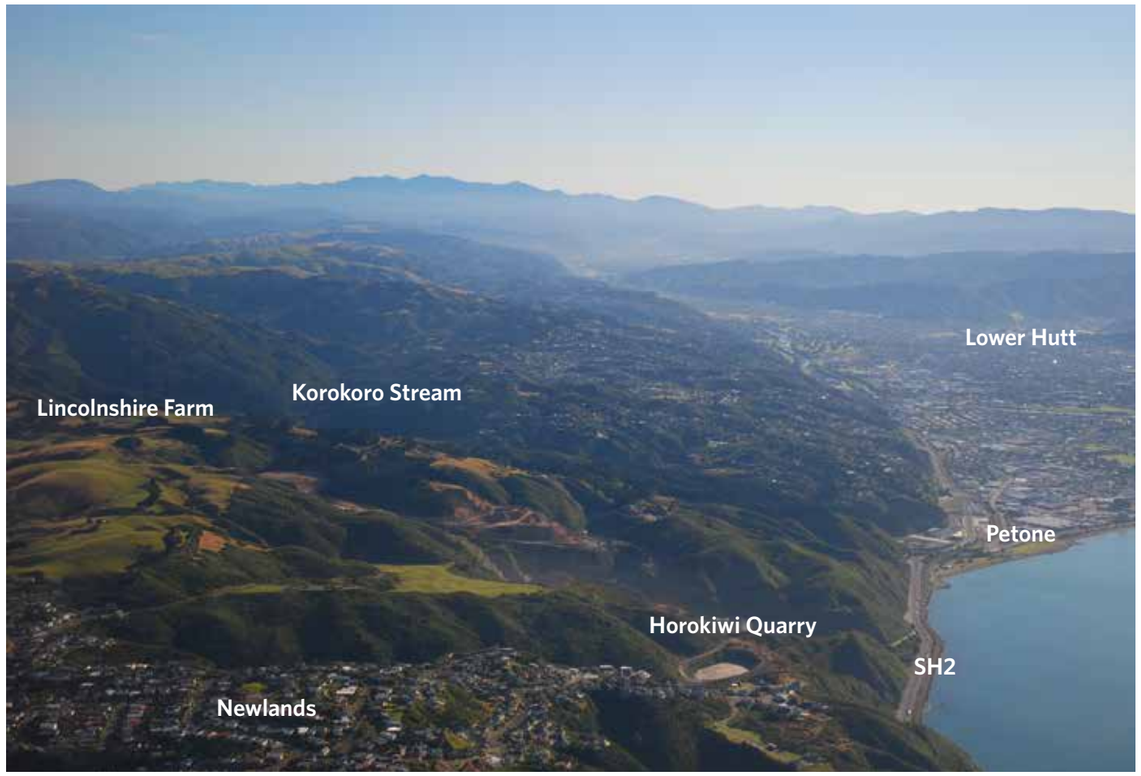


Figure 10-1: Oblique Aerial Photo – Petone to Horokiwi

Further to the west and over the hilltops is the Horokiwi to Linconshire Farm section. A number of hilltops in this area preserve remnants of a prominent geomorphic feature of the Wellington region – the "K-Surface". The K-Surface may have originated as a near-flat erosion surface that was formed during an early phase of the development of the Wellington landscape and has subsequently been uplifted and dissected so that only remnants of it are preserved as rounded ridge crests and undulating tableland surfaces (IGNS, 1996).

A prominent K-Surface remains in the Linconshire Farm area, shown in Figure 10-2. The geomorphology here is characterised by broad, undulating hilltops that gently dip to the northwest towards State Highway 1. This K-Surface remnant is generally of moderate relief, and has been incised by streams which are bounded by steeply sloping gully sides.

Figure 10-2: Oblique Aerial Photo - Horokiwi to Lincolnshire Farm

Figure 10-3: Oblique aerial photo - Grenada

Another area of note in the project area is the former Northern Landfill, between Mark Avenue and State Highway 1 (Figure 10-3). The geomorphology in this area consists of deeply incised hillslopes and gullies with moderate to steep slope angles. The Northern Landfill area is marked by flat terraces with steep slopes between the terrace surfaces.

The geomorphology of the section to the north of the landfill is characterised by steep greywacke hillslopes and deeply incised gullies. This section, up to the proposed Transmission Gully route, also contains the Takapu valley which is characterised by a narrow, winding valley floor, with steep side slopes and incised tributary gullies (Figure 10-4).

Figure 10-4: Oblique aerial photo – Takapu Road North of Landfill

10.2.2 Geology

The majority of the P2G Link Road would likely cross terrain underlain by greywacke bedrock. This consists of alternating bedded sandstone, siltstone and mudstone / argillite. Overlying the bedrock in the hill areas of the site are variable deposits of loess, colluvium and topsoil. Surficial deposits are thin at the crest of ridges, and will increase in thickness downslope. The hilltops in the project area preserve remnants of the K-Surface. These areas are likely to be underlain by a thin cover of loess and topsoil, but with a deeper weathering profile (>30 m) in the underlying rock (IGNS, 1996).

In the Petone area there are a series of prominent shore-parallel beach ridges, comprised of sand and gravel. Localised alluvial fan deposits are also mapped at the mouth of the Korokoro Stream gorge in the vicinity of the Petone Wool Mill site (IGNS, 1996).

10.2.3 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 P2G project area is provided in Table 10-1.

Table 10-1: Contaminated Site Summary Table

Site (GWRC File No)	Age/ Closure	Nature of Land Use	Identified/Potential Contaminants
Northern Landfill (SN/05/323/02)	2002	Refuse landfill	Hydrocarbons, metals, landfill gas
Cottles Landfill (SN/05/030/02)	1960s – 1980s	Refuse landfill	Hydrocarbons, metals, pesticides, herbicides, landfill gas
Pavements Asphalt Ltd (SN/05/118/02)	Current	Asphalt and bitumen production/storage	Hydrocarbons
Horokiwi Quarry (SN/05/121/02)	Current	Asphalt and bitumen production/storage	Hydrocarbons
Horokiwi Landfill	-	Refuse landfill (uncontrolled)	Hydrocarbons, metals, pesticides, herbicides, landfill gas
Ex Safety Kleen / ERS New Zealand (SN/03/106/02)	1996	Site of former Wellington Woollen Mill followed by waste treatment operators	Hydrocarbons
Disa Print / ex Pengellys (SN/03/130/02)	-	Service station, storage, commercial printing	Hydrocarbons, solvents
Mainfreight Logistics (SN/03/088/02)	Current	Prior: railway land, military stores, motor industries, timber storage.	
Current: storage, vehicle maintenance	Unknown; possible heavy metals, solvents, hydrocarbons		
Ex Wellington Foundry Ltd (SN/03/028/02)	-	Foundry, smelting, refining	Unknown; possible heavy metals
Ex Todd Motors / Bowland Petone (SN/03/102/02)	1975	Motor vehicle workshops	Unknown; possibly hydrocarbons
Ex Odlins Ltd / Te Puni Mail Centre (SN/03/006/02)	1926-1980s	Timber treatment	Heavy metals, arsenic

Asbestos is not identified as a contaminant at any of the sites identified in Table 10-1; 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 route. This will be followed at a later stage by detailed site investigations and laboratory testing, when the preferred alignment has been selected.

10.3 Seismic Hazards

10.3.1 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.

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

10.3.2 Fault Rupture

There is potential for the Wellington Fault to be located in close proximity to the P2G route in the vicinity of the interchange at Petone. The active trace of the Wellington Fault is indicated on geological maps to lie approximately 200 m from the interchange at Petone (IGNS, 1996). However, the exact location of the active fault trace, as well as the width and characteristics of the fault zone are not well known in the Petone area, which is a significant issue for the siting of any interchange structures.

The P2G route may also cross the Moonshine Fault as it is within the project area. The location, width, characteristics and form of the fault zone are poorly defined. This fault has a very long recurrence interval (>11,000 years) and accordingly has a very low probability of rupture. Therefore this fault is of lesser importance than the Wellington Fault to the selection of the P2G route and conceptual designs.

10.3.3 Earthquake Induced Slope Instability

The P2G route may traverse hills with moderate to steep slopes, particularly at the southern section between Petone and Horokiwi. Moderate to large earthquakes can lead to slope failures in steep to very steep slopes, including cuttings which are generally steeper than the natural hillslopes. The hillslopes in this area have been mapped as high susceptibility to earthquake induced landslides.

Large landslide blocks have also been identified in this area, such as the Ngauranga-Horokiwi gravity slide, which includes Gold's Landslide, and lies 0.5 km to the southwest of Horokiwi Quarry (Dellow, 1988). Strong ground shaking during the 1855 earthquake triggered slope failures in this area, such as Gold's Landslide near Horokiwi (Dellow, 1988).

10.3.4 Liquefaction

There is liquefaction potential around Petone, which reflects the variable compositions of the alluvial, marine and fan deposits. Liquefiable materials such as loose to medium dense silt, sand and gravel are likely to be present in the area around the Petone foreshore and possibly at the Cornish Street area at the bottom of the Korokoro Stream valley. Site investigations are required to quantify the liquefaction hazard and the consequences to the project, and to develop mitigation measures.

10.3.5 Tsunami

The Petone Interchange area is exposed to tsunami hazards. The remainder of the P2G route will likely climb above the tsunami evacuation zone from this point and accordingly the risk of tsunami inundation is very low.

10.4 Resilience

Resilience is a key objective for the project. In the context of the Wellington Region, given the limited number of routes and their poor resilience, the Petone to Grenada link road provides a valuable opportunity to enhance resilience of access for the Hutt Valley and the greater Wellington area. It is important to recognise that enhancing resilience is not just about reducing the vulnerability of the route, but also design, construct and operate it in a way that it can be quickly brought back into service after a damage causing event. It is important to consider options which can enable a holistic achievement of resilience.

The following factors need to be considered in the assessment of resilience of options:

- Ability to provide overall resilience of access in the region in the event of natural hazards; and
- Ability to provide alternative route in the event of operation and technological hazards such as hazardous spills or accidents, or wild fire.

The key issues affecting resilience in natural hazard events are:

- The relationship with the Wellington Fault Zone and the impact on the proposed road;
- Liquefaction and lateral spreading hazards and the impact on the route;
- Rock conditions along the route, steepness of the terrain along the route and the potential for landslides in earthquakes; and
- The extent of cuts and fills and their stability in earthquakes.

10.5 Geotechnical Engineering Issues and Solutions

Geotechnical issues have the potential to influence the development of the road alignment and form along the P2G route. The principal geotechnical engineering issues have been considered based on the outcomes of the desk study, review of regional geology and hazard maps, and the reconnaissance site visits. The principal issues and possible mitigation measures are provided in Table 10-2.

Table 10-2: Key Geotechnical Engineering Issues for the Petone to Grenada Link Road

Key Geotechnical Engineering Issues	Risk Management Measures and Possible Concepts
Petone • Proximity to active Wellington Fault • Variable ground conditions. • Shallow groundwater table. • Liquefaction hazard in earthquakes and impact on embankments and structures. • Foundations for structures at SH2 interchange. • Potentially contaminated ground • Stability, settlement and secondary compression of embankments on poor ground. • Ongoing settlement and hazards such as landfill gas.	• Geological investigations to confirm location, width and characteristics of the Wellington Fault zone. Locate structures away from fault zone. • Geotechnical investigations to confirm ground conditions and liquefaction hazard. • Site investigations to assess levels of contaminated land and risks to the proposed development. • Drainage of pavement through provision of sub-soil drainage.

Hillslope Areas • The degree of weathering and rock mass conditions. • Thickness and composition of any overburden deposits. • Stability of very high cuttings in fractured Wellington greywacke. • Stability of high embankment fills in steep terrain. • Earthquake and rainfall induced slope stability hazards.	• Geotechnical investigations to confirm degree of weathering, rock mass properties and the nature of rock defects. • Consider route alignment that minimises height of cuttings, and avoids areas of steep slopes. • Avoid large cuttings oriented parallel to regional geological structure, to reduce potential for adversely oriented defects.Geotechnical investigations to confirm degree and depth of weathering of rock mass.
Lincolnshire Farm • Degree and depth of weathering and rock mass conditions. • Properties and thickness of any overburden deposits (loess, colluvium) on the K-Surface remnant at the hilltop. • Stability of cuttings in highly weathered and fractured Wellington greywacke. • Thickness of compressible weak deposits in incised gullies.	• Geotechnical investigations to confirm ground conditions and thickness of overburden deposits. • Choose route alignment to avoid landfill area.
Northern Landfill • Road crossing areas underlain by refuse landfill on embankments • Variable and very poor ground conditions. • Thickness and properties of landfill materials.	• Geotechnical investigations to confirm the extent, thickness, composition and properties of landfill materials if unavoidable. • Preloading embankments where underlain by landfill materials to minimise post-construction settlements; Allow time for settlement during construction.
Grenada North • Variable ground conditions. • Foundations for structures at SH1 interchange. • Proximity to active Moonshine Fault. • Earthquake and rainfall induced slope stability hazards.	• Geotechnical investigations to confirm ground conditions. • Investigations to confirm location and width of Moonshine Fault zone. • Locate structures away from fault zone.

In addition to the specific issues identified in Table 10-2, the properties of the overburden materials and weathered greywacke materials and their suitability for use as construction fill is also a key issue that would influence earthworks quantities, cut/fill balance and the need for borrow and disposal sites.

The geotechnical issues described above in Table 10-2 can be resolved through:

- An appropriate level of geotechnical and investigations.
- Early consideration of issues during concept development and preliminary design.
- 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.

11

Physical Design Considerations

11 Physical Design Considerations

This chapter outlines the geometric standards and philosophy applied for the development of options for the P2G Scoping Report.

This chapter is broken down into the following topics:

- Design speed;
- Design standards, including horizontal and vertical design;
- Cross section;
- Barrier and median protection;
- Geotechnical considerations;
- Pavement / surfacing considerations;
- Drainage considerations; and
- Active user considerations.

11.1 Design Speed

The proposed design speed for the project is 80km/hr. This has been influenced by a number of design criteria including: terrain, horizontal and vertical alignment, compatibility with adjacent routes, comparable roads, traffic volumes and crash risks. Further information on the influence of the design criteria on design speed can be found in Appendix A. The 80km/hr design speed is supported by the initial option assessment work using Quantum which shows that alignments with an 80km/hr could have similar or lower earthworks volumes than the SKM PFR option. This is discussed further in Section 12.

11.2 Design Standards

The key design parameters that are achieved by the current design are listed in Table 11-1.

Table 11-1: Geometric Design Parameters

Design Guides:	Austroads Guide to Road Design Parts 3 and 6A
Design Speed:	80km/hr
Criteria	**Proposed Standards**
Horizontal Curves:	Curve Radius: 175m Maximum Superelevation: 8% (Table 7.5, Austroads Guide to Road Design Part 3)
Vertical Curves:	Minimum Sag Curve: 2800m Minimum Crest Curve: 2900m Minimum Curve Length: 80m (sag curve) Minimum Curve Length: 80m (crest curve) (Tables 8.7, 8.9 and Figure 8.7 Austroads Guide to Road Design Part 3)
Grade:	9.0% (Table 8.3, Austroads Guide to Road Design Part 3)
Sight Distance:	Minimum Sight Distance: 126 m (allowing for 8% grade (Table 5.4, Austroads Guide to Road Design Part 3)
Road Width	3.5m traffic lanes (with additional provision for vehicle tracking and curve widening) 2.0m minimum shoulder, 1.5m verge. (Table 4.6, Austroads Guide to Road Design Part 3)
Vertical Clearance, at significant road crossings	6.1m minimum (Figure A2, the NZTA Bridge Manual)

11.3 Cross Section

The minimum carriageway cross sections proposed for the project are shown in Figure 11-1.

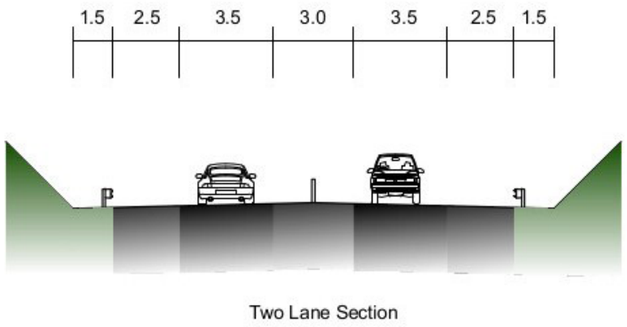


Figure 11-1: Proposed Minimum Carriageway Cross Sections

Figure 11-1 includes a six lane cross section proposed for steep sections of the route. Based on our speed profile analysis, HCVs are likely to crawl up and down the steep sections of the route at just 20km/hr. A crawler lane will be needed to prevent HCVs slowing other traffic, a condition that would erode economic benefits and impact on safety. To reduce the earthworks required to accommodate six lanes, we have proposed that the crawler lane utilise part of the road shoulder. This is illustrated in the six lane section on Figure 11-1. Figure 11-1 also illustrates that further optimisation of the carriageway cross section is proposed by replacing clear zones with crash barriers in line with a safe system approach.

11.4 Barrier and Median Protection

In line with the safe systems approach, it is proposed that median and edge protection barriers are provided. At this stage it is anticipated that this will include TL-3 W-section guardrail edge protection and TL-4 wire rope median protection.

11.5 Geotechnical Considerations

The project area is divided into reasonably distinct geological units. Therefore the geometric design will be influenced by the specific geotechnical issues associated with each geological unit as described in Section 10.

The cut and fill design should be based on information from geotechnical investigations along the route. Until the geotechnical investigations are carried out, it would be appropriate to use the following preliminary design for the development and comparison of options:

i. Cuttings – In rock, formed at 45° (1H:1V), with 3 m wide benches formed at 10 m height intervals, and some allowance made for targeted stabilisation of rock using rock anchors, rock bolting and mesh, and sub-horizontal drainage holes. In soil, formed at 26° (2H:1V) and rounded at the top of the cuttings.

ii. Embankments – Formed at 26° (2H:1V), with 3 m wide berms at 10 m height intervals. Where these cannot be fitted into the terrain, reinforced soil embankments may be adopted with steeper 45° (1H:1V) slopes and using geogrid reinforcement.

iii. Bridges requiring abutment walls incorporate Reinforced Soil Walls with inextensible (steel) reinforcement.

iv. At Petone, bridge structures should be piled with ground improvements under the bridge abutments to provide protection against liquefaction.

11.6 Pavement / Surfacing Considerations

Pavements will be designed based on the ground conditions encountered. Surfacing will be a chip-seal. Best practice design and construction will ensure that the chip seal performs appropriately on the steep grades with HCV demands. Stone mastic asphalt (SMA) or thin asphalt surfacing may be considered for the HCV crawler lanes.

11.7 Drainage Considerations

The drainage design will need to include short term stormwater control systems (temporary erosion and sediment control) and permanent stormwater systems. The design of these systems will need to consider statutory and territorial authority requirements.

The drainage system adopted will vary depending mainly on the terrain, ground conditions, scale of cuts and fills and the carriageway gradient.

The southern section of the project area consists of complex terrain comprising steep hill slopes and deeply incised gullies underlain by greywacke bedrock. The carriageway formation through this section is expected to be characterised by deep cuts, large embankment fills and steep gradients. Consequently the drainage system will need to be designed appropriately to accommodate these challenging characteristics. The permanent drainage design through this section is likely to comprise the following features:

- Clean water diversion drains at the tops of road cuts either directed away from carriageway formation or directed towards a permanent reticulation system for discharge;
- Channel drains at the bottom of road cuts with high capacity inlets to convey stormwater to a piped network. These may comprise rockfall channel drains at large cuts to address the weathering and washing down of rocks at the bottom of cuts over time and prevent loose rocks from entering the carriageway (these may need to be protected by road side barriers);
- Kerb and channel drains at embankment fills at the edge of seal to convey stormwater to a piped network or stabilised point of discharge (existing watercourse);
- Cross carriageway drains (culverts) to convey stormwater downslope of the carriageway formation and discharge to stabilised point of discharge (existing watercourse);
- Rock armouring or dissipation structures at all outlets where the outlet pipe is steep or forms a new watercourse;
- Stormwater treatment retention devices if required by the territorial authority. These may include retention ponds or proprietary devices;
- Culverts through embankment fills which intercept watercourses;
- Pavement drains at the edge of the carriageway in road cuts; and
- Tracks providing access to stormwater assets for routine maintenance.

The remaining section of the project area consists of less complex terrain comprising areas of broad, undulating hilltops. However, steep sloping incised gullies remain in some areas. The permanent drainage design through this section is likely to be similar to the southern section, as the carriageway formation is likely comprised of some deep cuts, large embankment fills and steep gradients. However there could be sections of carriageway formation with gentle gradients on gently undulating terrain. Along these sections of carriageway the permanent stormwater design is likely to comprise the following features:

- Kerb and channel drains at the bottom of road cuts to cross carriageway drains or turn outs at controlled outlets; and
- Non-reticulated system to convey stormwater over stabilised embankment to swale or land drains at the toe of embankment fills (discharged to stabilised locations).

Short term stormwater control systems will be designed to avoid, remedy or mitigate potential adverse effects on the environment from any erosion, sediment and dust discharges during the construction and commissioning phase. Features of the short term stormwater control system are likely to include:

- An environmental management plan process that identifies the processes and the techniques to control erosion and sediment generation to ensure effective environmental management of the site;
- Location specific activities which identify the type, size and location of the erosion and sediment control measures which may include sediment retention ponds, silt fences, earth decanting bunds, cut off drains, flumes and energy dissipation devices; and
- Subsoil drains under carriageway formation to manage groundwater.

11.8 Facilities for Pedestrians and Cyclists

The Petone to Grenada Link Road is not expected to be along a major desire line for cyclists. The route is very steep in some sections, with up to 9.0% grades as indicated in Table 11-1. There are also safety issues for cyclists sharing the road space with respect to the high volumes of HCVs and speed limits of 80km/hr. As seen in Figure 11-1, it has been proposed that the shoulder width be reduced to one metre for the six lane cross section in order to accommodate crawler lanes for HCVs. For speeds of 80km/hr, Austroads Guide to Road Design Part 3 (Section 4.8) suggests a desirable clearance from the traffic lane to the 'cyclist envelope' of 1.5m. The cyclist envelope (1m) allows for the width of a bicycle as well as slight variations in tracking and for the side to side movement made when riding uphill. The one metre shoulder through the six lane section means that 1.5m will not be provided through this section. Additional excavation would be required to provide 1.5m or a separate facility.

For these reasons, it may be preferable that any provision for cyclists should be in the form of a separate off-road shared use facility. The proposed cross section with shared use facility has been illustrated in Figure 11-2. Austroads also suggests limiting gradients to 3%, or a maximum of 5% for cyclists. As these grades are unachievable for the P2G Link Road, it may be unlikely that this facility would be used by cyclists. The traffic volumes and nature of the road may also deter pedestrians from using the shared used path for recreational purposes. Therefore, further investigation may be required to determine whether or not this facility is necessary. Transmission Gully, which passes through similar terrain and is not an expected desire line has not proposed any specific facilities for pedestrians and cyclists.

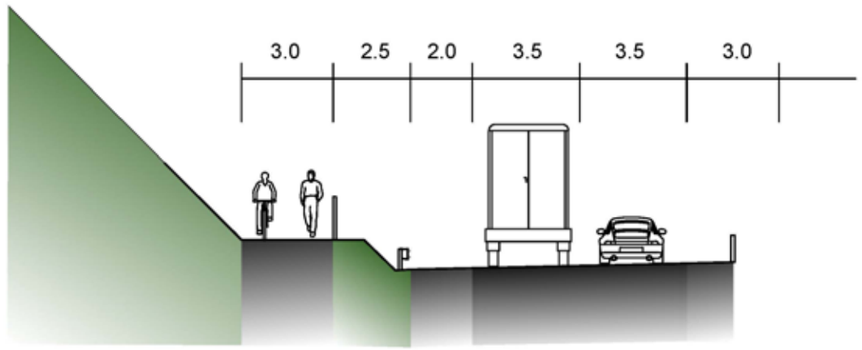
The New Zealand Household Travel Survey 2009-2012 provides information on average cycling and walking trip length. These trip lengths are summarised in Table 11-2. Using an approximate route length of 6km for the P2G Link Road, cycle trips from communities on SH2, such as Grenada, to Petone would be longer than the average cycling trip distance for adults. The Lincolnshire Farm development would be approximately 3km from Petone or Grenada. Based on distance alone, it may be feasible that some adults would travel via bicycle to locations within a few kilometres of the interchanges. However, the grades discussed previously would discourage some potential cyclists. The average walking distances are well below the trip lengths discussed above.

Table 11-2: New Zealand Average Walking and Cycling Trip Lengths

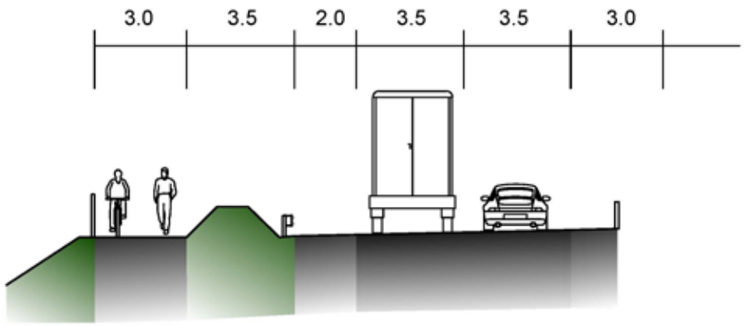
Age Groups	Walking [1]	Cycling [2]
Children (5-12)	0.83km	1.4km
Adolescents (13-17)		2.6km
Adults (18+)	0.78km	4.9km

Providing provision for cyclists as shown in Figure 11-2 below will involve widening the carriageway formation resulting in additional earthworks. The additional cost of this has been estimated at approximately $10M.

1 Based on median walking trip time and 1.5m/s walking speed. Source Walking in New Zealand.
2 Source Cycling in New Zealand.



Cycle and Walking in Cut



Cycle and Walking in Fill

Figure 11-2: Proposed Carriageway Cross Section with Off Road Shared Facility

12

Introduction to the Options

12 Introduction to the Options

12.1 Option Development Process

In March 2013 a one day Design Surgery Workshop was held with the project team and key stakeholders from NZTA, HCC, WCC and GWRC. The workshop was held to engage and involve key stakeholders at the early option development phase of this project. At the workshop early assumptions were challenged while issues and opportunities were explored. By the conclusion of the workshop the project objectives were ratified and the basis of design was established. A summary of the key outcomes were:

i. Likely to adopt a design speed of 80km/hr;

ii. The proposed PFR alignment between Petone and SH1 at Tawa is very challenging from a geometric and safety point of view;

iii. Early analysis indicates that there may be alignments that are cheaper than the PFR alignment;

iv. There are several challenges facing a connection at Petone with respect to the coastal escarpment and the Korokoro Valley;

v. The Lincolnshire Farm Structure Plan provides for the P2G Link Road, but does not constrain the location of the link road;

vi. A connection to TG is worth considering as it may be cheaper and it achieves increased transportation benefits, particularly for HCVs; and

vii. A "Beach to Bush" link should be investigated as part of this project.

Following this workshop four options were developed with variance at Petone, namely:

i. Option A: Petone to Grenada (Full Interchange);

ii. Option B:Petone to Tawa (North Facing Ramps to SH1);

iii. Option C: Petone to Tawa (Full Interchange); and

iv. Option D: Petone to TG (Including Links to Grenada Interchange and Tawa Interchange).

12.2 Early Economics to Test Connections to Transmission Gully

Alignments between Petone and SH1 in the vicinity of Tawa traverse very steep terrain and will include steep gradients. This is evident by the PFR alignment between Petone and Tawa which comprises steep gradients, of approximately 9%, along the majority of route. Steep gradients reduce travel speeds, increase travel time and therefore increase vehicle operating costs for HCVs. Given vehicle operating costs are a significant contribution to economic benefits, particularly for HCVs, we developed a simple economic model to analyse the impact of steep gradients on vehicle operating costs and travel time for HCVs by comparing the PFR route with longer and shallower routes. Three options, between Petone Interchange on SH2 and Takapu Interchange on TG, were assessed:

i. Existing SH2 from Petone to Ngauranga, SH1 to Kenepuru, and TG to Takapu;

ii. P2G PFR route from Petone to Tawa, SH1 to Kenepuru, and TG to Takapu; and

iii. New route from Petone to TG at Takapu.

These options are illustrated in Figure 12-1.

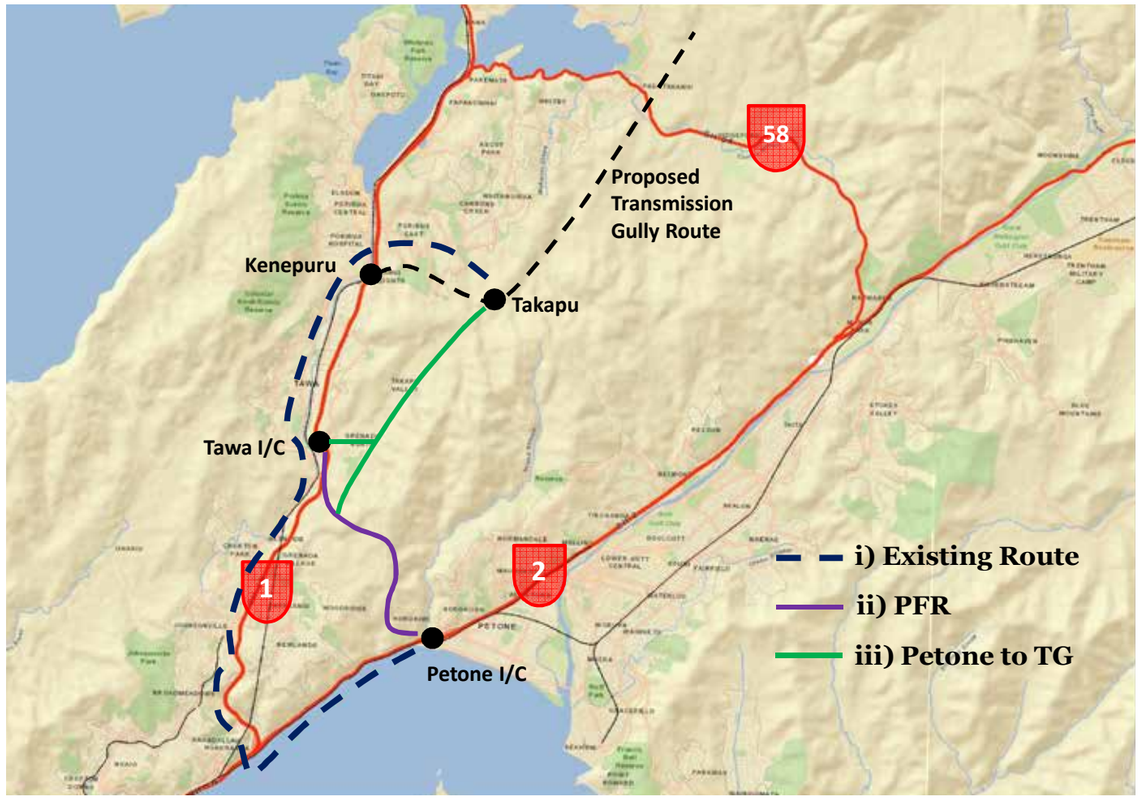


Figure 12-1: Option Comparison from Petone to TG

The analysis showed that both the PFR route and the new route to TG are shorter and have lower travel times for HCVs than the existing route along SH1 and SH2 route between Petone and Takapu. This is despite the lower average speeds from sustained high grades in the southern section of the route for both the PFR route and the new route to TG.

In terms of total cost, the new Petone to TG route is estimated to be around 20% more efficient than the PFR route and around 40% more efficient than the existing route for HCVs. The results indicate clearly that a shorter and steeper route is favoured, based on HCV travel costs, over a longer and shallower route.

On this basis we included a new route from Petone to TG at Takapu in the option evaluation process. Full details of the HCV on Grades Analysis are provided in Appendix B.

12.3 Using Quantm to Develop Options

12.3.1 Introduction

Some of the key objectives of this project are to provide a transportation route which improves the efficiency of the transport network, minimises impact on the environment and maximises value for money. To assist with identifying and assessing options we have utilised a rapid geometric route option software tool, known as Quantm.

Quantm is an alignment planning tool, owned by Trimble, which can generate multiple alternative 3D alignments between points using complex route optimisation technology. This tool integrates design standards, terrain contour data, cost information and any other data (selected by the team) simultaneously to return a range of the best options for review.

The purpose of this section is to summarise the process and findings, using Quantm, to generate, compare and select feasible route options for evaluation at the Options Evaluation Workshop. The team designed several tests to reach a view on:

i. The design speed that should be adopted for the scheme;

ii. Whether there were alternative cheaper alignments to that proposed by the PFR connecting Petone to Tawa;

iii. Whether there were alternative cheaper southern connections to the Hutt Valley to the connection at Petone proposed by the PFR;

iv. Whether it would be cheaper to pass through the Belmont Regional Park or landfills than try to avoid them; and

v. The most feasible route alignments, if the northern connection was extended to Transmission Gully.

12.3.2 Quantm Assumptions & Process

The purpose of this section is to outline the assumptions we used for Quantm and how Quantm was used to generate feasible route options.

12.3.2.1 Quantm Assumptions

The assumptions adopted for Quantm which have been integrated into the model include:

i. Preliminary geometric design criteria;

ii. Terrain contour data;

iii. Cost information;

iv. Landfill areas; and

v. Environmental areas.

Preliminary Geometric Design Criteria

The preliminary geometric design criteria adopted for Quantm is summarised in Table 12-1.

Table 12-1: Preliminary Design Criteria

Design Aspect	Preliminary Criteria Adopted
Horizontal Curvature	100km/hr design speed: Min horizontal radius = 410m Max super elevation = 8% Min sight distance = 179m K Crest = 36 K Sag = 16 80km/hr design speed: Min horizontal radius = 175m Max super elevation = 8% Min sight distance = 126m K Crest = 36 K Sag = 10 60km/hr design speed: Min horizontal radius = 410m Max super elevation = 8% Min sight distance = 81m K Crest = 15 K Sag = 6
Gradient	Max grade = 8%
	Max sustained grade = 5% over 3km
Cut Slopes	1H:1V
Fill Slopes	2H:1V
Road Cross Section	4 x 3.5m lanes, 3m median, 2m outer shoulders, 1.5m verges

Terrain Contour Data

The terrain contour data comprised the latest LiDAR data from Wellington City Council, Hutt City Council and Porirua City Council.

Cost Information

The cost information assumed in the model is shown in Table 12-2. The cost information is based on averaging cost rates from a range of green field projects. The rates are based on earthworks costs and used to develop costs only as a means of comparing alignments.

Table 12-2: Cost Information

Earthworks Activity	Cost	
	Cut to Fill/Disposal/Stockpile ($/m3)	Haul Cost ($/m3/km)
Cut Top 300mm Topsoil to Stockpile	2.1	0.48
Cut to Fill Next 5m of Material	8.3	0.48
Cut to Disposal Next 5m of Material	8.2	0.48
Cut to Fill Remainder of Material	10.4	0.48
Cut to Disposal Remainder of Material	10.3	0.48

Quantm includes a haulage cost to the cut to fill/disposal/stockpile costs. Quantm assumes all of the material is of a similar quality and is either fill or disposal in each section. In this model the haulage costs associated with cut to disposal and cut to stockpile were based on the assumption that the disposal and stockpile sites were located at either end of each alignment. Under this assumption Quantm selects the disposal or stockpile location at the closest end of the alignment when determining haulage costs.

Landfill Areas

There are several landfills in the study area. These landfill areas are identified in Figure 12-2 and discussed in the Preliminary Geotechnical Appraisal Report. Based on experience from other projects we know there can be considerable costs associated with running an alignment through landfills particularly with consenting, treatment and material re-deposition. These landfill areas have been included in the Quantm model and can be selected as areas to avoid (constraint) in the tests identified in Section 12.2.

Environmental Areas

The southwest section of Belmont Regional Park is within the study area and identified on Figure 12-2 with landfill areas. The Belmont Regional Park contains significant landscape, ecological and geological features and associated values which are flagged in regional and local government statutory and non-statutory policy documents. This area has been included in the Quantm model and can be selected as an area to avoid (constraint) in the tests identified in Section 12.2.

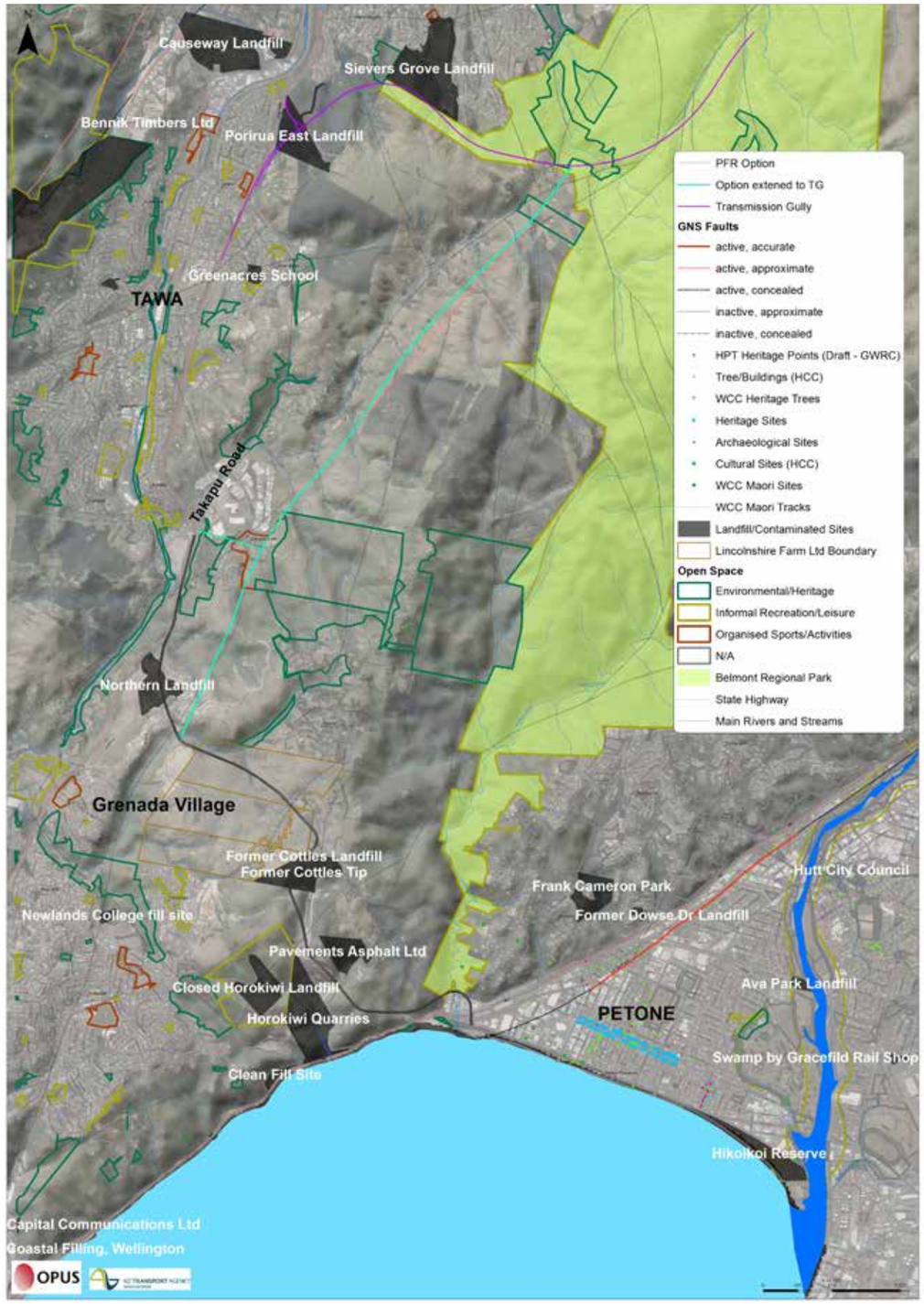


Figure 12-2: Study Area Features Map Showing Landfills and Environmental Areas

12.3.2.2 Quantm Process

As described in Section 12.3.1, Quantm is a tool which can quickly generate numerous alignments between points and return a range of options for review. The process we have applied includes:

i. Setting up the Quantm model using inputs described above;

ii. Inputting the PFR alignment as the baseline for comparing with alternative alignments;

iii. Running Quantm for the various tests identified in Section 12.2;

iv. For each test reviewing the 25 best alternative alignments returned by Quantm against the PFR alignment (Note Quantm typically returns 10 to 50 of the best alternative alignments);

v. Undergoing further refinements to the 25 alignments returned by Quantm;

vi. Selecting the 10 best alignments, based on lowest cost, which best represent the range of options returned from the previous step;

vii. Comparing the 10 best alignments selected above with the PFR alignment based on a cost comparison against the PFR alignment; and

viii. Presenting the results of each test in the form of a plan which shows the 10 best alignments, including the PFR alignment, each colour coded and linked to a legend which identifies the proportional cost of each alignment to the PFR alignment.

12.3.3 Selecting Scheme Design Speed

A safety report had confirmed that we should be adopting a design speed of 80km/hr or more. The purpose of this test was to determine how adopting different speeds would impact on the cost of the project. This was a particularly important question given the challenging topography.

Quantm was used to test the difference in cost between alignments with design speeds of 60km/hr, 80km/hr and 100km/hr following the process described in Section 12.3.2.2 above and adopting the preliminary design criteria in Table 12-1. The landfill and environmental areas were not included in these tests as areas to avoid (constraints) given the purpose of these runs was to compare the relative costs between design speeds.

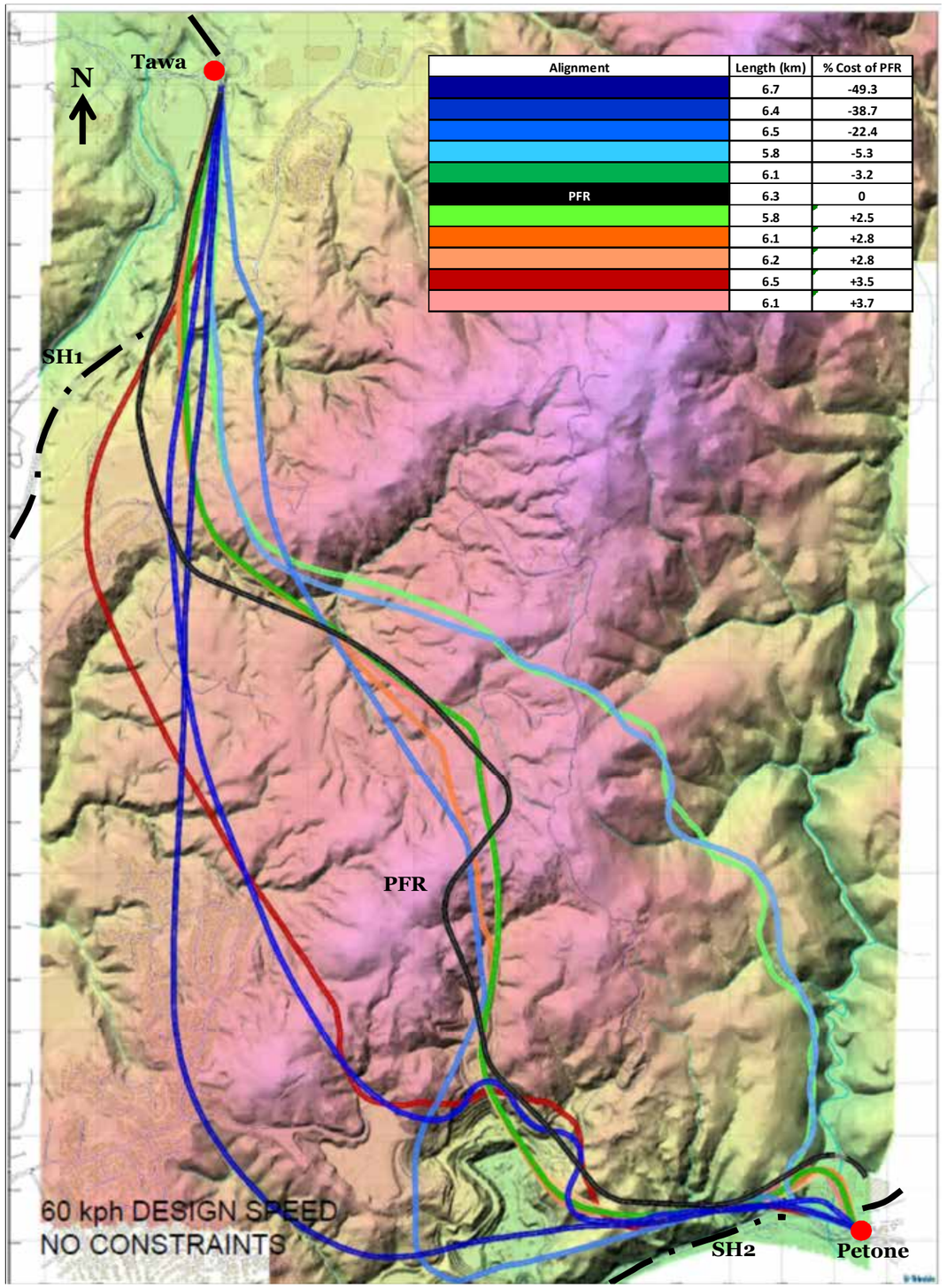
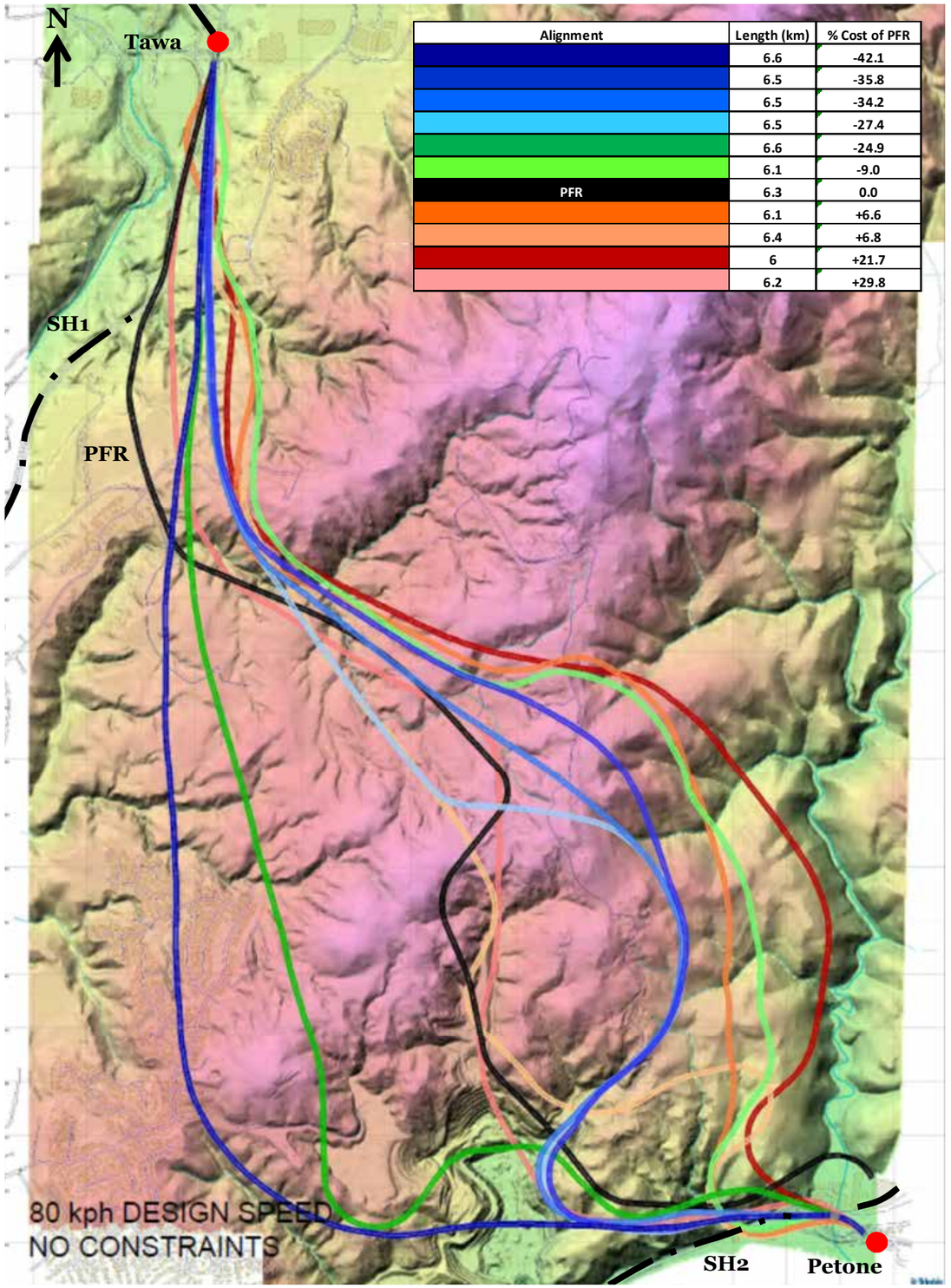


Figure 12-3: 60km/hr Design Speed

The results for the 60km/hr are shown in Figure 12-3. This figure plots the ten best alignments found by Quantm and compares them with the PFR alignment, which is shown in black. The alignments that are cheaper than the PFR alignment are coloured blue while those that are more expensive are coloured red. Those that have a similar cost are coloured green. While a number of alignments generated by Quantm follow the PFR alignment, Figure 12-3 shows that Quantm found a number of alternatives that vary from the PFR.

Figure 12-3 also compares the length and cost of each alignment with the PFR alignment and shows that the cheaper alignments are slightly longer than the PFR alignment. Quantm found the blue alignments are up to 50% cheaper than the PFR alignment. The results from Quantm for the design speeds of 80km/hr and 100km/hr are shown in Figure 12-4 and Figure 12-5.



Alignment	Length (km)	% Cost of PFR
	6.6	-42.1
	6.5	-35.8
	6.5	-34.2
	6.5	-27.4
	6.6	-24.9
	6.1	-9.0
PFR	6.3	0.0
	6.1	+6.6
	6.4	+6.8
	6	+21.7
	6.2	+29.8

Figure 12-4: 80km/hr Design Speed

Similarly Quantm returned a range of alignments both to the east and west of the PFR alignment that were cheaper than the PFR for design speeds of 80km/hr as shown in Figure 12-4. The alignments that are cheaper than the PFR alignment are coloured blue and green while those that are more expensive are coloured red. Like the results for the 6okm/hr design speed Quantm found the blue alignments are up to 50% cheaper than the PFR alignment. Quantm also demonstrated that there was only a minor increase in cost by increasing the design speed from 60km/hr to 80km/hr.

For a design speed of 100km/hr Quantm returned only one alignment that was cheaper than the PFR alignment as shown in Figure 12-5. This alignment was not only longer than the PFR option but also adversely impacts on the residential suburbs of Newlands and Woodridge as shown in Figure 12-5. The remainder of alignments returned by Quantm are between 11% and 227% more expensive than the PFR alignment.

Overall the results indicate there is only a minor increase in cost between 60km/hr and 80km/hr, but a significant increase in cost between 80km/hr and 100km/hr. These results support the findings of the safety report that an 80km/hr design speed should be adopted for this project. As a result we have adopted an 80km/hr design speed for all options going forward.

12.3.4 Testing Alignments between Petone & Tawa

The PFR alignment runs between Petone on SH2 to the south and Tawa on SH1 to the north. We have used Quantm to test if cheaper alignments exist between these two locations for two scenarios:

a. Scenario 1
    i. 80km/hr design speed; and
    ii. No constraints (landfills and the Belmont Regional Park not areas to avoid).

b. Scenario 2
    i. 80km/hr design speed; and
    ii. Constraints (landfills and the Belmont Regional Park as areas to avoid).

12.3.4.1 Scenario 1 – No Constraints

The results of this test are shown in Figure 12-6. Figure 12-6 illustrates that there are a range of alignments both to the east and west of the PFR alignment which are up to 42 % cheaper than the PFR alignment.

Two alignments cheaper than the PFR run to the west of the PFR. The cheapest runs across the quarry and bisects the residential suburb of Woodridge as it heads north to Tawa. Five other alignments which are up to 35% cheaper than the PFR run to the east of the PFR and avoid the quarry. Only one alignment, which is approximately 22% more expensive than the PFR, runs through the western edge of the Belmont Regional Park.

The trends which come through Scenario 1 are:

i. Alignments to the west of the PFR are cheaper than the PFR but cut across the quarry. They are longer and can also bisect residential suburbs;
ii. The majority of alignments to the east of the PFR are cheaper than the PFR and follow a similar pattern from Petone to Tawa, best described as an inverted 'S'. The pattern typically involves climbing eastward from Petone, curving back to the northwest before reaching the quarry then heading northeast to Tawa; and
iii. Alignments which pass through Belmont Regional Park are more expensive than the PFR.

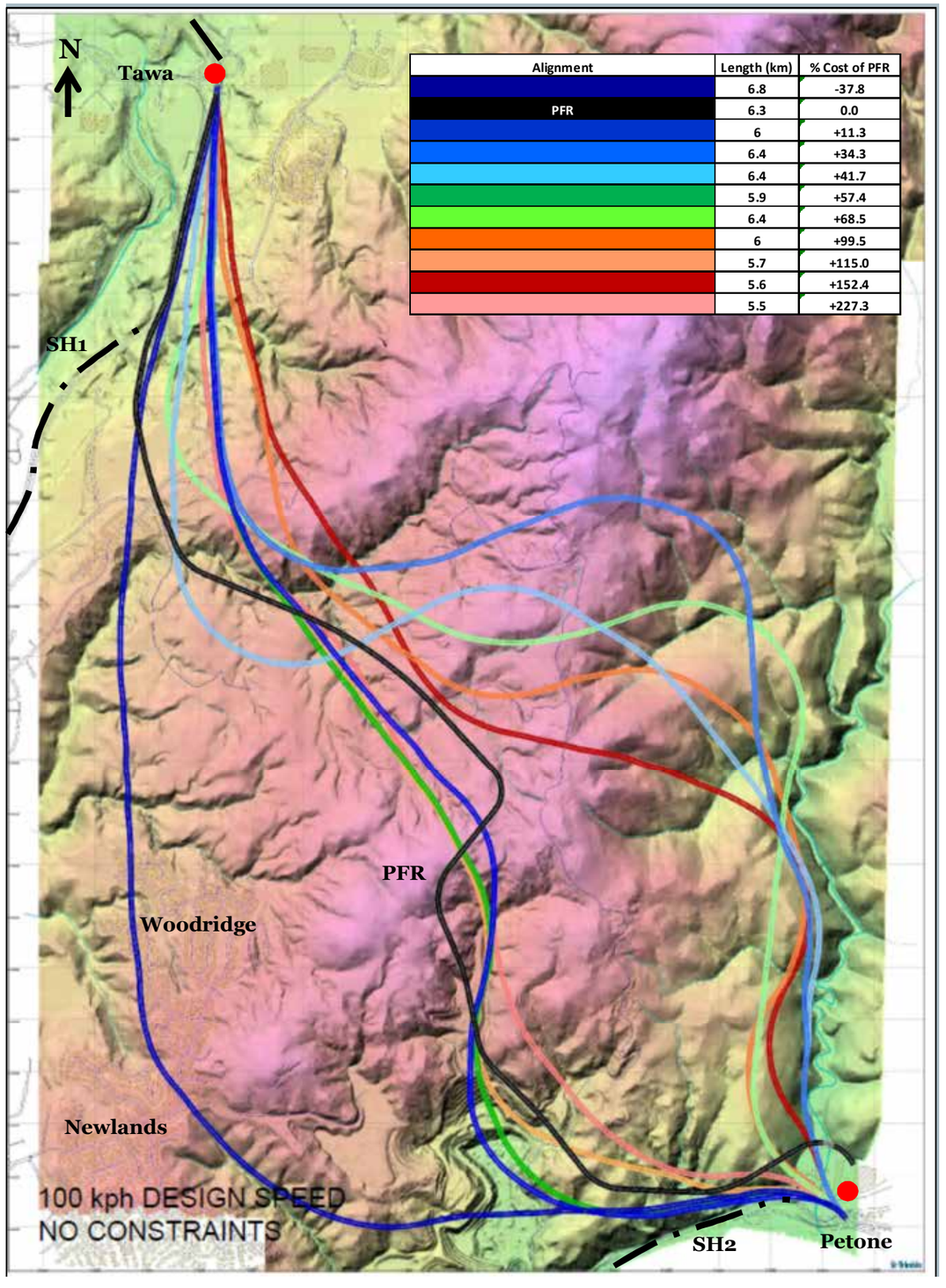
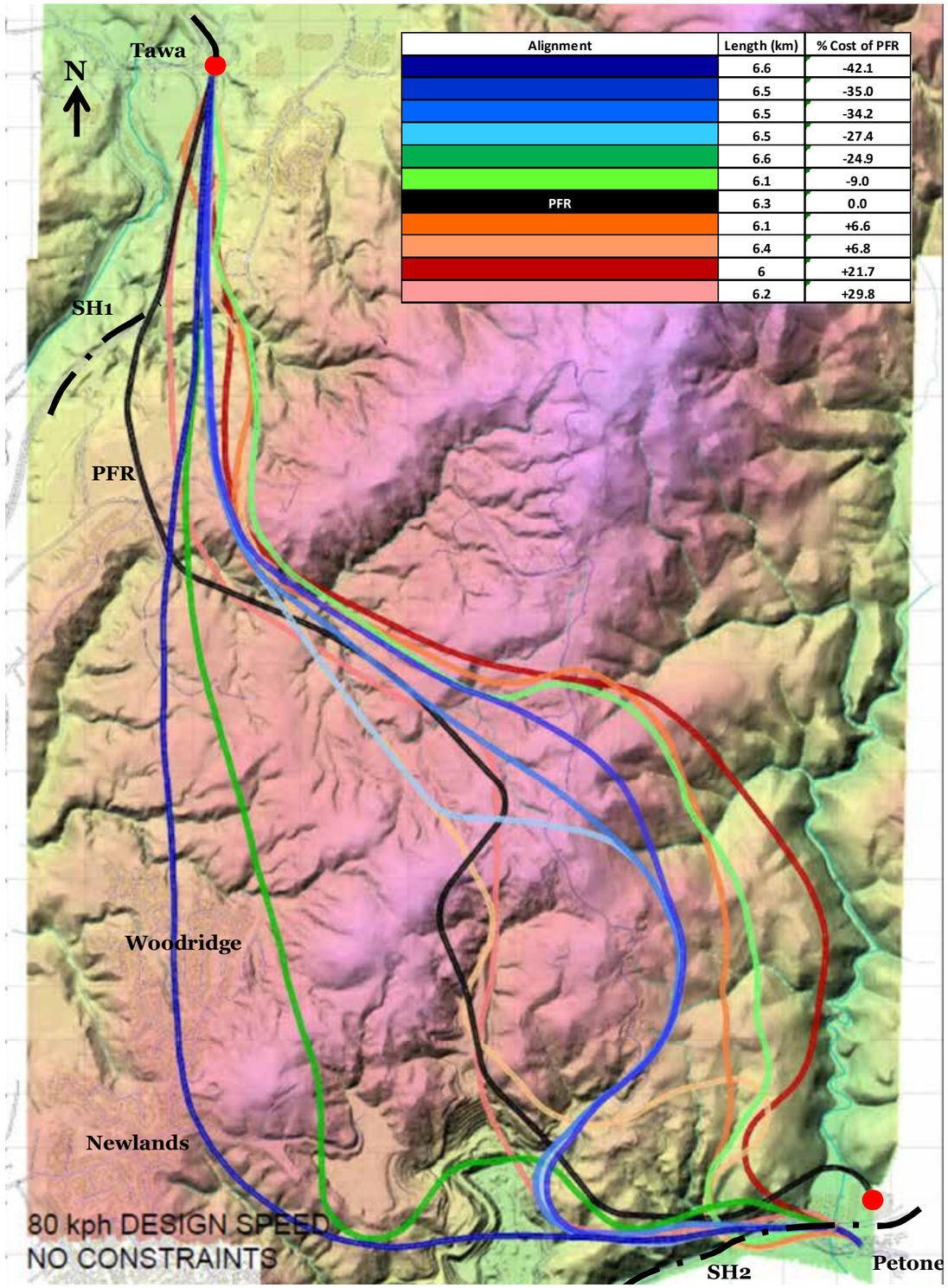


Figure 12-5: 100km/hr Design Speed



Alignment	Length (km)	% Cost of PFR
	6.6	-42.1
	6.5	-35.0
	6.5	-34.2
	6.5	-27.4
	6.6	-24.9
	6.1	-9.0
PFR	6.3	0.0
	6.1	+6.6
	6.4	+6.8
	6	+21.7
	6.2	+29.8

Figure 12-6: Scenario 1 -Petone to Tawa (No Constraints)

12.3.4.2 Scenario 2 –Constraints (Landfills & Belmont Regional Park)

The results of this test are shown in Figure 12-7. Figure 12-7 illustrates that even with constraints all the best alignments returned by Quantm are up to 46% cheaper than the PFR.

Figure 12-7 shows that by introducing landfills as constraints the majority of alignments returned by Quantm follow an inverted 'S' pattern from Petone to Tawa as described in Scenario 1. Figure 12-7 also shows that introducing the Belmont Regional Park as a constraint has little impact on the alignments returned by Quantm. This is evident in the Figure 12-6 under Scenario 1 in which Quantm only returned one alignment through Belmont Regional Park and this alignment was more expensive than the PFR.

The trends which come through Scenario 2 are:

i. It is cheaper to avoid landfills than to pass through them as made evident by the PFR alignment which passes through two landfills and is the most expensive alignment shown in Figure 12-7;

ii. It is cheaper to avoid the Belmont Regional Park than pass through it; and

iii. The cheapest alignments follow an inverted 'S' pattern and remain to the east of the PFR alignment for the majority of the route between Petone to Tawa.

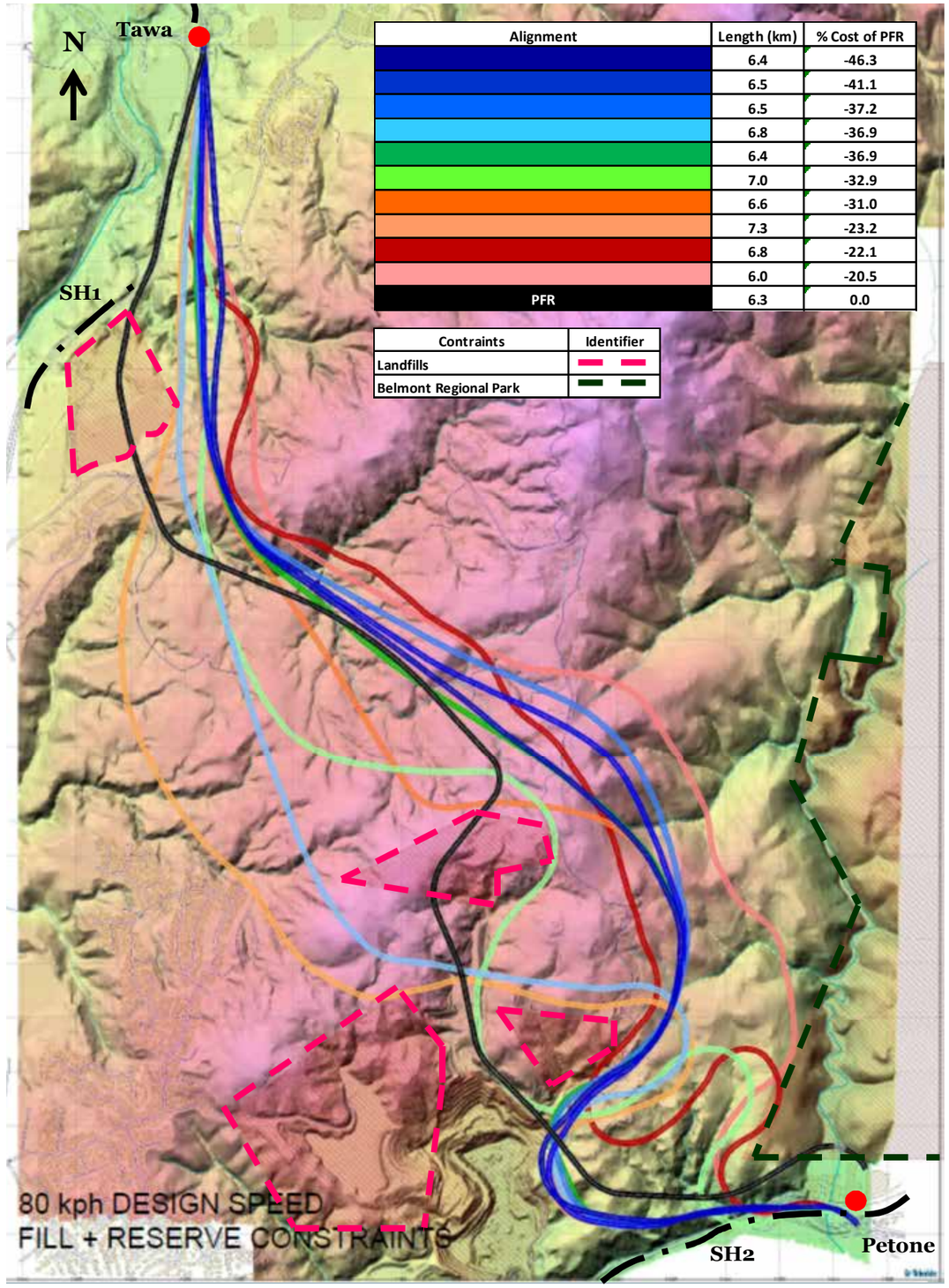


Figure 12-7: Scenario 2 – Petone to Tawa (Constraints)

12.3.5 Testing Alternative Southern Connections

The PFR alignment proposes a connection to SH2 at Petone as the link to the Hutt Valley. We have used Quantm to test if cheaper connection points exist at SH2. The alternative connection points tested are listed below and illustrated in Figure 12-8.

i. SH2/Dowse Interchange;

ii. SH2/Korokoro Crescent Intersection; and

iii. SH2/Horokiwi Road Intersection.

The alternative connections were tested following the process outlined in Section 12.3.2.2 above.

Figure 12-8: Alternatives to SH2 Connection at Petone

12.3.5.1 Alternative Connection 1 – SH2/Dowse

The assumptions adopted for Alternative Connection 1 included an 80km/hr design speed and allowing routes to pass through landfill areas and the Belmont Regional Park. The results of this test are shown in Figure 12-9.

Figure 12-9 shows that not only are all the alignments more expensive than the PFR but they all dissect the Belmont Regional Park and all go through residential areas, apart from one. The only alignment which does not go through residential areas is

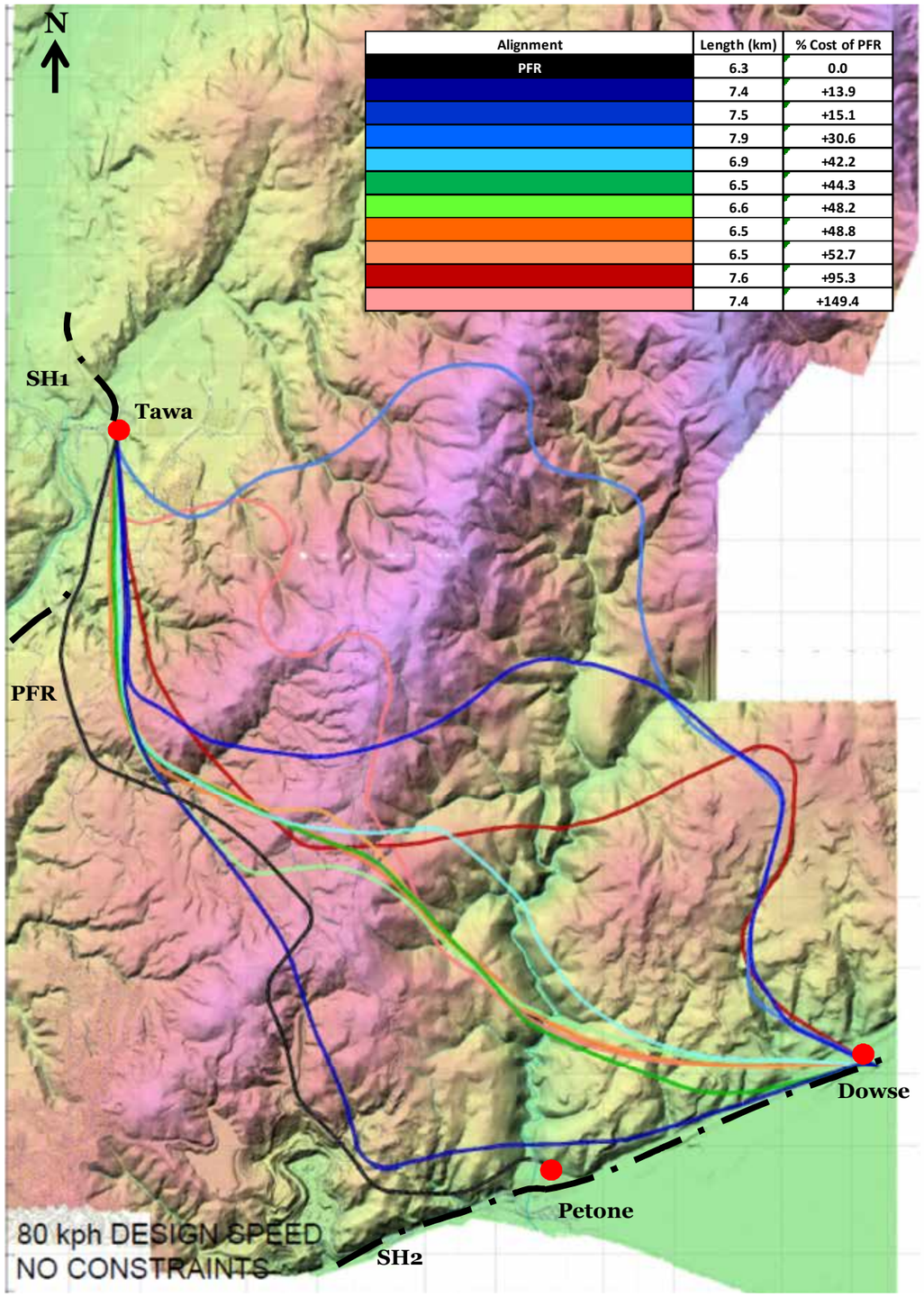


Figure 12-9: Alternative Connection 1 – SH2/Dowse

the cheapest of the alternative alignments (dark blue). This alignment actually follows SH2 westward before climbing upwards through the escarpment east of Petone. The cost of these alternative alignments range between 14% and 150% more expensive than the PFR cost.

This alternative connection has been ruled out on the basis that the best alignments generated by Quantm:

i. Cost more than the PFR alignment;

ii. Dissect the Belmont Regional Park; and

iii. Pass through residential areas (apart from one).

12.3.5.2 Alternative Connection 2 – SH2/Korokoro Crescent

The assumptions adopted for Alternative Connection 2 are identical to those for Alternative Connection 1. The results of this test are shown in Figure 12-10.

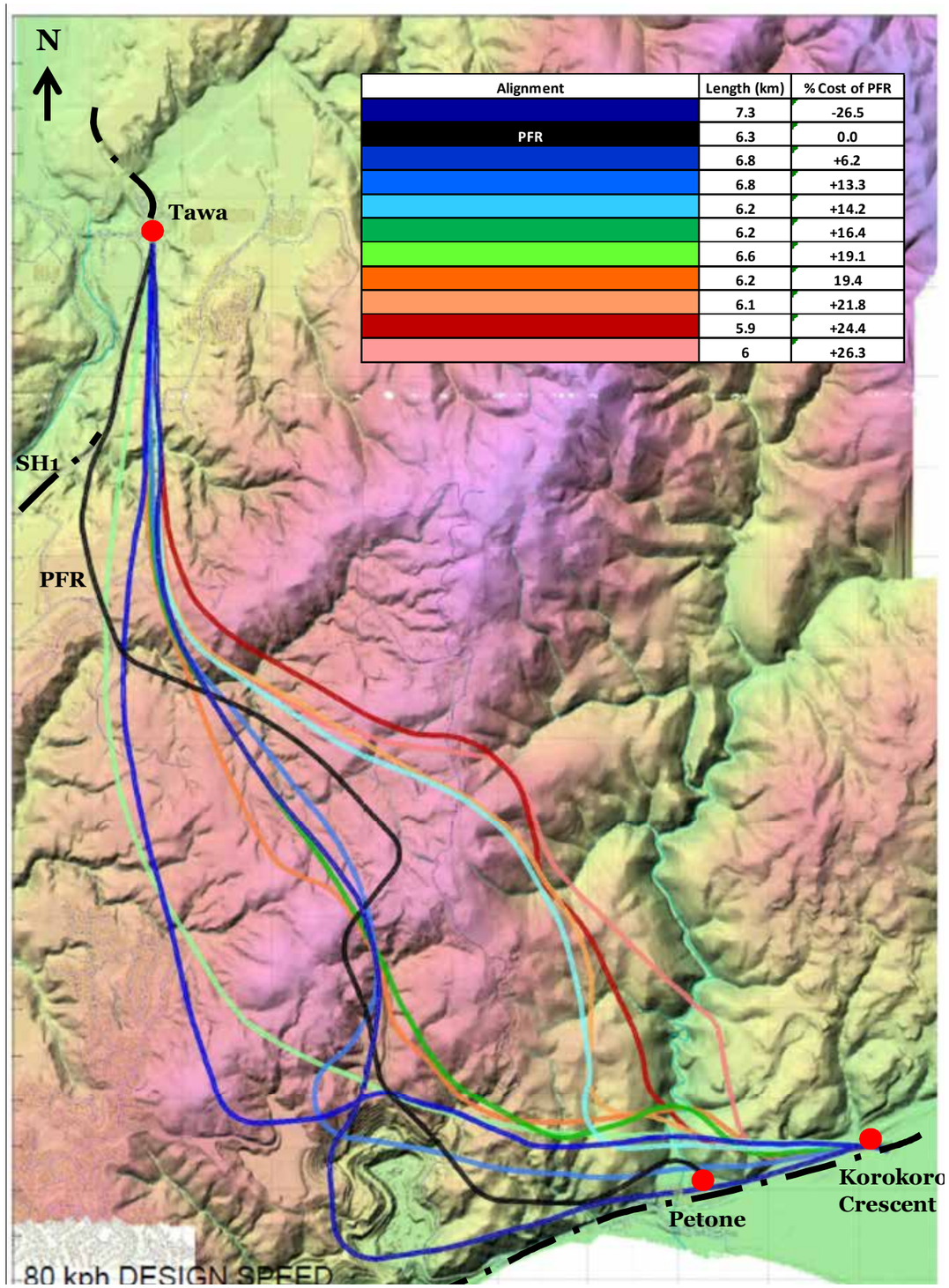
Figure 12-10 shows that all the alignments are more expensive than the PFR apart from one. The alignment which is cheaper than the PFR travels west along SH2 to Petone and uses Petone as a starting point before climbing up towards Tawa. We can infer from this that a connection at Petone is cheaper.

The remaining 9 alignments, which start their climb immediately at Korokoro, range between 6% and 26% more expensive than the PFR alignment. Additionally they cross the Korokoro Valley Stream and the Belmont Regional Park.

This alternative connection has been ruled out on the basis that the best alignments generated by Quantm, which effectively start at Korokoro:

i. Cost more than the PFR alignment; and

ii. Pass through the Korokoro Valley Stream and Belmont Regional Park.



Alignment	Length (km)	% Cost of PFR
	7.3	-26.5
PFR	6.3	0.0
	6.8	+6.2
	6.8	+13.3
	6.2	+14.2
	6.2	+16.4
	6.6	+19.1
	6.2	19.4
	6.1	+21.8
	5.9	+24.4
	6	+26.3

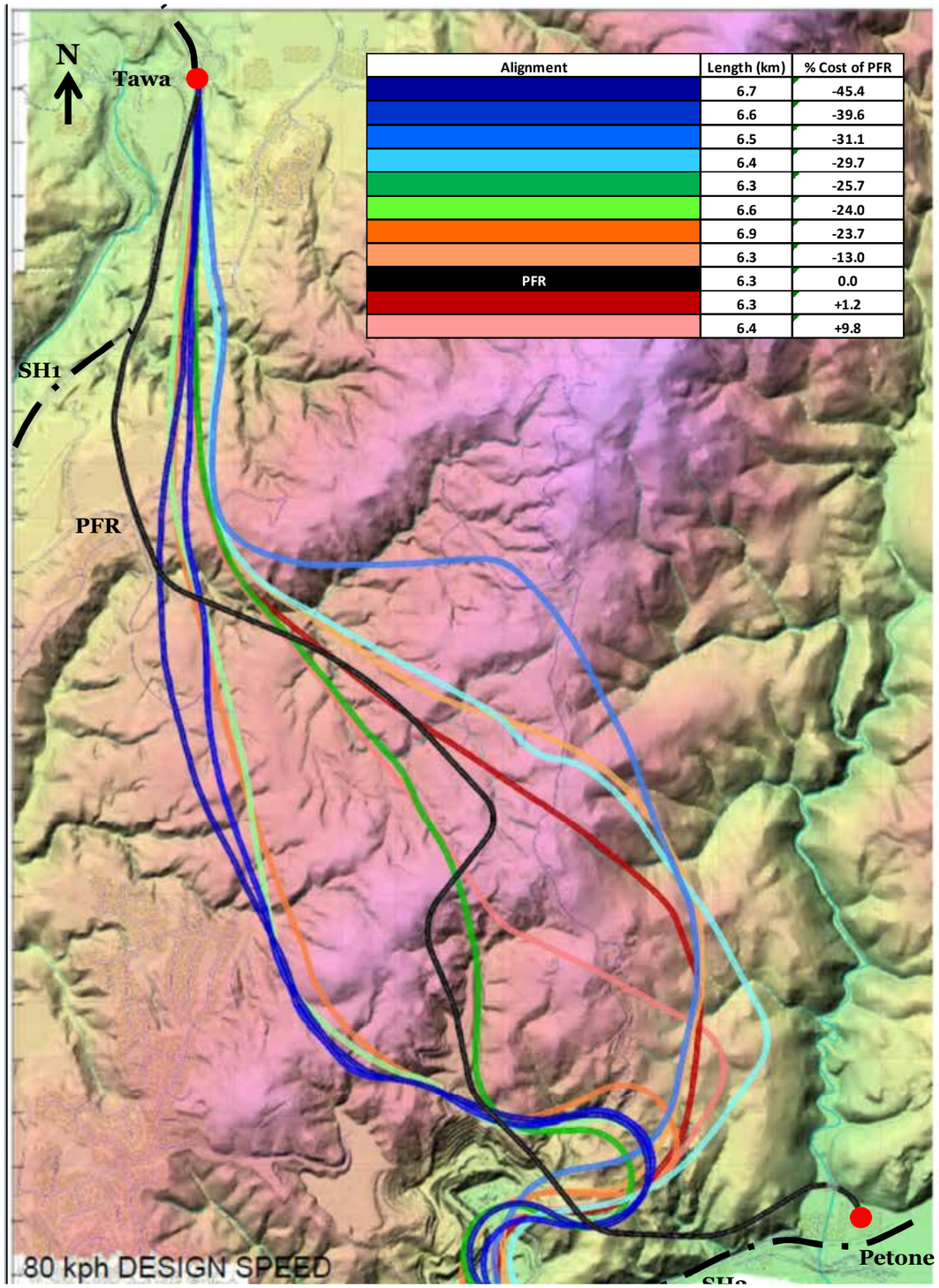
Figure 12-10: Alternative Connection 2 – SH2/Korokoro Crescent

12.3.5.3 Alternative Connection 3 – SH2/Horokiwi Road

Testing Alignments between SH2/Horokiwi Road and Tawa

The assumptions adopted for Alternative Connection 3 are identical to those for Alternative Connections 1 and 2. The results of this test are shown in Figure 12-11.

Figure 12-11 shows that the majority of the best alignments generated by Quantm range between 13% and 45% cheaper than the PFR alignment. All these alignments avoid Belmont Regional Park even though Quantm was not modelled to avoid this area. Based on these results, connecting at Horokiwi Road requires further examination including a comparison between the cheapest alignments between Petone and Tawa.



Alignment	Length (km)	% Cost of PFR
	6.7	-45.4
	6.6	-39.6
	6.5	-31.1
	6.4	-29.7
	6.3	-25.7
	6.6	-24.0
	6.9	-23.7
	6.3	-13.0
PFR	6.3	0.0
	6.3	+1.2
	6.4	+9.8

Figure 12-11: Alternative Connection 3 – SH2/Horokiwi Road

Comparing Connection Points at Horokiwi Road with Petone

To compare the costs of connecting at Horokiwi Road with Petone we need to consider:

i. The cheapest alignment having a connection at Horokiwi Road with the cheapest alignment having a connection at Petone; and

ii. The comparative cost of providing an interchange at Petone with a similar interchange at Horokiwi Road.

Figure 12-12 shows the cheapest alignment having a connection at Horokiwi Road with the cheapest alignment having a connection at Petone including landfills as a constraint. The reason for including landfills as a constraint is because it is cheaper to avoid landfills than to pass through them, as shown in Section 12.3.4, and the high costs associated with passing through landfills. Figure 12-12 also includes the PFR as a baseline to compare these two alignments.

Figure 12-12 shows that there is no cost difference between having a connection point at either Horokiwi Road or Petone, both alignments are the same length and both are almost 50% cheaper than the PFR alignment. Figure 12-12 also shows that, including landfills as a constraint, both alignments follow a similar path to Tawa once they climb beyond the coastal escarpment.

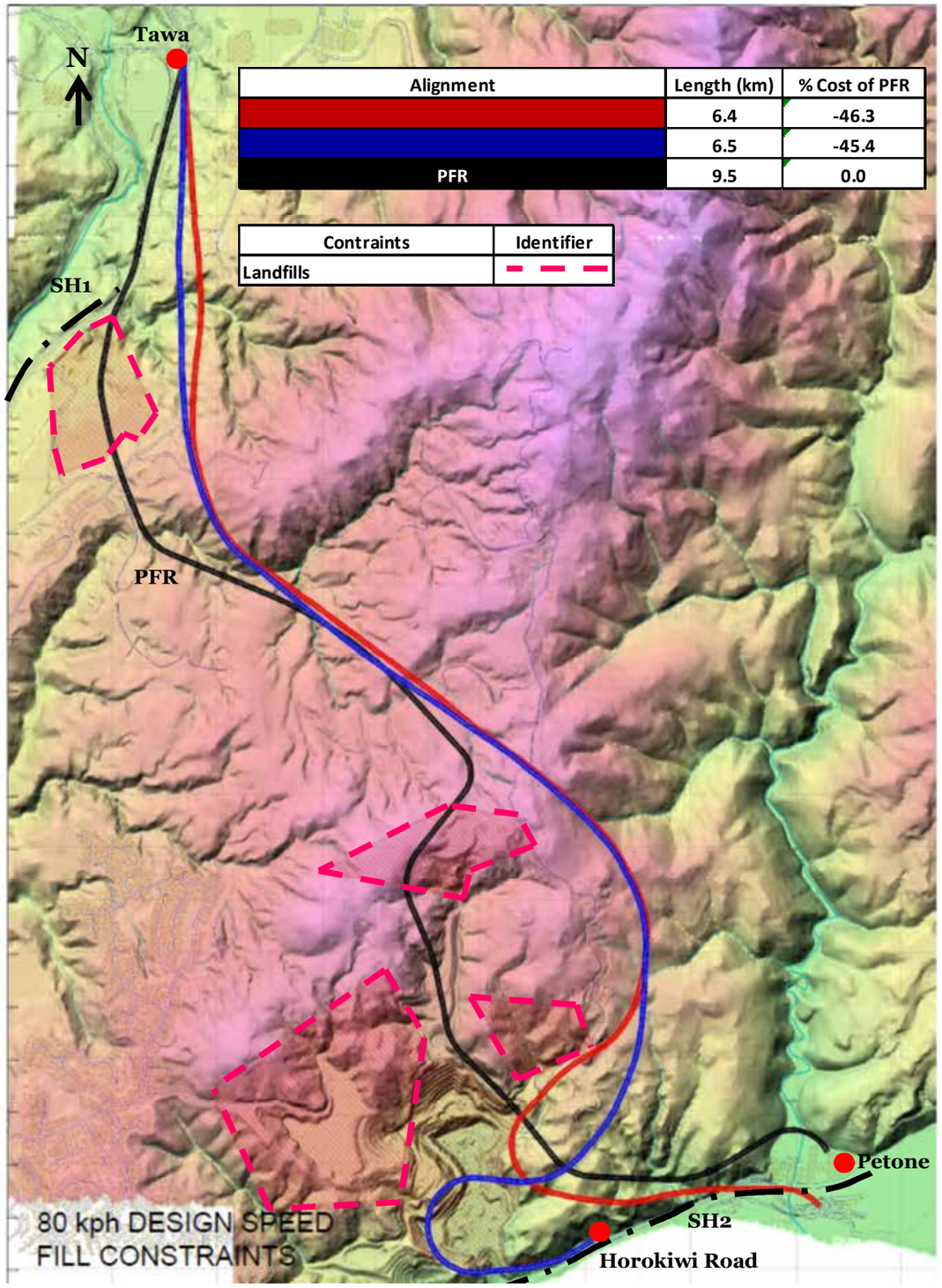


Figure 12-12: Comparing SH2/Horokiwi and SH2/Petone Connections

While Quantm shows that there is no cost difference between connecting at Horokiwi or Petone, a connection at Horokiwi would create a number of challenges.

Firstly, the section of SH2 between the existing interchange at Petone and the new interchange at Horokiwi Road would need to increase from 4 lanes to 6 lanes to accommodate the increase in traffic flows along this section as a result of shifting the connection from Petone to Horokiwi Road. This is illustrated in Figure 12-13 and Figure 12-14.

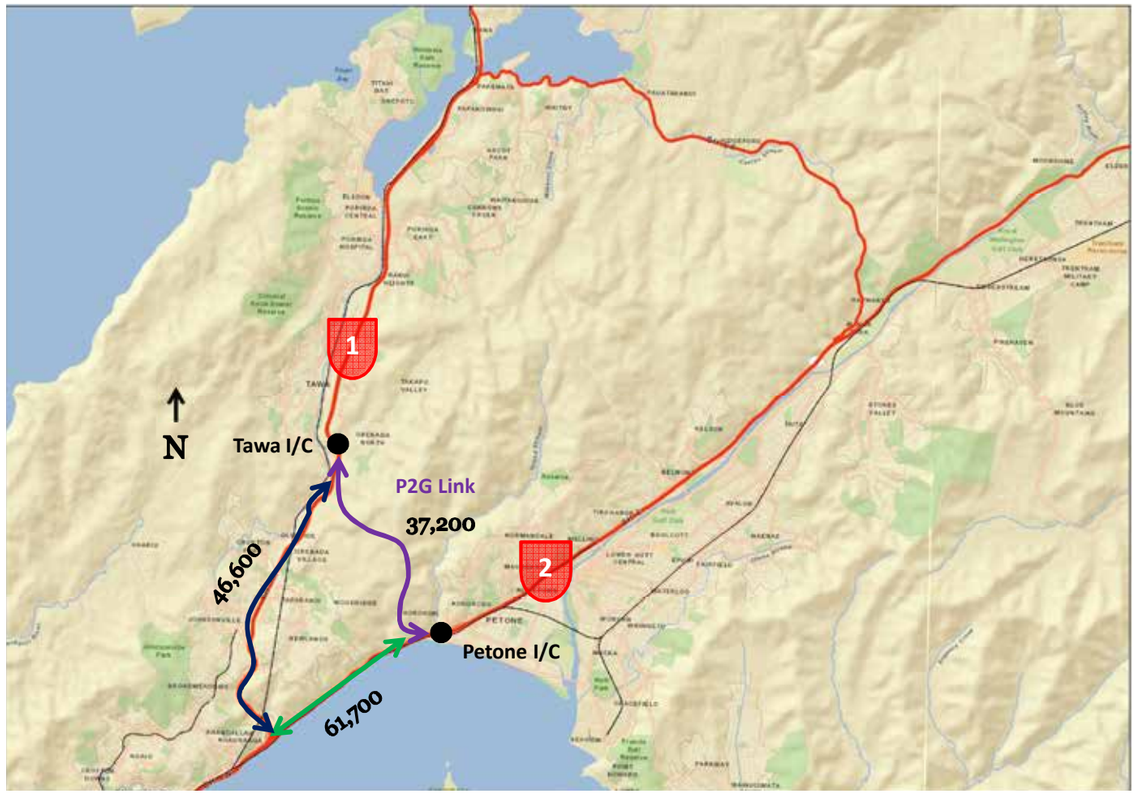


Figure 12-13: 2031 AADT with P2G Link at Petone

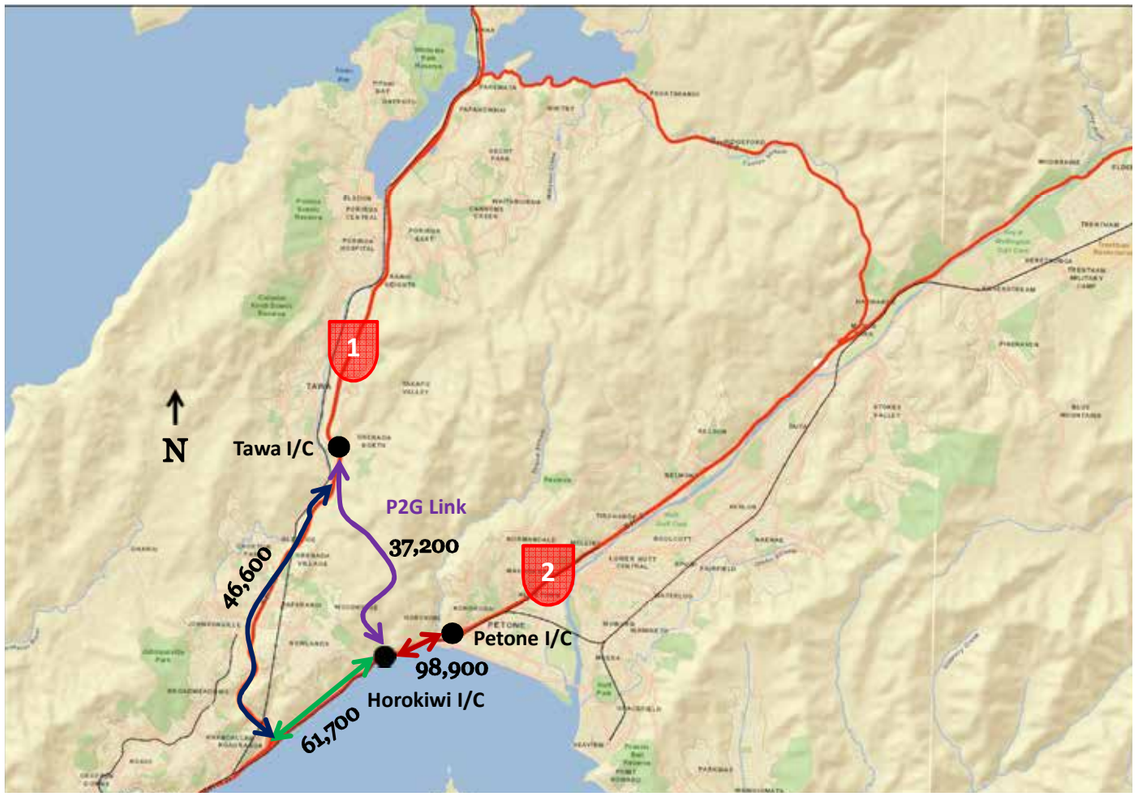


Figure 12-14: 2031 AADT with P2G Link at Horokiwi Road

Figure 12-13 shows the AADT flows for the forecast year 2031 from WTSM for SH1 and SH2 with a link between Petone and Tawa. Figure 12-14 illustrates that if this link is shifted from Petone to Horokiwi Road the AADT flows will effectively increase to 98,900 (61,700 + 37,200) along SH2 between Horokiwi Road and Petone. This section is currently only 4 lanes (2 lanes in each direction). The Highway Capacity Manual (HCM) requires 6 lanes (3 lanes in each direction) to accommodate the increase in traffic flows while providing the same level of service along this section.

Secondly, in addition to providing 6 lanes, Austroads Part 6 recommends a separation of 1,200m between the on and off ramps of the interchanges at Horokiwi Road and Petone. This separation is a requirement for safety and efficiency reasons to mitigate the effects of weaving traffic between interchanges. The separation between a new interchange at Horokiwi Road and the existing interchange at Petone is only 460m in the southbound direction and 620m in the northbound direction. Therefore to provide the separation required by Austroads the existing interchange at Petone will need to be relocated approximately 600m along SH2 to the northeast of its existing location.

Thirdly, a large area is required to locate the interchange and ramps on and off the interchange at Horokiwi Road. SH2 at this point is very constrained by the escarpment, railway and harbour at this location. In order to construct the interchange, reclamation into the harbour would be required.

Figure 12-15 shows the impact of an interchange at Horokiwi Road and the ensuing modifications required along SH2, including relocating the existing interchange at Petone.

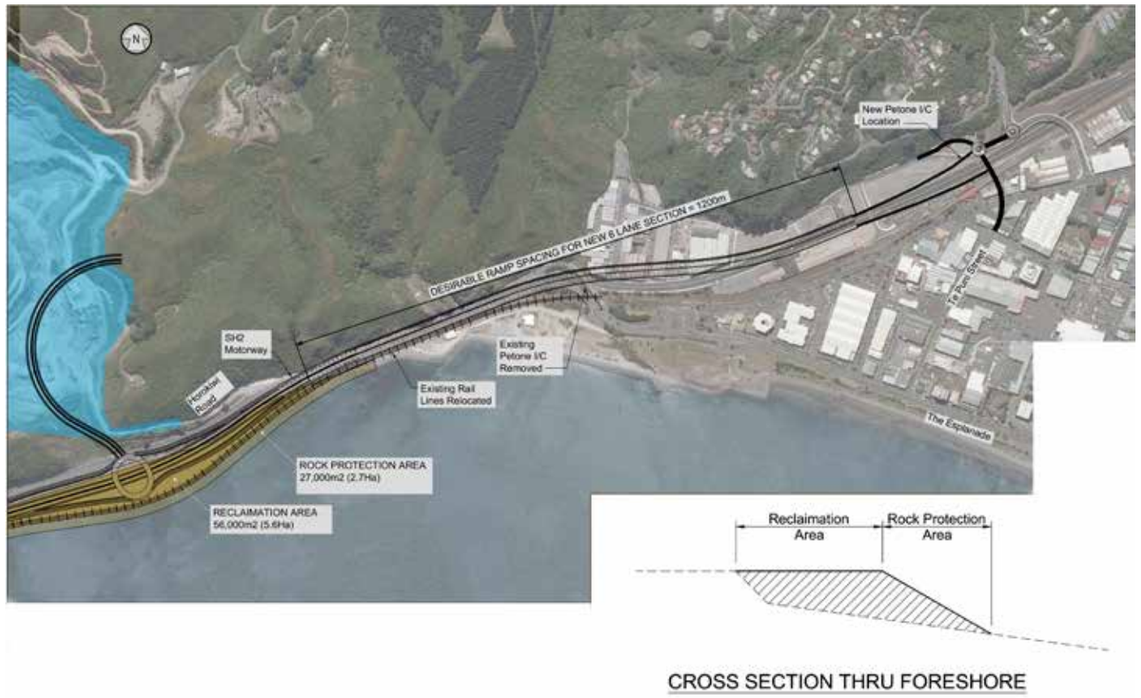


Figure 12-15: Potential Interchange at Horokiwi Road with Modifications to SH2 and the Petone Interchange

The large reclamation area required would have significant adverse impacts on the coastal area, although a mitigating factor is that coast line has already been significantly modified. This option assumes that the railway line cannot be retained in its current location as it clashes with the on and off ramps of the new interchange and as a result is relocated to the south on reclaimed land. A reclamation would be expensive (although the cost reduced somewhat if we needed a good place for excess fill). Adding to the cost is the need to realign SH2 to accommodate the interchange.

Removing the existing interchange at Petone and relocating it further along SH2 as shown in Figure 12-15 above would have significant adverse impacts on the distribution of traffic in Petone. The Esplanade would no longer function in its current form as an arterial connection to SH2. Instead traffic would redistribute along various local roads that were not designed to accommodate the increased volumes.

In conclusion an alternative connection at Horokiwi Road not only involves significant adverse impacts on the coastal area but also requires a new interchange at Petone which would have significant adverse impacts on traffic distribution and flows in Petone. On this basis the alternative connection at Horokiwi Road has been ruled out.

12.3.6 Testing Alternative Northern Connections

12.3.6.1 Background

The project scope identified the need to increase the capacity of SH1 between the Tawa Interchange and Transmission Gully interchange at Kenepuru if the link route between Petone and Tawa was constructed. To maximise value for money we offered to compare this proposal with the alternative option of extending the Petone to Grenada link route to connect with TG at the new interchange at Takapu. We determined that connecting to TG at Takapu was preferable than connecting to TG at the Kenepuru interchange as the route:

iii. Maintained shallow gradients from Tawa to Takapu as it traversed a broad ridgeline; and

iv. Avoided the need to cross Takapu Valley.

This is shown in Figure 12-16.

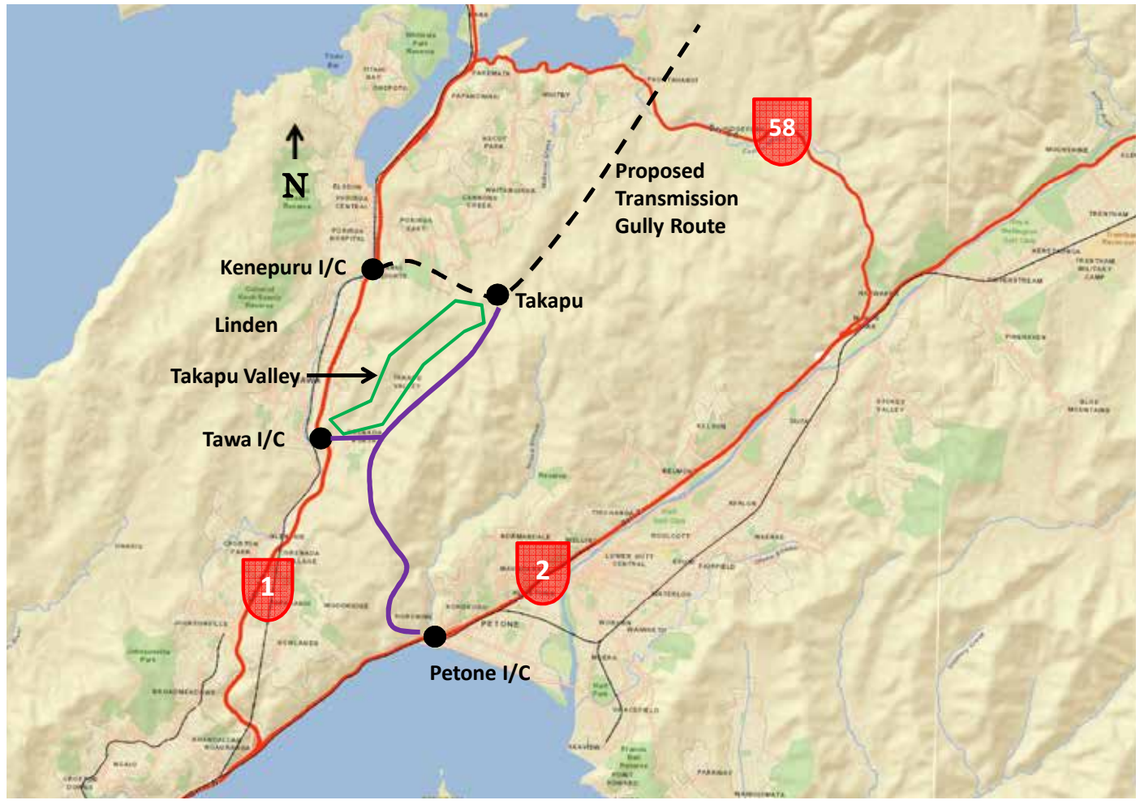


Figure 12-16: Alternative Northern Connection to TG

As discussed in the HCV on Grades Analysis, Appendix B, the PFR alignment between Petone and Tawa traverses very steep topography and comprises steep gradients, approximately 9%, along the majority of route. We know that steep gradients reduce travel speeds, increase travel time and therefore increase vehicle operating costs for HCVs. We also know that vehicle operating costs are a significant contribution to economic benefits, particularly for HCVs. Therefore we developed a simple economic model to analyse the impact of steep gradients on vehicle operating costs and travel time for HCVs by comparing the PFR route with longer and shallower routes. The following three route options were assessed:

i. Existing: Existing SH2 from Petone to Ngauranga, SH1 to Kenepuru, and TG to Takapu;

ii. Option X: PFR route from Petone to Tawa, SH1 to Kenepuru, and TG to Takapu; and

iii. Option Y: New route from Petone to TG at Takapu (Note this route follows the PFR route as far as Grenada before heading to TG.

This analysis concluded that the new route identified as Option Y, was 20% more efficient than Option X and 40% more efficient than the existing route in terms of total travel time and vehicle operating costs.

This analysis indicates a new route from Petone to TG at Takapu should be included in the option evaluation process. Subsequently the purpose of this test is to use Quantm to assist in determining the preferred alignment if a northern connection was made to Transmission Gully at Takapu while retaining a link to SH1 at Tawa as illustrated in Figure 12-16.

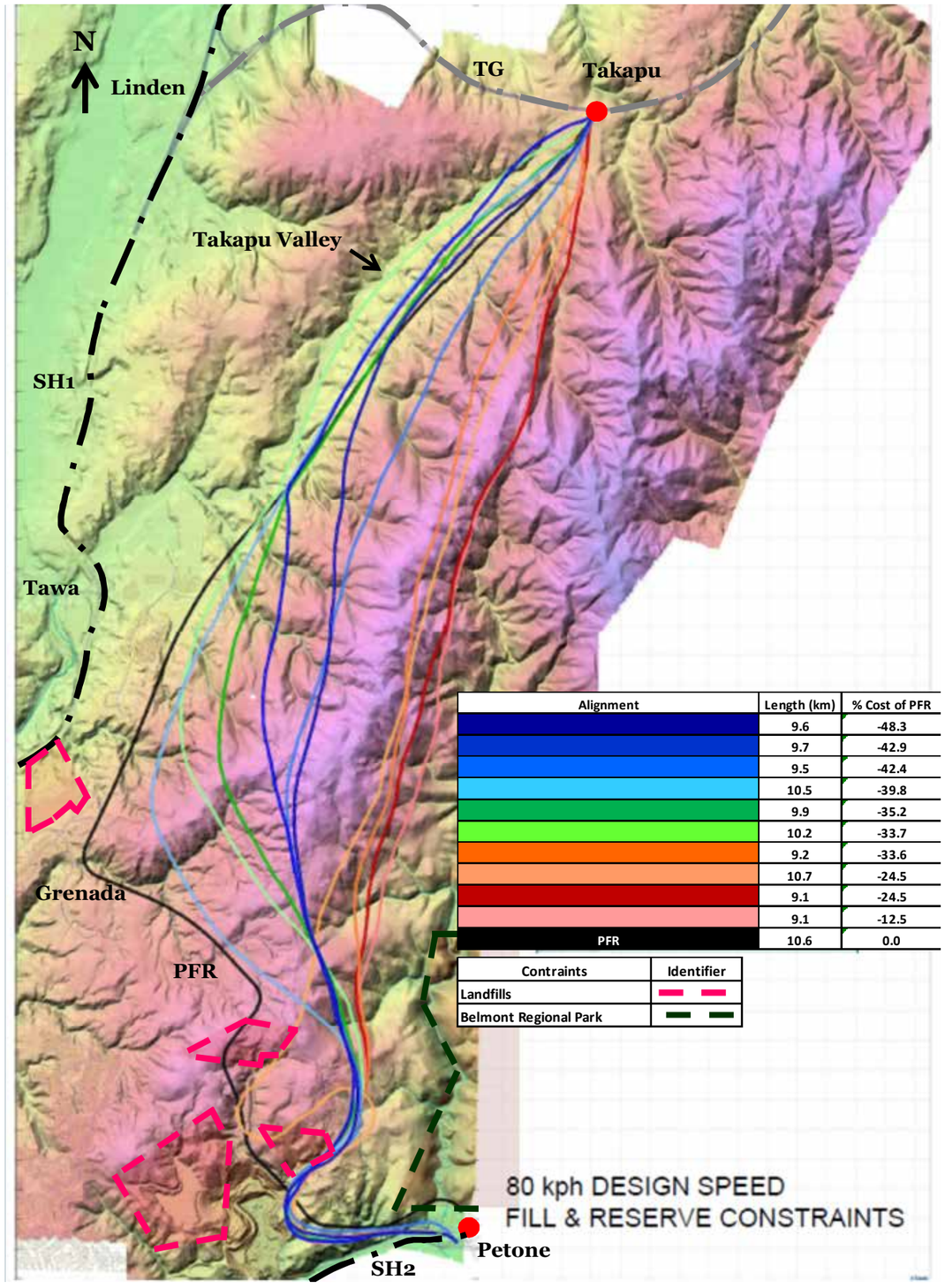
The assumptions adopted for this test include:

i. 80km/hr design speed; and

ii. Constraints (Landfills and the Belmont Regional Park as areas to avoid).

Landfills and the Belmont Regional Park have been selected as constraints as Quantm has demonstrated that it is cheaper to avoid landfills and the Belmont Regional Park than pass through them.

The results of this test are shown in Figure 12-17. An alignment which matches the PFR alignment as far as Grenada, but which continues to TG, is included as a basis of comparison between alignments.



Alignment	Length (km)	% Cost of PFR
	9.6	-48.3
	9.7	-42.9
	9.5	-42.4
	10.5	-39.8
	9.9	-35.2
	10.2	-33.7
	9.2	-33.6
	10.7	-24.5
	9.1	-24.5
	9.1	-12.5
PFR	10.6	0.0

Contraints	Identifier
Landfills	
Belmont Regional Park	

Figure 12-17: Petone to TG – Landfill and Reserve Constraints

The key findings from Figure 12-17 are:

i. The alignments which are furthest from SH1 and run close to the Korokoro Valley are not only the most expensive (apart from the PFR alignment) but they are also less suited to providing important connections to SH1 at Tawa and Grenada;

ii. The cheapest alignments are those which run midway between the most easterly and westerly alignments returned by Quantm. These are between 42% and 48% cheaper than the baseline alignment. Although these alignments are the cheapest they are also less suited to providing important connections to SH1 at Tawa and Grenada; and

iii. The alignments which are closest to SH1 are between 35% and 40% cheaper than the baseline alignment. While these alignments are between 2% and 8% more expensive than the cheapest alignments they are the best suited to providing important connections to SH1 at Tawa and Grenada.

12.3.7 Conclusions

By using Quantm we have established that:

i. Adopting a design speed of 80km/hr is significantly cheaper than a design speed of 100km/hr and similar in cost to adopting a design speed of 60km/hr;

ii. There are several alignments between Petone and Tawa which are significantly more cost effective than the PFR alignment;

iii. Avoiding landfills and the Belmont Regional Park is cost effective;

iv. Alignments with alternative connections to SH2 at either Korokoro Crescent or Dowse interchange are significantly more costly than alignments that connect at Petone and consequently should be ruled out on cost alone;

v. Alignments with an alternative connection to SH2 at Horokiwi Road are similar in cost to alignments that connect at Petone. However a connection at Horokiwi road requires foreshore reclamation and ensuing modifications along SH2 between Horokiwi Road and Petone together with relocating the interchange at Petone. The significant adverse impacts on the coastal area from foreshore reclamation and on traffic distribution in Petone from relocating the interchange at this location effectively rules out this connection; and

vi. There are alignments from Petone to TG which are between 35% and 40% cheaper than the baseline alignment (which follows the PFR alignment to Grenada before heading north to TG). These alignments are not only cheaper than the baseline alignment but also run close to SH1 providing important connections to SH1 at Tawa and Grenada.

12.4 Options Selected for Development

Based on the findings described above, four options were selected for the development process as follows:

i. Option A – Petone to Grenada;

ii. Option B – Petone to Tawa (with north facing ramps to SH1);

iii. Option C – Petone to Tawa (with a full interchange to SH1 and local road network); and

iv. Option D – Petone to TG (with connections to Grenada and Tawa).

These options are summarised on Figure 12-18.

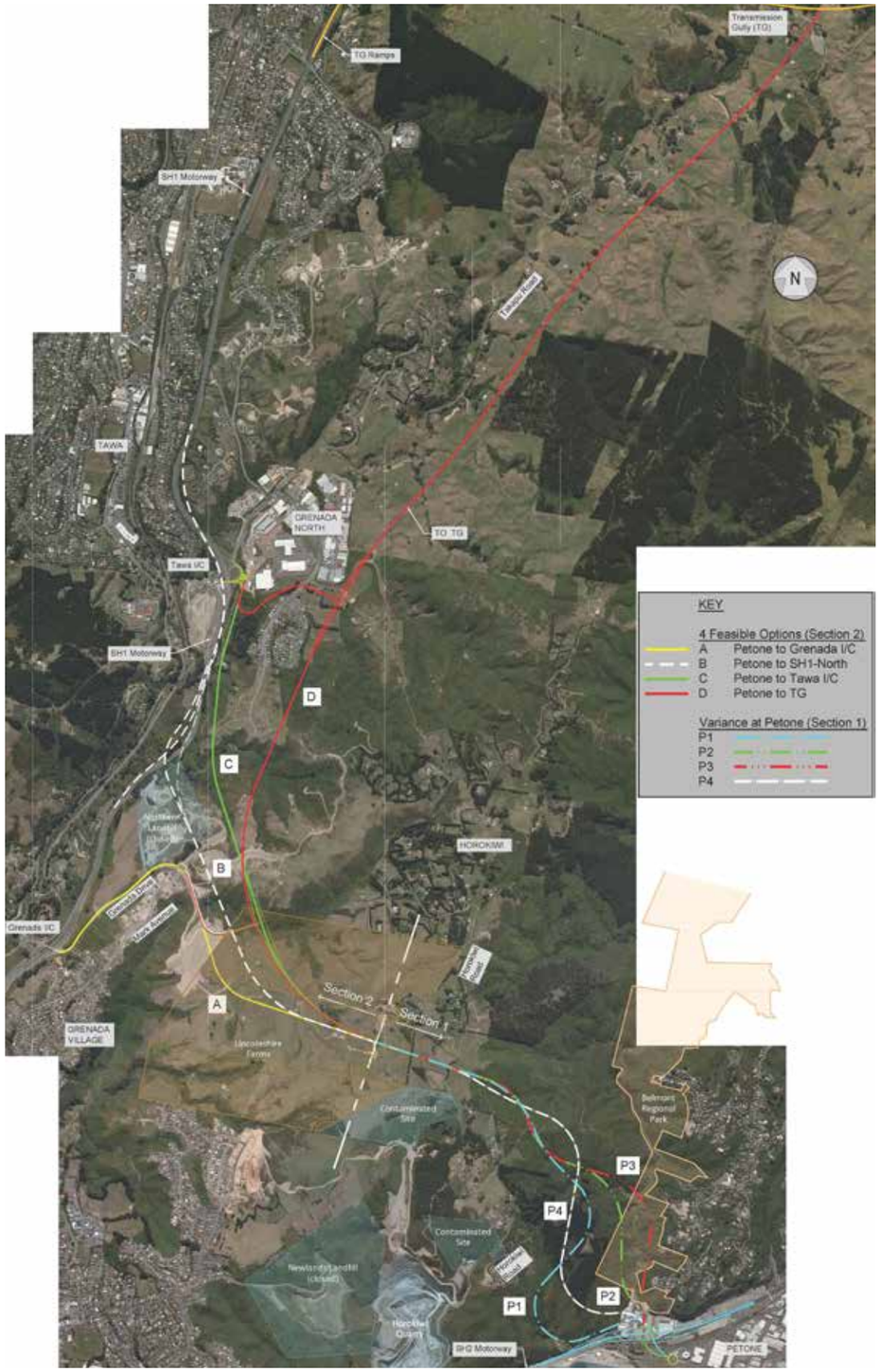


Figure 12-18: Options Selected for Development