WAKA KOTAHI
NZ TRANSPORT AGENCY

PROUDLY DELIVERING
New Zealand Upgrade Programme

Ōtaki to North of Levin

Detailed Business Case

WAKA KOTAHI NZ TRANSPORT AGENCY

New Zealand Government

More information

Waka Kotahi NZ Transport Agency
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If you have further queries, call our contact centre on 0800 699 000 or write to us:

Waka Kotahi NZ Transport Agency
Private Bag 6995
Wellington 6141

This document is available on our website at www.nzta.govt.nz

Document Control

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25 May 2022	1.2	Stantec (Strategic, Economic and Financial Cases) Waka Kotahi (Commercial and Management Cases)	Updated Draft for Issue
22 June 2022	1.3	Stantec (Strategic, Economic and Financial Cases) Waka Kotahi (Commercial and Management Cases)	Updated Draft for IQA
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Document review

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Related documents

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EXECUTIVE SUMMARY

1. On 29 January 2020, the Government announced the formation of the New Zealand Upgrade Programme (NZUP) along with a total funding allocation of $6.8Bn (for rail, roads, walking and cycling), inclusive of $817M for the Ōtaki to north of Levin (Ō2NL) Project, noting the next step was the development of the Detailed Business Case (DBC). The Ō2NL Project, as a four-lane offline highway and shared use path (SUP), was included to "improve safety and access, support economic growth, provide greater route resilience, and better access to walking and cycling facilities".

2. Through subsequent re-baselining and reprioritisation of NZUP during 2021, Cabinet approved additional funding for the project (up to $1.2Bn excluding tagged contingencies) based on available estimates. Waka Kotahi NZ Transport Agency (Waka Kotahi) was directed to prepare a final DBC as the new project baseline for Cabinet consideration by mid-2022, including updated project costs and governance arrangements.

3. In partnership with Muaūpoko and Ngāti Raukawa ki te Tonga, Waka Kotahi has been investigating potential upgrades and new alignment options to address the issues with the existing SH1 route and to support sustainable growth in Levin and local communities. Through this partnership, core principles and values for the project have been established and applied across project development processes for positive, measurable outcomes. This working approach permeates all levels of the Project and is reflected in all key project artefacts such as the charter, strategies/plans and documents.

4. The final DBC confirms that the strategic case for change remains imperative, with significant regional growth and poor safety trends (72 deaths or serious injuries over the 5-year period to 2021) supporting the urgent need for investment.

5. The DBC proposes construction of a new, offline highway and SUP which will be comprised of:

   - Approximately 24km four-lane[1] (two lanes in each direction), median divided highway between the end of the Peka Peka to Ōtaki (PP2Ō) Expressway[2] and north of Levin
   - A grade separated diamond interchange at Tararua Road providing access into Levin
   - Roundabouts where the Ō2NL Project crosses State Highway 57 (SH57) and where it ends at State Highway 1 (SH1) north of Levin
   - A half interchange with south facing ramps near Taylors Road and the connection to the new PP2Ō Expressway. This provides access from the existing SH1 onto the Ō2NL Project for traffic heading south from Manakau/ heading north from Wellington, as well as providing an alternate access to Ōtaki
   - Local road underpasses at Sorensons Road and South Manakau Road to retain local connections
   - Local road overpasses for continued local road connectivity at Honi Taipua Road, North Manakau Road, Kuku East Road, Muhunoa East Road, Tararua Road (as part of the interchange), and Queen Street
   - New local road connections between Tararua Road and Kimberley Road and between Waihou Road and McDonald Road, immediately east of the new highway, as well as new local roads at Kuku East Road and Manukau Height Road to provide access to properties located to the east of the Ō2NL Project
   - Relocation and improvement to the Tararua Road / SH1 intersection including the associated North Island Main Trunk (NIMT) level crossing
   - A separated SUP of a minimum width of 3.0m for walking and cycling along the entire length of the new highway.

[1] Analysis has shown that by adopting two lanes rather than four, a decrease in outcomes is achieved - at least a 17% decrease in benefits (likely more), significant risks with partners, stakeholders and the public and does not deliver an enduring legacy. In both the 75%ile and 95%ile growth scenarios, the capacity of the two-lane highway is predicted to be exceeded wi hin 10-30 years, resulting in the need to invest more in the new route at a future date with significant additional costs, impacts and embodied carbon disbenefits.
[2] Expected to open in late 2022

6. The preferred option is shown in the image below.

7. The preferred 4-lane option with the SUP is recommended as the only appropriate option to deliver on the strategic importance of SH1 and the defined investment objectives in terms of improving safety and access, supporting economic growth, providing greater route resilience, and better access to walking and cycling facilities.

8. A summary of the key outcomes (Investment Objectives) enabled by the investment in the offline highway are as follows:

- Reduce deaths and serious injuries by 50-55% per annum by 2035
- Reduce the duration of journeys affected by closures and delays by 60% by 2030
- Provide appropriate connections that integrate[3] the state highway and local road network to serve urban areas by 2030.
- Enable mode choice for journeys between local communities by providing a north-south cycling and walking facility by 2030
- Support inter and intra-regional growth and productivity through improved movement of people and freight by 2030

9. The economic performance of the recommended highway option is forecast at achieving a 1.2 benefit cost ratio (BCR), delivering $1,458M of net present value (NPV) benefits across the Ministry of Transport Outcomes Framework (Healthy and Safe people, Resilience and Security, Economic Prosperity and, Environmental Sustainability). Total NPV Costs of $1,202M includes NPV Capital Investment Costs of $1,180M.
10. The procurement assessment summarised in the commercial case confirms that the procurement delivery model should be a collaborative model (Alliance). Through recent market engagement about the Project and considering the current project timeline and known forward programme of works, the industry has confirmed they do not forecast major capacity issues to deliver this project, if there is early certainty and commitment from Waka Kotahi around delivery model and programme. It is considered the current timing for Ō2NL (construction between 2025-2029) aligns well with current major projects programme with several construction projects that should reach completion by or near to 2025, freeing up significant resources.
11. The property acquisition programme and the Resource Management Act (RMA) consenting programme are well advanced for the Project, further supporting the delivery milestones set out by the Joint Ministers. Subject to DBC endorsement by the Waka Kotahi Board and DBC approval by the Joint Ministers (all programmed for August 2022), the active property acquisition programme will commence immediately and the RMA consents application will be lodged in September 2022, via direct referral to the Environment Court.
12. Assessments have been completed which integrate the transport network post-opening of Ō2NL including the One Network Framework and revocation. s 9(2)(f)(iv) [redacted]

BACKGROUND / PROJECT CONTEXT

13. SH1 is New Zealand's premier highway, but the section between Ōtaki and Levin has extremely serious safety and resilience problems. These problems are being exacerbated due to exceptionally high growth currently occurring in the Horowhenua after a generation of little activity. Local and regional plans predict that this will continue for some time and large plan changes are underway (for example Tara-Ika[5], approximately 3,500 houses recently rezoned) to enable new developments which accommodate the growth.
14. The Ō2NL project team (Waka Kotahi, Muaūpoko Tribal Authority and hapū of Ngāti Raukawa ki te Tonga) have been investigating potential upgrades and new alignment options to address the issues with the existing SH1 route and to support sustainable growth in Levin. In 2018, the

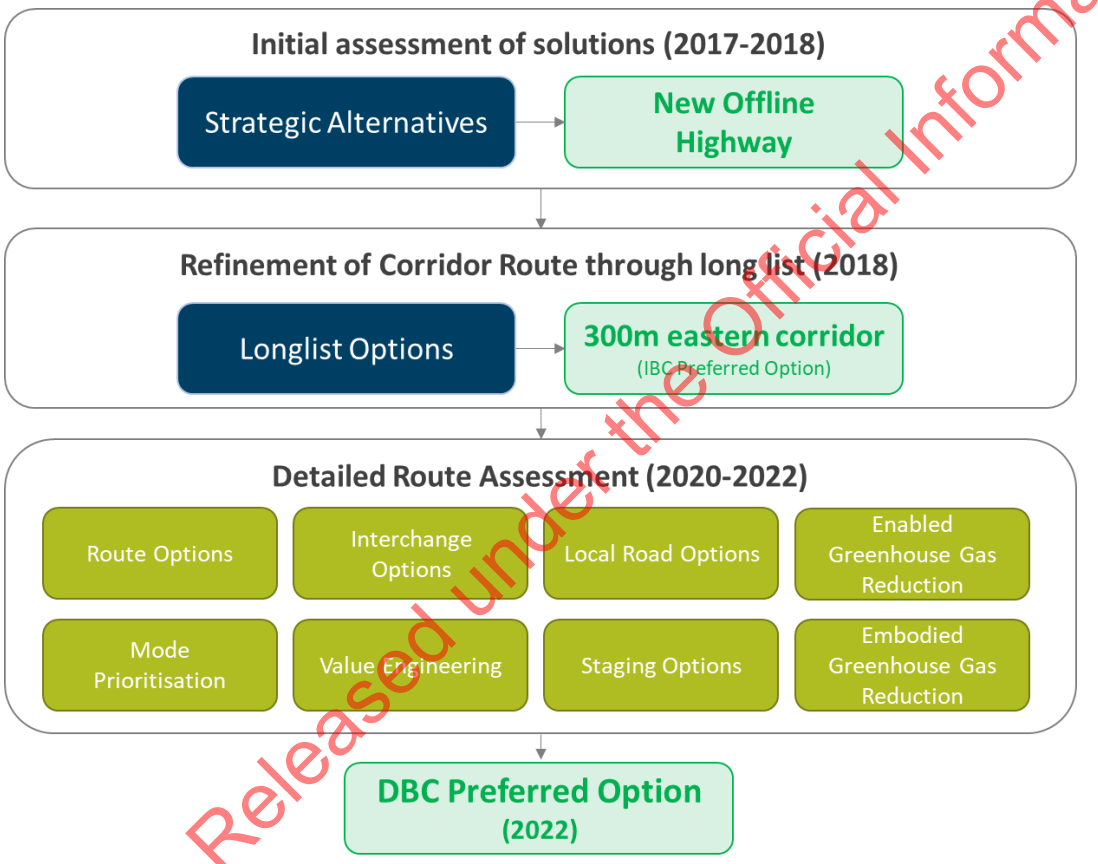
[3] The Tara-Ika Central Spine connection is proceeding ahead of or possibly in parallel to Ō2NL. Waka Kotahi and HDC have been working collaboratively to prepare a Principal Development Agreement (PDA) which will facilitate an integrated approach to the development and construction of critical projects which interface with Ō2NL. The intention of this agreement is to outline a range of principle level agreements (programme, funding) in a manner that will support both the functionality of Ō2NL and the District's growth.
[4] Tolling is a separate revenue collection mechanism Waka Kotahi may establish under the Land Transport Management Act 2003 (LTMA), which enables users of a road to contribute to its cost over time. Under section 46 of the LTMA, revenue from tolling may be used to contribute towards the 'planning, design, supervision, construction, maintenance, or operation of a new road'. It is Waka Kotahi policy to assess all new roads for tolling, utilising a multi-layer assessment process to determine tolling feasibility.
[5] The decision on the Tara-Ika plan change, made by an Independent Hearings Panel, was publicly notified on 4 July and the new rules enabling development also take legal effect on 4 July.

Waka Kotahi Board endorsed the Ō2NL Indicative Business Case (IBC) which included the recommendation to investigate an offline highway, from Taylors Road (in the south) to north of Levin, within a 300m corridor.

15. Following the Governments formation of NZUP, the DBC investigations programme commenced in early 2020. Through Waka Kotahi's partnership with Muaūpoko Tribal Authority and hapū of Ngāti Raukawa ki te Tonga, core partnership principles have been developed and applied regarding the development and assessment of options, selection of recommended options, analysis of effects and effect mitigation responses. Some indicative broader outcomes and legacy outcomes have also been identified in the Commercial Case.

16. Stakeholders and the community have also been involved in the project development process over the last few years through significant consultation and engagement exercises, workshops, hui and individual meetings. There is very strong support for the project, particularly in the Horowhenua district.

17. The Ō2NL DBC summarises the processes and engagement undertaken to develop and analyse options for SH1 and SH57 between Ōtaki and north of Levin. The DBC presents the outcome of investigations undertaken between January 2020 and May 2022, and next steps for implementation of the Preferred Option.



Analysis Summary

18. Crown Partnership:

Waka Kotahi recognise a relationship that upholds the rangatiratanga of te taiao (environment), and the relationship hapū have to their waterways and water bodies, whenua (land) and each other within Horowhenua. A central component of this Project is the recognition that iwi and hapū have an inalienable connection to te taiao and a responsibility for its health and wellbeing. The Project partners are committed to ensuring that because of this relationship, the health and wellbeing of te taiao impacted by Ō2NL will be improved by the application of agreed Project principles – this will bring benefits for the overall ecosystem, that improve overall wellbeing for whānau, hapū, iwi and the wider community. Hapū and marae are integral to the success of the relationship and the Project, working together in a collaborative manner.

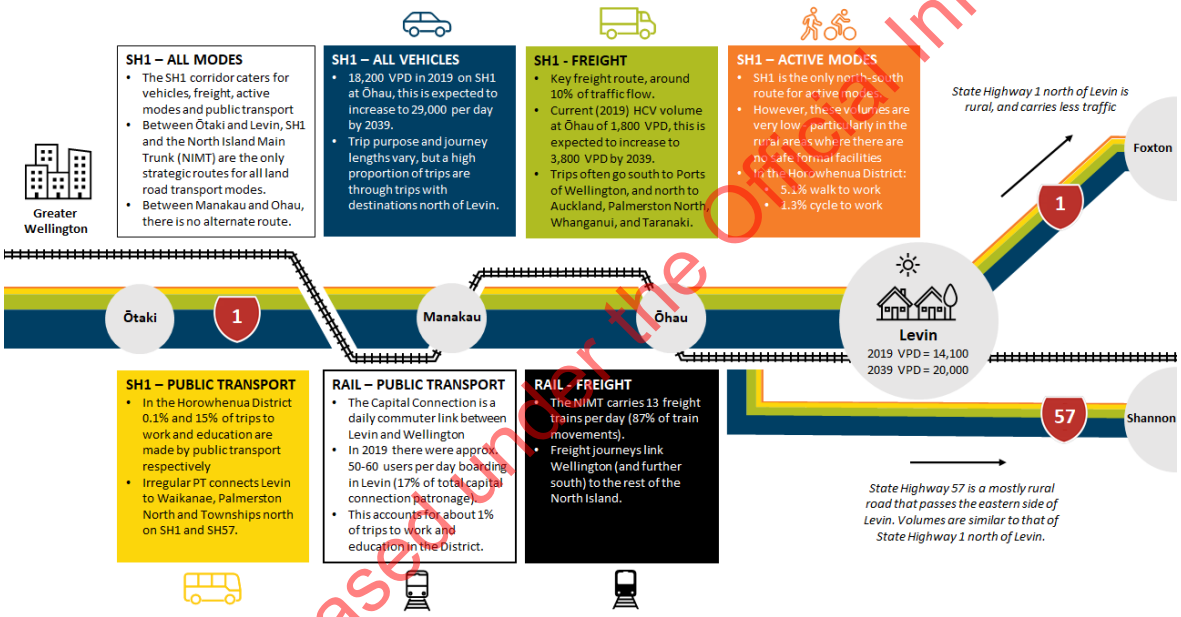
19. Project partners (Waka Kotahi, Muaūpoko Tribal Authority and hapū of Ngāti Raukawa ki te Tonga) have together been considering the aspects that make up the DBC including the relevant delivery strategies, including procurement, property, and RMA / consenting strategies. For example, ongoing exploration in these areas supports the inclusion of a hapū/iwi delivery objective which relates to enhancing the mana o te taiao as well as recognition of tino-rangatiratanga of our hapū and iwi partners.

20. The core partnership principles developed for the project are to:

- Tread Lightly, with the whenua
    - Me tangata te whenua (treat the land as a person)
    - Kia māori te whenua (let it be its natural self)
- Create an Enduring Community Legacy

Strategic Case

21. Between Ōtaki and Levin there is only one north to south route, SH1. It is all things to all people. It is the corridor shared by road freight, bus public transport, active modes and private motor vehicles, as presented in the figure below. It is a lifeline for all of these modes and movements. The only detour increases journeys by over two hours (more in peak times), via SH2 and the Remutaka ranges.



22. The strategic case for Ō2NL, based on the significant growth trends, poor safety records and meeting increasing resilience needs has not changed since 2018, in fact performance has deteriorated. The problems outlined below are current and to a scale which makes them nationally significant, especially when considering that all of these issues are compounded by the growing region and associated demand for travel along the corridor.

23. In the last five years to 2021, there were 72 deaths and serious injuries (DSI) along SH1 and SH57 within the project area, making it one of the country's most dangerous sections of road. The highways are classified as High-Risk Rural Roads and have a Star Rating of 2 out of 5. Although Waka Kotahi is investing approximately $60m over the next 3 years to improve safety on these two highways in this area, what can feasibly be achieved in the corridor is limited and there will remain a significant and unacceptable safety risk within this strategic national corridor.

24. The lack of resilience in the existing transport system means that journeys, particularly inter-regional, are regularly disrupted – most often by crashes. There is no alternate route to SH1 between Manakau and Ohau – this section also has ageing structures and is at high risk of closure due to regular flooding. This section of state highway has a 5L (meaning - extreme

consequence, likely) resilience risk hazard. This rating is forecast to deteriorate to the highest level of risk possible of 5VL (meaning - extreme consequence, very likely) by 2050 due to climate change impacts. This route is a key economic and social lifeline and closures add over 2 hours to any journey via SH2, which itself includes the high-risk Remutaka Hill.

25. The social and economic impacts of any closure, currently estimated at over $2.5M[6] per day (compared to just $0.034M per day for a closure of the SH3 Manawatū Gorge[7]), will rise as the demand for regional travel (as forecasted) increases.

26. Growth in the Horowhenua is occurring at the fastest rate for a generation. The district's 2020 population has already well surpassed the StatsNZ 2040 'high' growth projection developed in 2013 and is already outpacing more recent StatsNZ 2018 projections. Growth is forecast to continue, with an additional 16,000-26,000 people projected to live in the district by 2040.

Economic Case

27. Many strategic alternatives, options and sub-option refinements have been considered over the last 10 or more years to address the problems on this corridor. The relative economic performance of strategic alternatives and corridor options were examined fully during the IBC (in 2018), which informed the decision by the Waka Kotahi Board and Cabinet to proceed with a preferred corridor option to the east of the existing state highways.

28. Assessment has shown that the recommended new, offline 4-lane highway and SUP from north of Ōtaki to north of Levin delivers the best results against the problems and objectives whilst not creating impacts or risks that are unable to be mitigated. All approaches have different significant outcomes which are summarised in the table below.

Considerations	Strategic Alternative						
	Do Nothing	Minor Safety Improve-ments	Localised Highway Upgrades	Larger Highway Upgrades	Online Express-way to South of Levin	Ōtaki to South of Levin New Offline Highway	Ōtaki to North of Levin New Offline Highway
Problem 1: Safety	NO	NO[8]	Partially	Partially	Partially	YES	YES
Problem 2: Resilience	NO	NO	Partially	Partially	Partially	YES	YES
Problem 3: Regional Growth	NO	NO	Partially	Partially	Partially	Partially	YES
Problem 4: Levin Town Centre	NO	NO	NO	NO	NO	NO	YES
Reduces Community Blight	NO	NO	NO	NO	YES	Partially	YES
Iwi Support	NO	NO	NO	NO	NO	YES	YES
(Part of) Enduring solution	NO	YES	Possibly[9]	Possibly[10]		YES	YES

29. The new offline highway was progressed through further design refinement with partners and community inputs to identify the exact route, interchange locations, SUP alignment and local

[6] Ōtaki to north of Levin Measuring the Economics of Resilient Infrastructure Tool' (MERIT) assessment. Estimated economic impact of $18M for a 7-day closure increasing to $72M for a 28-day closure.
[7] The SH3 Manawatū Gorge closure impacts previously estimated using the MERIT methodology resulted in a cost per day of just $34,000. See: Waka Kotahi – Economic Impact of SH3 Manawatū Gorge 11/12 Outage
[8] Whilst DSIs would be reduced, increased traffic would result in future DSIs being similar to current numbers
[9] Enables new four lane offline highway at any location in the future. Online upgrades may be greater that what is required for revocation.
[10] Could upgrade to four lanes but it has significant impacts and may not meet long term outcomes. Could still build new offline route, but this online option would be much greater than revocation needs.

road connections and was subject to stakeholder and community engagement. This option has now been developed to a DBC level of detail.

30. The economic performance of this option is presented in the table below.

Type	MoT Framework	Benefit / Cost	NPV ($M)
Benefits	Healthy and Safe People	Cycling Health Benefits	$9.7
		Crash Cost Benefits	$139.8
		Health Emission Reduction Benefits	$16.1
	Resilience and Security	Resilience Benefits	$105.4
	Economic Prosperity	Travel Time (TT) Benefits	$1,150.1
		Travel Time Reliability (TTR) Benefits	$57.5
		Vehicle Operating Cost (VOC) Benefits	-$18.7
	Environmental Sustainability	CO_2e Emissions Reduction Benefits	-$1.9
		Total NPV Benefits	**$1,458.0**
Costs (P50)		Net PV Maintenance Costs	$22.2
		Net PV Capital Costs	$1,180.1
		Total Net PV Cost	**$1,202.3**
		Benefit Cost Ratio (BCR)	**1.2**

s 9(2)(j)

[11] The Financial Case presents both the Project Estimate (based on WTP) and the parallel estimate (BondCM). However, all escalation calculations have been based on the BondCM parallel estimate.

s 9(2)(f)(iv)

Environmental Sustainability Outcomes

37. Embodied construction emissions – GHG emissions due to construction activities are an unavoidable consequence of any construction project. For the Ō2NL construction phase, estimates of GHG emissions have been completed at different stages. The latest estimate is between 80,000-104,000 tCO_2e (tonnes of carbon dioxide equivalent). During the DBC process, opportunities that have been able to be quantified and incorporated into the design at this early stage in the design cycle resulted in the potential for approximately 7% reduction in GHG emissions. A range of other opportunities have been identified to be taken forward into procurement to achieve a 20% target reduction in partnership with the constructor.

38. Enabled emissions estimates – GHG emissions resulting from motor vehicles using Ō2NL from the 2029 road opening to 2049 have been calculated to be 36,750 tCO_2e greater than emissions resulting from continued reliance on the existing network over the same period (a 2.0% difference). Reductions will be achieved by land use / transport integration, further development of public transport and active mode networks, the use of a cleaner vehicle fleet into the future, alongside other initiatives such as high occupancy vehicle lanes, bus lanes, s 9(2)(f)(iv) all of which will continue to be investigated.

39. Infrastructure Sustainability Outcomes - The Waka Kotahi Sustainability Rating Scheme Policy (2020) will apply to Ō2NL. This policy requires the Ō2NL project to work towards an Infrastructure Sustainability (IS) Design/As Built rating. The preliminary IS process, and a Preliminary Sustainability Management Plan has been completed, however the formal IS assessment will take place during detailed design and construction and will be used as the framework to measure GHG emission reductions and other sustainability achievements.

IMPLEMENTATION READINESS

s 9(2)(j)

s 9(2)(j)

Management Case

51. The DBC outlines the project arrangements to ensure the successful delivery of the preferred option and to manage programme risks. The Ō2NL Project is a complex project with a wide range of interfacing plans, legacy documents, disciplines and deliverables being undertaken in the Horowhenua and Kāpiti Coast districts as well as Greater Wellington and Horizons Regional Councils.

52. The proposed structures (NZUP governance, Steering Committee with independent chair, accountable Sponsor, Director, management/leadership team, operational team) in the management case are geared towards an Alliance based procurement model. The proposed structure embraces and enables the Ō2NL Project to be delivered in partnership with the Muaūpoko Tribal Authority and Ngāti Raukawa ki te Tonga, whilst responding to project outcomes, benefits realisation, cost and programme drivers.

53. While revocation is being treated as a separate project (subject to separate funding approvals processes), it is part of the wider Ō2NL programme.

54. The revocation PBC recommends that an Integration Working Group (IWG) be established to ensure that the Ō2NL Project is developed and delivered efficiently into the local transport networks. The IWG is made up of representatives from Waka Kotahi and iwi partners, Horowhenua District Council and KCDC. This will enable effective integration with other planned infrastructure improvements that are needed to facilitate and support planned growth.

55. The primary role of the IWG is to ensure that effective revocation agreements are in place in sufficient time to enable the IWG agreed outcomes. This will enable investment to efficiently deliver an integrated transport system and will also underpin asset transfers as appropriate. The IWG will also facilitate information exchange to allow effective integration of capital investment, maintenance, and operational activities.

56. The Project team will continue to instigate lessons learnt reviews at key points of the project. The next point being the completion of the DBC phase. Key findings and responses will be included in the Project's reporting. The Ō2NL Project team will also continue to look across the wider Waka Kotahi project spectrum to identify lessons and potential improvements.

57. Appropriate resource management plans are in place for the current and upcoming phases of the project, to provide project continuity and intelligence and to leverage off established relationships.

58. Change management arrangements are in place to enable the clear identification of change during the project development before it has an impact.

59. To demonstrate how the objectives will be achieved by the project a Benefits Realisation Plan will be developed, based on the investment objectives and key performance indicators. It enables the benefits that are expected to be derived by the project to be planned for, tracked and realised. In the interim, an Appraisal Summary Table (AST) which outlines the anticipated benefits for the Project has been developed.

60. In addition, sustainability targets will be pursued through the detailed design and construction phase, with exact targets to be agreed in collaboration with the Alliance. Sustainability targets in relation to the following areas are envisaged:

    - Reduce embodied emissions from materials used in construction
    - Reduce energy use during construction

- Reduce construction emissions from fuel and construction processes and activities
- Substitute energy use during construction with renewable energy
- Reduce waste to landfill during construction

Risk Management arrangements

61. The Ō2NL Project will be managed at all phases in full accordance with the NZUP Risk Management Framework. A detailed Risk Register and Risk Management Plan is in place and is updated and regularly reviewed. An independent Quantitative Risk Assessment (QRA) has been completed identifying risk contingencies for both cost and schedule at P50 and P95 confidence levels.
62. The top five risks are included in regular reporting and risk is a standing agenda item for governance meetings. These are based on the NZUP Framework Risk Register for Ō2NL and includes the risks identified in the Z/44 risk register for the project.
63. The rolled-up risks (provided below) provide a strategic overview and context to risks, and thus provides an objective approach to understanding resourcing and management requirements of the Project, and allows Governance processes to be brought to bear accordingly.

Key Risks	Mitigation strategy	Residual risk level
Project cost escalation	Planned mitigation will include scope/cost trade-offs, value engineering exercises, and further investigations on key risks/contingencies. Identify opportunities and risk and develop mitigation through design and consultation with industry Property strategy to identify clear process including for Te Ture Whenua Māori Land.	High
Delays to the overall programme	Comprehensive controls in place/required specific to the cause including: • Implement communications and engagement strategy • Regular community and key stakeholder updates via media / website / newsletters • Implement property acquisition strategy. • Regular communication with consultants • Using correct cultural protocols for all site work • Manage and report the scope and cost against the baseline • Definitions of roles and responsibilities • Working collaboratively (Waka Kotahi staff and Stantec) • Regular community group meetings • Further refinement of the programme schedule (end to end) • Regular comms and hui with iwi partners and key stakeholders (operational / management / governance level) • Integrated programming • Identify and develop strategies with stakeholders to manage scope and programme risks	High

Key Risks	Mitigation strategy	Residual risk level
	• Regular (monthly) engagements with MoT/Treasury officials to understand shifts in government priorities.	
Environmental effects are more adverse than expected leading to mitigation increases / reduction in flexibility for construction and design:	Undertake robust effects assessments in consultation with Councils, Department of Conservation (DOC), Forest and Bird (F&B), and stakeholders. Collaborative and transparent approach to developing response to ecological effects with Councils, DOC and F&B. Ensure that communities understand the Project, its effects and how they are proposed to be managed. Develop clear conditions that relate precisely to effects, as needed, and develop designs / investigate where critical effects are identified.	High
Legislative and policy change / reform prior to project implementation results in:	Lodge RMA applications promptly (prior to November 2022) so as to minimise risks. Keep emerging legislation and policy under review to ensure that technical evidence is pre-emptively collected, with clear responses to emerging challenges identified (including implementation strategies).	Low
		High

Next Steps

64. It is critical that the Ō2NL Project continue to progress without delay to meet Ministerial milestones in particular construction commencement in 2025 and road opening in 2029. Commencement of procurement and completion of the property acquisition programmes remain on the critical path for this project.

65. The following table outlines the major actions that are needed over the next 7 years.

Phase	Action	Timing
RMA Consenting	Lodge RMA Notices of Requirement and regional consents package	Spring 2022
	Participate in the RMA public submissions, mediation and hearings processes	Summer 2022 to Winter 2023
Property	Strategic property acquisition	Advance purchases underway. Strategic purchase of full properties commenced in late 2021 and purchase of property located to East of Levin commenced from March 2022.
	Māori landowners	Underway in accordance with Te Ture Whenua Māori Land Act. Aim to complete by mid-2024

Phase	Action	Timing
	Partial property purchases	Willing seller acquisitions underway where have been approached by landowners. Active acquisition commences Spring 2022
Procurement	RFP development	Commenced and developed by Spring 2022
	RFP Alliance	Autumn 2023
	IPAA	Autumn 2023 to Spring 2024
	PAA Award	Spring 2024
Construction	Enabling works/ establishment	Commence Winter 2024
	Earthworks and Bridges	Commence Winter 2025
	Pavements, services etc.,	Commence Winter 2027
	Road open	End of 2029

1. INTRODUCTION AND CONTEXT

1.1 INTRODUCTION

1.1.1 Overview

State Highway 1 (SH1) is New Zealand's premier highway, but the section between Ōtaki and North of Levin (Ō2NL) has serious safety and resilience problems.

The importance of this section of SH1 is characterised by its function of connecting Wellington to the central and upper North Island, where no other resilient route exists. It also provides an essential economic connection to Palmerston North, the largest freight node in central New Zealand.

The Horowhenua is currently experiencing exceptionally high growth after a generation of little activity. Local and regional plans predict that this will continue for some time and large developments are currently underway[12]. Kāpiti Coast has also been experiencing growth and this is expected to continue[13].

In partnership with Muaūpoko and Ngāti Raukawa ki te Tonga, Waka Kotahi NZ Transport Agency (Waka Kotahi) has been investigating potential upgrades and new alignment options to address the issues with the existing SH1 route and to support sustainable growth in Levin.

The Indicative Business Case (IBC) for the project outlined a strong case for change and a thorough assessment of alternatives. In December 2018, the Waka Kotahi Board approved and endorsed the IBC's preferred option:

An offline highway, from Taylors Road (in the south) to north of Levin within a 300m corridor

This Detailed Business Case (DBC) summarises the process used to identify this preferred option and develops the option in more detail through the business case process to enable an investment decision to be made.

1.1.2 Partnership with mana whenua

Waka Kotahi recognises a relationship that upholds the rangatiratanga of te taiao (environment), and the relationship hapū have to their waterways and water bodies, whenua and each other within Horowhenua.

A central component of this Project is the recognition that iwi and hapū have an inalienable connection to the taiao and a responsibility for its health and wellbeing;

The Project partners are committed to ensuring that because of this relationship, the health and wellbeing of the taiao impacted by Ō2NL will be improved by the application of agreed Project principles – this will bring benefits for the overall ecosystem, that improve overall wellbeing for whānau, hapū, iwi and the wider community.

Hapū and marae are integral to the success of the relationship and the Project, working together in a collaborative manner.

1.1.3 Objectives, Key Principles and Values

The project objectives for the Ō2NL project are to:

- Enhance safety of travel on the state highway network;
- Enhance the resilience of the state highway network;
- Provide appropriate connections that integrate the state highway and local road network to serve urban areas;

[12] Waka Kotahi and Horowhenua District Council (HDC) have been working collaboratively to prepare a Principal Development Agreement (PDA) which will facilitate an integrated approach to the development and construction of critical projects which interface with Ō2NL. The intention of this agreement is to outline a range of principle level agreements (programme, funding), such as local road connections, revocation, constructing shared stormwater infrastructure and upgrading intersections in a manner that will support both the functionality of Ō2NL and the District's growth.

[13] See: Kāpiti Coast District Council – Growth Strategy

- Enable mode choice for journeys between local communities by providing a walking and cycling facility; and
- Support inter and intra-regional growth and productivity through improved movement of people and freight on the state highway network.

Through the Waka Kotahi, Muaūpoko and hapū of Ngāti Raukawa ki te Tonga partnership, core principles and values for the project have been established. These are summarised below.

Kaupapa Tumu / Core Principles

- Tread Lightly, with the whenua
  - Me tangata te whenua (treat the land as a person)
  - Kia māori te whenua (let it be its natural self)
- Create an Enduring Community Legacy

Tikanga / Values

- Te Tiriti (spirit of partnership)
- Rangātiratanga (leadership – professionalism – excellence)
- Ūkaipotanga (care – constructive behaviour towards each other)
- Pukengatanga (mutual respect)
- Manaakitanga (generosity – acknowledgement – hospitality)
- Kaitiakitanga (environmental stewardship)
- Whanaungatanga (belonging- teamwork)
- Whakapapa (connections)

Together, these values and core principles bring a focus on the project development and design response (and assessment, procurement, construction and management) for positive, measurable outcomes. This working approach permeates all levels and areas of the Project and is reflected in all key project artefacts (charter, strategies, plans, documents etc).

The core principles have guided the development and assessment of options, selection of recommended options (informed by the Multi Criteria Analysis (MCA) processes), and analysis of effects and initial thinking into mitigation responses. Hapū and iwi partners have led the team's efforts to incorporate these values in line with the overall outcomes and local values. This will continue through the project design and construction.

The values have been integrated in particular through the Cultural and Environmental Design Framework (CEDF) which is attached as Appendix L.

1.1.4 New Zealand Upgrade Programme

The New Zealand Upgrade Programme is investing $8.7 billion to get our cities moving, save lives and boost productivity.

The Ō2NL project is part of the 'Wellington Package' to *"improve safety and access, support economic growth, provide greater route resilience, and better access to walking and cycling facilities*".

The NZUP scope of this project was considered and agreed by Cabinet[14] to be a four-lane offline highway with a shared use path. This decision was made after detailed consideration by Waka Kotahi, and approval of this option by the Waka Kotahi Board.

This DBC re-evaluates the value for money proposition of this preferred option and a more detailed examination of risks and potential costs.

1.1.5 IBC Preferred Option

In 2018, an Indicative Business Case was prepared for Ō2NL which considered strategic alternatives and a wide range of corridor options.

[14] See: Waka Kotahi – NZUP Cabinet meeting notes

During this IBC process, Ō2NL was identified by the Government as one of 16 projects to be re-evaluated to help ensure the 2018-21 National Land Transport Programme (NLTP) delivered on the 2018-28 Government Policy Statement (GPS) on Land Transport funding.

The re-evaluation review of the Problem and Benefit Statements concluded that there remains a strong case for addressing safety and resilience in the project area. The Indicative Preferred Strategy confirmed through the re-evaluation process was route protection for an off-line highway and shared use path to be progressed as soon as possible, but that on-line safety enhancements should also be progressed immediately between Ōtaki and Levin. Accordingly, the re-evaluation process confirmed that the offline highway should continue as it was aligned with the GPS, and it addressed the identified problems.

The Waka Kotahi Board met in December 2018 to consider the IBC, the re-evaluation outcomes and agree the way forward for the Ō2NL project. At the meeting the Board:

> **Endorsed** the Ōtaki to north of Levin Indicative Business Case and its recommended preferred route for the new offline route for State Highway 1.

The project was re-presented to Cabinet in May 2021, who agreed in principle that Ō2NL proceed to delivery[15].

1.1.6 Detailed Business Case

This Detailed Business Case (DBC) progresses the preferred option identified during the IBC. It summarises the work undertaken to date and plans the future phases so that the project can be successfully implemented. The DBC is structured as follows:

- **Introduction and Context:** The section outlines the economic, environmental, policy and transport context of the project. This also includes consideration of how the impact of the COVID-19 pandemic may have influenced travel demands.
- **Strategic Case:** This captures policy changes and new evidence since the completion of the IBC that is relevant to the investment story, confirms the problems and outlines the investment objectives.
- **Economic Case:** A summary of the strategic alternatives that were considered during the IBC, the refinement of the preferred option through the DBC, the economic assessment and how this option meets the investment objectives.
- **Financial Case:** This section presents the updated project estimate and the outstanding financial risks in terms of affordability.
- **Commercial Case:** This presents the current thinking in regards to the procurement model for the detailed design and implementation phases of the project and how this will manage risk between the public and private sector.
- **Management Case:** A summary of how Waka Kotahi is currently structured to deliver this project and how it will manage change, benefits and risks.

[15] See: Waka Kotahi – NZUP Cabinet meeting notes (refer appendix 2, which confirms the scope of original option, outcomes sought, investment options and recommended option)

1.2 ECONOMIC CONTEXT

The Wellington Region has the second largest economy in New Zealand. It contains the centre of Government, 11% of the nation's population and produces 13% of the GDP. The economy is dominated by knowledge-intensive industries with 60% of the region's jobs located in Wellington City.

The Manawatū-Whanganui economy and population[16], whilst significantly smaller[17], has more recently been experiencing extraordinary growth. To continue Wellington's and Manawatū-Whanganui's growth, it is vital to get people and freight moving safely and efficiently to and from the rest of the North Island. Indeed Palmerston North, with its distribution hubs and inland ports, is the largest freight node in central New Zealand[18].

Horowhenua District Council is working closely with Accelerate 25 to stimulate and support economic growth and investment in the Manawatū-Whanganui Region; Ō2NL is identified as a key enabler of better economic outcomes[19].

In addition, the Council adopted a new Growth Strategy and Levin Town Centre Strategy at the end of 2018 to both encourage appropriate growth throughout the region and transform and re-vitalise Levin. Waka Kotahi is working with the Horowhenua District Council to align and integrate the design of the transport improvements with their economic development and urban growth aspirations. HDC revised its Growth Strategy in 2022, largely because the District's population was growing twice as fast as was expected in 2018 when the Strategy was originally prepared. Projections indicate this higher growth rate will continue, meaning that Council needed to identify additional growth areas.

In 2020 and 2021 the Kāpiti District recorded higher annual average GDP growth than the overall New Zealand figure, with construction being the largest among the broad industries in 2021[20].

1.2.1 Growth

Horowhenua has had mostly static growth in recent history, but district population has rapidly increased in recent years. Actual growth has occurred at a rate well above 2013 Statistics NZ projections and is tracking closely against the more recent 2018 Statistics NZ high growth forecast (Figure 1-1).

Horowhenua District Council projections to 2040 equate to an additional 16,000 people living in the district[21]. Horowhenua's population is projected to grow by 2.1% per annum over the next 10 years (75th percentile projection). This is more quickly than the national population growth rate per annum (1.2%), but similar to recent growth in Horowhenua over the past 6 years.

For the purposes of infrastructure development planning, HDC have adopted the 95th percentile growth projection for its Long Term Plan (LTP). This results in significantly higher growth numbers (population and additional households). For reference, according to the 95th percentile, the District's population will grow by approximately 26,000 over the next 20 years, resulting in 11,000 additional households.

Due to the potential volatility of growth and general uncertainty of future outcomes, the project team are testing three different growth scenarios: the 25th, 75th and 95th percentile population projections. These projections are presented in Figure 1-1 below.

[16] In 2018 the region had about 5% of New Zealand's population (Stats NZ: 2018 Census Summary)
[17] In 2018 the region had a GDP of 10.7 billion (3.8% of NZ GDP) (Stats NZ: 2018 Regional Economics Infographic)
[18] Horizons Regional Council: 2016 Accelerate 25 Manawatū-Whanganui Economic Growth Action Plan
[19] A partnership of Manawatū-Whanganui local councils to enable and facilitate economic growth. See: Accelerate 25
[20] See: Infometrics - Kāpiti Coast District Overview
[21] Horowhenua Socio-Economic Projections, Sense Partners (2020). Additional 16,000 people is based on the 75th percentile forecast

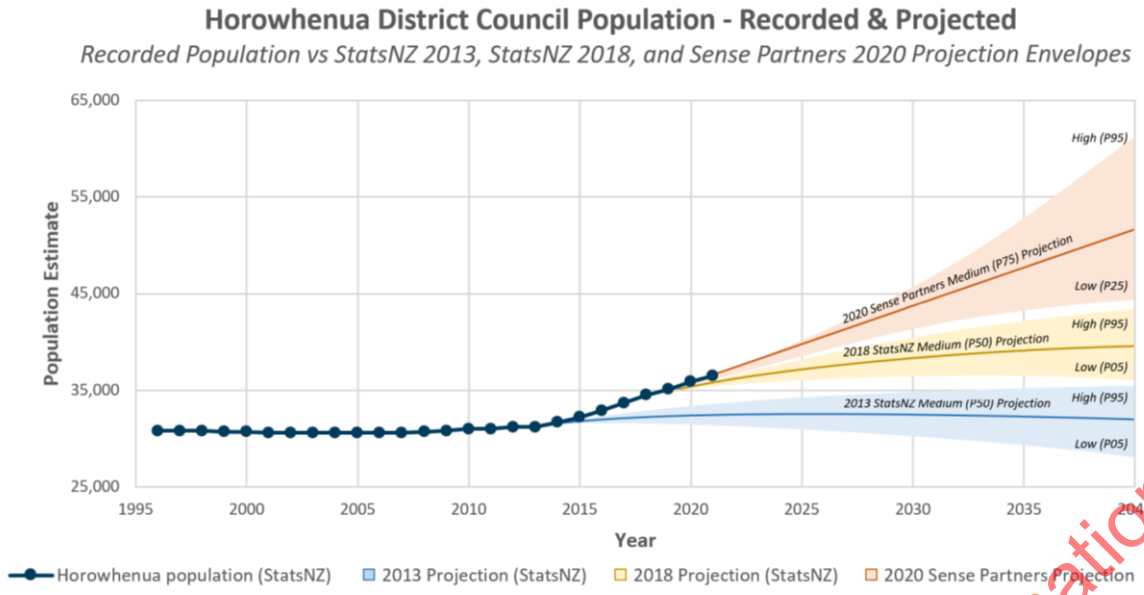


Figure 1-1. Population Estimations – Horowhenua District Council[22]

HDC have identified growth areas and are rezoning these (using the Resource Management Act (RMA) plan change process) to ensure there is sufficient development capacity to meet demand for housing and business land. The largest of these, Tara-Ika, has recently been rezoned, following an extensive master planning and RMA plan change process. The decision on this plan change, made by an Independent Hearings Panel (IHP), was publicly notified on 4 July and the new rules enabling development take legal effect on 4 July. This rezoning relates to a 420ha area of land on the east side of Levin. The decision of the IHP enables construction of 3,500+ houses, supported by a network of open spaces and commercial and community facilities (including a school). With the decision on the rezoning being released, construction is expected to begin imminently. Other identified growth nodes include Ohau and Manakau.

The Horowhenua District is a part of the Wellington Growth Framework, which identifies that the growth in the district can be supported by the major new transport investments in road and rail, and proximity to both the Palmerston North and Wellington employment markets and tertiary education providers.

In addition to growth in Horowhenua, the Kāpiti Coast is also expected to grow, with over 22,000 additional people forecast to be living in the district by 2041[23]. This is an increase of approximately 40% compared to 2021.

Continued population growth has wide-ranging implications for the DBC, affecting all of the identified problem statements. It has a direct relationship with traffic volumes, and flow-on effects to crash rates, delays accessing SH1, the number of people impacted by resilience events, and the number of heavy vehicles going through Levin.

It is vital these growth areas are progressed in an integrated and strategic manner with transport developments as otherwise this growth will lead to significant access and safety issues.

1.2.2 Supporting wider regional transport projects

The Ō2NL project will also help support wider regional strategic transport projects as shown in Figure 1-2 below, including the Kāpiti Expressway projects.

Improvements to regional links created by Ō2NL are recognised through the Accessing Central NZ (ACNZ) PBC and Palmerston North Integrated Transport Initiative (PNITI) PBC.

The project will also help support the outcomes of the SH3 Te Ahu a Turanga highway[24] (between Ashhurst and Woodville) which will improve access to Palmerston North, Taupō, the Hawke's Bay and Gisborne.

[22] Data based on Statistics NZ and Sense Partners Population Projects prepared for the Horowhenua 2040 (2022 update).
[23] See: Kāpiti Coast District Council – Population & Demographics
[24] See: Waka Kotahi – Te Ahu A Turanga

Figure 1-2. Wellington Northern Corridor

Table 1-1 outlines major projects that have developed since the IBC and their impact on Ō2NL.

Table 1-1. Major project developments

Project	Comment
Wellington Northern Corridor	Construction of the Peka Peka to Ōtaki expressway is due to be completed in 2022. Once complete, this will provide a minimum 4-lane expressway from the Wellington CBD to north of Ōtaki (Taylors Road), as the MacKays to Peka Peka expressway opened in February 2017 and Transmission Gully opened in March 2022. The completion of these will improve access to the southern end of Ō2NL from Wellington and will increase drivers' expectations of the route.
Whirokino Trestle	To the north of Levin, the Whirokino Trestle and Manawatū River Bridge replacement project was completed in early 2020, improving network route security and safety. The new bridge also enables HPMV to use SH1, avoiding a 14km detour. Initial surveys undertaken before and after the completion of the project suggest that an increased number of HPMV's are using SH1 north of Levin, with volumes growing from under 100 to over 400 per day. This will have a corresponding negative impact on the amenity of the Levin Town Centre.
Te Ahu a Turanga	The Manawatū Tararua Highway will provide strategic connection between the Port of Napier and Palmerston North and Wellington (the latter of which Ō2NL would form part of). It is currently due for completion before the end of 2024.
KiwiRail Regional Freight Hub	KiwiRail is progressing plans for a high-tech, intermodal freight hub which will help grow Palmerston North's role as a critical freight distribution centre for the lower North Island. It will support rail and road transport working together to meet the freight demand in the lower North Island, while boosting the regional economy. KiwiRail lodged a Notice of Requirement in October 2020, which was subsequently confirmed, with conditions, in April 2022 (Currently under appeal). Although the hub is a long-term project and is likely to be planned and delivered in stages (subject to funding) over the next decade, it reinforces the importance of strategic road and rail connections to Palmerston North.
Palmerston North Integrated Transport Initiative (PNITI)	Waka Kotahi and Palmerston North City Council are working together to develop a plan for the future transport network for Palmerston North to ensure that future land use and transportation networks are appropriate integrated. A Network Options Report was released in 2021 and the strategy will be implemented over time.
Regional Rail Plan (RRP) and the Lower North Island Rail Integrated Mobility Project (LNIRIM)	Greater Wellington Regional Council has been developing business cases for the Wellington Regional Rail Plan (RRP) and the Lower North Island Rail Integrated Mobility (LNIRIM) project, which are considering potential improved services and infrastructure, including in the Wellington to Palmerston North area. Refer Section 1.5.2 for further information.
Transforming Taitoko/Levin – Levin Town Centre Strategy	Potential place making improvements that have been identified as part of Horowhenua District Council's (HDC) 2018 strategy gives guidance to all parties that could be involved in redevelopment of the town, including private developers, Council and Waka Kotahi. A cornerstone of the strategy is the offline highway due to the amount of traffic, and particularly heavy vehicles, that it removes from the town centre. This strategy will continue to be implemented over time.

1.2.3 COVID-19

Waka Kotahi have been monitoring the impacts of the COVID-19 pandemic across different regions of New Zealand, including Manawatū-Whanganui. This section provides a summary of the impacts to this region as well as the Horowhenua District. It considers how the pandemic has influenced the local economy, land use forecasts and how quickly traffic volumes recovered to pre COVID-19 levels following the first lockdown in March 2020[25].

Economy

Economically, the forecast for the Manawatū-Whanganui region is relatively positive. The main reasons provided for this are:

- The scale of government services, healthcare and social assistance, and manufacturing sectors.
- The region is the country's least reliant on international tourism, with only 17% of tourism spend in the region coming from international visitors.
- Electronic card spending data, comparing 2019 to 2020, shows that the Manawatū-Whanganui region and Horowhenua district have outperformed national trends. The Horowhenua district recorded a 0.8% decrease between 2020 and 2019, compared to a 3.2% decrease nationally[26].
- The proximity of the region to Wellington, whose economy is forecast as relatively positive.

The most recent impact analysis was undertaken in May 2021[27]. Overall, it stated that regions that are tourism and migrant dependent have been impacted the most in terms of job losses[28].

Under the central scenario for 2020-2022, Manawatū-Whanganui has less than a -0.2% change in job numbers (which equates to less than 1,000 jobs). This places the region roughly mid-range relative to the performance of other New Zealand regions.

All regions are forecast to grow in jobs under the central scenario for the medium term. Manawatū-Whanganui has the 7th highest growth in jobs in % terms, and the 13th in absolute. The analysis did note:

> "Several of the better performing districts are in the lower North Island and this result is likely to be a continued effect of public sector resilience in Wellington"

Transport

Traffic movements for the year 2020 at three surveyed sites[29] all follow a similar pattern – beginning the year with similar volumes to 2019, a significant decrease during the level 4 lockdown and progressive increases in volumes as lockdown levels descended. Since mid-May 2020 volumes generally recovered back to, or higher than, the 2019 levels.

A similar pattern is evident in 2021 when another nationwide lockdown took place, with traffic volumes similarly recovering thereafter. Figure 1-3 demonstrates these trends with a representation of the traffic volumes at the telemetry station on SH57 near Shannon.

[25] Waka Kotahi: 2020 Manawatū-Whanganui Regional Summary
[26] Infometrics: Economic Growth
[27] See: Waka Kotahi – Arataki COVID-19 Economic Projections
[28] Under the central scenario, short term (2020-2022).
[29] SH1 Ohau Telemetry, SH57 Shannon Telemetry and SH1/3 Sanson Telemetry.

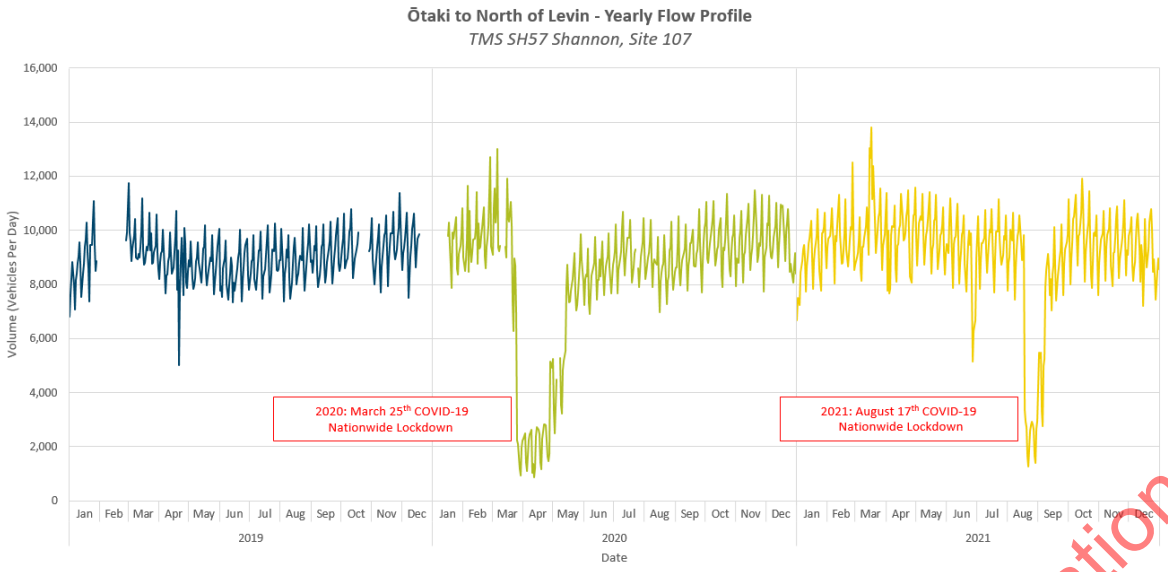


Figure 1-3. SH57 Shannon Telemetry - Traffic Flow Comparison of 2019 (blue) vs COVID-19 affected years, 2020 (green) & 2021 (yellow)

Whilst COVID-19 will likely continue to have an impact on society, traffic volumes on SH1 and SH57 did rebound to pre-lockdown (2020 and 2021) levels very quickly after restrictions were lifted. Given growth has continued to be very strong, no significant impact is expected on medium to long term travel demand.

1.3 ENVIRONMENTAL CONTEXT

Geographical, Physical and Environmental Context

Prior to settlement, the landscapes of Horowhenua supported a diverse range of habitats and vegetation patterns, from the Tararua Ranges, forested foothills, plains and sand dunes, formed through successive tectonic activity and river outflows, including volcanic deposits from the central plateau. These landforms are shaped by varied waterways including braided awa (rivers), that have ranged across the plains over time. Natural interdunal roto (lakes and lakelets) and repo (wetlands), feature where hydrological patterns were slowed by landform changes and can be fed by springs linked to a network of aquifers and unique patters of ground and overland flow.

Within the project area, the terrain is predominately flat, with undulations associated with water courses, wetlands and sand deposits. The land use is predominantly in pastureland and exotic forestry, although there are a number of market gardens associated with the very fertile soils in this region.

There are just a few remnant areas of forest standing in the open plains, which are important in both a landscape and ecological sense as habitat for a variety of species.

Cultural Context

Prior to the 1820s, the area was held by Muaūpoko. The migration of Ngāti Raukawa in the 1820s under Te Rauparaha culminated in a battle at Waiwiri-Lake Papaitonga in 1823. Today, Muaūpoko and Ngāti Raukawa both have mana whenua within the Project area.

Traditional Māori settlement was focused on the lakes (especially around Waipunahau-Lake Horowhenua and Waiwiri-Lake Papaitonga), the streams connecting the lakes with the sea (Hokio and Waiwiri), the forest edges and coastal estuaries. Māori lived in close connection with the taiao, which sustained their communities based on a series of marae, as well as various places of temporary occupation for harvesting mahinga kai. This environment was seriously disrupted by the onset of development, particularly after the railway opened up the district to sawmillers and farers. Māori land ownership decreased exponentially over the 19th century.

Hapū and iwi partners have led the team's efforts to ensure this cultural context is acknowledged and reflected in the development of a Cultural and Environmental Design Framework (CEDF) and in the Multi Criteria Analyses (MCA). This will be further enhanced by the completion of a number of Cultural Impact Assessments (CIA) for the project, by partnerships with marae, hapū and iwi.

Built Context

Pākehā contact and settlement was first associated with transport. The Wellington Manawatū Railway (now the North Island Main Trunk Railway ('NIMT') was pushed through the forest along the middle of the plains in the 1880s. The forest was then felled, and the plains converted to agriculture within a couple of decades. State highway 1 ('SH1') paralleled the railway line, with a pattern of no-exit side-roads branching off either toward the coast or the hills. For iwi the establishment of transport routes in Horowhenua (rail and the road) is associated with loss of land and removal of connections within communities; of 'taniwha' that work against holistic management, ki uta ki tai.

Manakau, Ohau, and Taitoko were established in conjunction with the railway. Each settlement was designed on a grid, and each retains traces of its original compact 'four-square' form.

1.4 POLICY CONTEXT

1.4.1 Government Policy Statement on Land Transport

Since 2018 a new Government Policy Statement on Land Transport (GPS) has been released. The latest GPS has continued concentration on safety, value for money, and changes to the Access, and Environment issues. Therefore, the change from 2018 to 2021 for Ō2NL is that the importance of freight connections has been further highlighted by the Government, as well as adapting to climate change and mitigating greenhouse gas emissions. However, as an NZUP funded project Ō2NL contributes to transport and wider outcomes, and generally aligns with GPS priorities (please refer to Appendix A.1 for detail), but is delivered separately from the GPS.

1.4.2 Other National Policies

There are many other recent and upcoming policy changes that have had to be considered by the project team including National Policy Statements (produced under the Resource Management Act 1991 (RMA)) on Freshwater Management, Urban Development, Indigenous Biodiversity (proposed), and Highly Productive Land (proposed). Whilst they are very important in relation to how the project is delivered (e.g. freshwater standards underline the importance of designing and constructing to maintain water flow and avoid and manage discharges), they do not fundamentally affect the business case.

The Resource Efficiency and Waste Minimisation Policy (2021) will also be important to the project through design and construction stages, driving change through a Resource Efficiency and Waste Management Plan and achieving better environmental outcomes.

1.4.3 Māori Land Policy and Treaty Claims

The Government has established policies and legislation regarding the maintenance and protection of Māori Land Ownership. The Project also takes place in one of the last remaining parts of the country where historical treaty claims (by both Muaūpoko and Ngāti Raukawa ki te Tonga) are yet to be settled. This legislative and policy environment places a particular responsibility on the Project Team to ensure Māori land interests are acknowledged and respected.

1.4.4 Climate Change

The passing of the Climate Change Response (Zero Carbon) Amendment Act in 2019, which commits NZ to Net Zero Carbon by 2050 (excluding biogenic methane), has led to a focus on understanding and prioritising climate change mitigation and adaptation and for the transport sector, this is being incorporated in Waka Kotahi Policy, including environmental and sustainability policy expectations (e.g. MoT Transport Outcomes Framework, GPS 2021, Waka Kotahi Sustainability Action Plan (Waka Kotahi), Resource Efficiency and Waste Minimisation Policy (Waka Kotahi), MoT Transport Emissions: Pathways to Net Zero by 2050 (MoT)). It has been recognised that reducing transport emissions is crucial to meeting NZ's climate targets.

To start the transition to a low carbon transport system, the government is introducing initiatives to reduce emissions from the transport sector, including the Clean Car Programme, Carbon Neutral Government Programme and the Sustainable Biofuels Mandate.

To reduce land transport greenhouse gas emissions from the transport sector and reach net zero by 2050, the approach in Toitu Te Taiao Our Sustainability Action Plan is to reduce reliance on

cars and support people to walk, cycle and use public transport, whilst rapidly adopting low-emission vehicles and fuels, and decarbonising heavy transport and freight. The target is to reduce Vehicle Kilometres Travelled (VKT) by cars and light vehicles through improved urban form and providing better travel options, particularly in our largest cities. However, current policies recognize that for personal travel in towns and smaller regional centres, cars will continue to be the mode of choice.

Two key approaches are being taken to considering climate change in this project, reducing greenhouse gas emissions (primarily embodied but also enabled) and improving the resilience of the road design through location and design standards which accommodate forecast climate changes and associated weather events. It is critical to note that these approaches sometimes require potential trade-offs to be considered. For Ō2NL, a key objective of the Ō2NL project is to improve the resilience of this section of the highway network, and the project is being advanced as part of the NZUP to address serious infrastructure deficits. However, in order to achieve the project objectives some emissions will inevitably be released during construction and use. It is essential these emissions are kept as low as possible, to limit further global warming, which would in turn worsen problems of resilience and wellbeing elsewhere.

1.5 EXISTING TRANSPORT SYSTEM

1.5.1 Overview

Between Ōtaki and Levin there is only one north to south route, SH1. It is all things to all people. It is the corridor shared by road freight, bus public transport, active modes, and private motor vehicles, as presented in Figure 1-4 below.

It is a lifeline for all these modes and movements. The only detour increases journeys by over two hours (more in peak times), via SH2 and the Remutaka Range.

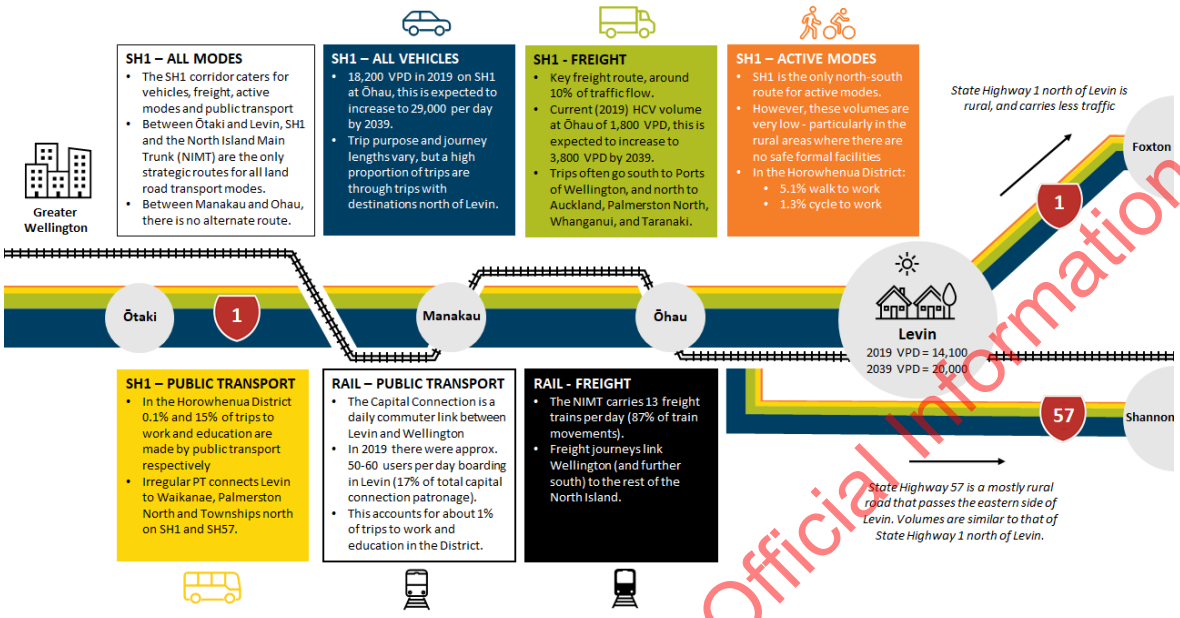


Figure 1-4. Transport System Schematic

Most of the land within the project area is characterised as rural, and the movement options and choices naturally reflect this given the low population density and longer distances between destinations. This means that movements are mostly by private vehicles and that public transport and active modes currently comprise a small proportion of the overall trips to work and education in the Horowhenua District.

Levin acts primarily as a service centre town for the rural community, and its transport system largely reflects this function; however, active mode and public transport use is low, but is more common here than the rest of the project area. There are also journeys between adjacent districts, in particular there are trips between the Horowhenua and Kāpiti Districts where residents and employees travel between locations for work, retail, recreation and healthcare.

Figure 1-5 provides a daily plot of traffic flow at Ohau which shows that on weekdays, the volume of traffic is generally spread throughout the day, peaking in the afternoon. There is no AM peak and no times which are significantly quieter during daylight hours. This is likely to be a result of no strong commuter movement coupled with Levin functioning as a rural service town. Figure 1-5 also highlights the high, and relatively flat, average weekend traffic profile, which is greater than the weekday afternoon peak volume.

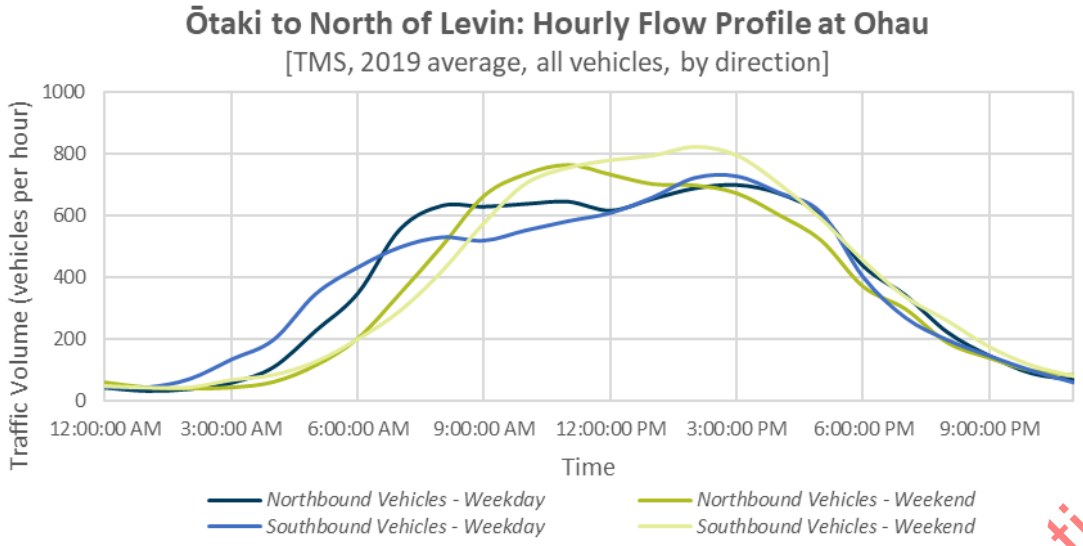


Figure 1-5. Typical Daily Flow Profiles at SH1 Ohau

1.5.2 Public Transport

There are only three bus routes and one return train service in the area, resulting in 17 services every week[30].Bath Street (immediately west of SH1) is the main bus hub area of Levin.

Currently public transport by bus makes up about 0.1% of the mode share total trips to work and 14.7% of trips to education in the Horowhenua District [31]. These bus services connect Levin to Waikanae, Palmerston north and the townships north of SH1 and SH57. There are also commercial inter-regional intercity services.

Currently public transport by train makes up about 1% of the mode share total of trips to work and education in the Horowhenua District [32]. The Capital Connection provides a daily commuter rail connection between Levin and Wellington. In 2019, there were approximately 50-60 users per day boarding in Levin, accounting for 17% of total capital connection patronage. The Levin Railway Station is located at the southern end of Levin and accessed via SH1 Oxford Street.

Greater Wellington Regional Council has been developing the Wellington Rail PBC, an overarching 30-year strategic rail plan for the region and cross-region connections, and the Lower North Island Rail Integrated Mobility (LNIRIM) DBC, which recommended improvements to long distance services, rolling stock, and infrastructure, including between Wellington and Palmerston North. The LNIRIM DBC proposal (which is before Treasury, and there may be an announcement in 2023) is to increase the frequency of Palmerston North to Wellington train services from the current (do-minimum) one return service per weekday (to Wellington in the morning peak and return in the evening peak) to four return peak hour services per weekday (to Wellington in the morning peak and return in the evening peak, one return off-peak service per weekday, and one off-peak return each weekend day).

1.5.3 Active Modes

SH1 in urban Levin is generally wide (about 16m kerb to kerb) with footpaths provided on either side of the road for most of the 3.3km that has a 50km/h posted speed. The volume of traffic and the width of the carriageway means it is difficult to cross the state highway in some parts of Levin. There is an absence of crossing facilities in Ohau or Manakau. Overall, SH1 is often dangerous for pedestrians and cyclists.

The SH1 urban corridor also serves many different needs and different customers, covering through traffic, local traffic, public transport, pedestrians, cyclists, parking for shoppers, and freight. With increases to traffic volumes forecast this road will remain ‘all things for all people’ on an increasing scale.

[30] Note that some of these are focussed on shoppers / accessibility rather than commuters.
[31] Stats NZ: 2018 Census Summary
[32] Main means of travel to work for employed people in Horowhenua District (Stats NZ: Commuter Waka)

HDC have recently delivered improvements in Levin, including intersection improvements at Queen St East and Cambridge Street and corridor improvements along Queen St West, with safety for active modes being key project drivers. A shared walking and cycling path along the rail corridor is also under investigation. Following the completion of Peka Peka to Ōtaki in 2022 there will be a shared use path south of Ōtaki.

The rural sections of SH1 have sealed shoulders of varying widths (no sealed shoulders on the rail overbridges), so it is not suitable, nor safe, for cyclists to use SH1 to connect to Ōtaki and further south.

Therefore, the urban and rural speed environments coupled with high overall traffic and heavy vehicle volumes strongly contribute to the poor uptake of active modes, particularly cycling. The long distances between townships south of Levin also makes cycling a less attractive mode of transport.

1.5.4 Rail (Freight)

As presented in Figure 1-4 above, the North Island Main Trunk (NIMT) rail line runs adjacent to the highway corridor for much of the study area and forms a key part of the overall land transport system, particularly for freight.

Currently 13 freight trains (in addition to the two passenger trains) use the NIMT rail line through the project area daily, transporting approximately 1.6M tonnes of freight in 2021[33].

It is anticipated that this daily volume of trains will grow to 16 by 2029, and 19 by 2039. It is also understood based on discussions with KiwiRail[34] that there are future plans to increase the maximum freight train length on this section of NIMT to 1,500m up from the current 800m.

1.5.5 Road Freight

SH1 is a crucial part of the road freight network in the Lower North Island. The 2019 HCV volume at Ohau was 1,800 vpd, or about 10% of the traffic volume. Key journeys and destinations include ports in Wellington, collection and deliveries in the Horowhenua, and trips north to Palmerston North, Whanganui, Taranaki, Napier Port and Auckland[35].

1.5.6 State Highway Network

As shown in Figure 1-2 above, the Ō2NL project is predominantly located in the Horowhenua district, just over an hour north of Wellington. The figure shows how this project fits within the wider state highway network and the other improvements that have recently been completed or are under construction.

Figure 1-6 below provides a representation of how traffic volumes are expected to increase along the current SH1 corridor if a 'Do minimum' approach is adopted; i.e. forecast growth happens as planned and there is no offline highway construction.

[33] This figure has been approximated using origin and destination based on MoT assumed routings through Manakau.
See: Ministry of Transport – Freight and logistics
[34] Based on discussions with KiwiRail undertaken as part of the Tararua Road Level Crossing Impact Assessment (LCSIA) in 2021.
[35] See: Waka Kotahi – Wellington to Palmerston North Corridor Management Plan

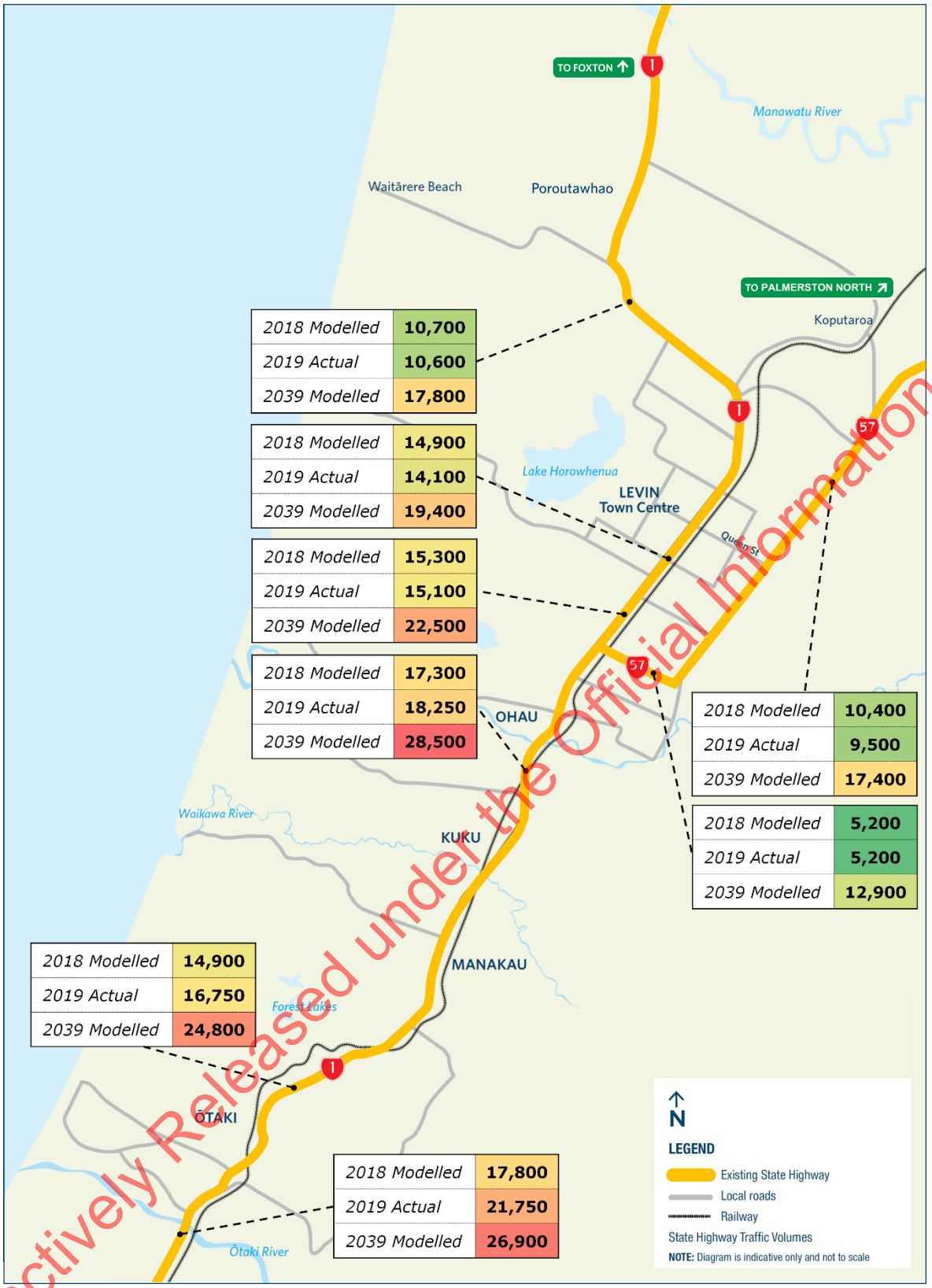


Figure 1-6. Actual and modelled (do minimum) 2-way project area traffic volumes (2019 vs 2018 & 2039)

(higher volumes are represented by hotter colours)

The figure shows:

- Approximately 18,250 vehicles per day (vpd), including over 1,800 heavy vehicles, currently travel along SH1 near Ohau (2019). This is expected to increase to over 28,000 vpd by 2039[36].
- North of the SH1/SH57 intersection, the existing traffic volume on SH1 through Levin is approximately 15,300 vpd (2019), this is forecast to increase to over 22,000 vpd by 2039.
- SH57 traffic volumes north of Queen Street are currently over 9,500 vpd (2019) and estimated to increase to over 17,400 vpd by 2039.
- These traffic volumes consist of a mix of freight and private vehicle trips capturing regional/inter-regional freight movements and local access movement of people.
- SH1 traffic volumes further south reduce from over 21,500 to less than 17,000 between the Ōtaki River and north of Ōtaki Township. However, with growth, volumes north of Ōtaki are forecast to increase to around 25,000 by 2039.

The modelling suggests that these traffic volume increases will result in travel time increases through the study area of between 20-30% or around an additional 5 minutes on a 15-20 minute journey from Ōtaki to Central Levin.

The expected growth in travel demand through the project area will likely result in delays and safety issues accessing the state highways along with reduction in passing opportunities, a reduction in mean speed, and a greater sensitivity to unplanned or unexpected events (e.g. slips, crashes, breakdowns or weather events are likely to cause congestion).

If the growth was to occur without transport investment, local movement around the district would be severely affected, this is discussed further in the Strategic Case (refer Section 2.2.3).

Route Classification and Customer Levels of Service

There are two classification systems in New Zealand, the One Network Road Classification (ONRC)[37], and the more recent One Network Framework (ONF)[38]. The ONF is currently under development, so the analysis presented has covered what is known from the ONF, along with an ONRC customer level of service assessment.

One Network Road Classification Customer experience on SH1 and SH57

An assessment has been undertaken of the performance of the current highways against the customer level of service measures of the ONRC. Where appropriate, this is presented in the problem statements within the Strategic Case, but overall it shows that the highways through the project area fall well below the customer journey expectations in the areas of safety, resilience, accessibility, optimal speeds and amenity.

One Network Framework (ONF)

The existing One Network Framework state highway network classifications for SH1 and SH57 have been defined by using the information provided in the Waka Kotahi RAMM database.

Figure 1-7 below presents the rural and urban movement and place matrix while Figure 1-8 highlights the application of the ONF to the existing SH network.

[36] The estimated future traffic projections are based on the 75th percentile and 95th percentile popula ion growth scenarios forecast for the Horowhenua District as predicted Sense Partners. Historic traffic growth is approximately 3.4% per annum from 2015 to 2019 at SH1 Ohau.
[37] See: Waka Kotahi – One Network Road Classification (ONRC)
[38] See: Waka Kotahi – One Network Road Classification Overview

Figure 1-7. Street categories as per the Waka Kotahi One Network Framework

In summary, most of the existing state highway network in the study area has been classified as Interregional Connectors. Interregional connectors are to provide safe, reliable and efficient movement of people and goods between regions and strategic centres in a rural context. Their focus is to provide for efficient movement of people and goods over significant distances, and therefore these roads will usually have reduced land use access along them, many being designated as limited access roads (LAR).

In reality, the majority of SH1 in the study area operates as a peri-urban road or stopping place due to the land use pressures and conflicting movements on the corridor. This is therefore impacting on the highways' ability to adequately provide the movement function required of this type of road and conversely, the place function within central Levin.

Please refer to Section 3.8 for ONF analysis and discussion relating to the future network with Ō2NL in place.

Figure 1-8. Existing ONF Classification

2. STRATEGIC CASE

2.1 CASE FOR CHANGE

2.1.1 Why do we need to act now?

The importance of SH1 is characterised by its function in connecting Wellington and the South Island to the upper North Island, where no other resilient route exists. It also provides an essential economic connection to Palmerston North, the largest freight node in central New Zealand.

However, the section of SH1 between Ōtaki and Levin has a number of serious problems.

In the last five years to 2021, there were 72 deaths and serious injuries (DSI) along SH1 and SH57 within the project area, making it one of the country's most dangerous sections of road. The highways are classified as High-Risk Rural Roads and have a Star Rating of 2 out of 5 in the project area. Waka Kotahi is investing approximately $60m[39] over the next 3 years to improve safety on these two highways in this area. However, a significant safety risk on the current state highways will remain and will need to be addressed.

The lack of resilience in the existing transport system means that journeys, particularly inter-regional, are regularly disrupted – most often by crashes. There is no alternate route to SH1 between Manakau and Ohau – this section also has ageing structures and is at high risk of closure due to regular flooding. This section of SH1 has a 5L (meaning - extreme consequence, likely) resilience risk hazard. This rating is forecast to deteriorate to the highest level of risk possible of 5VL (extreme consequence, very likely) by 2050 due to climate change impacts. This route is a key economic and social lifeline and closures add over 2 hours to any journey via SH2, which itself includes the high-risk Remutaka Hill.

The estimated economic impact of any closure, currently estimated at over $2.5M per day (compared to $0.034M per day for a closure of the SH3 Manawatū Gorge[40]), will rise as the demand for regional travel (as forecasted) increases.

Growth in the Horowhenua is occurring at the fastest rate for a generation. The district's 2020 population has already well surpassed the Statistics NZ 2040 'high' growth projection developed in 2013 and is already outpacing more recent StatsNZ 2018 projections. Growth is forecast to continue, with an additional 16,000-26,000 people projected to live in the district by 2040[41].

Although HDC are investing in infrastructure and rezoning land to proactively respond to growth, network capacity and intersection safety, particularly on the state highway network, are a major barrier to this. While COVID-19 has had an impact on traffic volume in the short term, in the medium to long term population growth is predicted to be largely unaffected, as the growth forecasts have considered the impacts of the pandemic.

The Levin Town Centre faces several challenges due to earthquake prone buildings, limited retail and hospitality offerings, limited transport choice and is compromised by heavy traffic on SH1 (Oxford Street) which is also the main retail street. HDC consulted on a town centre strategy for Levin (Transforming Taitoko/Levin) at the beginning of 2018 and adopted this Strategy at the end of 2018. Addressing transport problems was identified as the key to achieving this transformation.

In terms of mode choice, there are no frequent public transport services along the corridor and the urban and rural speed environments contribute to the poor uptake of active modes, particularly cycling. The long distances between townships south of Levin also makes cycling a less attractive mode of transport.

The problems identified above are current and to a scale which makes them nationally significant, especially when considering that all these issues are compounded by the growing demand for travel along the corridor.

[39] Includes feasibility estimates for SH1 north and south of Levin and the tendered physical works amount for SH57 improvements.
[40] Ōtaki to north of Levin Measuring the Economics of Resilient Infrastructure Tool' (MERIT) assessment. Estimated economic impact of $18M for a 7-day closure increasing to $72M for a 28-day closure, Refer Appendix K.3. The SH3 Manawatū Gorge closure impacts previously estimated using the MERIT methodology resulted in a cost per day of just $34,000.
See: Waka Kotahi – Economic Impact of SH3 Manawatū Gorge 11/12 Outage
[41] Range based on the 75th and 95th percentile Sense Partners population growth projections (95th percentile adopted by HDC Growth Strategy 2022 for long term planning purposes).

2.1.2 What happens if we do nothing?

Death and serious injuries will continue to increase because of higher traffic volumes, creating more potential conflicts, on a corridor which already has significant safety deficiencies. The social cost of crashes along the highway network has already increased by over 19% to $26M per annum in the five years to 2021 when compared to the preceding five-year period. The standard of the highways will also be further exposed once the Peka Peka to Ōtaki expressway (PP2Ō) opens this year and road users will have driven from as far away as Wellington on a KiwiRAP[42] 4-5 star median divided highway. There is a real possibility of an increase in crashes at and after this time.

High risk structures will continue to age until end-of-life replacements and, coupled with climate change, will result in increased frequency and severity of flooding and other natural hazard events. The social and economic impacts of any closure, currently estimated at over $2.5M per day, will rise as demand for regional travel increases[43].

Levin will become a less 'liveable' town and affect social wellbeing for locals as the number of vehicles passing through Levin will continue to increase, along with the corresponding effects such as noise, safety, emissions, community severance and reduced active mode attractiveness. Traffic south of Levin is projected to increase from 14,100 in 2019 to 22,000 vehicles per day by 2039, this includes a near doubling of the number of heavy vehicles to over 2,000 per day. As a result, the vision within Transforming Taitoko will not be able to be fully realised.

Regional growth is likely to be stifled, and/or growth will occur in a manner that results in the inefficient use of land, causing undesirable land-use integration/ town planning outcomes and worsening of future transport issues. For example, development in Tara-Ika may be limited and modelling indicates delays of over several minutes for side road traffic trying to access SH1 in a several locations south of Levin by 2029 (in many situations no other route or mode exists).

There will still be a lack of mode choice, with limited opportunity to easily improve as road-based modes will continue competing for space on busy existing highways. There would be no north-south walking and cycling spine to develop a cycle network around, and bus services would be hampered by the poor and deteriorating traffic performance on the road network.

The need for investment has been recognised by central government, with the Ō2NL being included as part of the NZUP package for the Wellington Region.

[42] New Zealand Road Assessment Programme
[43] If these structures are bypassed as part of the project, investigations for ongoing management and/or replacement of these structures will be addressed as part of the revocation process, as will appropriate solutions and funding arrangements.

2.2 DEFINING THE PROBLEM

The original problem statements, developed as part of the IBC, are presented within Table 2-1.

Table 2-1. Problem Statements

Problem statements	Weight
Problem 1 – Safety A high and increasing demand for travel coupled with inadequate transport infrastructure is resulting in increasing numbers of deaths and serious injuries on the roading network	50%
Problem 2 – Resilience The lack of resilience in the existing transport system means that connections, particularly inter-regional, are regularly impaired or lost	30%
Problem 3 – Horowhenua Development Growth may not be realised as efficiently as possible as safety and traffic concerns are stymying the efficient development of planned growth areas	10%
Problem 4 – Levin Town Centre Amenity High volumes of traffic, including trucks, through the centre of Levin is reducing the attractiveness of the main retail area and limiting investment and development	10%

The problem statements and weightings were developed through the IBC, challenged through the re-evaluation of the project in 2018 and agreed by the Waka Kotahi Board when the IBC was approved.

There have been several changes since the IBC stage that have influenced the evidence base – notably around growth, the impacts of COVID-19 and a stronger government directive to incorporating climate change considerations. A review of the latest evidence established that the problems established during the IBC remain relevant (with all the problems worsening), the weightings remain unchanged and the case for change remains strong.

The following sections present a summary of the evidence base behind the problem statements, but this is expanded upon in the appendices:

- **Appendix A.1** – Detailed updated evidence base, presenting the cause, effect, and consequence for each of the problems summarised below.
- **Appendix A.2** – Key stakeholders involved in the development of the project
- **Appendix A.3** – Strategic context assessments
- **Appendix A.4** – Outcome measures
- **Appendix B** – Investment Logic Map (ILM).

2.2.1 Safety

Since the IBC crashes have continued to increase, and coupled with traffic volume increases, are not anticipated to abate. Deaths and serious injuries in particular have increased by nearly 50% between the IBC and DBC crash analysis periods[44].

In the last five years to 2021, there were 72 deaths and serious injuries (DSI) along SH1 and SH57 within the project area, making it one of the country's most dangerous sections of road [45]

COVID-19 has also had very little impact on crashes, as despite temporary travel demand reductions, 2021 alone recorded 16 DSI, as highlighted in Figure 2-1 below.

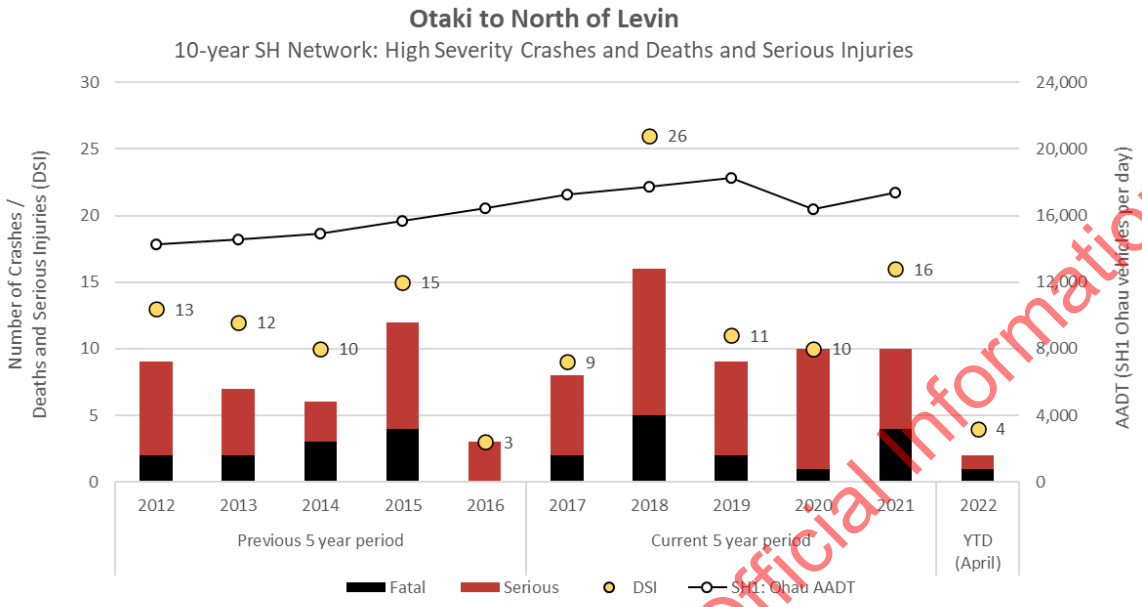


Figure 2-1. 10-year High Severity Crash History

SH1 and SH57 in the study area have a range of specific deficiencies and forecast growth in travel demands will further increase the exposure risk:

- **Poor geometry and road alignment** – SH1 has nine out of context horizontal curves and 14 deficient vertical curves.
- **Narrow Shoulders**: Over 50% of the SH1 and 20% of SH57 corridors have shoulders less than 1.2m.
- **Roadside Hazards:** Approximately 82% of the length of SH1, and 89% of length SH57, is rated as consisting of either a moderate or a severe roadside hazard.
- **Intersections and Accessways:** There are almost 40 intersections and over 400 accessways on the rural sections of SH1 and SH57, which is over five times higher than the recommended spacing[46] would allow. Some of these are highly used such as those for marae and urupā.
- **Active Modes:** There are no facilities provided outside urban areas, with cyclists in particular having to share the narrow shoulders with high volumes of high-speed state highway traffic. The NZ Cycle Trail states (as a guide to cyclists): *"Public transport recommended. There is no enjoyable cycling route between Waikanae and Palmerston North as the highway is very busy."*[47]

[44] IBC and DBC crash analysis periods of 2013-2017 and 2017-2021 respectively
[45] From a historic perspective the section of SH1 from Paraparaumu to Levin was 1 of 5 corridors identified nationally as having a persistently high collective risk over three consecutive 5 year data periods, 2002 – 2016. This means for the five year crash record periods of 2002-2006, 2007-2011, and 2012-2016 this corridor maintained a high collective risk. Source: KiwiRAP 2018 compressed.pdf. Note, SH1 from Paraparaumu to Ōtaki has been (or is being) addressed through the delivery of a new state highway.
[46] See: Waka Kotahi – Accessway Standards and Guidelines
[47] See: Ngā Haerenga – New Zealand Cycle Trails

- The above causation factors increase both the probability and severity outcome of a crash. Substandard geometry coupled with high traffic volumes, increase the risk of head-on and loss-of-control crashes by restricting driver's forward sight distance, reducing the time to react to the constantly changing and challenging road environment.
- The inconsistent and narrow seal width contributes to the overall risk associated with deficient geometry, and the prevalent and severe roadside hazards mean that if a vehicle does leave the road the chances of serious injury are very high. These risks and outcome severities are further exacerbated by the undivided nature of the carriageway along both SH1 and SH57.

The SH1 (National High Volume) and SH57 (National) corridors both currently have a published KiwiRAP 2 Star Rating. The SH1 corridor represents one of the longest continuous lengths[48] of 2-3 Star rated state highway on a National High-Volume road[49] in New Zealand.

It is likely that the poor safety record will worsen over time, as the trend of increasing traffic volumes and significant local development will result in a greater exposure risk for vehicles to conflict with either opposing vehicles or other hazards[50].

The standard of the highways will also be further exposed once the Peka Peka to Ōtaki expressway (PP2Ō) opens (programmed for 2022) and road users will have driven from as far away as Wellington on a KiwiRAP 4-5 star median divided highway. There is a real possibility of an increase in crashes at and after this time.

The assessment of against the ONRC customer levels of service in Table 2-2 shows that the current highways are well below what is expected of National highways.

Table 2-2. Safety Assessment of current against the ONRC

Performance Measure	SH1 South of Levin (National – High Volume)		SH1 North of Levin and SH57 (National)	
	Target	Current	Target	Current
Safety	Mostly forgiving roads and roadsides, equivalent to KiwiRAP 4-Star standard.	2 and 3 Star highway with some 1 star sections.	A high KiwiRAP 3 or 4-star standard, or equivalent, with consistent and predictable alignment.	2 and 3 Star highway with some 1 star sections.
	User hazards absent or mitigated including head on risk.	82% of hazards are moderate or severe. No median barrier.	User hazards mostly mitigated.	82% of hazards are moderate or severe.
	Active road users generally do not have access - if present, they are provided with separate space or are physically separated.	No specific facilities for wa king or cycling and some sections have no shoulder. Urupā separated from marae by SH1.	Active road users (if present) are mostly provided with separate space or are physically separated.	No specific facilities for walking or cycling and some sections have no shoulder.

[48] As viewed in 5000m scale on SafetyNET (KiwiRAP tool). Note that at a 100m scale, there are sections of 1 star at intersections (refer Appendix A.1).
[49] See: Waka Kotahi – Customer Levels of Service for information on road category ONRC targets.
[50] It is acknowledged that safety improvements are now happening prior to Ō2NL implementation to reduce DSIs in the short term, refer to section 3.2.5 for the impact on the Economic Case

2.2.2 Resilience

The core resilience issues of route criticality coupled with high incident likelihood are unchanged since the IBC. As demand for travel continues to grow, coupled with climate change and the continued ageing of structures, the journeys impacted by incidents will increase in the future.

This section of SH1 in particular is at high risk of closure from:

- **Crashes** – as outlined in Section 2.2.1 above. Crashes, as shown in Table 2-3 below, constitute the majority of recent closures.
- **Earthquakes** – five bridges have a high or significant earthquake disruption risk
- **Flooding** – the existing highway passes through 200-year flood re-occurrence risk areas[51] and is also subject to surface flooding.
    - Two recent large-scale events fully closed the highway– one for 90 minutes[52] and the other for over 24 hours[53]. Flood frequency and severity is expected to increase as a result of climate change.
    - The Waka Kotahi National Resilience PBC (2020)[54] highlights that the overall flooding risk for the section of SH1 between Manakau and Ohau increases from a current rating of 5L (extreme consequence, likely) to the highest risk possible risk of 5VL (extreme consequence, very likely) by 2050 as a result of climate change.

The importance of this route cannot be overstated. SH1 is critical in the overall accessibility of Wellington as the only other alternative route is on SH2 via Remutaka Hill which is at high risk of closure in a significant event. For SH1, two of the highway bridges with the highest risks are over the railway line, so if they fail, it affects all modes. These issues in the context of the lower north island transportation network are outlined in Figure 2-2.

When an event occurs between Manakau and Ohau that closes the highway, the trip from Wellington to Levin increases by over 2 hours. These times will be much longer during peak hours, or during busier weekends and holidays[55]. The alternate route includes road gradients and alignments undesirable for efficient HPMV movements (movements which are anticipated to increase). The impact on local communities, including those Māori communities with marae close to the highway, is particularly significant.

The social and economic impacts of any closure on SH1 between Manakau and Ohau, currently estimated at over $2.5M[56] per day (compared to $0.034M per day for a closure of the SH3 Manawatū Gorge[57]), will rise as demand for regional travel increases.

[51] Source: Horizons Regional Council Flood Risk Mapping
[52] On 12 June 2016, SH1 near Manakau was closed for over 90 minutes with no diversions available. This same event was recorded in the Waka Kotahi Traffic Road Event Information System (TREIS) as causing delays for 7 hours. See: Wellington.Scoop » SH1 closed for 90 minutes by flooding between Ōtaki and Levin
[53] On 20 June 2015, SH1 was closed for over 24 hours due to floodwaters washing away parts of the banks of the Waikawa Stream Bridge. See: SH1 closed north of Wellington due to flooding | Waka Kotahi NZ Transport Agency (nzta.govt.nz)
[54] National Resilience Programme Business Case. Risk matrix ranges from 1UL (minor impact, unlikely) to 5VL (Extreme impact, very likely). Manakau to Ohau Risk ID W6.

[55] Once the Peka Peka to Ōtaki expressway (PP2Ō) is open, weekend and holiday traffic may result in future congestion and reliability issues as a result of the 2 lane to 1 lane merge north of Ōtaki. This is turn may increase the likelihood of small events such as breakdowns and crashes having larger network impacts on journeys.

[56] Ōtaki to north of Levin Measuring the Economics of Resilient Infrastructure Tool' (MERIT) assessment. Estimated economic impact of $18M for a 7-day closure increasing to $72M for a 28-day closure. Refer Appendix K.3.
[57] The SH3 Manawatū Gorge closure impacts previously estimated using the MERIT methodology resulted in a cost per day of just $34,000. See: Waka Kotahi – Economic Impact of SH3 Manawatū Gorge 11/12 Outage

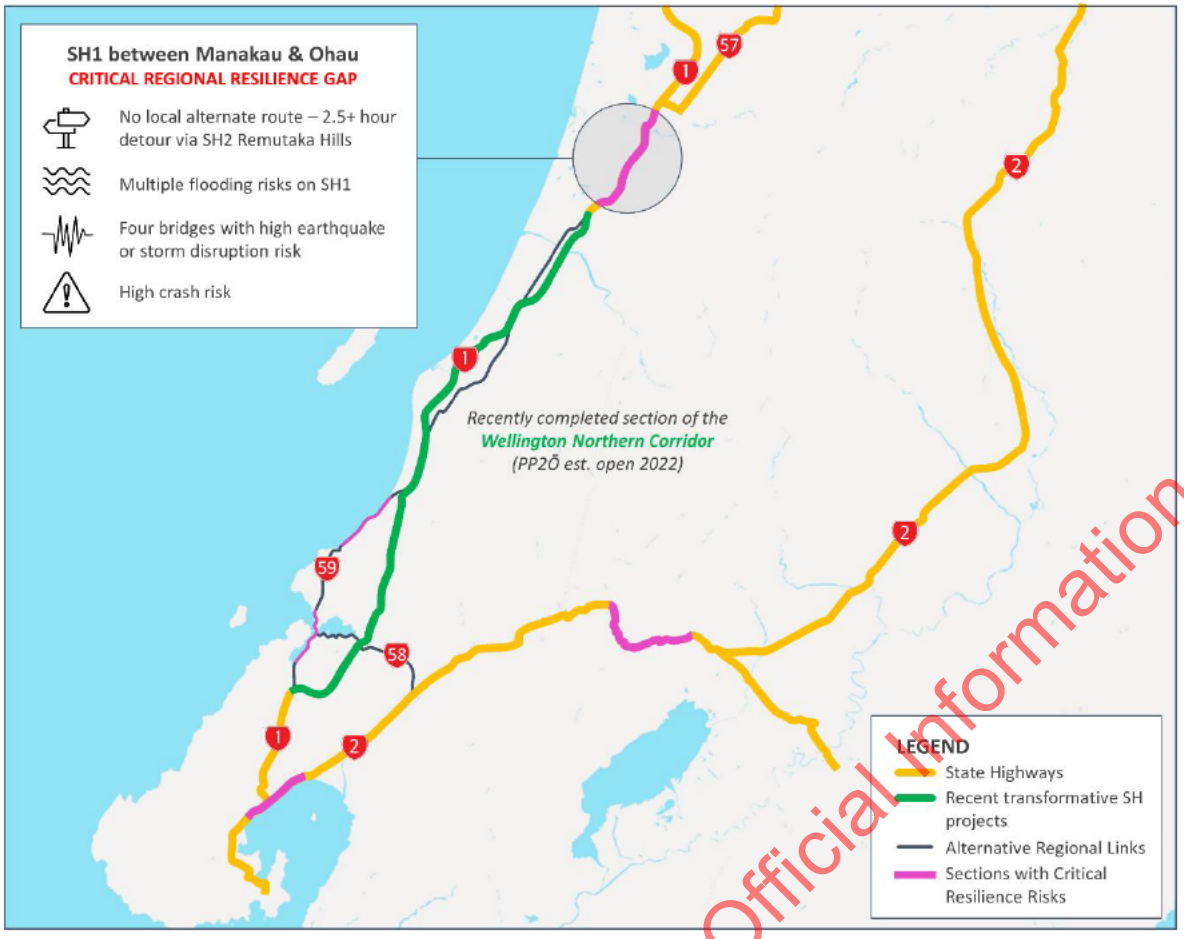


Figure 2-2. Wider Wellington Strategic Network resilience risk

The assessment against the ONRC customer levels of service in Table 2-3 shows that the current highways are well below what is expected of National highways.

Table 2-3. Resilience Assessment of current against the ONRC

Performance Measure	SH1 South of Levin (National – High Volume)		SH1 North of Levin and SH57 (National)	
	Target	Current	Target	Current
Resilience	Route or viable alternative is always available.	Local alternative routes do not exist between Ohau and Manakau. South of Manakau a local detour exists via Waitohu Valley, but it is unsuitable for two-way HCV movements. Between 2017/18 and 2021/2022[58] there were at least 28 unplanned closures, primarily relating to crashes. There were also 135 natural events that caused cautions, including fires, surface water, flooding, fallen trees, rockfalls, ice, and drop out. This will worsen as flood frequency increases as a result of climate change.	Route is always available during major weather or emergency events and viable alternatives exist.	Alternative routes do exist. Between 2017/18 and 2021/2022 there were at least 5 unplanned closures, all on SH57, all due to crashes. In addition to full closures there were 42 natural events that caused cautions including flooding, fallen trees, strong winds, and fires.

[58] Note the 2022 data is up till early March

2.2.3 Regional Growth

Horowhenua is growing faster than experienced over the last few generations, and growth is also occurring (and expected to continue) in the Kāpiti District. Population growth in Horowhenua significantly outpaced the 2013 high growth projections, and is already tracking at or above the 2018 projections, as highlighted in Section 1.2.1 above.

There is now greater certainty around future growth areas. This includes Tara-Ika which has now been rezoned and will result in an additional 3,500+ houses around the path of the proposed offline highway. HDC are also actively investing in other developments.

However, a number of growth areas may be unable to be efficiently developed due to current and predicted access and safety issues associated with increased traffic volumes. Whilst previously growth was estimated to result in approximately 22,000 vehicles per day on SH1 south of Ohau by 2039, the current estimates have this occurring at least 10 years earlier.

Potential scenarios that may emerge are:

- Growth will be stifled; either not occurring, or reduced due to conditions placed on development or limited uptake.
- The growth will occur, but not in the manner, or the location planned, resulting in less land-use integration and other future transport issues.

Not investing will also impact on the realisation of a number of current strategies including the Horowhenua Growth Strategy 2040[59], Accelerate 25 and the Wellington Regional Growth Framework and inhibit the growth potential of the Horowhenua. If growth areas are not supported, HDC will not be able to provide sufficient land to meet demand for housing and business land. This will be at odds with government directions (e.g., NPS-UD) and will lead to higher land prices and worsening housing affordability. This would be a poor community outcome.

In addition to growth in Horowhenua, the Kāpiti Coast is also expected to grow, with over 22,000 additional people forecast to be living in the district by 2041[60]. This is an increase of approximately 40% compared to 2021.

If the growth was to occur without transport investment, local movement around the district would be severely affected. Figure 2-3 below shows the number of side roads that would have delays of over 1 minute per vehicle just to turn out of the side road. The majority of these locations have no local alternative route and / or no ability to use other modes.

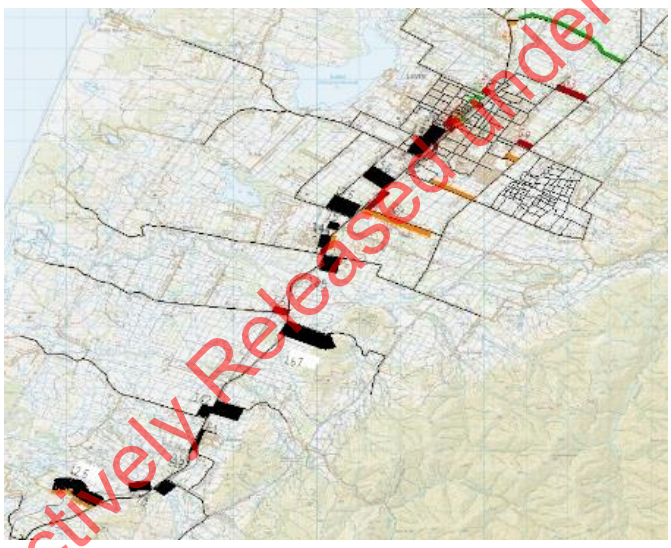


Figure 2-3. Vehicle delay on side roads during the 2039 PM peak (thick black lines indicating delays of over a minute)

The increased delays can lead to traffic from side roads forcing a gap on the highway and leading to safety risks and delays for through traffic. In addition, as intersections become busy, there will be

[59] Note: HDC revised its Growth Strategy in 2022, largely because the District's population was growing twice as fast as was expected in 2018 when the Strategy was originally prepared. Projections indicate this higher growth rate will continue, meaning that Council needed to identify additional growth areas.
[60] See: Kāpiti Coast District Council – Population & Demographics

fewer opportunities for pedestrians and cyclists to cross the corridor and the complexity of decision-making for all users increases, leading to greater safety risk.

2.2.4 Levin Town Centre

The conflict between the use of SH1 Oxford Street as an inter-regional corridor carrying large amounts of freight and a town centre main street is evident from the One Network Framework classifications presented earlier (Figure 1-8).

SH1 (Oxford Street) runs straight through the middle of Levin, bisecting the town. As shown in Figure 2-4, this results in the town centre attractiveness being much lower than it otherwise could be, particularly for active modes. This is due to a range of factors such as:

- noise;
- emissions;
- safety;
- smell (stock trucks); and
- severance.

Figure 2-4. SH1 Oxford Street Levin Traffic[61]

These concerns were confirmed by the community during the consultation phases and reported in the Engagement Summary Report. Safety in particular is a problem and crashes in Levin Town Centre have been increasing in recent years, with 17 urban injury crashes on SH1 involving pedestrians or cyclists in the five-year period to 2021.

Local issues have worsened due to faster than expected growth in the Horowhenua District since the Indicative Business Case was delivered. This growth has, in part, resulted in an increase of traffic in the town centre. The opening of the new Whirokino Trestle Bridge in 2020 has also seen a large increase in the numbers of high productivity motor vehicles (HPMVs) travelling through Levin.

If growth occurs as forecast, the number of vehicles passing through Levin will increase from 14,000 to 22,000 vehicles per day by 2039 with heavy vehicles almost doubling to over 2,000 per day. Previous investigations have shown that providing an alternate through route could reduce traffic volumes in central Levin by 30% and over 50% for heavy vehicles.

Consequently, Levin would be unlikely to be able to transform as envisaged[62]. Without intervention, the number of vehicles passing through Levin will continue to increase, along with the corresponding effects such as noise, safety, emissions, smell, community severance and reduced active mode attractiveness.

Overall, the presence of a nationally strategic state highway in Levin is reducing the attractiveness of the main retail area and materially affecting Levin's ability to transform.

[61] Source: stuff.co.nz / David Unwin
[62] Key relevant objectives include; becoming a destination that does not rely on SH traffic for success, consolidating the town centre, improve the commercial offerings, supporting and encouraging a range of transport options that serve the community and ensuring that the town centre is safe and inclusive. transforming-taitoko-strategy.pdf (horowhenua.govt.nz)

2.3 OBJECTIVES, BENEFITS AND OUTCOMES

2.3.1 Project Objectives

The project objectives for Ō2NL are to:

- Enhance safety of travel on the state highway network;
- Enhance the resilience of the state highway network;
- Provide appropriate connections that integrate the state highway and local road network to serve urban areas;
- Enable mode choice for journeys between local communities by providing a walking and cycling facility; and
- Support inter and intra-regional growth and productivity through improved movement of people and freight on the state highway network.

Project objectives were initially developed as part of the IBC phase; however, they have since been refined to reflect the NZ Upgrade Programme. The key change to the objectives is the addition of a specific objective aimed at providing appropriate facilities to enable active mode connections.

2.3.2 Benefits and Investment Objectives

The benefits and investment objectives are developed from the problems discussed in Section 2.2 above and the project objectives outlined above.

Figure 2-5 below presents the relationships between the problems, benefits, and investment objectives.

These objectives were not quantified at the start of the process to ensure that a wide range of options were considered. These have now been quantified through this business case and will be used as a benchmark for future project phases to ensure benefits are not eroded. Refer Section 3.6 of the Economic Case for quantification of outcomes.

The benefits and investment objectives are discussed in further detail in the sections below. Refer Appendix A.1 for an outline of the problem development process, along with an assessment against the 2021 GPS.

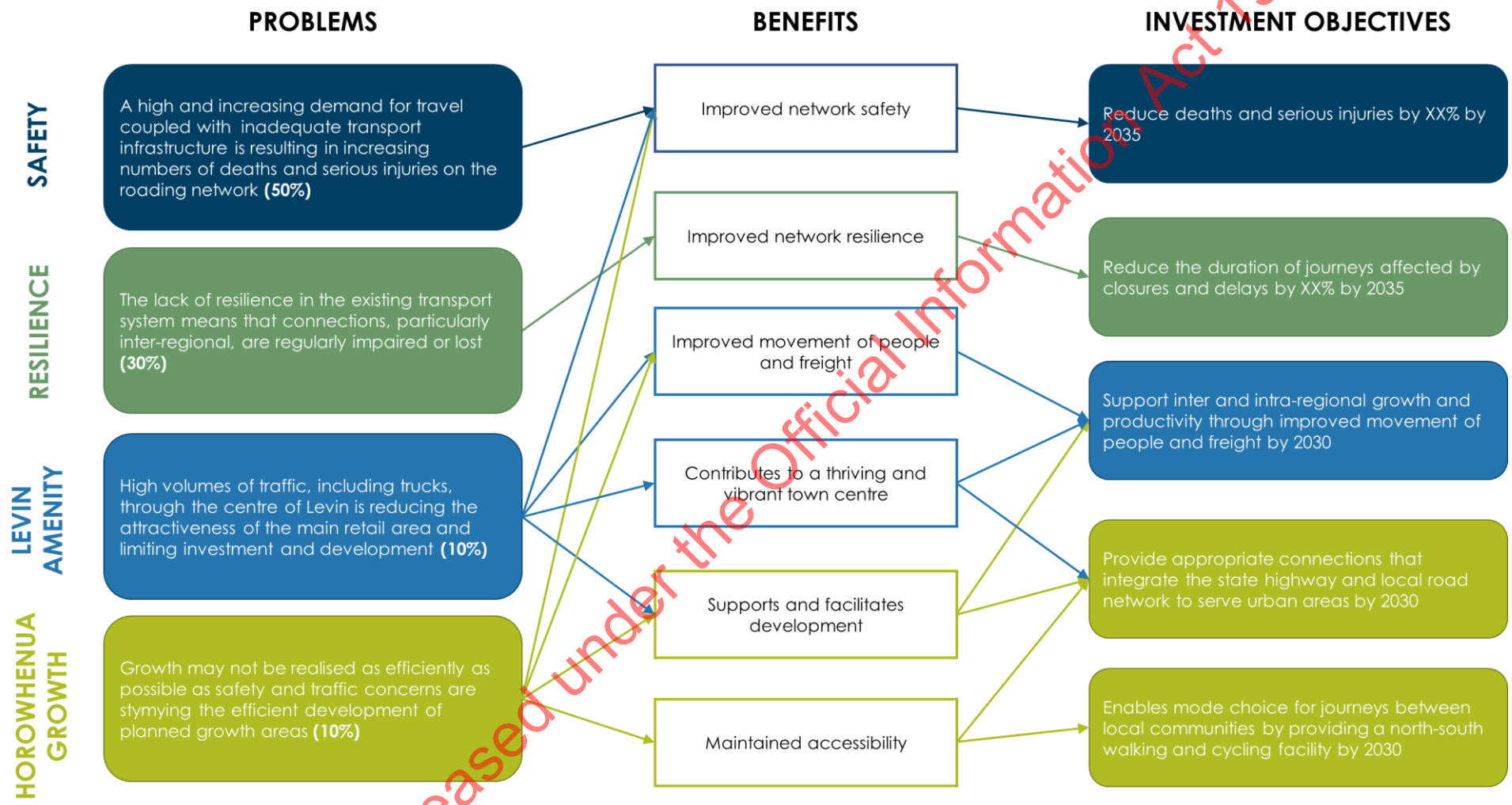


Figure 2-5. Problems, Benefits and Investment Objectives

2.3.3 Benefit Measures and Outcomes

The investment objectives are presented below broken down into the elements of SMART[63] objectives.

As outlined above, measures were initially developed in the IBC and these have informed optioneering processes to date. The investment objectives along with the specific measures have since been refined and were primarily used in the DBC for assessing the preferred option. They are reflected in the Appraisal Summary Table (Appendix I.1), and in the Benefit Realisation section (Section 6.6)

Table 2-4 presents how each of the identified benefits and outcome measures relate to the investment objectives. Appendix A.4 provides additional detail, including the baselines and targets for each key performance indicator (KPI).

Table 2-4. Investment Objectives, Benefits and Outcome Measures[64]

Investment Objectives	Transport Outcomes Framework	Benefit	Measure	Key Performance Indicators (KPI)
Reduce deaths and serious injuries from by XX% by 2035	Healthy and safe people	1.1 Impact on social cost and incidents of crashes 1.2 Impact on safe system	1.1.3 Deaths and serious injuries 1.2.2 Road assessment rating - state highways	1. Deaths and Serious Injuries (5y) 2. KiwiRAP Star Rating
Reduce the duration of journeys affected by closures and delays by XX% by 2035	Resilience and security	4.1 Impact on system vulnerabilities and redundancies	4.1.1 Availability of a viable alternative route to low-probability high-impact events 4.1.2 Level of service and risk	1. Availability of a viable alternate route to low-probability high impact events 2. Number of high resilience risk structures with no alternate route 3. Number of unplanned closures on the SH network (5y) 4. Length and duration of detoured journeys from Wellington to Levin
Provide appropriate connections that integrate the state highway and local road network to serve urban areas by 2030.	Inclusive access Economic prosperity	10.1 Impact on user experience of the transport system 10.3 Impact on access to opportunities 11.3 Impact on townscape		1. New transport network fits into agreed future road hierarchy 2A. Trip length/time for local trips 2B. Number of side roads at capacity 3. Development in identified growth areas are supported.

[63] Specific, Measurable, Achievable, Relevant and Time bound

[64] The numbers preceding the benefits and measurements align with the Waka Kotahi benefit framework. See: Waka Kotahi – Transport Benefits Framework Overview

Investment Objectives	Transport Outcomes Framework	Benefit	Measure	Key Performance Indicators (KPI)
Enable mode choice for journeys between local communities by providing a north-south cycling and walking facility by 2030	Inclusive access Economic prosperity	10.3 Impact on access to opportunities 10.2 Impact on mode choice	10.3.1 Access to key social destinations (all modes)	1. Preserve existing active mode links 2. Removing barriers/enabling new links between urban areas and from urban areas to existing walking and cycling tracks 3. Increase mode share for walking/cycling trips to work and education in the Horowhenua District
Support inter and intra-regional growth and productivity through improved movement of people and freight by 2030	Economic prosperity	5.2 Impact on network productivity and utilisation 5.1 Impact on system reliability 10.3 Impact on access to opportunities 10.2 Impact on mode choice	5.2.6 Access to key economic destinations (all modes) 5.1.2 Travel time reliability - motor vehicles 10.3.1 Access to key social destinations (all modes) 10.2.2 Accessibility - public transport facilities	1. PM peak travel times along three key routes 2. Number and percentage of heavy vehicles through Levin 3. Journey time reliability for the above three routes 4. Ensuring efficient links retained or improved to Bus Station and Train Station 5. Providing more route options for public transport services to be implemented

2.4 KEY CONSTRAINTS, DEPENDENCIES AND ASSUMPTIONS

The project is subject to many constraints, dependencies and assumptions. This section presents some key elements.

Management strategies and registers will be developed to record these and they will be carefully monitored during the project development and implementation (Refer Section 6.6).

An uncertainty log has been developed that notes the various demand, supply, and cost factors that could affect the option, and is contained in Appendix C. s 9(2)(f)(iv) [redacted] Uncertainties relating specifically to the cost of construction have been identified separately as part of the Financial Case in Section 4.2.4 below.

This information has helped inform the development of the preferred option and the risk register.

2.4.1 Constraints

Various constraints were mapped during the IBC phase (see Appendix D). Constraints were considered along with the other criteria and objectives to choose the preferred alignment and optimise the outcome. There are some remaining constraints within the 300m corridor that have been mapped in more detail and managed during the DBC option development by individual specialists through the MCA processes; these include:

- Social effects and effects on dwellings
- Native forest remnants including Prouse, Arapaepae and Staples Bush
- Heritage buildings including Prouse Homestead and Annandale
- Tara-Ika development and the future expansion of Levin
- Waterways
- Tangata Whenua Areas of Significance - Ngāti Raukawa and Muaūpoko have noted some concerns within the corridor primarily around waterways, land holdings and other cultural aspects. However, compared with options west of SH1, that these are more readily able to be resolved through design and mitigation[65].

2.4.2 Inter-dependencies

This section outlines the key inter-dependencies identified that would be needed to achieve the wider regional transport and land use objectives. How to manage these following the DBC, falls into two categories depending on whether Ō2NL goes ahead.

If Ō2NL does not proceed, then the parties/agencies responsible for the delivery of each inter-dependency will need to decide how to proceed.

If Ō2NL does go ahead then it is anticipated the inter-dependencies will be managed by the parties/agencies responsible for their delivery, in discussion with Waka Kotahi as required as Ō2NL develops and is ultimately delivered. These inter-dependencies are discussed further in the Management Case.

[65] Ngāti Raukawa and Muaūpoko have advised that they will oppose any route that is located west of SH1 and Levin. The west includes many large areas of cultural significance, including urupa, marae, Lake Horowhenua, Lake Papaitonga and land holdings.

Table 2-5. Key dependencies

Inter-dependencies	Notes and management strategies
Tara-Ika	The preferred corridor runs through the Tara-Ika growth area (recently rezoned to enable development of over 3,500 houses and supporting commercial and community facilities). Waka Kotahi and HDC have been working collaboratively to prepare a Principal Development Agreement (PDA) which will facilitate an integrated approach to the development and construction of critical projects which interface with Ō2NL, like Tara-Ika. The intention of this agreement is to outline a range of principle level agreements (programme, funding), such as East-West arterial, revocation, constructing shared stormwater infrastructure and upgrading intersections in a manner that will support both the functionality of Ō2NL and the District's growth
National and Rail Programmes	**National Resilience Programme Business Case (NRPBC)** Two sites are identified in the NRPBC within the project area. Treating these sites are not dependent on Ō2NL, however it is noted in the NRPBC that Kuku Stream flooding will be less of an issue following the construction of Ō2NL. Therefore, if Ō2NL is not progressed the treatment option(s) may change. **National Rail Plan, Regional Rail Plan and Lower North Island Rail Integrated Mobility (LNIRIM) project** Rail upgrades can be delivered independently of Ō2NL, however if Ō2NL is not progressed then elements of the Rail Plans may need to be revisited.
Levin Town Centre – Transforming Taitoko	The ability to successfully deliver the Transforming Taitoko - Levin Town Centre strategy will be diminished without Ō2NL and the proposed revocation programme of works. Ō2NL will redistribute a significant portion of traffic, particularly heavy vehicles, out of the town centre and doing so will help, in part, address the issue of poor amenity and East-West connection (as identified in the strategy).
HDC and KCDC growth areas	HDC have identified future growth areas in and around Levin, Manakau, Ohau, Waitārere Beach and Waikawa Beach as well as other areas around the district. KCDC have identified several intensification and greenfield growth areas around Ōtaki, with a particular focus on intensification around the Ōtaki Station. The timing of Ō2NL works may have an impact on the scope and timing of these developments.
Kāpiti Expressway	Peka Peka to Ōtaki expressway is expected to open in 2022. If Ō2NL does not proceed, then safety considerations at this northern tie-in will need to be addressed (on a long-term as opposed to short-term basis).
ACNZ, PNITI, Regional Freight Hub and Te Ahu a Turanga	Whilst not directly dependent, Ō2NL and these other projects are part of a combined strategy for improving access and freight movement in the Manawatū region.

2.4.3 Assumptions

This section outlines the key assumptions that have underpinned the DBC. Latter sections of this DBC further break down some of the assumptions and where they have been used (e.g. the option analysis).

Section 3.7 outlines the economic analysis of the preferred option, including specific assumptions on matters such as growth, crashes, resilience, and active modes.

Section 4.2 of the financial case also outlines the assumptions around project cost estimation.

Table 2-6. Key assumptions

Assumptions		Notes and management strategies
A1	Growth (estimate)	It is assumed that over the assessed project period population growth will proceed in line with the scenarios in the Horowhenua Socio-Economic Projections Update Report. For the purposes of the assessment, the project team have modelled the 25%ile, 75%ile and 95%ile projections, with the 75%ile adopted as the core scenario (Noting that HDC have adopted the 95th percentile for long term planning purposes). In part a consequence of the population growth assumption, it is also assumed that there will be no significant drop in travel demand, given the rural nature of the study area. Traffic model forecasts assume business as usual travel continues, rather than the changes signalled in the Waka Kotahi Sustainability Action Plan approach, which identifies the need to reduce light vehicle VKT. The reduction in VKT initially focusses on the major cities and light vehicles will continue to be the mode of choice in rural areas for some time. This assumption has no impact on project need, but does affect timing of benefits. Both the lower and higher growth scenarios have been considered to understand this as part of the Economic Case sensitivity testing.
A2	Horowhenua growth strategy (2022)	It is assumed that the growth will happen in the areas identified in the strategy, but the strategy does not indicate likely timing. As few of the growth areas are currently zoned for the identified level of growth in the district plan, the project team have assumed that growth in each of these areas is equally likely, with the exception of Tara-Ika (which has recently been rezoned), and will therefore progress concurrently. This assumption has no impact on project need or scope, but does affect timing of benefits and other complementary activities.
A3	Wider network elements	It is assumed that in order to deliver a comprehensive multi-modal response to the identified problems that other parallel elements such as public transport and passenger rail improvements (e.g. from the Regional Rail Plan and LNIRIM) and shifting freight to rail (e.g. National Rail Plan) will be supported and developed as necessary and appropriate. The detail of some of these wider programme elements are not yet known and are yet to be developed. It is assumed that Ō2NL, and possible public transport projects, can be developed in a manner that is complementary, and in the case of on-road public transport beneficial. However, as none of these projects have funding approved, the traffic forecasts and economics have been progressed without these elements, based on the Monetised Benefits and Costs Manual (MBCM) requirements. Traffic forecasts assume business as usual travel continues.

Assumptions		Notes and management strategies
		Refer to Section 7 for an outline of the risks and next steps following the DBC.
A4	Active mode connections	It is assumed that in order to deliver a comprehensive multi-modal response, HDC and KCDC will develop walking and cycling network connections (additional to those provided through the project) to supplement the shared use path being delivered as part of this project. The active mode connection response is not yet known so connections that link to the shared use path have not been included in the economic analysis, with access provided by current roads and footpaths only. This assumption does not affect project need or significantly affect benefits.
A5	Revocation strategy	The existing portions of SH1 and SH57 that will be bypassed will be considered for revocation, with investigations underway with local councils in the form of a Revocation Programme Business Case (PBC). Refer to the Economic Analysis section for how the costs and benefits of the Revocation PBC have been allowed for in the DBC.
A6	Bridge replacements (estimates)	That the following bridges will require replacement once they reach their 100-year design life within the next 40 years: Manakau North Rail Overbridge (2030s) Waikawa Stream Bridge (2040s) Kuku Stream Bridge (2040s) Ohau River and Rail Bridge (2050s) These assumptions, based on bridge condition assessments, have been reflected in the economic analysis, refer to Section 3.7 Note that these replacement assumptions will be different if the bridges are to be bypassed[66].
s 9(2)(f)(iv)		[redacted]

[66] Horowhenua District Council has noted their concerns about the cost implications of taking ownership of these bridge structures in their current condition. The revocation and associated processes, to be led by the Integration Working Group, will investigate this, including appropriate solutions and funding arrangements.

3. ECONOMIC CASE

Many strategic alternatives, options and sub-option refinements have been considered over the last 10 or more years to address the problems on this corridor.

The relative economic performance of strategic alternatives and corridor options were examined fully during the IBC (in 2018), which informed the decision by the Waka Kotahi Board and Cabinet[67] to proceed with a preferred corridor option to the east of the existing state highways.

More detailed assessments for the option refinements and design elements were undertaken during the DBC, including a revision of the Do Minimum option, and full economic analysis for the preferred option.

Summary of the Economic Performance of the Preferred Option

A summary of the assessment of alternatives presented in this Economic Case is presented below. The assessment has shown that a new offline highway from north of Ōtaki to north of Levin is the only alternative which addresses all problems and objectives.

Table 3-1. Strategic Alternative Summary

Considerations	Strategic Alternative						
	Do Nothing	Minor Safety Improve-ments	Localised Highway Upgrades	Larger Highway Upgrades	Online Express-way to South of Levin	Ōtaki to South of Levin New Offline Highway	Ōtaki to North of Levin New Offline Highway
Problem 1: Safety	NO	NO[68]	Partially	Partially	Partially	YES	YES
Problem 2: Resilience	NO	NO	Partially	Partially	Partially	YES	YES
Problem 3: Regional Growth	NO	NO	Partially	Partially	Partially	Partially	YES
Problem 4: Levin Town Centre	NO	NO	NO	NO	NO	NO	YES
Reduces Community Blight	NO	NO	NO	NO	YES	Partially	YES
Iwi Support	NO	NO	NO	NO	NO	YES	YES
(Part of) Enduring solution	NO	YES	Possibly[69]	Possibly[70]		YES	YES

The new offline highway was progressed through further design refinement with partners to identify the route, interchange locations and local road connections and was subject to stakeholder and community engagement (refer to Appendix F.1 to F.4 for further in information on engagement). This option has now been developed to a DBC level of detail. The economic performance of this option is presented in the table below.

[67] See: Waka Kotahi – NZUP Cabinet meeting notes

[68] Whilst DSIs would be reduced, increased traffic would result in future DSIs being similar to current numbers

[69] Enables new four lane offline highway at any location in the future. Online upgrades may be greater that what is required for revocation.

[70] Could upgrade to four lanes but it has significant impacts and may not meet long term outcomes. Could still build new offline route, but this online option would be much greater than revocation needs.

Table 3-2. Preferred Option – BCR

Type	MoT Framework	Benefit / Cost	NPV ($M)
Benefits	Healthy and Safe People	Cycling Health Benefits	$9.7
		Crash Cost Benefits	$139.8
		Health Emission Reduction Benefits	$16.1
	Resilience and Security	Resilience Benefits	$105.4
	Economic Prosperity	Travel Time (TT) Benefits	$1,150.1
		Travel Time Reliability (TTR) Benefits	$57.5
		Vehicle Operating Cost (VOC) Benefits	-$18.7
		Wider Economic Benefits (WEBs)	-
	Environmental Sustainability	CO_2e Emissions Reduction Benefits	-$1.9
		Total NPV Benefits	$1,458.0
Costs (P50)		Net PV Maintenance Costs	$22.2
		Net PV Capital Costs	$1,180.1
		Total Net PV Cost	$1,202.3
		Benefit Cost Ratio (BCR)	**1.2**

Economic Case Contents

This Economic Case summarises the entire process and outcomes of the wider ranging investigation process, and more detail has been appended[71].

As a guide:

- **Section 3.1** provides a high level overview
- **Section 3.2** summarises assessments of all the strategic alternatives, with Table 3-1 summarising relative economic performance, assessment against Project Outcomes and key risks. These assessments led to the recommended new offline highway approach i.e. further development of the Ōtaki to north of Levin New Offline Highway
- **Section 3.3** summarises the range of corridor options considered in the 2018 IBC with comparative economic assessments for the shortlisted options summarised in Table 3-3. This analysis resulted in the IBC preferred corridor option, endorsed by Board in 2018.
- **Section 3.4** summarises the refinements applied to the preferred option in terms of interchanges and local roads, opportunities to prioritise freight, public transport and vehicles carrying multiple people, reductions in GHG emissions and staging options
- **Section 3.5** describes the key features of the preferred option
- **Section 3.6** summarises the project outcomes from the perspective of Investment Objectives and anticipated environmental sustainability outcomes

[71] Refer IBC 2018 and the 2021 MCA Report.

- **Section 3.7** presents the full economic analysis of the preferred option (alongside the updated Do Minimum) in accordance with the latest Waka Kotahi Monetised Benefits and Costs Manual full procedures, with references to the economic peer review (appended)
- **Section 3.8** summarises assessments which integrate the transport network post-opening of Ō2NL, including the One Network Framework, revocation, s 9(2)(f)(iv)

3.1 OVERVIEW OF OPTION DEVELOPMENT AND ASSESSMENT PROCESSES

A large number of alternatives, options and sub-option refinements have been considered over the last 10 or more years to address the problems on this corridor. The process over the last 6 years is summarised in the two figures below. The strategic alternatives and corridor options were examined fully during the IBC and the option refinements and more detailed design elements were undertaken during the DBC. This case reports on the entire process.

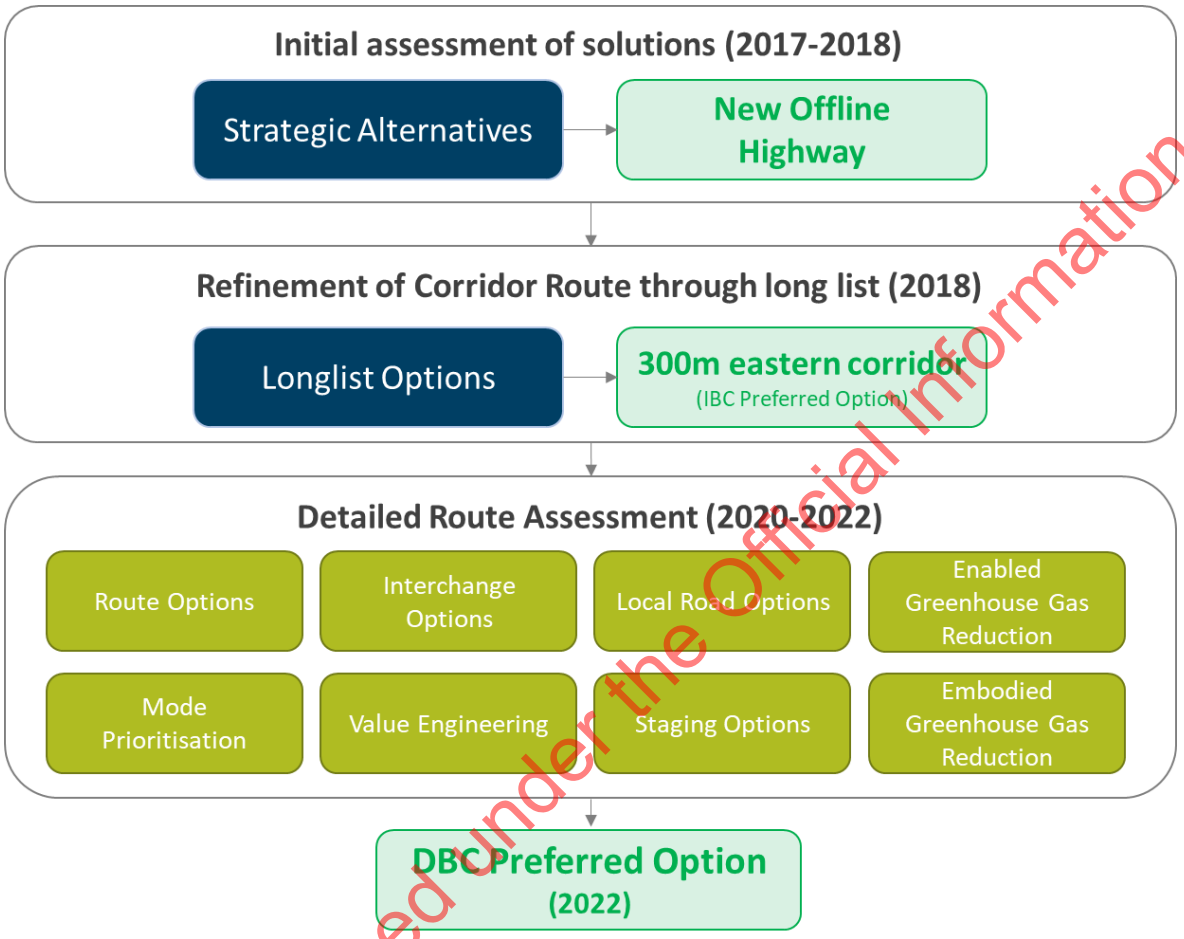


Figure 3-1. Overview of Option Development

The optioneering approach is explained in the following reports:

- *Ō2NL IBC* – this report sets out in detail the alternative and option assessment process, including a strategic alternatives assessment, that ultimately led to the Waka Kotahi Board endorsing a preferred 300m wide corridor route for the Ōtaki to north of Levin off-line highway in 2018;
- *Multi Criteria Analysis Summary Report: (October 2021)* – this report details the option and development process undertaken to identify the new highway alignment (within the 300m corridor), interchange location / forms (for the new highway) and local road connections; and
- *East of Levin Multi Criteria Analysis Report (November 2021)* – this report details the option and development process for the intersection options at Queen Street and Tararua Road and the highway between them

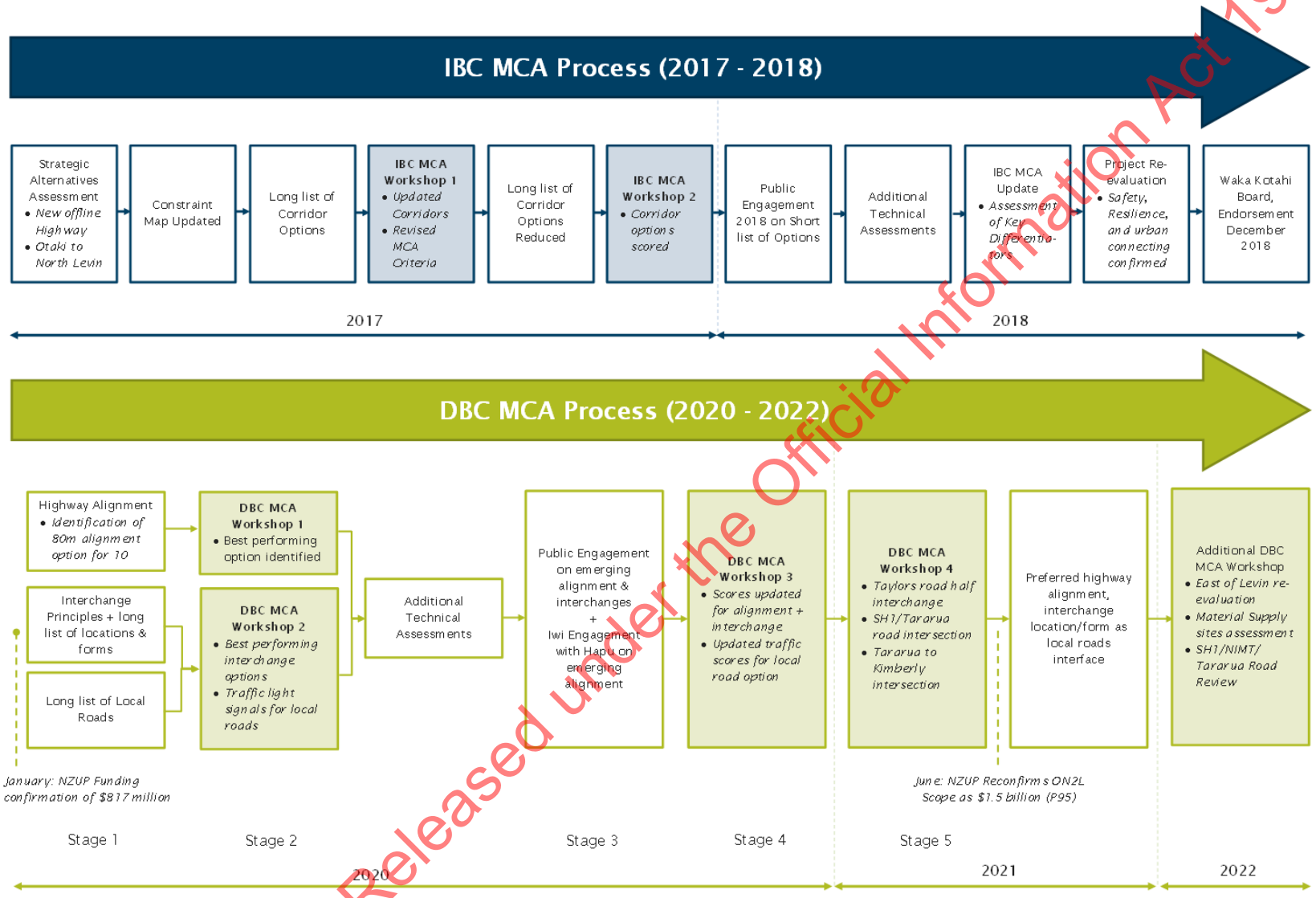


Figure 3-2. Option Development Timeline

3.2 STRATEGIC ALTERNATIVES ASSESSMENT

Extensive analysis on strategic alternatives and options was undertaken in the Indicative Business Case which informed the decision by the Waka Kotahi Board and Cabinet to proceed with a preferred corridor option to the east of the existing state highways. The outcomes associated with that analysis, as calculated during the IBC, are presented in this section as an indicative comparison between options being considered in this current phase. However, since the problems have worsened over the intervening period this comparison should not be used to identify what the expected outcomes would be. Expected outcomes for the preferred option are presented in the Preferred Option section.

It is also noted that the outcomes sought have subtly changed between the IBC and DBC. Whilst there has been a constant focus on safety and resilience, there have been some variation in other outcomes, for example the addition of a walking and cycling outcome and climate change considerations in relation to Board Directive on greenhouse gas reduction target and requirement for NZUP to consider. Nevertheless, the conclusions of the IBC remain robust and relevant.

Different alternatives have been developed to address the short and long term needs of the transport network between Ōtaki and north of Levin including:

- Solutions on the full extent of the intervention hierarchy i.e. integrated planning, demand management, optimising existing and new infrastructure
- Road based and multi-modal solutions
- Solutions that use the current highway (online) and those which propose a new (offline) route

The alternatives considered include:

- **Integrated Planning** – land use growth and development located spatially to maintain current levels or reduce the number of journeys made by private motor vehicles (including trucks)
- **Public Transport improvements** – to reduce the demand on the road network
- **Speed Management** – a low cost way to partially address the serious safety issue
- **Online expressway solutions –** upgrade the existing state highway to an expressway standard road (2 lanes and then 4 lanes)
- **Minor Safety Improvements** – includes installing signs, line-marking, surfacing, barriers and intersection improvements to reduce the crash risk/severity
- **Localised Highway Upgrades** – infrastructure upgrades to the existing network at the major problem areas on the current highway network
- **Larger Highway Upgrades –** combining some of the nearby localised upgrades to provide a more consistent road environment
- **Ōtaki to south of Levin new offline state highway** – from the end of the Peka Peka to Ōtaki expressway to the current state highway around Ohau
- **Ōtaki to north of Levin new offline state highway** – extending the PP2Ō expressway from the south to also bypass Levin

The remainder of this section discusses the above options and how effectively they resolve the identified problems as well as their economic performance (costs, benefits), impacts and considerations of key risks. The key summary is presented in Table 3-3 below.

3.2.1 Alternatives that do not resolve the problems

Several alternatives were not assessed in detail because, by themselves, they fundamentally do not resolve the identified problems. These alternatives are discussed below.

Whilst they may not be developed further as an entire solution, elements of these alternatives are very important as part of the overall response for the land use and transport network between Ōtaki and north of Levin. These need to be progressed after, and separate to, this DBC.

Integrated Planning and Travel Demand Management

Integrated planning can have significant benefits in addressing travel demand, particularly in major urban areas. However, this is unlikely to be the case in Levin.

This is predominantly because Levin operates as a rural service centre and a through route for SH1. The transport context section earlier in this document outlined the lack of a morning peak in the traffic flow profile and noted that SH1 is being used by a multitude of different uses through the Horowhenua and Kāpiti Districts. Consequently, opportunities for condensing land uses to eliminate car journeys would only address a small proportion of journeys and therefore an integrated planning approach is unlikely to make significant reductions in overall private vehicle travel demand in the short to medium term.

Levin is currently experiencing significant population growth. Accordingly, integrated planning in the context of Levin is about ensuring any transport investment complements and serves current and future planned growth areas in a manner that manages future transport demand and delivers on economic development, growth and Levin Town Centre objectives of Horowhenua District Council, Kāpiti Coast District Council and the Wellington Regional Growth Framework.

Public Transport Improvements with no investment in Roads

Overall, investment in public transport would provide benefits for the travelling public but would not fundamentally address the identified problems for this network. In particular, to significantly reduce the number of vehicle crashes, a very large and unrealistic level of mode shift is required, and to deliver on the resilience problem, a separate route would be required.

Increasing the proportion of public transport usage in the Manawatū/Whanganui Region (currently 0.5%) to match the Kāpiti District (9.7%; an increase by a factor of 20)[72], would result in about 1,300 fewer vehicles per day on the busiest rural section of SH1. This is a high and unrealistic estimate as there is not a significant commuter movement from Levin to areas which currently have a train station, and these are the trips that are best attracted to public transport.

If walking and cycling in Levin (which currently is about 15% of trips to work) was increased to a mode split similar to Ōtaki (18%)[73], this would equate to approximately 75 fewer vehicles on the local roads in Levin.

In terms of freight, goods that are low cost and not time critical are suited for rail or coastal shipping. In terms of rail nationally, the most commonly moved freight by rail (in terms of tonnes moved) is coal, dairy, pulp and paper, and meat[74]. The amount of dairy products moved by rail is already higher in the Manawatū / Whanganui Region than nationally[75], and coal and pulp and paper do not have operations in the Horowhenua. However, as a test scenario, if 30% of the freight that is currently on SH1 was able to be transferred to rail, this would result in a reduction of about 500 heavy vehicles a day on SH1.

Combining the above aspects, the scenario with the greatest impact would have a shift of approximately 1,875 vehicles off SH1 per day. However, this only equates to around a 10% reduction in vehicular traffic, and is equivalent to only three to four years of traffic growth (at the current growth rates). An exceptionally large investment in both public transport and rail infrastructure (as well as other initiatives to encourage mode shift) would be needed to achieve this.

Nevertheless, rail and public transport improvements are key components of the future transport system in the Horowhenua. If an offline solution were progressed for the highway, this can align with and enable investment in the rail corridor, as the location of the current state highways

[72] Ōtaki Area Unit has a similar PT usage of 11%
[73] Statistics NZ Commuter View
[74] See: Horizons Regional Council – Regional Land Transport Plan (page 13)
[75] See: Horizons Regional Council – Regional Land Transport Plan (page 13)

(notably the bridges) could constrain this from occurring. In addition, the growth forecast in Levin and surrounds, will provide a much larger population base if extensions to the Wellington urban rail network are considered.

Speed Management

Speed management should always be considered when addressing a safety problem. It has been relatively effective for the Manakau and Ohau Township improvements implemented a few years ago as part of the overall Ō2NL project. This saw speed reductions implemented alongside shoulder widening and infrastructure upgrades to reduce the speed environment. Both speeds and crashes have dropped as a result.

However, implementing a lower speed limit over 20km of a National Strategic High Volume state highway outside of urban areas is not appropriate. This intervention may be appropriate for short sections or as an interim measure whilst awaiting larger scale improvements, but not as a medium to long term treatment. If implemented, it is likely to attract widespread criticism from stakeholders and the public as often people consider that SH1 should be a fast through route, and indeed it soon will be - all the way from Wellington to immediately south of the project area.

In addition, speed management measures in isolation are unlikely to result in significant long-term benefits. The current average speed along SH1 is well below the posted speed limit as shown in the figure below, which means that most drivers are already managing their speed rather than driving at the speed limit. Therefore, speed management measures alone will not address the problem statements.

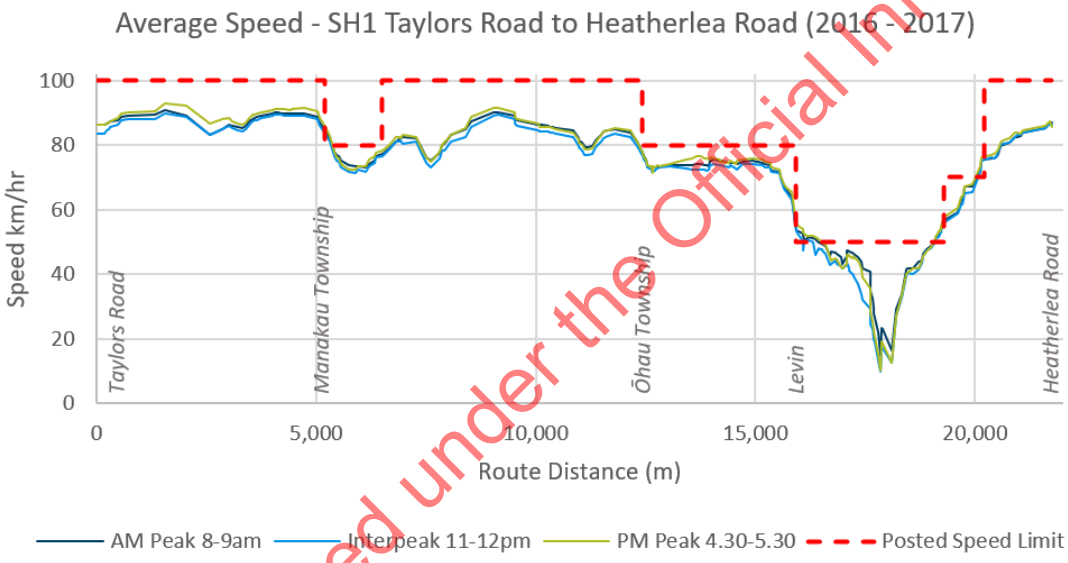


Figure 3-3. Average speeds on SH1

Speed management should be included as part of a staged approach to project delivery to reduce the number of fatal and serious crashes whilst any long-term solution is being progressed.

3.2.2 Alternatives that may solve the problems

Online expressway

IBC investigations concluded that a full online upgrade to expressway standards was determined to be unachievable for the following reasons:

- The requirement for replacing five old sub-standard bridges (at the railway and river crossings) means that the new highway would need to be offline through those sections.
- To meet design standards whilst avoiding historical constraints, the highway would also need to be significantly realigned at several deficient curves.
- Parallel service roads are likely to be required to service the remaining frontage properties safely (within the project area there are approximately 400 accessways on the rural

sections of SH1 and SH57 which is over five times higher than the recommended spacing[76]). These parallel roads will have their own physical impacts and costs.

- There are many important places adjacent to the existing alignment including Marae, Urupa, and historic buildings which would be affected as part of the upgrade either by road widening or by the need to provide service lanes. In addition, these constraints would significantly limit opportunities for future four laning (should that be needed).
- The current SH1 alignment traverses through the Ohau and Manakau townships. Should a four-lane expressway be needed in these locations then that would involve removal of an entire row of commercial/residential properties adjacent to the highway, and modifying or curtailing remaining access. Such four laning would also cause significant severance between the eastern and western sides of these established communities.

Figure 3-4 shows an alignment that stays online as much as possible. By avoiding constraints and improving the alignment to current design standards, over 70% of the alignment is actually offline. By going offline, benefits are increased, and costs and impacts are likely to be significantly decreased. As outlined above, an online expressway will have a larger footprint and have greater effects than an offline alignment. It would also be take longer and be more complex to construct around existing traffic and constraints. Therefore, online expressway options were not considered further.

Figure 3-4. Online expressway 70% offline due to constraints

[76] See: Waka Kotahi – Accessway Standards and Guidelines

Minor Safety Improvements

A minor safety improvements approach was investigated in 2017 (Ōtaki to north of Levin RoNS: Interim Safety Improvements (25 September 2017))[77]. This approach would involve minor upgrades to the current state highway to ensure a consistent level of road safety provision with an aim to achieve a KiwiRAP 3 star rating and to reduce the number of deaths and serious injuries.

The focus of this approach is on safety maintenance, safety management and safer corridor treatments including:

- Signs and markings (delineation) improvements;
- Wide centrelines;
- Intersection improvements;
- Speed management;
- Hazard mitigation (safety barriers).
- Audio-tactile paving (ATP/rumble strips);
- Reallocation of road space;
- Skid resistance improvements;
- Hazard removal; and

Even with this investment in safety measures it is expected that the SH1 route south of Levin will remain high risk as the fundamental form of the highway (two-lane two-way curvilinear highway with deficient bridges, no median barrier and high access frequency) is inconsistent with the highway's function (inter-regional connector, see Section 1.5.6). It is likely that a high number of fatal and serious crashes would continue to occur on this highway.

It also does little to address the resilience, growth, and town centre amenity problems.

Nevertheless, the benefits associated with this option were considered high enough to warrant further consideration as an interim measure to reduce deaths and serious injuries before a larger scale option could be implemented. This is discussed further in Section 3.2.5.

Localised Highway Upgrades

Localised improvements to the existing highway network would address its worst performing sections, particularly from a safety point of view. These locations are listed below and shown in Figure 3-5:

Online improvements would comprise:

1. **Forest Lakes Upgrade**[78] –widening the existing alignment to provide a safer cross section including a median barrier and consistently wide shoulders[79].
2. **Forest Lakes to Manakau** – this involves continuing the wider cross section, including a median barrier, from the Pukehou Rail Overbridge to the southern end of Manakau.
3. **Manakau Rail Bridge** – realign the overbridge to enable a new rail bridge and Waikawa Stream bridge on an appropriate alignment[80].
4. **Ohau Rail and River Bridges** –realignment and replacement of the two sub-standard bridges in this location[81].
5. **SH1/ SH57 Intersection** – the current intersection would be replaced with a roundabout and a grade separated crossing of the rail line[82].

[77] See: Waka Kotahi – Ō2NL RONS: Interim Safety Improvements
[78] See: Waka Kotahi - Ō2NL Forest Lakes Project Feasibility Report
[79] Ibid
[80] See: Waka Kotahi - Ō2NL Manakau to Ohau Bridges Project Feasibility Report
[81] Ibid
[82] See: Waka Kotahi - Ō2NL SH57 Intersection & Arapaepae Curve Project Feasibility Report

6. **SH57 Kimberley / Arapaepae Corner** – this involves realigning this corner to create one sweeping curve with a single T intersection in the middle of the curve for traffic wanting to turn on or off SH57[83]

Figure 3-5. Localised Highway Upgrades scope

Localised highway upgrades would result in some crash savings, but less than larger investments. Overall, it would be a high level of investment (but not as much as an offline highway) that does not satisfactorily resolve all the identified problems. There would still be only one route between Manakau and Ohau and therefore resilience would still be a major issue. The high and increasing traffic volumes means that access to and from the highway is still going to deteriorate and there is no opportunity to improve the Levin town centre. This option, whilst limited in scope still has significant effects, including on local marae and urupa.

Overall, this would not be an enduring solution as it could not be upgraded to four lanes, resilience would continue to be an issue and it does not address current and future amenity and growth issues.

Larger Highway Upgrades

The Manakau bridges, Ohau Bridges and SH57 are near to each other and solutions impact on adjacent problem locations. Considering them together opens up other opportunities such as realigning the road to the western side of the railway line (removing the need for two rail overbridges and at least three substandard curves) and enabling an improvement to the connection between SH1 and SH57 up to Palmerston North.

Accordingly, this scheme involves replacement of four of the projects outlined above with a single project, the SH1/SH57 Connection (see SH1-57 Connection Scoping Report (November 2013)[84]. This would involve safety improvements to the current highway from PP2Ō to Manakau, a re-aligned highway new road from the north of Manakau which would continue on the western side of the railway line until north of the Ohau River. From this point, SH1 traffic would re-join the current alignment, and a new route would provide for SH57 traffic, joining Arapaepae Road (the existing SH57 route) in the vicinity of Kimberley Road. This is illustrated in Figure 3-6 below.

[83] Ibid
[84] See: Waka Kotahi - Ō2NL SH1 - SH57 Connection Scoping Report

The overall form of SH1 under this scenario would be a two-lane highway[85] with median and side barriers from Ōtaki to south of Levin.

Figure 3-6. Highway Upgrades scope (potential alignment only)

Overall, these improvements would provide a much better level of service in terms of safety and efficiency compared to the localised safety improvements, at a similar cost (it is a larger project but requires fewer structures). However, there is still a risk in regard to resilience, as there would still only be one route between Manakau and Ohau, access onto the highway will continue to be difficult and the highway continues through the Levin town centre.

This option is also completely offline from north of Manakau to Kimberley Road. Accordingly, if offline options are being considered, then the full range of offline possibilities needs to be investigated properly to ensure the optimal solution is adopted and in the context of the future likely requirements, which in this instance is ultimately a bypass of Levin.

This alignment is difficult to adapt to become a four lane state highway, due to constraints around the Ohau area including the river, the railway line, the urban conurbation, urupa, vineyards, native bush areas and the need to connect to the current local road network. These same constraints mean that even a two lane route is likely to have significant adverse effects and run the risk if disturbing sites of significance to Māori.

Those sections which are online will be subject to increasing access difficulties due to the presence of the median barrier, and parallel service roads may need to be considered, which will involve additional land purchase to what has currently been estimated.

[85] As it would connect in with two lane sections south of Manakau and north of Ohau.

Ōtaki to south of Levin New Offline Highway

Based on the previously discussed online vs offline considerations, investigations were undertaken into options which involve an offline highway from Ōtaki to south of Levin, but retains SH1 traffic through Levin.

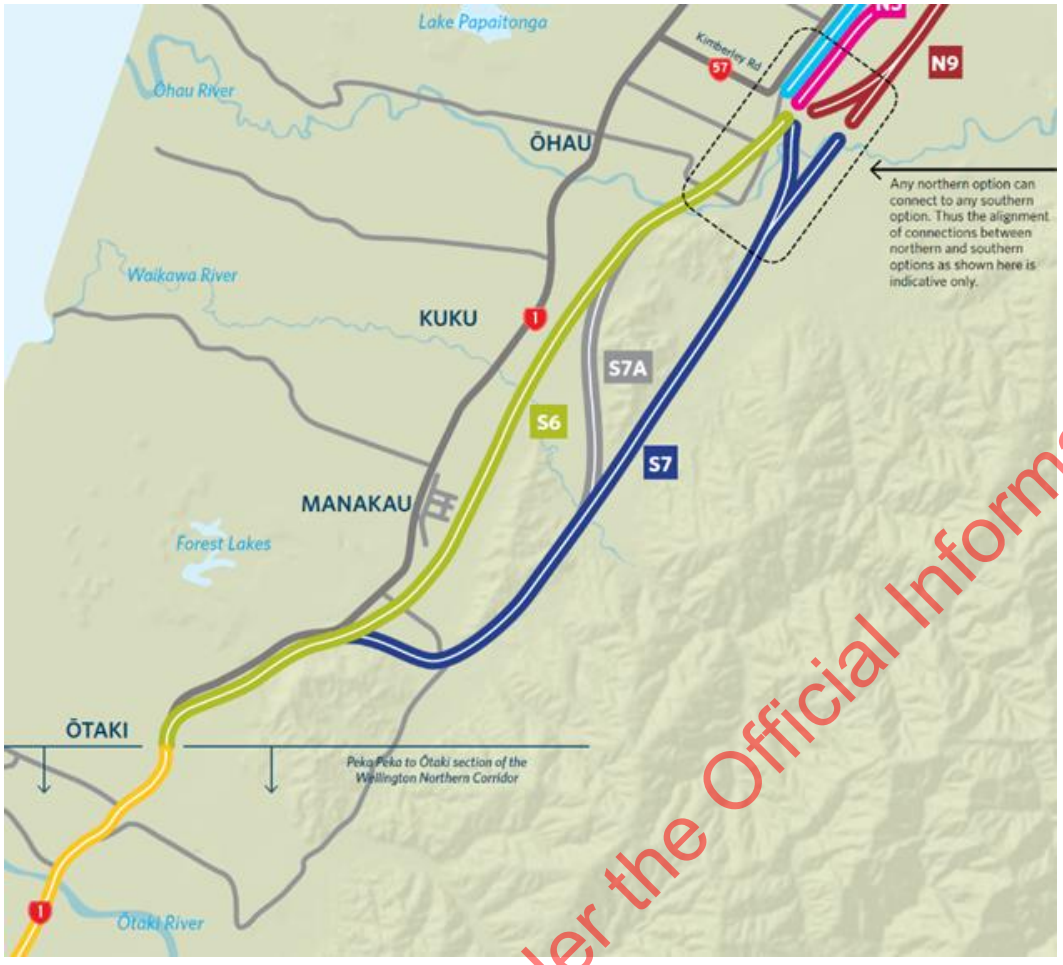


Figure 3-7. Potential alignments for a Ōtaki to south of Levin highway[86]

Investigations of these routes have shown that the best performing routes do not use the SH1/SH57 connection route [87] [88].

The Ōtaki to south of Levin Offline Highway scenario addresses the problems identified for the southern part of the project area and can be used as the first stage in a full new state highway from Ōtaki to north of Levin (see Section 3.4.5).

By just constructing improvements south of Levin, this option does not address high traffic volumes through central Levin or help support growth to the east of Levin.

Ōtaki to north of Levin New Offline Highway

The Ōtaki to north of Levin approach would comprise an offline highway from Ōtaki to immediately north of Levin.

A route all the way to the Manawatū River has not been proposed, as traffic volumes drop to less than 10,000 vpd on SH1 north of Levin and online improvements were considered to provide a state highway that is fit for purpose and ties in appropriately with the two lane bridge that has been constructed across the Manawatū River. Traffic flows on the state highway network north of the proposed SH1/57 intersection (north of Levin) are roughly half that on SH1 south of this intersection.

[86] This image shows the shortlist of options consulted upon in 2018 as part of a full offline highway route. A much wider range of options have been investigated previously and these are referenced in Appendix A of the IBC.
[87] See: Waka Kotahi - Ō2NL Preliminary Options Report and Addendum
[88] See: Waka Kotahi - Ō2NL Taylors Road to Ohau River Four Laning Further Options Report

Again, only offline routes have been investigated as they are lower cost and lower impact. The short list of these options is presented in Figure 3-8.

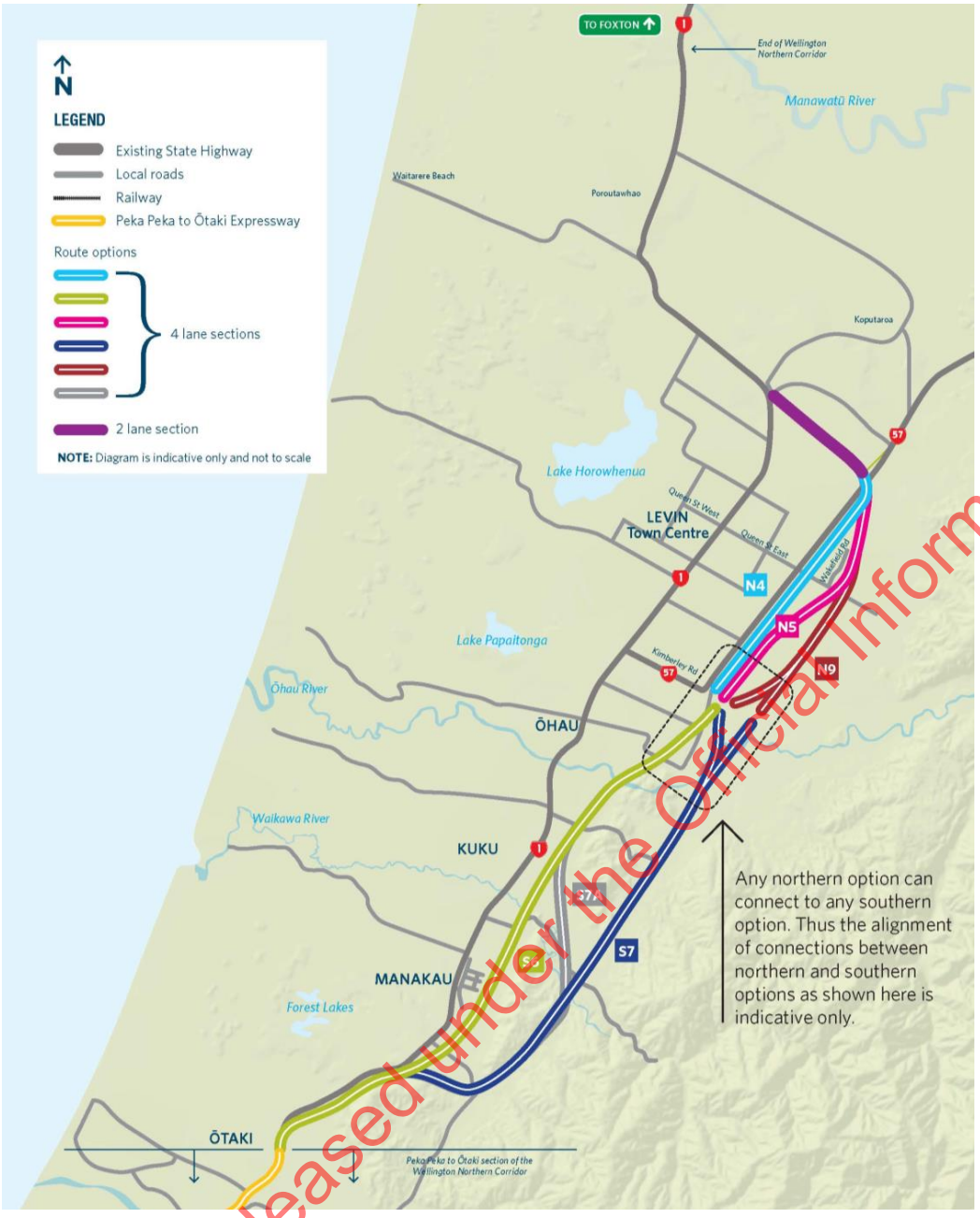


Figure 3-8. Potential alignments for a Ōtaki to north of Levin new offline highway

Strategic Alternative Comparison

Each of the approaches have been investigated and evaluated to understand the benefits, costs and impacts. These are reported in the tables below.

As presented earlier, the work and analysis on strategic alternatives was undertaken in the Indicative Business Case and therefore the information presented is based on pre-2018 data and analysis. The outcomes associated with these options are presented to enable a comparison between options, but should not be used to identify what the current outcomes would be. As problems have worsened since this time, the difference in outcomes would be even greater than that presented, i.e. the preferred option would perform even better as compared to the alternatives and no new alternatives become available.

Table 3-3. Summary of strategic alternatives assessed and how they address the identified problems

Project Outcome		Measure	Minor Safety Improvements	Localised Highway Upgrades	Larger Highway Upgrades	Ōtaki to south of Levin New Offline Highway	Ōtaki to north of Levin New Offline Highway
IBC Project Outcomes[89]	Safety	DSI Savings per 5 years	5-7	7-10	11-15	25-30+ depending on local road and revocation	35 – 40+ depending on local road and revocation
		KiwiRAP Star Rating	3	3 - 3.5	3 - 4	3 - 4.5	4.5+
	Resilience	Number and duration of journeys affected	Still no local alternative route (detour >2hr). Slight reduction in number of journeys affected due to reduced crashes.	Still no local alternative route (detour >2hr). Moderate reduction in number of journeys affected due to reduced crashes.	Still no alternative route (detour >2hr). Moderate reduction in number of journeys affected due to reduced crashes.	Alternative route provided. Crash and flooding problems addressed	Alternative route provided. Crash and flooding problems addressed
	Horowhenua Growth	Appropriate connections to urban areas	No change to current	Potential improvements would facilitate access to Ohau growth area.	Potential improvements would facilitate access to Ohau growth area	Removal of through traffic improves safety of Manakau and Ohau growth areas. Ease of access dependent on interchange strategy.	Removal of through traffic improves safety of East Levin, Manakau and Ohau growth areas. Ease of access dependent on interchange strategy.
	Levin Town Centre	Reduce number of trucks in the main retail area of Levin	No change	No change	No change	No change	Significant reduction as Levin can be bypassed
	Inter-regional Growth	Travel times on SH network	No change	Minor improvement	Minor improvement	Minor Improvement	Improvement for all key routes
Value for Money		Cost	~$5-10M	~$260-$280M + ? property	~$240-260M + ? property	~$375M+ + $75M property	~$575M+ +$125M property
		BCR	3+	~1	~1	<1	<1[90]
Major Risks			Very high number of deaths and serious injuries continue. Contrary to public expectation. No certainty for landowners in terms of future upgrades.	Significant expenditure without consideration of long term strategy. Median barrier installation will impact a large number of landowners. Option may be opposed by iwi. Contrary to public expectation. No certainty for landowners in terms of future upgrades	Option would be opposed by iwi. The above issues, especially the property impacts of median barrier installation, would make it very difficult to consent, and would affect land acquisition process. Contrary to public expectation. Not the optimal offline option. Does not align with optimal offline highway options. No certainty for landowners in terms of future upgrades.	Large numbers of affected landowners. Significant social / amenity impacts on residential properties located to south and east of Manakau. Does not address Levin Town Centre issues. No certainty for some landowners in terms of future upgrades.	Very large number of affected landowners. Significant social / amenity impacts on residential properties located to south, east and north of Manakau, Kuku, east of Ohau and east and north of Levin

Impacts Key	Very Negative	Negative	Neutral/ Unknown	Positive	Very Positive

[89] The assessment was undertaken comparing these options to a future do minimum option.
[90] Subsequent analysis on a refined version of this option (See Section 3.7.6) shows that this option will yield a BCR of greater than 1.

3.2.3 Need for four lanes

Whilst the strategic alternatives assessment clearly shows that there is only one option that addresses the problems on these parts of SH1 and SH57, further consideration has been undertaken as to whether any new route should provide two lanes (one in either direction) or four.

A four lane offline highway would provide a consistent environment from the expressway sections to the south (Wellington Northern Corridor) and would typically contain grade separated interchanges or high speed roundabouts to access the local road network.

A two lane offline highway would need to provide regular passing lanes (1.5km long every 5km according to current guidance[91]) for safety, travel time reliability and reduced driver frustration, and would typically have high speed roundabouts, rather than grade separated interchanges.

The key elements considered as part of this assessment include the forecast traffic demand, the capacity of the two options, the impact on the Project's problems and objectives and the impact on partners, stakeholders and the community.

Guidance

The Waka Kotahi Planning Policy Manual (PPM)[92] identifies that a transition to 4 lanes should be made when traffic volumes are in the 20,000 to 25,000 vpd range.

Te Ara Tuhono Warkworth to Wellsford also used the 25,000 vpd as one of the trigger points for when the project should proceed.

However, these are relatively coarse measures and do not take into account the changes in hourly flow and the impact of merging from two lanes to one (as would occur at the end of the PP2Ō expressway or at the end of passing lanes). The PPM identifies that this merge capacity is typically 1,200-1,400 vph[93], and this is consistent with the HCM.

Austroads (GRD Part 3) also recommends that the cross section of a facility should be based on the estimated traffic volumes at the end of the design life to avoid expensive future alterations. For new roads this is suggested to be 30 years, but 50 years for land acquisition and 100 years for new bridges.

Demand

The traffic model forecasts the expected future daily traffic volumes, accounting for predicted growth on different parts of the proposed offline new highway as seen in Table 3-4.

Table 3-4. Modelled Daily traffic volumes along proposed offline highway.

Ō2NL location	75%ile Growth VPD			95%ile Growth VPD		
Year	2029	2039	2049	2029	2039	2049
East of Ohau	18,300	22,600	**26,000**	19,300	**26,000**	**32,700**
East of Levin	13,400	16,600	20,400	14,300	20,000	**29,700**
North of Levin	7,700	10,200	12,500	8,300	12,400	19,100

These numbers are in comparison to current traffic volumes on the section of SH1 at Ohau of over 18,000 vehicles per day.

[91] Waka Kotahi, Planning Policy Manual (PPM), Appendix 3E Passing and Overtaking Policy
[92] Ibid
[93] This is lower than the capacity of a single lane (1700 vph) but is due to vehicles slowing down and finding gaps to merge at higher traffic volumes.

The flows presented above are average daily figures and do not take into account of the fact that weekends typically have flows 10% greater (as shown in Figure 1-5) and holiday weekends have greater demand again.

It is clear that high traffic volumes are forecast for the majority of the offline highway, up to the point where SH57 traffic would diverge. It is also worth noting that current traffic volumes and future forecasts from the traffic modelling do not show a significant reduction in traffic north and south of Ōtaki.

If using 25,000 vpd as a measure of when the new highway would need to be upgraded to four lanes, this trigger point is reached within 20 years of opening under the 75%ile growth scenario and within 10 years of opening under the 95%ile growth scenario.

The traffic model also forecasts the peak hourly flow for an average weekday, as shown in Table 3-5.

Table 3-5. Modelled Peak one-way traffic volumes along proposed offline highway

Ō2NL location	75%ile Growth 1-way Peak Hour Volume			95%ile Growth 1-way Peak Hour Volume		
Year	2029	2039	2049	2029	2039	2049
East of Ohau	780	960	1,100	820	1,090	1,300
East of Levin	580	730	890	620	880	1,340
North of Levin	360	460	550	380	540	840

The data shows that the merge capacity is not exceeded within 20 years for the 75%ile growth scenario, but it would be in weekends and holiday periods due to traffic volumes being at least 10% higher. The merge capacity is likely to be exceeded within 20 years under the 95%ile growth scenario. Once the merge capacity is exceeded, this could lead to the continuation of the current approach on the existing highway of needing to use cones to close passing lanes on the new highway to better manage traffic flow.

In all the above situations, the capacity of the infrastructure will be exceeded before the 30 year period for new roads identified in the Austroads guide.

Outcomes

Project Outcome		Measure	Two Lanes plus passing lanes	Four Lanes
IBC Project Outcomes[94]	**Safety**	DSI Savings per 5 years	65% of four lane benefit as traffic returns to current SH1	35 – 40+ depending on local road and revocation
		KiwiRAP Star Rating	4+. Lower than four lane option due to passing lanes and at-grade roundabouts	4 - 5
	Resilience	Number and duration of journeys affected	Alternative route provided. Crash and flooding problems addressed on new route, but due to reduced cross section, any closures likely to affect both directions rather than just one. Closure durations for crashes and breakdowns also likely to be longer as a single lane cannot be opened for traffic. Congestion issues in future years. Delays all traffic if agricultural vehicles use the highway for local trips. More trips affected by crash and flooding problems on old route. Maintenance activities will more likely result in closure of entire direction as cannot just close one lane. Less ability to cater for sudden traffic influx (e.g. resilience event in Wellington or SH2)	Alternative route provided. Crash and flooding problems addressed
	Horowhenua Growth	Appropriate connections to urban areas	Removal of through traffic improves safety of East Levin, Manakau and Ohau growth areas. More limited support for growth due to capacity issues in future years	Removal of through traffic improves safety of East Levin, Manakau and Ohau growth areas. Supports growth in line with strategies.
	Levin Town Centre	Reduce number of trucks in the main retail area of Levin	Reduction as Levin can be bypassed, but not as significant as four lanes	Significant reduction as Levin can be bypassed
	Inter-regional Growth	Travel times on SH network	Improvement for all key routes in short term, but capacity issues arise in as early as 10 years after opening	Improvement for all key routes

Costs and Benefits

Analysis has shown that a two-lane option would likely cost in the order of 84% of the cost of building the entire four lanes. This accounts for a reduction in structure costs, a reduction in earthworks movement and a reduction in pavement costs.

The costs are still much greater than 50% of the cost of a four lane option as the cross section is only 7m[95] narrower; other elements such as shoulders, medians, drainage swales, the shared use path and landscaping are still required regardless. This means that a reduction in property purchase is not significant.

[94] The assessment was undertaken comparing these options to a future do minimum option.
[95] 27% of sealed width, and less than 10% of entire required width

It has also been calculated that to build the additional two lanes in the future would result in a total project cost of 108% of the current cost. This translates to the widening costing at least 50% more to build in the future (excluding escalation) rather than as part of the project. This additional construction would also be hugely disruptive to traffic on the new highway and would also result in significant additional carbon emissions than building at the same time.

Traffic modelling shows that the option would result in 83% of the benefits in the short to medium term. This is mostly due to a reduction in safety benefits with additional traffic using the old state highways. This percentage figure does not account for the increase in congestion on the new highway, and the consequent impacts on travel time and travel time reliability which are expected to begin occurring 10-20 years after opening depending on growth.

Partners, Stakeholders and the Public

Iwi partners have advised that they do not support a two-lane option. One of our project principles is “Enduring Legacy” and providing only two lanes is not enduring. The whenua has already had many scars forced upon it with past railway and road alignments and the risk of having to scar the landscape twice with this alignment is considered unacceptable and against the other project principle “Tread Lightly”.

Whilst our key stakeholders and the public have not been formally consulted on the possibility of a two lane option, when this possibility was raised as part of a potential approach by the Government and Waka Kotahi in October 2018, consistent and strong feedback to the Ō2NL project team from landowners and members of the public was that constructing four lanes was essential.

There was little, if any, support for a two lane option.

If the decision was made to only construct two-lanes, this would likely be seen as another reversal of decisions in a long line of reversals for this project. The public and landowners have been subject to the project starting, stopping, going online, going offline and reviewing alignments in a string of decisions over the last 12 years, and even longer under other project names.

Other Issues and Risks

There are a range of other issues and risks that need to be highlighted when considering whether to proceed with two lanes.

- **Prevents prioritising modes –** providing four lanes enables future consideration of prioritising lanes for cars with 2 or more occupants, public transport or freight.
- **Staging –** constructing a two lane highway in a way that would enable upgrading to four lanes in the future would be significantly different to constructing a two lane highway that is not future proofed. For example if future proofed, then bridges would be designed and constructed differently, more earthworks would be undertaken initially, the SUP alignment would be closer to the road to reduce land take, and the project designed and constructed in a way that enabled widening in the future. This however significantly increases costs compared to not future proofing.
- **Revocation –** only constructing two lanes may change the function of the current state highways as there will be higher volumes of traffic on the existing SH1 and therefore greater investment may be required, including in the bridges, to ensure the appropriate level of service after the new highway opens.
- **Over-dimensional vehicles –** OD vehicles typically cannot travel down routes with wire rope barrier on either side. This would then result in these vehicles using the old state highways and local roads.
- **Growth –** Constructing two lanes may result in growth redistributing elsewhere in the region.

Two Lane Summary

The analysis has shown that it is possible to reduce the project cost by around 16% by adopting two lanes rather than four, however this results in a decrease in outcomes achieved, at least a 17% decrease in benefits (likely more), significant risks with partners, stakeholders and the public and does not deliver an enduring legacy.

In both the 75%ile and 95%ile growth scenarios, the capacity of the two lane highway is predicted to be exceeded within 10-20 years, resulting in the need to invest more in the new route at a future date with significant additional costs, impacts and embodied carbon disbenefits.

3.2.4 Recommended Approach

The recommended approach is one that addresses the problems.

The tables presented above, along with the summary below, clearly show that the Ōtaki to north of Levin New Offline Highway is the only alternative which addresses all the problems and objectives.

Table 3-6. Strategic Alternative Summary

Considerations[96]	Strategic Alternative						
	Do Nothing	Minor Safety Improvements	Localised Highway Upgrades	Larger Highway Upgrades	Online Express-way to South of Levin	Ōtaki to South of Levin New Offline Highway	Ōtaki to North of Levin New Offline Highway
Problem 1: Safety	NO	NO[97]	Partially	Partially	Partially	YES	YES
Problem 2: Resilience	NO	NO	Partially	Partially	Partially	YES	YES
Problem 3: Regional Growth	NO	NO	Partially	Partially	Partially	Partially	YES
Problem 4: Levin Town Centre	NO	NO	NO	NO	NO	NO	YES
Reduces Community Blight	NO	NO	NO	NO	YES	Partially	YES
Has Iwi Support	NO	NO	NO	NO	NO	YES	YES
(Part of) Enduring solution	NO	YES	Possibly[98]	Possibly[99]	NO	YES	YES

All other options provide temporary or limited relief of the problems, but most do not fit with the long term future, i.e. investment in the other alternatives would still require investment to ultimately construct a new offline highway. Based on the problem statements, that need is urgent.

The recommended option also provides enduring future proofed infrastructure that fits with regional growth plans.

[96] 1. Safety – Does the alternative significantly reduce deaths and serious injuries
2. Resilience – Does the alternative replace the at-risk bridges or provide an alternative route
3. Regional Growth – Does the alternative support new growth locations
4. Levin Town Centre – Does the alternative reduce traffic volumes and heavy traffic in Lein
5. Reduced Community Blight – Does the alternative provide certainty for landowners along potential offline highway routes
6. Has Iwi Support – Does the alternative have support from local iwi
7. Part of Enduring solution – Does the alternative form part of the long term solution that addresses all the problems

[97] Whilst DSIs would be reduced, increased traffic would result in future DSIs being similar to current numbers

[98] Enables new four lane offline highway at any location in the future. Online upgrades may be greater that what is required for revocation.

[99] Could upgrade to four lanes but it has significant impacts and may not meet long term outcomes. Could still build new offline route, but this online option would be much greater than revocation needs.

The discussion below presents the cheapest option to the most expensive to help determine whether lower cost scenarios deliver substantial outcomes with minimal risk.

- The lowest cost option, **Minor Safety Improvements**, would not address the problems in terms of significantly reducing DSIs on this section of SH1 and SH57 (which is one of the worst state highways in the country). Minor Safety Improvements could include a reduction in speed limits, but this is not considered appropriate for a National Strategic High Volume state highway for the medium to long term. The Minor Safety Improvements proposed would not have significant environmental or social impacts but still has a large risk in terms of the weight of public and landowner expectation.
  Nevertheless the minor safety improvements are necessary and appropriate interim measure whilst the larger project is progressed through the pre-implementation phases (See Section 3.2.5).
- The **Localised Highway Upgrades** would partially remedy the key safety problem areas on SH1 south of Levin. However, they cost about the same as the Larger Highway Upgrades and do not provide the same level of benefit in terms of safety, resilience or access, particularly for SH57 traffic, which comprises a third of the trips travelling north from Ōtaki. They also cannot be the first part of staged approach towards a four lane highway, as the highway would need to be offline due to the significant negative impacts and costs associated with constructing a highway online. A major impact with this approach is on marae and urupa and it still has the large risk of not providing certainty for an offline corridor, which will be needed in the future to cater for, and support, growth.
- The **Larger Highway Upgrades**, including the SH1/SH57 Connection could be an appropriate strategy if four lanes are not required. It provides benefits in terms of safety and access, but does not provide a fully resilient network (as there would still only be one route between Manakau and Ohau). This project cannot be the first stage of a four lane highway due to constraints around Ohau, which means that it is not on the optimal offline alignment. Also it would be very difficult to consent. A further consideration is that iwi would likely oppose this project as the alignment has significant negative cultural effects on places of significance.
- The **Ōtaki to south of Levin New Offline Highway** is an appropriate strategy. It solves all the issues for the southern part of the corridor in terms of safety, resilience and access. It is around 50% more expensive than the Larger Highway Upgrades, and would involve some redundant expenditure (e.g. the connection at the northern end would need to be replaced when the highway is extended in the future)) but is future proofed, thereby also giving certainty to landowners in the southern part of the area. It does not however, solve the issues in the Levin Town Centre or growth in and around Levin.
- The **Ōtaki to north of Levin New Offline Highway** addresses the key problems identified of safety, resilience, access and to assist the re-vitalisation of the Levin Town Centre. This option solves all of the problems, is in line with policy, community and partner expectations, and gives an enduring solution.

Accordingly, further development of the **Ōtaki to north of Levin New Offline Highway** was progressed to the optioneering phase.

3.2.5 Wider Programme

Whilst the Ō2NL project results in vast improvements in safety, resilience and access, it is still approximately 8 years from opening. The project also needs to fit within a wider programme of projects to achieve all transport and land use outcomes sought by local and central government.

Other projects that will assist in achieving these wider objectives are listed below, with Ō2NL being the backbone of this strategy.

Short Term:

- Completion of Kāpiti Expressway resulting in a 4 lane expressway all the way from Wellington to north of Ōtaki
- Implementation of online safety improvements and speed management measures on SH1 and SH57 to improve safety in the short term before Ō2NL is open. Further discussion on this is presented in the next section.

Medium Term:

- Ō2NL new highway and shared use path

Medium to Long Term

- Revocation investment to the current SH1 and SH57 sections bypassed by Ō2NL to ensure they are fit for purpose for their new function in the transport hierarchy.
- Transforming Taitoko: a range of improvements to urban Levin to improve the urban and commercial environment. These improvements are yet to be funded but rely on Ō2NL to remove traffic from Levin.
- Rail improvements to improve both people and freight movements along this corridor and encourage mode shift to rail from both the Regional Rail Plan and LNIRIM. These improvements are also yet to be funded, but could include service frequency improvements from additional rolling stock, electrification and double tracking from the south to Levin.
- Travel Demand Management to encourage mode shift towards walking, cycling and public transport. Whilst national priority is being given to larger urban centres, travel demand management will also have benefits in regional centres.

A plan of the wider programme is presented in the figure below.

Figure 3-9. Ō2NL and wider programme

Short Term Speed and Infrastructure Programme Improvements

It was acknowledged by the Waka Kotahi Board in 2018 that the opening of an offline highway was still approximately 10 years away and that there was a need to improve safety on the current highway in the interim. It is noted that these improvements will remove some safety benefits from the offline highway, but it was considered untenable to allow the current deaths and serious injuries to continue.

Since that time significant progress has been made on implementing safety upgrades to the following sections of the state highway network. These have been undertaken through the Speed and Infrastructure Programme (SIP) (not part of Ō2NL) and comprise the following:

- **SH1 south of Levin:** These improvements include wide centreline treatments, wire rope median barrier, turn around facilities, edge protection and removal of passing lanes. The detailed design for the project is largely complete and community engagement is also complete. Wide centreline safety improvements and sections of reseal were fast tracked and delivered in early 2022. Subject to funding confirmation, the plan is to commence the balance of works in mid-2022, with construction taking approximately 1 year.
- **SH57**: These improvements include wide centreline, edge protection and new roundabouts at Queen Street and Tararua Road. A physical works contract has been awarded and construction of all elements except the Tararua Road roundabout has begun. This contract is due for completion by the end of 2022.
- **SH1 Levin to Foxton**: These improvements are currently being investigated and may include median improvements, edge barrier and a new roundabout at Waitārere Beach Road. The Feasibility Report has been completed to determine scope and funding, and the proposals will now go through community engagement, detailed design and consenting. Subject to approvals and funding, physical works are targeted for commencement in mid-2022 for completion in 1 construction season.
- **Safe Speed Review (SH1 / SH57)**: Community consultation has been completed and approvals in place to reduce the posted speed on SH57, with implementation expected in late 2022. Speed limit reviews on SH1, for both north and south of Levin, are underway and the first round of community engagement has been completed. The timeline for the close out for SH1 engagement, associated approvals processes, and implementation is yet to be confirmed.

The outcomes achieved by these improvements have been quantified to understand the impact they will have on the economic case for Ō2NL. Whilst they will have a marked decrease in the number of fatal and serious injuries on the corridor and a reduction in overall risk in the short term, escalating traffic volumes means that by 2039, without Ō2NL the risk will increase again to current levels. The change in network safety risk, and impact on DSI, is presented in Figure 3-10 and Table 3-7 below.

By 2039, even with the SIP improvements, there are likely to be similar levels of deaths and serious injuries every five years as the existing situation, and 37% of the highway will have a High collective risk.

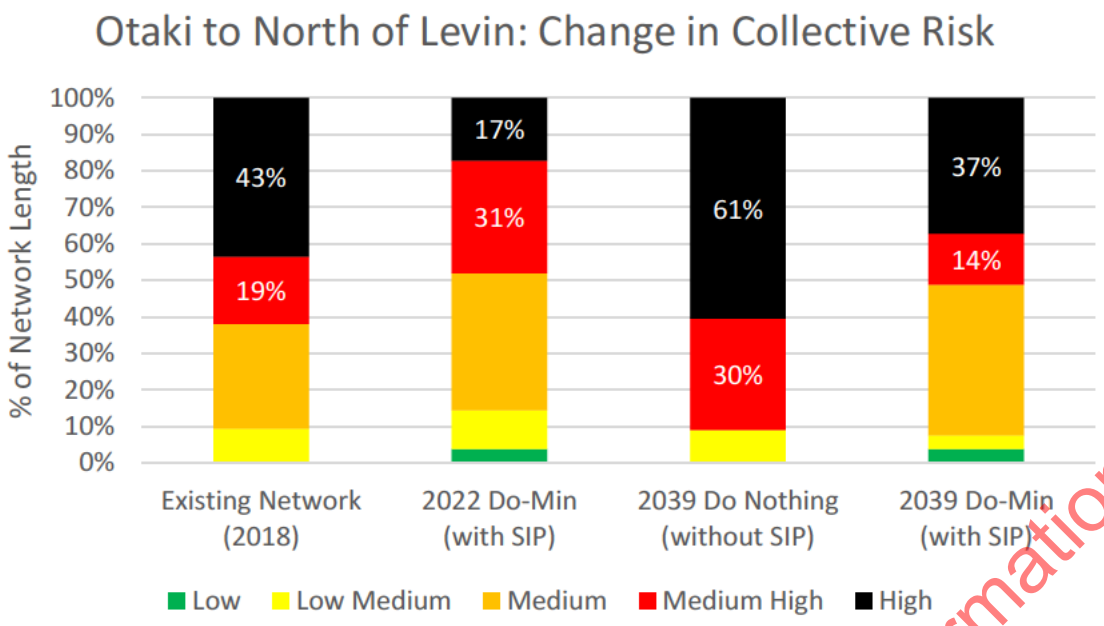


Figure 3-10. Impact of the Speed and Infrastructure Programme (SIP) on Ō2NL Safety Risk

Table 3-7. Estimated Impact of SIP

Measure	Current Situation	2039 Do Nothing (without SIP)	2039 Do-Minimum (with SIP)
Deaths and Serious Injuries (DSI)	72 actual DSI over five years (2017-2021)	Estimated 90 DSI over five years	Estimated 63 DSI over five years
Collective Risk	43% of State Highways High Collective Risk	61% of State Highways High Collective Risk	37% of State Highways High Collective Risk

Implementing the SIP works prior to Ō2NL will have an impact on the Ō2NL outcome baselines and BCR, although the difference compared to the IBC benefits will not be severe, as crash numbers have increased since 2018 (when the IBC benefits were calculated), and the long term crash risk is still high.

The outcomes and BCR calculated in Section 3.6 and 3.7 respectively reflect SIP as part of the Do Minimum.

3.3 CORRIDOR OPTIONS

3.3.1 Long List of Corridor Options

As with the previous section, this section also reports on outcomes calculated during the IBC phase.

Constraints and Design Philosophy

Before identifying a long list of off-line highway corridor options, the constraints maps for the Project Study Area were updated[100]. This process involved identifying and updating local geographical / landscape features, heritage[101] values, Tangata whenua values, lifeline routes and hazards, social / economic features, land ownership and ecological values.

The following high-level design philosophy was developed to identify the key design characteristics of the highway corridor to be evaluated[102]:

- Standard: Expressway standard throughout;
- Speed and geometry: a design speed of 110 km/h (operational speed of 100 km/h);
- Capacity: two lanes in each direction, median divided;
- Access: all access to the highway via grade-separated interchanges[103], no direct side road intersections or direct property access; and
- Interchanges: initial consideration was given to these including how they would serve the current and future urban form and their technical requirements (noting that interchange location would not significantly impact corridor route choice).

The next step in the IBC process was to develop and assess a long list of approximately 300m wide corridor routes for the new Taylors Road to Levin off-line highway.

The approximate 300m width for the corridor routes allows flexibility to locate the new highway within the corridor whilst leaving room to avoid any key constraint features and address other adverse effects that may come to light during development of the DBC.

Long to Short List of Corridor Route Options

The initial long list developed by the Project Design Team was based on historic state highway studies and previous Ō2NL investigation stages (which had included inputs from the community). In summary, the long list identification process identified southern and northern corridor routes to both the west and east of SH1 (and SH57).

IBC MCA Workshop 1

IBC Workshop 1 was held in early August 2017. Its purpose was to review the preliminary long list of corridor route options and the proposed MCA assessment criteria for evaluating each option. Key members of the Project Team, technical specialists, iwi, stakeholders and the Project Reference Group (PRG) attended this workshop. Because of workshop discussions, additional corridor options were added to the long list. The final long list of corridor route options is set out in Figure 3-11 below:

[100] The Project Study Area is bounded in the south by the PP2Ō Expressway, to the north by the Manawatū River, to the west by environmentally and culturally sensitive sand dunes (this area also contains a concentration of high tension power transmission lines and high pressure gas mains) and to the east by the foothills of the Tararua Ranges

[101] Note that Heritage nomenclature is used to convey built historic heritage and structures, historic areas and archaeological sites (which may or may not also have cultural values)

[102] These are in accordance with Waka Kotahi practice and standards and ensures consistency with the remainder of the Wellington Northern Corridor projects

[103] This assumption was used to ensure the highway would be appropriate for this form.

Figure 3-11. Long List Corridor Options

The MCA assessment criteria agreed to be used to evaluate the corridor options at the IBC MCA Workshop 2 were as follows:

- Landscape/Visual Impact;
- Ecological Impacts;
- Impact on Heritage;
- Tāngata Whenua Cultural Values;
- Productive Land Values;
- Social/Community/Recreation Impacts;
- Impacts on Dwellings;
- District Development;
- Fit to Project Objectives;
- Property Degree of Difficulty;
- Engineering Considerations; and
- Cost – indicative order of cost of options.

IBC MCA Workshop 2

IBC MCA Workshop 2 was held in late August 2017. Key members of the Project Team, technical specialists, iwi, stakeholders and the PRG attended this workshop.

At the workshop, each MCA assessor presented and discussed their evaluations and scores (using a 5 point scoring scale) for each southern and northern corridor route option. To help further examine the unweighted (raw) scores a weighting system was applied to help test each option against different sensitivities, which included a workshop weighting, a “Section 6 of the RMA”, a quadruple bottom line (i.e. social, environmental, cultural and economic) and community / PRG weighting scenarios.

The IBC MCA Workshop 2 process reduced the long list of corridor options, but also identified that further investigations into Tangata whenua impacts (e.g. impacts on sites of cultural significance), traffic modelling (e.g. access from the new highway to the key destinations of Levin or SH57 north of the project area) and constructability (e.g. ability to construct) was required. Ultimately, these additional investigations enabled further corridor route options to be removed.

The final short list of corridor route options is set out in Figure 3-12 below.

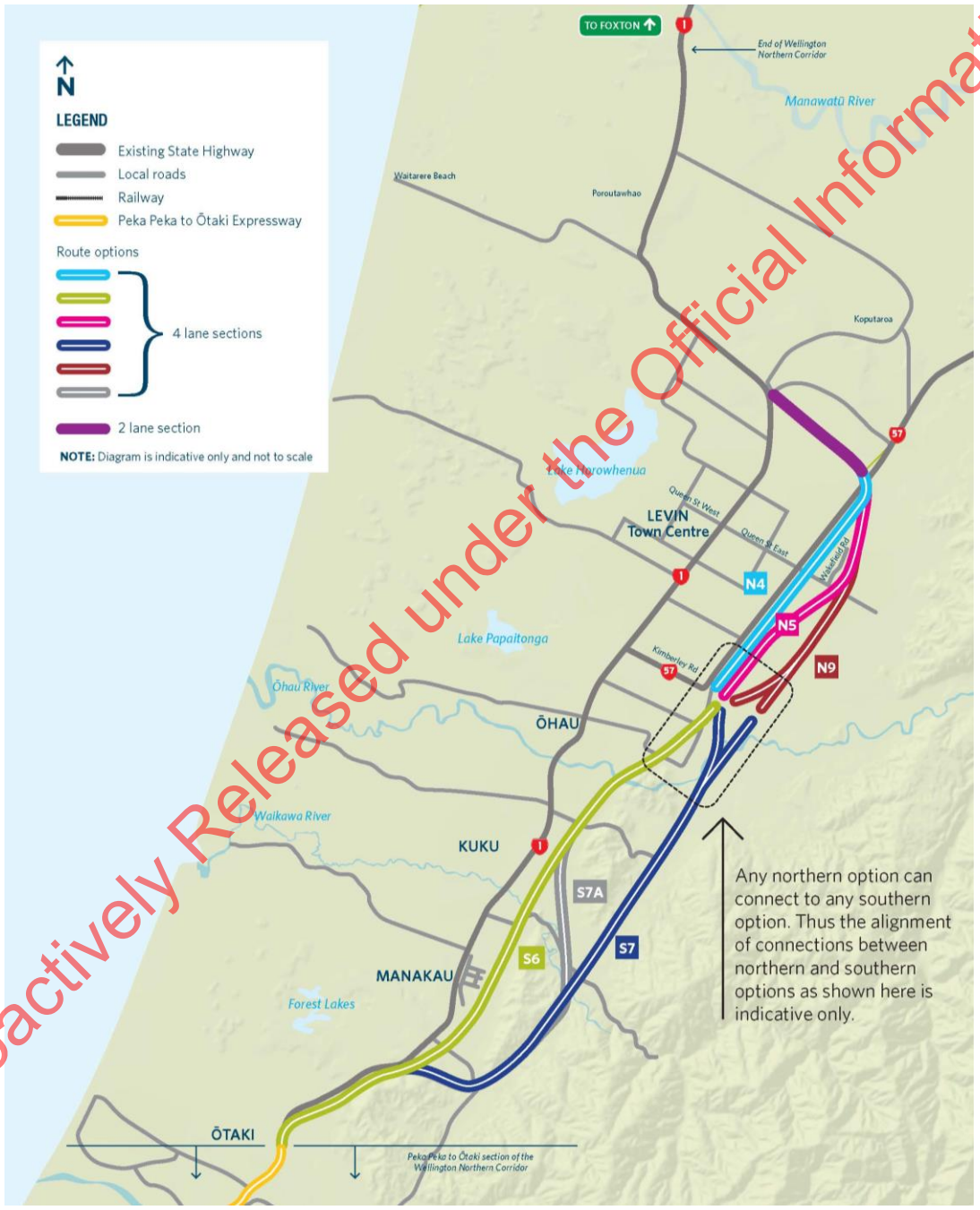


Figure 3-12. Short Listed Corridor Options

A summary of the key attributes of the shortlisted options are summarised in Table 3-8 below.

Table 3-8. Shortlisted Corridor Options Summary (used for consultation)

Criteria	Southern Options			Northern Options		
	S6	S7	S7A	N4	N5	N9
Length (km)	14.7	15.7	16.7	9.5	9.8	9.5
Number of Dwellings located in corridor option	39	29	26	76	76	73
Amount of Productive Land located in corridor option (ha)	230	315	290	40	95	130
Cost Estimate ($M) (IBE) 4L = 4 lane / 2L = 2 Lane	4L ~$450 2L ~$360	4L ~$690 2L ~$550	4L ~$600 2L ~$480	4L ~$300 2L ~$240	4L ~$300 2L ~$240	4L ~$300 2L ~$240
Transport BCR (excl. Wider Economic Benefits) (4L)	0.33 – 0.37	0.22 – 0.24	0.22 – 0.25	0.24 – 0.37	0.22 – 0.33	0.22 – 0.33
Traffic removed off current SH1	75% (with N4)	66% (with N4)	64% (with N4)	75% (with S6)	68% (with S6)	<68% (with S6)
Other Key Environmental Effects	Severance & Amenity around Manakau	Resilience, Ecology	Landscape, Ecology	Ecology, Heritage Buildings	Social Impact	Social Impact
Alignment with key project objectives	✓✓✓✓✓	✓✓✓	✓✓✓	✓✓✓✓✓	✓✓✓✓✓	✓✓✓✓✓
MCA performance (best to worst by section relative to one another)[104]	1st	2nd	3rd	2nd	1st	3rd

There are advantages and disadvantages with all of the shortlisted options. S6 is shorter and cheaper than the other southern options and takes more traffic off the current SH1, but has additional impacts in regards to dwellings, severance and amenity. The northern options are much more similar and have less to choose between them. Notably, N4 would remove more traffic from the existing SH1 than the other northern options.

All options were taken forward to public consultation.

3.3.2 Short Listed Corridor Option Assessment Process

The first step in the short-listing process was to undertake engagement with landowners, key stakeholders and the Horowhenua community on the shortlisted corridor options. This engagement occurred between January and March 2018 (and is referred to as the "Public Engagement Programme 2018").

The Public Engagement Programme 2018 was focused on asking people to identify what they liked or did not like about each short-listed option in order to understand their reasoning for an option preference.

[104] MCA was undertaken considering the following criteria: Landscape/Visual Impact, Ecological Impacts, Impact on Heritage, Tāngata Whenua Cultural Values, Productive Land Values, Social/Community/Recreation Impacts, Impacts on Dwellings, District Development, Fit to Project Objectives, Property Degree of Difficulty, Engineering Considerations and Cost

Public Feedback on the Southern Route Options

For the Southern Route, Option S6 was favoured by most due to its safety benefits, journey time savings, resilience, and cost effectiveness, but its potential (negative) impacts on Manakau were noted. Southern Route Option S7 was favoured by some due to its reduced impacts on Manakau, but concerns around its resilience, landscape, and ecology impacts were noted.

Some people acknowledged Option S7A was a good compromise between Option S6 and Option S7. However, there was limited overall support for this option as it was longer, less direct and did not meet the project objectives to the same extent as Option S6 or Option S7.

Public Feedback on the Northern Route Options

In the north, Northern Route Option N4 was favoured by many submitters. They considered that this option would best meet the project objectives and that it was located near existing developments. However, a number of concerns were raised about this option's effects on ecology, productive land, heritage and on existing dwellings. Option N9 was favoured by some submitters for a connection to S7 and due to it affecting the least number of dwellings. Option N5 received limited comments from submitters.

Further technical assessments

Further technical assessments were undertaken on the short-listed options in early 2018 and prior to the MCA update outlined below, including:

- Cost estimates – identified that the northern options had similar costs and the southern sections had the largest cost ranges with S6 being the least expensive;
- Transport modelling – examined travel time savings for the key regional journeys under a low and "HDC Long Term Plan" growth scenarios. Under both scenarios, the modelling showed that trips to SH1 North of Levin and to SH57 North east of Levin would result in significant savings for all routes. The modelling also showed that some of the Northern Corridor Route options that were located further away from Levin would result in travel time increases. The analysis also showed the new highway would attract between 65% and 75% of existing SH1 traffic (south of Ohau) with options S6 and N4 removing the most traffic off the current network; and
- Economic analysis – identified high level transport benefits and BCR sensitivities. This analysis identified that the routes would deliver safety (i.e. crash savings), resilience, vehicle operating, travel time savings and carbon dioxide benefits. The results of the economic analysis are presented in Table 2-3.It shows that the results across the options are broadly similar, but with S6 and N4 having the highest BCR.

MCA Update Process

Between March and June 2018, each of the MCA assessors reviewed their original evaluations based on the feedback received from the Public Engagement Programme 2018 and the technical assessments outlined above. In addition, further technical information was gathered on potential noise, heritage and ecology effects of the short-listed options. An assessment of the relative social impacts of the short listed options was also undertaken.

Southern Section

For the southern section the "differentiator analysis" focused on seven (of the 12) MCA assessment criteria that had more than a 1 point difference for the shortlisted options, the most common feedback themes from the Public Engagement Programme 2018 and the additional technical assessment results.

Corridor Route Option S6 was recommended in the IBC as the preferred option performing well through the MCA process, including being the lowest cost option and the one that performed the strongest against the project objectives.

Northern Section

For the northern section, the differentiator analysis focused on two (of the 12) MCA assessment criteria that had more than a 1 point difference for the shortlisted options (these being ecology and heritage), the most common feedback themes from the Public Engagement Programme 2018 and the additional technical assessment results. For the purposes of the assessment, it was assumed that the northern options will be connected to the preferred S6 corridor route.

The IBC recommended that **Corridor Option N4** be advanced as the preferred northern option as it performed the strongest in terms of the achievement of project objectives, and would have the least social effects and impacts on existing properties.

A summary of the combined southern and northern preferred corridor route option for the Ō2NL Project is set out in Figure 3-13.

Figure 3-13. Ōtaki to North of Levin Preferred Corridor Route

The following project outcome assessment summary is from the IBC. It highlighted that all project outcomes were met through the Ōtaki to north of Levin preferred corridor route.

Table 3-9. Preferred Option Outcome Assessment

This analysis was undertaken in the Indicative Business Case and therefore the information presented is based on pre-2018 data and analysis. This information has not been updated and should not be used to identify what the current outcomes would be.

Project Outcomes		Measure	Ōtaki to north of Levin New Offline Highway
IBC	Safety	DSI Savings per 5 years	35 – 40+ depending on local road and revocation treatments
		KiwiRAP Star Rating	4.5+
	Resilience	Number and duration of journeys affected	Alternative route provided. Crash and flooding problems addressed
	Horowhenua Growth	Appropriate connections to urban areas	Removal of through traffic improves safety of East Levin, Manakau and Ohau growth areas. Ease of access dependent on interchange strategy.
	Levin Town Centre	Reduce number of trucks in the main retail area of Levin	Significant reduction as Levin can be bypassed
	Inter-regional Growth	Travel times on SH network	Improvement for all key routes
Value for Money		Cost	~$575M+ +$125M property
		BCR	0.37

3.4 PREFERRED OPTION REFINEMENT

Significant refinement of the IBC preferred option was needed to better understand the costs, outcomes, effects and network implications of the project. This was undertaken through a number of different processes as part of this DBC:

- **Highway alignment** – this work was undertaken to reduce the 300m corridor down to a route that would need to be designated and for which property would need to be purchased.
- **Interchanges** – there are many locations where interchanges could be located, so investigations were undertaken to determine the preferred locations and form of the connections
- **Local Roads** – the corridor passes over many existing local roads, so a separate workstream was developed to determine how these should be reconnected to the network
- **Prioritisation** – The NZUP scope required investigations into opportunities to prioritise freight, public transport and vehicles carrying multiple people
- **Value Engineering** – consideration of opportunities to improve value for money of the project by reconsidering scope, standards and assumptions.
- **Greenhouse Gas Emissions** – consideration of opportunities to reduce enabled emissions and embodied greenhouse gas emissions through construction by considering scope, materials, construction practices etc

3.4.1 Highway Alignment, Interchange and Local Roads

The MCA processes and outcomes for these processes to identify the preferred alignment for the new highway (to be located within the IBC's preferred corridor route), the location for the new interchanges and local road connections, are fully described in the *Multi Criteria Analysis Assessment Report: Assessment of New highway alignment, interchange and Local Road Options (October 2021)*. This report is referred to in this DBC as the "MCA Report 2021".

In summary, the MCA DBC processes undertaken to identify a preferred new highway, interchange locations / forms and local road connections were undertaken in accordance with the following steps:

- **Stage 1** – Long to short list assessment processes to identify a short list of alignment and interchange location / form preferences for detailed MCA evaluation.
- **Stage 2** – Short list of alignments and interchange MCAs, including MCA Workshops 1 (Alignment) and 2 (Interchanges and Local Roads).
- **Stage 3A** – Iwi engagement on the draft preferred highway alignment and interchange options and iwi MCA scoring on the options.
- **Stage 3B** – Public engagement on the draft preferred alignment, interchange and local road options. Refer to Appendix F.2 through to F.4 for further information.
- **Stage 4** – Preferred alignment and interchange MCA Workshop (November 2020).
- **Stage 5** – Additional MCAs for the interchange close to Taylors Road (Ōtaki), Tararua to Kimberley local road reconnection and SH1 / Tararua Road intersection and NIMT crossing.
- **East of Taitoko/Levin MCA** – A separate process was undertaken on the integration of the highway into the landscape and future urban form east of Taitoko/Levin.

The following section summarises the preferred option for the Ō2NL Project (i.e. the combined preferred alignment for the new highway, the interchange locations / forms for the new highway, and local road connection options).

Preferred new highway alignment

To determine the preferred alignment, the highway was broken into 10 zones and a number of different alignments were considered within each zone, and taken through stages 1-4 above. The outcome of this process was a narrower route (compared to the 300m wide IBC corridor) which has been brought through into the concept design.

Preferred interchange locations / forms

The outcome of the process investigating interchange locations / forms for the Ō2NL Project is set out in Table 3-10 below. Note Figure 3-13 shows the locations.

Table 3-10. Interchange location / form option preferences

Interchange Location	Preferred interchange location / forms for Ō2NL Project
Manakau / Kuku	No connection, but if a connection is to be provided in the future, then there is a preference for an interchange to be located at Kuku (form undecided)
Kimberley or Tararua	A full grade separated (compact diamond) interchange at Tararua
SH1 / SH57 Split	Roundabout
North Levin	Roundabout

The above combination of interchange forms/locations is consistent with the interchange principles and strategy identified during the IBC phase. It was not considered necessary to consider different combinations of forms and locations. The best options at each location form a coherent strategy which maximises project outcomes.

Preferred local road options

The outcome of the process investigating local road connection options for the Ō2NL Project was a set of connection options that was taken through into concept design.

However, based on community feedback, iwi partner feedback and geotechnical investigations a couple of locations were subject to additional consideration, including the connection at the southern end of the project, and connections east of Levin to Tara-Ika.

In summary, the proposed local road connections are:

- A half interchange with southbound ramps near Taylors Road and the connection to the new Peka Peka to Ōtaki expressway. This provides access from the existing SH1 onto the Ō2NL Project for traffic heading south from Manakau/ heading north from Wellington, as well as providing an alternate access to Ōtaki;
- Local road underpasses at Sorensons Road and South Manakau Road to retain local connections
- Local road overpasses for continued local road connectivity at Honi Taipua Road, North Manakau Road, Kuku East Road, Muhunoa East Road, Tararua Road (as part of the interchange), and Queen Street;
- New local road connections between Tararua Road and Kimberley Road and between Waihou Road and McDonald Road, immediately east of the new highway, as well as new local roads at Kuku East Road and Manukau Height Road to provide access to properties located to the east of the Ō2NL Project;

This combination ensures good connectivity for the local community and maximises project outcomes.

SH1 / Tararua Road intersection option

The preferred option at the SH1/Tararua Road intersection (to ensure safe and efficient connection from the highway interchange back to SH1 in Levin over the railway line) is signalisation of a Tararua Road extension. This would provide a new four arm intersection which would include signalisation of the railway line through the intersection.

Partner Involvement

Hapū and iwi partners were involved throughout the option refinement process and had specific involvement in the multi-criteria analysis. The project principles that were developed with iwi partners through the CEDF also influenced the project decisions through this time.

Consultation

A shortlist of the critical refinement and connection options was taken through a large public and stakeholder engagement exercise as part of a community update of the entire Ō2NL project. This was undertaken in August and September 2020 via community events, property owner meetings and Social Pinpoint online mapping. In particular feedback was sought on how people would use the new highway and connections, options for connecting local roads (including options for Kimberley Road area and around Waihou and McDonald roads), and considerations for a shared path. The Ō2NL project team published an Engagement Summary Report with the findings of this engagement in March 2021, refer Appendix F.2[105].

During this exercise, the project as a whole received broad support and the inputs on specific options was considered before a decision on the preferred option was made. Key feedback included:

- Support for a full diamond interchange at Taraua
- Support for the local road connections including the option for a parallel local road in the vicinity of Kimberley Road
- Support for the walking and cycling SUP and suggestions that it be fully connected with townships, river reserves and available for all users.

3.4.2 High Occupancy Vehicle, Freight and Public Transport

The NZ Upgrade Programme scope stated that Investigations will look at opportunities to prioritise freight, public transport and vehicles carrying multiple people.

High Occupancy Vehicle Prioritisation

The benefits of high occupancy vehicle (HOV) lanes have been noted across the country with success in improving road network performance in Auckland and Christchurch. In light of this, a qualitative analysis of HOV lanes along the Ō2NL highway was undertaken to determine the impact these lanes would have on highway performance.

In the absence of HOV statistics for the Ōtaki and Levin areas, a previous study[106] was utilised to inform the HOV numbers. based on this study a conservative rate of 20% HOV usage was assumed for the peak hour analysis, together with a highway with a single general traffic lane and single HOV lane in each direction. The qualitative analysis revealed that vehicles will travel on the new highway at uncongested, free-flow speed conditions, with the details shown below:

- The general traffic lane would theoretically operate at 94km/h and
- The dedicated HOV lane would operate at free flow speed, 98km/h.

It is expected that introduction of a HOV lane would not result in any significant change in car sharing. This is because:

[105] See: Waka Kotahi - Ō2NL Engagement Summary report (August – September 2020)
[106] See: Waka Kotahi – Priority Lanes

- The difference in speed between the HOV lane the general traffic lane would be negligible; and
- There are limited commuter flows on this part of the network. This is evidenced by the hourly traffic flows in Section 1.5.1 which shows hourly traffic flows are similar between 8am and 2pm; and
- There are no HOV lanes on the PP2Ō expressway or any other part of the road network in the lower north island.

Nevertheless, HOV lanes could be implemented on the new highway without affecting the footprint of the project or the statutory authorisations for which are being applied. Supporting design details such as road markings, signage, and ITS application(s) would be considered during detailed design. This special purpose lane could be implemented at any point in the future when capacity constraints are being felt and more of a differentiation would be seen between travel speeds.

Freight Prioritisation

An additional scenario with a single general traffic lane and a shared freight and HOV lane was analysed. Previous model forecasts showed freight utilisation on the road network at approximately 8%. This would have similar result to the above scenario:

- The general traffic lane would theoretically continue to operate at 94 km/h
- Speeds for freight (max 90 km/h) would for the most remain unaffected irrespective of two general traffic lanes or a single shared lane; and
- A shared freight / HOV lane would not result in improved performance as the operating speeds of 90 km/h max would likely be less than the general traffic lane speed of 94 km/h.

Based on the above, the introduction of a priority lane for freight would not benefit freight under the expected traffic demand.

Public Transport Prioritisation

Consideration has been given as to how to provide prioritisation for public transport on the new highway. Again, there is not expected to be any benefit in this as public transport services currently use, and would likely continue to use, the current SH1, as this is the best route to connect the townships of Ohau, Manakau and Levin. Regional rail public transport is served by the capital connection service contracted by Horizons and Greater Wellington Regional Councils.

However, with the reduction in traffic using the current SH1, public transport services will benefit, both in terms of improved travel times and improved reliability. The new highway will also open up additional opportunities to increase public transport attractiveness along the old highway in terms of safety and infrastructure. These should be integrated with any rail public transport improvements as progressed through LNIPIM.

The proposed Ō2NL Integration Group will provide a pathway towards masterplanning which provides integration and support for active and public transport options, including bus and rail.

3.4.3 Greenhouse Gas Emissions

Climate change is a key strategic priority for the government. Through the New Zealand Upgrade Programme (NZUP), Ō2NL is also established as a key priority – addressing a serious infrastructure and safety deficit in the region. The existing highway between Ōtaki and north of Levin is among New Zealand's most dangerous roads. In the last five years 72 people were killed or seriously injured and there is no alternative route.

Reducing greenhouse gases (GHG) is a high priority for this project. It is essential emissions are kept as low as possible to limit further global warming, which would in turn worsen problems of resilience and wellbeing elsewhere. This priority sits alongside the need to improve the resilience of the design through location and design standards that accommodate forecast climate changes and associated weather events.

While it is inevitable some emissions will be released during construction and use of Ō2NL, we have a unique and early opportunity to identify ways to reduce emissions during construction,

including embodied emissions – the largest contributor for this project. There are also valuable actions we can take to reduce enabled emissions in the local area, and which Ō2NL can help to deliver.

Changes we identify now are only the beginning. Identifying and documenting emissions this early in the project will support further emission reductions that may not be realised if deferred. Additionally, once the project is at detailed design, far greater savings are expected to be quantified with further research and advances in technology.

Three sources of greenhouse gas emissions were considered:

- Construction Emissions:
    - Emissions that arise during the construction of land transport infrastructure. This includes use of machinery and equipment on site, and transport of material to/from the site.
    - Embodied emissions that arise from the production of materials used in construction, with the quantity of emissions depending on the types and quantities of materials used.
- Operational Emissions:
    - Emissions that arise through regular operation and maintenance of the infrastructure.
- Enabled Emissions:
    - Emissions that arise from motor vehicles using the infrastructure once it has been completed.

To decide how best to reduce emissions, baseline estimates of enabled and construction emissions were calculated (refer to section 3.6.3 for calculation methodology and assumptions), providing the following baseline:

- Total construction and embodied emissions: estimated at between 80,000 and 104,000 t CO_2e
- Change in total network enabled emissions (2029-2049): compared to Do Minimum network: 36,750 t CO_2e.

The assessment showed that construction emissions were significantly higher than enabled emissions. Scope to reduce enabled emissions is discussed below and to reduce embodied emissions is discussed in the following section.

Based on the Waka Kotahi Monetised Benefits and Costs Manual and latest high carbon price pathways, the total CO_2e emissions would amount to less than $25M, a fraction of the overall project cost estimate. However, the focus is on achieving broader climate change outcomes. The economic analysis presented in Section 3.7 below considers these economic impacts in more detail.

Enabled Emissions

As acknowledged in Our Sustainability Action Plan, the greatest potential for reducing emissions is by reducing vehicle kilometres travelled by light vehicles within NZ's largest cities. Although the Ō2NL project area is not in a city, the Avoid-Shift-Improve model from the Our Sustainability Action Plan to achieve 'Sustainable Urban Access' has been applied to Ō2NL in Table 3-11, to consider potential opportunities to reduce enabled emissions.

Table 3-11. Ō2NL Sustainability Framework applications

Approach	Ō2NL
Avoid/Reduce the need to travel, or the time or distance travelled by car while improving	Integrated Land Use and Transport Planning - land use growth and development located spatially to maintain current levels or reduce the number of journeys made by private motor vehicles

Approach	Ō2NL
accessibility e.g. through integrated land use and transport planning for urban form that supports well connected multi-modal access to local services and employment	(including trucks) - was considered in the IBC as a strategic alternative (see Section 3.2), but it was determined that it would not resolve the problems. However, Ō2NL can help support better and higher density land use near existing urban areas through removal of traffic from the existing highway and reduction in safety and efficiency constraints to development. For example, Ō2NL will support the development of up to 3,700 new houses at Tara-Ika, adjacent to the existing Levin urban area, and the SUP provides an active mode spine along the project extent which can connect to current and future communities .
Shift/Maintain focuses on shifting people to more energy efficient modes such as public or active transport, e.g. through better provision of low carbon travel options and incentives to choose them	The Shared User Path (which provides connections to all local roads and to Manakau, Ohau and Levin) is a step change in provision for cycling in the district and region. This will provide a significantly improved north / south walking and cycling facility through the district. A complementary programme could be developed separately to Ō2NL for a district cycle network that capitalises on the new SUP as the primary cycling corridor. The function of SH1 is primarily to provide for vehicle trips within the district. As such, Ō2NL will continue to support driving over other modes of transport. However, the project has potential to enable shorter local trips to be made by alternate modes to some degree through enabling changes to the existing highway. For example, public transport services could be improved along the current SH1 as Ō2NL would remove many other vehicles making PT journeys more attractive. This is outside the scope of Ō2NL, but the Ō2NL project team will continue to pursue this with HDC and KCDC through the revocation programme. Increased frequency of passenger train services to Wellington and Palmerston North would support mode shift, and can be pursued as appropriate alongside (but separate to) Ō2NL.
Improve focuses on improving the energy efficiency of motorised vehicles; and optimisation of transport infrastructure and operations for more efficient vehicle movement	Ō2NL does not contribute to this approach as it focuses on fleet improvements and optimising the existing network. This will be considered when a decision is made as to whether to propose revocation of the state highway status from the current highways. If revocation is proposed, the activities that need to be undertaken to make the current state highways fit for purpose as local roads will also need to be considered. This will include optimisation of transport infrastructure. The Ō2NL project team have begun this process and work to date is summarised in Section 3.8.1.

Table 3-11 demonstrates that there are valuable actions that can be taken to reduce enabled emissions in the local area, and Ō2NL infrastructure or related initiatives support these.

The Minister has directed NZUP projects to focus on reducing construction emissions - which have been identified through CIPA (Climate implications of policy assessment) to contribute most significantly to emissions resulting from NZUP Projects. Construction emissions include embodied emissions, which are those that have been released during the process of extracting/manufacturing materials required for construction, and emissions arising from the construction process e.g. fuel

used to transport materials to the site, energy used in construction processes. These are discussed in the next section.

3.4.4 Embodied Greenhouse Gas Emission Reduction and Value Engineering

During the refinement of the preferred option, assessments of GHG reduction opportunities and project cost efficiency/cost reduction opportunities (through a value engineering (VE)) processes were undertaken.

Given the similar process, and the fact that many opportunities would benefit both outcomes, these two workstreams were closely integrated. Furthermore, GHG reduction is an appropriate item to cover within an overarching value engineering scope, given reducing embodied carbon is a value driver for the project, noting that VE is more holistic than simply seeking cost reduction.

As directed by the Waka Kotahi Board, two approaches to reducing GHG were investigated, one which targets a 20% reduction in construction emissions (Workstream 1), and one which explored how zero net emissions could be achieved, delivering safety, resilience and other project outcomes 12-months later than initially proposed - resulting in construction completion shifting (Workstream 2).

For full details of the methodology and opportunities identified refer to the GHG Reduction Opportunities Process Report (Appendix J.2).

Figure 3-14. Opportunity Identification and Shortlisting

GHG emission reduction opportunities for the project were identified through a series of interviews with technical discipline leads (geometrics, drainage/stormwater, earthworks, pavement, structures, construction, civil/roading, ground improvements, landscaping and urban design, operation) and sustainable infrastructure experts. Feedback was also sought from iwi partners.

VE opportunities for the project, including cost or scope reduction, were identified by the project design team.

The Value Engineering opportunities register was incorporated into the GHG reduction opportunities register to create a combined VE/GHG longlist. This allowed for both the value

engineering opportunities and GHG opportunities to be screened and assessed with regards to their GHG emission reduction impact potential, cost/scope reduction potential and wider project impacts, while still achieving the project objectives and consistency with the project scope.

All opportunities in the combined long list register were reviewed by the wider project team and qualitatively assessed using a scoring system to categorise the project impacts of each.

A project workshop was held to review the scores for each opportunity and allocate it to one of three categories:

- **Workstream 1** - short listed opportunities for immediate investigation, targeting a 20% reduction in emissions
- **Workstream 2** – short listed opportunities requiring further investigation, which, along with Workstream 1 opportunities would target net zero emissions project but which may delay the Project construction completion by up to 12 months (or have an impact on the project scope).
- **Workstream 3** – opportunities that were not taken forward as the assessment process identified they were not suitable for this project, but could be considered for other projects.

GHG embodied emissions reduction potential

A total of 126 opportunities were identified as having GHG reduction potential (through the current design as well as in future detailed design and subsequent project phases), with 87 considered feasible for further investigation and the GHG reduction impact of each quantified or confirmed as high, medium or low, or where possible, their GHG quantified[107] (see Appendix J.2).

While both Workstreams were investigated, Workstream 1 (targeting a 20% reduction in GHG) has been taken forward because:

- Zero net emissions cannot be achieved on the project (even with a 12 month delay) unless the project purchases GHG emissions offsets.
- Waka Kotahi is focussed on addressing emissions at source, rather than offsetting, although guided in this space by the Government's broader initiatives/approach to offsetting which may change in the future.
- The amount and cost of off-setting is not easily quantifiable, which makes it difficult to accurately estimate or comply.

Once further quantification of the feasible opportunities had occurred, the Workstream 2 opportunities were reviewed again to see if any high or medium reduction opportunities could continue to be investigated and then implemented without causing delay to the project. As a result, the opportunity to 'reduce lane numbers where four lanes are not required for capacity (i.e. north of SH57 roundabout)' is recommended for further investigation (see the discussion of staging below).

To maximise the potential for any of the Workstream 1 opportunities to be implemented, an internal pathway document (Appendix J.3) has been developed to provide early signals regarding:

- Where changes to Waka Kotahi technical standards and specifications are required to enable any of the opportunities identified to date to be considered
- Immediately identified research requirements for any opportunity
- Where the opportunity could be included as Principal and Minimum Requirement in construction contracts with the supplier (as an opportunity which has already been included

[107] It was not possible to quantify all opportunities because either:
- The level of design is insufficient to effectively determine quantities at this stage or requires additional design development to determine quantities or change (i.e. there is too much uncertainty to materially provide data that would support quantification);
- The opportunity identifies a process or general approach that does not result in a direct material substitution or change – and therefore typically requires additional work to be able to directly implement;
- They are matters that are typically determined by the design and construction contractors commissioned to deliver the work; and/or
- Some of the opportunities had already been included in the design.

in the project design or methodology or is good construction practice that has been successfully implemented on other Waka Kotahi projects)

- What procurement strategy could be used to encourage implementation of the opportunity to achieve the 20% GHG reduction target and beyond

Incorporation of ten opportunities that have been able to be quantified and are recommended as contractual requirements has resulted in the potential for approximately a 7% reduction in GHG emissions. These opportunities are:

- The reuse of site won materials such as sand
- Optimise cut/fill balance to reduce earthworks
- Reduce vertical profile on crest to reduce fill
- Reduce median width to 3m total on long straight sections
- Change to w-section safety barrier which will reduce shoulder width, and make swale slopes steeper front and back (e.g. 1V:2H)
- Cut more into Sorensen property to balance the Zone 1 mass haul (to reduce movement of material)
- Reduce long low fills to reduce total amount of earthworks
- Source materials for pavement aggregate supply from borrow sites close to the new roadway
- Rail bridge reduced in overall width by approximately 12m
- Utilise narrower shoulders and median via use of rigid barrier types to reduce bridge footprints. Opportunity to remove or narrow footpaths from bridge structures narrowing the structure and reducing materials required.

This is the first time in NZ that any emissions savings have been identified this early in a project and this early approach to identifying and documenting emissions should aid the project and design teams in further emission reductions that may not be readily realised if deferred to later project stages. Greater savings are expected to be quantified once the project is at the detailed design phase, particularly as research is undertaken and technology is advanced. The two and half year lead up to construction means there is time to carry out the opportunity realisation/investigation and potential implementation pathways identified for each opportunity.

Value Engineering

Prior to the formal GHG/VE process, a number of design changes which would constitute 'VE' activity had already been initiated but were primarily identified and completed through normal design progression and iteration as the design work for the Project was advanced.

These included the following elements that are quantified further in the Value Engineering Report (see Appendix M.2).

- Taylors Road connection alteration to half interchange reducing bridge costs
- Geometric design philosophy to reduce footprint and earthworks
- Removal of the dual SUP over the NIMT Rail Bridge to reduce bridge costs and providing alternate connectivity
- Recognising the opportunity to locate some sections of the SUP onto the existing state highways to reduce earthworks and better connect communities
- SH57 roundabout connection rather than a full interchange (chosen primarily through MCA analyses but has cost benefits)

Through the later formalised VE activities, additional opportunities were identified. The opportunities that are considered to have a 'high' cost reduction potential are:

- **Options around material supply and better balancing of earthworks, including reduction in vertical profile standards and identification of local material supply and spoil sites**
- **Alternative edge treatment incorporating w-section barrier, reducing area behind barrier and steeper swale front slope to reduce material quantities**
- **Reduce median width to 3.0m total on long straight sections or large radius curves when no impact on sight distance**
- Reducing lane numbers where four lanes are not required for capacity (i.e. north of SH57 roundabout) - as discussed in the stating section below.
- Reduction in road surface levels to remove a number of long low fills across the project.

Those identified in bold above (as well as some other minor opportunities) have now been brought into design and are included in the cost estimate for this DBC. The remaining opportunities have been retained and will be investigated further during the detailed design phase. The two-laning north of SH57 is a relatively high-cost-saving opportunity which is discussed further later in this report.

An overarching VE cost saving in the order of $100M (including Preliminary and General (P&G) etc) was identified. Given some items may not be progressed when the implications are carefully tested, a cautious approach should be taken here and a cost saving (relative to the Dec 2021 reconciled estimate) in the order of $50-70M is likely.

3.4.5 Staging Options

Staging options for the preferred alignment were identified and considered in the 2021 DBC Interim Staging Assessment Report (Refer Appendix E). The staging report reviewed the effects of several geographic and form staging permutations against the project objectives. This section provides a summary of the key findings.

The current scope of the project, as defined by the New Zealand Upgrade Programme, includes four lanes, and public expectations have been set for a four lane highway. In addition, the assessment undertaken in Section 3.2.3 concluded that four lanes will be required well within the 30 year design life of the highway and there would be significant impacts and effects if only two lanes were adopted. Nevertheless, a staging assessment has been undertaken to determine if there are opportunities to defer some elements of the project whilst still delivering the outcomes and benefits sought.

Staging Options

Geographic Staging Options Considered

There are three main geographic options that can be considered for the delivery of the new highway:

- Construct the south section only, from Ōtaki to the Kimberley Road / Arapaepae Road intersection (red, exclusive of the dotted line)
- Construct the northern section only, linking SH1 and SH57 to the north of Levin (yellow)
- Construct the northern and southern sections, but use the existing /current SH57 between Kimberley Road and the northern section i.e. between the red and yellow sections.

These sections are shown in Figure 3-15.

Figure 3-15. Geographic sections of the highway

Construction of just the section parallel to SH57 has not been considered as an early stage as it delivers only minimal benefits to a small number of regional journeys (i.e. those using SH57 between Tararua/Kimberley Road and Heatherlea East Road) in comparison to the sections to the north and south.

Form Staging Options Considered

The new highway has also been considered in terms of being a two lane or four lane highway with the following permutations.

- Two lanes for the entire new highway with 1.5km passing lanes every 5km and at-grade intersections
- Four lanes from the south up to the Tararua Interchange (red included dotted line), then two lanes further north (blue and yellow)
- Four lanes up to the SH1/57 split (red and blue) then two lanes further north (yellow)

For this assessment, it was assumed that the central two lanes would be constructed, as opposed to the eastern or western two lanes; this enables median separation.

Interchange Staging

No interchange staging options were assessed. This was due to the following:

- As the only major grade separated interchange, only the indicative Tararua interchange is suitable for staging
- Interchange staging does not remove enough costs to deliver any significant cashflow benefits

Assessment of Outcomes

Each staging option was assessed against the project objectives, relative to the Do-minimum, along with consideration of the costs, benefits and disbenefits. Two options were recommended to be discarded based on this assessment, outlined in Table 3-12.

Table 3-12. Staging Options – Achievement of Objectives

Option	Safety	Resilience	Horowhenua Growth	Integrated Access	Reliability	Mode Choice	Outcome
South Only	Moderate	Moderate	Minor	Minor	Moderate	Minor	
North Only	Neutral	Neutral	Negative	Neutral	Negative	Minor	*Exclude as disbenefits relative to Do Min*
North and South	Moderate	Moderate	Moderate	Minor	Moderate	Major	*Exclude as severe future impacts on Tara-Ika, less benefits than two lanes*
Two Lanes - full	Moderate	Moderate	Moderate	Major	Moderate	Major	
Four Lanes to Tararua - Two Lanes Onwards	Moderate	Major	Moderate	Major	Moderate	Major	
Four Lanes to SH1/57- Two Lanes Onwards	Major	Major	Major	Major	Major	Major	
4 Lanes	Major	Major	Major	Major	Major	Major	*For comparison*

The 'north only' option delivers a disbenefit compared to the do-nothing option, as well as not delivering against the project objectives. The purpose of this option was to see if it provided a 'Levin Bypass' but the modelling shows that this is not attractive and therefore would not be used by significant volumes of traffic. It would not result in many trucks being removed from Levin but would put more traffic through a growth area. It should therefore be discarded.

The 'north and south' option delivers less benefits when compared to the 'two lane - full' option and places additional traffic demand on SH57. There would also be significant effects in constructing four lanes through Tara-Ika in the future once development has occurred. In the interim, there would also be disbenefits in terms of the traffic generated by the Tara-Ika development conflicting with highway traffic.

Feasible Options

Four scope and staging options were considered feasible:

- South Only: Constructing the southern section only (from Taylors Road to SH57 Arapaepae Road).
- Two Lanes – full:
- Four lanes to Tararua – Two Lanes Onward
- Four lanes to SH1/SH57 – Two Lanes Onward

These options are discussed further in Table 3-13 below[108], alongside the no staging option for comparison.

[108] Note that the Staging Assessment was completed in January 2021, prior to updated final cost estimation, full procedures economic analysis or emissions modelling. However, the cost estimates in the Table 3-1 have been scaled to reflect the current four lane September 2021 estimate of $1.546B.

Table 3-13. Assessment of Staging Options

Option	Project Objectives					Cost and Benefit Estimates (% of 4L)				Comments
						Standalone Stage			Total Cost of both stages	
	Safety (SH Network)	Resilience (SH Network)	Appropriate Connections (integration of SH & local roads)	Enable mode choice (local communities)	Support Growth	P50 Cost ($m)	Cost Relative to 4L	Benefits Relative to 4L		
4 lanes (No staging)	Returns 100% of the safety benefit	Provides future-proofed alternative route	Decreased traffic on streets in Levin, improving safety and amenity and facilitating Transforming Taitoko	Provides a full shared use path	Supports planned growth areas	$1,546	100%	100%	100%	
South only	Returns 41% of the safety benefit	Provides future-proofed alternative route for critical issues in the south	Retains traffic on streets in Levin, negatively impacting safety and amenity and limiting Transforming Taitoko improvements	Does not provide full shared use path	Does not significantly support Tara-Ika or growth areas to the north	$1,000	65%	59%	104%	Significant future disruption of building a new highway through Tara-Ika
4 lanes to Tararua	Returns 82% of the safety benefits	Provides future-proofed alternative route	Decreased traffic on streets in Levin, improving safety and amenity and facilitating Transforming Taitoko	Provides a full shared use path	Partially supports growth areas	$1,450	94%	96%	110%	Significant future disruption of building four lanes through Tara-Ika
4 lanes to SH57	Returns 94% of the safety benefit	Provides future-proofed alternative route	Decreased traffic on streets in Levin, improving safety and amenity and facilitating Transforming Taitoko	Provides a full shared use path	Supports growth areas	$1,500	98%	97%	101%	Little impact on outcomes as traffic demand on this section is reduced
2 lanes - full	Returns 65% of the safety benefit	Limited resilience benefits compared to a four-lane highway for responding to an unplanned event	Decreased traffic on streets in Levin but not to the same extent as four laning	Provides a full shared use path	Partially supports growth areas	$1,290	84%	83%	108%	Very disruptive to expand to four lanes in the future as affects the entire length with particular issues at Tara-Ika and where creating grade separation.

There are no environmental benefits from staging as if the full scheme is being developed in the future, these impacts need to be catered for during the first stage (i.e. land purchase, RMA conditions). Whilst no detailed assessment has been undertaken on embodied carbon, it is assumed that this will change in line with cost reductions.

In summary, none of the options provide a better return on investment than the full offline highway, they either have a similar ratio of % costs to % benefits, or worse.

It is not recommended that staging options be considered further as they have a significant impact on outcomes and benefits and would create significant effects when coming back to deliver the full 4 lanes, particularly through the Tara-Ika growth area. The previous Section 3.2.3 demonstrated that providing two lanes also has significant risks with partners, stakeholders and the public and does not have enough capacity to deliver an enduring legacy.

It is recommended that the full project proceed without staging. This would still be the right option even if the economy does not track as expected as it is the only way to fully realise the outcomes needed in relation to safety, resilience and amenity in the Levin town centre. Building the project in two stages ultimately increases costs, increases disruption, increases effects and increases carbon emissions.

However, there is an opportunity to reduce cost by and potential carbon impacts with a negligible impact on project outcomes. This is possible by constructing four lanes from Taylors Road to the new SH57 roundabout north of Levin, then two lanes across to SH1 north of Levin. This would not need four laning in the medium to long term as the traffic volumes north of where SH57 traffic leaves are significantly lower.

This option is discussed further in the Value Engineering section (see Section 3.4.4). This option is recommended for further investigation through the next phase of project development.

3.5 PREFERRED OPTION DESCRIPTION

The Ō2NL Project includes the following features (as displayed in Figure 3-16):

- Approximately 24km four-lane (two lanes in each direction), median divided highway between Taylors Road north of Ōtaki and north of Taitoko/Levin, where it connects back into the existing SH1. The highway is currently designed to enable a speed limit of either 100km/h or 110km/h and connects to the end of the Peka Peka to Ōtaki Expressway;
- A grade separated diamond interchange at Tararua Road providing access into Levin;
- Roundabouts where the Ō2NL Project crosses SH57 and where it ends at SH1 north of Levin;
- Bridges over the Waiauti, Waikawa and Kuku Streams, the Ohau River, and the NIMT rail;
- A half interchange with south facing ramps near Taylors Road and the connection to the new Peka Peka to Ōtaki expressway. This provides access from the existing SH1 onto the Ō2NL Project for traffic heading south from Manakau/ heading north from Wellington, as well as providing an alternate access to Ōtaki;
- Local road underpasses at Sorensons Road and South Manakau Road;
- Local road overpasses for continued local road connectivity at Honi Taipua Road, North Manakau Road, Kuku East Road, Muhunoa East Road, Tararua Road (as part of the interchange), and Queen Street;
- New local road connections between Tararua Road and Kimberley Road and between Waihou Road and McDonald Road, immediately east of the new highway, as well as new local roads at Kuku East Road and Manukau Height Road to provide access to properties located to the east of the Ō2NL Project;
- Relocation and improvement to the Tararua Road / SH1 intersection including the associated NIMT level crossing;
- A separated shared use path (SUP) of a minimum width of 3.0m for walking and cycling along the entire length of the new highway that will link into shared path facilities built as part of the PP2Ō expressway (and further afield to the M2PP expressway shared path), helping to significantly extend the region's cycleway network;
- Stormwater treatment wetlands, stormwater swales, drains, sediment traps[109];
- Culverts to reconnect streams crossed by the proposed works and stream diversions to recreate and reconnect streams;
- Approximately 10km of stream rehabilitation, 9ha of ecological wetland planting and 8ha of ecological terrestrial planting;
- Spoil sites at various locations;
- Five borrow sites for material supply near Waikawa Stream (x3), the Ohau River and south of Heatherlea East Road; and
- Predominately epoxy modified OGPA surfacing with a foamed bitumen stabilised based pavement design.

[109] Note, changing weather pattern risk as a result of climate change will be considered in the design, materials selected, etc, to better achieve resilience and climate change adaptation objectives.

Figure 3-16. Preferred alignment of new offline highway

A typical cross section of the new highway is presented below in Figure 3-17, with the Design Drawings provided in Appendix G and the Design and Construction Report provided in Appendix H.

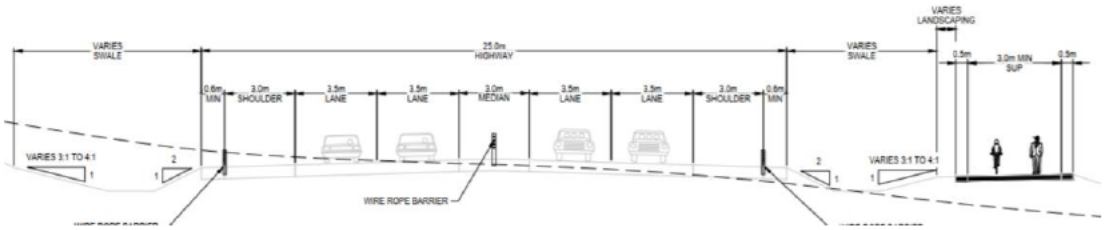


Figure 3-17. Typical cross section example

3.6 PROJECT OUTCOMES

This section of the business case outlines how the preferred option will deliver on the Investment Objectives, benefits measures, and environmental outcomes.

3.6.1 Investment Objectives

Table 3-14 provides an assessment of the preferred option against the key investment objectives while Table 3-15 below provides a more detailed assessment against the benefit measures and KPIs.

Table 3-14. Preferred option alignment vs Investment Objectives

Theme	Assessment	
Safety	**Investment Objective**	**Reduce deaths and serious injuries by 50-55% per annum by 2035**
	Project Outcome	Expected to save in the order of 32-37 DSI's per 5-year period following its opening. This represents a 50-55% reduction in DSI's on the network between Ōtaki and Levin compared to the do-minimum scenario (noting that the do-minimum includes the speed and infrastructure programme (SIP)). This is primarily achieved by the reduction in traffic on a substandard section of highway and shifting it to a high quality directionally separated road. This provides much stronger protection against head on crashes. The KiwiRAP star rating for the new highway will be significantly higher and is designed to target a 4 - 5 star rating.
	Alignment	Strong
Resilience	**Investment Objective**	**Reduce the duration of journeys affected by closures and delays by 60% by 2035**
	Project Outcome	The preferred option will provide a significantly shorter viable local alternative route, remove traffic off high resilience-risk structures, improve the redundancy of the wider transport network by providing additional river/stream crossings and reduce the number of unplanned closures. The transport network will be futureproofed for a changing climate, as flood risk on the existing highway becomes more extreme. In the event of an unplanned closure the revoked section of SH1 will be a much shorter detour option than the current route via the Remutaka Range (which is also prone to closures). Key resilience benefits are: • If the current SH1 route (or Ō2NL) is blocked, an alternative is available that does not require a multiple hour detour. Ō2NL provides at least a 60% reduction in the duration of

Theme	Assessment	
		journeys impacted if an event was to occur between Ōtaki and Levin[110]. The additional route also improves wider system redundancy by providing alternate river and stream crossings. • A reduction in the number of unplanned closures. In the five-year financial year period from 2017-18 to 2021-22 there were 28 unplanned closures on SH1 and 5 unplanned closures on SH57 (within the project area). Of these closures, 32 related to crashes. The project will significantly reduce the likelihood of closures on the state highway network due to crashes. Structures will also be designed to a higher standard than existing structures on the current SH1, making non crash related closures less probable. • The SUP also increases viable mode redundancy. For example, if the Ō2NL or existing SH1/SH57 route(s) are blocked for vehicular travel choosing to walk or cycle is safer and more viable. • Ō2NL will be designed to modern design standards which will recognise route hazards and the more extreme risk profile as the climate changes.
	Alignment	Strong
Local connectivity	Investment Objective	Provide appropriate connections that integrate the state highway and local road network to serve urban areas by 2030.
	Project Outcome	The highway provides access to the local road network east of Levin, at SH57 and north of Levin. These were evaluated as being appropriate connections through the MCA process. All local roads that are crossed by the new highway are planned to be re-connected ensuring that the local road network continues to provide efficient links for local trips. The preferred option will form part of an agreed road hierarchy developed by Waka Kotahi and HDC. It will also reduce travel delays and congestion on the existing SH1, which will make it easier for side road traffic to access the state highway. To this end, the reduction in traffic and improvement in level of service helps to support regional growth.
	Alignment	Strong
Mode choice	Investment Objective	Enables mode choice for journeys between local communities by providing a north-south cycling and walking facility by 2030.
	Project Outcome	A new north-south cycling facility will be delivered by the preferred option enabling mode choice. The shared use path is estimated to attract 150-200 trips per day by 2029. The preferred option also allows for the preservation of existing active mode links. The reduction in traffic along the existing SH1 and SH57 will also make those routes safer and more attractive for cyclists.
	Alignment	Strong
Supporting growth	Investment Objective	Support inter and intra-regional growth and productivity through improved movement of people and freight by 2030

[110] Journeys impacted between Wellington and Levin would reduce in length by at least 60% (95 km Do Min, 256 km detour (via Saddle Road), 97km Ō2NL). However, a journey impacted between Manakau and Ohau would reduce by 90% (6.6km Do Min, 306km detour, 30km Ō2NL).

<table>
<tr><th>Theme</th><th>Assessment</th><th></th></tr>
<tr><td rowspan="2"></td><td>Project Outcome</td><td>Growth and productivity will be supported through the reduction of travel times and notable improvements in reliability. Predicted 2039 travel times (applying the anticipated growth rate) for the Do Minimum and with project scenarios are shown below.

<table><tr><th></th><th colspan="2">2039 75%ile growth (2DIs_M1)</th></tr><tr><th>Route</th><th>Do Min</th><th>Ō2NL</th></tr><tr><td>Ōtaki to SH1 North</td><td>31.1 min</td><td>21.3 min</td></tr><tr><td>Ōtaki to Central Levin</td><td>21.7 min</td><td>17.4 min</td></tr><tr><td>Ōtaki to SH57 North</td><td>27.7 min</td><td>16.6 min</td></tr></table>
Travel will also be significantly safer, and travel times will be more reliable.

The Ō2NL project is expected to support further population growth in the Horowhenua District, which has been growing at a faster rate than previously anticipated.

HDC's population projections indicate an additional 5,400[111] households will be needed to accommodate expected population growth by 2040, with over 3,500 households to be in the new Tara-Ika development on the eastern side of Levin.</td></tr>
<tr><td>Alignment</td><td>Strong</td></tr>
</table>

3.6.2 Benefits and KPIs

Table 3-15 provides an assessment of the preferred programme against the benefits measures of the project.

Refer to the Appraisal Summary Table (AST), contained in Appendix I.1, for further detailed information on the expected outcomes and KPIs.

Additional monetised benefits including the impact of air emissions on health, carbon dioxide emissions, physical health benefits from active modes are discussed further as part of the Economic Analysis in Section 3.7 below.

[111] 75%ile growth scenario. 11,000 households are being planned for in the HDC Long Term Plan.

Table 3-15. Preferred option alignment vs benefits and KPIs (Key Performance Indicators)

Enduring Outcome	Benefit	Benefit Measures	KPI(s)	Baseline(s)	Target	Expected Outcome(s)	Time-frame	Source
Healthy and safe people	1.1 - Impact on social cost and incidents of crashes	1.1.3 - Deaths and serious injuries	Deaths and Serious Injuries (5y)	Existing: 72 DSI (2017-21 SH network) Estimated Do-Minimum (including SIP): 61 DSI per 5 year period on the SH network (2029 Modelling)	A minimum 50% DSI reduction	50-55% reduction in network DSIs compared to the Do-Minimum.	By 2035	Crash Analysis System (CAS)
	1.2 - Impact on safe system	1.2.2 - Road assessment rating	KiwiRAP Star Rating	SH1 and SH57 both < 3 star	KiwiRAP 4 – 5 Star Road	KiwiRAP 4 to 5 Star as the new highway will be a four-lane divided carriageway with controlled access.	By 2030	KiwiRAP Assessment Tool (KAT)
Resilience and security	4.1 - Impact on system vulnerabilities and redundancies	4.1.1 - Availability of a viable alternate route to low-probability high-impact events	Availability of a viable alternate route to HILP events	None (SH1 between Manakau and Ohau)	One viable alternative local route	Ō2NL provides a local alternate route between Manakau and Ohau. There will be no high-risk resilience structures on Ō2NL (e.g., the designs include adaptation for climate change)	By 2030	Design Plans
			Number of high risk structures with no alternate route	Four (Ohau River, Ohau Rail, Waikawa Stream, Manakau Rail)	Zero		By 2030	Waka Kotahi Resilience Analysis / RAMM
		4.1.2 - Level of service and risk	Number of unplanned closures on the SH network (5y)	33 unplanned closures on SH (2017/18-2021/22*) *through to March 2022	Reduce by >90% on SH	Crash related closures on Ō2NL are expected to be less than 1 per year, or a 90%+ reduction compared to the baseline. In addition, at a least 50-60% reduction in wider network crash related closures is expected (former SH network, local roads and Ō2NL) Flooding events on the offline highway are expected to be minimised through design; however, flooding events will continue to occur on revoked SH1 sections (with detours now available via Ō2NL).	By 2035	TREIS
			Length and duration of detour journeys from Wellington to Levin	**Length:** 95km (open) to 253km (detour) **Duration**: 1.25 hours (open) to 3.15 hours (detour – uncongested) (via SH3 Te Ahu a Turanga)	>60% reduction in duration of unplanned road closures/ disruptions of ≥2 hours	Detour travel length between Wellington and Levin would reduce by at least 60% (95 km Do Min, 253 km detour, 97km Ō2NL). However, a journey impacted between Manakau and Ohau would reduce by 90% (6.6km Do Min, 303km detour, 30km Ō2NL).	By 2030	Design Plans
Inclusive access	10.1 - Impact on user experience of the transport system	-	New transport network fits into agreed future road hierarchy	HDC/ Waka Kotahi through Revocation PBC based on Network Operating Framework (NoF) and One Network Framework (ONF)	Agreed road hierarchy with HDC/KCDC	To be monitored through design and revocation processes	By 2030	HDC/KCDC/Waka Kotahi
	11.3 Impact on townscape	-	Development in identified growth areas are supported.	Tara-Ika w/o Ō2NL or Plan Change 4 = 1,480 lots. Tara-Ika with Ō2NL and PC4 = up to 3700	No developments prevented due to prohibitive transport investment required	Sufficient state highway network capacity to support planned level of development at Tara-Ika	By 2030	HDC/NZTA

Enduring Outcome	Benefit	Benefit Measures	KPI(s)	Baseline(s)	Target	Expected Outcome(s)	Time-frame	Source
	10.3 Impact on access to opportunities	10.3.1 Access to key social destinations (all modes)	Preserve existing active mode links	Refer AST	Improve	Ō2NL provides a new north-south shared path (estimated to attract 150-200 new users), results in reduced vehicle volumes along existing state highway routes, and maintains existing local connections.	By 2030	Local Connectivity Plans
	10.3 Impact on access to opportunities	10.1.9 Travel time	Trip length/time for local trips	**A.** Number of sector level routes with an increase in travel time **B.** Number of side roads at capacity LoS E/F in the 2029 PM Peak	**A** % of trips same travel time or shorter. **B:** 13 intersections at LoS E or F	**A** 14% reduction in average sector level route travel times. **B** 1 intersection at LoS E/F (92% reduction).	By 2030	Ō2NL Traffic Model; Local Connectivity Plans
	10.2 Impact on mode choice	10.2.1 People – mode share	Increase mode share for walking/cycling trips to work and education	Refer AST	Improve	As above, Ō2NL provides a new north-south shared path (estimated to attract 150-200 new users), results in reduced vehicle volumes along existing state highway routes, and maintains existing local connections. The net impact of the SUP and reduced traffic volumes across the former network, through Levin and other townships is expected to support increases in walking and cycling mode share over time.	By 2030	Census
	10.2 Impact on mode choice	10.2.2 Accessibility - public transport facilities	Ensuring efficient links retained or improved to Bus Station and Train Station	Refer AST	Improve	The preferred option will result in the redistribution of traffic away from existing state highways. Improving access to key bus areas such as Bath Street (Levin), and Honi Taipua Street (Manakau), as well as the Levin Train Station.	By 2030	Local Connectivity Plans
	10.2 Impact on mode choice	10.2.2 Accessibility - public transport facilities	Providing more route options for public transport services to be implemented	Refer AST	Increase	A new route option provided, well suited to an express type bus service e.g. PN to Wellington. The option will also redistribute traffic from SH1, improving it as a potential route option for other services.	By 2030	
Economic prosperity	5.2 Impact on network productivity and utilisation	5.2.6 Access to key economic destinations (all modes)	PM peak travel times for along three key routes	**Taylors Rd to SH1 North:** 2039: 31.0min **Taylors Road to/from Levin:** 2039: 21.7min **Taylors Road to SH57 north):** 2039: 27.7 min	Reduce	**Taylors Road to/from SH1 North of Levin (Manawatū River):** 2039: 21.3 mins (-9.8min) **Taylors Road to/from Levin:** 2039: 17.4 mins (-4.3min) **Taylors Road to/from SH57 north of Levin (Potts Hill):** 2039: 16.6 mins (-11.1min)	By 2030	Ō2NLTraffic Model
			Number and percentage of heavy vehicles through Levin	**Number and % of heavy vehicles through Levin:** *2029: 1,530 HCVs (10% of total traffic)*	Reduce by 50%	>50% reduction in HCVs through Levin Town Centre by opening year. A larger reduction in the HPMV class of heavy vehicles is expected, as Levin will remain an origin/destination for smaller heavy vehicles. 2029: 780 HCVs (8% of total traffic)	By 2030	
	5.1 Impact on system reliability	5.1.2 Travel time reliability - motor vehicles	PM Peak journey time reliability for the above three routes	**Taylors Rd to SH1 North** 2018 - COV 0.085, Buffer Time 2.7 min **Taylors Rd to Levin: 2018** - COV 0.067, Buffer Time 0.9 min **Taylors Rd to SH57 north:** 2018 - COV 0.066, Buffer Time 2.8 min	**3** Reduce / Maintain	Travel time reliability is expected to improve through increased network capacity. Additional capacity will reduce the journeys impacted by the day-to-day variability in demand as well as journeys impacted by unexpected reductions in capacity (e.g. breakdowns).	By 2030	

3.6.3 Environmental Sustainability Outcomes

The Ministry of Transport Outcomes Framework[112] identifies five core outcomes for improving wellbeing and the liveability of places through the transport system:

1. Inclusive access
2. Healthy and safe people
3. Economic prosperity
4. Resilience and security
5. Environmental Sustainability

The benefits of Ō2NL map directly to the first four outcomes as demonstrated in 3.6.2. It is necessary to also consider the Environmental Sustainability outcome which is defined as 'transitioning to net zero carbon emissions, and maintaining or improving biodiversity, water quality and air quality'[113]. An important indicator for this outcome area relevant to Ō2NL is greenhouse gases emitted from the transport system.

This section presents quantification of this outcome. The economic impacts of both enabled and embodied (construction) emissions are considered in Section 3.7.5 below.

More broadly, the project has a strong focus on and commitment to addressing effects on biodiversity (ecology), water quality and air quality. These matters are being carefully assessed by experts preparing technical reports to support the RMA applications for the project. Measures to address those effects are being recommended and will be implemented. In particular, a range of measures to avoid, mitigate and offset or compensate for effects on ecological values will be provided (including restoration of streams and planting of forest habitat).

The Resource Efficiency and Waste Minimisation Policy (2021) applies to the project and includes requirements for construction and operational carbon, which will be important for achieving better environmental outcomes through the design and construction stages of the project.

Construction Emissions

Greenhouse gas emissions due to construction activities are an unavoidable consequence of any construction project for new infrastructure or replacement of structures due to end of life. For the Ō2NL construction phase, estimates of greenhouse gas emissions (t CO_2e) have been completed at different stages. The latest estimate is based on Design Freeze 3, using the methodology shown in Appendix J.2. The latest estimate is shown in Table 3-16.

Table 3-16: Estimated construction emissions for Ō2NL (based on Design Freeze 3)

GHG Estimate (t CO_2e) *(based on Design Freeze 3 – December 2021)*		
Fuel Use	Allowance to transport material to site	11,083
Material	Concrete and cement	28,954
	Steel	22,323
	Aggregates and earthworks	12,771
	Asphalt and bitumen	5,234
All	**Reported Total Emissions**	**80,365**
Contingency	**Allowance of 30%**	**24,000**
Emissions Estimate	**Range**	**80,000-104,000**

[112] See: Ministry of Transport – Transport Outcomes Framework
[113] See: Waka Kotahi – Environmental Sustainability

The assessment showed that steel and concrete/cement contribute most significantly to the overall materials footprint for Ō2NL.

As described in Section 3.4.4, incorporation of the ten opportunities that have been able to be quantified and incorporated into the design at this early stage in the design cycle resulted in the potential for approximately 7% reduction in GHG emissions compared to the 2021 estimate of 80,000. A range of other opportunities have been identified through the process set out in Section 3.4.4, which are opportunities to work with the project constructor, and internally within Waka Kotahi (through research or changes to standards) to achieve the 20% target identified by the Waka Kotahi Board. See Appendix J.2 and J.3 for further information.

The 2.5 year lead up to construction means that there is opportunity to harness rapidly emerging innovation in the carbon change space, as well as carry out the necessary opportunity realisation/investigation and implementation needed for the opportunities chosen to achieve the 20% reduction,

Enabled Emissions Estimates

In order to understand changes in enabled emissions as a result of the offline highway, it is important to consider the expected function of the highway. It is expected that by 2029, trips will be as follows:

- 66% to or from Ōtaki and Levin (with 17% of trips directly between Ōtaki and Levin, and 49% starting or ending in Ōtaki and Levin but with the origin or destination further afield but still within the local hinterland)
- 34% through trips, between south of Ōtaki and north of Levin

This demonstrates that two thirds of the use of the network is for trips within the district, and distances are often too far for active modes. Traffic volumes will therefore be dominated by increases in local population, which is expected to continue growing rapidly.

For the Do Minimum network, the existing SH1 will also continue to serve a function as the premier National Highway connection for journeys between Wellington and Palmerston North as well as most other destinations in the north (and south) island. This is a vital route for freight due to the access to Wellington Port, the freight hub of Palmerston North and further afield to Napier Port. In the Preferred Option, this strategic highway function shifts to the offline highway.

Enabled emissions are those arising from use of the road by vehicles once it is constructed. Initial estimates of greenhouse gas emissions were undertaken in July 2021 by Waka Kotahi based on information provided by the project team. Enabled emissions were calculated for traffic on the existing state highway network and the Ō2NL Project and considered both Vehicle Kilometres Travelled (VKT) and speed.

This modelling has since been refined by Stantec (initially in August 2021 and reupdated in May 2022) to include the wider network, enabling a 'big picture' view of the Ō2NL project impacts. The results of this updated greenhouse gas emissions assessment are provided in

Table 3-17 below for the Ō2NL project and for the Do Minimum, based on VEPM 6.3[114] and the 75[h] percentile population growth scenario[115]. Including a comparison to the Do Minimum (continued reliance on the existing network) is important because an increase in emissions may arise as a result of population growth/land use changes regardless of whether the project proceeds or not.

Table 3-17: Estimated Cumulative Enabled Emissions for Ō2NL

Wider network + Ō2NL Expressway - Cumulative Enabled Emissions (t CO_2e)			
	2029-2038	2039-2049	Total (2029-2049)
Do Minimum	980,500	889,750	1,870,250

[114] Waka Kotahi Vehicle Emissions Prediction Model (VEPM), version 6.3 released in May 2022.
[115] Horowhenua Socio-Economic Projections, Sense Partners (2020).

Wider network + Ō2NL Expressway - Cumulative Enabled Emissions (t CO_2e)			
	2029-2038	2039-2049	Total (2029-2049)
Preferred Option	1,005,750	901,500	1,907,000
Net Change	+ 25,250	+ 11,750	+ 36,750
% Change	+ 2.6%	+ 1.3%	+ 2.0%

The assessment results demonstrate that:

- The main use of SH1 is to support local trips in the area, which is at odds with its primary function. The effect of local population growth resulting from Tara-Ika and other planned developments is therefore expected to result in increased trips on the network. As a result, local population growth is driving emissions to increase initially, in both the Do Minimum and Preferred Option scenario, however the net impact of Ō2NL is minimal.
- The preferred Ō2NL option increases emissions more than the Do Minimum in the short term between 2029 and 2038 (noting the cumulative increase in greenhouse gas emissions is small at +2.6% for the overall network). This increase is driven by some journeys being longer on the Ō2NL route (e.g. an additional 2km for a journey between Ōtaki and Levin). In addition, Ō2NL results in more journeys at higher speeds.
- In the longer term, between 2039 and 2049, the traffic volumes increase as a result of local population growth to such a point that the congestion in the Do Minimum (no new highway) is significant, and the preferred option begins to result in only a small increase in emissions as the decongestion benefits begin to outweigh the impacts of higher speeds and additional distance travelled.
- This is highlighted in Table 3-18 and Figure 3-18 which shows how the yearly VKT and CO_2e emissions change over time between the Do-Minimum and Ō2NL.

Table 3-18. Estimated Yearly enabled emissions and VKT for Ō2NL

Wider network + Ō2NL Expressway - Yearly Enabled VKT & Emissions						
Model Year	Annual VKT (km)			Annual Enabled Emissions (t CO_2e)		
	DM	Ō2NL	% Difference	DM	Ō2NL	% Difference
2018	277,202,750	-	-	76,250	-	-
2029	385,478,500	393,708,000	**+2.1%**	99,500	102,500	**+3.0%**
2039	469,752,750	480,580,000	**+2.3%**	96,250	98,000	**+1.8%**
2049	543,001,000	563,415,000	**+3.8%**	65,500	65,750	**+0.4%**

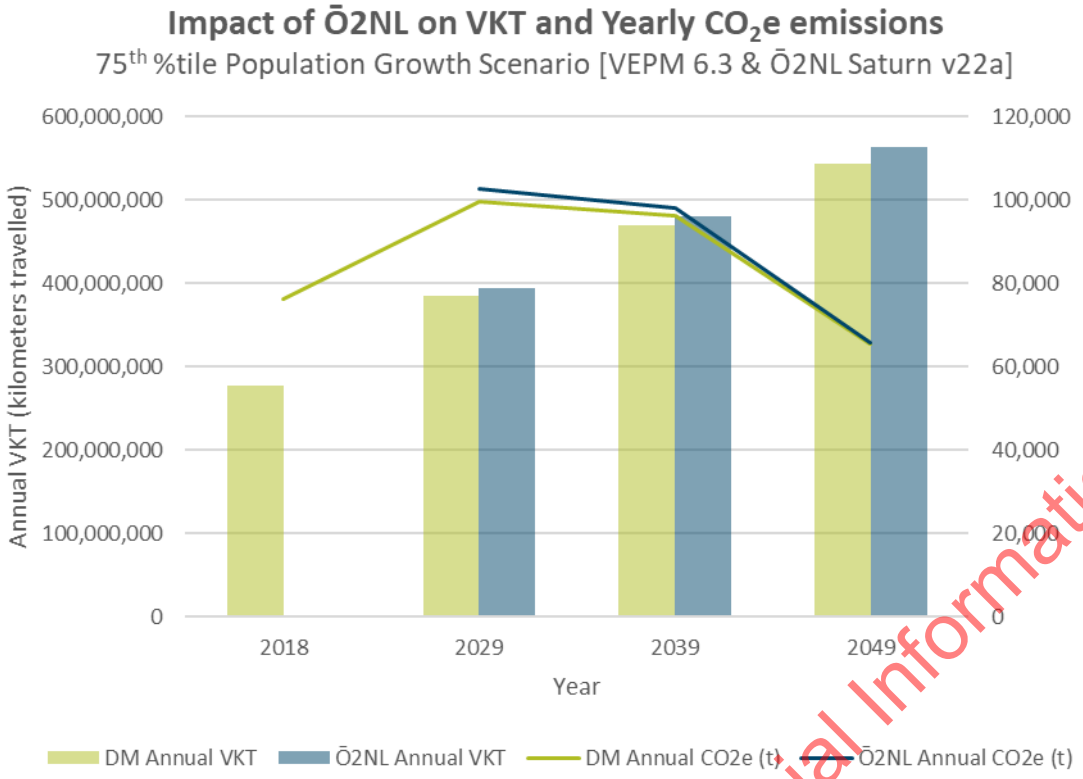


Figure 3-18: Impact of Ō2NL on VKT and CO_2e emissions

This assessment determined that the impact of the project on overall network enabled emissions is small over the 2029-49 period at +2.0% (36,750 t CO_2e) compared to the Do Minimum. However, there are several uncertainties in the future that will influence this result, particularly regarding future population growth, changes in the vehicle fleet and in people's behaviour as a result of Government policy to mitigate greenhouse gas emissions.

Limitations of this assessment are:

- VEPM 6.3: This is an average speed based emissions prediction model, and as such does not consider the effect of speed change cycles, idling at signals, etc on emissions. This may lead to an underestimation of the enabled emissions impact of the Do Minimum scenario in future years as congestion grows.
- Traffic modelling: The Ō2NL model is based on several assumptions around trip generation and is based on fixed demand matrices for all underlying scenarios. It does not include induced traffic ('new' trips on the network that are made as a result of better infrastructure), which may lead to underestimation of enabled emissions with Ō2NL[116].
- There is no regional model that covers this area, and which would allow forecasting of mode splits and lead to a better understanding of any induced traffic effects.

As there are no significant public transport or walking and cycling networks, it is considered unlikely that there will be any induced traffic from other modes. The project will support additional growth in the Horowhenua, and this will be offset by less growth elsewhere in the region/country and therefore it is inappropriate to assess the carbon impacts of shifted growth exclusively as part of this project.

[116] As per Table 4 of the Monetised Benefits and Cost Manual (MBCM) a 'fixed trip matrix' is appropriate for a large scale roading project in a rural setting/small urban centre.

Infrastructure Sustainability Outcomes

The Waka Kotahi Sustainability Rating Scheme Policy (2020) will apply to Ō2NL. This policy requires the Ō2NL project to work towards an Infrastructure Sustainability (IS) Design/As Built rating. The preliminary IS process has been completed to identify possible sustainability opportunities in the project, and the formal IS assessment will take place during detailed design and construction. The project will aim to achieve the Silver rating level of the IS v2.1 rating scheme.

A Preliminary Sustainability Management Plan is provided in Appendix J.1, which explains the gaps and priorities to be taken forward for the IS Design Rating phase.

3.6.4 Māori Outcomes

Project partners are also working on a Māori Outcomes Framework to help identify how the Project can achieve outcomes for hapū and iwi partners and Māori generally, refer Section 1.1.2 and 1.1.3 above. As the Project proceeds through design and procurement stages, consideration will be given to how it can help achieve these outcomes, whether through direct investment, technical assistance and capacity building, or catalysing other relationships and investment.

3.7 ECONOMIC ANALYSIS

The economic evaluation of the preferred option has been carried out in accordance with the latest Waka Kotahi MBCM (Monetised Benefits and Costs Manual) full procedures.

The net present value (NPV) costs and benefits over and above the Do Minimum have been reported using a using a 60-year analysis period and a 4% discount rate. In line with the MBCM, an analysis period of 60 years is suitable given that the Ō2NL is a significant piece of long-term infrastructure. A sensitivity analysis has also been undertaken using a 40 year analysis period with a 4% discount rate.

The economic evaluation has been peer reviewed, with the draft economic peer review report contained in Appendix K.2.

3.7.1 Do Minimum

Fundamentally, the Do Minimum option is to retain the existing network with committed SIP improvements and ongoing operational and maintenance investment.

The 'Do minimum' option is detailed in Appendix K.1. For clarity, it includes:

- Speed and Infrastructure Programme:
    - Safe and appropriate speed (SaAS) adjustments from South of Manakau to South of Levin, from SH1/57 to SH57/Tavistock Rd and from SH1 north of Levin to the Manawatū River.
    - Construction of roundabouts at the SH1/57[117], SH57/Queen St and SH57/Tararua Rd intersections
    - Removal of short substandard passing lanes on SH1 (completed Christmas 2021)
    - Corridor improvements to centrelines, flush medians, signs, markings, and median barriers on sections of SH1 and SH57
- HDC Local improvements:
    - Upgrading roundabouts at Queen St East/Cambridge St and Queen St West/Weraroa Rd
    - Construction of cycle lane on Queen St from Oxford to Salisbury
- Growth Scenarios and Distributions of growth are outlined in Appendix K.1. For the purposes of economic evaluation, three population growth scenarios have been considered a 25th Percentile, a 75 h percentile (base) and a 95th percentile based on Sense Partners projections developed for HDC.
- Tara-Ika Master Plan roading layout
- End of life bridge replacements
- On-going maintenance and operations

3.7.2 Preferred Option

The Ō2NL preferred option is outlined in Section 3.5 above.

3.7.3 Timing

The time zero for the economic assessment is July 2021. The assumed timeframes for each phase of the project are outlined in Table 3-19 below.

[117] Note the SH1/57 roundabout is under review by the Speed and Infrastructure Programme (SIP).

Table 3-19. Assumed programme timeframes

Design / Pre-Implementation	Property	Construction	First Year of Benefit
2021-2024	2021-2025 (Purchase) 2030-2032 (Disposal)	2025-2029	2030

3.7.4 Costs

Refer Section 44, Financial Case, for further information on the project delivery costs.

Capital Costs

The cost estimates for the preferred option that have been applied for the purpose of the economic assessment are shown in Table 3-20.

Table 3-20. 50th and 95th percentile cost estimates

Phase	Expected Estimate (P50) ($M)	95th Percentile Estimate (P95) ($M)
Development	s 9(2)(j)	
Property		
Pre-Implementation		
Implementation		
Total		

The above costs were converted into NPV costs for the purpose of economic assessment based on the estimated timeframes outlined above.

Property disposal costs have been estimated by the Ō2NL project team to range from s 9(2)(j) For the purposes of economic analysis, as land is not a sunk cost, these future cost savings have been adopted as s 9(2)(j) spread between 2030-2032.

Bridge replacement costs in the Do-Minimum and deferred replacement[118] as part of the Option have also been included in the overall costs as outlined in Section 3.7.1 above.

Maintenance Costs

The maintenance assumptions and costs relating to the economic analysis are presented below:

Do-minimum:

- Assumes on-going maintenance of the existing SH1 and SH57, with a total seal area of approximately 384,000m^2 based on RAMM.
- Periodic reseals have been assumed at an 8-year frequency at a rate of \$10/m^2 for chipseal and rehabilitation at 25-year frequency at a rate of \$150/m^2. Annual maintenance based on a rate of \$0.55/m^2 for chipseal was also adopted based on RAMM.
- However, due to data limitations with the RAMM forward works programme, for the purposes of this economic assessment it has been assumed that the periodic costs will occur annually with the proportion of total area treated based on the frequency (i.e.1/8th of the total seal area will be resealed and 1/25th rehabbed per annum).
- Bridge repairs and maintenance costs have not been considered; however, bridge replacements have been included in the capital costs as outlined above and in Section 3.7.1.

[118] Assumes 20year deferred replacement due to reduced traffic volumes, particularly heavy vehicles.

Option:

The preferred option for Ō2NL will result in additional maintenance due to:

- Approximately 24km of new four lane highway, interchanges and ramps with a total new seal area of 650,000m^2 (predominately Epoxy Modified OGPA). EMOGPA has a typical extended design lifetime of up to 40 years; however, a conservative 25-year reseal has been adopted at a rate of \$50/m^2 based on research suggesting noise attenuation loss after this period[119].
- 23km of new wire rope median barrier. The Waka Kotahi Barrier Strikes Tool (Research Report 580) has been used to estimate the likely annual costs based on the predicted traffic volumes. The annual maintenance costs in 2029 are expected to be \$82,000, increasing in future years with traffic growth.
- New local road sections with a total estimated seal area of 42,000m^2 (chipseal). Periodic reseals have been assumed at 12 year frequency at \$10/m2 for chipseal and rehabilitation at 40 year frequency
- 14 new bridge structures. Annual inspections at \$2,500 per bridge and principal inspections at \$10,000 per bridge every 6 years have been included in the assessment. Bridge repairs and renewals are currently excluded.
- Annual maintenance based on a rate of \$0.55/m^2 for surfacing was also included based on RAMM data.
- Other comparatively minor maintenance and operational considerations are currently excluded from the assessment such as lighting and ITS.
- Landscaping and shared use path maintenance across the project is anticipated to require annual maintenance costs of \$1.0M noting establishment of the landscaped areas and planting has been incorporated into the landscape capital cost, for a period up to 5 years (i.e. landscaping maintenance costs will begin from year 5 onwards). These annual costs are assumed to gradually reduce as ground cover is established over time.
- The option will also include continued maintenance of the old SH network, with periodic reseals and rehabs reducing to 12 and 30-year periods respectively (spread annually as per the Do-minimum).

In summary, Ō2NL is expected to increase the overall NPV maintenance costs over the 60-year evaluation period by a total of \$22M compared to the Do-Minimum, with annual maintenance costs expected to be \$1M at opening year (increasing to \$2M per year after five years as landscaping annual maintenance costs begin).

This figure appears relatively low, but it reflects the high cost of operating and maintaining the current state highways which are not fit for purpose for the high volumes of traffic. In addition, a large proportion of maintenance costs are typically related to surfacing and reseals and as the preferred option has long life EMOGPA surfacing (equating to a high initial capital cost), this results in reduced ongoing future maintenance costs.

3.7.5 Assessment of Transport Benefits

The economic analysis has considered the following quantifiable road user costs:

- Travel time and reliability costs;
- Vehicle operating costs;
- Carbon dioxide and other greenhouse gas emissions costs;
- Health costs associated with emissions;

[119] See: Waka Kotahi – OGPA and EMOGPA Research Summary

- Crash costs;
- Resilience costs;
- Active mode costs; and
- Wider economic benefits.

Travel Time and Vehicle Operating Costs

The Travel time (TT) and vehicle operating costs (VOC) were calculated using the Ō2NL SATURN model, based on the 2029, 2039 and 2049 modelled years for both the Do-Minimum and Option.

The travel time costs were determined using the SATURN network free flow travel time and queuing delay outputs. Travel time reliability benefits have been assumed as 5% of the total travel time benefits, based on similar projects.

Vehicle operating costs were calculated based on the rate of fuel consumption obtained from the Waka Kotahi Vehicle Emissions Prediction Model (VEPM 6.3) along with SATURN vehicle kilometres travelled (VKT) and speeds inputs at a link by link level, separately for light and heavy vehicles, for each peak period.

Key inputs and assumptions included:

- Model expansion and annualisation factors outlined in Table 3-21 below based on analysis of SH1 Ohau and SH57 Shannon Telemetry count site data
- A composite traffic split of 75% Rural Strategic and 25% Urban Arterial was adopted based on modelled VKT.
- Uncongested values of time for the above composition were adopted for SATURN free flow travel times costs whilst congested values of time were used for SATURN queuing delay costs.
- Conversion of fuel consumption to total VOC was based on MBCM factors for the composite traffic mix along with the latest resource costs of petrol and diesel (MBIE June 2021).
- Travel time delays across network were also capped at 300 seconds at a link level, noting that under the 75th percentile growth scenario, this only impacted a few intersections in the 2049 AM and PM peak periods. Further capping was applied to the 2049 PM peak in the Do-Minimum due to convergence issues.
- Due to the uncertainty in future growth projections, all road user costs were conservatively capped at 2049 values as this corresponds with the last modelled year.

Table 3-21. Annualisation Factors

	AM Model (8:00-9:00AM)	IP Model (12:00-1:00PM)	PM Model (4.30-5.30PM)
Equivalent model periods per weekday	1.9	11.0	1.9
Weekdays per year	245	245	245
Eq. model periods per weekend/ holiday		7.6	
Weekend/Holidays days year		120	
Base Annualisation Factors	470	3,609	475

Figure 3-19 below highlights how the annual travel time and vehicle operating costs change over time for both the Do-Minimum and the Option for the 75 h percentile population growth scenario.

While travel time costs trend upwards due to increasing volumes (particularly for the Do-Minimum), vehicle operating costs trend downward as the VEPM includes the impact of future fleet changes (i.e., electrification). The option results in VOC disbenefits of approximately $3M p.a. in 2029; however, by 2049 Ō2NL results in lower disbenefits of $120,000 p.a, largely from decongestion effects.

Travel time benefits are significant and increase over time, these benefits largely correspond to reduced journey times and intersection delays (e.g. 2039 PM peak trips from Ōtaki to either SH1 or SH57 north of Levin reduce by over 10 minutes compared to the Do-Minimum). Travel time benefits increase from over $16M p.a. in 2029 to $62M p.a. by 2049.

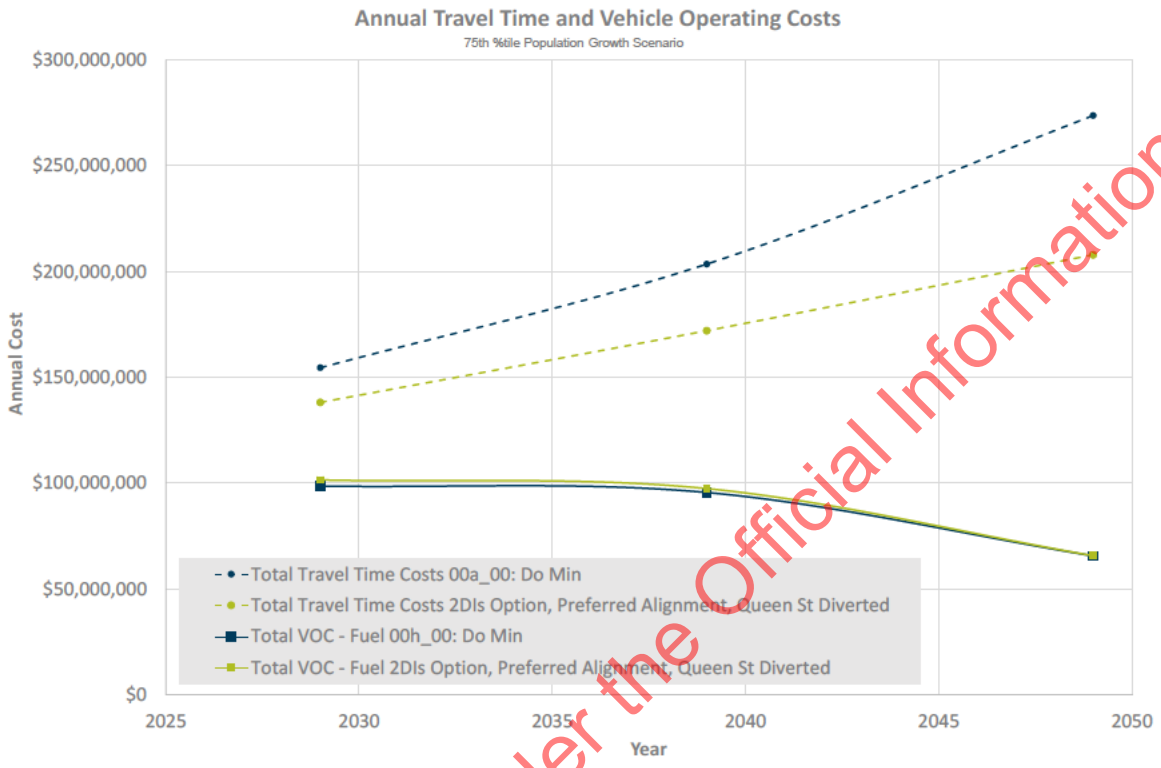


Figure 3-19. Annual Travel Time and Vehicle Operating Costs

Greenhouse gases and health emissions costs

Similar to vehicle operating costs, monetisation of greenhouse gases and a range of other harmful air pollutants resulting from vehicle emissions were based on VEPM 6.3 with SATURN link by link VKT and speed inputs, by light and heavy vehicles, for each peak period. The outputs of VEPM in addition to fuel consumption (used for the VOC), includes emissions rates (g/km) for Particulate Matter (PM10), Nitrogen Oxides (NOx), Carbon monoxide (CO) and hydrocarbons (HCs). Emissions rates, combined with SATURN VKT and unit cost rates from the MBCM allow for monetisation.

Key inputs and assumptions included:

- CO_2 equivalents rates based on the central shadow price pathway, with sensitivity testing at the low and high pathways, based on MBCM Section 3.4[120].
- Health emission rates ($/tonne) based on MBCM Table 12, with PM10 having the highest cost of $460,000/tonne. The MBCM values were based on the 2016 value of statistical life (VoSL), an update factor of 1.18 was applied to update to 2021 VoSL.

Figure 3-20 below highlights how the total health emission costs generally reduce over time, again a function of the VEPM future fleet assumptions, with Do-minimum forecast to emit a greater volume of harmful air pollutants largely due to higher particulate matter (PM10) emissions at lower

[120] See: Waka Kotahi – Economic Evaluation of Greenhouse Gas Emissions

speeds or in more congested networks. This results in health related emissions benefits for Ō2NL increasing from $350,000 p.a. in 2029 to over $1M p.a. by 2049.

However, the Do-minimum is predicted to release slightly lower CO_2 equivalent emissions as although these are produced at higher rates for congested networks, the Ō2NL highway results in higher speeds and increased distances for some journeys, therefore emitting slighter higher net greenhouse gases. This results in disbenefits for Ō2NL. Under the central CO_2 equivalents pathway, the cost of emissions for both the Do-minimum and Ō2NL increases until 2039 as a result of growth in VKT. From 2039 onwards, the increase in the cost rate of CO_2 emissions is offset by the fleet decarbonisation impacts. However, the difference in CO_2 equivalent emissions between the Do-Minimum and Ō2NL is small, with disbenefits reducing from $250,000 p.a. in 2029 to $20,000 p.a. by 2049.

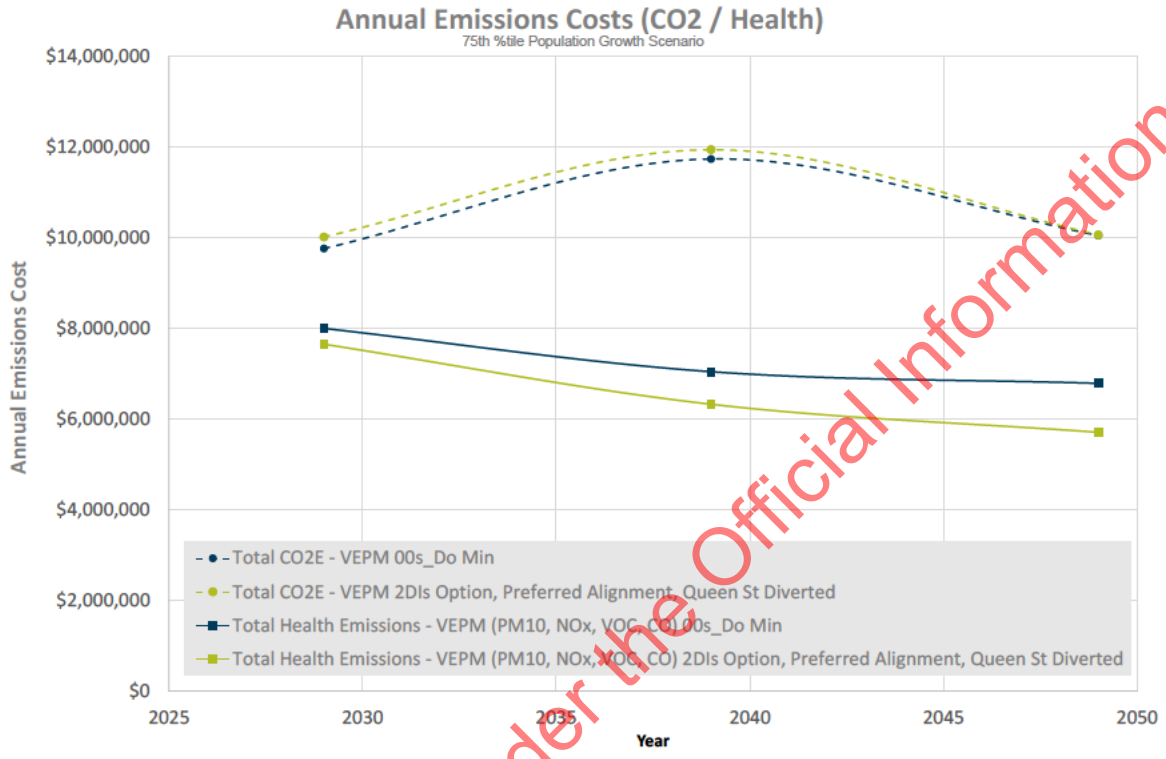


Figure 3-20. Annual CO_2 and Health Emission Costs

Monetisation of construction emissions was considered as part of a sensitivity test, refer Section 3.7.8 below.

Crash Costs

A network model of the existing highway network, key arterial roads and the new highway was developed using MBCM and Crash Estimation Compendium methods.

Sections for the model were identified based on a combination of flow difference model outputs[121], speed limit changes and infrastructure upgrades. The network crash models imported traffic volumes from the SATURN model for the 2029, 2039 and 2049 years for each of the three growth scenarios.

Three scenarios were assessed as part of the network model: a Do-Nothing, the Do-Minimum and the Option. A Do-Nothing scenario was included as the Do-Minimum includes speed management and a range of safety interventions as outlined in the sections above.

The scenarios are further detailed in Table 3-22 below. Note that any potential revocation improvements are excluded from the Option as these are being investigated separately; the option crash costs are therefore likely to be conservative.

[121] Sections typically greater than 1km+ in length with a 1,000 vpd difference between the Do Minimum and Option were included in the network model. It is noted that there are several shorter or lower volume links in central Levin with flow reductions, therefore the crash model is conservative as it focuses on longer sections with higher flow differences.

Table 3-22. Crash Network Assumptions

Scenario	Key Assumptions	Crash Method	Methodology
Do Nothing	Network as per 2017-2021 CAS data SATURN Do-Minimum volumes adopted.	Existing Network: Method A and C as appropriate based on crash thresholds	Network crash model based on the Ō2NL study area split into 22 sections covering urban and rural midblocks and intersections. 16 of which relate to SH1 and SH57 while 6 relate to local roads or intersections.
Do-Minimum	SIP treatments as outlined above, including speed management to 80km/h on section of the SH network	Existing Network: Method A and C. Method B for new roundabouts proposed as part of SIP.	Do Nothing network crash model with crash modification factors (CMFs) applied for changes in the posted speed limit, wide centreline, median and edge barrier. Crash rate analysis (method B) for new roundabouts.
Option	New Highway	Existing Network: Method A, B and C New Highway: Method B	Do Minimum crash network combined with CMFs which relate to the change in flow as a result of the Ō2NL highway (e.g. some sections of SH reduce by 80%). Expanded network model to include new highway sections based on crash rate analysis (Method B). Motorway models with roundabout models for the proposed interchanges were adopted. The CMFs for the motorway models were based on observed injury crash rate data from M2PP and other recent expressways.

Figure 3-21 below shows the annual network crash costs for the Do Nothing, Do Minimum and the option, across the urban and rural speed environments for the highway and local road sections.

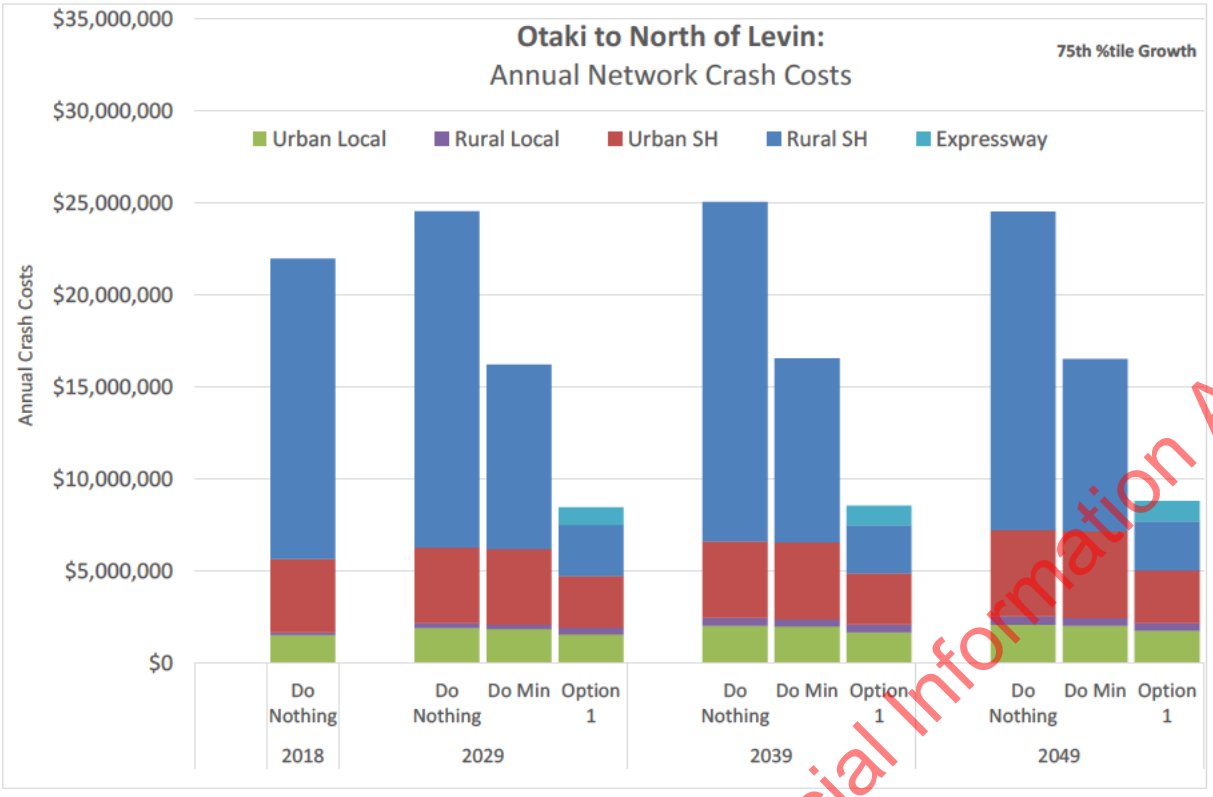


Figure 3-21. Annual Network Crash Costs

The figure highlights that:

- The suite of speed management and safer corridor treatments proposed in the Do-Minimum as part of SIP result in an 30% overall reduction in network crash cost by 2029; as highlighted in the figure above, these benefits are limited to rural SH journeys (indicated in blue).
- Ō2NL results in a further 50-55% overall reduction in the network crash cost compared to the Do-Minimum, primarily as a result of reduced traffic along the existing SH and local road network (as traffic is transferred to the new highway).
- Compared to the Do-Minimum, Ō2NL results in further reductions on the rural SH network as well as safety benefits through urban Levin and the local road network.
- Future growth in crash costs is tempered by the MBCM methodology of adjusting future growth by -2% per annum in rural areas to reflect the general decline in crash rates since the 1980's. A sensitivity test in Section 3.7.8 below considers the impact of removing this assumption.

Resilience

Resilience costs were based on both Low Impact High Probability (LIHP[122]) events including crashes and flooding and a high level assessment of High Impact Low Probability (HILP[123]) events such as earthquakes and storms.

Both resilience assessments focussed on the key section of SH1 between Manakau and Ohau which, as outlined in the Strategic Case and Appendix A.1, does not have a viable local detour route and contains a number of at-risk structures.

[122] LIHP events were assessed based on CAS crash data and resilience event data from NZ Transport Agency's TREIS database.
[123] HILP events were assessed at a high level based on NZ Transport Agency resilience risk maps, developed as part of the National Resilience Project, for Earthquakes (1/1000yr return period) and Storms (1/100 year return period). The maps identify the likely disruption or outage periods which was used along with the detour costs to calculate likely road user benefits.

Resilience benefits as part of Ō2NL relate to a combination of reduced hazard exposure (volume reduction due to new highway) coupled with a significant reduction in detour length if an event were to occur between Manakau and Ohau with the new highway in place.

Key inputs and assumptions included:

- Low impact high probability (LIHP) Flooding:
    - Travel time impacts of flooding events (closure and short delays) along SH1 between Manakau and Ohau were considered based on 2011-2020 TREIS data.
    - Travel time costs at MBCM rates uplifted by 'unexpected delay factor' as per Research Report 670[124].
    - A 1% growth per annum in flooding event closure and delay durations was adopted for future years to include the impacts of climate change. Future delay impacts were capped based on the detour travel time.
- Low impact high probability (LIHP) Crashes:
    - Travel time impacts of crash events, by severity and time of day, along the stretch of SH1 between Manakau and Ohau were considered.
    - This is conservative as crash delay impacts of crashes on other corridor sections are excluded, noting that north of Ohau local alternate routes/detours do exist in the event of a crash.
    - Crash data was based on 2017-2021 CAS with closure data based on TREIS/Network knowledge (closure durations by severity).
    - Travel time costs at MBCM rates uplifted by 'unexpected delay factor' as per RR670 as per LIHP flooding events.
- High impact low probability (HILP) events:
    - HILP events were assessed based on Waka Kotahi resilience risk maps, developed as part of the National Resilience Project, for Earthquakes (1/1000yr return period) and Storms (1/100 year return period).
    - Assumes that the earthquake event damage is localised and that other infrastructure north and south of the area is traversable, i.e. excludes the consideration of a catastrophic Wellington Faultline scenario. The road user costs of HILP events are therefore conservative.
    - The maps identify the likely disruption or outage periods which was used along with the structure and detour costs to calculate likely benefits under the Do-Minimum and Option scenarios.
    - Road user costs for a detour event between Manakau and Ohau considering travel time and vehicle operating costs were estimated at $3.2M per day, based on 75% of journeys diverting via SH2 through the Remutaka Ranges[125].
    - Five structures were assessed between Manakau and Ohau – Ohau River Bridge, Ohau Rail Bridge, Waikawa Stream Bridge, Manakau Rail Bridge and the Waiauti Stream Bridge. The Pukehou Rail Bridge between Ōtaki and Manakau was also assessed.

[124] Research Report 670: Better measurement of the direct and indirect costs and benefits of resilience. The MBCM currently does not report a cost or method for unexpected delay time, RR670 recommended an unexpected delay time multiplier of 3.2, which is the value recommended by the Transport for NSW guidelines

[125] Detour as per Waka Kotahi – Detour Routes Tool. Existing SH1 Manakau to Ohau 6.6km with an average travel time of 5 mins. The Waka Kotahi approved detour is 306km, an incremental route length of 299km or 235 mins. With Ō2NL in place, an event occurring between the SH1 Manakau and Ohau, results in a diversion using the new highway of an additional 15 mins or 24km (a reduction of over 90%).

- Based on MapHub resilience for the Manakau to Ohau section, a 1/100 Storm event adopted an outage of 1 week with structural repair only, whilst a 1/1000 earthquake event assumed an outage of 6months with structural replacement.
- Although there were multiple structures at-risk structures, in a storm or earthquake event the weakest link governs. Therefore, road user costs were only claimed once, however structure repair or replacement costs were considered for all structures.
- As the at-risk structures are all bridges, full road user costs are capped at 1 month due the availability of Bailey Bridges (assumes a worst-case scenario as Bailey Bridge can be deployed in 2 weeks depending on the scale of event).
- The resilience assessment has not considered the impact on services, fuel supply, additional crash costs or the impact to rail.
- The wider resilience economic impacts in terms of Gross Domestic Product (GDP) were assessed using the Modelling the Economics of Resilient Infrastructure Tool (MERIT). However, as these are considered wider economic benefits, they are considered as a sensitivity test in Section 3.7.8.

Figure 3-22 below shows how the annual resilience costs change over time by scenario, highlighting:

- The LIHP events such as flooding and crashes account for a large proportion of the overall resilience costs.
- The Do-Minimum provides a reduction in LIHP crash costs compared to the Do-Nothing as a result of proposed SIP treatments and speed management.
- Resilience benefits as part of Ō2NL relate to a combination of reduced hazard exposure (volume reduction due to new highway) coupled with a 90% reduction in detour length if an event were to occur on the revoked section of SH1 between Manakau and Ohau with the new highway in place.

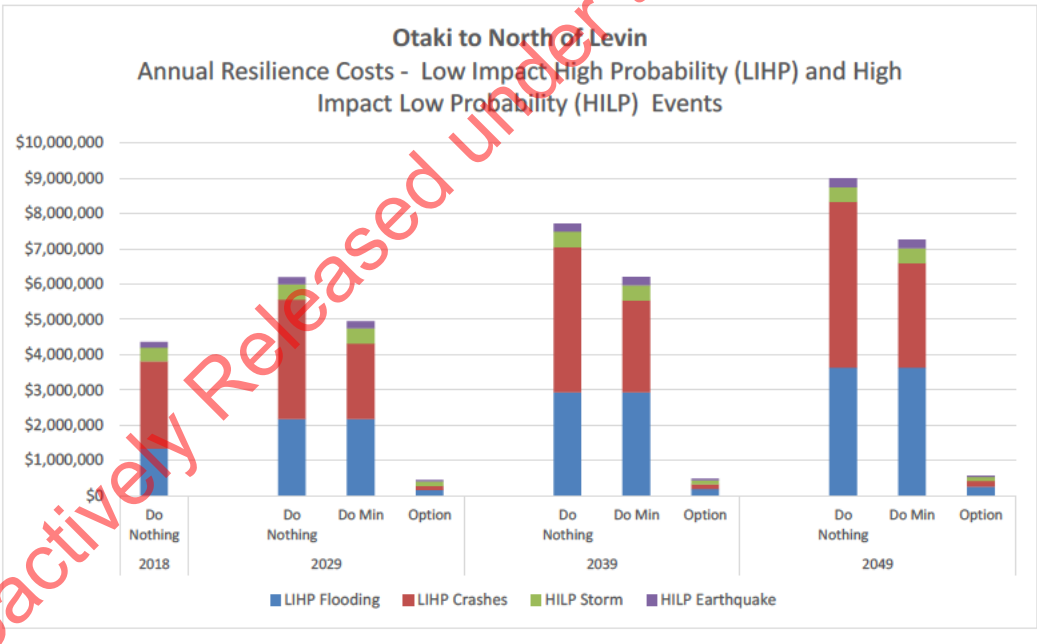


Figure 3-22. Annual Resilience Costs

Active modes

The active modes assessment considered the health benefits gained through additional cyclists on the shared use path (SUP) proposed as part of the Ō2NL preferred option.

Key inputs and assumptions included:

- The SP11 tool was used as a means of estimating the potential new users based on population densities along the corridor. The 2018 Census population within buffers of 400m, 400-800m and 800-1.6km around the proposed SUP alignment were assessed at a meshblock level using GIS (Refer Figure 3-23 below).
- Figure 3-23 demonstrates that the majority of the potential SUP catchment is located around SH57 / Eastern Levin, as the northern and southern sections have significantly lower population densities. Tara-Ika is therefore well positioned to benefit from the SUP planned as part of Ō2NL.
- Similar to other benefit measures, three growth scenarios were considered corresponding to the 25th, 75th and 95th population growth projections. For the 75th %tile growth scenario, by 2029, the SP11-7 methodology estimates up to 187 new daily cyclists would use sections of the SUP (compared to an estimated 145 cyclists based on the 2018 census).
- Based on MBCM Table 10, composite health benefits per new user of $2/km and a maximum annual benefit[126] of $2,400 per new user were adopted based on an assumed 80% conventional and 20% electric assisted split.

Note that the methodology does not capture a potential increase in cycling along the existing SH1, which may become more attractive to new users if traffic significantly reduces with Ō2NL.

Overall, the annual walking and cycling benefits increase from $450,000 p.a in 2029 to $620,000 p.a by 2049 based on the 75th percentile growth scenario.

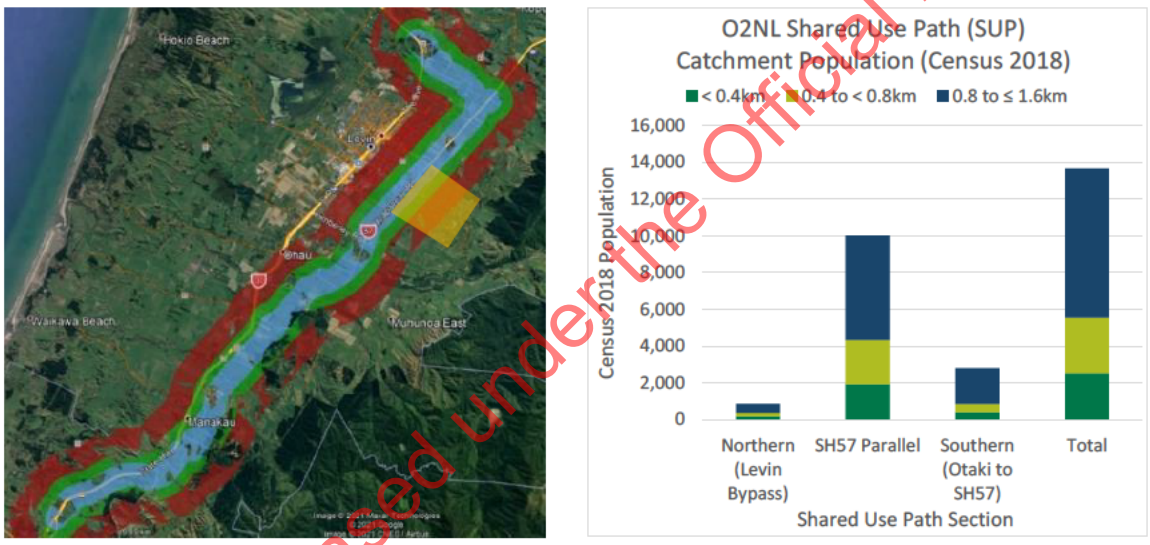


Figure 3-23. Ō2NL Shared Use Path - Potential Catchment

Wider Economic Benefits

Section 3.10 of the MBCM states: *"The required spatial concentration of economic activity for realising agglomeration benefits is only likely to occur in the major industrial and urban centres of New Zealand. It is only the large and complex urban transport activities that will provide the relevant conditions that justify an analysis of agglomeration benefits."*.

Based on the definition in the MBCM, while Ō2NL is of a sufficient scale, it would likely not meet the spatial concentration test for agglomeration due to the relatively small sizes of the urban areas and distance from the main centres of Wellington and Palmerston North.

As such, Wider Economic Benefits (WEBS) have not been captured as part of the economic evaluation and this approach has been confirmed with the IQA team at Waka Kotahi. However, a range of sensitivity tests have been considered in Section 3.7.8, as Ō2NL is a significant supporter of growth and other economic enabling activities around the region.

[126] The maximum annual benefits cap relates to the total estimated economic health benefit for converting an inactive person to an active person for conventional cycling.

3.7.6 Cost Benefit Analysis

Table 3-23 provides a summary of the cost benefit analysis and BCR for the preferred option based on a 60-year evaluation period with a 4% discount rate, the expected cost estimate (P50) and the 75 h percentile population growth scenario.

Table 3-23. Preferred Option – BCR

Type	MoT Framework	Benefit / Cost	NPV ($M)
Benefits	Healthy and Safe People	Cycling Health Benefits	$9.7
		Crash Cost Benefits	$139.8
		Health Emission Reduction Benefits	$16.1
	Resilience and Security	Resilience Benefits	$105.4
	Economic Prosperity	Travel Time (TT) Benefits	$1,150.1
		Travel Time Reliability (TTR) Benefits	$57.5
		Vehicle Operating Cost (VOC) Benefits	-$18.7
		Wider Economic Benefits (WEBs)	-
	Environmental Sustainability	CO_2e Emissions Reduction Benefits	-$1.9
		Total NPV Benefits	$1,458.0
Costs (P50)		Net PV Maintenance Costs	$22.2
		Net PV Capital Costs	$1,180.1
		Total Net PV Cost	$1,202.3
		Benefit Cost Ratio (BCR)	**1.2**

Note that as Ō2NL is a NZUP funded project, an assessment against the Investment Prioritisation Method (IPM) is not required; however, this assessment which combines the BCR with key strategic outcomes is contained in Appendix K.4.

3.7.7 Comparison to IBC Phase

As presented in Section 3.3.2, the BCR of the preferred option developed as part of the IBC in 2018 was 0.37, compared to the updated BCR of 1.2.

Compared to the IBC, and taking account of changes to the MBCM including an extended 60 year assessment period and a lower discount rate, the BCR has increased largely due to the significant growth that has occurred and is forecast for the district and the wider region. Existing Safety and resilience issues, as outlined in the Strategic Case, have also worsened, meaning that the benefits for addressing these in the future, with additional growth, are also increased.

Table 3-24 below compares the cost and benefit streams considered at both IBC and DBC.

Table 3-24. IBC vs DBC BCR comparison

Type	MoT Framework	Benefit / Cost	2018 IBC	NPV ($M)
Benefits	Healthy and Safe People	Cycling Health Benefits	N/A	$9.7
		Crash Cost Benefits	$84	$139.8
		Health Emission Reduction Benefits	N/A	$16.1
	Resilience and Security	Resilience Benefits	$28	$105.4
	Economic Prosperity	Travel Time (TT) Benefits	$90	$1,150.1
		Travel Time Reliability (TTR) Benefits		$57.5
		Vehicle Operating Cost (VOC) Benefits	$0	-$18.7
		Wider Economic Benefits (WEBs)	-	-
	Environmental Sustainability	CO_2e Emissions Reduction Benefits	N/A	-$1.9
Costs (P50)	Total NPV Benefits		$201	$1,458.0
	Total Net PV Cost		$539	$1,180.1
	Benefit Cost Ratio (BCR)		0.37	1.2

The table demonstrates:

- The majority of benefit streams have increased, due to significant changes in the MBCM since the IBC which have increased the evaluation period from 40 years to 60 years and the discount rate from 6% to 4% (higher realisation of longer term benefits).
- Crash benefits have increased as existing safety issues have worsened; however, these haven't increased to the same extent as other benefits as the Speed and Infrastructure Programme improvements (SIP) are now included in the Do-Minimum.
- Travel time and reliability benefits have increased significantly.
    - During the IBC, the StatisticsNZ medium growth forecasts were negative for the Horowhenua District and traffic modelling was therefore very conservative.

- As part of the DBC, due to the rapid growth that has occurred, and is forecast to continue, the traffic model was re-baselined from 2011 to 2018, with growth projections updated to include the latest HDC sense partners forecasts in 2020.
- Speed limit reductions in the Do-Minimum on SH1 are also a factor in the increase in travel time benefits of Ō2NL.

- The DBC has also considered additional benefit streams not assessed in earlier stages, such as walking and cycling and health costs resulting from emissions.
- Costs have increased since the IBC due to greater progression of the project design and requirements alongside several external factors, refer to the Financial Case for further discussion.

Overall, despite significant increases in the total project cost, this has been offset by the changes in the MBCM coupled with scale of growth forecast, resulting in the higher BCR.

3.7.8 Sensitivity analysis

Sensitivity analysis involves defining a range of potential values for an uncertain variable in evaluation and reviewing the variation in the evaluation as the variable changes within the range.

The following tests have been undertaken, by varying the factors which are the most influential to the overall BCR, focusing on cost, programme and benefit variables.

Table 3-25. Sensitivity Analysis

Sensitivity scenario	Sensitivity test	BCR
	Cost Variability	
Project Cost Estimate *(60 years @ 4%, 75th percentile population growth)*	95th percentile cost estimate	1.1
	Expected estimate (P50) (baseline)	1.2
	Base Estimate[127]	1.5
Property Cost – Surplus Land re-sale	Include disposal of property of $100M spread over 2030-2032, based on Waka Kotahi property estimates of $110-130M (as land is not considered a sunk cost as per MBCM). (Baseline)	1.2
	Exclude	1.2
	Programme and Timing Variability	
Discount rate and analysis period *(P50 costs and 75th percentile population growth)*	40 years @ 4%	1.0
	60 years @ 4% (baseline)	1.2
	60 years @ 3%	1.6
Construction Start and Duration *(P50 costs and 75th percentile population growth)*	Construction start 2025, duration 6.5 years	1.2
	Construction start 2025, duration 4.5 years (baseline)	1.2
	Construction start 2027, duration 4.5 years	1.3

[127] Waka Kotahi, Cost Estimation Manual (SM014). The Base Estimate is an assessment of the total sum of all of the elements that make up the estimate. This value includes Provisional Sums, Provisional Quantities, and the Cost of Treatment (as applicable) for all known scope but excludes all Contingencies and Escalation.

Sensitivity scenario	Sensitivity test	BCR
	Benefit Variability	
Land use and Population growth	25th percentile population growth	0.6
	75th percentile population growth (baseline)	1.2
	95th percentile population growth	3.2
Vehicle Operating Costs	Method: SATURN VKT and Speed	1.2
	Method: VEPM fuel consumption based on SATURN VKT and Speed inputs (baseline)	1.2
Travel Time Reliability	Method: Exclude TTR as 5% of Travel time	1.2
	Method: Include TTR as 5% of Travel time benefits (baseline)	1.2
Travel Time Costs	Method: Capped link delays due to congestion at 300 seconds and 2049 DoMin PM capped due to convergence (Baseline)	1.2
	Method: Uncapped link delays due to congestion, 2049 DoMin PM peak uncapped (High)	1.3
Travel Time and Vehicle Operating Costs	Method: Volume based annualisation factors (baseline)	1.2
	Method: Exclude night-time benefits	1.1
Crash Cost	Method: MBCM/ CEC methodology – Option provides ~50% reduction network wide crash cost reduction c.f. Do-Minimum.	1.2
	Method: Option provides an 80% network wide crash cost reduction c.f. Do-Minimum	1.3
Crash Cost – Growth Adjustment	Method: MBCM/ CEC methodology – long term -2% growth adjustment factor for rural crash rates and -1% for urban areas	1.2
	Method: Assume growth adjustment factors do not apply (i.e. set to 0%)	1.3
Emissions - CO_2e Price	Low Shadow Price – Low future price path of CO_2e emissions	1.2
	Central Shadow Price - Central future price path of CO_2e emissions	1.2
	High Shadow Price - High future price path of CO_2e emissions	1.2
Construction Carbon Emissions	Include Construction Carbon Emissions at High Future Shadow Price ($232/tonne CO_2e on an 80,000t – 104,000t baseline) as a disbenefit	1.2
	Exclude Construction Carbon Emissions cost (Baseline based on MBCM)	1.2

Sensitivity scenario	Sensitivity test	BCR
Resilience – Probability, outage states	Earthquake: 1/1000yr with 3 month outage, (Bailey at 1 month) Storm: 1/100yr with 1 week outage Road user costs: 50% traffic wait or divert to alternate route Flooding – 0% growth p.a. costs due to climate change impacts Unexpected TT delay factor – exclude	1.2
	Earthquake 1/1000yr with 6 month outage, (Bailey at 1 month) Storm 1/100yr with 1 week outage Road user costs: 75% traffic wait or divert to alternate route LIHP Flooding – 1% growth p.a. costs due to climate change impacts (baseline)	1.2
	Earthquake 1/1000yr with 12 month outage (Bailey at 1 month) Storm 1/50yr with 2 week outage Road user costs: 75% traffic wait or divert to alternate route LIHP Flooding – 5% growth p.a. costs due to climate change impacts	1.3
Model changes and Updates	Variable Trip SATURN Model. Sensitivity testing, using rule of half shows travel time and VOC benefit reductions of 8-12% with an elastic model.	1.1
	Fixed Trip Model SATURN Model (**baseline**), appropriate as per MBCM Table 4 (large scale roading based activity with small urban centre/rural township)	1.2
Revocation	Exclude Revocation costs and benefits (**baseline**)	1.2
	Include Revocation costs (P50) and benefits	1.2
	Include Revocation costs (P95) and benefits	1.2
Wider Economic Benefits and Impact on GDP	Exclude (**Baseline**)	1.2
	WEBs as a percentage of conventional benefits (Low range - 15%)	1.4
	WEBs as a percentage of conventional benefits (Medium range - 30% - similar to the Wellington Northern Corridor)	1.6
	WEBs as a percentage of conventional benefits (High - 50%)	1.8
	GDP Impact - including the overall net GDP impact of the Ō2NL Project of up to $1.258Bn (Economic Effects Assessment - Market Economics, Dec 2021)	2.3

The sensitivity analysis identified the following:

- Benefit Variability:
    - The BCR is highly sensitive to the assumed population growth scenario because most of the project benefits relate to travel time, and the higher the growth the more congested the base network.
    - Figure 3-24 below shows influence of growth on the BCR, highlighting that in the 95 h percentile growth scenario, the benefits accelerate greatly. Conversely, in the 25 h percentile growth scenario, the benefits reduce and the BCR drops below 1.0.
    - Due to the scale of travel time benefits, the sensitivity of the BCR to a range of other benefit input variables tested is limited, and generally within a range of 1.1 to 2.3, with the upper end including WEBs.
    - Changes in input variables to smaller scale benefits such as active modes have been assessed, but are not reported as they do not materially impact the BCR.
- Cost Variability:
    - Based on the latest estimates, the BCR is likely to range from 1.1 (95th percentile estimate) to 1.5 (Base Estimate). Cost confidence is discussed further in the Financial Case.
- Programme Variability:
    - A 2-year delay during construction is likely to reduce the BCR slightly, while delaying the start of construction by 2 years increases the BCR slightly. Due to NZUP funding, further delays to the start of construction have not been considered.

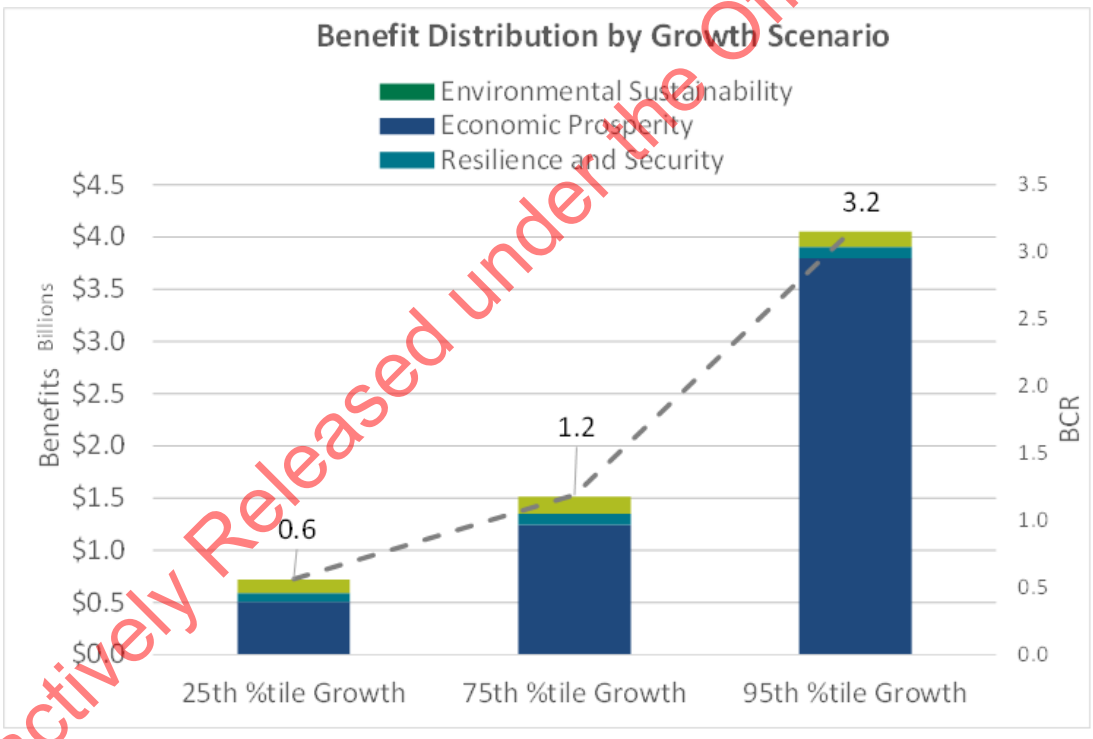


Figure 3-24. Influence of population growth scenarios on the BCR

3.7.9 Summary

The Ō2NL preferred option has been assessed to have a BCR of 1.2 based on the expected estimate of $1.5B and the consideration of a range of conventional benefits from safety, resilience, health and emissions along with travel time and vehicle operating costs. Sensitivity testing shows the BCR is highly sensitive to the population growth scenario that is assumed (BCR ranges from 0.6 to 3.2 between the 25th and 95th percentile growth estimates). In terms of cost sensitivity, the BCR ranges from 1.1 (95th %tile Estimate) to 1.5 (Base Estimate).

Compared to the IBC, and taking account of changes to the MBCM including an extended 60 year assessment period, the BCR has increased largely due to the significant growth that has occurred and is forecast for the district and the wider region. Existing safety and resilience issues, as outlined in the Strategic Case, have also worsened.

In addition to the conventional benefits, wider economic benefits to the region are expected to accrue as a result of Ō2NL. Whilst the current economic analysis excludes this consideration, this project is a significant supporter of growth and other economic supporting activities around the region. Sensitivity testing shows that if WEBs were included the BCR would range from 1.4 to 2.3.

As outlined in Section 3.4.4, a value engineering workstream was undertaken and some of those outcomes have already been included in the Expected Estimate. However, further opportunities are available (see the Financial Case), and if realised would result in a higher BCR.

3.8 NETWORK INTEGRATION

The new transport system will mean the existing SH1 between Ōtaki and Levin will no longer have to be "all things to all people". A significant amount of traffic will reassign to the new highway freeing up space to consider local movement and place functions on the old corridor.

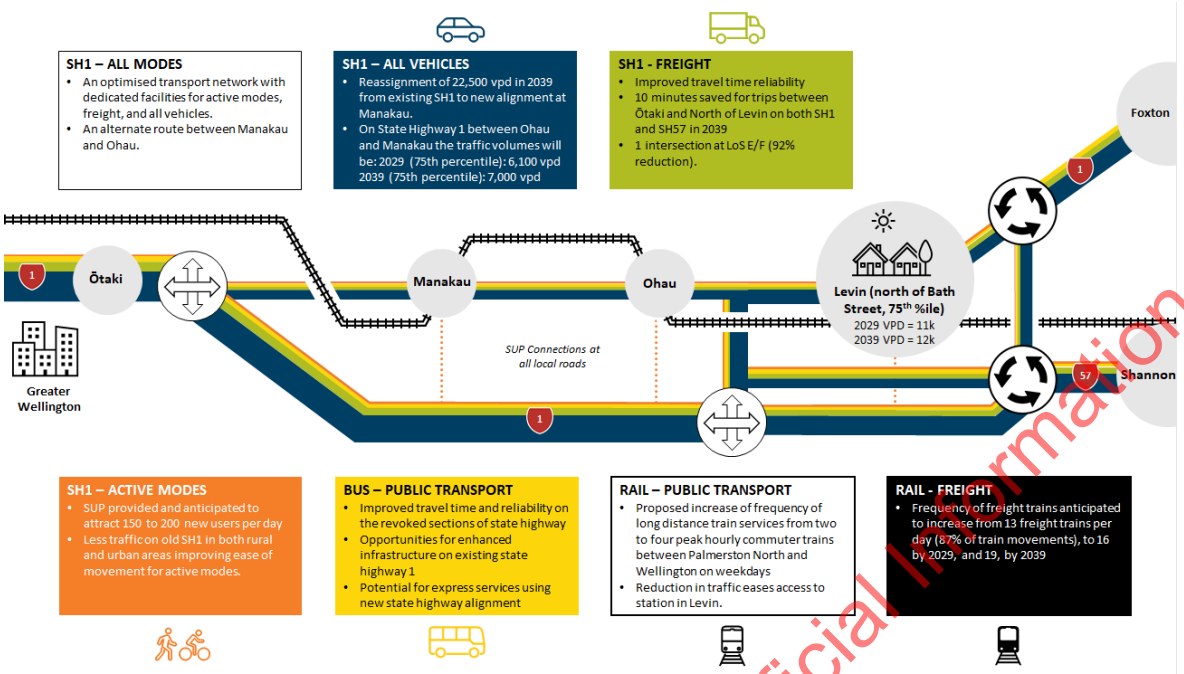


Figure 3-25. Network Integration Schematic

The new transport system will be characterised by improved access and increased choices.

Active modes will have a high quality north-south facility that connects to all communities, and the reassignment of traffic away from the existing state highways will also help to increase appeal for walking and cycling on parts of those corridors, including between marae and their communities. The SUP is anticipated to attract 150 – 200 new trips per day and is expected to be a catalyst to future spur lines as the HDC network is developed.

The reduction in traffic on the existing highway will also help improve physical and consequentially social connections and relationships between and within communities, including Māori communities.

Public Transport funders and operators will have increased choice as to where to locate bus stops, and routes (Ō2NL may be desirable for express services). Freight operators will have greater choice between using corridors better served for access or movement. Concurrent to Ō2NL are investigations and developments in rail public transport and rail freight. Under the current rail public transport proposals there will be a significant increase in services between Palmerston North and Wellington.

Resilience is also vastly improved with two north-south routes, one of which is able to withstand both low and high impact events.

These current and planned improvements will be the backbone of the new transport network, but they, and other improvements, will need to be developed consistently and systematically, with iwi partners to ensure that the network does not begin to impact on Māori way of life, like the current highway. Waka Kotahi will support others to develop regional strategies to ensure the best outcomes are achieved

In September 2021 a draft Network Operating Framework (NOF)[128] was developed for the Horowhenua district. One of the purposes of its development was to support HDC, Waka Kotahi, and stakeholders with multi-modal network planning for the Horowhenua district. The framework recognises the needs of all road users, and in particular the needs of general traffic, freight, public transport users, pedestrians, and cyclists while considering the inter-relationship of those modes

[128] Draft Levin Network Operating Framework (NOF), prepared by GHD for Waka Kotahi, September 2021)

with land use. The draft NOF has been developed under the assumption that the new Ō2NL highway and the revocation of SH1 and SH57 will be progressed, the framework also considers expected landuse such as the Tara-Ika development will occur. The NOF identifies the following transport networks:

- **Pedestrian Network:** Primary network located on higher classification local roads, for example in Levin Town Centre, Queen Street, and Liverpool Street. Overall, the routes were developed with a consideration for connectivity with Ō2NL.
- **Cycling Network:** The primary cycle network is similar to the pedestrian network. The existing SH1 (combination of primary and secondary route from the new SH1 to Ohau), SH57 (secondary route), and Ō2NL SUP (primary route), form much of north-south movement corridors. East-west primary routes include Queen Street, Liverpool Street, and Tararua Road among others.
- **General traffic Network:** Ō2NL is the preferred traffic route. Traffic routes include the existing SH57, Tararua Road east of Ō2NL, part of Liverpool Street (from the existing SH1 leading into Tara-Ika), and much of the existing SH1 except a central Levin section.
- **Freight traffic Network:** Ō2NL will be the primary freight route, along with the Tararua Road that links Ō2NL to the existing SH1, Hokio Beach Road, C.D. Farm Road (portions of which being secondary freight routes)

Changes to the transport system can also be quickly recognised through the expected changes to the ONF classification of the existing and proposed state highways (refer to Figure 3-26 below)

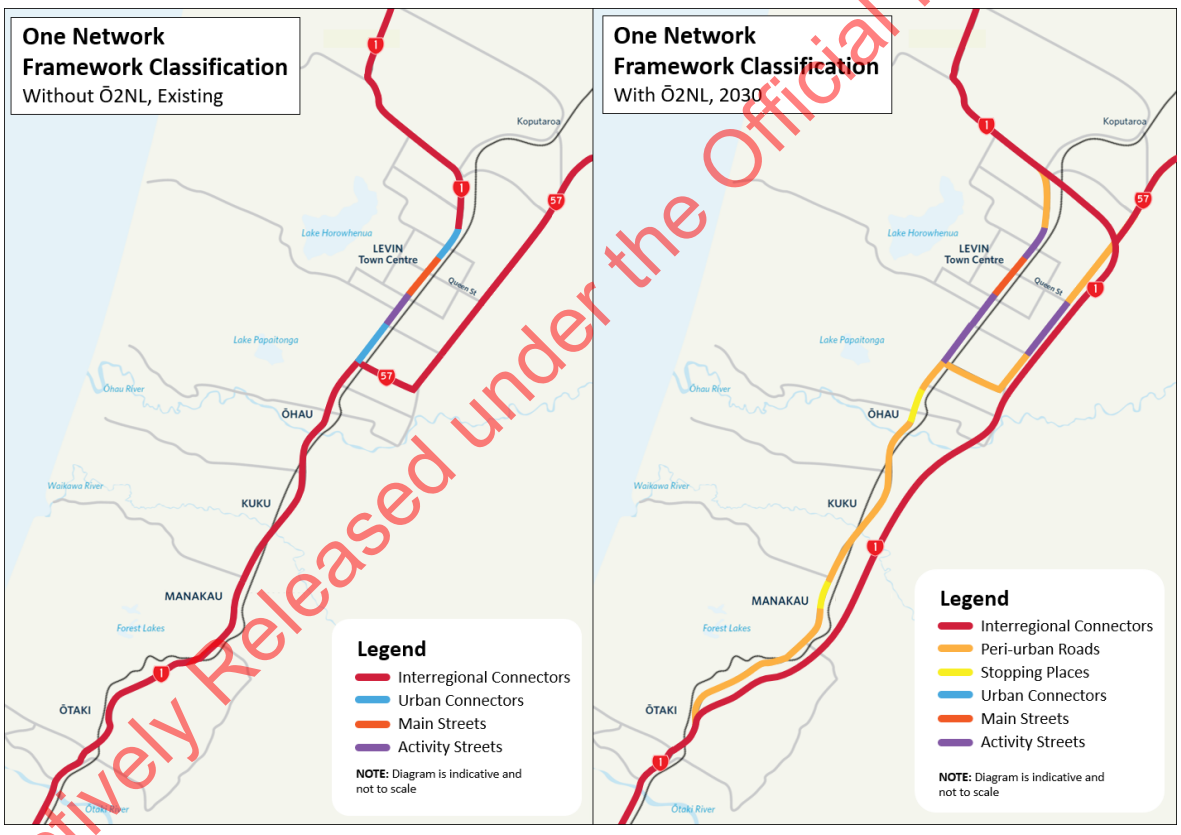


Figure 3-26. One Network Framework – With and Without Ō2NL

Notable features of the ONF changes include the new classifications in Manakau and Ohau (changing from Interregional Connectors to Stopping Places), the majority of rural existing SH1 and SH57 changing from Interregional Connector to Peri-urban Roads, and SH1 in Levin (more prevalent City Hub classification), and SH57 between Queen Street and Tararua Road (Activity Centre) also changing. Ō2NL will be an Interregional Connector.

3.8.1 Supplementary Projects

Section 2.4.2 discusses the potential interdependencies of Ō2NL and Section 3.2.5 presented how the IBC Preferred Option fits within the wider transport programme, to ensure that the Do Minimum network for Ō2NL was well defined.

With the preferred option now being better defined, the revocation s 9(2)(f)(iv) orkstreams, which are parallel and not funded by NZUP, can be confirmed.

Revocation

Due to the Waka Kotahi decision to pursue an offline highway, and as set out in Figure 3-27 below, it will eventually need to make recommendations to the Secretary of Transport on whether the following existing sections of the existing state highway network should be revoked:

- **SH1** – Taylors Road (Ōtaki) to Koputaroa Road (North Levin), and
- **SH57** – SH1 / 57 (Kimberley Road) intersection to south of Heatherlea East Road.

Prior to revocation, the revocated highways need to be considered fit for purpose, which may mean investment is needed. The Ō2NL project team have begun this process by developing a Programme Business Case (PBC) and the work to date is summarised below.

Revocation activities are not part of the NZUP scope and therefore will need to be funded by the National Land Transport Fund.

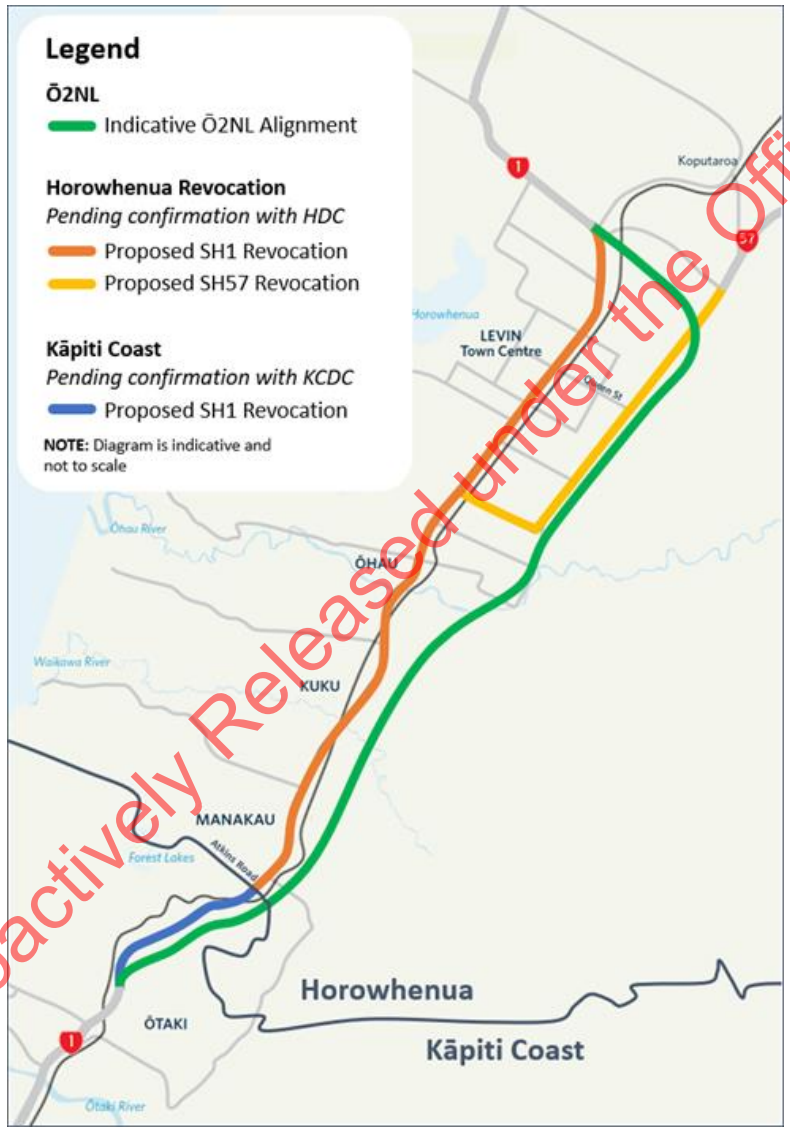


Figure 3-27. Sections of SH1 and SH57 to be considered for revocation

The starting point for the development of the "Revocation PBC" was the Waka Kotahi Revocation Policy 2021[129]. Key features of this policy include incorporating revocation investigations in DBCs and ensuring the revoked sections of SH1 and SH57 are fit-for-purpose at handover. In recognition that revocation is still some eight years away, the focus of the PBC was on establishing the "starting blocks" for how revocation might occur, and identifying what the next steps are for ensuring the revocation outcomes the PBC seeks are ultimately achieved.

This PBC was prepared in collaboration with Regional Councils (HRC, GWRC) and the Ō2NL revocation project partners – HDC, KCDC and iwi partners – targeting a 2030 date for revocation. It has identified problems and investment objectives. The latter seeks to achieve fit-for-purpose, sustainable financial management, mode choice and amenity outcomes for revocation of the state highways.

To assist in developing a recommended revocation programme, including identifying fit-for-purpose standards based on future One Network Road functions, the Ō2NL project team adopted a "traffic light assessment" process. This expert led process identified revocation options, and in particular improvement options for ensuring the highways would be fit-for-purpose at handover based on 2022 information.

The PBC's recommended programme comprises of walking and cycling provisions, road safety / monitoring provisions and master planning for SH1 through the Levin Town Centre, Ohau and Manakau. The PBC has also identified that SH1 Bridge repairs and pavement / drainage rehabilitation would also need to be undertaken by Waka Kotahi prior to formal revocation and as per its Revocation Policy. Other key features of the programme include incorporating the next steps for revocation from 2022 to 2029 (e.g. the need for formal revocation agreements that will set out final roles and responsibilities and funding allocations) in the pending Ō2NL Principal Project Development Agreement with Horowhenua District Council.

A critical aspect of the Revocation PBC is its Management Case. This case sets out the key management processes for the recommended revocation programme, such as, who will be responsible for implementing the supporting monitoring and technical assessment regimes as well as for the day-to-day governance and management responsibilities.

The Revocation PBC recommends that an Integration Working Group (IWG) be established to ensure that the Ō2NL Project is developed and delivered efficiently into the local transport networks. The IWG is made up of representatives from Waka Kotahi and iwi partners, Horowhenua District Council and KCDC. This will enable effective integration with other planned infrastructure improvements that are needed to facilitate and support planned growth.

Initial costs have been identified for the recommended revocation programme that range from $36M (P50) to $51M (P95). These costs are high level, subject to further design refinement processes, including detail option development / assessment processes, and the outcomes of the monitoring and technical assessment programmes identified in the Management Case. All revocation project partners acknowledge that there are uncertainties regarding the final scope for the recommended programme and therefore its final costs. These uncertainties are expected to be resolved over the next eight years leading up to when formal revocation agreements will be in put in place.

The recommended revocation programme's BCR is 1.5 and is expected to generate safety (from reduced speed and intersection improvements) and walking and cycling health benefits. These benefits are in addition to the benefits of the new Ō2NL highway.

It is noted that Horowhenua District Council has concerns about the cost implications of taking ownership of some of the current state highway bridge structures in their current condition. To mitigate these concerns and reduce consenting risk for Ō2NL, consideration will need to be given to how this is addressed.

s 9(2)(f)(iv)

[redacted]

[129] See: Waka Kotahi – State Highway Revocation Policy & Guidance

s 9(2)(f)(iv)

Maintenance and Operations

Construction of the Ō2NL highway will result in an increase in maintenance expenditure. This is discussed further in Section 4.2.6.

Speed and Infrastructure Programme

The agreed form of the Ō2NL highway has influenced the form of the interim online safety works as discussed in Section 3.2.5 and in turn the form of the safety works have been taken into account in determining the project and economic outcomes of the Ō2NL project.

s 9(2)(f)(iv), s 9(2)(j)

s 9(2)(j)

[130] Waka Kotahi Delegation Letter - Hon Michael Wood, 24 September 2021

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(j), s 9(2)(f)(iv)

[131] The NZUP baselining was concluded and approved in June 2021, but used estimate figures developed in January 2021, based on the level of design at that time.

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(f)(iv), s 9(2)(j)

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(j), s 9(2)(f)(iv)

s 9(2)(j), s 9(2)(f)(iv)

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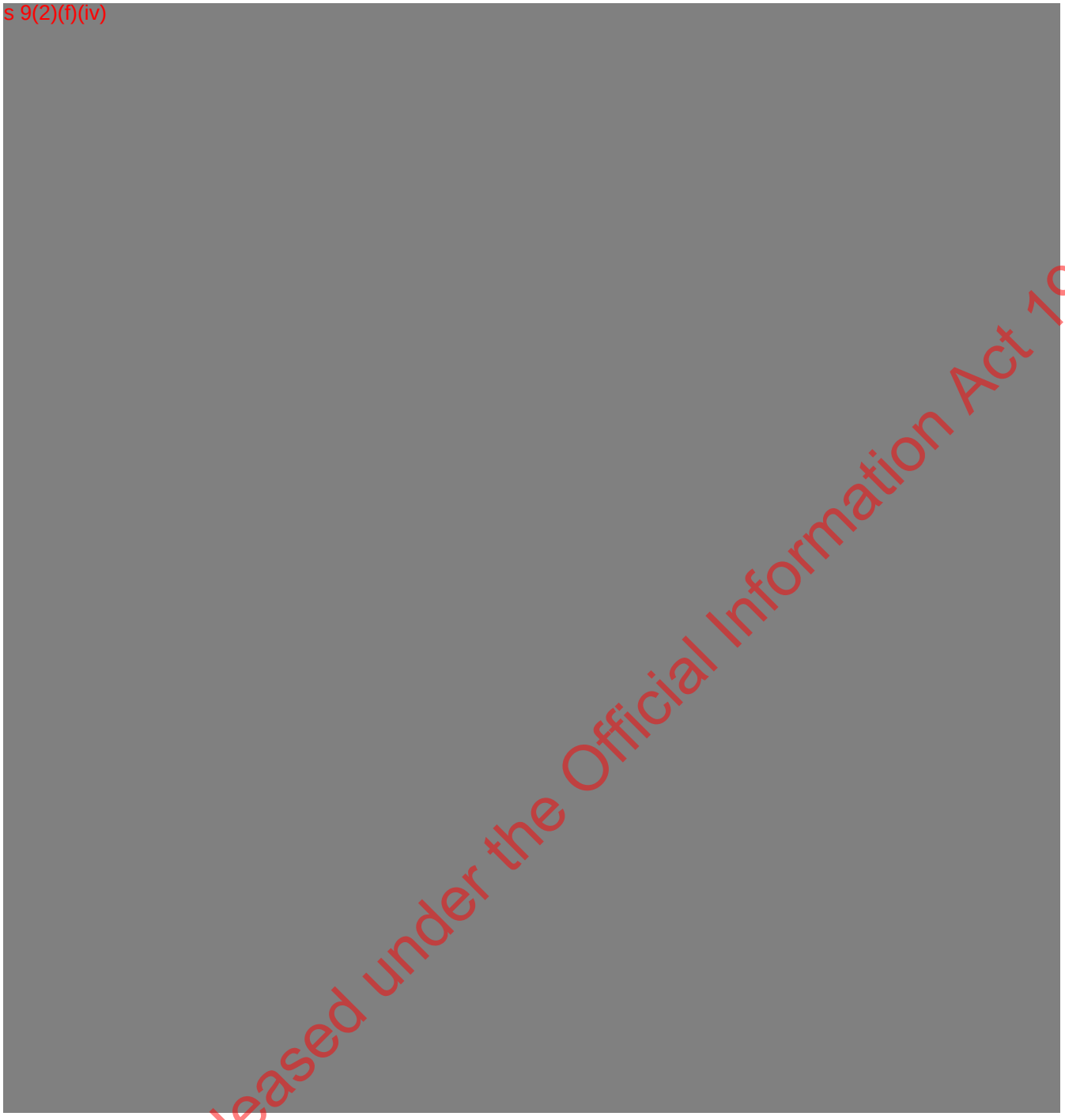

s 9(2)(j)

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6. MANAGEMENT CASE

The purpose of this management case is to outline the arrangements the project have and will establish to ensure the successful delivery of the preferred option and to manage programme risks.

The Ō2NL Project is a complex project with a wide range of interfacing plans, legacy documents, disciplines and deliverables being undertaken in the Horowhenua and Kāpiti Coast districts as well as Greater Wellington and Horizons regions. The proposed structures in the management case are geared towards an Alliance based procurement model.

The proposed management structure embraces and enables the Ō2NL Project to be delivered in partnership with the Muaūpoko Tribal Authority and Ngāti Raukawa ki te Tonga, whilst responding to project outcomes, benefits realisation, cost and programme drivers.

This management case reflects the current Ō2NL project scope and does not include the management processes required across the related workstreams e.g. SIP or revocation.

As with the entire project the management case also reflects the project core principles and values as presented in Section 1.1.3. This working approach permeates all levels and areas of the Project and is (will be) reflected in all key project artefacts (charter, strategies, plans, documents etc).

6.1 MANAGEMENT STRATEGY AND FRAMEWORK

6.1.1 Governance

The Ō2NL Project delivery approach is consistent with the Waka Kotahi role and delegations as detailed in the delegations letter from Joint Ministers to the Waka Kotahi Board Chair. This letter also sets out the Minister's role in the decision making and approval process.

Figure 6-1 below provides details the broader governance framework and summarises the different roles and responsibilities. Figure 6-2 below provides details the NZUP governance system membership, including key personnel.

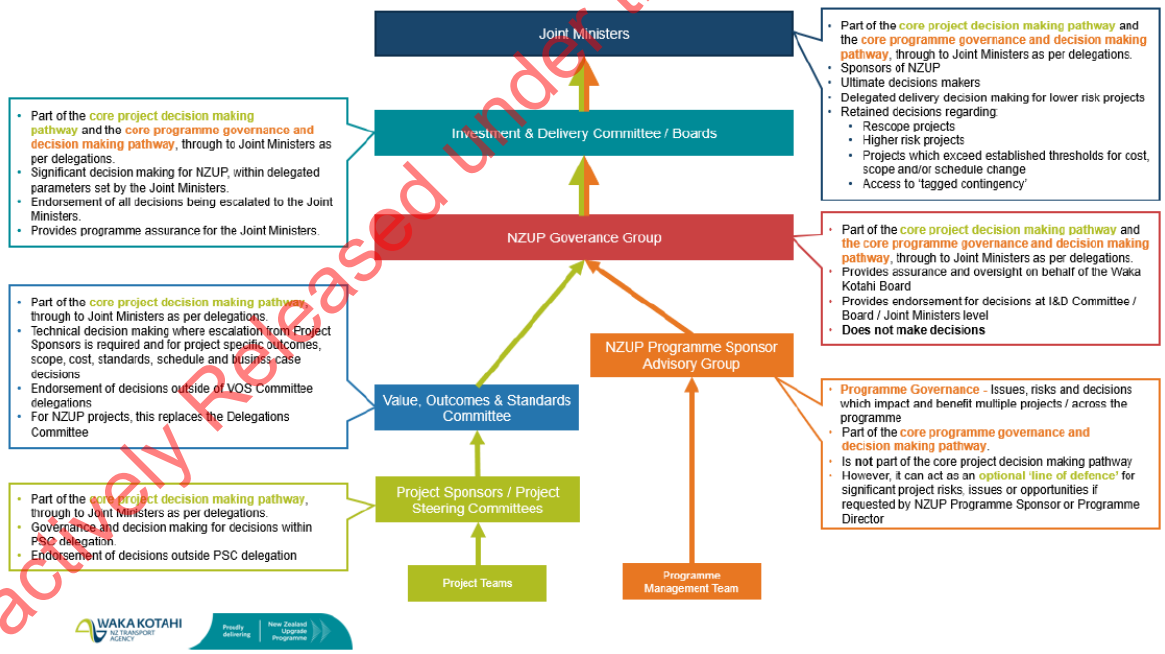


Figure 6-1. Governance Framework roles and responsibilities

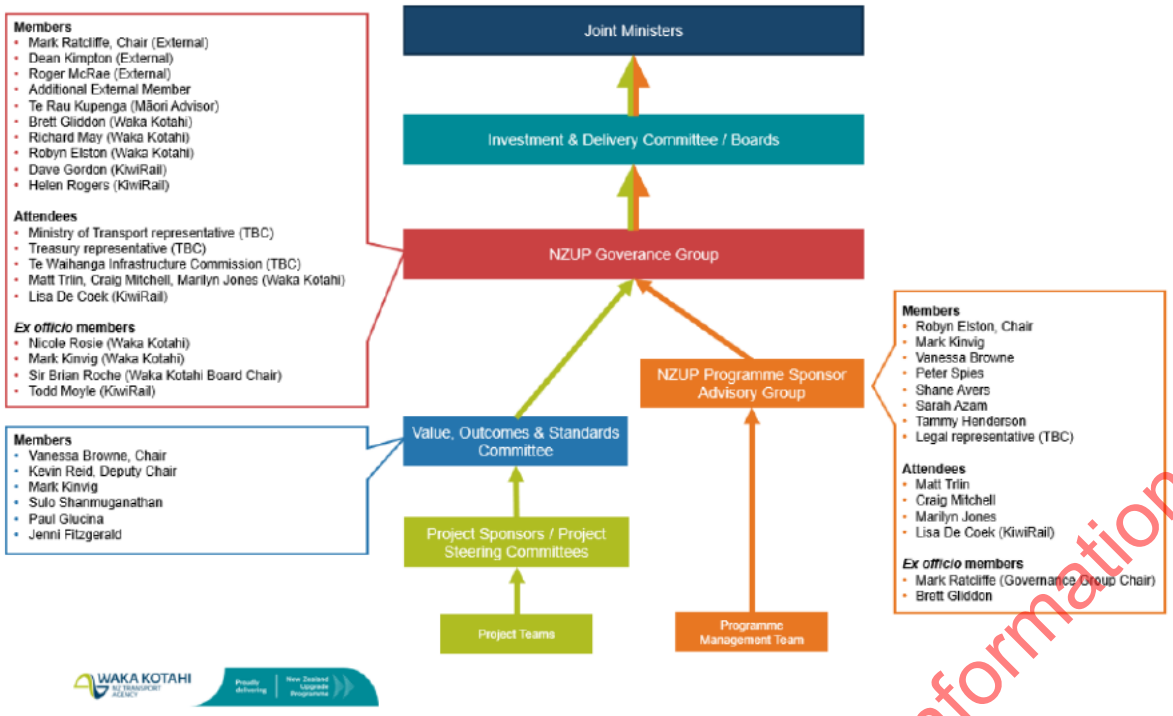


Figure 6-2. NZUP Governance membership/personnel

Table 6-1 below sets out the governance team for the current design phase. This will be adapted and integrated with the successful constructor team once selected.

Table 6-1. Project Specific Governance Approach

Role	Responsibilities
Project Sponsor	Alignment of the project with organisational drivers. Ownership of project benefits from business case.
Project Steering Committee	Decisions on scope change, risk and major variations. Ownership of step-change drivers.
Collaborative Constructor Team	To be established once constructor team selected

Project Steering Committee

At a project level, a Project Steering Committee (PSC) provides oversight of the project. The scope of the PSC includes steering of complimentary investigations and improvements (the Ō2NL Programme) as specified in 5.2. This ensures that the Ō2NL Project is delivered integrated and cognisant of wider programme of works. The Integration Working Group (discussed below) also reports to the PSC. The PSC is comprised of the following personnel:

- Will Reet (Independent Chair)
- Kevin Reid (Project Sponsor)
- Di Rump (representative of Muaūpoko Tribal Authority)
- Hayden Turoa (representative of Ngāti Raukawa ki te Tonga)
- Chloe Grosser (Waka Kotahi, Communications and Engagement)
- Linda Stewart (Waka Kotahi, Director Regional Relationships)
- Sara Downs (Waka Kotahi Regional Manager, System Design)
- David McCorkindale (HDC)

- Independent representative (TBC)

The PSC meet monthly to review progress, discuss key risks including scope, cost and schedule. Minutes are taken at the meetings and actions are recorded and tracked.

The PSC also provides regular updates to the NZUP Governance Group as part of the overall programme. This includes programme and cost summaries, risks and issues so NZUP has a comprehensive summary of project progress. Project updates are provided to Ministers via regular NZUP briefings.

Regional Leadership Team

While not formally part of the Project's governance, the Waka Kotahi regional leadership team have a role in supporting the Ō2NL Project team, particularly in managing regional relationships and giving the project regional context. The Regional Leadership Team includes the Infrastructure Delivery and Maintenance and Operations Regional Managers, the System Design Regional Manager, the Director of Regional Relationships and the Pou Arahi for the region.

Integration Working Group (IWG)

While revocation is being treated as a separate project (subject to separate funding approvals processes), it is part of the wider Ō2NL programme.

The revocation PBC recommends that an Integration Working Group (IWG) be established to ensure that the Ō2NL Project is developed and delivered efficiently into the local transport networks. The IWG is made up of representatives from Waka Kotahi, their iwi partners, and Horowhenua District Council and KCDC. This will enable effective integration with other planned infrastructure improvements that are needed to facilitate and support planned growth.

The primary role of the IWG is to ensure that effective revocation agreements are in place in sufficient time to enable the IWG agreed outcomes. This will enable investment to efficiently deliver an integrated transport system and will also underpin asset transfers as appropriate. The IWG will also facilitate information exchange to allow effective integration of capital investment, maintenance, and operational activities.

6.1.2 Project Management Plan

A Project Management Plan is in place and serves as a reference point for delivery processes and expectations, to provide a road map for the wider framework of deliverables and documents. The Ō2NL Project delivery framework is consistent with Waka Kotahi standards and NZUP PMO plans and strategies hierarchy including governance, reporting and general assurance.

6.1.3 Project Roles and Responsibilities

The table below sets out the roles and responsibilities within the Project. This table does not include external suppliers.

Table 6-2. Roles and Responsibilities

Role	Name	Responsibilities
Project Sponsor	Kevin Reid	Sponsorship of project as part of NZUP / interface between Project and NZUP Programme Governance
Project Director	Lonnie Dalzell	Project leadership taking whole of project lifecycle view.
Project Manager	Rob Napier	Supports and oversees the project delivery team during development and review of key documentation for project business case approval. Support the Project Director with Business Case development and approvals process.

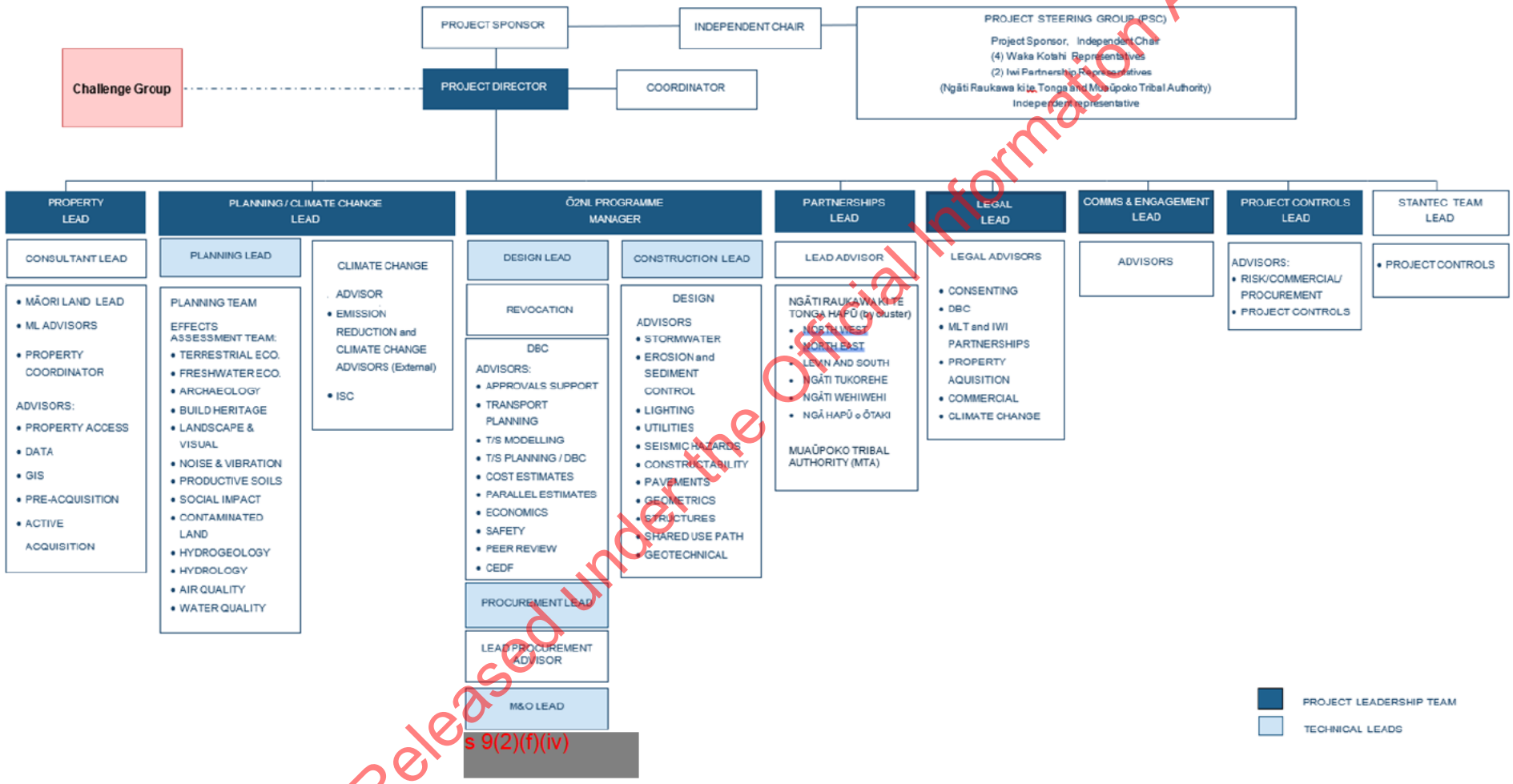
Role	Name	Responsibilities
Construction Lead	Sarah Heappey	Project and procurement management, project establishment in support of the Programme Manager. Ensure appropriate resourcing and interfaces managed (internal/external). Review RMA consent documentation and advise in respect of constructability risk/ issues / opportunities.
Project Controls	Rhys Stickings	Manage, administer, and report on project controls (financial management, risk management, schedule management, project registers).
Project Controls Specialist	Anshita Bum	Support Project Controls Lead
Project Coordinator	Kate McLaren	Provide coordination for project management activities
Design Lead	William Wallace	Review design from traffic planning perspective. Preparation of design and minimum requirements
Delivery Improvement Lead	Eugene Stansfield	Deliver broader delivery improvement outcomes as part of the NZUP programme
NZUP PMO Interface	Craig Mitchell	Provide guidance to and act as a conduit with the wider NZUP programme team, including MoT and Treasury.
Property Lead	Rano Lealuga	Support process of title handover and reporting on risk and program of property acquisition
Property Specialist	Rod McGregor	Support Property Lead
Property Project Coordinator	Julie Davey	Coordinate engagement and communications with owners of property affected by the Project
Partnerships Lead (iwi)	Mike Dreaver	Support Project Director and Project Manager in developing effective partnership with marae, hapū and iwi partners.
Project partners - Kaiārahi and Kaimahi	TBC	To provide cultural advice and support to the project including ongoing design, consenting, cultural and environmental processes. Assistance with procurement processes to help deliver broader project outcomes and benefits.
Communications and Engagement Lead	Raewyn Pudsey	Coordinate communication and engagement with the local community and stakeholders

Role	Name	Responsibilities
Communications and Engagement specialists	Barbara Becker Caitlin Salter	Support Communications and Engagement Lead.
Planning Lead	Caitlin Kelly	Manage and coordinate planning workstream. Lead engagement with stakeholders and community. Overview of technical outcomes related to environmental design and compliance.
Planning Advisor	Greg Lee	Assist and support Planning Lead. Provide technical leadership and coordination of RMA consenting activities. Support marae, hapū and iwi partnership involvement in RMA consenting and approvals processes. Engage and consult with stakeholders and community.
Climate Change Lead	Caitlin Kelly	Facilitate climate change / ISC workstream to achieve maximum sustainability outcomes and carbon reductions. Coordinate activity with procurement and Waka Kotahi standards teams to set objectives and targets.
Legal Lead	Bridget Burt	Provide advice and review throughout consenting, property and tendering process and on side agreements. Instruct external legal suppliers as required. Identify potential legislative changes. Manage litigation associated with RMA, property and other statutory approvals and permits (e.g. Wildlife Act, Heritage NZ Pouhere Taonga Act).
Procurement Lead	Johann Steyl	Commercial procurement advice to inform selection of preferred procurement approach. Support collaboration with construction industry. Lead the preparation of contracts and tendering processes.
Procurement Advisor	Delphine Haas	Support Procurement Lead.
s 9(2)(f)(iv)		
Urban Design Team Lead	Sam Bourne	Review of technical outcomes related to environmental design and compliance.
Maintenance and Operations Lead	Aarin Bang	Provision of input into operational requirements and handover expectations from operator perspective. Input into maintenance requirements. Support in development of Minimum Requirements.
Revocation Lead	Peter Martineau	Lead revocation business case investigations and establish implementation phase. Development of agreements with district councils.

It is expected that the above nominated roles will continue through to at least construction start with some continuing through Project completion. Key roles specified below in section 5.5.1 are expected to form part of the Alliance that is charged with completing the design and then constructing the Project.

6.1.4 Management Structure

The current project management structure is outlined below.



6.1.5 Reporting arrangements

Project reporting is currently undertaken monthly. The consultant supplier team generate a monthly update, which the Project Controls lead builds on and inputs to the monthly planview report (progress in key project management areas, key risks and issues, budget). In addition, the Project Control lead and Project Director provide an update on progress to the Project Steering Committee every month. Planview reporting is monitored both internally within Waka Kotahi, and externally to central government stakeholders via NZUP.

6.1.6 Lessons learnt

The Project team will instigate lessons learnt reviews at key points of the project. The next point being the completion of the DBC phase. Key findings and responses will be included in the Project's reporting. The Ō2NL Project is also looking across the wider Waka Kotahi project spectrum to identify lessons and potential improvements. Key examples of these are provided in Table 6-3 below.

Table 6-3. Lessons learnt across projects

Lessons learnt - key examples	Ō2NL response which re-invests lesson learnt
Improved local government engagement - Work more closely with local government to better integrate our proposal with RLTPs while communicating better internally to ensure we tell a consistent story to our external partners.	We have governance (PSC, RLT, elected members), management (exec and officers) and operational structures which provide a forum for addressing key issues/risks/opportunities and support integration across project and programme. Examples include – strategic planning, revocation PBC development, investigation of options (supported by Multi Criteria Analysis) and technical reports to assist development of options and identification of preferred option.
Better project management - Release a detailed timeline to ensure products are delivered on time and those responsible are held to account while also ensuring the project is adequately resourced.	Seeking to drive better project outcomes as we have resourced Councils and stakeholders (for example KiwiRail) to ensure delivery of inputs.
Effective governance and decision-making arrangements - Clear decision-making pathway that enables the project to make effective decisions. Need to ensure we communicate with Executive Leadership Teams, the Board and the Minister early on critical decisions like debt financing.	Governance strategy on Ō2NL has been modified through the introduction of an Independent Chair, iwi partners, rationalisation of membership by Waka Kotahi representatives (PSC) but also the NZUP structure (as shown above)
Procurement models which inadequately allocate risk to private sector	We are engaging early with industry on project/supplier risks and will have risk allocation available for review prior to seeking approval to procure.
MoT/Treasury PenLink guidance on business case and implementation strategy best practice.	The project has cross-referenced this material and engaged with PenLink project team to incorporate as relevant into this DBC.

6.2 OUTLINE ACTIVITY PLAN

The key milestones for the Ō2NL Project are summarised below in Table 6-4 for the Programme Plan).

Table 6-4. Key Milestones

Milestone	Date
RMA consents and approval applications lodged	Spring 2022
Active acquisition programme of property commence*	Spring 2022
Release of ROI for shortlisting of Alliance	Summer 2022
Award of contract (Alliance)	Mid to end of 2023
Detailed design and mobilisation	Early 2024
Enabling works (physical mobilisation)	Mid 2024
Construction start	Early 2025
Construction completion/ road open	End of 2029

*property acquisition processes of strategic properties commenced in October 2021

6.3 RESOURCE MANAGEMENT

The Project Director and workstream leads regularly review resource requirements to ensure appropriate resource is in place for the current and upcoming phases of the project. Key parts of the review and management process are:

- A weekly project management team meeting to discuss programme and resource requirements
- Monthly meeting with the Programme Steering Committee (PSC), including representation from Project Sponsor and senior managers across disciplines and relationships to review progress, programme, engagement and risks management.
- Documentation of all milestone (key and interim) and key work breakdown structure (WBS) items in an integrated project program, which is maintained up to date by the project controls team
- Change and scope management are managed by the Project Controls Team in liaison with technical leads and suppliers.
- Project finances are managed utilising a cashflow and forecasting spreadsheet (including allocation of WBS items). TIO and SAP form the financial record.

6.3.1 Business continuity - implementation phases

The team structure will change when a constructor is established and key members of the team will be embedded in the future structure to provide project continuity and intelligence and to leverage of established relationships. The Project Director will likely be involved in project governance structures, thereby influencing resourcing as well as maintaining overall responsibility of resourcing the wider team.

Existing governance and team structures have been established with a view to the future establishment of an Alliance model for design and construction phases. The Alliance model has been selected because of the benefits of early contractor involvement and accordingly governance and project teams will be agile and respond to these new opportunities in a manner that retains Project knowledge and integration of the Ō2NL Project with the broader programme. The PSC is expected to have representation on the Project Alliance Board.

Project team members that may be transitioned into the Alliance (and future implementation phases) to embed project business continuity, relationships and momentum, are:

- Project Director
- Programme Manager
- Construction Lead
- Maintenance and Operations Lead
- Partnerships Lead
- Climate Change Lead
- Comms and Engagement Lead

6.3.2 Broader network of teams

In addition to the resources assigned as described in the preceding table, the Ō2NL Project interacts with a number of Waka Kotahi teams, as summarised in Table 6-5 below:

Table 6-5. Power of networked teams

Team Name	Input Required and When	Accountabilities
Engagement and Partnerships	Support stakeholder management and communications initiatives to the project.	Stakeholder Management
Safe and Sustainable Standards Team	Technical review and support of assessments, strategic to manage effects including conditions.	Planning and Consents
Specialist Project Delivery Advisors	Provision of commercial and engineering guidance relating to key decision making on commercial procurement	Commercial and Engineering
OPPP Safety and Environmental Team	Provision of technical support and input into design requirements as relates to (but not limited to) the following: - Bridge structures and culverts - Quality assurance - Pavements - Design standards.	Technical Engineering Inputs
Safety and Wellbeing Team	Provision of input from a wider safety and wellbeing outcomes perspective into minimum requirements and project plans.	Safety Excellence Inputs
NZUP PMO Team	Provision of guidance and structure relating to reporting, governance and consistency of the project as relates to the objectives of the broader NZUP.	PMO Support
I&F Investment Assurance	Inputs are pending further consultation with the NZUP PMO team on potential requirements relating to business case.	Investment Assurance
s 9(2)(f)(iv)		
Environment and Sustainability Team	Policy advice in respect of resource efficiency, climate change and greenhouse gases.	Waka Kotahi climate change policy
Maintenance & Operations	Review of project design and proposals to manage environmental effects of the new road that have maintenance implications beyond the construction period.	Ongoing maintenance requirements following construction

6.4 COMMUNICATIONS AND ENGAGEMENT APPROACH

The following section outlines the communications and engagement approach for ongoing investigations and planned improvements within the Ō2NL corridor. It forms the basis for consistent and coordinated messaging and engagement with local communities and provides the basis for the Ō2NL Project team to gather information from stakeholders. The approach has been developed using the International Association for Public Participation spectrum.

All communications and engagement activity is planned by the Waka Kotahi Communications and Engagement Lead who is a member of the project management team and reports to the Project Director, with the support of Communications and Engagement specialists. Activities are planned in response to the requirements of the workstream leads, notably Planning / Carbon and Property leads. Communications and engagement activity with landowners (affected by the Project) is coordinated by the Property Project Coordinator, consistent with this strategy and with the Property Strategy.

The approach delivers on the NZUP communications and engagement strategic objective:

> *'Tell the overarching story of the NZ Upgrade Programme by highlighting and explaining what and how it will deliver for New Zealanders by future proofing the economy, getting our cities moving and making our roads safer. We will inform, engage, consult and communicate in a proactive and transparent way to ensure communities and stakeholders feel a part of this massive investment in infrastructure, and understand the implications and choices we jointly face in delivering this programme.'*

The Project communications and engagement objectives are to:

- Explain the background to the project and why it is required
- Advise the affected parties and communities of the potential extent of the proposed works as well as any potential effects and mitigation measures
- Ensure key target audiences and stakeholders have an accurate understanding of how the projects fit into strategic regional development
- Receive feedback from those parties and consider implications on the project
- Provide consistent information
- Engage genuinely and constructively with key stakeholders/target audiences
- Minimise uncertainty and dispel misinformation
- Maintain and enhance existing relationships
- Enhance stakeholders' awareness of the outcomes of NZUP. The outcomes include safer journeys, enhancing walking and cycling, supporting economic growth and building network resilience.
- Explain how Ō2NL Project contributes to the expected outcomes of NZUP

Tactical plans for each phase of investigation are developed to guide specific communications and engagement activities. This approach ensures that activity occurs mindful of the long history associated with the Ō2NL Project and specifically:

- Recognises and understands the history of engagement
- Provides clear transparent messaging about the whole programme
- Takes a long term view of relationships
- Provides proactive and regular information
- Ensures project team are approachable and available.

6.4.1 Reporting and Communications

All stakeholder engagement activities are recorded in our management software, Consultation Manager. Meeting minutes are documented and, where appropriate, agendas provided. Meeting notes are assigned to the relevant stakeholders and, where further actions are required, these are to be logged and appropriate action taken to close them out.

A summary of ongoing engagement activities is provided below:

- 4 – 6 weekly newsletter that provides programme information and details of current site investigations activity and planned engagement is circulated to approximately 1,900 local communities and stakeholders
- Iwi weekly hui – to discuss the Project and mitigation, design, effects avoidance and management approaches and to integrate cultural aspects into the Project
- Project workshops / site visits – whole of project team along with stakeholders convene to discuss and resolve overall Ō2NL Project issues. Stakeholders invited to become involved or to observe depending on their role
- Topic workshops, notably in respect of ecology, noise and natural character and Councils, Department of Conservation (DOC), Forest and Bird (F&B) and iwi partners are invited to attend. Workshops allow targeted consideration of design of mitigation / offset options
- Condition workshops with the Councils (and their enforcement officers) and stakeholders (DOC, F&B, KiwiRail) to develop common understanding as to the form and function of conditions. Conditions to be promulgated within agreed principles framework
- RMA officer hui – monthly (becoming bi-weekly as required) to ensure alignment in terms of processes and resources. Offer cost recovery agreement approach to all Councils to provide ongoing resource certainty
- RMA documentation – share draft reports and technical information with stakeholders and Councils to ensure that scope and methodology are understood and appropriate and seek to agree mitigations as appropriate
- Ō2NL Community Groups – approximately three-monthly hui open invitation to community to discuss design and investigations. Community noise interest group once a month to discuss technical design and investigations aspects relevant to noise, seeking to agree methodology and mitigation
- KiwiRail – develop legal agreements in respect of work within and across rail corridors (bridge and level crossing relocation and improvement)
- Other stakeholders – notable transport groups and stakeholders met with to discuss design specification to ensure that design is understood and appropriately scoped
- Landowners (whose property is affected by the Project) – meet and agree with landowners how access, utilities and use of the land (including farming) will be managed during and re-instated post construction. Letters and update plans issued to landowners as required
- DOC and F&B – share technical reports, monthly catchups (or as required) to discuss progress and programme, and facilitate communications between experts to ensure that issues are understood and being appropriately resolved
- Heritage New Zealand – share technical reports and agree process for obtaining any Heritage Act approvals / consents required.

The above activities are supported by targeted and specific communications as required and includes:

- Public consultation and engagement exercise comprising open days and information evenings held during May 2022 which provides project design, construction and operational information and is supported by technical experts and advisors
- Targeted landowner visits to provide Project design, construction and operational information, supported by property advisors as required

Discussions with Māori landowners affected by the Project to investigate how mana can be enhanced through the Project.

6.5 CHANGE MANAGEMENT ARRANGEMENTS

At the outset of each phase of the Project, it is critical that the scope of work is clearly defined and agreed between the project partners and consultant/contractor. This will enable the clear identification of change during the project development, ideally before it has an impact.

There is a hierarchy of controls dependent on the level of change. At a project level, if the change does not trigger a change to the baseline scope, cost or schedule then this is managed within the project and the PSC are informed.

Should a change affect (or potentially affect) scope, cost, schedule, risk, benefits or project objectives as defined in the baseline report, the Project Director raises this with the Sponsor via the PSC. It is then escalated to NZUP Governance Group and dependent on the level of change raised to the Waka Kotahi Investment and Delivery Committee / Board as appropriate.

Escalation to Joint Ministers is consistent with the escalation thresholds as defined in the delegations letter to the Waka Kotahi Board Chair. An early warning will be provided should there be a risk of an escalation threshold being triggered.

Project Change is to be managed in accordance with the process provided in the Waka Kotahi Project Management Manual, Part 2 Processes, Chapter 9.5 Change Control. This includes establishing a change control register enabling interdependencies of change to be managed appropriately.

Change will be managed within an understanding of the tolerances of the Project related to funding, scope, risk, quality, and benefits. The change control register will sit alongside the risk register and should be managed by the project manager. Any risk that is realised will result in a change to the Project, including adjustment of cost, programme or quality that will be subject to approval by the NZUP governance.

The below table provides an overview of key steps, with changes managed through a Change Control Register and in accordance with the Project Management Manual.

Table 6-6. Change Management Approach

Change Process Step	Document
Programme Manager identifies an issue and its priority or severity	Logs in issues and change register. Notifies Project Director by email and updates Planview
Project Director assesses impact on Project objectives and risks. Then identifies, evaluates and recommends options	Recommends and outlines the change within Planview
Project Director either accepts or rejects the option. If the degree of change is outside project delegations as outlined in the Waka Kotahi Project Management Manual the request will be escalated to the governance owner	If necessary, the Project Director sends an exception memo to the Project Sponsor
When a change is agreed, the Programme Manager updates plans and records	Updates register, business case, and other documents as required

6.6 BENEFITS MANAGEMENT ARRANGEMENTS

Benefits Realisation Plan

A Benefits Realisation Plan will be developed, based on the investment objectives and key performance indicators for the purpose being to demonstrate how the objectives will be achieved by the project. It enables the benefits that are expected to be derived by the project to be planned for, tracked and realised.

Appendix I.1 provides an Appraisal Summary Table (AST) which outlines the anticipated benefits for the Project and this is summarised in the Table below.

Table 6-7. Investment Objectives and Key Performance Indicators

Proposed Investment Objectives	Transport Outcomes Framework	Benefit Measures and Key Performance Indicator(s)	Baseline(s)	Target	Schedule	Source	Responsibility
Reduce deaths and serious injuries by 50-55% per annum by 2035	Healthy and Safe People	1. Deaths and Serious Injuries (5y)	1A) 72 DSI SH 1 and SH57 (2017-21) 1B) 82 DSI Ō2NL wider network, including key local roads (2017-21)	A minimum 50% DSI reduction	By 2035	1 Crash Analysis System (CAS)	Waka Kotahi (Safety Team)
		2. KiwiRAP Star Rating	SH1 and SH57 both < 3 star	KiwiRAP 4 – 5 Star	By 2030	2 KiwiRAP Assessment Tool (KAT)	Waka Kotahi (Safety Team)
Reduce the duration of journeys affected by closures and delays by 60% by 2030	Resilience and Security	1. Availability of a viable alternate route to low-probability high impact events	None (SH1 between Manakau and Ohau)	One viable alternative route	By 2030	1 Design Plans	Waka Kotahi (Network Operations)
		2. Number of high resilience risk structures with no local alternate route	Four (Ohau River, Ohau Rail, Waikawa Stream, Manakau Rail). Note: Pukehou Rail Overbridge is also high risk but has a local detour.	Zero	By 2030	2 NZTA Resilience Assessment/ RAMM	Waka Kotahi (Network Operations)
		3. Number of unplanned closures on the SH network (5y)	33 unplanned closures state highway network (2017/18-2021/22))	Reduce by >90% on SH	By 2035	3 TREIS	Waka Kotahi (Network Operations)
		4. Length and duration of detoured journeys from Wellington to Levin	4A) Length: 95km (open) to 253km (detour via Saddle Road) 4B) Duration: 1.25 hours (open) to 3.15 hours (detour – uncongested)	>60% reduction in duration of unplanned events ≥2 hours	By 2030	4A) Design Plans 4B) Google maps	Waka Kotahi (Network Operations)

Proposed Investment Objectives	Transport Outcomes Framework	Benefit Measures and Key Performance Indicator(s)	Baseline(s)	Target	Schedule	Source	Responsibility
Provide appropriate connections that integrate the state highway and local road network to serve urban areas by 2030.	Inclusive access and Economic Prosperity	1. New transport network fits into agreed future road hierarchy	HDC/KCDC/Waka Kotahi as part of Revocation PBC	Confirmed road hierarchy with HDC and KCDC	By 2030	HDC/KCDC/Waka Kotahi	Integration Group
		2. Trip length/time for local trips	2A) Number of sector level routes with an increase in travel time 2B) Number of side roads at capacity LoS E/F in the 2029 PM Peak: 13	2A) 14% reduction in the average trip times between sectors 2B) <2 intersections at LoS E/F	By 2030	Baseline: Ōtaki to North Levin Traffic Model, Connectivity Plans Future: TomTom /BlipTrack or similar travel time monitoring system	Integration Group
		3. Development in identified growth areas is not prevented i.e. because they would have significant impact on the transport network	Growth proceeds as per Horowhenua Growth Strategy 2040	No developments prevented due to prohibitive transport investment required	By 2040	HDC/KCDC/NZTA	Integration Group
Enable mode choice for journeys between local communities by providing a north-south cycling and walking facility by 2030	Inclusive access Economic prosperity	1. Preserving existing active mode links 2. Removing barriers/enabling new links between urban areas and from urban areas to existing walking and cycling tracks 3. Increase mode share for walking/cycling trips to work and education in the Horowhenua District (Monitor)	1. Refer AST for further detail 2. Refer AST for further detail 3. 6% (work), 23% (education) (Census 2018)	1 Improve 2 Improve 3 Improve	By 2030	1 Local Connectivity Plans, Accessibility surveys 2 Local Connectivity Plans, Accessibility surveys 3 Census Travel data	Integration Working Group

Proposed Investment Objectives	Transport Outcomes Framework	Benefit Measures and Key Performance Indicator(s)	Baseline(s)	Target	Schedule	Source	Responsibility
Support inter and intra-regional growth and productivity through improved movement of people and freight by 2030	Economic prosperity Inclusive access	1. PM peak travel times along three key routes (2018)	**1A)** Taylors Road to/from SH1 North of Levin (Manawatū River): 26.1 min **1B)** Taylors Road to/from Levin: 17.4 mins **1C)** Taylors Road to/from SH57 north of Levin (Potts Hill): 21.2 mins	Reduce	By 2030	Baseline: Ōtaki to North Levin Traffic Model Future: TomTom /BlipTrack or similar travel time monitoring system	Waka Kotahi (Network Operations)
		2. Number and percentage of heavy vehicles through Levin (2018)	Number and % of heavy vehicles through Levin: 1,233 HCVs (9%)	Reduce by 50%	By 2030	Baseline: Ōtaki to North Levin Traffic Model Future: Waka Kotahi TMS	
		3. PM peak Journey time reliability for the above three routes	**3A)** Taylors Road to/from SH1 North of Levin (Manawatū River): 2018 - COV 0.085, Buffer Time 2.7 minutes **3B)** Taylors Road to/from Levin: 2018 - COV 0.067, Buffer Time 0.9 minutes **3C)** Taylors Road to/from SH57 north of Levin (Potts Hill): 2018 - COV 0.066, Buffer Time 2.8 minutes	Reduce / Maintain	By 2030	Baseline: Ōtaki to North Levin Traffic Model Future: TomTom /BlipTrack or similar travel time monitoring system	Waka Kotahi (Network Operations)
		4. Ensuring efficient links retained or improved to Bus Station and Train Station	Refer AST for further detail	4 Improve	By 2030	Local Connectivity Plans	Waka Kotahi / HDC
		5. Providing more route options for public transport services to be implemented	Refer AST for further detail	5 Increase	By 2030	Local Connectivity Plans	Waka Kotahi / HDC

In addition, the following sustainability targets will be pursued through the detailed design and construction phase. The exact targets will need to be agreed in collaboration with the supplier (Refer Commercial Case).

Table 6-8: Sustainability Targets

Outcome	Benefit Measures and KPIs	Baseline	Target	Schedule and Source
Improved Infrastructure Sustainability Performance	Reduce embodied emissions from materials used in construction	Embodied emissions: 69,300-90,000 tCO_2e (Design Freeze 3)	Reduce by X% (TBC) compared to the Base Case	To be established via the Infrastructure Sustainability Rating Process The exact targets will need to be agreed in collaboration with the supplier (Refer Commercial Case).
	Reduce energy use during construction	TBC	Reduce by 15% (TBC) compared to the Base Case	
	Reduce construction emissions from fuel and construction processes and activities	Fuel Use, allowance to transport material to site: 11,100-14,400 tCO_2e (Design Freeze 3)	Reduce by X% (TBC) compared to the Base Case	
	Substitute energy use during construction with renewable energy	TBC	Substitute 15% (TBC) compared to the Base Case	
	Reduce waste to landfill during construction	TBC	Reduce by X% (TBC) compared to the Base Case	

6.7 RISK MANAGEMENT ARRANGEMENTS

The Ō2NL Project will be managed at all phases in full accordance with the NZUP Risk Management Framework.

A detailed Risk Register and Risk Management Plan has been developed including key roles and responsibilities, reporting lines, mitigation plans and escalation processes. The Risk Register has been updated and is regularly reviewed. The Risk Register is a living document.

As presented in the Financial Case, an independent Quantitative Risk Assessment has been completed identifying risk contingencies for both cost and schedule at P50 and P95 confidence levels.

The top five risks are included in regular reporting and risk is a standing agenda item for governance meetings. These are based on the NZUP Framework Risk Register for Ō2NL and includes the risks identified in the Z/44 risk register for the project.

The rolled-up risks (provided below) provide a strategic overview and context to risks, and thus provides an objective approach to understanding resourcing and management requirements of the Project, and allows Governance processes to be brought to bear accordingly. Monthly reporting from workstream leads includes risk reporting. These are rolled up by the Project Controls Team and agreed with the workstream leads, Project Manager and Project Director. This process allows workstream leads to continue focusing on and managing specific and detailed risks as reported in Z/44 register.

A summary of the 'rolled up' current top project risks is provided below.

Table 6-9. Top Current Risks (rolled up)

Key Risks	Mitigation strategy	Residual risk level
Project cost escalation	Planned mitigation will include scope/cost trade-offs, value engineering exercises, and further investigations on key risks/contingencies. Identify opportunities and risk and develop mitigation through design and consultation with industry Property strategy to identify clear process including for Te Ture Whenua Māori Land.	High
Delays to the overall programme	Comprehensive controls in place/required specific to the cause including: • Implement communications and engagement strategy • Regular community and key stakeholder updates via media / website / newsletters • Implement property acquisition strategy. • Regular communication with consultants • Using correct cultural protocols for all site work • Manage and report the scope and cost against the baseline • Definitions of roles and responsibilities • Working collaboratively (Waka Kotahi staff and Stantec) • Regular community group meetings • Further refinement of the programme schedule (end to end) • Regular comms and hui with iwi partners and key stakeholders (operational / management / governance level) • Integrated programming • Identify and develop strategies with stakeholders to manage scope and programme risks • Regular (monthly) engagements with MoT/Treasury officials to understand shifts in government priorities.	High

Key Risks	Mitigation strategy	Residual risk level
Environmental effects are more adverse than expected leading to mitigation increases / reduction in flexibility for construction and design:	Undertake robust effects assessments in consultation with Councils, Department of Conservation (DOC), Forest and Bird (F&B), and stakeholders. Collaborative and transparent approach to developing response to ecological effects with Councils, DOC and F&B. Ensure that communities understand the Project, its effects and how they are proposed to be managed. Develop clear conditions that relate precisely to effects, as needed, and develop designs / investigate where critical effects are identified.	High
Legislative and policy change / reform prior to project implementation results in:	Lodge RMA applications promptly (prior to November 2022) so as to minimise risks. Keep emerging legislation and policy under review to ensure that technical evidence is pre-emptively collected, with clear responses to emerging challenges identified (including implementation strategies).	Low
		High

The Project Controls Lead also has ongoing responsibility for the following across the entire lifespan of the project:

- Management of the Risk Register and Risk Management Plan in accordance with the NZUP Risk Framework and the Waka Kotahi Risk Management Practice Guide (Minimum Standard Z/44). This includes regular reviews (monthly) of risk registers. Only risks assessed as high or very high are reported in the monthly Project Progress Report
- A full risk review and workshops at key future milestones (notably prior to lodgement of the RMA resource documents with Councils and procurement phases) including:
    - Two months prior to RMA lodgement
    - Post RMA lodgement, notification, submissions and RMA hearings phases
    - Kick-off collaboration with constructor phases
    - Completion of draft Minimum Requirements and Reference Design
    - Completion of ROI Phase
    - Completion of Tender Phases prior to engagement of consortium
- Collaboration with successful consortium
- Tracking key risks and project issues via Planview. The NZUP programme PMO will track some risks at a programme level to establish where efficiencies can be engineered or lessons learned, for wider benefits to be realised
- Management of the Change Register to track changes to core scope and reasoning as approved

6.8 CONTRACT AND SERVICE MANAGEMENT ARRANGEMENTS

The project team (project controls) keeps a Contract Register which is managed by the Project Control lead. This register includes up to date information on engaged contracts and any variations relating thereto. Contract management is done in compliance with the relevant Waka Kotahi manuals.

All engagements and/or variations follow a project process whereby an 'execution request form' is issued to all relevant project members to confirm the correctness of the scope, fees, sufficient funding and DFA for approval before the relevant contract document is executed and submitted to the consultant.

All consultant progress claims are reviewed and approved during a claim review process, between the relevant project managers, Project Controls Lead and the Project Director, before the consultant issues a progress invoice.

6.9 PROGRAMME ASSURANCE ARRANGEMENTS

6.9.1 Quality Management

A Quality Plan has been developed to confirm the quality and formal sign-off of key deliverables. This is a living document and is regularly updated.

6.9.2 Assurance

A number of peer reviews have been completed and these are summarised below:

- Independent peer review of the Detailed Business Case
- Internal Quality Assurance has been undertaken via a peer review of this document, external to the team
- Parallel cost estimation
- Safety audits – a safety audit has been undertaken of the DBC design and the outcomes have been incorporated into the DBC design contained in this report.
- Modelling Peer review of the transport model
- Economic Evaluation Peer Review
- Waka Kotahi SME's review of initial draft and then final draft versions
- The draft Detailed Business Case was reviewed by Horowhenua District Council and Kāpiti Coast District Council in the period August - November 2021 and again in April, May and June 2022.

The above steps have assisted the Waka Kotahi Investment Quality Assurance (IQA) and Internal Readiness Review process which has been ongoing throughout the project. Recommendations from the IQA and IRR teams have been incorporated into this Detailed Business Case.

This Detailed Business Case has been reviewed and endorsed by:

- Endorsed by Project Sponsor
- Ō2NL Project Steering Committee – 6 July 2022
- Value Outcomes Standards Committee (VOSC) – 8 July 2022
- NZUP Governance Group – scheduled for 1 August 2022
- Investment and Delivery (I&D) Committee – 17 August 2022
- Waka Kotahi Board – 18 August 2022

6.9.3 Stage Gate and Gateway Reviews

As part of ongoing quality assurance for the project, there are internal ‘gate’ and external ‘gateway’ reviews the overall project. For Ō2NL Project there are two key gateway milestones, namely the Waka Kotahi Stage Gate 2 ‘Internal Review’ and the Treasury Gateway Review 2 ‘Delivery Strategy DBC Review’.

Looking forward, Treasury Gateway Review 3 will review an Implementation Business Case that outlines how the Project will be implemented and the review will focus on the robustness of the project, governance and procurement undertaken to date, and into the next phases. Passing the Gateway Review 3 is key to progressing the Implementation Business Case through to ultimate approval by the Minister of Transport. This process will be supported by internal Waka Kotahi Gateways 3 and 4 which focus on procurement, confirming the documentation and processes are in place for successful engagement and delivery of the alliance contract.

6.9.4 Post-Project Reviews

The post-implementation monitoring and performance data tracking requirements and plans will be developed during the next phases of investigation and will focus on how benefits wanted by the Project are being realised.

It is expected that activity will begin as soon as the new road opens. The KPIs identified in Section 6.6 above will be used to the monitor the actual performance of this investment, relative to investment targets.

6.10 NEXT STEPS

The following table outlines the major actions that are needed over the next 12 months. This reflects the requirements of the overall project programme to ensure construction start in 2025 in line with the NZ Upgrade Programme dates.

Table 6-10. Next Steps

Phase	Action	Timing
RMA Consenting	Lodge RMA Notices of Requirement and regional consents package	Spring 2022
	Participate in the RMA public submissions, mediation and hearings processes	Summer 2022 to Winter 2023
Property	Strategic property acquisition	Advance purchases underway. Strategic purchase of full properties commenced in late 2021 and purchase of property located to East of Levin commenced from March 2022.
	Māori landowners	Underway in accordance with Te Ture Whenua Māori Land Act. Aim to complete by mid-2024
	Partial property purchases	Willing seller acquisitions underway where have been approached by landowners. Active acquisition commences Spring 2022
Procurement	RFP development	Commenced and developed by Spring 2022
	RFP Alliance	Autumn 2023
	IPAA	Autumn 2023 to Spring 2024
	PAA Award	Spring 2024
Construction	Enabling works/ establishment	Commence Winter 2024
	Earthworks and Bridges	Commence Winter 2025
	Pavements, services etc.,	Commence Winter 2027
	Road open	End of 2029

GLOSSARY

Term	Description
AADT	Annual Average Daily Traffic
ACNZ	Accessing Central New Zealand
ADR	Alternate Dispute Resolution
AEE	Assessment of Environmental Effects
ALR	Auckland Light Rail
AST	Appraisal Summary Table
ATP	Audio Tactile Profiled
AWHC	Additional Waitematā Harbour Connections
BCR	Benefit-cost Ratio
BIM	Building Information Modelling
BoI	Board of Inquiry
CAS	Crash Analysis System
CBD	Central Business District
CBR	California Bearing Ratio (measure of subgrade material strength)
CEC	Crash Estimation Compendium
CEDF	Cultural and Environmental Design Framework
CH4	Methane
CIPA	Climate implications of policy assessment
CMF	Crash Modifications Factors
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COV	Coefficient of Variation
COVID-19	Coronavirus Disease 2019
CRS	Crash Reduction Study
D&C	Design and Construct

Term	Description
DBC	Detailed Business Case
DM / Do Min	Do minimum
DOC	Department of Conservation
DSI	Death & Serious Injury
EAP	Economic Action Plan
EC	Environment Court
ECI	Early Contractor Involvement
EDoD	Engineering Degree of Difficulty
EMOGPA	Epoxy Modified Open Graded Porous Asphalt
EPA	Environmental Protection Authority
EV	Electric vehicle
F&B	Forest and Bird
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIS	Geographic Information System
GPS	Government Policy Statement (on Land Transport) 2021
GRD	Guide to Road Design (Austroads)
GWRC	Greater Wellington Regional Council
HCs	Hydrocarbons
HCM	Highway Capacity Manual (Transportation Research Board)
HCV	Heavy Commercial Vehicle
HDC	Horowhenua District Council
HILP	High-impact low-probability
HITS	Horowhenua Integrated Transport Strategy
HOV	High Occupancy Vehicle
HPMV	High Productivity Motor Vehicles
HRC	Horizons Regional Council

Term	Description
I&F	Investment and Finance
IBC	Indicative Business Case
IBE	Indicative Business Case Estimate
ILM	Investment Logic Map
IP	Inter-peak
IPA	Independent Professional Advisor
IPAA	Interim Project Alliance Agreement
IPM	Investment Prioritisation Method
IQA	Investment Quality Assurance
IREX	Inter-island Resilient Connection (KiwiRail)
IS	Infrastructure Sustainability
ISCA	Infrastructure Sustainability Council of Australia
ITS	Intelligent Transport Systems
IWG	Integration Working Group
KAT	KiwiRAP Assessment Tool
KCDC	Kāpiti Coast District Council
KiwiRAP	New Zealand Road Assessment Programme
KPI	Key Performance Indicator
KRAs	Key Result Areas
LAR	Limited Access Road
LARS	Land Impact Resolution Service
LCISA	Level Crossing Safety Impact Assessment
LGWM	Let's Get Wellington Moving
LIHP	Low-impact High-probability
LINZ	Land Information New Zealand (Toitū Te Whenua)
LNIRIM	Lower North Island Rail Integrated Mobility
LoS	Level of Service

Term	Description
LRPs	Land Requirement Plans
LS	Lump Sum
LTMA	Land Transport Management Act
LTP	Long Term Plan
LUC	Land use Capability
M&V	Measure and Value
M2PP	MacKays to Peka Peka
MBCM	Monetised Benefit Cost Manual
MBIE	Ministry of Business, Innovation and Employment
MCA	Multi-criteria Analysis
MERIT	Modelling the Economics of Resilient Infrastructure
MFE	Ministry for the Environment
MoT	Ministry of Transport
N2O	Nitrous Oxide
N2P	Ngauranga to Petone
NB	Northbound
NIEMS	National Incident and Event Management System
NIMT	North Island Main Trunk
NLTF	National Land Transport Fund
NLTP	National Land Transport Programme
NOF	Network Operating Framework
NoR	Notice of Requirement
NOx	Nitrogen Oxides
NPV (or Net PV)	Net Present Value
NRPBC	National Resilience Programme Business Case
NZIER	New Zealand Institute of Economic Research
NZTA (or the Transport Agency)	The New Zealand Transport Agency

Term	Description
NZUP	New Zealand Upgrade Programme
Ō2NL	Ōtaki to North Levin
Ō2NL Project Team	Waka Kotahi, Muaūpoko Tribal Authority and hapū of Ngāti Raukawa ki te Tonga
OGPA	Open Graded Porous Asphalt
ONF	One Network Framework
ONRC	One Network Road Classification
OPPP	Operational Policy, Planning and Performance
P&G	Preliminary and General
P50	50th percentile estimate
P95	95th percentile estimate
PAA	Project Alliance Agreement
PBC	Programme Business Case
PDoD	Property Degree of Difficulty
PDP	Project Delivery Plan
PDPS	Preliminary Design Philosophy Statement
PM10	Particulate Matter 10 micrometres and smaller
PMO	Programme Management Office
PMP	Project Management Plan
PNITI	Palmerston North Integrated Transport Initiative
PPM	Planning Policy Manual (Waka Kotahi)
PP2Ō	Peka Peka to Ōtaki
PRG	Project Reference Group
PS	Professional Services
PSC	Project Steering Committee
PT	Public Transport
PV	Present Value
PW	Physical Works

Term	Description
PWA	Public Work Act (1981)
QRA	Qualitative Risk Analysis
QS	Quantity Surveyor
RAMM	Road Assessment and Maintenance Management
RED	Regional Economic Development
REWMP	Resource Efficiency and Waste Management Policy
RFT	Request for Tender
RLT	Regional Land Transport
RLTP	Regional Land Transport Plan
RMA	Resource Management Act
ROI	Registration of Interest
RR	Research Report
RRP	Regional Rail Plan
RTA	Road Transport Association
SAAS	Safe and Appropriate Speed
SAP	Systems, Applications and Products in data processing
SH#	State Highway (number)
SIP	Speed and Infrastructure Programme
SM014	Cost estimation manual
SMA	Stone Mastic Asphalt
SMART (goals)	Specific, Measurable, Achievable, Relevant and Time bound
SME	Subject Matter Expert
SUP	Shared Use Path
T2Ō	Taylors Road to Ōtaki
TAIP	Transport Agency Investment Portfolio
TIA	Transport Impact Assessment
TIO	Transport Investment Online

Term	Description
TMS	Traffic Monitoring System
TOC	Target Outturn Cost
TREIS	Traffic Road Event Information System
TT	Travel Time
TTM	Temporary Traffic Management
TTR	Travel Time Reliability
TTWMA	Te Ture Whenua Māori Act (1993)
VE	Value Engineering
VEPM	Vehicle Emissions Prediction Model
VKT	Vehicle Kilometres Travelled
VMS	Variable Message Sign
VOC	Vehicle Operating Costs
VOSC	Value Outcomes and Standards Committee
VoSL	Value of Statistical Life
VPD	Vehicles Per Day
WBS	Work Breakdown Structure
WCL	Wide Centreline
WEBs	Wider Economic Benefits
WHO	World Health Organisation
WIM	Weigh-in-motion

APPENDICES

Appendix A

A.1 Evidence Review

A.2 Key Stakeholders

A.3 Strategic Context

A.4 Outcome Measures

Appendix B Investment Logic Map

Appendix C Uncertainty Log

Appendix D Combined Constraints Map (IBC)

Appendix E Staging report

Appendix F

F.1 Shortlisted Corridor Options Engagement Summary Report (2018)

F.2 Interim Engagement Summary, August-September 2020 (December 2020)

F.3 Engagement Summary Report, August-September 2020 engagement (March 2021)

F.4 Engagement Summary Report, April-May 2022 engagement (July 2022)

Appendix G Design Freeze 4 (DF4) Design Package Drawings 200422

Appendix H Design and Construction Report

Appendix I

I.1 Appraisal Summary Table (AST)

Appendix J

J.1 Preliminary Sustainability Management Plan

J.2 Ō2NL GHG Reduction Opportunities Process Report

J.3 Ō2NL 2NL carbon opportunities implementation and investigation pathway 2.0

Appendix K

K.1 Do-Minimum

K.2 Economic Analysis - Draft Economic Peer Review

Review carried out on September 2021 draft DBC economics – an updated peer review is underway

K.3 Economic Analysis - MERIT Report

K.4 Investment Prioritisation Method (IPM) Assessment

Appendix L Ō2NL Draft Cultural and Environmental Design Framework (CEDF)

Appendix M

M.1 WTP Cost Estimate Report

M.2 Value Engineering Report

M.3 Parallel Estimate Report

Appendix N

N.1 Property Delivery Plan

N.2 Stage 1: Procurement Strategy

Appendix O

O.1 High Level Programme

Appendix P

P.1 Project Charter

Appendix Q Online Sources

Footnote(s)	Summary	URL (accessed May 2022)
13	Kāpiti Coast District Council – Growth Strategy	https://www.kapiticoast.govt.nz/your-council/projects/draft-strategies-and-policies/growth-strategy/#:~:text=Our%20population%20has%20increased%20by,of%20Paraparaumu%20and%20Raumati%20combined
14, 67	Waka Kotahi – NZUP Cabinet meeting notes	https://www.nzta.govt.nz/assets/Roads-and-Rail/20-011/nz-upgrade-programme-an-update-on-programme-options-20210531.pdf
19	Accelerate 25	https://www.accelerate25.co.nz/
20	Infometrics - Kāpiti Coast District Overview	https://ecoprofile.infometrics.co.nz/kapiti%2Bcoast%2Bdistrict/PDFProfile#:~:text=GDP%20in%20Kapiti%20Coast%20District,pa%20in%20the%20national%20economy
60	Kāpiti Coast District Council – Population & Demographics	https://www.kapiticoast.govt.nz/our-district/the-kapiti-coast/population-and-demographics
24	Waka Kotahi – Te Ahu A Turanga	https://www.nzta.govt.nz/projects/te-ahu-a-turanga/
27	Waka Kotahi – Arataki COVID-19 Economic Projections	www.nzta.govt.nz/assets/planning-and-investment/arataki/docs/arataki-covid-19-economic-projections-update-final-report-may-2021.pdf
33	Ministry of Transport – Freight and logistics	https://www.transport.govt.nz/statistics-and-insights/freight-and-logistics/sheet/figs-rail
35	Waka Kotahi – Wellington to Palmerston North Corridor Management Plan	https://www.nzta.govt.nz/assets/Highways-Information-Portal/Processes/Corridor-management/Corridor-management-plans/CMP-documents/19-CMP-Wellington-to-Palmerston-North-Final-Jan-2018.pdf
37	Waka Kotahi – One Network Road Classification (ONRC)	https://www.nzta.govt.nz/roads-and-rail/road-efficiency-group/projects/onrc
38	Waka Kotahi – One Network Road Classification Overview	https://www.nzta.govt.nz/planning-and-investment/planning/one-network-framework/

Footnote(s)	Summary	URL (accessed May 2022)
57	Waka Kotahi – Economic Impact of SH3 Manawatū Gorge 11/12 Outage	https://www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Resilience/Resilience-evaluation-process/MERIT-Manawatu-pilot-Final.pdf
46	Waka Kotahi – Accessway Standards and Guidelines	https://www.nzta.govt.nz/assets/resources/planning-policy-manual/docs/planning-policy-manual-appendix-5B-accessway-standards-and-guidelines.pdf
47	Ngā Haerenga – New Zealand Cycle Trails	https://www.nzcycletrail.com/find-your-ride/new-zealand-cycling-map/
49	Waka Kotahi – Customer Levels of Service	https://www.nzta.govt.nz/assets/Road-Efficiency-Group-2/docs/customer-levels-of-service.pdf
64	Waka Kotahi – Transport Benefits Framework Overview	https://www.nzta.govt.nz/resources/land-transport-benefits-framework-and-management-approach-guidelines
74, 75	Horizons Regional Council – Regional Land Transport Plan	https://www.horizons.govt.nz/HRC/media/Media/Bus-Route-Timetable/Final-RLTP-2015-25.pdf?ext=.pdf
77	Waka Kotahi – Ō2NL RONS: Interim Safety Improvements	https://www.nzta.govt.nz/assets/projects/otaki-to-north-of-levin/docs/technical-reports/O2L-SH1-Interim-Safety-Measures.pdf
78, 79	Waka Kotahi - Ō2NL Forest Lakes Project Feasibility Report	https://www.nzta.govt.nz/assets/projects/otaki-to-north-of-levin/docs/pfr-01-forest-lakes.pdf
80, 81	Waka Kotahi - Ō2NL Manakau to Ohau Bridges Project Feasibility Report	https://www.nzta.govt.nz/assets/projects/otaki-to-north-of-levin/docs/pfr-03-manuakau-ohau-bridges.pdf
82, 83	Waka Kotahi - Ō2NL SH57 Intersection & Arapaepae Curve Project Feasibility Report	https://www.nzta.govt.nz/assets/projects/otaki-to-north-of-levin/docs/pfr-05-sh1-sh57-arapaepae-curve.pdf
84	Waka Kotahi - Ō2NL SH1 - SH57 Connection Scoping Report	https://www.nzta.govt.nz/assets/projects/otaki-to-north-of-levin/docs/sh1-sh57-scoping-report.pdf
87	Waka Kotahi - Ō2NL Preliminary Options Report and Addendum	https://www.nzta.govt.nz/assets/projects/otaki-to-north-of-levin/docs/technical-reports/four-laning/O2NL-Taylors-to-Ohau-Four-Laning-Preliminary-Options-Report-and-Addendum-April-2015.pdf

Footnote(s)	Summary	URL (accessed May 2022)
88	Waka Kotahi - Ō2NL Taylors Road to Ohau River Four Laning Further Options Report	https://www.nzta.govt.nz/assets/projects/otaki-to-north-of-levin/docs/technical-reports/four-laning/O2NL-Taylors-to-Ohau-Four-Laning-Further-Options-Report-September-2015-front-only.pdf
105	Waka Kotahi - Ō2NL Engagement Summary report (August – September 2020)	https://www.nzta.govt.nz/assets/projects/o2nl-proposed-new-highway/O2NL-engagement-summary-report-aug-sept-2020.pdf
106	Waka Kotahi – Priority Lanes	https://www.nzta.govt.nz/assets/projects/ramp-signals/Priority-Lanes.pdf
112	Ministry of Transport – Transport Outcomes Framework	https://www.transport.govt.nz//assets/Uploads/Paper/Transport-outcomes-framework.pdf
113	Waka Kotahi – Environmental Sustainability	https://nzta.govt.nz/planning-and-investment/learning-and-resources/benefits-management-guidance/the-land-transport-benefits-framework/environmental-sustainability/
119	Waka Kotahi – OGPA and EMOGPA Research Summary	https://www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Resource-efficiency/Case-studies/OGPA-and-EMOGPA-research-summary-AECOM-2020.pdf
120	Waka Kotahi – Economic Evaluation of Greenhouse Gas Emissions	https://nzta2.cwp.govt.nz/assets/resources/Monetised-benefits-and-costs-manual-technical-notes/Technical-report-Economic-evaluation-of-GHG-emissions-FINAL.pdf
125	Waka Kotahi – Detour Routes Tool	https://detours.myworksites.co.nz/
129	Waka Kotahi – State Highway Revocation Policy & Guidance	https://nzta2.cwp.govt.nz/assets/resources/state-highway-control-manual/docs/state-highway-revocation-policy-202109.pdf