Petone to Grenada Re-Evaluation

Qualitative Option Assessment Summary Report (Report 2)

12 December 2018

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Executive Summary

The purpose of this report is to summarise the work done so far on the Petone to Grenada Re-Evaluation to inform the December 2018 Board Paper and recommendations for potential programmes to be taken forward into a full Programme Business Case (PBC) process.

A re-evaluation of the Petone to Granada (P2G) Project has been undertaken in light of the 2017 Project review by the New Zealand Transport Agency (the Agency) and the release of the 2018 Government Policy Statement on Land Transport (GPS). The problem statements for the project as well as the investment objectives have been re-visited by the Agency within the context of the GPS. The re-evaluation has involved fresh thought leadership and holistic thinking to look at east-west connectivity within the Ngauranga Triangle transportation network, namely between Porirua, Tawa, Johnsonville and Lower Hutt.

It is important to note that this preliminary assessment has been conducted utilising an abridged Programme Business Case approach. This has necessitated limited concept development, qualitative rather than quantitative assessment, and limited stakeholder engagement input to the draft MCA evaluation and outcomes. Further stakeholder engagement is therefore required to confirm problem statements, investment objectives, and outcomes from the package MCA process, prior to confirming the programmes for further, more detailed, business case evaluation.

Draft problem statements had been developed over the course of 2018 with stakeholders (prior to the TAIP Review process) and the wording of these was discussed and refined over a series of further workshops. The identified Problems and Investment Objectives focus on resilience, multi-modal connectivity to increase travel choice, and safety within the context of East-West connectivity in the Ngauranga triangle.

A long list of possible interventions was developed with inputs from the WSP Opus project team and NZ Transport Agency at a workshop on 16 August 2018.

A Long List of approximately 120 interventions were developed and categorised as follows:

- Infrastructure (83 interventions);
- Operational (6 interventions);
- Planning/Governance (17 interventions); and
- Travel Demand Management (13 interventions).

These interventions were screened (Coarse Screen) against the primary objective of resilience and were narrowed down to 40 interventions which were then grouped into seven packages of works. The Long List and grouped Packages were presented to stakeholders[1] at a workshop on 11 September 2018, where an additional two Packages were developed following feedback from the Stakeholders. The initial 7 Packages were:

- Package 1 - Land Use interventions to reduce dependency on inter-regional travel and access and influence travel choice through TDM and ITS (re-mode, re-time, re-route, reduce)
- Package 2 - Active management and upgrades to existing infrastructure for low impact high frequency events
- Package 3 - Existing infrastructure upgrades to enhance public transport, safety and resilience for high impact low frequency events
- Package 4 - Extensive new smart solutions to improve resilience , safety public transport and connectivity

[1] Stakeholders from the NZ Transport Agency, Greater Wellington Regional Council, Wellington City Council, Hutt City Council and Upper Hutt City Council attended. Porirua City Council did not attend.

- Package 5 - Ngauranga resilience improvements and a new east-west local connection
- Package 6 - New smart connection between Petone and Grenada (surface)
- Package 7 - New east-west smart connection (tunnel)

The two additional packages introduced following the Stakeholder feedback were:

- Package 8 - SH58 Upgrade
- Package 9 - Enhanced Public Transport and active user infrastructure and services

In addition, Package 1 was also split into 1A and 1B for a total of 10 packages.

These Packages were assessed relative to a Do-Minimum and put through a Multi Criteria Assessment (MCA) process, with four primary criteria:

- Investment objectives
- Alignment with GPS
- Implementability
- Assessment of effects

Within each of the four primary criteria were a number of sub-criteria questions that were scored by various Technical Specialists (e.g. transport planners, ecologists, landscape, economics etc).

The initial MCA analysis does not show a clear "preferred package". The assessment results are mixed with Packages 3, 4, 6, 7 and 9 delivering the best results against the Investment Objectives, but Packages 4, 7 and 9 then scoring worst on Implementability.

The MCA process identified that there were two general approaches to achieve the Investment Objectives, either:

A. A significant improvement in the resilience of the existing network, by reclamation along SH2 between Ngauranga and Petone to provide resilience against landslides following a Low Probability, High Impact event and further major improvements along SH1 near Johnsonville and at the SH1/SH2 Ngauranga interchange
B. A new East/West smart connection.

Since the MCA assessment on the initial Package options, two alternative Programmes based on the two general approaches (A and B) were developed by taking complementary elements of the different packages. The two Programmes share some common interventions that effectively meet some of the Project's Investment Objectives and can be implemented in the short to medium term. These common elements are referred to as the Base Programme. The interventions that form the Base Programme are typically either:

- (Relatively) low-cost short-term resilience improvements; or
- Behaviour / policy / infrastructure changes that will result in reduced reliance on state highway travel (by single occupancy vehicles) to improve east-west accessibility.

However, the Base Programme in itself does not fully answer all of the identified Problems or Investment Objectives in full, as shown in Table 1. Therefore, the Base Programme must be combined with a higher cost, long-term major infrastructure intervention in order to meet the Investment Objectives.

Table 1: Programme Alignment with Investment Objectives

Investment Objectives		Base Programme	Option A	Option B
Resilience (70%)	High Impact Low Probability (HILP)	Low	High	Medium
	Low Impact High Probability (LIHP)	Medium	Medium	Medium
Access (20%)	Active Modes	Medium	Medium	Medium
	Passenger Transport	Medium	Low	Medium
	Motor Vehicles	Low	Medium	High
Safety (10%)	Active Modes	Medium	Medium	Medium
	Motor Vehicles	Low	Low	Medium
Other Considerations		**Base Programme**	**Option A**	**Option B**
Supporting growth in the Ngauranga Triangle Area	Residential and Business Growth	Medium	Low	High
Staging		Medium	Medium	Medium

Two options for further assessment have been proposed:

- Programme Option A includes significant resilience improvements at critical sections of the existing state highway network. It also looks to upgrade the existing network to respond to the Investment Objectives and provides additional Public Transport capacity that supports east-west accessibility and encourages mode shift away from private motor vehicles. In terms of the key Investment Objective (resilience), this is delivered in Option A by reclamation along SH2 between Petone and Ngauranga, improvements on SH1 at Johnsonville and SH58 between Mt Cecil and the interchange with SH2;
- Programme Option B includes a new smart connection between Petone and Tawa / Grenada, minor slope stabilisation on State Highway 1 at Johnsonville, and completion of the W2HV walking and cycling link. Option B provides resilience by providing an alternative route in an event that block the existing east-west network (SH1, SH2 and SH58).

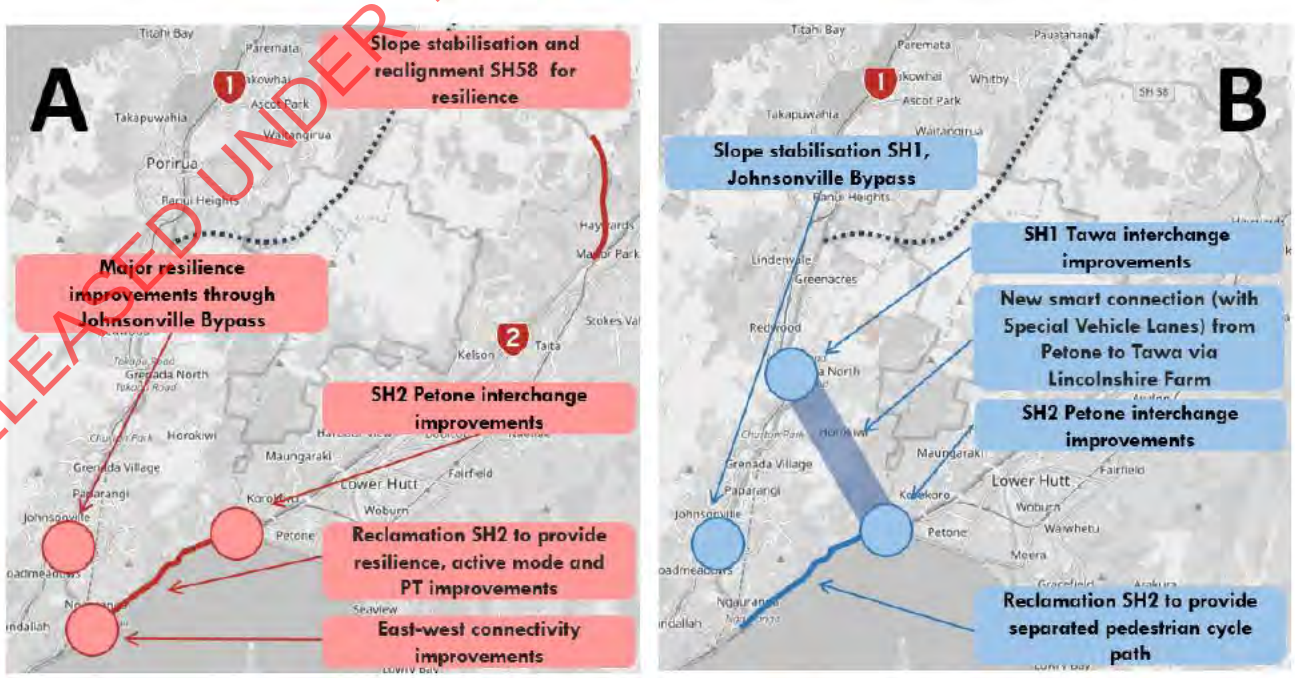

Figure 1: Programmes A and B

This process for deriving the short-listed programmes is shown in Figure 2.

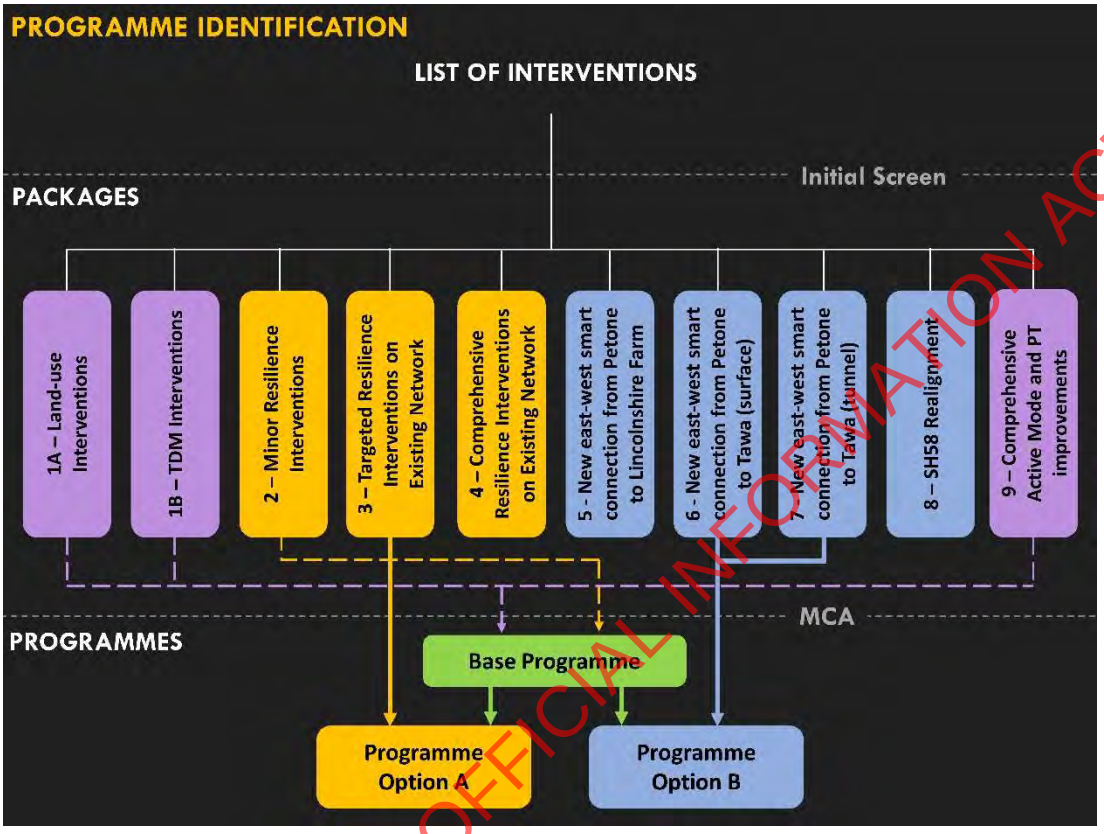

Figure 2: Programme Identification

Potential timing for the Programmes of between 0 to 20 years have been identified, which will be investigated further at the next stage with the development of a Programme Business Case (PBC) and decision on a preferred programme. Critical work around which Programme best addresses the Investment Objectives in full will be assessed as part of the future business case process. This will include:

1. Stakeholder engagement and agreement on:
   - The value placed on resilience and improving east-west connectivity; and
   - The problem statements and investment objectives.
2. Technical refinements – specifically the viability of reclamation along SH2 and interaction with the Wellington to Hutt Valley Walking and Cycling Project, and the form and function of a new east-west connection.

Indicative cost estimates have been prepared for the Packages and Programmes, for comparative purposes only. The project team is cognisant of previous designs and estimates produced for the former P2G scheme. However, no design work has been completed since the 2017 evaluation for any of the work being estimated (given the compressed timeframe for the TAIP review). As such, there is a very high level of uncertainty and many assumptions have had to be made for estimation purposes and to try to ensure estimates are made on a like for like basis. The estimate ranges provided include a lower and upper limit, but these are not the 5th and 95th percentile estimates typically used as risk has not been able to be fully assessed or modelled at this time.

Whilst some of the Programme Components in the Base Programme would be led by the Transport Agency others will be led by partner agencies. All of the additional components

identified in Programmes A and B would be led by the Agency. It is important to note that there has not yet been any engagement with local partners and stakeholders on the TAIP Review outcomes or proposed programme options. Some of the interventions identified are also featured in other Project programmes (Resilience PBC, Wellington to Hutt Valley Walking and Cycling Link).

An Uncertainty Log has been developed to capture ambiguities that may generate a degree of uncertainty or risk for the project. The full register can be found in Appendix A. Key uncertainties have been assessed as:

- Re-evaluation process;
- Inputs and assumptions;
- Identifying a preferred option;
- Interdependencies;
- Stakeholders;
- Costs; and
- Pre-implementation/implementation.

The level of uncertainty for each issue has been ranked and categorised as either near certain, more than likely, reasonably foreseeable and hypothetical.

Both Programme A and Programme B have the potential to address the Problems Identified during the review in consultation with Stakeholders, in particular the current lack of resilience on the current transport network and the lack of east/west connectivity. In addition to addressing these primary problems the Programmes include elements that would significantly improve active modes and public transport, open up land for development, improve journey times and support lifelines.

Staged delivery and costs mean that both Programmes present opportunities to deliver early, mode-neutral outcomes. Opportunities are also available to enable forward thinking, future-proofed solutions such as special vehicle lanes and smart motorways. The Programmes also allow potential interfaces with other programmes of work such as Let's Get Wellington Moving, the Wellington to Hutt Valley Cycleway or a potential cross valley link for example.

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1	Edits following NZ Transport Agency initial review

Glossary

Term	Meaning
AC	Asphalt Concrete
CBD	Central Business District
CCTV	Closed Circuit Television
CEM	Cost Estimation Manual
DBE	Detailed Business Case Estimate
EMOGPA	Epoxy-Modified Open Grade Porous Asphalt
GPS	Government Policy Statement on Land Transport
GWRC	Greater Wellington Regional Council
HCC	Hutt City Council
HILP	High Impact Low Probability
ITS	Intelligent Transportation System
kph	Kilometre per hour
LIHP	Low Impact High Probability
LGWM	Let's Get Wellington Moving
MaaS	Mobility as a Service
MCA	Multi Criteria Assessment
MSQA	Management, Surveillance and Quality Assurance
P2G	Petone to Grenada
PBC	Programme Business Case
PCC	Porirua City Council
PT	Public Transport
RS1 and RS2	Rail Strategy 1 and 2
SH	State Highway
Special Vehicle Lanes	Special vehicle lanes have signs or markings that indicate they are only for the use of specific kinds of vehicles, such as buses, cycles, taxis or vehicles carrying a specified number of passengers (transit lanes).
TAIP	Transport Agency Investment Proposal
TDM	Travel Demand Management
TG	Transmission Gully
TTM	Temporary Traffic Management
W2HV	Wellington to Hutt Valley Walking and Cycling Link
WCC	Wellington City Council
WREDA	Wellington Regional Economic Development Agency

1 Introduction

This report serves as a Summary Report on the work done so far to evaluate the packages of works that could be used to address East West connectivity and community resilience between Porirua, Tawa, Johnsonville and Lower Hutt. The assessment process has been undertaken as part of the Transport Agency Investment Proposal (TAIP) re-evaluation process for Petone to Grenada (P2G).

A re-evaluation of the P2G Project has been undertaken considering the 2017 P2G Link Road Evaluation by the NZ Transport Agency (the Agency), and the release of the 2018 Government Policy Statement on Land Transport (GPS). New problem statements for the project as well as the investment objectives have been re-visited by the Agency within the context of the GPS, however these are yet to be fully signed off by Stakeholders. The re-evaluation has involved fresh thought leadership and holistic thinking to look at east-west connectivity within the Ngauranga Triangle transportation network, namely between Porirua, Tawa, Johnsonville and Lower Hutt. New Problem Statements and Investment Objectives have been developed and documented in Report 1 (produced by NZTA's Independent Project Director) for the purposes of the TAIP re-evaluation and set out in section 2.1 of this report.

It is important to note that this preliminary assessment has been conducted utilising an abridged Programme Business Case approach within the TAIP Review timeframe. This has necessitated limited concept development, qualitative rather than quantitative assessment, and limited stakeholder engagement input to the draft Multi Criteria Assessment evaluation and outcomes. Further Stakeholder engagement is therefore required to confirm problem statements, investment objectives, and outcomes from the package MCA process, prior to confirming the programmes for further, more detailed, Programme Business Case (PBC) evaluation. Stakeholder engagement is also needed to define the value placed on a resilient transport network and improved east-west connectivity.

Section 2 of this document contains a description of the methodologies used for option development, identifying packages and carrying out a MCA. The MCA described in Section 2 (and Appended in full in Appendix D) enabled the various different options to be assessed by experts as to the potential opportunities, risks and impacts. It is worth noting that the package descriptions have evolved since the earlier appended working papers and the sketches shown are indicative – for example additional rail tracks are shown as representing potential additional PT capacity.

Section 3 identifies and discusses the proposed programmes of work that have been identified, while Section 4 discusses timing and staging options for proposed works. Section 5 contains rough order cost estimates, with uncertainties detailed in Section 6 and a summary with recommendations and opportunities identified in Section 7.

2 Methodology

2.1 Option Development

The process used in option development is shown in Figure 3

A long list of possible interventions was developed with inputs from the WSP Opus project team and NZ Transport Agency at a workshop on 16 August 2018. The full long list of interventions can be found in Appendix B.

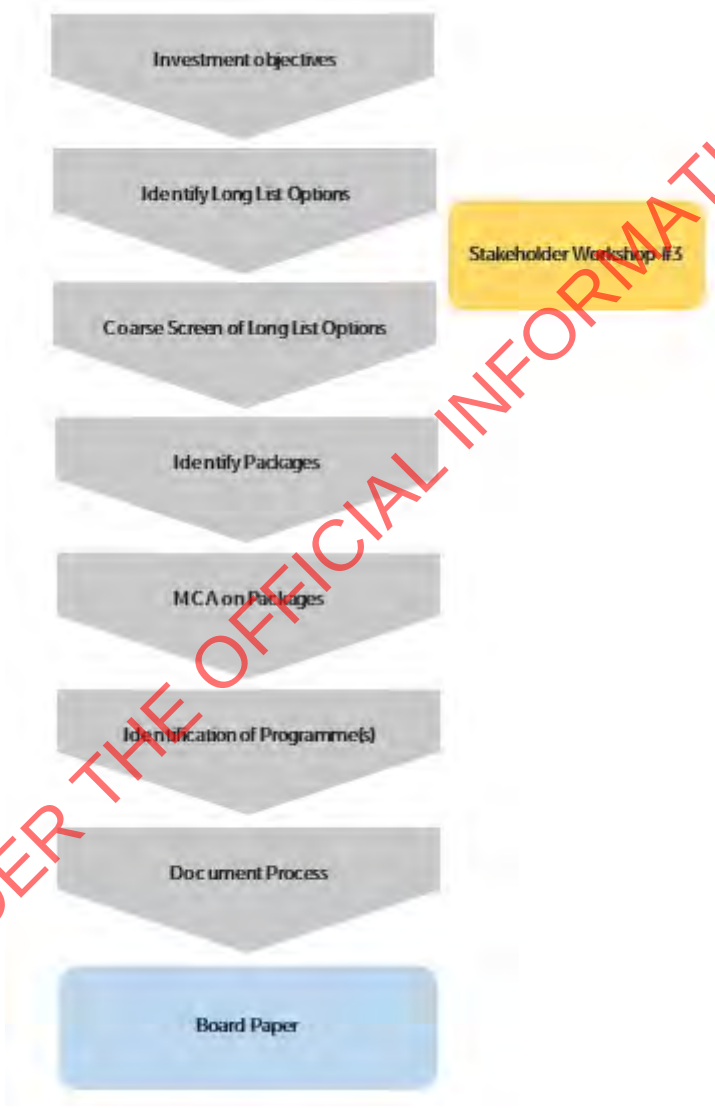

Figure 3: Option Development Process

Draft problem statements had been developed in two initial workshops with stakeholders (prior to the TAIP review process) and the wording of these and the Investment Logic Map was discussed and refined, over a series of further workshops prior to completion of the re-evaluation. The identified Problems and Investment Objectives focus on resilience, multi-modal connectivity and travel choice, and safety within the context of East-West connectivity in the Ngauranga Triangle area. The Project's primary purpose is to address the following two problem statements:

Problem 1 – Wellington's east west transport network lacks resilience to natural disasters and regular interruptions, which can cause major economic and social disruption

Problem 2 – routes limit modal options, safety and direct connections between adjacent communities, curbs economic growth and social interaction

In doing so the investment must achieve the following Investment Objectives[2]:

1 Reduce the number and duration of closures on the east west transport network following major and minor hazard events and network operational incidents as follows:

- Following a HILP event, the duration of predicted closures of the east/west land transport network is reduced by 20XX
- Following a LIHP event, the number of journeys affected on the east/west land transport network is reduced by 20XX

2 Improve access to key destinations and urban growth areas between Porirua/Tawa/Johnsonville and Lower Hutt by providing increased mode choice by 20XX.

3 Improve network safety by reducing the number of DSI's and non-injury accidents for all transport users by xx% between 20XX and 20XX

A long list of approximately 120 interventions were developed and categorised as follows:

- Infrastructure (83 interventions);
- Operational (6 interventions);
- Planning/Governance (17 interventions); and
- Travel Demand Management (13 interventions).

The programmes were then grouped into similarly themed interventions, which are listed in Table 2 below.

Table 2: Long List Intervention Groupings

Category	Sub-Category	Description
Infrastructure (83 interventions)	I-1	Ngauranga to Petone (N2P)
	I-2	East-West Link
	I-3	SH1 corridor (TG to Ngauranga)
	I-4	SH2 corridor (SH58 to Petone)
	I-5	SH58 corridor (TG to SH2)
	I-6	Hutt Valley (non-SH2)
	I-7	Johnsonville – Porirua (non-SH1)
	I-8	Rail
	I-9	Other
Operational (6 interventions)	O-1	Responsiveness
	O-2	Enforcement
	O-3	Other
Planning/Governance (17 interventions)	P-1	Collaborative Regional Planning
	P-2	Improved Development Planning
	P-3	Resilience Collaboration and Planning
	P-4	Other
TDM (13 interventions)	T-1	Social Marketing
	T-2	Real-Time Information and Integrated Ticketing
	T-3	Training
	T-4	Travel Planning

[2] The target reductions and dates will be defined in the PBC

	T-5	Localised TDM Measures
	T-6	Charging
	T-7	Community Resilience
	T-8	Vehicle Technology

Following the development of a long list, an initial assessment of the options identified in Table 2 was carried out.

The interventions were firstly assessed against the primary objective of resilience and given a null/medium/low/high rating. They were then assessed against the secondary benefits of modal choice, land use and safety. This coarse screening process is illustrated in Figure 4.

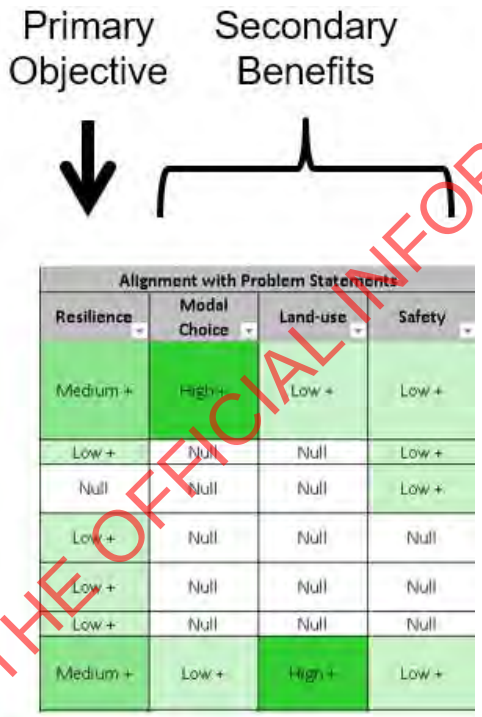

Figure 4: Initial Assessment of Long List Options

The minimum passing criteria was a "medium+" rating against resilience. Using this screen, 40 interventions were grouped into 7 Packages, identified as Packages 1-7 in Table 3. The interventions were grouped into packages based on the themes of the interventions, levels of service they offered, and the outcomes it was anticipated that they would produce.

These seven Packages were presented to Stakeholders[3] at an independently facilitated Investment Logic Mapping workshop on 11 September 2018, where an additional two Packages (8 and 9) were developed following feedback from the Stakeholders and Package 1 was split into 1A and 1B.

2.2 Packages

Table 3 lists the packages that have been identified in response to the Investment Objectives. These are outlined in the following pages, with more detailed information found

[3] Stakeholders from the NZ Transport Agency, Greater Wellington Regional Council, Wellington City Council, Hutt City Council and Upper Hutt City Council attended. Porirua City Council did not attend.

in Appendix C. It is worth noting that the following package descriptions have evolved and the figures presented in Appendix C are indicative only. For example, the alignment of routes and interchange locations are concept level only, Public Transport corridors, shown as additional rail tracks, could be dedicated bus routes rather than rail etc.

Table 3: Packages Identified

Reference	Name
0	Do-Minimum
1A	Land Use interventions to reduce dependency on inter-regional travel and access
1B	Influence travel choice through TDM and ITS (re-mode, re-time, re-route, reduce)
2	Active management and upgrades to existing infrastructure for low impact high frequency events
3	Existing infrastructure upgrades to enhance public transport, safety and resilience for high impact low frequency events
4	Extensive new smart solutions to improve resilience, safety public transport and connectivity
5	Ngauranga resilience improvements and a new east-west local connection
6	New smart connection between Petone and Grenada (surface)
7	New east-west smart connection (tunnel)
8	SH58 upgrade
9	Enhanced Public Transport and active user infrastructure and services

2.2.1 Package 0: Do-Minimum

A do minimum 'Package 0' which consists of Transmission Gully (currently under construction and due to open in April 2020), SH58 Safety upgrades (currently in design phase with construction scheduled to start in 2019) and being cognisant of the growth nodes in the various areas was identified to assess the packages against. The proposed SH2 cycleway from Ngauranga to Petone was not included as part of the Do-Minimum as it presents significant statutory challenges, and resource consents have not yet been applied for or granted.

The Do-Minimum is important as it is used as a base when comparing and evaluating options in the MCA.

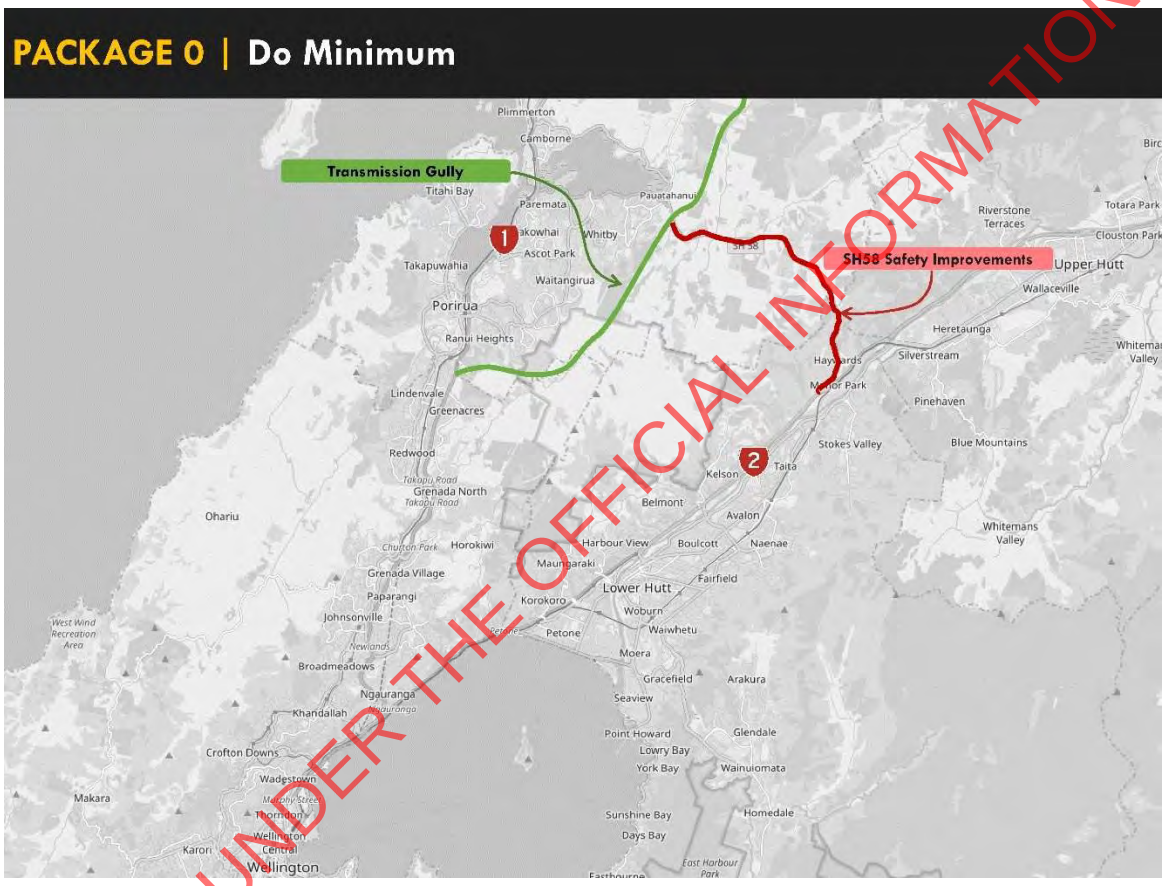

Figure 5: Do-Minimum

2.2.2 *Package 1A - Land Use interventions to reduce dependency on inter-regional travel and access*

This package investigates opportunities to reduce reliance on SH1 and SH2 links between Porirua area, Hutt Valley area and Wellington CBD (and other inter-regional journeys), thereby reducing vehicle volumes on these roads during peak times and enhancing connections through congestion relief on existing network. The aim is to improve recovery after Low Impact High Probability (LIHP) events such as slips or flooding. After High Impact Low Probability (HILP) events such as major earthquakes, communities would be more self-reliant and there would therefore be less need for east-west connections.

The interventions are primarily focussed on policy, travel planning and land use planning, i.e. aiming for more journeys within local areas and travel behaviour change.

Ultimately, this package would show whether non-infrastructure interventions could improve resilience east-west and access within the study area.

A more detailed description of this option can be found in Appendix C.

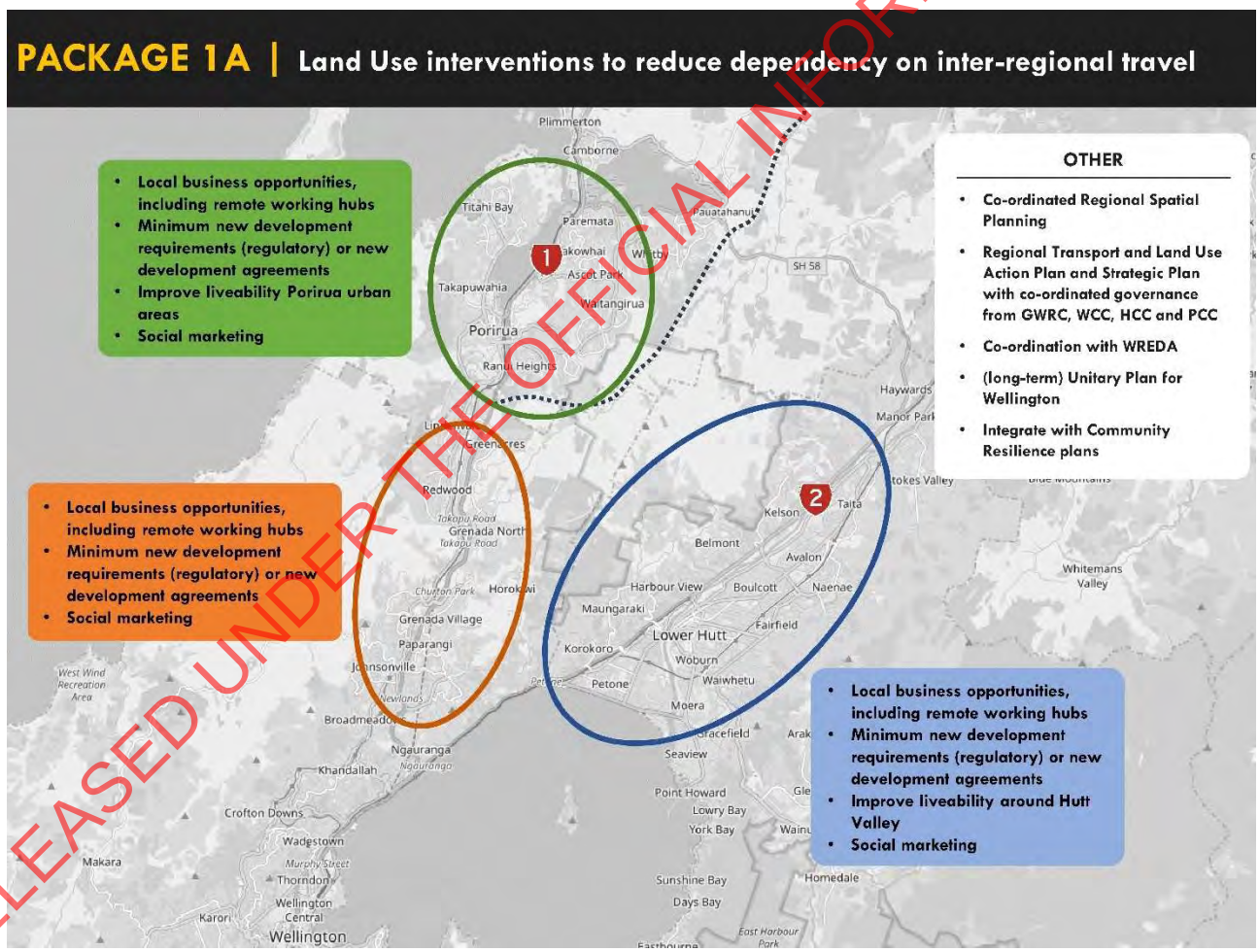

Figure 6: Package 1A

The key components of the package are described below:

- Regional Transport and Land Use Action Plan and Strategic Plan with co-ordinated governance from GWRC, WCC, HCC and PCC
- Co-ordinated Regional Spatial Planning

- Co-ordination with WREDA (Wellington Regional Economic Development Agency)
- Local business opportunities, including remote working hubs
- (long-term) Unitary Plan for Wellington
- Minimum new development requirements (regulatory) or new development agreements
- Improve liveability in regional areas
- Integrate with Community Resilience plans
- Social marketing

2.2.3 *Package 1B – Influence travel choice through TDM and ITS*

A suite of travel demand management measures and network optimisation interventions including use of intelligent transport systems to influence travel choice and manage demand. Ultimately this package aims to better utilise existing and new technologies as well as Travel Demand Management (TDM) to influence travel demand on the network, reducing the need for increased roading infrastructure or new roads and indirectly improving east-west connectivity by reducing reliance on travel by private vehicle and enabling travel choices to be made after a LIHP or HILP event.

A more detailed description of this option can be found in Appendix C.

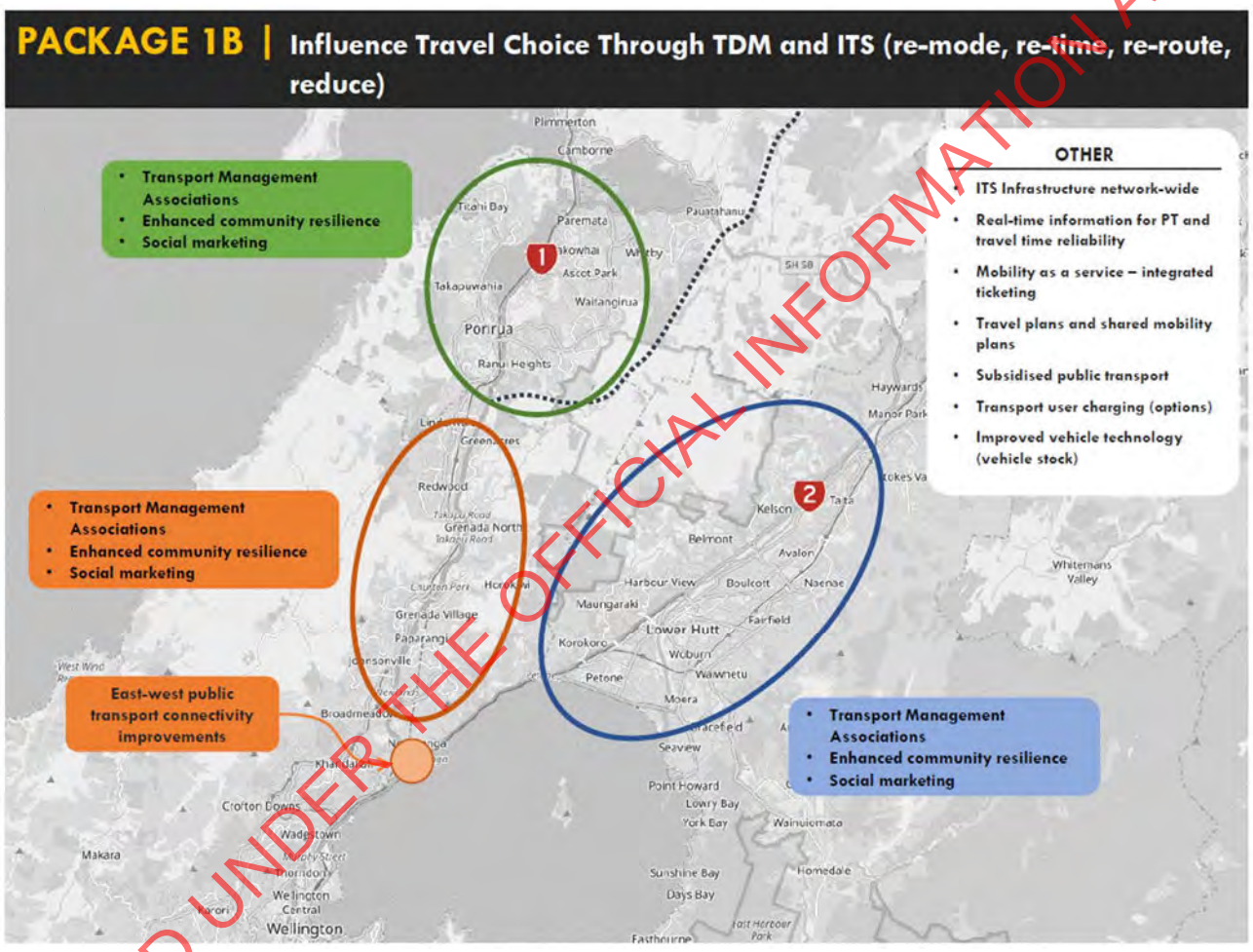

Figure 7: Package 1B

The key components of the package are described below:

- Intelligent Transportation System (ITS) Infrastructure network-wide
- Extend Real-time information for PT and travel time reliability
- Mobility as a service – integrated ticketing
- Travel plans and shared mobility plans
- Transport Management Associations
- Further subsidise public transport
- Transport user charging (options)
- Improved vehicle technology (vehicle stock)
- Enhanced community resilience
- Social marketing / community behaviour change
- Improved east-west bus connectivity

2.2.4 *Package 2 - Active management and upgrades to existing infrastructure for low impact high frequency events*

The purpose of this package is to identify the resilience improvements on the existing transport network which can be undertaken with relatively low costs and Implementability risks to respond to the East-West problem statements and investment objectives. The interventions are generally within the existing road reserve and are not intended to provide safety or connectivity benefits.

A more detailed description of this option can be found in Appendix C.

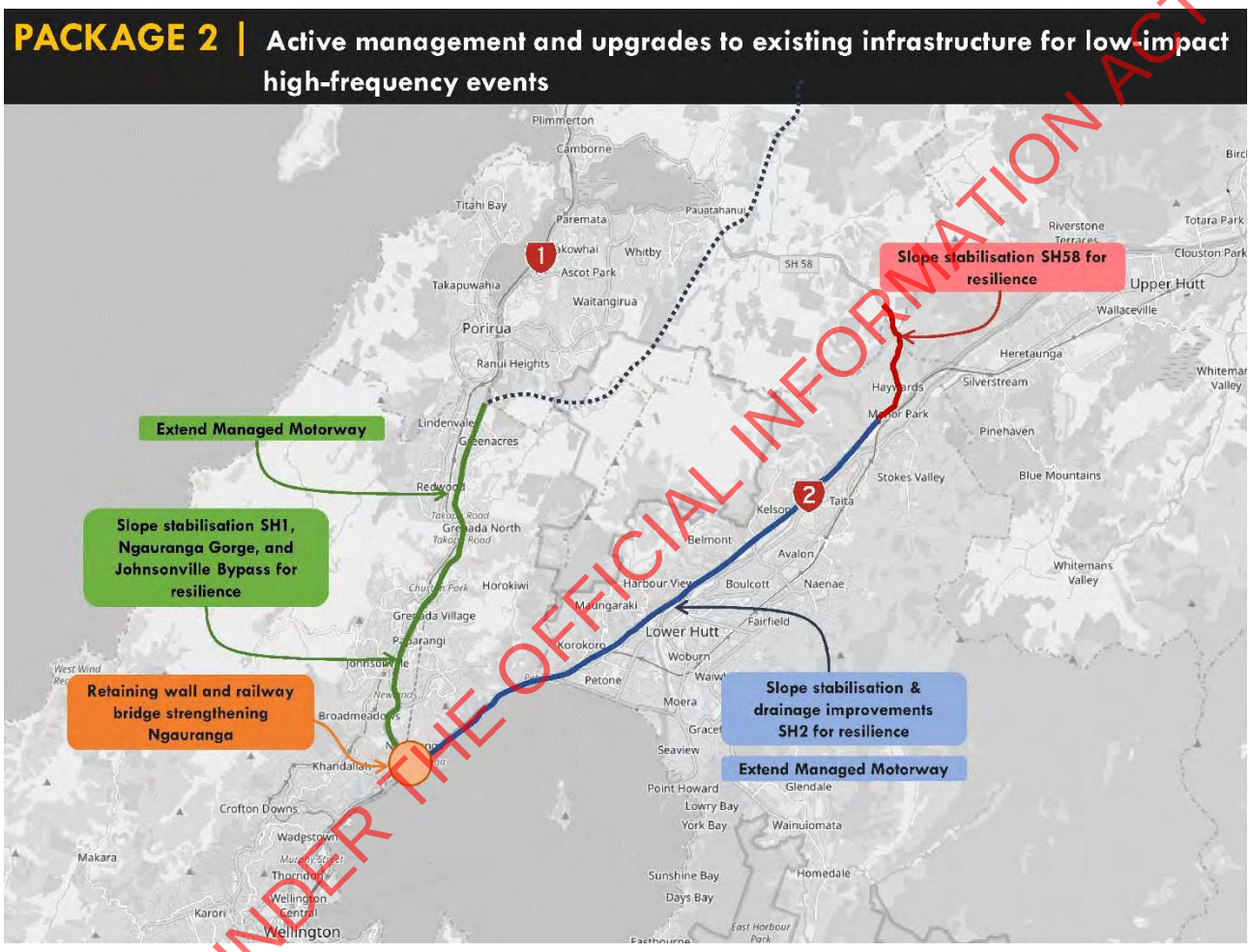

Figure 8: Package 2

The key components of the package are described below:

- SH58 slope stabilisation;
- SH2 slope stabilisation / drainage improvements;
- SH2 managed motorway extension (resilience based);
- SH1 Ngauranga interchange resilience improvements;
- SH1 slope stabilisation; and
- SH1 managed motorway extension (resilience based).

2.2.5 *Package 3 - Existing infrastructure upgrades to enhance public transport, safety and resilience for high impact low frequency events*

The purpose of this package is to address sections of the east-west network with a criticality rating of extreme or very-high (as identified in the Wellington Regional Land Transport Resilience PBC 2018 (the draft Resilience PBC)) by making improvements on the existing transport network in response to the Investment Objectives. It also includes additional Public Transport capacity, resilience and safety improvements at the Petone Interchange and improvements at Ngauranga Interchange that will improve east-west connections. This package does not address all of the very-high rated sections from the Resilience PBC that fall within the project area but focusses on those that improve east-west connections.

A more detailed description of this option can be found in Appendix C.

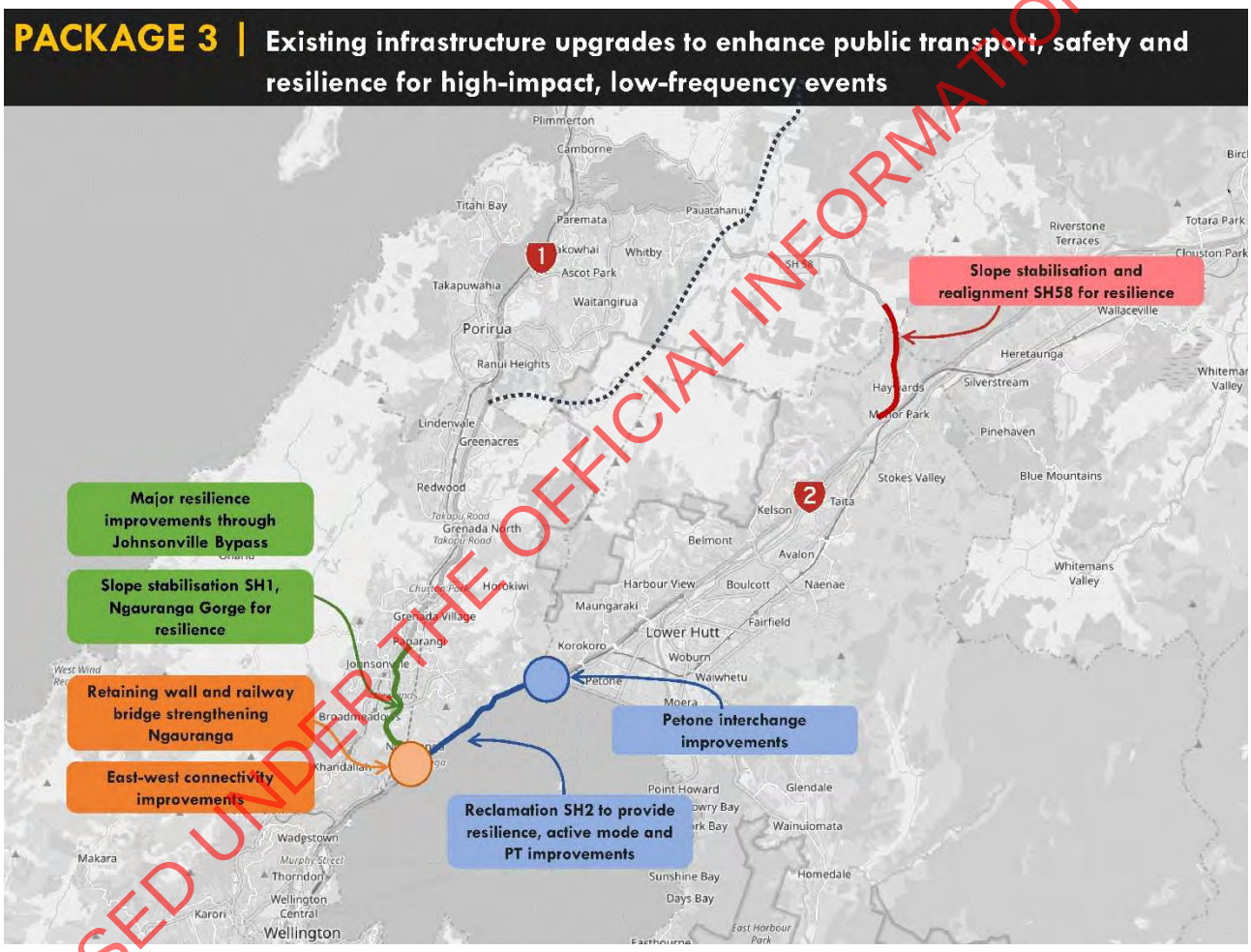

Figure 9: Package 3

The key components of the package are described below:

- SH58 realignment / slope stabilisation;
- SH2 Petone interchange improvements to enhance resilience and safety;
- SH2 Petone to Ngauranga reclamation with additional passenger transport capacity added for resilience and active mode improvements;
- SH1 Ngauranga interchange resilience improvements;
- SH1 Ngauranga interchange east-west connectivity improvements;
- SH1 Ngauranga gorge slope stabilisation; and
- SH1 Johnsonville bypass major resilience improvements, or alternative tunnel to enhance resilience.

2.2.6 *Package 4 - Extensive new smart solutions to improve resilience, safety, public transport and connectivity*

The purpose of this package is to address sections of the network with a criticality rating of extreme or very-high (as identified and defined in the Wellington Transport Resilience PBC). This package addresses all the very-high rated sections that fall within the project area by making improvements on the existing transport network.

The package also provides enhanced east-west connectivity (as well as North-South) on the existing state highway network by providing new dedicated special purpose lanes and pedestrian and cyclist facilities on all sections of the state highway between Transmission Gully and Ngauranga. The special purpose lanes could be bus lanes or other multimodal capacity improvements.

A more detailed description of this option can be found in Appendix C.

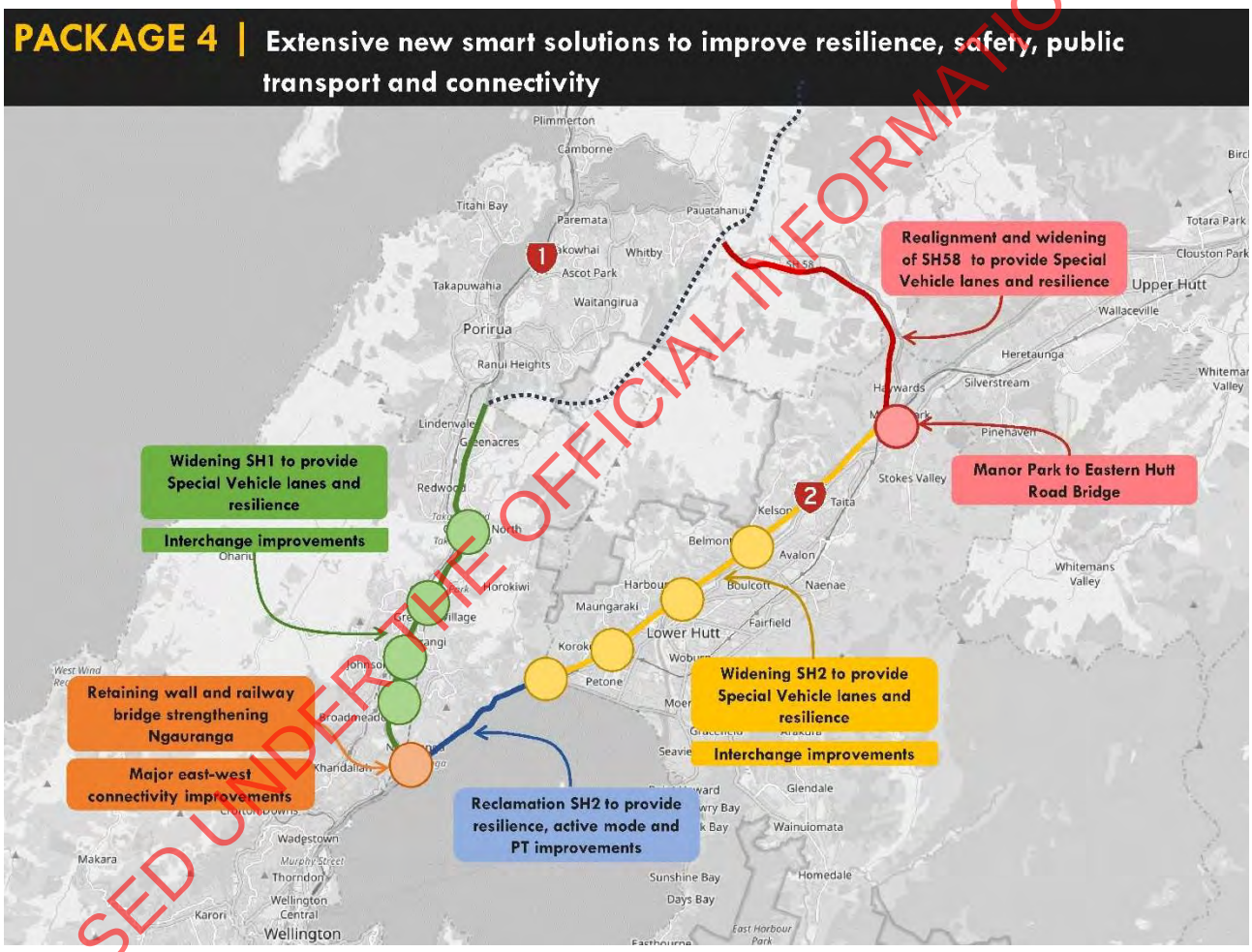

Figure 10: Package 4

The key components of the package are described below:

- Realignment and widening or SH58 to provide Special Vehicle lanes and resilience;
- New bridge from Manor Park to Eastern Hutt Road;
- Widening SH2 to provide Special Vehicle lanes between SH58 and Petone;
- SH2 interchange improvements between SH58 and Petone;
- SH2 Petone interchange improvements to enhance resilience and safety;
- SH2 Petone to Ngauranga reclamation with additional passenger transport capacity added;
- SH1 Ngauranga interchange resilience improvements;

- SH1 Ngauranga interchange east-west connectivity improvements;
- Widening SH1 to provide Special Vehicle Lanes on between Ngauranga and Transmission Gully; and
- SH1 interchange improvements between Ngauranga and Transmission Gully.

2.2.7 *Package 5 - Ngauranga resilience improvements and a new east-west local connection*

The purpose of this package is to provide resilient access to the lower Hutt Valley for emergency response following a high impact low probability event. The package will also provide connectivity between Lincolnshire Farm and Petone. The link is designed to provide local access only and would not have capacity for high volumes of traffic. It is envisaged to be 2 lanes with a 50-60 kph speed limit and is therefore not expected to remove significant amounts of traffic from the existing state highway network, which would have resulted in easier east-west movements and improved safety. Supplementary resilience enhancements are planned on SH1 in lieu of SH2 improvements.

A more detailed description of this option can be found in Appendix C.

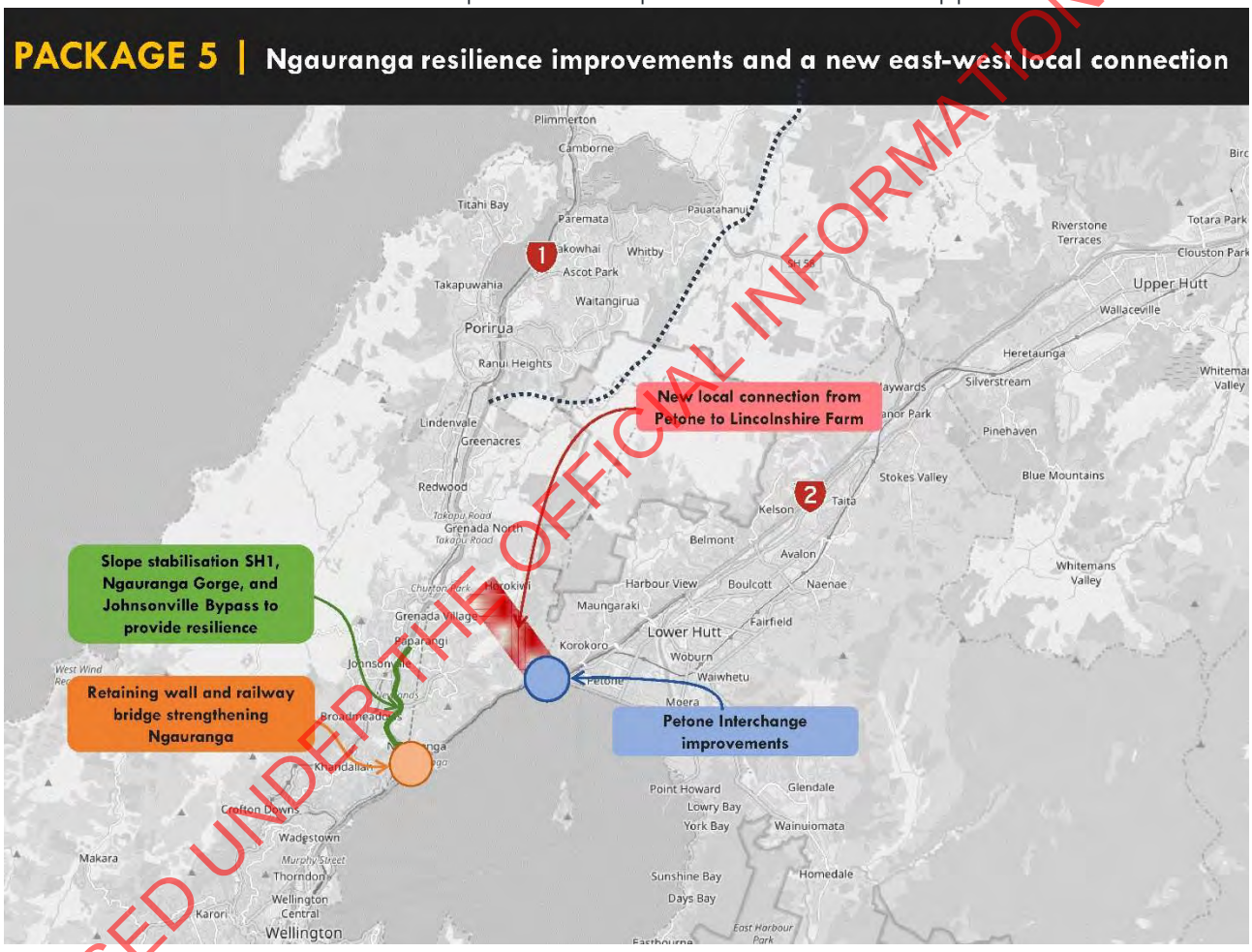

Figure 11: Package 5

The key components of the package are described below:

- New local connection from Petone to Lincolnshire Farm with connections to the existing road network at Woodridge and Grenada Village (2-lane, 50-60kph);
- SH2 Petone interchange improvements (capacity and safety improvement);
- SH1 Ngauranga interchange resilience improvements (retaining wall and railway bridge strengthening to improve east-west resilience given the limited capacity of the link;
- SH1 Ngauranga gorge slope stabilisation; and
- SH1 Johnsonville slope stabilisation.

2.2.8 *Package 6 - New smart connection between Petone and Grenada (surface)*

The purpose of this package is to provide a proxy for the previous P2G project taking on board the feedback from the 2017 evaluation report with regard to resilience and connectivity. The link provides enhanced east-west connectivity and a connection to Lincolnshire Farm in the form of a smart connection between Petone and Tawa with a connection to the existing road network at Grenada Village through a two-lane link. The smart connection is expected to have four lanes with a Special Vehicle and General traffic lane in each direction, with an expected speed limit of 80kph.

A more detailed description of this option can be found in Appendix C.

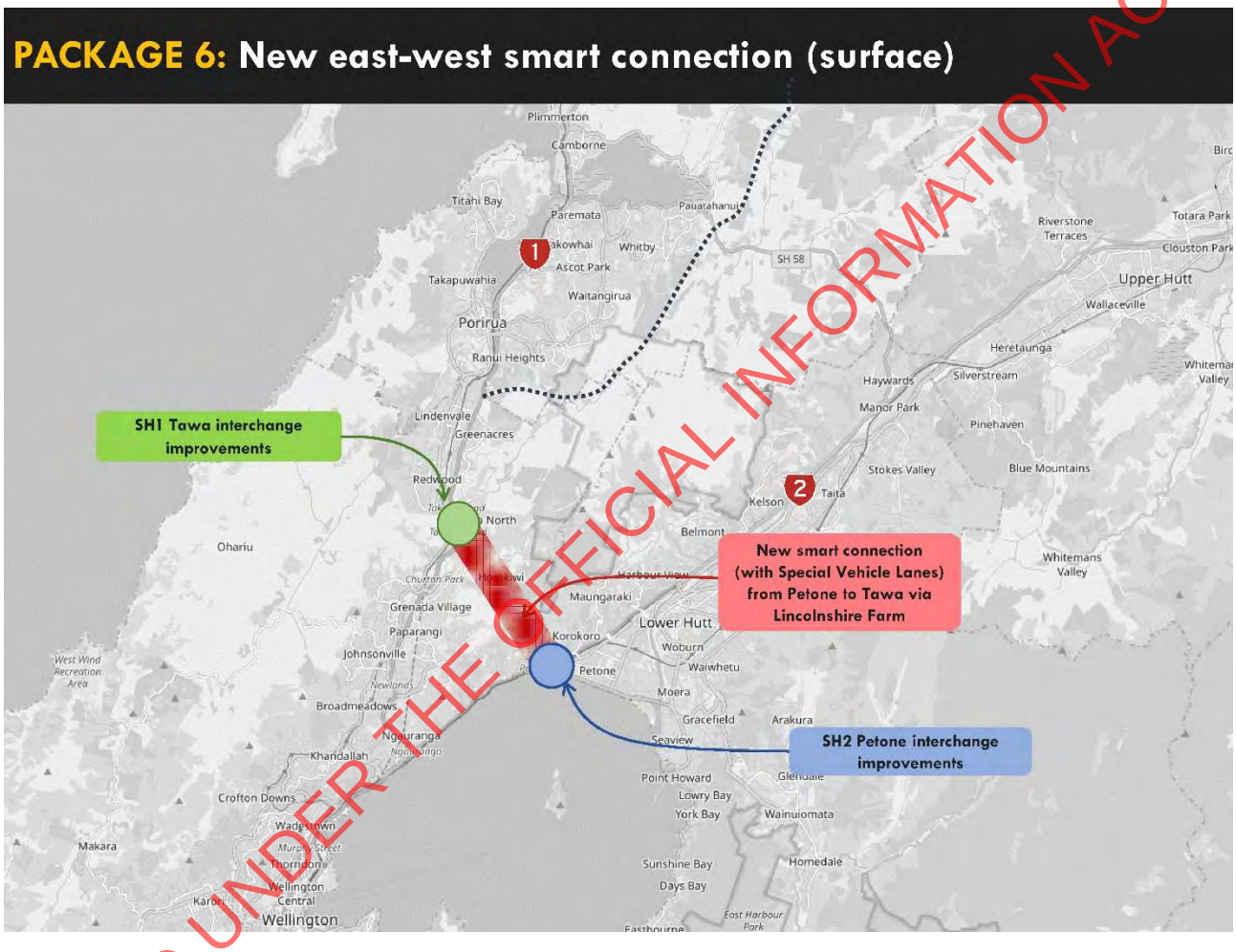

Figure 12: Package 6

The key components of the package are described below:

- New smart connection between Petone and Tawa (2 Special Vehicle lanes and two general traffic lanes) with an 80kph speed limit. There would be a connection to the existing road network at Grenada Village through a two-lane link, and provision for cyclists;
- SH2 Petone interchange improvements (connectivity, safety, performance improvements); and
- SH1 Tawa interchange improvements.

The previous P2G scheme identified that similar improvements led to an upgrade of SH2 from Dowse to Petone to and Melling interchange. These improvements have not been included in this scheme but could be key interdependencies which will require further assessment in future business cases.

2.2.9 *Package 7 - New east-west smart connection (tunnel)*

The purpose of this package is to provide a new resilient east-west connection via a four-lane smart connection tunnel between Petone and Tawa (with no link to Lincolnshire Farm). The smart connection is expected to have four lanes with a Special Vehicle and General traffic lane in each direction, with an expected speed limit of 80kph.

Other sub-options include links between different destinations on each side and different alignments. The option designed to improve resilience while providing east-west connectivity.

A more detailed description of this option can be found in Appendix C.

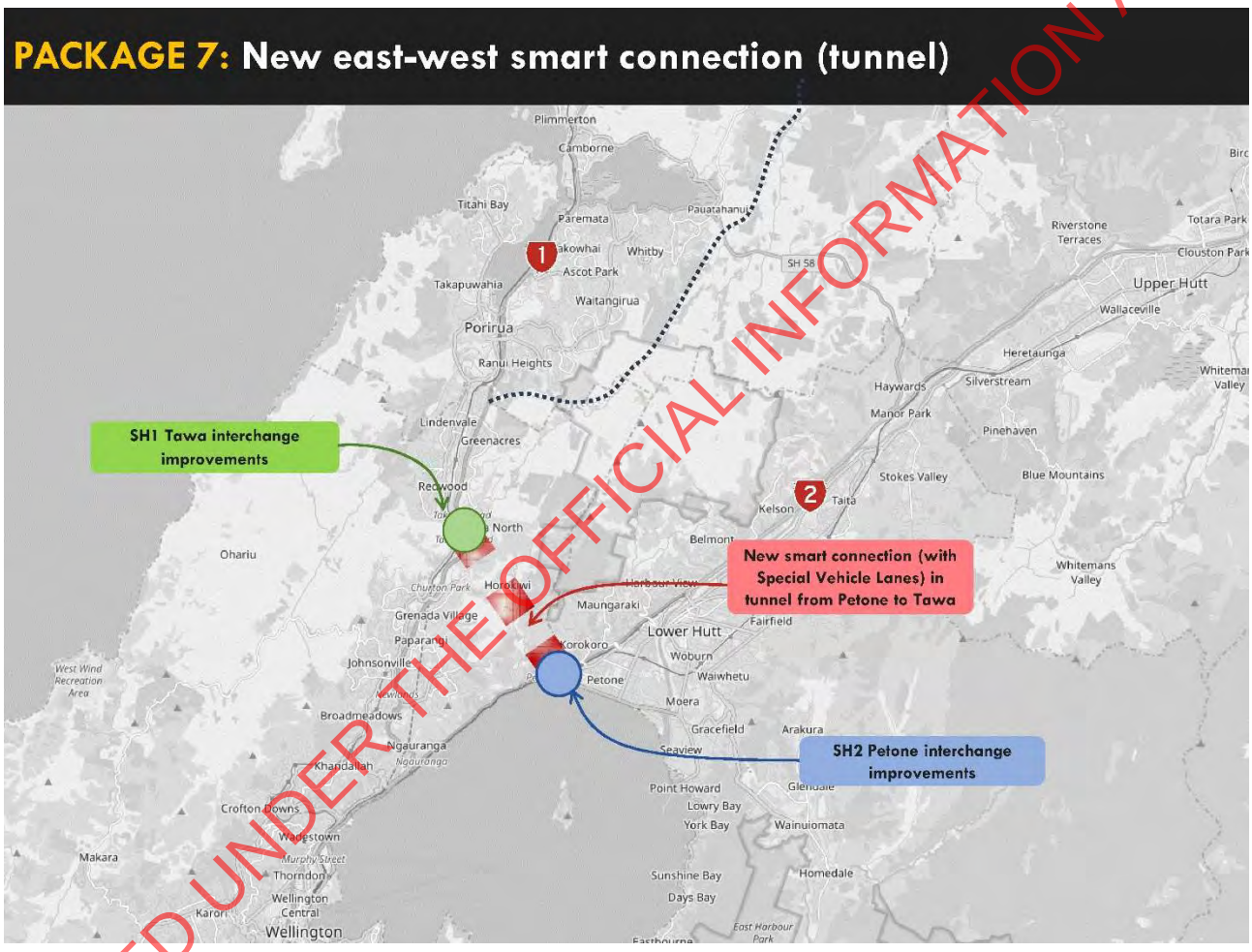

Figure 13: Package 7

The key components of the package are described below:

- New four-lane smart tunnel connection between Petone and Tawa, including two Special Vehicle lanes and two general traffic lanes with an 80kph speed limit;
- SH2 Petone interchange improvements; and
- SH1 Tawa interchange improvements.

The previous P2G scheme identified that similar improvements led to an upgrade of SH2 from Dowse to Petone to and Melling interchange. These improvements have not been included in this scheme but could be key interdependencies.

2.2.10 Package 8 - SH58 upgrade

The purpose of this package is to consider the benefits of upgrading SH58 in isolation to respond to the Investment Objectives. This package could also be a proxy for another high capacity east-west link in an alternate location that connects to Transmission Gully.

A more detailed description of this option can be found in Appendix C.

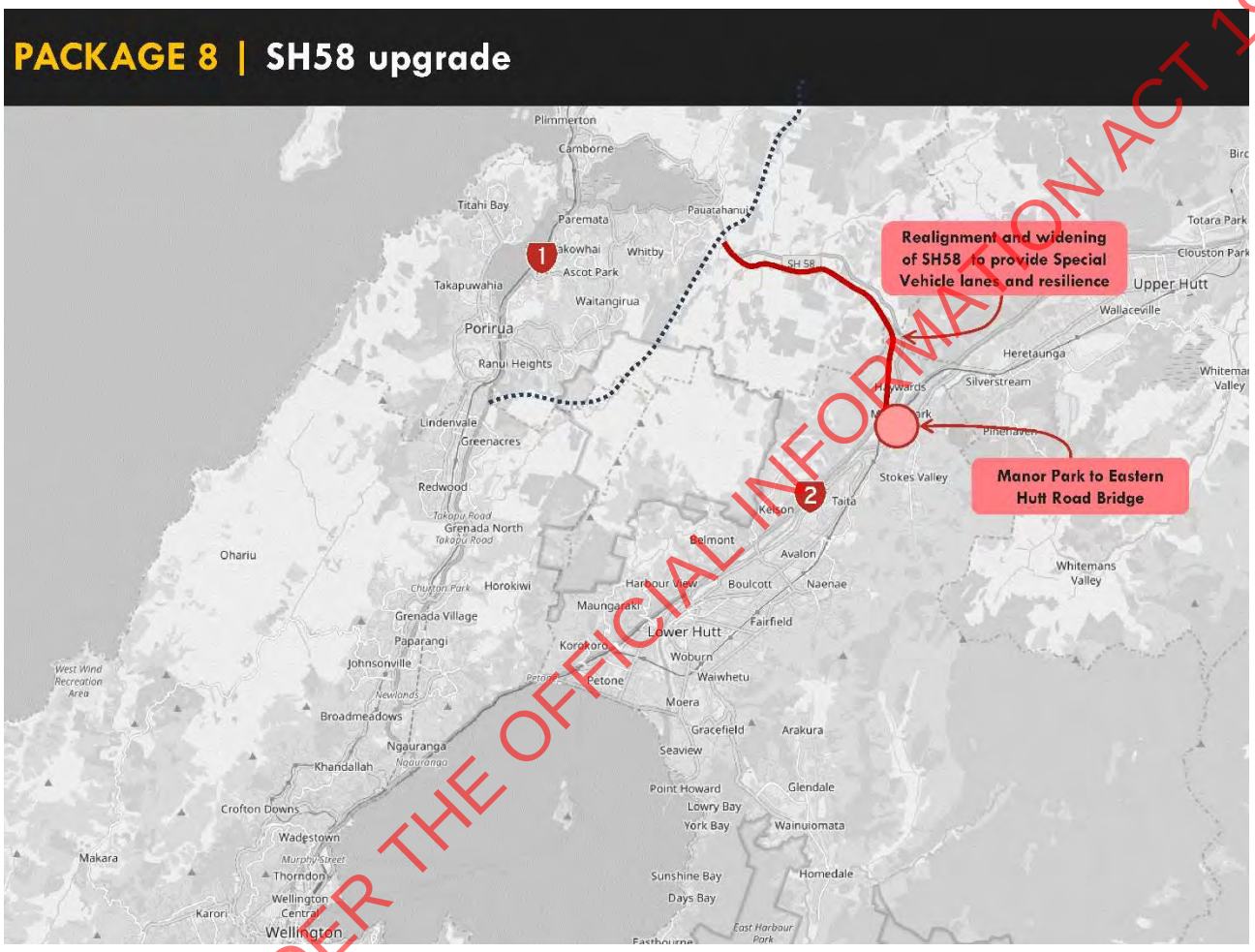

Figure 14: Package 8

The key components of the package are described below:

- SH58 realignment and widening to provide Special Vehicle lanes and resilience; and
- New bridge from Manor Park to Eastern Hutt Road to provide improved connectivity to the eastern Hutt Valley and add redundancy to the local road network.

2.2.11 *Package 9 - Enhanced Public Transport and active user infrastructure and services*

The purpose of this package is to provide additional public transport and active user enhancements to respond to the Investment Objectives. East-West connectivity is enhanced by the Smart Connection tunnel and improved public transport connections at Ngauranga that will enable east-west trips without the need to transfer at Wellington Railway Station.

A more detailed description of this option can be found in Appendix C.

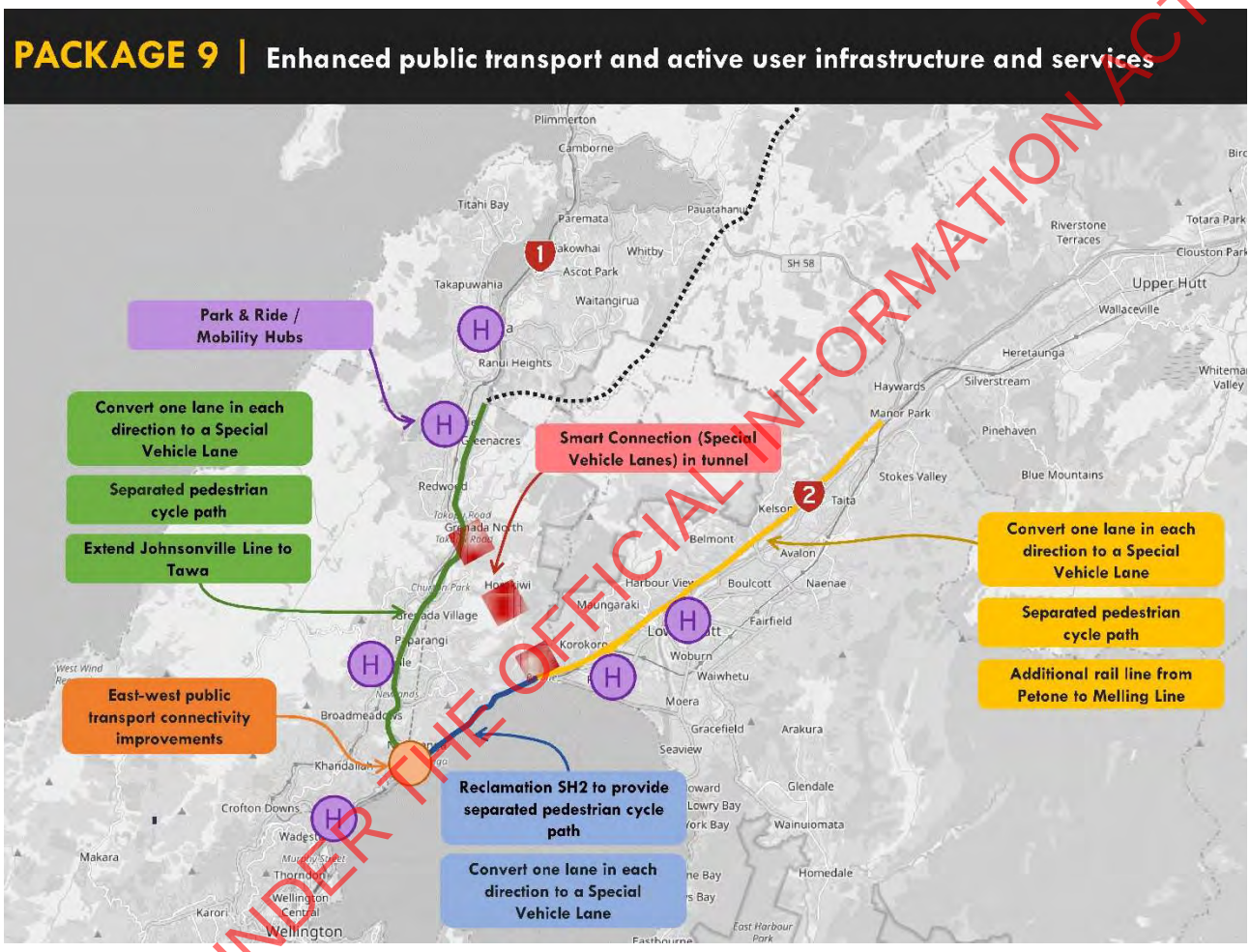

Figure 15: Package 9

The key components of the package are described below:

- SH1 convert one lane in each direction to a special purpose lane and provide off-road pedestrian and cycle facilities from Ngauranga to Transmission Gully;
- SH2 convert one lane in each direction to a special purpose lane and provide off-road pedestrian and cycle facilities from SH58 to Ngauranga;
- Extend Melling Line to Petone (additional track) in the south;
- Extend Johnsonville Line to Tawa and provide a new station between Johnsonville and Takapu serviced by both the Johnsonville and Kapiti lines;
- SH2 Petone to Ngauranga reclamation;
- New two-lane tunnel (special purpose lanes) between Lower Hutt and Tawa;
- Mobility hubs at key locations; and
- Rail Strategy 1 and Rail Strategy 2.

A key technical uncertainty with this package is likely to be the extent of mode shift required for the general traffic and SPV lanes to function effectively.

2.3 Multi Criteria Assessment

A Multi Criteria Assessment (MCA) has been undertaken to evaluate the ten packages of works identified, as well as the Do-Minimum option, that could address East West connectivity and resilience between Porirua, Tawa, Johnsonville and Lower Hutt. An MCA process is one in which alternatives and criteria are specified, data is entered, and an MCA evaluation is undertaken to provide information in assisting the decision makers.

A key feature of an MCA is its emphasis on the judgement of the decision-making team, in establishing objectives and criteria, assessing relative importance weights and, to some extent, in judging the contribution of each option to each performance criteria.

An MCA has advantages as:

- It is open and explicit;
- The choice of criteria that any decision-making group may make are open to analysis and to change if they are felt to be inappropriate or require redefining;
- Scores and weights, when used, are clear and are developed according to a process;
- It can provide an important means of communication, within the decision maker and sometimes, later, between that body and the wider community; and
- It provides an audit trail.

The MCA process assists people in making decisions and is useful in generating discussion and interrogation of decision making processes. The assistance that an MCA can provide for decision makers is that it can provide structure to discussions, documenting the process, separating matters of fact from matters of judgement, making value judgements unambiguous, creating shared understanding about the issues, generating a sense of common purpose and often, gaining agreement about the way forward.

For the P2G re-evaluation, the packages include a number of individual components, which have not been developed to a level of detail that would allow the components to be individually assessed. The MCA process has been a useful tool in obtaining the views of relevant specialists and considering the overall packages against other key measures including investment objectives. More stakeholder and technical refinement is required in order to complete the MCA and decision-making process.

The scores (including sum scores and scenarios) have provided valuable information about each package, and discussions around the drivers for the scores have also been valuable in facilitating discussions about individual components of each package.

However, the Project team has been careful not to treat the individual scores or sum total / weighted scores as definitive evaluations of the relative worth of each package. An essential part of the process has been for the Project team to apply a 'sense check' to the MCA performance of each package – including in particular the practical affordability of some of the higher performing, high intervention packages.

The full MCA report can be found in Appendix D.

2.3.1 Assessment Criteria

The assessment criteria were generated in draft form and then socialised with stakeholders at a workshop on 11 September 2018. The role of the MCA is to help the project team assess and compare the various relative opportunities, risks, challenges and likely effects of the packages.

The following criteria were used by various specialists to assess the packages. A full MCA report including set of criteria and the results spreadsheet can be found in Appendix D.

Table 4: MCA Assessment Criteria

Category	Criteria	Sub-Criteria
Investment Objectives	Objective 1	To improve resilience by reducing the number and duration of closures on the east west transport network following major and minor hazard events and network operational incidents as follows: - Following a HILP event, the duration of predicted closures of the east/west land transport network is reduced by 20XX - Following a LIHP event, the number of journeys affected on the east/west land transport network is reduced by 20XX. - following a HILP even, the duration of predicted closures of SH2 and SH1 is reduced by 20XX - Following a LIHP event, the number of journeys affected on SH1 and SH2 transport network is reduced by 20XX.
	Objective 2	To improve access to key destinations and urban growth areas between Porirua/Tawa/Johnsonville and Lower Hutt by providing increased travel mode choice by 20XX.
	Objective 3	Improve network safety by reducing the number of DSI's and non-injury accidents for all transport users by XX% between 20XX and 20XX.
Alignment With GPS	Safety	A safe system free of death and serious injury
		Investing in safety improvements on high risk SH and local roads
	Access	A land transport system that provides increased access to economic and social opportunities
		A land transport system that enables transport choice and access
		A land transport system that is resilient
	Environment	A land transport system that reduces greenhouse gas emissions, as well as effects on the local environment and public health
	Value for Money	A land transport system that delivers the right infrastructure and services to the right level at best cost
Implementability	Feasibility	Are there any design and delivery risks involved in developing or implementing this option?
		Are there any design and delivery risks involved in developing or implementing this option?
	Affordability	Are there any factors that might affect the ability to fund, operate or maintain the option over its projected life?
	Stakeholders	Is the option likely to be acceptable to the key council stakeholders?
Assessment of Environmental Effects	Safety	To what extent will the option enhance safety for different types of transport users?
		Does the option address safety issues presenting a high crash risk or in a Safer Journey's area of concern?
	Cultural and Historic Heritage	Are there significant sites that would be impacted by the option?
	Environment and Visual	To what extent does the option impact on the natural and urban landscape, including matters relevant to urban design, landscape character and visual amenity values
	Social	Does the option affect accessibility for the public, including access to jobs, communities, shops, services and other facilities?
		Does the option improve wellbeing?
	System Integration	Does the option result in improved system integration?
	Economy	Does the option improve economic activity?
		Does the option address a gap in the accessibility for the opening up of land development opportunities?
	Ecology	To what extent does the option impact on ecology?

2.3.2 Scoring Methodology

The MCA applied numerical analysis in two stages:

- Scoring
- Weighting

Scoring

The expected consequences of each option were assigned a numerical score on a strength preference scale for each package for each criterion.

In this way packages that better achieve objectives or have lesser environmental impact score higher on the scale, and those packages that do not achieve the objectives or have greater environmental impacts score lower. The numerical values ascribed are from -3 to 3 with -3 being effects that are significant and cannot be fully mitigated and 3 being significant positive effects, as shown in Table 5. The scoring methodology of -3 to 3 was based on the NZ Transport Agency guidelines "Multi Criteria Analysis for Transport Business Cases" February 2017.

The scores for the criteria and the packages were based on an overall assessment by the specialists of the proposal (i.e. each overall package) in relation to the Do Minimum which is which is described in detail in Section 2.2.1. The -3 to 3 scores were assigned on an absolute basis, with each package being assessed relative to the Do Minimum. In other words, differentiation in scores between the packages was not sought to be achieved through relative scoring of those packages.

Following the MCA briefing and discussion on the criteria on 12 October 2018, the MCA was issued to specialists on 17 October 2018. The specialists were assigned criteria relevant to the area of their expertise and were asked to score the relevant criteria accordingly. The MCA workshop to challenge the scoring was held on 24 October 2018.

All scoring of the packages against the criteria were scored on a -3 to 3 scale. Table 5 below shows the context of the scoring of the criteria.

Table 5: Scoring used for each of the criteria

Rating	Score	Comments
Significantly Adverse	-3	Significant adverse impact with serious long-term effects
Moderately Adverse	-2	Moderate adverse impact, that may be managed or mitigated
Slightly Adverse	-1	Minor adverse impact, which can be mitigated or managed
Neutral	0	Similar impact to the do-minimum
Slightly Positive	1	Minor positive impact
Moderately Positive	2	Moderate positive impact, which may provide improvements and opportunities

The workshop held on 24 October 2018 to confirm scores and weight the criteria, was attended by:

- Specialists: Pathmanathan Brabhaharan (WSP Opus - Resilience), Steph Brown (WSP Opus – Social Impacts), Eliza Sutton (WSP Opus - Transport), Louise Baker (WSP Opus - Travel Demand Management) and Leigh Bull (Ecology) were present at the workshop;
- Project Team: Selwyn Blackmore (NZ Transport Agency), Campbell Ogilvie (WSP Opus - Project Manager), Sam Thornton (WSP Opus – Principal

Transportation Engineer), Cathy Crooks (WSP Opus – Senior Planner) and Tony Coulman (WSP Opus – Project Director); and

- Not present at the workshop were Gavin Lister (Isthmus – Urban Design), Michelle Grinlinton-Hancock (WSP Opus - Consenting), Richard Paling (Richard Paling Consulting Ltd - Economics) and Mark Stanko (WSP Opus - Constructability and Cost Estimating).

At the workshop the technical experts presented their assessment of the options against the criteria and the score they had assigned to each option. In some cases, amendments were made to the scores as a consequence of discussion. For those not in attendance where discussion resulted in a query or a suggested amendment to a score this was reported back to the specialist and they were given the opportunity to consider the suggested change and amend where necessary.

A meeting was held on 25 October 2018 with the Agency and the Team[4] for the purpose of presenting the outcome of the MCA workshop of 24 October 2018 and to work through programmes A and B which had been distilled from the MCA process.

Weighting

MCA decision making preferences are expressed through raw scores and weighted scores. In doing so the importance of each criteria relative to other criteria is expressed. A number of different weighting scenarios were developed to assess the proposed packages. The scenarios considered are shown in Table 6.

Table 6: Weighing Scenarios

Weighting Scenario	Investment Objectives	Alignment with GPS	Implementability	Assessment of Effects
Unweighted (raw)	25%	25%	25%	25%
1	70%	0%	20%	10%
2	60%	0%	20%	20%
3	70%	0%	10%	20%
4	70%	0%	20%	10%
5	40%	30%	20%	10%

The rationale behind choosing these weightings scenarios was to compare the relative impact of each of the criteria groupings and to also take into account the challenge of double counting that was generated by the inclusion of the GPS criteria (relative to the Investment Objectives). This "double counting" arises because the Investment Objectives (increased resilience, east/west connectivity and safety) align very tightly with the GPS Access and Safety Criteria.

Although scenarios 1 and 4 appear to be the same, in scenario 1 the investment objectives was based on the investment objectives being weighted differentially, whereas in scenario 4 each of the investment objectives was weighted equally.

For scenarios 1 – 4 it was agreed that the Alignment with the GPS should be 'turned off' as these criteria introduced a degree of double counting with the Investment Objectives.

[4] Including Thaddeus Ryan from Buddle Findlay

2.3.3 MCA Scoring

The initial step in undertaking the scoring was to assign scores by the specialists, these scores were then allocated a proportional value so that each of the headline criteria did not exceed 100%. The three investment objectives were ascribed a 70%/20%/10% weighting in line with the Investment Logic Mapping (ILM) associated with the development of the problem statements and benefit mapping.

Questions within the remaining three criteria groups were proportioned so that the headline criteria were on an equal basis prior to the weighting scenarios being applied.

The MCA scoring process was undertaken as follows:

1 Raw scoring;
2 Weighted scenarios

Raw scoring

Figure 16 summarises the raw rating of each package against the four major categories listed in Table 4:

- Investment objectives
- Alignment with GPS
- Implementability
- Assessment of effects (system, economic, social, environmental)

Figure 16: Initial Scoring for Packages for Each Criteria Group

The figure shows:

- The infrastructure-based packages score best against the investment objectives, particularly package 4. Packages 3, 6, 7 and 9 also score well.
- Most of the packages score well against the GPS with package 2 being the exception to this. This is due to package 2 not providing a high level of connectivity and/or resilience and no safety improvement.
- All packages score poorly against Implementability with packages 4, 7 and 9 scoring noticeably worse than the other packages due predominantly to the high likely costs of these packages coupled with likely construction issues associated with tunnelling and/or large-scale reclamation of the foreshore between Ngauranga and Petone being required.
- The infrastructure-based packages generally all scored poorly against the assessment of effects, with the packages 1A and 1B which had lower infrastructure investment, scoring positively.

Weighted Scenarios

As part of the workshop that was undertaken on the 12 October 2018 the specialists discussed and agreed that a number of scenarios should be run. The agreed weighting scenarios are shown in Table 6.

Scenarios 1, 2, 3 and 5 were based on the investment objectives being weighted 70/20/10 as per the ILM.

Scenario 4 was based on the investment objectives being weighted equally.

For scenarios 1 – 4 it was agreed that the Alignment with the GPS should be 'turned off' as these criteria introduced a degree of double counting with the Investment Objectives.

Again, the intention of the scenarios was to provide additional information in terms of the relative performance (in sum total scores terms) of each package when different elements of the criteria are emphasised.

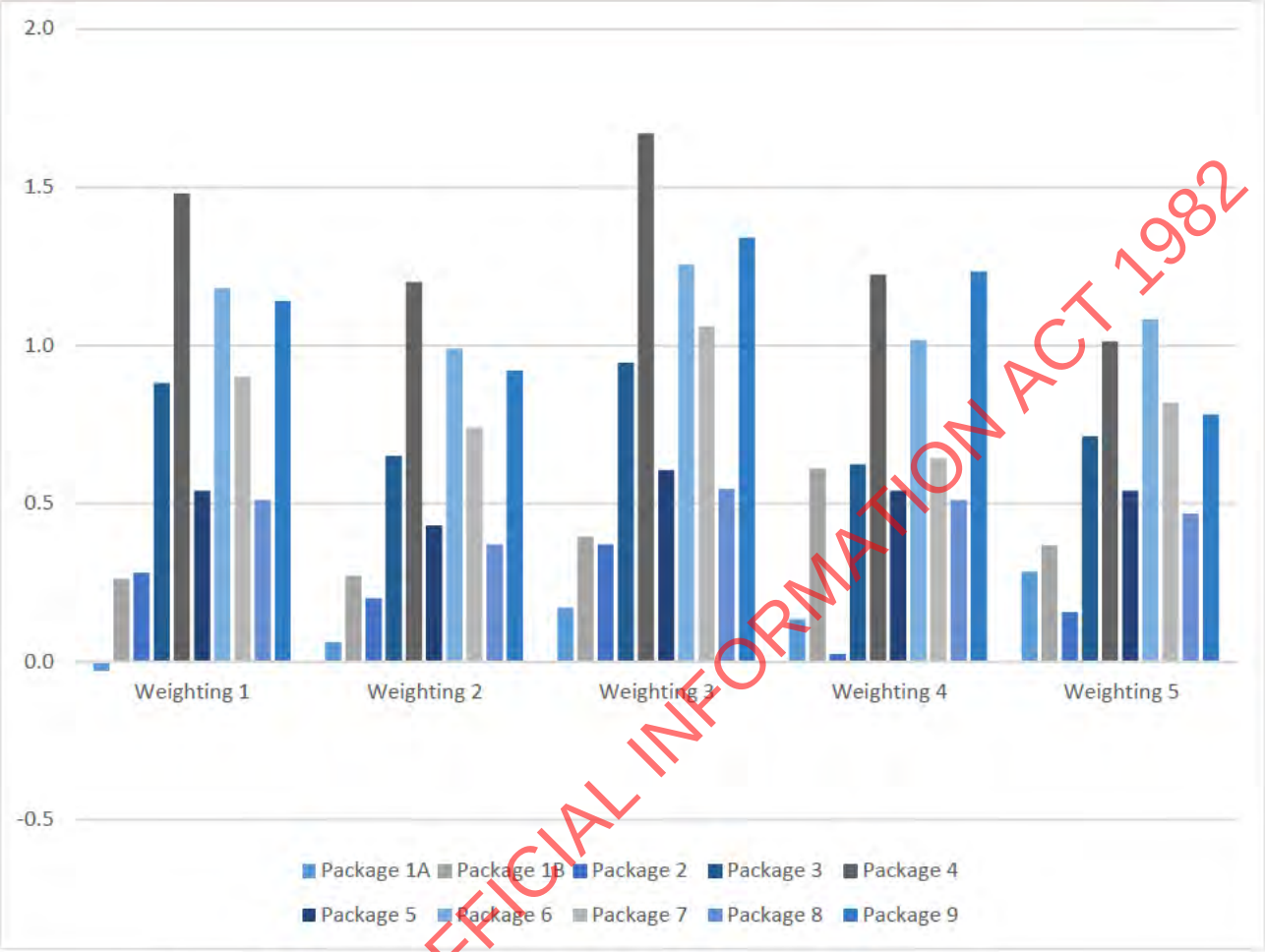

Figure 17: Raw scores for different weighting scenarios

Figure 17 shows the package scores compared against the five weighting scenarios considered in Table 6.

Figure 17 shows that:

- Package 4 ranks highest in weighting scenarios 1, 2 and 3. Package 9 ranks highest in weighting scenario 4 and package 6 ranks highest for scenario 5.
- Packages 4, 6 and 9 are ranked either 1st, 2nd or 3rd for all weightings except scenario 5 where package 9 drops to 4th and package 7, which is ranked 4th in all other scenarios rises to 3rd.
- Package 3 consistently ranks in fifth place.
- Packages 5 and 8 generally score similarly (ranked 6th ,7th or 8th) but vary between the different weighting scenarios.
- Packages 1A, 1B and 2 are the lowest scoring and ranked packages, the rankings vary between the different weighting scenarios primarily due to the fact they do not address the Investment Objectives as strongly as infrastructure-based packages.
- The weighting of scenario 4 (where each of the investment objectives was weighted equally) generated the greatest degree of change in the package rankings.

Overall the outcome of the implementation of the various scenarios was that generally Packages 4 and 6 scored consistently highest in terms of the sum of scores.

2.3.4 *Critical Thinking Around Packages*

In the sections below, commentary on the packages has been provided. As set out above, it is important (particularly for an MCA that considers high level packages with multiple individual components) that the 'sum total' scores are not automatically viewed as definitive 'rankings' of which packages are 'best' and should therefore be taken forward. The MCA scores, and commentary and discussion around those scores, are intended to provide information to the Project team and Transport Agency in deciding next steps.

With that in mind, the commentary relates to the way in which each package scores in terms of the MCA, with consideration given to (in particular):

- What factors are driving the overall sum total scores for each package, including what components of the packages drive the scores (for example, the reclamation along SH2 that is included in a number of packages); and
- Whether on reflection, considering the information derived from the MCA exercise, there are additional / alternative 'pick and mix' packages that can be developed, compiling elements of the assessed packages.

Packages 1A, 1B and 2

Packages 1A, 1B and 2 are the lowest scoring and ranked packages in the MCA.

These packages score relatively low against the investment objectives which are aspirational long-term objectives, however they generally have positive or negligible environmental effects and have good alignment with the GPS.

Effective interventions from these packages are proposed to be included in the proposed programme(s) as supporting measures and to provide short to medium term improvements whilst larger scale interventions are developed.

Package 3

Package 3 consistently ranks 5th against the other packages. It scores well against the investment objectives with relatively poor scores against implementabilty.

Package 3 is proposed to form one of the larger scale intervention options as part of a programme for further consideration. Programme 3 also provides a scaled down version of the highest-ranking Package 4 without some of the concerns associated with this Package (refer below).

Package 4

Package 4 consistently scores well and ranks top of the packages considered for three of the identified scenarios. It scores best against the investment objectives and worst for implementability. It is also likely to be the second most expensive package (after package 9). Following the MCA, the Project Team propose that Package 4 does not form part of a proposed programme. The reasons for this include:

- Very high cost
- Very high implementability risk
- Provides additional capacity which is contrary to GPS intent
- Interventions provide significant benefit for north south movements which help the intervention score highly but the capacity benefits are realised beyond the Ngauranga Triangle focus area.

Packages 5-7

Packages 5, 6 and 7 all provide a new east-west connection between the lower Hutt Valley and north Wellington / Porirua.

Package 6 consistently scores higher than Package 7 as a result of the improved connectivity and support for land development. Package 5 consistently scores and ranks lower.

A higher capacity new east-west connection (e.g. Package 6 or 7) is proposed to form one of the larger scale intervention options as part of a programme for further consideration. At this stage for the purposes of the programme assessment, the option could be either Package 6 or 7.

Package 5 has not been progressed.

Package 8

Package 8 consistently ranks in the lower half of the packages.

Whilst the programme delivers resilience and connectivity benefits for the northern Hutt Valley, it does little to provide for the east-west accessibility between the lower Hutt Valley and north Wellington / Porirua.

The additional capacity on SH58 could create downstream problems for SH2 which is already at capacity in some sections.

For the reasons listed above, package 8 has not been progressed.

Package 9

Package 9 consistently ranks in the top 4 packages in the weighted scenarios. It scores second highest against the investment objectives and second worst for implementability and is the most expensive package. Following the MCA, the Project Team propose that Package 9 does not form part of the proposed programme(s) in its entirety. The reasons for this include:

- Very high cost
- Very high implementability risk
- Removes significant existing capacity on the highway network with a high degree of operational risk
- The rail interventions provide significant benefit for north south movements which help the intervention score highly but do not facilitate east-west movement.

Effective interventions from these packages are proposed to be included in the short-listed programme(s) to provide short to medium term improvements whilst larger scale interventions are developed e.g. mobility hubs, park 'n' ride, cycle linkages.

3 Programmes

The MCA process identified that there were two general options to achieve the Investment Objectives, either:

A. A significant improvement in the resilience of the existing network, by reclamation along SH2 between Ngauranga and Petone to provide resilience against landslides following a Low Probability, High Impact event and further major improvements along SH1 near Johnsonville and at the SH1/SH2 Ngauranga interchange

B. A new East/West smart connection.

Since the MCA assessment on the initial Package options developed, two alternative Programmes based on the two general options (A and B) were developed by taking complementary elements of the different packages. The two Programmes share some common interventions that effectively meet some of the Project's Investment Objectives and can be implemented in the short to medium term. These common elements are referred to as the Base Programme.

Figure 18 summarises which packages have been taken forward in part (1A, 1B, 2 and 9) or completely (3 and 6 or 7).

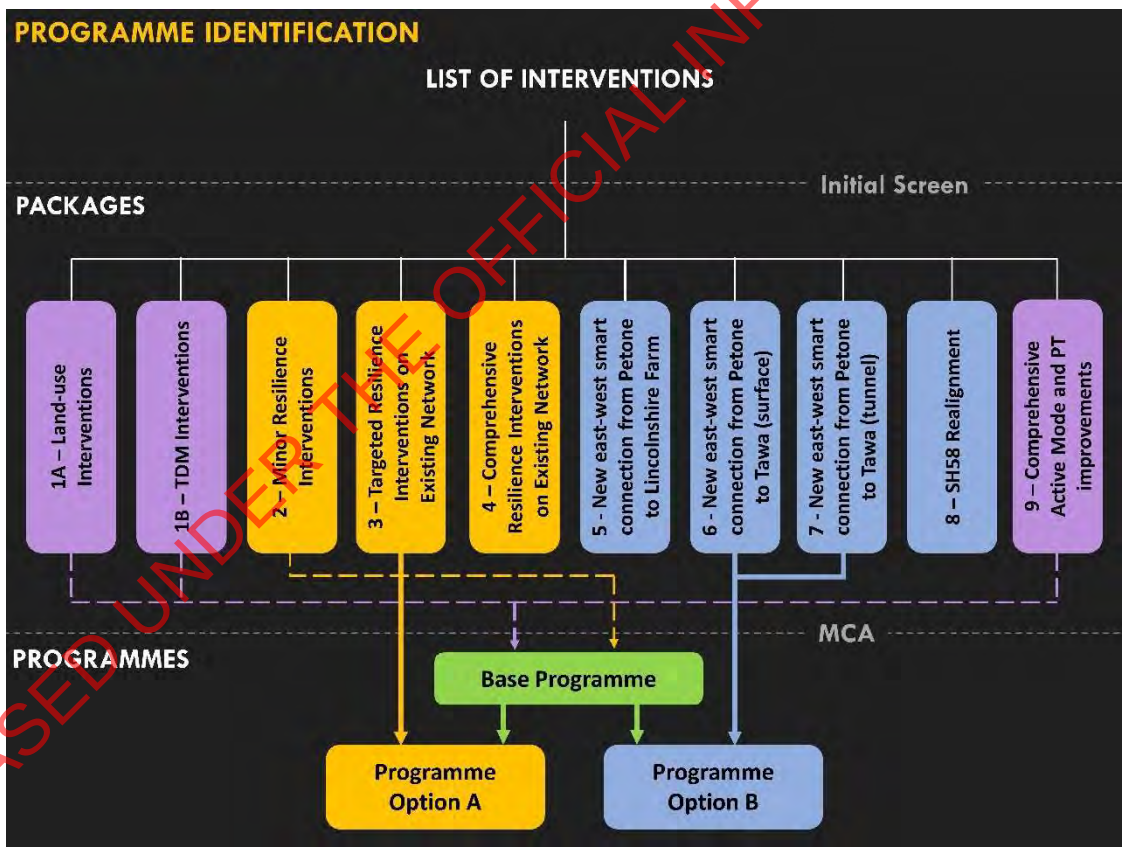

Figure 18: Programme Identification

3.1 Base Programme

There are some common interventions that effectively meet some of the Project's Investment Objectives and can be implemented in the short to medium term. These common elements are referred to as the Base Programme, which is made up from elements of Packages 1A, 1B, 2 and 9. The interventions that form the initial stage of the Base Programme are typically either:

- (Relatively) low-cost short-term resilience improvements; or
- Behaviour / policy / infrastructure changes that will result in reduced reliance on state highway travel (by single occupancy vehicles) to improve east-west accessibility.

The Base Programme is shown in Figure 19 and Table 7.

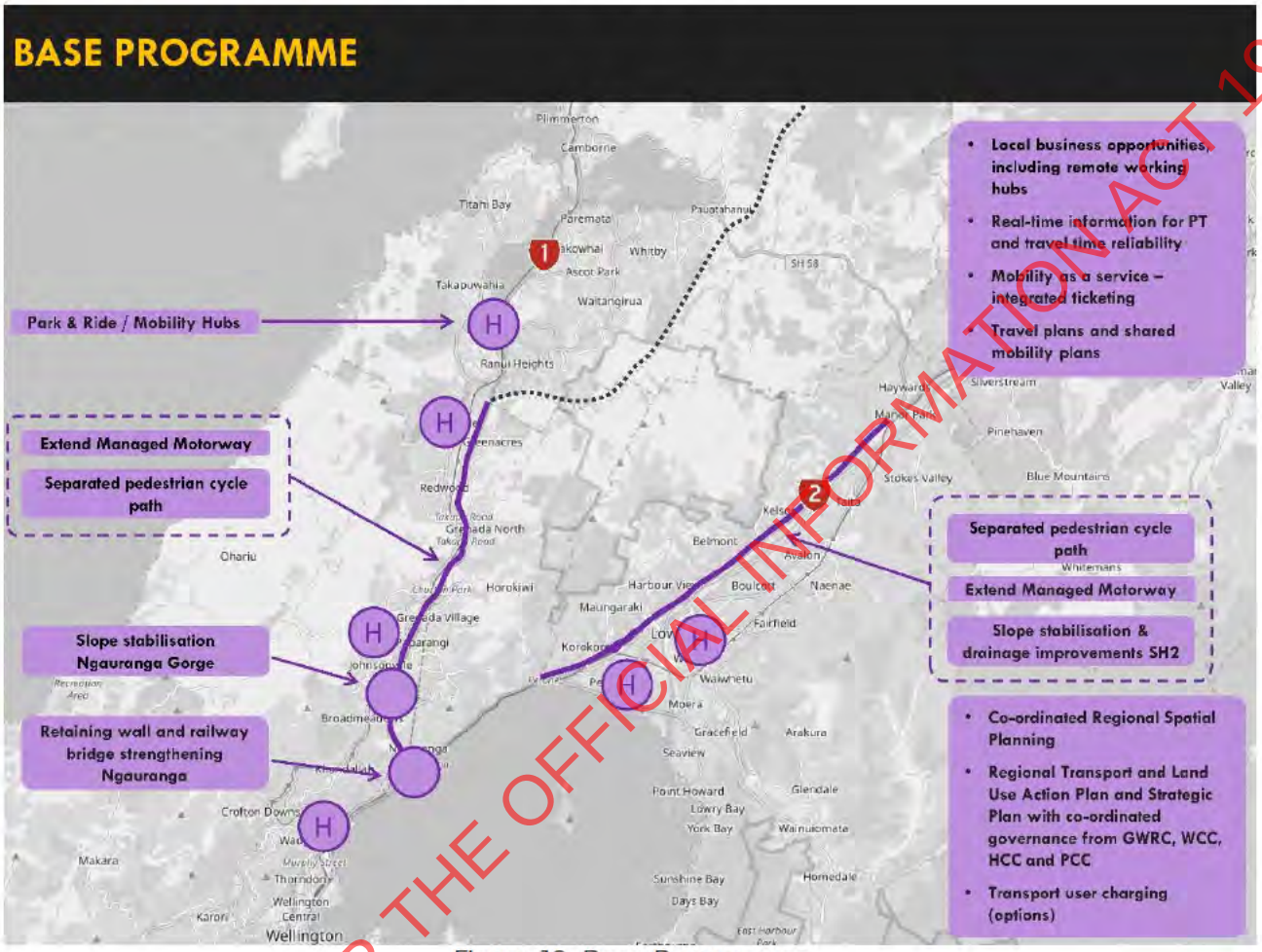

Figure 19: Base Programme

Table 7: Base Programme Components

Component	Justification
SH1 Ngauranga interchange resilience improvements	Improves resilience of critical section of SH1, providing a more resilient connection for east-west travel
Park and Ride / Mobility hubs[5] at key locations	Provide and enable efficient and safe interchanges between sustainable transport modes improving east-west connectivity. Includes re-opening Kaiwharawhara Station as a mobility hub. Potential to enable Transit Oriented Development in the long-term.
Provide off-road pedestrian and cycle facilities from Ngauranga to Transmission Gully;	Provides for multi-modal travel with improved east-connectivity.

[5] Mobility Hubs provide a focal point in the transportation network that seamlessly integrates different modes of transportation, multi-modal supportive infrastructure, and place-making strategies to create activity centres that maximize first-mile last mile connectivity. Source: http://www.urbandesignla.com/resources/docs/MobilityHubsReadersGuide/lo/MobilityHubsReadersGuide.pdf

Provide off-road pedestrian and cycle facilities from SH58 to Ngauranga;	Provides for multi-modal travel with improved access to new infrastructure that enables east-west connectivity.
SH2 slope stabilisation / drainage improvements	Improves resilience of very high-risk section of SH2, providing a more resilient connection for east-west travel
SH2 managed motorway extension	Improves safety and operational resilience of SH2 as part of an east-west connection
SH1 managed motorway extension	Improves safety and operational resilience of SH1 as part of an east-west connection
Regional Transport and Land Use Action Plan and Strategic Plan[6]	Reduces single occupancy vehicles and promotes sustainable transport modes improving east-west connectivity and resilience
Co-ordinated Regional Spatial Planning	Reduces single occupancy vehicles and promotes sustainable transport modes improving east-west connectivity and resilience
Local business opportunities including remote working hubs	Reduces intra-regional travel improving east-west connectivity and resilience
Extension of real-time information for PT and travel time reliability	Enables efficient sustainable transport modes improving east-west connectivity
Mobility as a Service[7] – integrated ticketing	Enables efficient sustainable transport modes improving east-west connectivity
Travel plans and shared mobility plans	Reduces single occupancy vehicles and promotes sustainable transport modes improving east-west connectivity
Transport user charging (options) in conjunction with other programmes e.g. Let's Get Wellington Moving	Reduces single occupancy vehicles and promotes sustainable transport modes improving east-west connectivity
East-west bus connectivity improvements	Provides for multi-modal travel with improved east-connectivity.

3.1.1 *Ownership of Initiatives*

Whilst some of the Programme Components in the Base Programme would be led by the Transport Agency, as shown in Figure 20, with others led by partner agencies, as shown in Figure 21.

[6] An integrated, strategic plan that links land transport and spatial planning.
[7] Mobility as a Service (MaaS) offers a single, connected network-wide transport system focused on providing people-centred services.

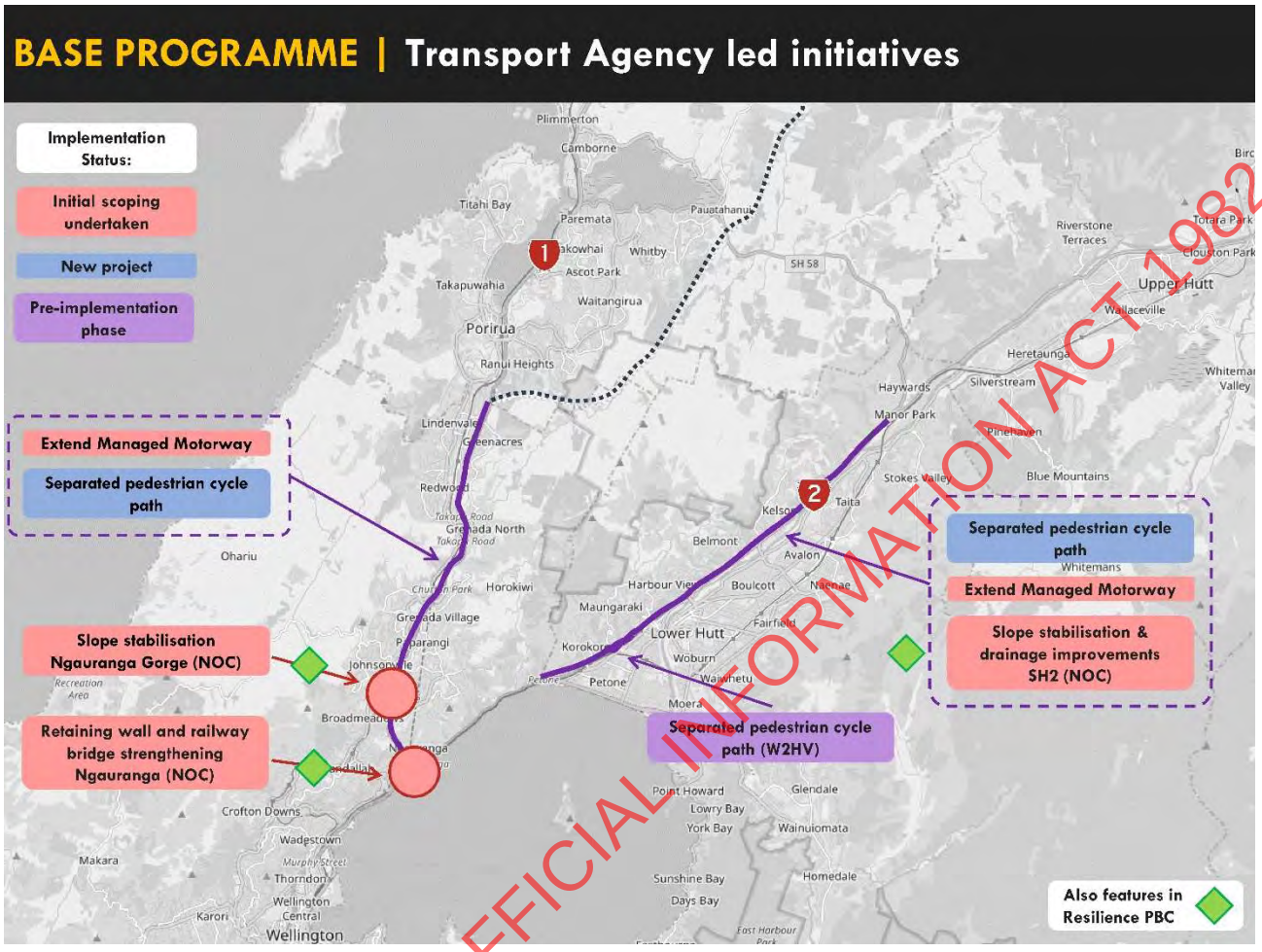

Figure 20: Transport Agency-Led Initiatives

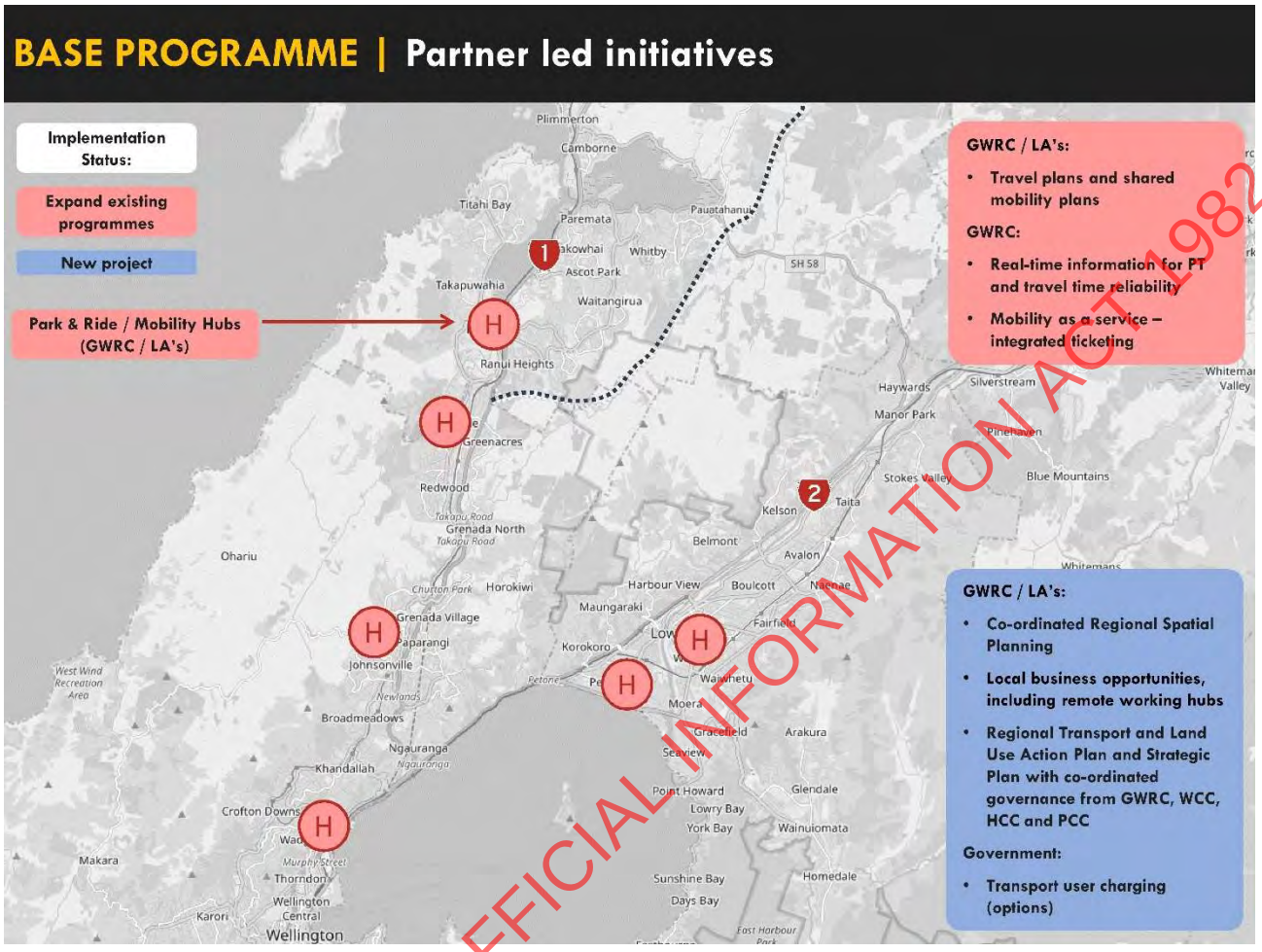

Figure 21: Partner-Led Initiatives

It is important to note that there has been not yet been any engagement with local partners and stakeholders on the proposed programme options and this needs to be undertaken early in the next stage of the business case process.

3.1.2 Grouping with Other Packages

However, the base programme in itself does not fully resolve all of the identified Problems or Investment Objectives in full, as shown in Table 11**Error! Reference source not found.**. Therefore, the Base Programme needs be combined with a higher cost, long-term major infrastructure intervention in order to meet the Investment Objectives. Two options for further assessment have been proposed:

- **Programme Option A** is based around Package 3 and includes significant resilience improvements at critical sections of the existing state highway network. It also looks to upgrade the existing network to respond to the Investment Objectives and provides additional Public Transport capacity that supports east-west accessibility and connections at the Ngauranga Interchange, and encourages mode shift away from private motor vehicles. In terms of the key Investment Objective (resilience), this is delivered in Programme A by reclamation along SH2 between Petone and Ngauranga, improvements on SH1 at Johnsonville and SH58 between Mt Cecil and the interchange with SH2;
- **Programme Option B** is based around Packages 6 and 7 and includes a new smart connection between Petone and Tawa / Grenada, minor slope

stabilisation on State Highway 1 at Johnsonville, and completion of the W2HV walking and cycling link.

3.2 Programme A – Existing infrastructure upgrades to enhance public transport, safety and resilience

3.2.1 Programme Purpose

The purpose of this programme is to:

- Address sections of the network within the project area that have a criticality rating of extreme or very-high (as identified in the Wellington Transport Resilience PBC by making improvements on the existing transport network to make east-west connections more resilient.
- Incorporate land-use and travel demand measures to improve east-west connectivity and resilience via the Base Programme.
- Incorporate cost effective public transport improvements to improve east-west connectivity and modal choice.

3.2.2 Programme Overview

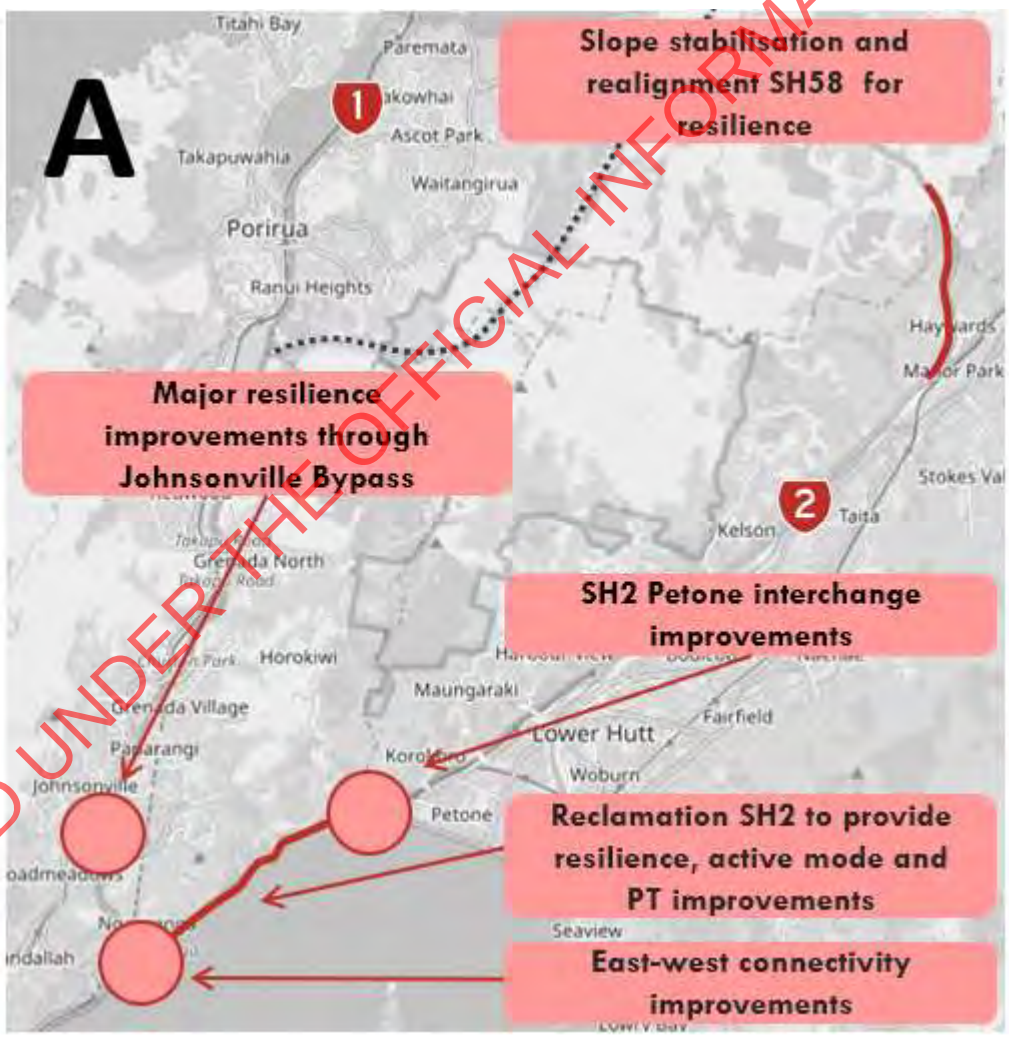

Figure 22: Programme A

The key components of the package (in addition to those described in Table 7 as part of the Base Programme) are detailed in Table 8, with further information found in Appendix E.

Table 8: Programme A Components

Component	Justification
SH58 realignment / slope stabilisation	Improves resilience of very high-risk section of SH58, providing a more resilient east-west connection to the Hutt Valley
SH2 Petone to Ngauranga reclamation	Improves resilience of critical section of SH2, providing a more resilient multimodal connection to the Hutt Valley that includes increased capacity for public transport and active modes.
Petone Interchange Improvements	Improves safety, operational resilience and accessibility of lower Hutt Valley
SH1 Ngauranga interchange east-west connectivity improvements (including improved PT connections)	Improves east-west connectivity and provides for multi-modal travel such as new routes on existing networks, new facilities such as stations or hubs, or improved timetabling.
SH1 Johnsonville bypass – major resilience improvements	Improves resilience of very high-risk section of SH1, providing a more resilient connection for east-west travel

3.2.3 Ownership of Initiatives

All of the Programme Components in the Programme A would be led by the Transport Agency, as shown in Figure 23.

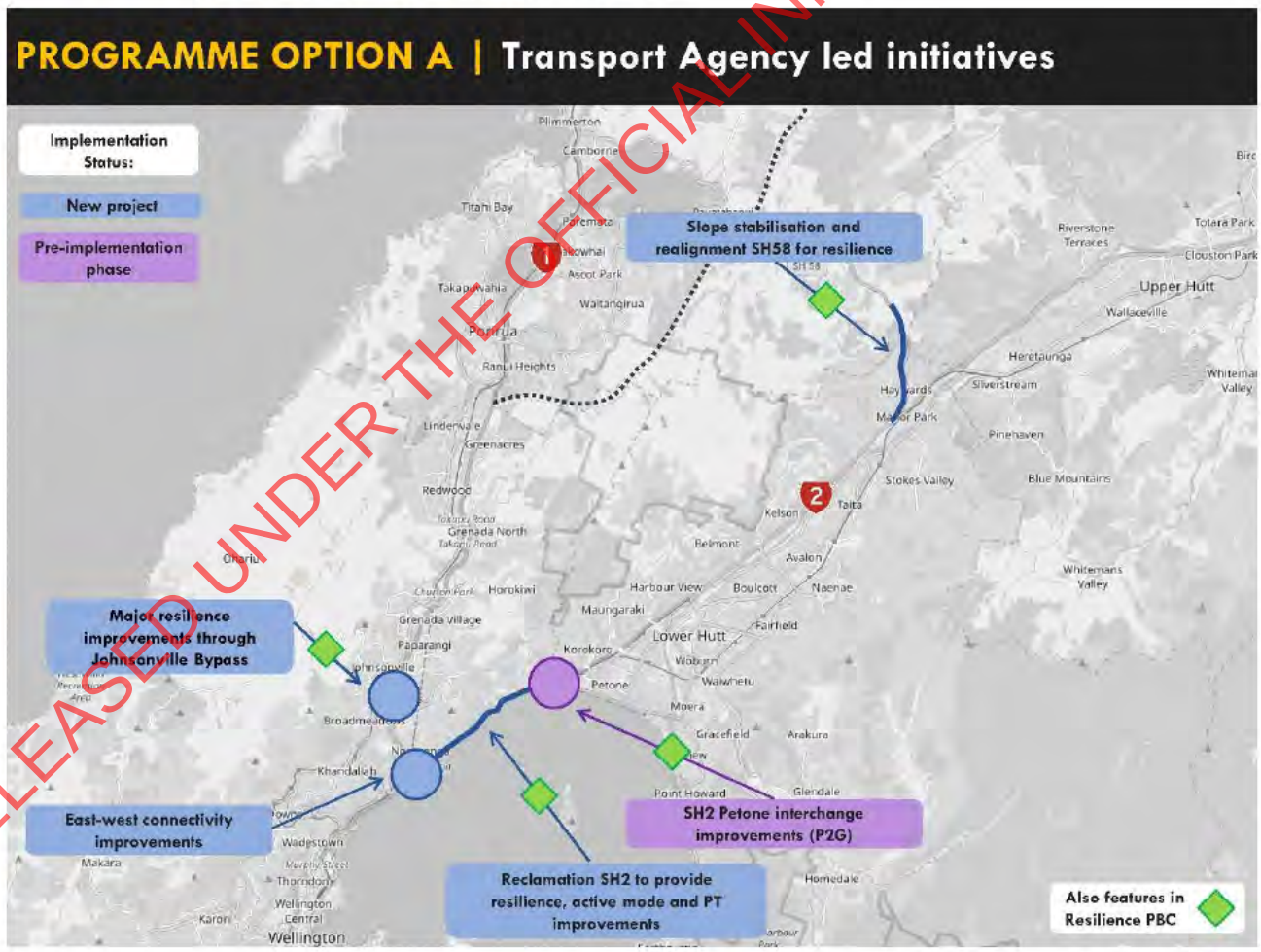

Figure 23: Programme A Transport Agency Led Initiatives

3.3 Programme B - Existing infrastructure upgrades and new smart connection between Petone and Grenada to enhance public transport, safety and resilience

3.3.1 Programme Purpose

The purpose of this programme is to:

- Provide a new east-west 'Smart' connection taking on board the feedback from the 2017 evaluation report regarding resilience and connectivity. The link provides enhanced east-west connectivity and a connection to Lincolnshire Farm. The link also provides the primary improvements for east-west resilience. Alternatively, this could be a tunnel from Petone to Tawa with no other connections or provision for cyclists
- Incorporate cost effective public transport improvements to improve east-west connectivity.
- Incorporate lower-cost resilience improvements on key locations around the supporting network.
- Facilitate the Wellington to Hutt Valley Walking and Cycling Link via reclamation.

3.3.2 Programme Overview

An overview of the programme is shown in Figure 24 and in Appendix E.

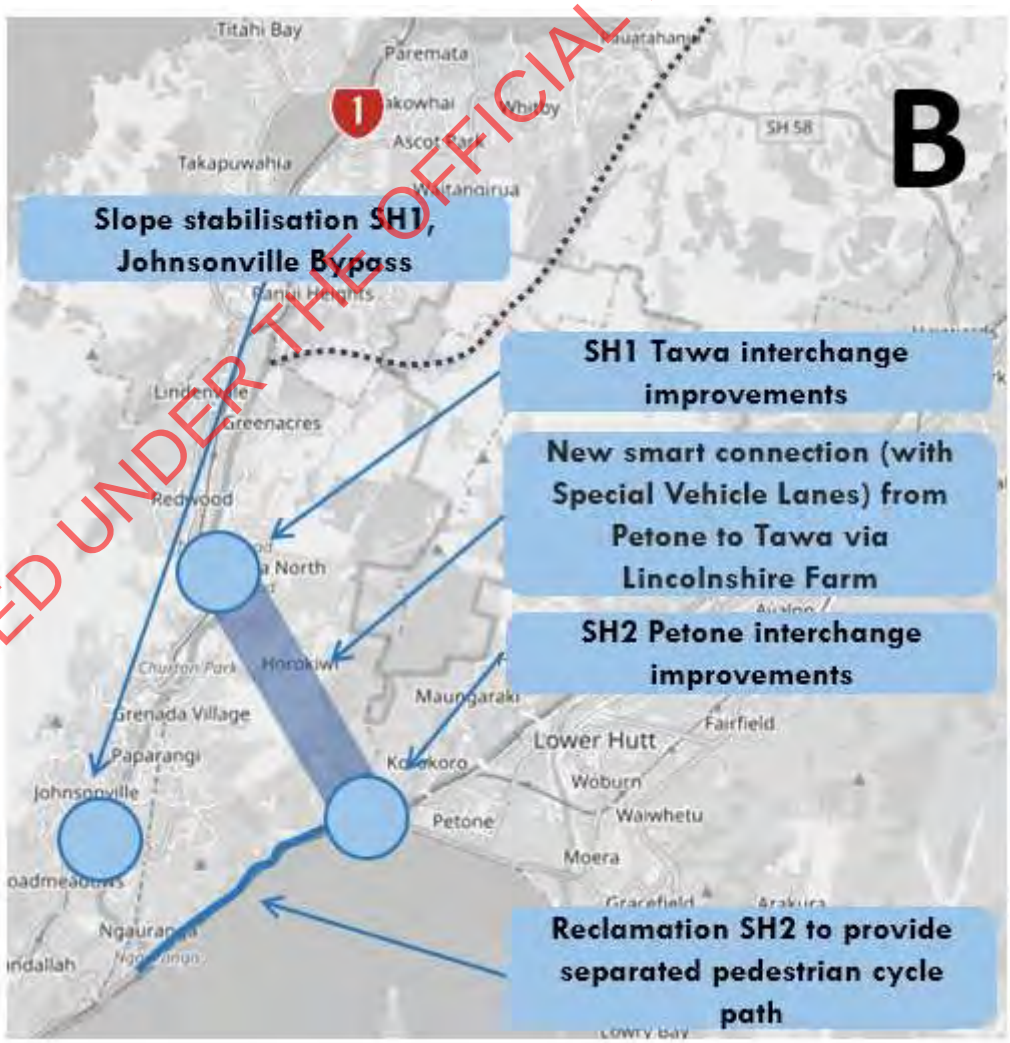

Figure 24: Programme B

The key components of the package (in addition to those in the Base Programme described in Table 7) are detailed in

Table 9.

Table 9: Programme B Components

Component	Justification
New four-lane smart connection between Petone and Tawa either via surface with connections to Lincolnshire Farm, or via a Tunnel.	Provides redundancy for critical and very high-risk sections of the transport network, provides a resilient east-west connection, improve multi-modal east-west connectivity and supports land-use opportunities in north Wellington.
SH2 Petone interchange improvements	Improves safety, operational resilience and accessibility of lower Hutt Valley
SH1 Tawa interchange improvements	Improves safety, operational resilience and accessibility of north Wellington
SH1 slope stabilisation (Johnsonville)	Improves resilience of very high-risk section of SH1, providing a more resilient connection for east-west travel
Provide separated pedestrian and cycle facilities from Petone to Ngauranga	Provides for multi-modal travel with improved east-connectivity via completion of the Wellington to Hutt Valley Walking and Cycling Project (W2HV)

3.3.3 Ownership of Initiatives

All of the Programme Components in Programme B would be led by the Transport Agency, as shown in Figure 25.

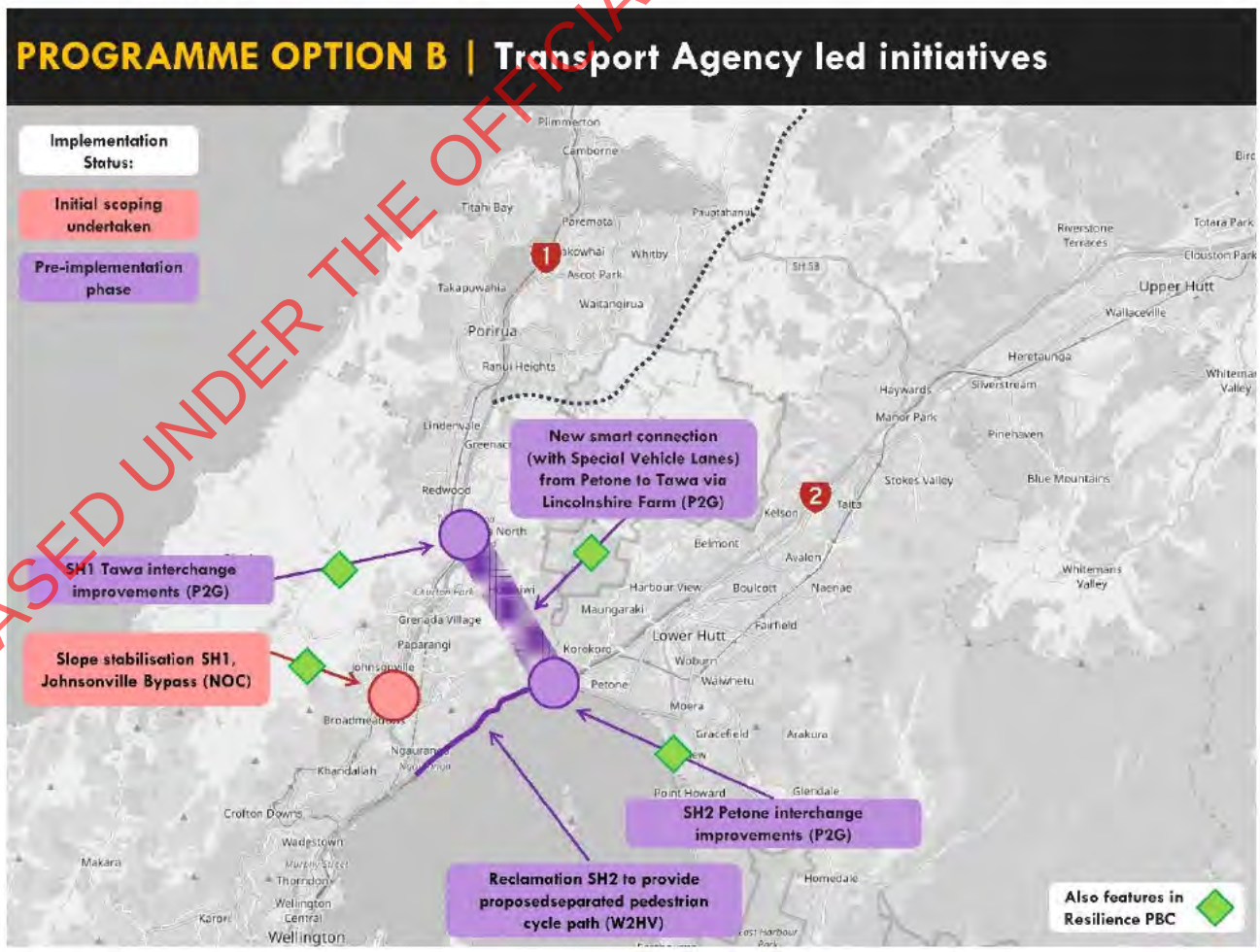

Figure 25: Programme B Transport Agency Led Initiatives

Table 10 shows how the Programmes align with the Investment Objectives and other considerations.

Table 11: Programme Alignment with Investment Objectives

Investment Objectives		Base Programme	Option A	Option B
Resilience (70%)	High Impact Low Probability (HILP)	Low	High	Medium
	Low Impact High Probability (LIHP)	Medium	Medium	Medium
Access (20%)	Active Modes	Medium	Medium	Medium
	Passenger Transport	Medium	Low	Medium
	Motor Vehicles	Low	Medium	High
Safety (10%)	Active Modes	Medium	Medium	Medium
	Motor Vehicles	Low	Low	Medium
Other Considerations		**Base Programme**	**Option A**	**Option B**
Supporting growth in the Ngauranga Triangle Area	Residential and Business Growth	Medium	Low	High
Staging		Medium	Medium	Medium

4 Programme Timing

4.1 Base Programme Implementation

Figure 26 and Table 12 detail the proposed implementation timing for this programme, which will be investigated further at the next stage of the business case process. Please note that this is implementation only – investigation, engagement, detailed design consenting and procurement processes need to occur prior to this.

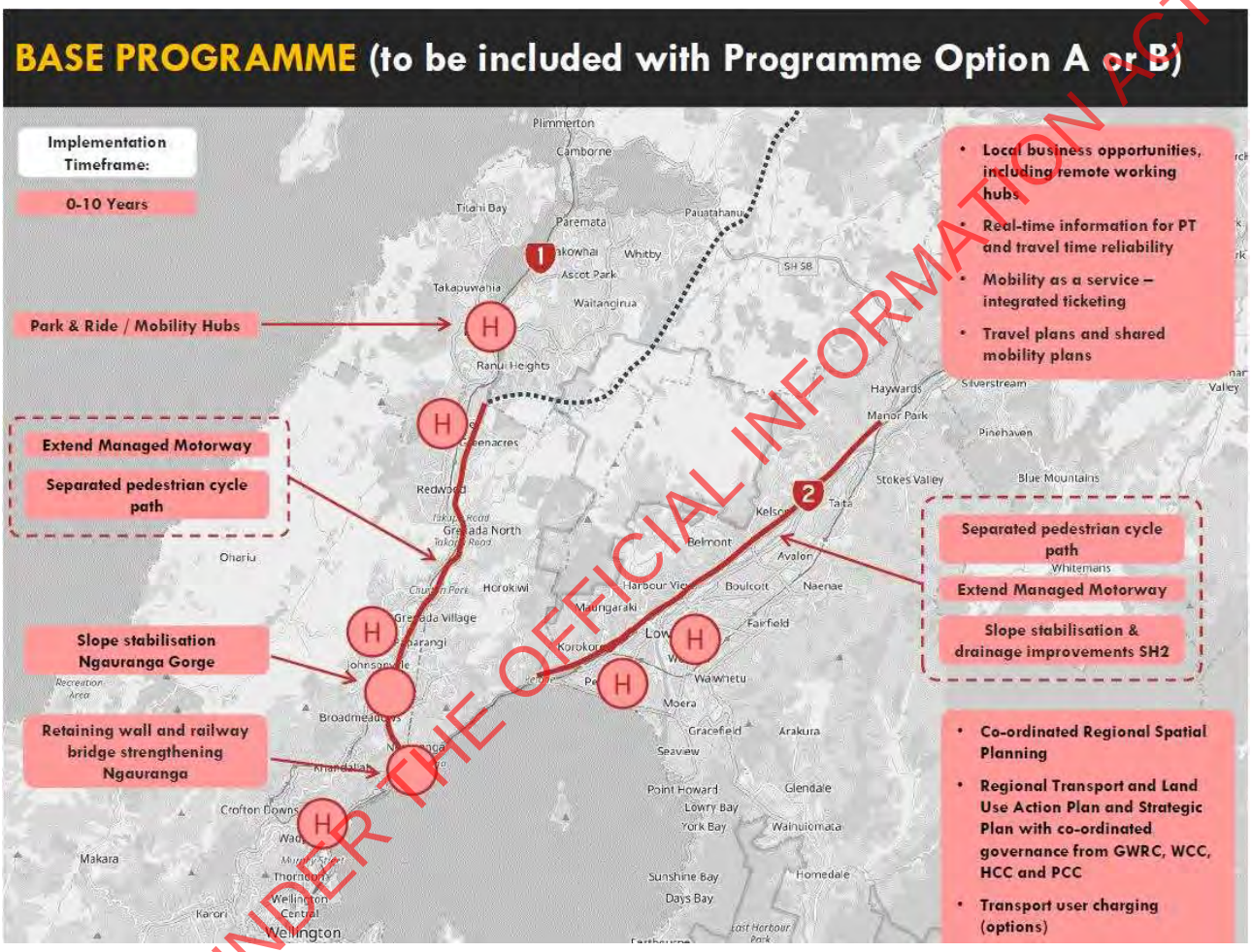

Figure 26: Base Programme Timing

Table 12: Base Programme Timing

Time frame	Components
0-10 years	• SH1 Ngauranga gorge slope stabilisation • Mobility hubs at key locations • SH2 slope stabilisation / drainage improvements • SH2 managed motorway extension • SH1 managed motorway extension • Local business opportunities including remote working hubs • Extension of real-time information for PT and travel time reliability • Mobility as a service – integrated ticketing • Travel plans and shared mobility plans • SH1 Ngauranga interchange resilience improvements • SH1 Johnsonville bypass slope stabilisation • SH1 Ngauranga interchange east-west connectivity improvements • Provide separated pedestrian and cycle facilities from Ngauranga to Transmission Gully • Provide separated pedestrian and cycle facilities from SH58 to Ngauranga • Regional Transport and Land Use Action Plan and Strategic Plan • Co-ordinated Regional Spatial Planning • Transport user charging (options)

4.2 Programme A Implementation

Figure 27 and Table 13 describe the potential implementation timing for this programme, which will be investigated further at the next stage of the Programme Business Case. Please note that this is implementation only – business cases, investigation, engagement, detailed design consenting and procurement processes need to occur prior to this.

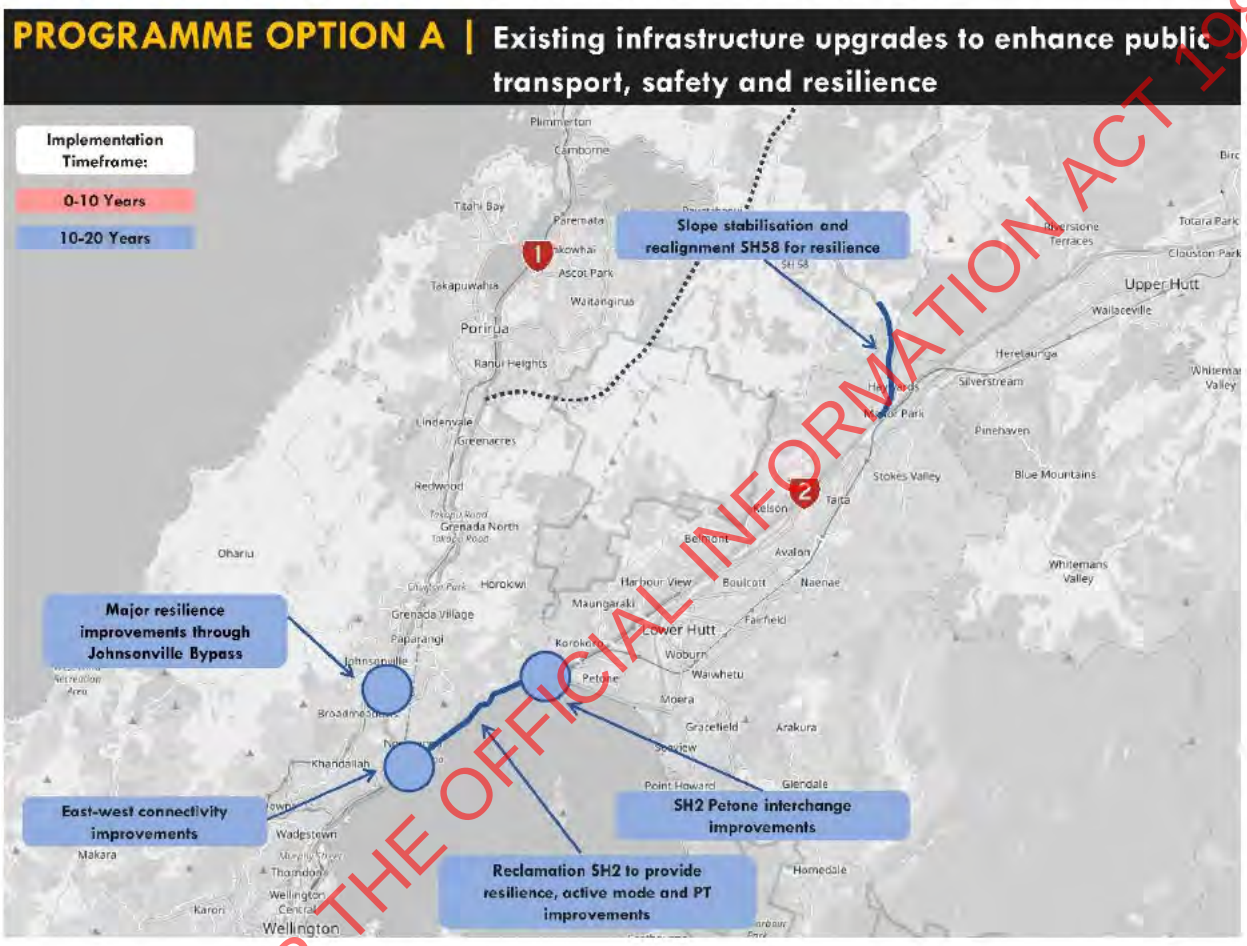

Figure 27: Programme A Timing

Table 13: Programme A Timing

Time frame	Components
0-10 years	• Pre-implementation work to enable the works listed below such as business cases, investigation, engagement, detailed design consenting and procurement
10-20 years	• SH58 realignment / slope stabilisation • SH2 Petone interchange improvements • SH1 Ngauranga interchange east-west connectivity improvements • Provide off-road pedestrian and cycle facilities from Ngauranga to Transmission Gully • SH2 Petone to Ngauranga reclamation • SH1 Johnsonville bypass resilience improvements

4.3 Programme B Implementation

Figure 28 and Table 14 detail the proposed implementation timing for this programme, which will be investigated further at the next stage of the business case process. Please note that this is implementation only – business cases, investigation, engagement, detailed design consenting and procurement processes need to occur prior to this.

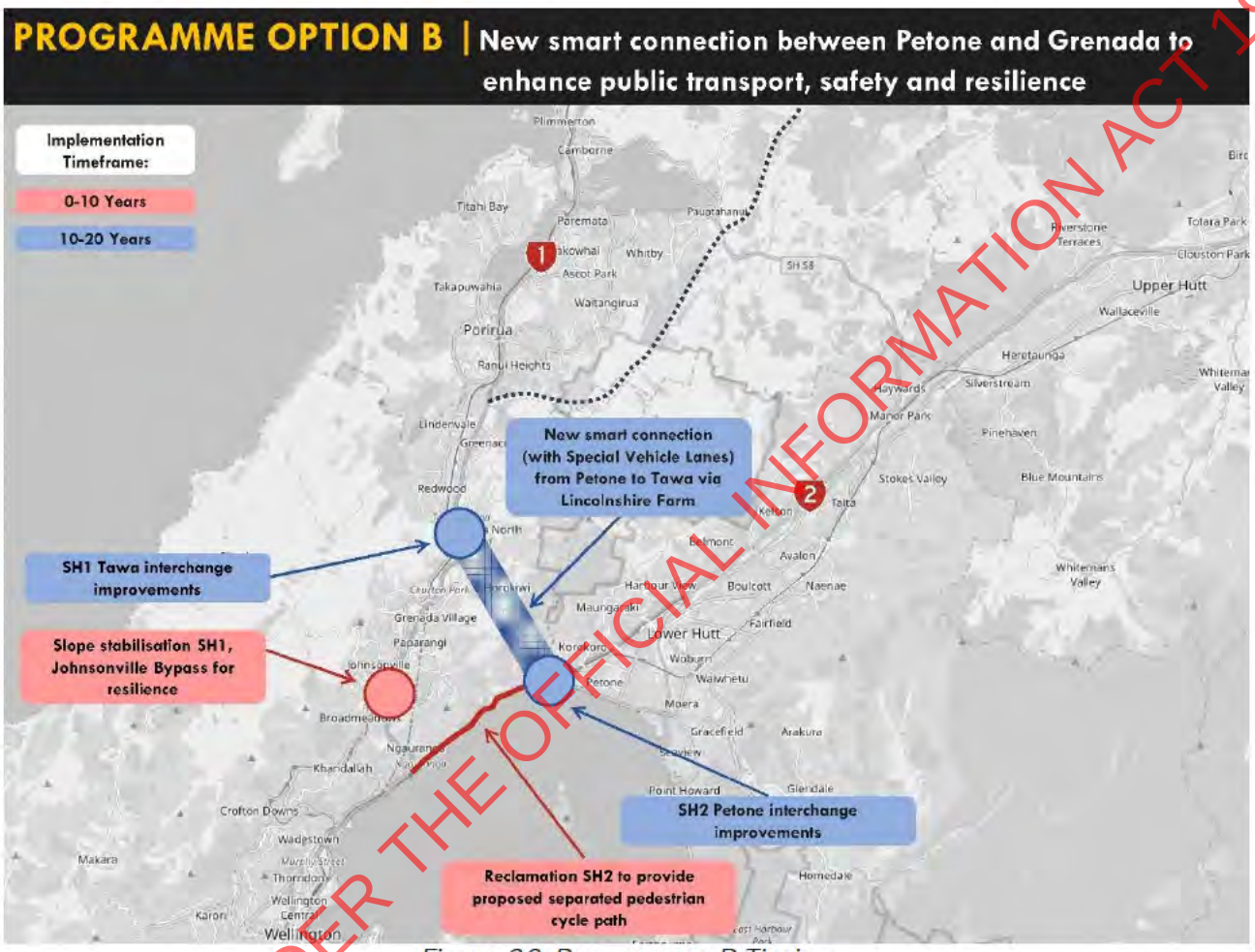

Figure 28: Programme B Timing

Table 14: Programme B Timing

Time fame	Components
0-10 years	• Pre-implementation work to enable the works listed below such as business cases, investigation, engagement, detailed design consenting and procurement • SH2 Petone to Ngauranga reclamation for separated pedestrian and cycle path • SH1 slope stabilisation through Johnsonville Bypass
10-20 years	• New smart connection between Petone and Tawa via Lincolnshire Farm • SH2 Petone interchange improvements • SH1 Tawa interchange improvements

4.4 Indicative Timing and Implementation

P2G Review: Potential Implementation Programme 2018/2019 - 2027/2028

Grouping	Interventions	Total Cost ($M)	2018/19 - 2020/21		2021/22 - 2023/24				2024/25 - 2026/27			2027/28
			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Base Programme - Partner Led	Park and ride / mobility hubs	$200 - $400	Initial stakeholder engagement and completion of PBC assessment	Single stage business case (s)	Pre implementation		Implementation					
	Travel plans and shared mobility plans				Operate							
	Real time information for PT and travel time reliability				Pre implementation	Implementation						
	Mobility as a service - integrated ticketing											
	Co-ordinated regional spatial planning				Pre implementation		Implementation		Operate			
	Local business opportunities including remote working hubs											
	Regional transport and land-use action plan and strategic plan with coordinated governance											
	Transport user charging options (including parking)				Pre implementation		Implementation					
Base Programme - Transport Agency Led	SH2: separated path Petone to Melling	$250 - $750			Pre implementation	Implementation						
	SH2: separated path Melling to Manor Park			Single stage business case (s)			Pre implementation	Implementation				
	SH2: extend managed motorway					Pre implementation	Implementation					
	SH1: extend managed motorway											
	SH2 slope stabilisation and drainage improvements				Pre implementation	Implementation						
	SH1: Ngauranga interchange resilience improvements											
	SH1: Ngauranga gorge resilience improvements											
	SH1: separated path							Pre implementation	Implementation			
Programme Option A - Transport Agency Led	SH58: slope stabilisation and realignment	$750 - $2200	Initial stakeholder engagement and additional technical development	Further stakeholder engagement and completion of PBC assessment BOARD DECISION ON OPTION	*Single stage business case (s)*						*Pre implementation*	
	SH2: Petone interchange improvements						*Pre implementation*			*Implementation (part)*		
	SH2: major reclamation for resilience and accessibility											
	SH1: Ngauranga interchange connectivity improvements											
	SH1: Johnsonville bypass major infrastructure improvement								*Pre implementation*			*Implementation (part)*
Programme Option B - Transport Agency Led	SH2: Petone interchange improvements	$900 - $1800			*Single stage business case (s)*		*Pre implementation*			*Implementation (part)*		
	East west smart connection											
	SH1: Tawa interchange improvements											
	SH1: Johnsonville bypass slope stabilisation							*Pre implementation*	*Implementation*			
	SH2: minor reclamation (W2HV cycleway)				*Pre implementation*		*Implementation*					
Programme Option A Costs ($M)		$1000 - $2500	$4 - $6	$4 - $6	$16 - $23	$16 - $23	$20 - $30	$20 - $30	$27 - $40	$190 - $280	$200 - $290	$190 - $280
Programme Option B Cost ($M)		$1000 - $2000	$3 - $5	$3 - $5	$14 - $20	$14 - $20	$40 - $70	$50 - $80	$120 - $170	$250 - $370	$170 - $260	$170 - $260

Note: Some of these interventions are existing projects

5 Rough Order Cost Estimates

5.1 Estimation Approach

Cost estimates have been prepared for the Packages and Programmes, for comparative purposes. The project team is cognisant of previous designs and estimates produced for the former P2G scheme. However, no design work has been completed since 2017 for any of the work being estimated, nonetheless, some elements of the estimate have been scaled from previous estimation work for the previous Petone to Grenada Detailed Business Case Estimate (P2G DBE).

A brief outline of the package scope and indicative maps outlining potential physical works were used to derive rough order cost estimates, along with a summary package description, which is included in Appendix F. Many assumptions have had to be made for estimation purposes and the estimates are therefore based on example high-level options and theoretical alignments that could be achievable (with significant implementation risk) for each package.

Due to the uncertainty around detail and scope, the large variety of potential physical works and the short estimation timeframe, this estimate lies outside of the Business Case estimates outlined in SM014 – NZTA's Cost Estimation Manual (CEM). However, the general principles outlined by the manual are consistent with the development of this estimate.

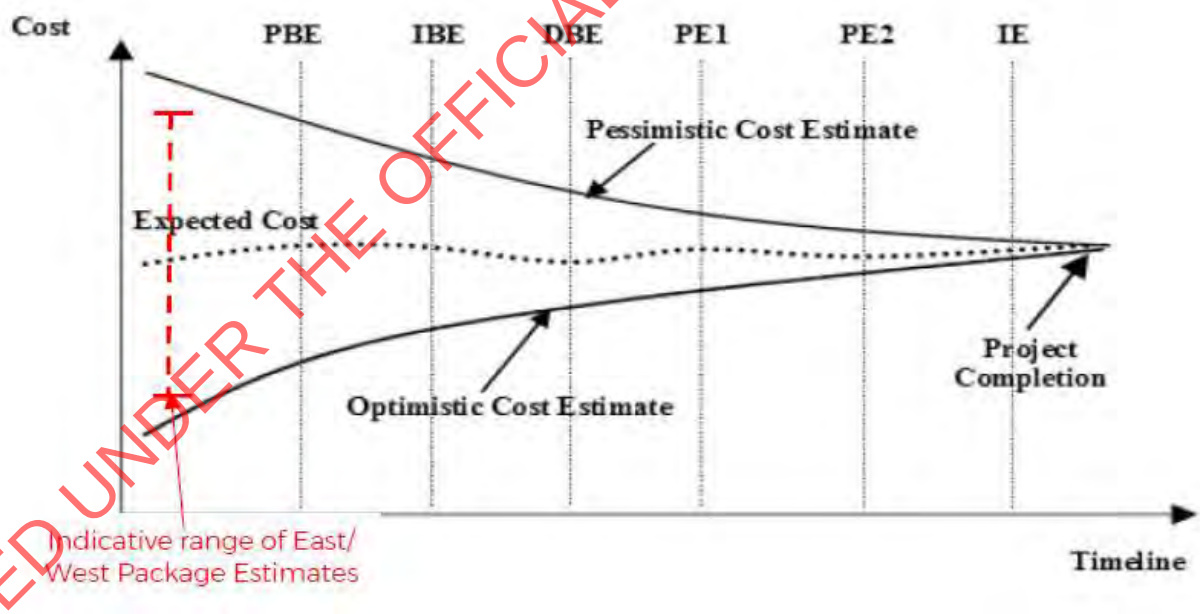

Figure 29: Indicative diagram of where these estimates lie in relation to NZTA business case

The estimate ranges provided include a lower limit and an upper limit, but these are not the 5th and 95th percentile typically used as risk has not been fully assessed and/or modelled. Figure 299 shows the indicative range of these package estimates.

It is acknowledged that more economical alignments could potentially be found with further investigation. Therefore, the lower limit of the estimate range is not the optimistic estimate referred to in the CEM the project value could potentially lie outside of the range.

5.1.1 Constructability

One of the biggest factors that affects the costs of physical works and is often insufficiently allowed for by early stage estimated is the cost associated with constructability, temporary works and traffic management.

For the P2G DBE, a constructability assessment of the Petone Interchange highlighted how complex the work would be and the requirements for many sequential construction stages, temporary roads, temporary bridges and extensive traffic management. This assessment had a major impact on the cost estimate.

Given the preliminary nature of these packages, a constructability assessment has not been completed to quantify a suitable constructability allowance for the estimates. The upper limit contingency described in Section 5.1.2 contains some contingency to cover constructability aspects, but this will not be sufficient should there be major constructability challenges. For example, the reconstruction/widening of bridges on SH1 and SH2 within some packages, could have high costs for temporary works and diversions to maintain traffic flow and connectivity during the work. The modification of reinforced abutments whilst maintaining functionality will incur heavy costs for temporary works and/or cause disruption.

All packages are considered possible to construct. However, there will be a significant cost associated with the difficulty of construction. During the design stage, the constructability considerations would be factored into the design solution. Some of the constructability factors that can affect cost include:

- The requirements to maintain connectivity and traffic flow on existing roads and bridges;
- Safety control measures of works in proximity to hazards and the public;
- Requirements for diversions, temporary structures;
- Construction of new assets over existing infrastructure footprints requiring staged construction and/or temporary works;
- Works affecting existing retaining walls or ground improvements;
- Impact of utility service relocation on construction staging; and
- Need for higher specification materials to work around geometric limitations.

It is recommended that a full constructability assessment of the recommended programme is completed as early as possible in the Project's development.

5.1.2 Upper and Lower Limit Contingency Allowances

Due to the preliminary status of the packages, large scope and variety of physical works within the packages, it is almost certain that some cost elements have been missed in these elements.

Depending on the package 10-20% has been added to the 5th percentile estimated to account for general exclusions and estimating error expected with the scope and estimation method used for this exercise.

For the upper contingency, a percentage has been applied based on the relative uncertainty for the package scope and estimate. These percentages range from 25% up to 400%. These have been applied based on expert judgement of the uncertainty level.

5.1.3 Property

The estimate of land required, and associated costs has been calculated based on work undertaken for the P2G DBC estimate supplemented by high level estimates of property requirements for some packages.

Property compensation and purchase costs are highly variable and there will be significant impact from some of these packages which require large areas of commercial/industrial land which is not easily replaceable in the Wellington region.

A modest allowance has been made for compensation with any significant business loses and relocation allowances excluded.

5.1.4 Earthworks

Earthworks volumes have been estimated based on assumed alignments for Packages 3, 4, 5, 6, 7, 8 and 9 with no design work undertaken. The generation of large surplus cut material will likely require new fill sites to be found and utilised as previously planned for Petone to Grenada. These have not been included apart from for Package 6.

All earthworks have been allowed for as conventional earthworks with no reinforced soil embankments.

5.1.5 Geotechnical

Geotechnical estimates have been included based on parameter rates for similar works. The existing conditions of many slopes covered in the packages is unknown and more investigations and geotechnical analysis/design will be required. The scope of stabilisation measures for each package has a high level of uncertainty and the confidence level in this cost is low.

Geotechnical estimates mainly include stabilisation measures for cuttings and identified strengthening of existing retaining walls/structures (e.g. in the Ngauranga Gorge). Potential need for new reinforced embankments, MSE walls or other structures for reasons other than geotechnical that may be identified during the advanced phases of design are not included in the estimate.

5.1.6 Pavement

Pavement estimates are based on subbase, basecourse, Chip Seal and Asphalt Concrete (AC) surfacing for all new roads in the package. Epoxy Modified Open Grade Porous Asphalt (EMOGPA) has been allowed for in addition on major new highways/ expressways.

Resurfacing has been excluded for smaller packages of work such as Smart Motorway upgrades.

5.1.7 Traffic Services

Traffic services have been estimated based on a parameter rate for the level of road including line marking, lights and assumed crash barrier requirements.

Smart Motorway upgrades have been estimated based on Closed Circuit Television (CCTV) cameras at 1.2km spacing, gantries at 600m spacing, Fibre cables, power cables and signs only.

5.1.8 Drainage

The extent of drainage requirements for Package 2 is uncertain. A cost estimate has been produced based on advice on key problem areas from Capital Journeys.

Drainage estimates for new roads are based on a parameter rate for median size culverts and pipes. No design work on flow capacity has been completed.

The Petone to Grenada DBE included some streams being opened up with culverts removed and other streams being placed in large culverts with energy dissipation structures. The extent of stream rehabilitation and/or diversions has not been assessed for packages other than Package 6.

5.1.9 *Coastal*

Coastal Reclamation rates assume formation of a rock bund and end tipping of hardfill with a 2m surcharge for compaction.

Coastal reclamation material volumes have been estimated based on online coastal bathymetry data and are expected to have a low level of accuracy. The lower limit quantities include 10% contingency in addition to other general contingencies.

Rock Armour has been allowed for along the length with different rates used for the lower and upper wall due to expected placement methodology.

No property or compensatory allowance has been made for coastal reclamation.

A 4m x 4m bund between the road and slope has been allowed for as additional rockfall protection.

5.1.10 *Structures*

Cost estimates for new structures and repairs is based on parameter rates per m^2. Plan area for new bridges are based on assumed carriage widths and bridge spans. These are highly variable. There is also significant uncertainty with the impact of ground conditions and seismic risk on cost estimates.

5.1.11 *Rail*

An attempt was made to gather updated rail costs from rail specialists. This could not be done in the required timeframe, so the rates use parameter rates used previously for Petone to Grenada and Peka Peka to Otaki DBE estimates. There are high level parameter rates and the costs for station reconfiguration and upgrades to signalling is excluded.

5.1.12 *Tunnels*

Research of tunnel rates from New Zealand, Australia and other global projects was undertaken to develop parameter rates applied based on tunnel length, depth and bore diameter. Tunnel rates are highly variable due to factors such as ground conditions, ground faults, tunnelling equipment availability, tunnel methodology (TBM, road header, mined), tunnel safety requirements, fire requirements, ventilation requirements. need for cross tunnels and vertical shafts, Iwi considerations, spoil disposal, drainage requirements.

5.1.13 *Temporary traffic management*

The extent and duration of temporary works and traffic management is almost impossible to determine at this stage. An allowance has been made based on scale relative to the Petone to Grenada DBE estimate. Where this has not been applicable approximate durations and Temporary Traffic Management (TTM) extents/ rates have been used to include and allowance.

5.1.14 *Service Relocations*

Surface water drainage has been allowed for within new road alignments.

Some allowance has been made for water supply, wastewater, power and gas based on work completed on the Petone to Grenada DBE. This has been scaled accordingly for other packages.

At this stage It is not possible to estimate the extent of service relocations required and design work can be completed to mitigate this somewhat. Any allowance for utility service relocation has a very low level of confidence with the extent of underground services unknown and subject to change prior to the work. On a project of this scale, utility betterment is likely which could affect project scope, programme and cost.

5.1.15 *Landscaping and Environmental*

The P2G DBE included landscaping allowances for the new interchanges. It also included extensive shared paths and opening of streams from culverts.

That level of detail is not possible for most packages. A small allowance has been made for landscaping based on the package scale, but any significant landscaping work is excluded.

Shared paths and footpaths are excluded apart from where they form a part of a package.

Temporary environmental controls and offset mitigation have a minor allowance included on each package to the scale of that allowed in the P2G DBE.

5.1.16 *Extraordinary Items*

The extent of the Mobility hubs was unknown and only a lump sum allowance of $10Million has been allowed in the 5% percentile estimate.

5.1.17 *Professional Services*

Investigation, design, consenting and Management, Surveillance and Quality Assurance (MSQA) consultant fees have been estimated based on typical percentages of the physical works estimate adjusted for perceived scope and difficulty. These costs are highly variable and influenced by consent process, required ground investigation extent and procurement/delivery model. D&C contracts have been assumed for the large-scale packages.

5.1.18 *General Exclusions*

The following items are general exclusions form all estimates.

- Mitigation costs for cultural impacts or loss of land.
- Business losses from property acquisition.
- Constructability risk as outlined in section 1.2.
- Temporary diversion routes and structures.
- Relocation of major utility service infrastructure such as gas transfer stations, reservoirs, substations etc.
- Rail Operation Costs
- Noise Mitigation
- Stream Mitigation
- Extensive landscaping works
- Flood protection works
- Relocation and upgrade of power, gas, water, wastewater and other services has an allowance made for some packages but is excluded in others.

- Allowances for increased rates due to shortage of materials and resources potentially caused by simultaneous implementation of large scale capital works.
- Assessment of and allowance for Archaeological risk
- Assessment of other works planned prior to package implementation that will affect the design/ construction and impact on package cost.

5.2 Estimates

5.2.1 Package Estimates

Rounded estimates for each package are shown in Table 15.

Further details of pricing for each package are shown in Appendix F.

Table 15: Rounded Packages Estimates ($ Millions) Subject to Allowances and Exclusions

Package	Lower	Upper
1A	$200	$400
1B	$100	$300
2	$100	$350
3	$1,000	$2,000
4	$2,500	$4,200
5	$300	$600
6	$700	$1,600
7	$1,500	$3,000
8	$300	$650
9	$4,500	$9,000

5.2.2 Preferred Programme Estimates

Rounded estimates for the Base Programme and Programme A and B are shown in Table 16.

Further details of pricing for each package are shown in Appendix F.

Table 16: Preferred Programme Rounded Estimates ($ Millions)

Programme	Lower	Upper
Transport Agency Responsibilities	$250	$750
A	$750	$2,200
B	$900	$1,800

6 Uncertainties

An Uncertainty Log has been developed for this Report (noting that a high level uncertainty log was developed for Report 1 as well) to capture ambiguities that may generate a degree of uncertainty or risk for the project. The full register can be found in Appendix A. Table 17 summarises the key uncertainties.

Table 17: Uncertainties

Factor	Uncertainty
Re-evaluation Process	Incomplete evidence to support problem statements
	Problem statements/investment objectives yet to be agreed with key stakeholders
	Evidence/understanding of east-west demands
	Cursory level of detail in package/programme identification & assessment
Inputs / Assumptions	LGWM / Wellington CBD uncertainties/congestion charge
	Technology update / evolution
	Uncertainty in residential growth plans
	Uncertainty in employment growth
Identifying a preferred option	Uncertainty around which option will provide more resilience benefit
	Limited concept development leaves significant cost uncertainty & risk.
	Uncertainty around consentability of reclamation / Belmont Regional Park
	Limited available information to compare options (utilities, geotech, ecology)
	Uncertain benefits of packages/programmes as no transport modelling
	Uncertainty around extent of uptake and modal shift Programme A or B
Interdependencies	Competition for funding (from other projects in the region)
	Uncertainty around impact of committed projects e.g. Transmission Gully
	Uncertainty around future of linked interventions (e.g. integrated ticketing)
	Uncertainty around LGWM and the regional transport changes
	Uncertainty around what other projects will deliver
	Uncertain impact on other projects and the wider system if P2G not built
Stakeholders	Uncertainty around political support for process and outcomes
	Uncertainty around stakeholder support for process and outcomes
	Uncertainty around public support for process and outcomes
Cost	Scope of works within package is highly variable and subject to change
	Resource shortages - labour and material
	Change in technical standards and requirements can affect cost and design
	Extent of Utility service relocation highly unknown.
	Feasibility/effectiveness of slope stabilisation methods is highly uncertain.
	Changes to land use can impact project property costs and requirements
	Archaeological Sites impact consenting, design and construction
	Cultural sites impact consenting, design and construction
	Major Earthquake/natural disasters can change priorities
	Stream mitigation & landscape needs very variable & impacted by consenting
	Flood protection requirements change and impact design.
	Shortage of technical capacity in New Zealand for design and construction
	Traffic management constraints will affect project durations and costs.
	Unknown ground conditions will affect construction material costs.
	Construction methodology unknown at this stage.
Pre-implementation / Implementation	Non-Transport Agency led interventions are not supported by partners
	Insufficient funding available to implement/prioritise programmes

The level of uncertainty for each issue has been ranked and categorised as either near certain, more than likely, reasonably foreseeable and hypothetical. Once ranked, the issues are then assessed.

7 Summary and Recommendations

This report summarises the option development process carried out as part of the Petone to Grenada Re-Evaluation. It described the processes undertaken to group potential interventions into Packages that address the Problem Statements and Investment Objectives, how these Packages have been assessed using an MCA process, and further refined into Programmes of work that could be taken forward. The staging and timing of these Programmes as well as rough order costs and uncertainties have also been identified and discussed.

Both Programme A and Programme B have the potential to address the Problems identified during the review in consultation with Stakeholders, in particular the current lack of resilience on the current transport network and the lack of east/west connectivity. In addition to addressing these primary Problems the Programmes include elements that would significantly improve active modes and public transport, open up land for development, improve journey times and safety, and support lifelines.

Staged delivery and costs mean that both Programmes present opportunities to deliver early, mode-neutral outcomes. Opportunities are also available to enable forward thinking, future-proofed solutions such as special vehicle lanes and smart motorways. The Programmes also allow potential interfaces with other programmes of work such as Let's Get Wellington Moving, the Wellington to Hutt Valley Cycleway or a potential cross valley link for example.

Going forward, the following actions are recommended:

1. That additional stakeholder engagement on the Problem Statements, Investment Objectives and MCA approaches and outcomes is carried out;
2. That further investigation and engagement with Stakeholders and other programmes with regard to identified uncertainties (refer to uncertainty log in Appendix A) as part of PBC process are carried out.
3. That the two programmes recommended to be taken forward for further consideration be subject to a separate and additional MCA process that will be generated specifically for the purpose assessing these programmes.
4. That further Business Case investigations and assessments (including modelling and concept design development) are carried out to confirm the preferred Programme;
5. That further constructability assessments as part of the Business Case process, and a parallel, independent estimate review to confirm likely funding ranges and technical delivery risks are carried out; and
6. That an independent parallel cost estimate is prepared in the next phase of work;

Appendix A: Uncertainty Log

Appendix B: Long List of Interventions

Appendix C: Package Descriptions

Appendix D: MCA Report

Appendix E: Programme Descriptions

Appendix F: Cost Estimates

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