SH1: Cambridge to Piarere (C2P) Long Term Improvements

Detailed Business Case (DBC)

May 2021

Issue 7

NZ TRANSPORT AGENCY
WAKA KOTAHI

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APPROVAL

PREPARED BY	INTERNAL REVIEW COMPLETED BY	REVIEWED BY	REVIEWED BY	EXTERNAL PEER REVIEW	ENDORSED BY	ENDORSED BY
s 9(2)(a) [redacted]	s 9(2)(a) [redacted]	Peter Murphy, Francisca Simone	Barry Dowsett Mark Jack	s 9(2)(a) [redacted]	Chris Gasson	
WSP Team Leader WSP –Technical Director WSP –Engineer - Transportation	WSP Technical Principal WSP Project Director WSP Technical Principal	Project Manager NZTA Transport Planning	NZTA Planning and Investment/IQA	GHD	NZTA – Project Sponsor	
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Issue 2	7 August 2020	Updated evidence, alignment to draft 2021 GPS, estimates, economics, consenting, property, financial, commercial (procurement) and management case.
Issue 3	30 October 2020	Updated report as per the external peer review
Issue 4	26 January 2021	Updated report as per the IQA process
Issue 5	4 February 2021	Updated report as per internal Waka Kotahi Legal Review
Issue 6	14 May 2021	Final minor amendments as per Waka Kotahi Legal Review

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Issue 7	4 June 2021	Minor amendments post May Board Meeting – Note Walking and Cycling Addendum required to complete business case

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GLOSSARY OF TERMS

ABBREVIATION	TERM
ACRE	Area, Corridor, Route, Easement
AEE	Assessment of environmental effects
Alternative	A Transport Planning response to address an issue.
AO	Approved organisation
BCR	Benefit-cost ratio
CAS	Waka Kotahi's Crash Analysis System
CLoS	Customer Levels of Service
D&C	Design and construct
DBC	Detailed Business Case
DBE	Detailed Business Case estimate
EEM	Economic evaluation manual
ESR	Environmental Social Responsibility Screen
Go to Group	Waka Kotahi's Review Team
GPS	Government Policy Statement
HCV	Heavy commercial vehicle
HNO	Highways and Network Operations
HNZ	Heritage NZ
HPMV	High Productivity Motor Vehicles
IAP2	International Association for Public Participation
IBC	Indicative Business Case
ILM	Investment logic map
IQA	Investment Quality Assurance
ITS	Intelligent transport systems
KiwiRAP	NZ Road Assessment Programme
KPI	Key performance indicator
MOU	Memorandum of understanding
NLTF	National Land Transport Fund
NLTP	National Land Transport Programme
NOR	Notice of requirement
NPC	Net present cost
NPV	Net present value
ONRC	One Network Road Classification
OPPP	Operational Planning Policy and Performance
P&I	Planning and Investment
PBC	Programme Business Case
PWA	Public Works Act 1981
RAMM	Road Assessment and Maintenance Management
RLTP	Regional Land Transport Plan

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ABBREVIATION	TERM
RLTS	Regional Land Transport Strategy
RMA	Resource Management Act 1991
RoNS	Road of national significance
SH (#)	State Highway (number)
TA	Territorial Authority
TDM	Traffic demand management
TOC	Total outturn cost
VMS	Variable message sign
Waka Kotahi	The New Zealand Transport Agency

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EXECUTIVE SUMMARY

This business case supports a recommendation to build 16km of new four lane expressway between the end of the Cambridge section of the Waikato Expressway and intersection of state highway 1(SH1) and SH29 at Piarere.

The development of this project has progressed over several years with the strategic case identifying the need for change on this corridor in 2013, a PBC completed and endorsed in 2015, and the IBC/DBC commencing in 2016 with a draft issued in 2018 and a further update in 2020 following a re-evaluation in 2018 which identified the need to confirm the recommended timeline for implementation of the preferred programme.

Throughout the project life cycle the Waka Kotahi Business Case process (including stakeholder consultation) has been followed in order to confirm the case for change and determine the best solution for the identified problems. This executive summary outlines the preferred option identified by this process. For more information on how the preferred programme was determined please refer to the option development and evaluation section of this report.

The recommended option follows the existing corridor from the end of the Waikato Expressway to a grade separated interchange at Karapiro Rd. The route then heads offline through steep county to form a large rural roundabout just north of the existing SH1 intersection with SH29. The DBC identifies a predominantly offline route due to better environmental outcomes, enhanced safety, improved access and construction efficiencies

Where the expressway follows the existing SH1 alignment, parallel service roads on both sides of the highway would provide connections to local roads and access for residential properties, farms, businesses and the school. A grade separated interchange is provided near Karapiro Rd to provide a safe and convenient connection across the highway for nearby communities. This will be particularly important for enabling access to Karapiro School and other community facilities.

To date, the investigation for the route selection has comprised of desk top studies and walkovers of parts of the site where access was available. There is a possibility that more detailed investigations in the next phases of the project could identify constraints (e.g. a previously unrecorded archaeological site or an ecological feature), which could lead to an alternation to this route moving forward.

s 9(2)(b)(ii), Redacted -Commercially confident, s 9(2)(j), Redacted - prejudicial to negotiations
Expected delivery cost is [redacted] a range of $504M to $721M [redacted]

Proposals for the new C2P expressway have been developed over several years and have been subject to numerous internal assurance processes and an external review commissioned as part of the 2018 re-evaluation of the NLTP resulting from the updated Government Policy Statement for Land Transport.

In parallel with the development of this business case, the Government has committed to the delivery of a roundabout at the intersection of SH1 and SH29. This will be delivered as part of the Government's New Zealand Upgrade Programme.

Connections between Tauranga and Auckland via Hamilton, and SH1 to the South, form the country's most important freight corridor

Arataki[1] identifies the SH1 corridor as being a "'nationally significant' connection for both freight and tourism and it identifies SH29 as nationally significant for freight (Figure E-1). It establishes that the "road and rail routes between Tauranga and Auckland (via Hamilton) form the country's most important freight corridor". This business case builds from the direction set in Arataki, other strategic work and the overarching programme business case which was approved by the regional decision making team in June 2015.

Research undertaken during the development of this business case demonstrates that SH1 does not currently deliver to the standard that would be expected for a route of this importance and its performance is expected to decline in future. The research concluded that the **current highway does not meet customer needs for a high volume national route** in terms of safety, resilience and travel speeds.

Furthermore, the high traffic volumes, proportion of HCVs and vehicle speeds are impacting upon communities that live alongside and close to the road. These factors increase the risk that regular road users

[1] Arataki is Waka Kotahi New Zealand Transport Agency's (Waka Kotahi) 10-year view (2021 to 2031)[1] for land transport system in New Zealand.

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are involved in a crash. They also mean that local access to properties and local community facilities is affected.

Figure E - 1: Upper North Island: Strategic Connections (Waka Kotahi)

Key findings that informed this conclusion were:

- While safety improvements are being delivered to the existing SH1 before 2021, the highway will remain a high-risk rural road. There will continue to be high numbers of high severity crashes (21) as well as deaths and serious injuries (27 DSIs). The safety level of service (KiwiRAP star rating 3.25) will be significantly lower than is desirable (4-star rating) for a road of this importance
- On average, full road closures occur every 10 days with an average period of 6.39 hours which is unacceptable for a national high volume route. If the current alternative route has to be used, this could represent an increase of 60 minutes to a journey time. High productivity motor vehicles tend to be delayed for even longer as they are less able to make use of alternative routes
- For journeys between Auckland and Tauranga, the current SH1/SH29 route is approximately 29km longer that the SH2 alternative. It takes an extra 30 minutes by car encouraging more car and truck drivers to choose routes that are less desirable due to their poor crash history and impact on multiple townships.

Project is designed to improve levels of service, safety and local access

Iwi partners and stakeholders were involved throughout the development of this business case. Active engagement enabled buy-in to the problems or issues associated with the existing situation and to the outcomes sought from any investment. The investment objectives for this project are to:

1) Improve Corridor Customer LoS by:
   - Reducing travel time on SH1
   - Reducing risk or consequence of unplanned road disruptions
   - Improving average daily freight travel time.
2) Improve local access and distance travelled to key community features by all transport modes
3) Improve Safety by:
   - Achieving a 70% reduction in DSIs
   - Reducing the Collective Risk (number of high severity crashes per km per road) to no more than a medium
   - Maintaining a low personal risk (High severity crashes by 100 million vehicle km travelled).

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A Broad Range of Options were considered

Working with iwi partners and stakeholders, a long list of options was identified. These fitted within three broad categories of alternative:

1) Changing demand:
   - By reducing local traffic demand using measures such as controls on land development, relocating community facilities to avoid the need to drive, improving provision for active modes
   - Through the promotion of rail freight or freight consolidation centre
   - By reducing the attractiveness of alternative routes (i.e. SH2 to Tauranga and SH2/SH27 South).
2) Changing the way the road is managed:
   - Through speed management measures (reduce, increase, enforce)
   - Through use of technology / intelligent transport systems
   - Through targeted road modifications such as special vehicle lanes or removal of passing lanes.
3) Increasing supply through road capacity increases either:
   - Following existing or new alignments or various combinations thereof
   - Creation of new roads operating as a one-way pair
   - Increasing the capacity in one direction but not the other

Options that changed demand were discarded as they tended to be ineffective within the project timeframes or were outside the direct control of Waka Kotahi. Changes to the way in which the road is managed were discarded either because they were not expected to substantially achieve the investment objectives or required major policy shifts outside the scope of the project.

Six Corridor Options were Identified for Further Investigation

Six corridor options associated with changes to the road network were identified. These are shown in Figure E-2, below.

Figure E-2 – Corridor Options

Four (Options A, B, C and D) of the six corridor options followed the existing State Highway alignment and involved improvements to the existing highway corridor. The level of intervention ranged from minor improvements to a 4 lane expressway. Two offline corridors were considered, (E1 and E2). These were both 4-lane expressway standard roads expected to have grade separated intersections with no direct access from adjacent land.

The six corridor options were endorsed by Iwi and stakeholders before being approved for further investigation by the Waka Kotahi New Zealand Transport Agency in March 2017.

Options Following the Existing Corridor Impact the Community, Environment and Cultural values associated with the Waikato River

The six corridor options were developed further before being assessed by specialists to determine the effectiveness at delivering the investment objectives, their likely social and environmental effects as well as practical considerations about risk and order of cost. Feedback on the options was also sought from the community and from Iwi and stakeholders during a series of workshops.

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The lower scale corridor options (Corridors A, B and C) that followed the existing alignment did not improve safety to a desirable level, made little difference to local access issues and tended to worsen the environment whilst still creating inconvenience for local communities. These options also did less to improve the attractiveness of SH1/29 relative to the alternative SH2 and SH2/27 corridor. An expressway online option provided significant improvements to safety and access, but there were concerns from the community at the impact on existing properties fronting the highway and the significant disruption from construction. Iwi and community feedback tended to favour routes furthest from the river that created the opportunity for the river to become a more pleasant place for visitors and locals to enjoy recreationally, and for a safer, lower volume alternative route to be available.

While the creation of an expressway in a new corridor will involve breaking new ground and new infrastructure where it hasn't been before, it involves less risk and less cost than an online expressway version (Corridor D). This is due to the online version being within a constrained physical environment, the requirement to keep the highway open during construction resulting in significant disruption and a longer construction period than the offline version. The two offline options (E1 and E2) resulted in similar outcomes such as alignment to investment benefits for safety, access and network resilience, corridor characteristics, costs, however Corridor E1 provided an increased travel distance for those travelling on SH1 South compared to the other (Corridor E2),

As a result of this evaluation and after considering engagement feedback, Waka Ko ahi, Iwi and stakeholders agreed that E2 was the preferred corridor.

Recommended Option Minimises Cost and Risk

Following confirmation of the recommended corridor, multiple localised route alignments were considered within the corridor. In collaboration with Iwi and stakeholders, alternative options were considered for interchange and local road connections. Further, more detailed, specialist assessments were completed. The recommended route is shown in Figure E-3.

Figure E-3: Cambridge to Piarere Customer Journey Map[2]

There is little difference in the effectiveness with which each of the localised route alignments delivers against the investment objectives. The recommended total route option (made up of sub routes) was chosen over other sub route options because it:

- Has the lowest cost (due to preferred section in the middle of the entire route)
- Minimises property impacts
- Allows staged delivery of works to address current safety issues
- Involves less risk (in terms of MCA assessments)

Although the route has some potential adverse effects (such as proximity to Karapiro School, increased community severance, archaeological, ecological and cultural effects) these can be mitigated to a reasonable level.

s 9(2)(b)(ii), s 9(2)(j) a range of $504M to $721M. s 9(2)(b)(ii), s 9(2)(j)

[2] Noting that the specific opportunity and the location of these opportunities could be confirmed in any subsequent phases of the project

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[redacted]. The transport economic efficiency is forecast to be between 0.63 and 0.65 respectively.

[redacted] allowance has been made for changes to the existing, bypassed section of SH1 which it is assumed would be revoked of its state highway designation.

There are also opportunities to increase the scope of the project to deliver advanced network management through the use of intelligent transport systems and other smart road enablers. Any further development of the project will also explore the appropriateness of better providing for long distance cyclists and how this may be delivered (likely as part of a separate project).

An alternative SH1 alignment will be needed after 2030

Analysis summarised within this business case has sought to identify when the creation of an alternative SH1 C2P corridor will be needed. This analysis found that there are already significant delays turning between side roads and private access to and from the highway. These delays cause some people to take risks which result in deaths and serious injuries.

While the safe networks packages 1 and 2[35] (due to be completed before 2022) will improve safety for people turning between the highway and some local roads, it will remain a high-risk rural road. The analysis in this business case shows that delays associated with vehicle turn-around facilities proposed as part of safe networks packages 1 and 2 will be close to a minute (LOS F) from 2030 depending on the proportion of heavy vehicles. This would likely be accompanied by an increase in deaths and serious crashes.

The proposed safe networks package 3 extends the central barrier to the full corridor and provides further intersection improvements. This would have the potential to further reduce some of the safety risks, delaying the need for investment until 2040. Safe networks package 3 will however, reduce the speed of the route making it less attractive for moving freight between Auckland and Tauranga. Furthermore, investment to deliver Safe Networks package 3 would be redundant, if or when the new expressway alignment is delivered.

None of the safe network packages help to improve the reliability of the road or its resilience to unplanned events. An alternative SH1 alignment will be needed after 2030 for safety reasons and after 2040 for capacity reasons. It is concluded that Waka Kotahi should complete pre-implementation consenting and plan to deliver the project from 2030.

Implementation Pathway

This business case seeks endorsement for ongoing work to develop a pre-implementation design and obtain the necessary statutory approvals for implementation of the expressway. [redacted]

The scale and complexity of this project lends itself to either a Design and Construct (D&C), Competitive Alliance, or Hybrid Alliance Commercial model. A decision on an appropriate procurement model can be deferred until the construction start date is decided.

[redacted]

Due to the high safety risk at the intersection of SH1/SH29, the New Zealand Government provided funding as part of the NZUP programme for a new roundabout to be constructed. As a result of this funding, the SH1/29 roundabout is being implemented in advance of the remainder of the Long Term programme and is committed for a construction start by 2022. The solution to be implemented will be future-proofed for the long-term C2P project

Summary

The preferred option in this business case aligns well with the project investment objectives, provides a high level of customer outcomes and delivers a high-standard long-term solution to this strategically important part of the transport network.

Delivery of this investment will ensure that this part of SH1 is able to perform in accordance with its function as the most important freight connection between Auckland and Tauranga via Hamilton, and SH1 in the South. The key investment outcomes for this project will enable it to perform this function are listed below:

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- Ensuring the journey time for all customers is consistent; whatever time of day or time of year they travel along the route
- 90% reduction in unplanned road disruptions (from one unplanned event every 10 days to every 102 days), and always having a suitable alternative route available for State highway users
- Approximately a 2.2-minute travel time saving for SH1 users by shortening the route and lifting the average travel speed compared to the existing route (thereby contributing to make the SH1 and SH29 corridor the preferred route for travel between Auckland, Waikato and Bay of Plenty)
- Improved access for local traffic and to local community features, thereby maximising the opportunity for future growth in the community and increased local tourism
- 19.4 fewer deaths and serious injuries over a 5 years period, based on 2015-2019 data.

Recommendation

It is recommended that the current C2P Pre-implementation phase continues to progress to enable long-term corridor protection, securing of consents, and to ensure an integrated tie in with the SH1/29 Project being implemented separately as part of the New Zealand Upgrade Programme.

Furthermore, it is recommended that:

- the C2P long-term project is designed and constructed in a single stage
- the C2P long-term project is funded so that implementation can commence prior to 2030 given the low resilience, safety, and accessibility CLoS on the existing SH1, even once the Safe Network Programme (SNP) Stage 1 and 2 improvements have been implemented
- Tolling of the route is not pursued as it is not considered to be viable
- consideration is given to SNP Stage 3 if it is decided the C2P long term project should not progress.

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The Case for Investment

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1 INTRODUCTION

1.1 Purpose and Scope of DBC

This is a Detailed Business Case (DBC) for the State Highway 1 (SH1): Cambridge to Piarere (C2P) Long Term Improvements. The study area starts at the southern end of the Cambridge section of the Waikato Expressway on SH1, approximately 15km south of Hamilton through to an area in the vicinity of the SH1 and SH29 intersection (Figure 1-1). It provides details on the problems and the case for investing in this section of SH1 as part of a wider strategic network considering Auckland to Piarere, SH1 south and SH29 from Piarere to Tauranga.

The primary purpose of this DBC is to document the process to establish a need for investment and developing a preferred option for SH1 from Cambridge to Piarere. It will provide certainty around validated and agreed problems, robust option development and assessment, timing of need, and what outcomes investing in this project will achieve. It will:

- Outline the financial, management and operation aspects of the preferred route
- Recommend the next steps.

Note – this report was issued in 2018 and put on hold as part of a re-evaluation process. In 2020 a review and update to the 2018 report has been completed which recognises changes in evidence, government strategies, and planned safety works along the corridor. The intention of the 2020 update was to review if the preferred option remained the same, given the change in GPS priorities and to document the triggers for when Waka Kotahi should implement the preferred option.

Since the 2018 DBC was issued, a roundabout at the intersection of SH1 and SH29 has been committed as part of the New Zealand upgrade programme. This roundabout has been bought forward from the preferred programme for implementation due to the high safety risk at the SH1/29 intersection. As a result of this funding, the SH1/29 roundabout is being implemented in advance of the remainder of the Long Term programme and is committed for a construction start by 2022. The solution to be implemented will be future-proofed for the long-term C2P project

The implementation section of this report (Sections 14 to 18) recognises that the roundabout is in place, specifically that the estimates, economics and procurement discussion and programmes focus on the rest of the long-term corridor (with the roundabout excluded).

Figure 1-1: Cambridge to Piarere Long Term Improvements - Site Location

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1.2 Background

1.2.1 Context

The C2P corridor connects directly to the southern end of the Waikato Expressway (the Expressway) and carries 20,000 vehicles per day (vpd) (Figure 1-2), which is projected to rise to 26,000 vpd by 2046.

Figure 1-2: Current (2020) Traffic Volumes[3]

Once Puhoi to Wellsford and the Waikato Expressway are completed (the latter in 2021), the C2P corridor will be the last and only section of the national high volume (H1 route from Wellsford and the SH1/SH29 junction remaining undivided and in its original form. Arataki[4] identifies the SH1 corridor as being a "'nationally significant' connection for both freight and tourism and SH29 nationally significant for freight (Figure 1-3). Specifically, it establishes that the road and rail routes between Tauranga and Auckland (via Hamilton) form the country's most important freight corridor".

Figure 1-3: Upper North Island: Strategic Connections (Waka Kotahi)

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[3] https://maphub.nzta.govt.nz/view/?appid=86c05ba685fc4a34a126501ba224b3d7

[4] Arataki is Waka Kotahi New Zealand Transport Agency's (Waka Kotahi) 10-year view (2021 to 2031)[4] for land transport system in New Zealand. It

Currently the C2P corridor does not provide a suitable transition between an expressway road standard to a lower standard rural road. There are no cues to alert a driver for a need to change their behaviour as the transition from expressway to non-expressway, and traffic volume conditions do not warrant the existing sudden reduction in road standard. This is creating an unsafe corridor for both road users and adjoining communities.

Significant safety investment has been made in the SH1 corridor, and further safety improvements are planned to attract traffic away from the alternative SH2 and SH27 corridor. Although this alternative is a shorter route between Auckland and the Bay of Plenty, it is less safe for the volumes it currently attracts. Drawing vehicles away from SH2/27 will reduce risk and improve the Customer Levels of Service (CLoS) on both corridors. The objective is to get customers safely to and from the intersection of SH1 and SH29 where those corridors (SH29 to Tauranga, and SH1 to Taupo) have better ability to serve the needs of the customers due to reduced demand. In addition, provision of other facilities to serve alternative transport modes have been considered.

1.2.2 Process to date

Figure 1-4 shows the development of the C2P business case process and that this DBC Report is the last step in the overall development of the IBC and DBC.

This DBC Report summarises the previous work completed for the overall process and the key decisions and outcomes of the process. This includes why we are investing in this project, how we address the problems and benefits, and outlining the assessment and engagement methods to arrive at a preferred route.

Figure 1-4 illustrates the link between the outputs and the stage of an ACRE approach (Area, Corridor, Route and Easement) used in identifying the preferred route option. The ACRE process is described in more detail in section 7.1.

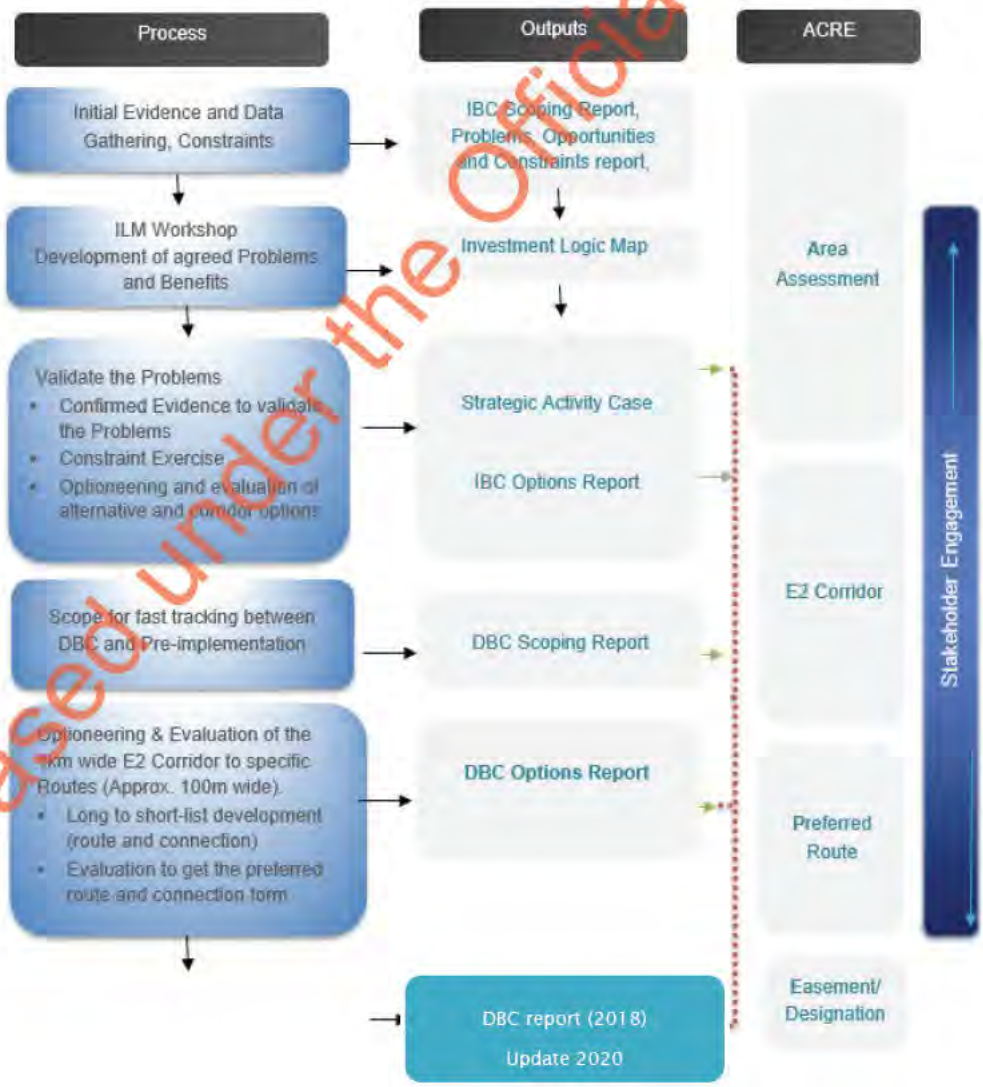

Figure 1-4: Business Case process to date

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1.2.3 Linked or dependent projects

The following table describes any programmes and projects that are linked or have an impact on this project.

Project	Impact on C2P
New Zealand Upgrade Programme (NZUP) A national programme to upgrade the transport infrastructure in six main growth areas of Auckland, Waikato, Bay of Plenty, Wellington, Canterbury and Queenstown. It identifies where vital infrastructure is needed to improve travel times, unlock housing development and to invest in rail to make roads safer by reducing and removing trucks. The intersection at State Highway 1 and State Highway 29 has been included in the NZUP.	The programme identifies that a roundabout is due to be constructed at the intersection of SH1/29 in 2022. The proposed roundabout will be designed to allow connection with the preferred Cambridge to Piarere alignment. This has been discussed further in this report.
Safe Network Programme – SH 1 and 29 (Stages 1 and 2) A short to medium-term project to address safety risks (road widening, central median barrier from just west of Fergusson Gully road to Maungatautari road). Construction planned to start 2020.	The outcome of the short-term project forms the baseline measure for the long-term project (this DBC).
Safe Network Programme – SH 1 and 29 (Stage 3) Stage 3 is being considered and could include the remainder of the corridor being retrofitted with central wire rope barrier, additional roadside barrier, roundabouts at Hydro Road and Karapiro Road and possible 80kmh speed limit.	Stage 3 was not considered as part of the baseline due to the uncertainty of the proposal and timing of construction. However, Stage 3 has been considered as part of the triggers and staging discussion in section 7.1.
SH29 and SH1 PBC Programme business cases have been finalised for SH29, from its intersection with SH1 through to Tauranga, and SH1 (south of Piarere) to Waiouru.	PBC's to be taken into consideration in any further development for this project. Further investigations on those corridors were progressed through an IBC/DBC phase; however, these were not completed and are currently on hold. Further safety measures are also being investigated on these corridors as part of the Safe Network Programme.
Shared Path Connections There is a desire to link the Waikato River Trails, Hauraki Rail trails with Te Awa (Cambridge to Ngaruawahia) in the vicinity of SH1/29, including a separated crossing facility at the intersection.	This was a gap in the 2018 DBC that needs to be addressed as it is not acceptable and safe for active users to currently use this route and intersection. This work is currently underway and will be added as an addendum to this DBC.
Higher speed limit As allowed under the Speed Management Rule, Waka Kotahi increased the posted speeds to 110km/h on the Cambridge Section of the Waikato Expressway (WEX) immediately north of this project boundary. If the appropriate safety features are in place along the remainder of WEX, then a 110km/h speed limit could be consulted on and implemented.	In terms of C2P, there would be an expectation from a customer travelling on WEX that the same approach would be applied south of WEX.

Table 1-1: Linked or Dependent Projects

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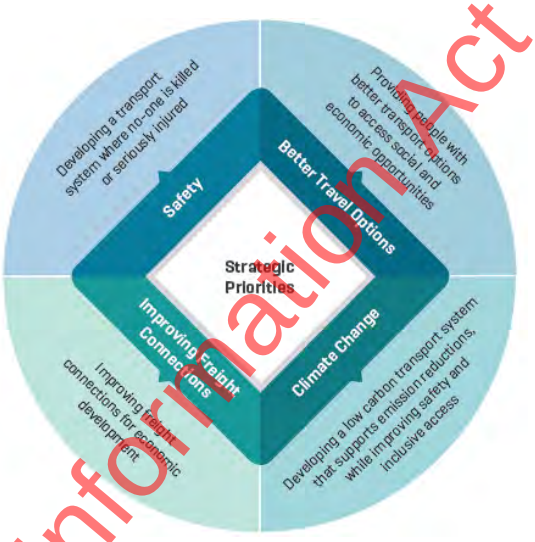
1.3 National and Regional Strategies

1.3.1 Government Policy Statement

The C2P project has been developed under the 2021 GPS[5], with its four priorities:

- Safety
- Better Travel Options
- Improving Freight Connections
- Climate change



The 2021 GPS expects that the strategic priorities will guide investment to meet outcomes identified in the transport outcomes framework, with the aim of providing a transport system that improves wellbeing and liveability. The transport outcomes include:

- Inclusive access
- Healthy and safe people
- Economic prosperity
- Resilience and security
- Environmental sustainability.

1.3.2 Regional Strategies and Plans

The Waikato Regional Transport Plan (RLTP) 2015-2045 (2018 update)[6] sets out the strategic direction/context to address key transport problems for land transport in the Waikato region over the next 30 years. Integrated land use and transport planning sets the overall strategic context for the plan and focusses investment and effort in three core components:

1) **Protecting the function and investing in strategic corridors** – the RLTP states that "These corridors perform a variety of functions which are of critical importance for facilitating the inter and intraregional movement of people and freight" and "SH1/29, North Island Main Trunk and East Coast Main Trunk road and rail corridor is the primary freight corridor linking Auckland, Hamilton and Tauranga and associated sea and inland ports"
2) **Improving road safety** – recognising failures in the system and how user behaviour contributes to risk and a disproportionate number of deaths and serious injuries; and therefore, the need to continue to improve road safety outcomes for the Waikato region
3) **Providing access and mobility needs (and greater transport choices) for communities** – recognition that a "changing social, demographic, economic and technological landscape is impacting some communities' ability to access the transport system".

Both the Waikato Regional Land Transport Plan[6] and the Bay of Plenty Land Transport Plan[7] have recognised the SH1 Cambridge to Piarere Long-Term Improvements as activities of regional significant activities or inter regional significance in in terms of economic development, efficiency and safety.

The discussion above describes what the policies are. In section 5 and Appendix D we state how the project aligns to those strategies.

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[5] https://www.transport.govt.nz/multi-modal/keystrategiesandplans/gpsonlandtransportfunding/
[6] https://www.waikatoregion.govt.nz/assets/WRC/Council/Policy-and-Plans/Transport/RLTP/2018-update/RLTP-WEB.pdf
[7] https://www.boprc.govt.nz/media/3034/bay-of-plenty-regional-land-transport-plan-2018-web.pdf

2 PARTNERS, KEY STAKEHOLDERS AND ENGAGEMENT

The business case has been developed through an ongoing engagement process. Along with Waka Kotahi's Mana whenua partners, a number of stakeholders have been involved in the business case process, including local authorities, government agencies, potentially affected landowners, and the wider community. This involvement has resulted in a better understanding and confirmation of the existing problems and the potential benefits associated with this project. That involvement has also assisted in the development of ideas, alternatives, corridors and routes to arrive at the preferred route.

Waka Kotahi and the project team has followed the IAP2[8] guiding principles for engagement and Waka Kotahi's Public Engagement Guidelines 2016 in determining the projects engagement objectives, who we engage with and how that engagement is undertaken. The level of engagement has been commensurate to an engagement partners' level of interest in the project, and its potential impacts on them (including, if applicable, as a Treaty partner). A Mana Whenua Working Group for the project was set up in late 2016 and has been actively involved throughout the business case process.

2.1 Engagement Approach

A Stakeholder and Community Engagement Plan (Engagement Plan) has been developed that outlines the approach taken and provides an engagement implementation plan. Subsequent engagement strategies have also been prepared as the project reached critical milestones during the business case process.

The primary purpose of engagement for the business case is to:

- Inform decision-making associated with the business case
- Identify problems and opportunities as recognised by the engagement partners
- Generate alternatives, new ideas, and options with input from engagement partners
- Understand reactions and implications or consequences of different options.

For more information, a copy of the Engagement Plan is provided in Appendix C.

2.2 Engagement Partners

There are three distinct sets of engagement partners that we have worked with throughout the business case process:

1) Stakeholders – workshop and non workshop
2) Potentially affected landowners
3) Wider community.

2.2.1 Stakeholders (workshop and non-workshop)

Two types of stakeholders have been engaged with; 'Workshop' stakeholders that have cultural, investment or policy interests in the project area (e.g. local authorities and Waka Kotahi's Mana Whenua partners) and participated in workshops with the project team throughout the IBC and DBC phases, and; 'non-workshop' stakeholders that have a general interest in the project (e.g. Transpower and Mercury Energy) and were met with on an as-required basis.

The workshop and non-workshop stakeholders are listed in Table 2-1.

[8] IAP2 = International Association for Public Participation

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Workshop Stakeholders
Waka Kotahi including: Outcome Planning, Transport Planning, Road Safety, Network Operations, Planning & Investment, Property & Network Maintenance Managers, NOC and Safe Roads
Local and regional authorities, including: Waipa District Council, South Waikato District Council, Matamata Piako District Council and Waikato Regional Council
Other governmental organisations including NZ Police, Heritage NZ, Department of Conservation and Ministry of Education
Mana Whenua comprising representatives of: Ngaati Koroki Kahukura, Ngaati Hauaa and Raukawa
Other Waka Kotahi business case teams for SH29 (Piarere – Te Poi) and SH1 (South)
Transport industry representation including: Freight Logistics Action Group, Road Transport Association and Heavy Haulage Association.
Non-Workshop Stakeholders
St. John Ambulance, NZ Fire Service, Transpower, Automobile Association, Waikato District Health Board, Hamilton and Waikato Tourism, Hon Louise Upston (MP for Taupo), Hon Lindsay Tisch (MP for Waikato), Port of Tauranga, Fonterra Lichfield, Kinleith Pulp & Paper, Federated Farmers, Waikato Fish and Game, Cycle Action Waikato, KiwiRail, Mercury Energy, Broad Spectrum and WEL Networks.

Table 2-1: Stakeholders

2.2.2 Potentially Affected Landowners

Once a preferred corridor (E2) for the expressway route was decided, approximately 120 properties were identified as either wholly or partly located within that corridor. The affected landowners comprised a mixture of properties used for rural primary industries, various small to medium sized businesses, and rural-residential properties. One-on-one meetings with those landowners commenced in July 2017.

As we have refined the potential options and worked through the evaluation of those options we have continued to liaise with potentially affected landowners, including further one-on-one meetings in October 2017 and February 2018. Once arriving at a preferred route, the total number of affected landowners was in the order of 50 separate properties.

2.2.3 Wider Community

The wider community (excluding affected landowners) are also recognised as a distinct group who the project team has engaged with throughout the IBC and DBC phases. This has primarily been through project updates, online surveys, public information days and information kiosks.

2.2.4 Engagement Methods

Various engagement methods have been applied throughout the business case process. These are listed in Table 2-2. These methods have been used not only to inform the business case process, but such engagement is also best practice to help inform the consenting phase under the Resource Management Act 1991.

Accordingly, our approach to engagement will be seamless from the business case phase through to the pre-implementation phase of the project.

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Engagement Method	Engagement Partner	Level of Engagement	Reason for Method
Workshops	Workshop stakeholders	Involve & Collaborate	Ensures those with a greater interest in the project are involved at the critical stages.
Mana Whenua – hui	Ngaati Koroki Kahukura Ngaati Hauaa Raukawa	Involve & Collaborate	Recognises special relationship as Treaty partners between Mana Whenua and the Crown and an opportunity for Mana Whenua to provide feedback in a forum more aligned to their own cultural values.
One-on-one Meetings	Non-workshop stakeholders (if requested) E2 landowners	Involve & Collaborate	Builds trust and shows engagement is genuine. Provides opportunity to explore and resolve key issues.
Project Updates	Non-workshop stakeholders E2 landowners Wider Community	Inform	Quick way to disseminate key information to a wide audience.
Project Website			
Media Releases			
Social Media			
Information Kiosk	Wider Community	Inform & consult	Opportunity for informal meetings with wider community and another avenue for information dissemination.
Information Days	Non-workshop stakeholders E2 landowners Wider Community	Inform & Consult	An easy and interactive way to distribute information and have people ask questions.
Online Surveys	Non-workshop stakeholders E2 landowners Wider Community	Inform & Consult	Seeks feedback and ideas from a very wide audience in an interactive way using Maptionnaire or similar.

Table 2-2: Engagement Methods

2.2.5 Engagement Outcomes

Engagement with stakeholders, affected landowners and the wider public has ensured that all engagement partners have been kept up to date with the project and, where appropriate, input from those engagement partners has informed the business case. We have received positive feedback throughout the process about the transparency of the project, the availability of project team members to talk about the project, and the level of engagement that has taken place.

As part of the 2020 update to this DBC, the new evidence and baseline measures were discussed with core stakeholders (Mana Whenua, Waipa DC, South Waikato DC and Matamata Piako DC). No other engagement has occurred during 2020, however further engagement with the wider stakeholder group, landowners and the public is planned in the next phase of the project.

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3 STRATEGIC ASSESSMENT – WHY INVESTMENT IS NECESSARY?

3.1 Summary of Strategic Need

The strategic needs and why investment is necessary are summarised as follows;

1) **The current highway does not address customer needs.** The current safety and predicted risk profile (both corridor and access), restricted land use opportunities, travel speeds, and accessibility constraints are creating a hindrance on regional economic growth. Various studies have confirmed the need to invest[9]
2) **It is regionally important** to not only connect Auckland to the Waikato and Bay of Plenty regions, but also to provide protected corridors for future growth, address road safety, resilience, freight and planning for road, rail and land use. This is stated as part of a joint set of objectives by the Waikato and Bay of Plenty Regional transport committees
3) This section of SH1 is noted as a national significant freight and tourism route (Arataki) linking Auckland, Waikato and Bay of Plenty. The combined SH1/29 route is the preferred route for east and southbound freight, and the C2P project is needed because:
    a. It completes what will be a significantly improved route allowing an improved customer journey
    b. Completion of the Waikato Expressway (late 2021) will draw customers off poorer quality routes onto the high-quality corridor. Modelling projections indicate this step-change in traffic could be a further 500 vehicles per day, adding to existing problems on this stretch of SH1 between Cambridge and Piarere
    c. The corridor is presently (2019) carrying approximately 20 000 vehicles per day (with 11% HCVs). At the SH1/29 intersection, the vehicle flows split with approximately 58% travelling south on SH1 and 42% on SH29 to Tauranga. The SH1/29 junction is the logical point where a change in the driver experience (safety, travel time and ride quality) can be implemented for customers travelling further east or south.

Consistency with these priorities is critical so that investment is made at the right time and place, and to the right level, to enable growth at both a local and strategic level. A summary of those strategies and how they align to the long-term strategy is provided in Appendix D.

An outline of whether this DBC meets Waka Kotahi' requirements (and therefore presents a clear rationale for investing in this project) relates to a 16-question framework provided in Appendix E.

3.1.1 Cambridge to Piarere Programme Business Case

To reflect its importance, the strategic cases for Hamilton to Waiouru and Hamilton to Tauranga, the National Roads and Roadsides PBC and the C2P PBC (2015) confirmed the case for change along this section of State Highway. This reflects and documents the importance of addressing issues relating to strategic journey connectivity between Auckland, Hamilton and Tauranga, delays of goods getting to markets, freight efficiency, and reduced customer levels of service including safety, access and resilience. The C2P PBC however, did not confirm the long-term form for this section of SH1; nor how it should connect to the Waikato Expressway and SH29. The C2P PBC recommended three activities[10]:

- Short-term safety improvements
- Upgrading the SH1 and SH29 intersection
- Long-term efficiency improvements (this DBC).

3.1.2 Cambridge to Piarere Long Term improvements - Strategic Activity Case

A strategic activity case was subsequently developed for the long-term improvements confirming a set of updated activity problems and benefits in the Investment logic map (ILM). The ILM was developed during a stakeholder workshop on 2 November 2016. The starting point for this workshop were the problems and benefits identified within the programme business case. The purpose of the workshop was to agree the need

[9] Strategic Cases for Hamilton to Waiouru and Hamilton to Tauranga, as well as the National Safer Journeys Roads & Roadsides PBC, and the C2P PBC, Strategic Activity Case and IBC/DBC have confirmed the case for change and the need for this route.

[10] Approved by Waka Kotahi's Board

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for any changes to the ILM to make it more specific for the long-term improvements. The workshop included the stakeholders listed in Table 2-1. The key conclusions from the workshop were:

- With the completion of the Expressway in late 2021, traffic volumes are going to increase on the C2P corridor (drawing traffic away from SH2, SH27 and other alternative routes). The workshop participants felt that the form of this section of the SH1 corridor is not consistent with other parts of the route north of here carrying similar traffic numbers, and therefore, this corridor should provide a similar customer experience. That is, that experience should be safe, convenient, efficient, accessible, and reduce driver frustration. It should be a well-controlled corridor with excellent ride quality and a 4-star KiwiRAP safety rating with frequent and available passing opportunities
- If improvements were not made to this section of the SH1 corridor the workshop participants felt that investment made on the Waikato expressway would not be maximised
- Safety is an important issue. The short-term safety works proposed by Safe Roads and the Safe Network Programme would address approximately 27 percent of Deaths and Serious Injuries (DSIs). However, the workshop participants recognised that further work would be needed to address safety in the long term for the corridor to be consistent with the desirable level of service for the National Strategic (high volume) classification of the highway
- The PBC ILM focussed on the ability of the existing road to cater to forecasted demand and its effects on efficiency. The workshop participants agreed that this was still an issue and that the problem stemmed from a desire to reduce traffic on alternative and less appropriate routes. This is consistent with previous strategic cases and PBC's
- Although safety was still a significant factor, the stakeholders determined it was paramount we focussed on solutions that responded to both the types of customers and their specific needs, so that CLoS in the long term were acceptable to all customers using SH1. This would realise the full benefit of the investment in the Waikato Expressway to date.

Further changes were made to the ILM in 2020 to reflect new evidence which validates the existing problems previously identified. The strategic activity case and the updated ILM are provided in Appendix A. The validated and stakeholder agreed problems confirmed in 2020, are shown below:

- **Problem one**: In future, unacceptable levels of customer service discourages customers from choosing the SH1/SH29 and SH1 south corridor as their preferred route resulting in customers selecting a route with a poor level of service (60 %)
- **Problem two:** Competing priorities between local access and high volumes of SH1 traffic and the unforgiving nature of the corridor is contributing to crashes and harm (40 %).

The ILM is attached in Appendix A. A summary of the problem linkages from the strategic case to the PBC to the DBC is provided in Figure 3-1 and the details are within the strategic activity case.

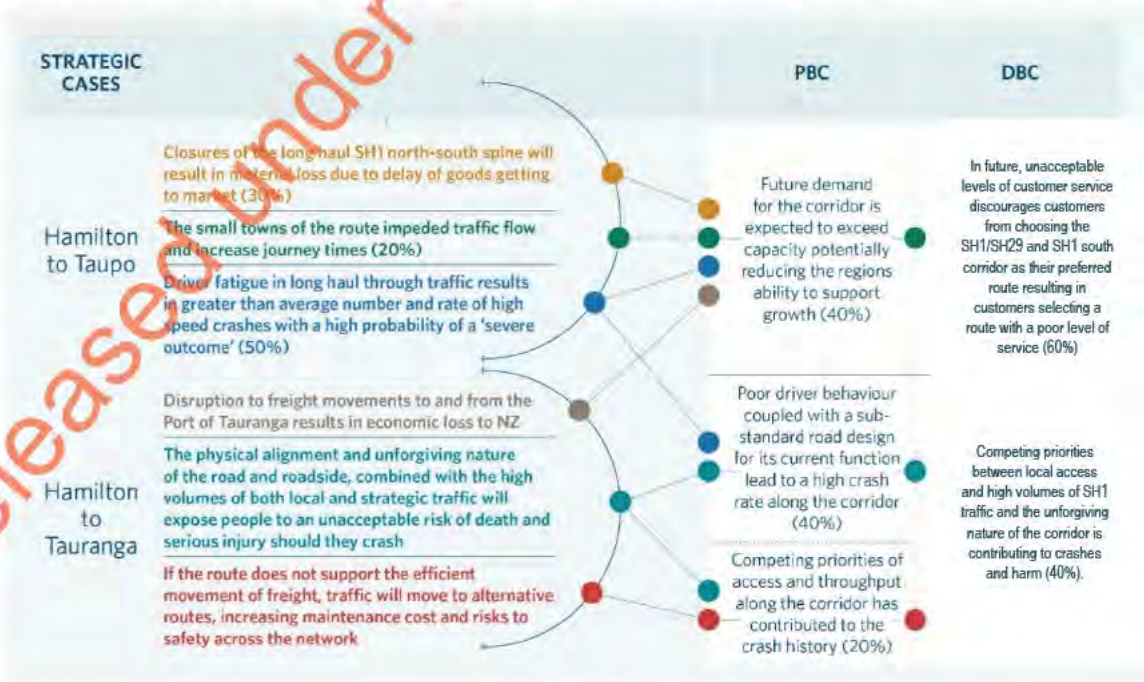

Figure 3-1: Changes in the problems through business case stages

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3.2 Benefits of Investment

At the first stakeholder workshop in 2016 (held to reconfirm the ILM) the stakeholders acknowledged that after the crash benefits had been applied from the short-term Safe Roads (now SNP) safety improvements, the baseline data would still leave a high number of DSIs and the corridor would still be defined as a high risk rural road. Note that with the updated 2020 evidence and revised short-term works, the corridor would still be a high-risk road.

The stakeholders agreed that the best way to ensure customers are attracted to the SH1/29 corridor is to improve the CLoS for the overall journey. By focussing on the strategic context of what its customers are expecting for this section of SH1, will support the right traffic uses the right roads. The 2020 update also established that the CLoS on this corridor to attract customers to SH1 south is also as important as the SH1/29 journey. Stakeholders also agreed that an additional benefit of 'improving community access' was important due to the perceived difficulty that the community faced when making turning manoeuvres off the corridor to valued recreational areas. Some stakeholders also felt that the existing road had a significant negative impact on the amenity of the communities within or along the corridor. This was later shown to be an important aspect identified by the community within the survey of over 480 respondents. The flow-on effect from improving access was identified as an opportunity to grow communities and enhance the district's tourism sector.

In summary, the stakeholders identified and agreed the following benefits for the proposal:

- Improved customer corridor level of service 50%
- Improved access to community features and key destinations 20%
- Improved safety 30%.

The Benefit Map is attached in Appendix A. This links the above benefits to Key Performance Indicators (KPIs), and measures associated with fulfilling these benefits, which are provided within the C2P strategic activity case report. The changes in the investment benefits from the strategic case, and PBC through to the DBC are shown in Figure 3-2. How these align to the 2021 GPS themes is also shown below.

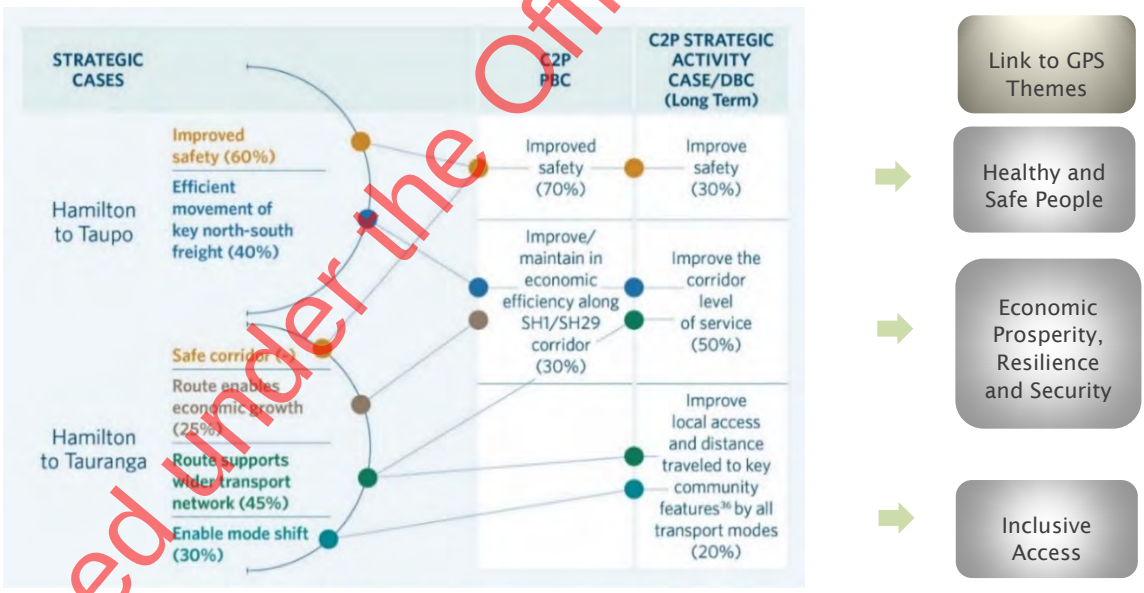

Figure 3-2: Changes in investment benefits through business case stages

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4 DEFINING THE PROBLEMS

The collection of evidence and analysis of problems considers the parallel projects being undertaken and/or planned previously by Safe Roads and currently by the SNP team for the short-term safety improvements. These projects consider the immediate safety needs for the next 10-20 years (to between circa 2030 and 2040). In addition, given that this long-term project relates to the level of service post-2030 to 2040, and issues occurring now that are not addressed by SNP, there is a need to identify when the problem would become an issue. Further discussion on trigger points (timing of need) and staging of the recommended option is provided in section 15.

Maptionnaire surveys[11] were undertaken by Waka Kotahi in February 2016 to better understand the needs and expectations of the customers using the SH1, SH2, and SH29 corridors. The strongest themes coming through those two surveys were concerns around safety, local access, convenience, and congestion. This information was important to help define and validate the stakeholder problem statements developed for the long-term improvements.

4.1 Problem Statement 1

"In future, unacceptable Levels of Customer Service discourages customers from choosing the SH1/SH29 (Auckland to Tauranga) and SH1 south of SH29 corridors as their preferred route" (60%)

In terms of this problem statement, we have thought of this in a strategic context; specifically:

- Understanding customer centricity is part of everything we do; that is addressing current demands and why customers use the route
- How it fits in with the surrounding State Highway network
- That any option gives effect to wider strategies
- The importance of getting the right traffic on to the right transport corridor and the desire to reduce traffic on other alternative transport corridors that are not deemed to be preferable for carrying large volumes of inter-regional traffic (including freight)
- A corridor that is fit for purpose in the long term.

These key issues have been outlined in the following section.

4.1.1 Who are the customers?

SH1 customers include freight, inter regional and regional traffic, local traffic, recreational traffic, other vehicles (such as electric vehicles and emergency services), and specific users such as active modes and tourists (Table 4-1). Importantly, the Waikato Regional Land Transport Plan identifies that this corridor carried up to 4 million tourists (regional and international) in a single year (2011).

Issue – Risk of a high number of unfamiliar drivers[12] mixing with other road users, all with different purposes on a road that is not fit for its purpose.

FREIGHT	TRAFFIC	SPECIFIC USERS	EMERGENCY SERVICES	ENFORCEMENT
Over Dimension HPMVS Stock Effluent Weigh in Motion	Inter-regional Regional Local Recreational EV Tourists	Motorcyclists Pedestrians Cyclists (on and off road) Fatigue PT	Ambulance Fire	CVIU General

Table 4-1: C2P Customers

[11] Waka Kotahi Customer Insight Investigation Upper North Island – Phase 1 February 2016
[12] In comparison to approximately 6.5M total vehicles per year on the existing SH1 corridor

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As stated in the Waka Kotahi Customer Design Principles[13] there are ten key principles that we have considered as part of this business case, not only in the problems and benefits, but also the potential opportunities to make sure that the customer is at the core of the process.

4.1.2 Unacceptable Customer Levels of Service

The customers using the C2P corridor have a certain expectation of level of service when travelling on a route of National Strategic importance (i.e. SH1). These levels of service include factors such as:

- Safety
- Efficiency (ability to travel at desired speed)
- Amenity (level of travel comfort or ride quality/ aesthetics/ convenience/ security)
- Reliability (predictable travel times)
- Accessibility (ease of reaching destinations)
- Resilience (to road disruptions or closures etc.).

Whether the experience is deemed acceptable by the customer, or not, is dependent on several factors, including whether the experience:

1) Is consistent with that provided throughout their entire journey (i.e. for the similar traffic conditions and environment)

2) Matches their expectation for SH1 (in this case the ONRC has C2P as a National (High volume) road – the highest class).

Many of the indicators for level of service are subjective and difficult to accurately measure and compare. However, several performance measures were agreed by the workshop stakeholders to ensure the right outcomes were targeted when optioneering was undertaken. Those key indicators include:

1) Average Travel Speed (relating to efficiency)
2) Safety – covered in Problem 2
3) Freight travel time reliability
4) Resilience.

Most of these categories are also mirrored in Arataki[14], Waka Kotahi's 10-year view on what is needed to deliver on the governments priorities and long-term objectives for the land transport system (Figure 4-1).

Figure 4-1:Existing and Emerging significant level of service deficiencies[15]

4.1.3 The preferred route

SH1 and SH29 is the preferred strategic route for a range of customers between Auckland, Waikato, and Bay of Plenty[16] (and long-haul trips further south) but in its current form it does not attract the full potential of

[13] NZTA Business Case Bite, Jan 2018 (www.nzta.govt.nz)
[14] https://www.nzta.govt.nz/planning-and-investment/planning/arataki/
[15] https://www.nzta.govt.nz/assets/planning-and-investment/docs/arataki/pan-regional-summary-upper-north-island-december-2019.pdf
[16] Waikato Regional Land Transport Plan 2015-2045

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those customers. The road corridor currently (and as an expressway) allows the flexibility of movement for freight and other customers that they are seeking, and that rail perhaps cannot.

Issue: Currently (2020 after Huntly Section opened), the SH1/29 route is approximately 29.4km longer than the SH2 alternative from Pokeno turnoff through to Tauranga, taking an extra 30 minutes by car (as shown Figure 4-2), leading to customers taking alternative routes (i.e. SH2) that are not well equipped, or do not have the appropriate ONRC, to cater for these types of traffic volumes.

Post opening of the Hamilton Section of the Expressway (in 2021), travel distance via the SH1/29 route will reduce by approximately 3.1km, and the travel time by car will reduce to an additional 18mins (instead of 30mins). The travel time for HCVs will also continue to be longer on the SH1/29 route. In addition, the gradients of the Kaimai Range (on SH29) are expected to continue to be a deterrent for HCVs travelling along SH1 and using the SH29 corridor.

Issue: The SH1/29 route as it stands (now and after the Hamilton Section of the Waikato expressway opens) will simply cost freight operators more than alternative routes and therefore does not attract the heavy traffic off other routes as per Waka Kotahi expectations.

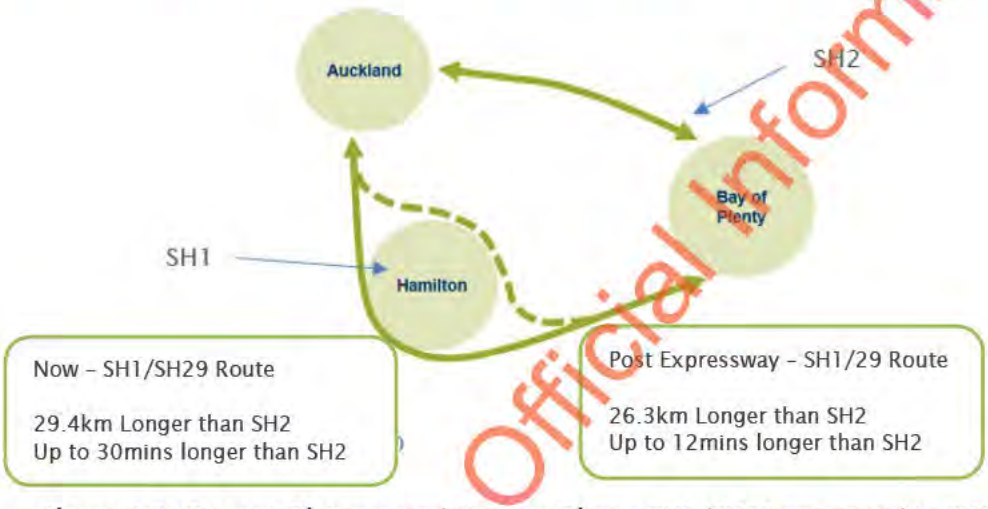

Figure 4-2: Current Distance and Journey Time – SH1/SH29 compared to SH2

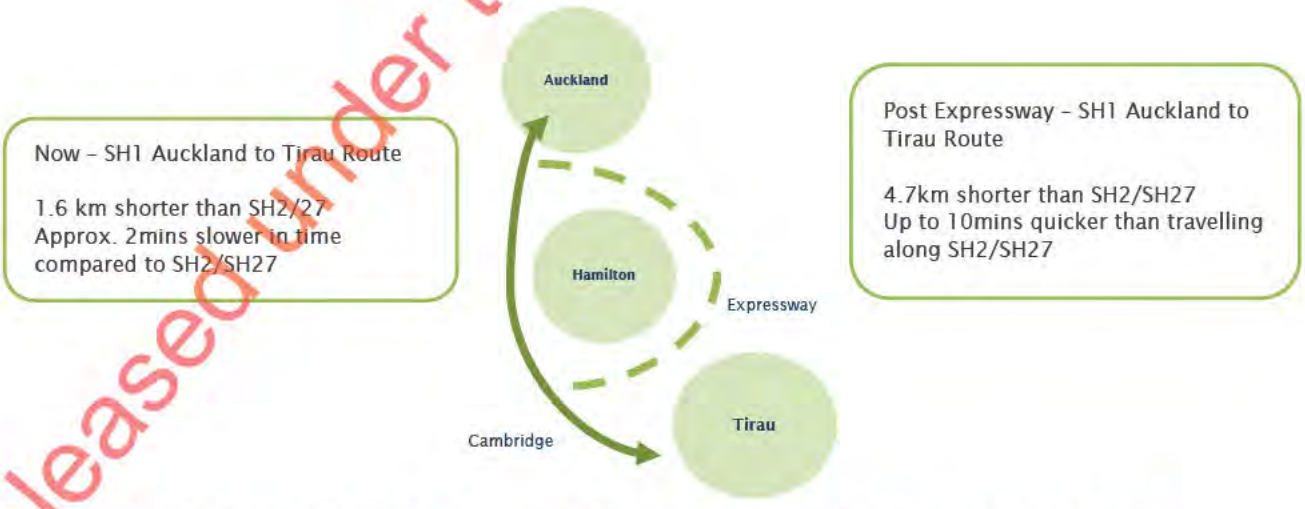

Figure 4-3: Current Distance and Journey Time - SH1 South compared to SH2/ SH27 route

A large portion of the customers on this corridor are not looking to access Tauranga and will continue to travel south on SH1. At the intersection of SH1 and SH29, existing and likely future traffic volumes split in the order of 58%/42% in favour of the SH1 corridor south of the SH1/29 Intersection and illustrates:

1) The importance of providing for both customer routes (SH29 to Tauranga and SH1 south of Piarere)

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2) The SH1/29 junction provides a logical location to consider a change in the experience and feel for customers travelling beyond the C2P corridor, given the significant split in traffic volumes on each corridor (SH1south and SH29)
3) The recommended solution needs to allow for flexible freight movements and a range of customers heading in various directions. For example, a rail option would not provide for these needs.

Issue: The evidence suggests that (when considered in isolation) any changes to the C2P portion of SH1 is unlikely to attract (the desired) significant portions of freight and local traffic from SH2 to SH1/29 unless significant improvements are made to reducing the overall distance of the SH1/29 route. However, improvements to SH1 may attract up to 500vpd that currently use the SH2/27 route in favour of SH1 when travelling between the greater Auckland region to destinations south of Tirau.

Other factors that may influence a shift in route selection include:

- Further (or forced) degradation of the CLoS experienced on the SH2 and SH27 route
- Reducing the gradient on SH29 over the Kaimai ranges
- Better convenience (such as provision of service centres and/or rest areas)
- Pricing of the transport corridors (to overcome the cost of additional distance travelled and/or travel over the Kaimai ranges)
- Education /logistics (i.e. change in freight patterns by introducing inter-regional points of change).

The definitions and issues/data regarding these measures are described in the following sections in more detail.

4.1.4 Key indicators in problem statement 1:

Speed and Travel Time

Theme	*Output*	*Implications*
2019 Average Speed over a 4hr daily period (365days/yr.)	88.7km/h[17]	The evidence shows that capacity problems are not as pronounced as those that were reported in the PBC (which predicted existing speeds of 80km/h and degradation of travel speeds to 60km/h by 2040). However, the resulting LoS provided to customers, based on efficiency requirements, means that *the corridor does not achieve the expected ONRC travel speed of 100km/h (now or in the future), nor does it align with the wider strategic investment strategy.*
ONRC requirements	Represents a low level of service ((daily average of LOS C[18]) provided on the corridor. This will degrade to LOS D around 2046.	
Projected (2050) Fri Southbound peak hour avg speed	< 83km/h[19]	
Avg Travel time reliability for Freight over a 4hr daily period (365days/yr.)	Existing travel time reliability is calculated to be +1.3minutes on an average daily travel time of 11.1minutes (hence a +12% variation in travel times).	The travel time reliability of +12% is greater than the ONRC expectation of 5% maximum delay in travel time (noting that it is less than the alternative maximum of +5minutes).

[17] As determined from 2019 TomTom data sources for both directions between 12noon and 4pm.
[18] Based on the time spent following as defined by the 2016 Highway Capacity Manual v6.0 for a Class 1 highway
[19] Calculated speed flow relationship based on 2019 Tom Tom data for entire corridor. Passing lane merges are at capacity and breakdown in flow starts. If passing lane closed speed over entire route likely to be in the order of 83km/h. Defined by Highway Capacity Manual (HCM)-verified with existing TomTom data.

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Theme	Output	Implications
Target – Speed	110km/h[2021]	Provides speeds and efficiency outputs that are more consistent to the customer expectations provided on similar parts of the SH1 and SH29 journeys for the same traffic conditions. Consistent with the ONRC for C2P and aligned with wider Waka Kotahi strategies[22].
Target – LoS	LOS A at all times of the day[23]	

Traffic Volumes

The Karapiro Telemetry site indicates an average 2019 daily flow of close to 20,000 vpd and an underlying average growth rate of 1.1% between year 2006 and 2015[24] as shown on Figure 3-7. The traffic volumes in the surrounding network are shown in Figure 4-4.

Figure 4-4: Network Performance[25]

A closer inspection of the data indicates that there have been step changes in traffic flow, as sections of the Waikato Expressway have opened. For instance, between 2016 and 2019 the linear growth rate is closer to 4.6%, with a significant increase in flow between 2015 and 2016 (+12.9%). Some additional flow is expected to be attracted to the SH1 route after opening of the Hamilton Section of the Waikato Expressway.

Currently traffic flows are based on a future linear growth rate of 1.1% between 2020 and 2066, based on previous growth between 2006 and 2015. This is indicated on Figure 4-5. The growth in hourly flows is likely to result in traffic flows exceeding the available roadway capacity, especially in the merge areas at the end of the passing lanes. On the mid-block sections this will take many years to reach as the roadway capacity is much higher at 1,700vph[26]/direction. On this basis, we would expect the following:

1) A daily flow of 22,800 vpd at 2026 increasing to 26,200vpd in 2046 and 30,400 vpd by year 2066.
2) An average 3 hourly flow/peak direction on a Friday afternoon of close to 1,350 vph by 2060. However, as indicated on Figure 4-6, the passing lane capacity is expected to be reached by 2050 during the Friday peak hour (4pm to 5pm) resulting in forecast flow breakdown and significant queuing on the highway. In the mid block two lane sections, capacity is not expected to be reached until well after year 2066.

[20] In comparison, the average speed achieved on opened sections of the Expressway = 94 km/h (from 2019 TomTom data), which provides LOS A/B

[21] Existing Waikato expressway seeking a change to a 110km/h speed limit. Cambridge section already 110km/h.

[22] Including the Upper North Island Investment Strategy and the Long Term Strategic View

[23] As determined using the HCM2016 ver 6 procedures

[24] This excludes the step change in traffic flows as a result of opening the Cambridge Section of the Waikato Expressway.

[25] Source – NZTA Map hub – Network Performance

[26] The Highway Capacity Manual 2016 ver 6.1, indicates that passing lane merge capacity is 1400vph/direction, whilst mid-block sections are 1,700vph/direction.

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3) By 2040, at least one hour a day on 35 days/year (9.6%) is predicted to exceed the capacity of the passing lane merges, resulting in flow breakdown and significant queuing on the highway. In the mid-block section this is likely to occur on 9days/year in 2050. See Figure 4-7.

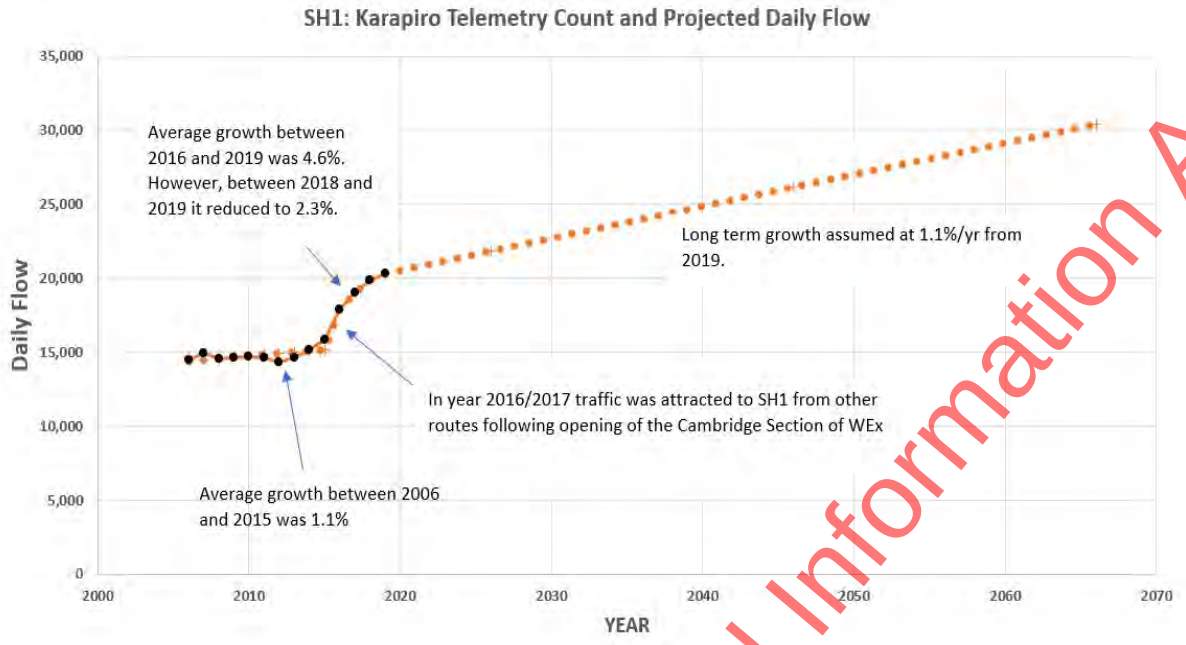

Figure 4-5: Existing and Predicted daily traffic flow on SH1

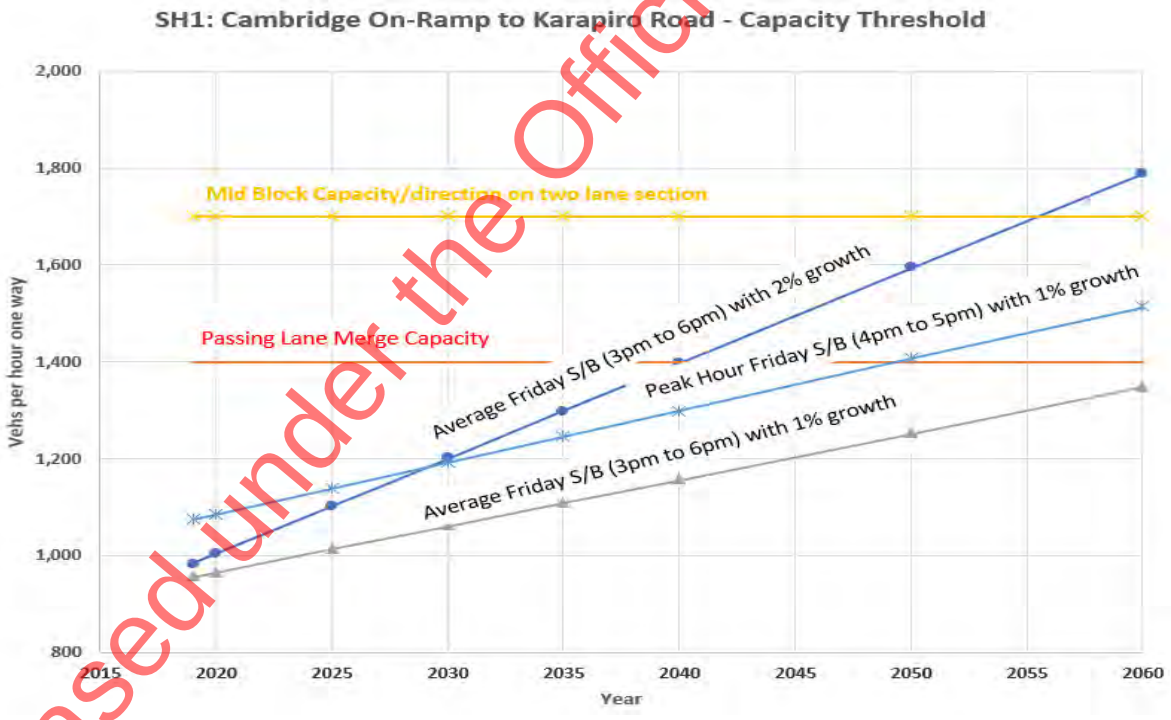

Figure 4-6: Predicted hourly flows and existing capacity constraints (1% growth beyond 2019)

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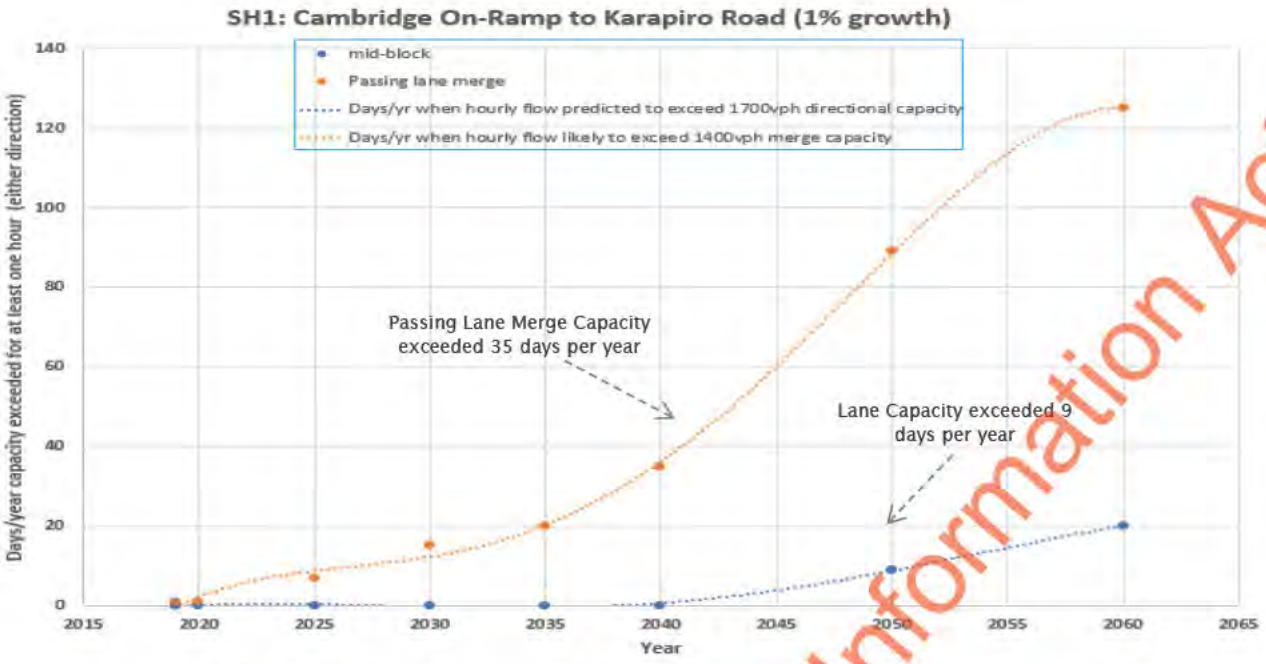

Figure 4-7: Predicted Days/year when SH1 Capacity Exceeded (1% growth beyond 2019)

Leaving the C2P corridor 'as is' after the SNP works have been implemented is undesirable as it would not:

- Match the intentions of Waka Kotahi's Strategy to provide a 'nationally significant' connection for both freight and tourism for SH1 and freight for SH29
- Achieve the investment objectives agreed with work shop stakeholders to improve levels of customer service for travel time, resilience and reliability, improve local access to key community features and improve safety by reducing the number of high severity crashes.

Resilience

The following table provides a summary of the key themes provided in the evidence and their implications.

Theme	Output	Implications
Unplanned events resulting in delays or inconvenience	179[27] unplanned events including road closures, caution, congestion. On average 1 unplanned event occurs every 10 days.	During an unplanned incidence, *customers experience considerable delays to their journeys, and these delays affect significant volumes of traffic.* Certainty of transport accessibility is a critical element in providing a safe, efficient, and effective transport system; particularly where freight logistics are concerned. *Combining average closure time with an event occurring every 10 days is considered unacceptable[28] for a national high-volume route.*
Recorded Incidence that result in road closures	Thirteen[27], with eleven relating to crashes.	
Average full road closure period	6.39 hours ranging from 2 to 36 hours	
Current Detour route (type and length)	When SH1 is closed, the current detour route may be of substantial length (10-50km) depending on the destination of vehicles and the location of the disruption (as shown in Figure 4-8).	Although available, *using a current alternative route could represent an increase of 60 minutes to a journey time.*

[27] Updated unplanned event information from the West Waikato NOC for the period 1 January 2015 to 31 December 2019 (1826 days).

[28] https://www.nzta.govt.nz/planning-and-investment/planning-and-investment-knowledge-base/assessment-of-activities-by-activity-class/assessment-of-local-road-regional-and-state-highway-improvement-activities/

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Theme	Output	Implications
Alternative Detour Routes	There are no viable detour routes for High Productivity Motor Vehicles (HPMV), so they are unable to make an alternative route choice prior to this section of SH1 unless given advance warning through VMS signage for example.	*HPMV's may be forced to wait for the entire duration of the road disruption before re-commencing their journey*. This is not reflective of the ONRC or strategy in terms of attracting freight off other routes on to an efficient highway.

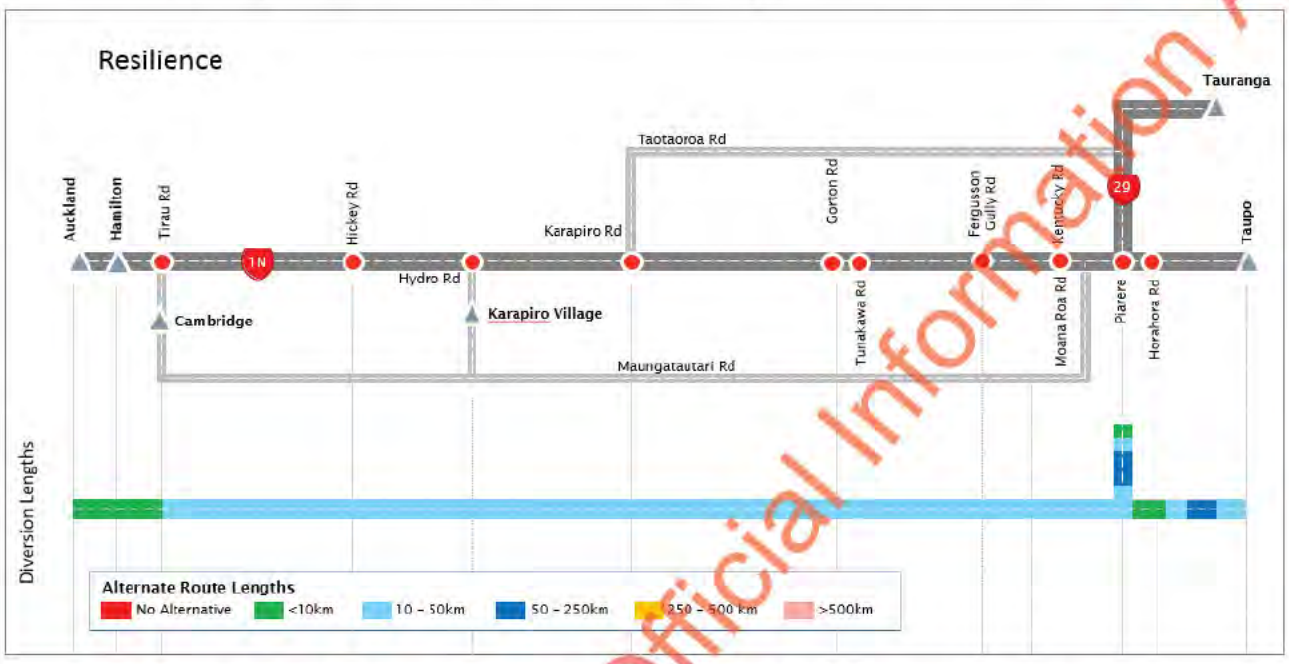

Figure 4-8: C2P Infographics: Resilience - Diversion and alternative route lengths

4.2 Problem Statement 2

"Competing priorities between local access and high volumes of SH1 traffic is contributing to crashes and harm" (40%).

The key phrases in the problem statement relate to:

- Access arrangements
- Contributing to crashes and harm.

4.2.1 Access Arrangements

There are 86 known access points along the existing SH1 corridor. Access points in this context relate to formal intersections and entranceways to both residential properties and key features, such as reserves. These access points comprise of nine[29] minor at-grade tee-intersections with local roads, and one major intersection (with SH29), with corresponding traffic volumes on the side roads ranging between 40 vpd and 7,500 vpd[30]. In addition to these formal intersections, there are 76 direct access points with adjoining properties. A higher number of these access points are located on the northern side of SH1, and more are concentrated at the northern portion of the SH1 study length (i.e. between Cambridge Section and Fergusson Gully Road). Within those 76 access points, there are six[31] recognised rest areas/stopping places, and two formal (boat) access points to Lake Karapiro located along the route.

[29] Hickey Road, Hydro Road, Karapiro Road, Gorton Road, Tunakawa Road, Moana Roa Road, Fergusson Gully Road, Kentucky Road and Maungatautari Road.

[30] Mobile Roads, 2018 ADT, https://mobileroad.org/ Accessed 8 April 2020...

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Issue: All these access points represent a safety risk by creating potential conflict points between varying customers and risk can be increased by 2 percent for each additional access location[31] as its presence adds side friction and speed differentials between through and local access traffic. Intersection type crashes are an issue. Almost 18 percent of high severity crashes occur at intersections compared to national figures of 12 percent for rural state highways (Table 4-2).

Vehicles exiting the intersections of Hydro and Karapiro Roads are likely to be experiencing high delays during peak periods as sufficiently sized gaps in the SH1 traffic flow become less available. In some instances, the increasing delays may result in crashes as drivers misjudge the gap size or become impatient and take risks. Using SIDRA software, the expected[32] delays for traffic right turning out of any side road along the route are shown on the graph below, based on varying two-way flows of traffic along SH1.

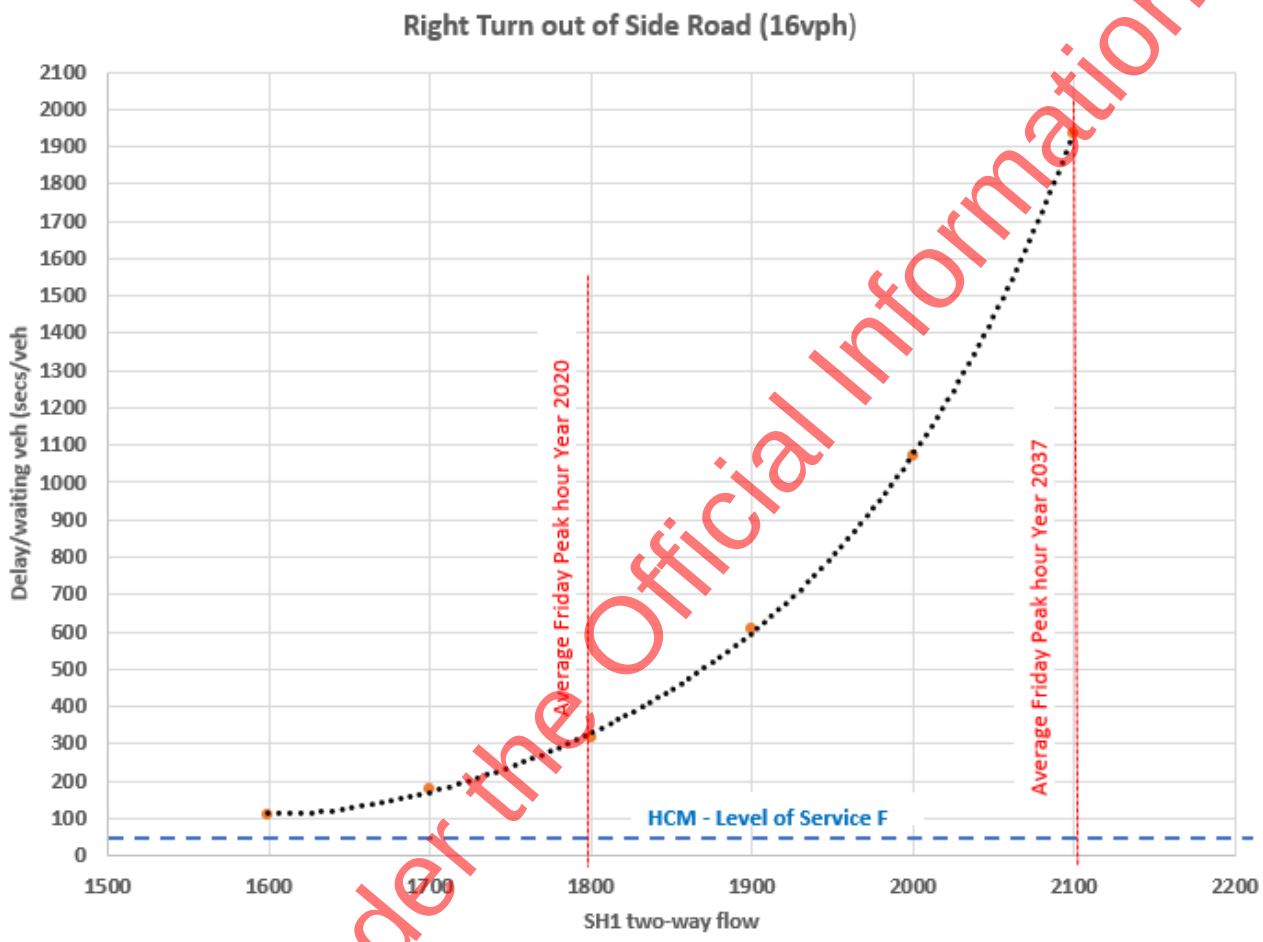

Figure 4-9: Predicted delays for side road traffic on SH1

Through engagement with landowners we know that many perceive the highway to be unsafe. People are avoiding right turns into and out of their properties and incurring self-imposed detours of up to 3 to 6km to avoid undertaking these movements. Some landowners have also noted a reluctance of family and friends to visit their properties due to the perceived access safety issues. The installation of some central barriers along the route, as part of the SNP Stages 1 and 2, would create more travel time and possibly result in unsafe u-turn manoeuvres to access properties.

The desired customer outcome for accessibility of a National High-Volume State highway is that "land use access for road users [are] rare and highly engineered with infrequent connections"[33]. This is clearly not reflective of the route now, or after the short-term works have been implemented.

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[31] SH1 Strategic Corridor Study – 2010, WSP Opus Consultants

[32] Surveys have not been undertaken to verify the predicted model delays. In practice the delays may be less, as drivers select smaller gaps than the model parameters

[33] NZTA One Network Road Classification, Revision 1.0

4.2.2 Crashes and harm

The crash history for this section of SH1, and key contributory factors, have been identified via the Crash Analysis System (CAS) for the 5-year period between 2015 and 2019 inclusive. The analysis covers the section of SH1 between RP 574/2.8 to 594/0; broadly 2.5 km north of Hickey Road to 460 m south of SH1 and 660 m East along SH29 from the intersection of SH29 at Piarere[34] (Figure 3-4). A total length of 17.5km.

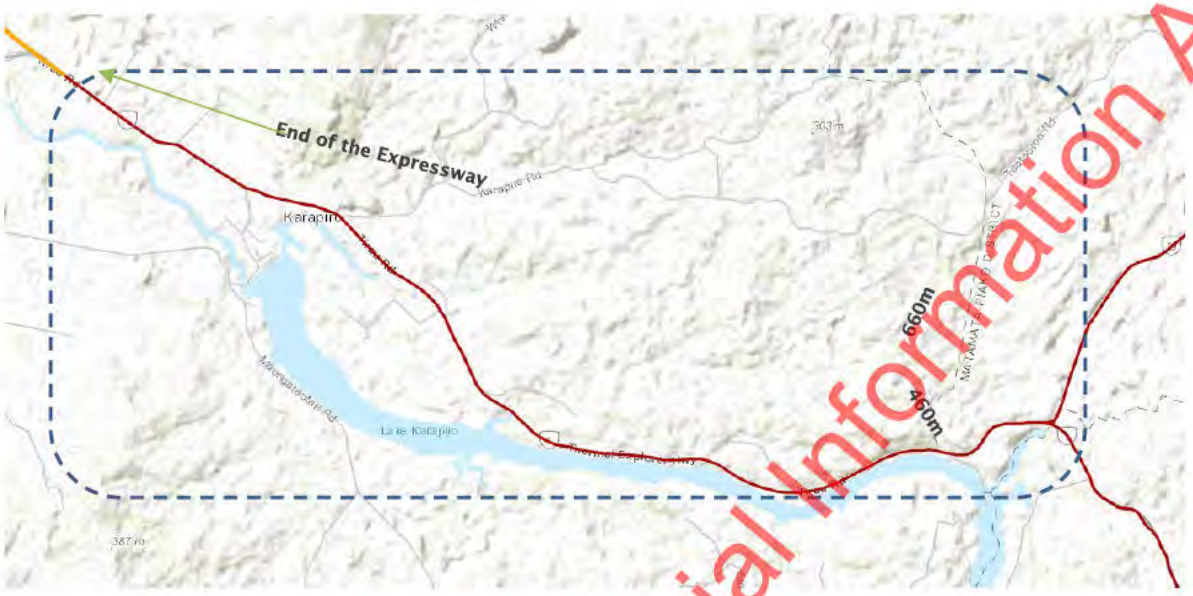

Figure 4-10: Extent of crash data collection

The crash data is based on the specific intention of providing a 'single point of truth' data set between the information used on both the short-term and long-term C2P projects. The baseline data for the long-term project is an estimate of high severity crashes based on Stage 1 and 2[35] of the Safe Network Programme (SNP) achieving a:

- 65 percent DSi reduction[36] where median barriers are planned
- 35 percent DSi reduction where the RIAWS are planned.

Note, 65 percent of high severity crashes, and an estimated small proportion of minor crashes would be addressed by the SNP project because of Stage 1 and 2 of SNP. Those crashes have been removed from the raw data set to develop the estimated b se line for the long-term project. No other crashes have been removed as there is likely to be an increase in minor or non-injury crashes with the installation of a central median barrier on a portion of the route and no other works are proposed on the rest of the corridor. Given this, for 2015-2019, the long-term crash data set has been estimated to consist of 147 crashes including 5 fatal, 16 serious, 33 minor (56 injury) and 93 non-injury crashes resulting in 27 Deaths and Serious Injuries (DSis) (Figure 4-11, Figure 4 12). The overall number of crashes has increased since 2015.

Anecdotal evidence from landowners living adjacent to key intersections (such as SH1/SH29) is that many crashes go unreported.

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[34] Consistent with the analysis completed for short term project
[35] Stage 1 & 2 – Central barrier from just west of Fergusson Gully Road to Maungatautari, right turn bay at Keely's Landing
[36] As per the recommendations in Waka Kotahi's Standard Safety Intervention toolkit

Figure 4-11: Estimated Crashes and Severity 2015-2019 (post short term projects)

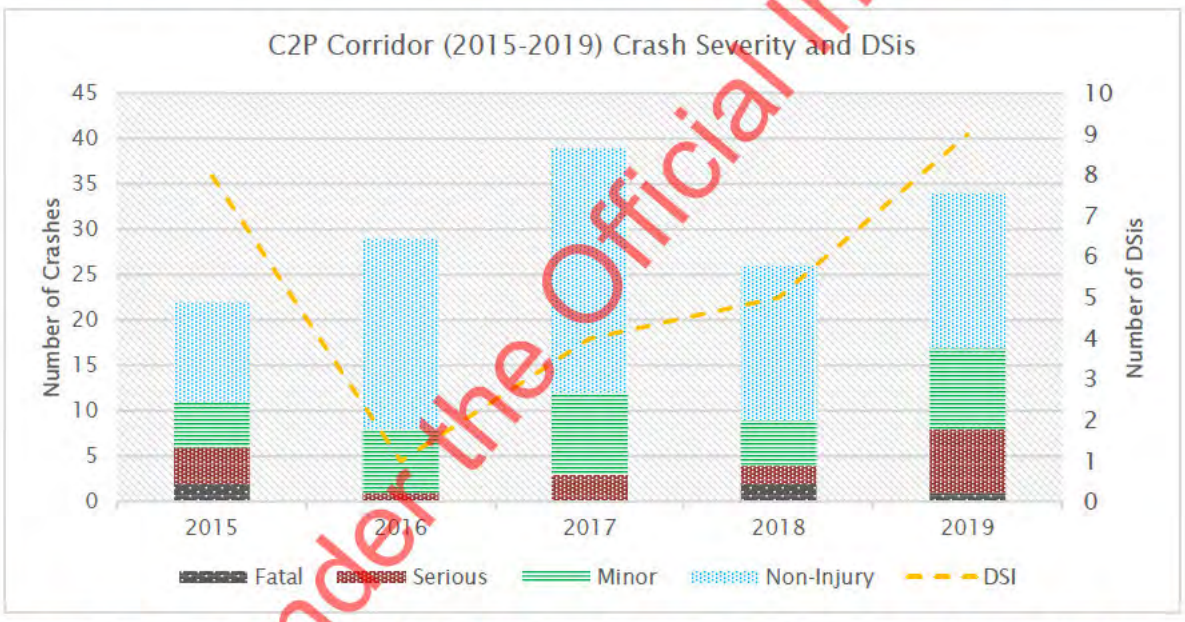

Figure 4-12: C2P - Estimated Corridor Crash Severity and DSis 2013-2017 (post short term projects)

These key facts have also been compared to all New Zealand Rural State highway figures to identify whether there are certain crash rates, risk and types of crashes that are over-represented. *Issue: 73 percent of all crashes and 82 percent of high severity crashes include the three crash movements of 'run off road', 'head on', and 'intersections' crashes.* These are the key crashes that should be addressed. Intersection crashes and causes (such as failing to give way) are overrepresented compared to national figures.

Although some causes (such as alcohol, failing to give way, and poor observation behaviours) are over-represented, addressing these is part of developing a solution that recognises people make mistakes, and is consistent with wider Safe System discussion with other key partners (such as enforcement and education providers). The key findings are shown in Table 4-2 with the shaded areas indicating where C2P is over-represented compared to national rural state highway figures.

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Crash Theme	Crash data[37]	All NZ[38]	C2P[39]
Run off Road Crashes	All Crashes	46%	36%
	High Severity	45%	23%
Intersection	All Crashes	8%	25%
	High Severity	12%	18%
Head on	All Crashes	6%	12%
	High Severity	24%	41%
Alcohol	All Crashes	31%	14%
	High Severity	23%	38%
Speed	All Crashes	18%	13%
	High Severity	21%	7%
Poor Observation	All Crashes	30%	33%
Poor Handling	All Crashes	24%	23%
Failed to Give Way	All Crashes	5%	17%
Fatigue	All Crashes	9%	12%
Vehicles	Cars - All Crashes	73%	71%
	Vans/Utes – All Crashes	14%	14%
	Trucks – All Crashes[40]	8%	11%
	Motorcycles – All Crashes	3%	1%

Table 4-2: Summary of actual Crash Data

Crash and infrastructure data was also used to determine a KiwiRAP[41] collective and personal risk (actual risk) and star rating (predicted risk) profile for the route. A summary is shown in Figure 4-13[42] and Table 4-3 The potential for future risk also needs to be considered and any preferred option will still need to ensure the highway is fit for purpose for the ONRC in terms of its customer levels of service. For safety, this includes the provision of a 4-star road[43]. This corridor (after the short-term safety works are completed) is estimated to have a predicted star rating of 3.25-3.30 which falls short of the desirable outcome for this ONRC.

The posted speed limit is 100km/h. The safe and appropriate speed (SaaS) is between 80km/h to 100km/h. In addition, approximately half of the 15km route from the Cambridge Section of the Waikato Expressway to Fergusson Gully Road and west of SH1/29 is identified[44] as a 'high speed Benefit Management' corridor with an "Engineer Up" category[45].

[37] Estimate based on removing crashes likely addressed as part of the Short term projects

[38] Crash data for all rural open State Highways 2015-2019

[39] Highlighted cells are those that are over-represented compared to national rural state highway figures

[40] Trucks equate to 11% AADT, compared to 12% on all rural state highways.

[41] The NZ Road Assessment Programme (KiwiRAP) analyses the road safety of the State highway network, and provides a means to measure and rate the relative safety of a road corridor and predicted risk for the highway including star rating

[42] Note there are currently no post-short term project KiwiRAP maps, however, further analysis was completed to identify whether there was still a residual issue after the short term project had realised its benefits (from 2026).

[43] The Star rating is a "predictive measure of the personal safety of a longer length of road based on the 100m Road Protection Scores (RPSs) and typically averaged over 5km lengths" [NZTA High risk rural roads guide, 2011]. As part of the ONRC there are certain Customer Levels of Service (CLOS) that relate to the ONRC for this route; specifically, that a National High Volume Highway should have a 4 star rating

[44] Waka Kotahi's MegaMaps

[45] This indicates the route as being meant for efficient travel, but not designed for it - Road Safety Strategy Speed Reference group presentation, Ministry of Transport, Sept 2018

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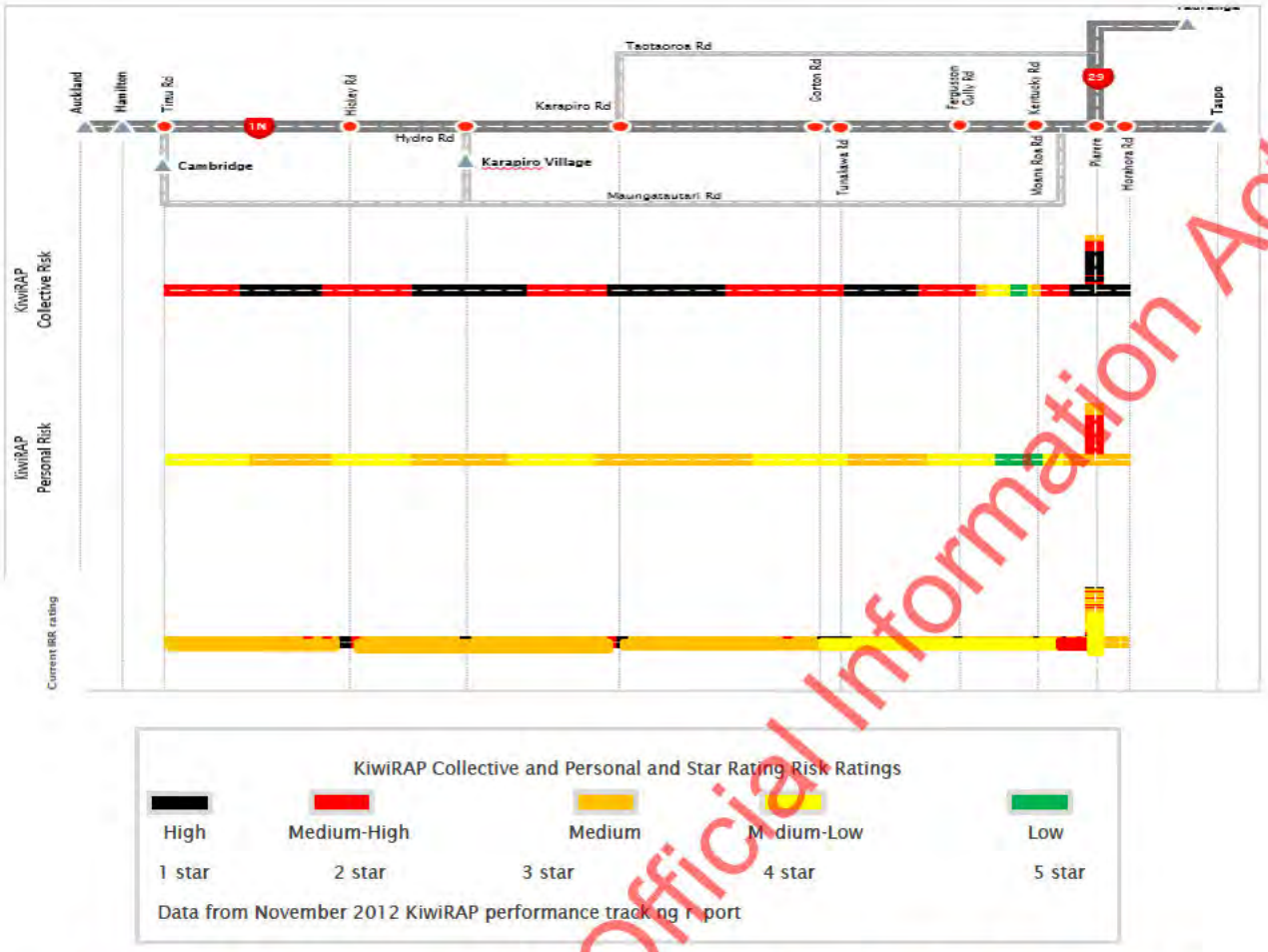

Figure 4-13: C2P Infographics: Road Safety - KiwiRAP Risk plans (pre Safe Roads and SNP)

The current risk analysis is based on traffic volume (ADDT) of 20,000 vpd[46].

Risk Rating	Output
Star Rating	3.25-3.30[47]
IRR	Low medium to medium high
Collective Risk	High
Personal Risk	Low-Medium

Table 4-3: Key Safety Risk Outputs

4.2.3 Summary of the Key indicators in Problem Statement 2

Although the short-term safety improvements project is delivering some exceptional safety benefits, there will still be a high number of crashes not addressed. The work is limited to addressing head on crashes only at certain portions of the route, with only minor measures directed to reduce intersection crash risk. 'Run off road' and 'intersections' high severity crashes contribute to 42 percent of the total high severity crashes

Issue: Even after the short-term safety project has been completed this route is still likely to have a high number of high severity crashes (21) and DSIs (27) related to head on, run off road, intersection, accesses and other, a less than desirable star rating (3.25-3.30) for the road classification all of which defines this as a high risk rural road[48] when compared to other national rural roads.

[46] 2017 Karapiro Telemetry site records.
[47] Estimated based on SNP stage 1 and 2 works
[48] As defined by the NZTA High risk rural roads guide 2011

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Crash Theme	Data[49]	Implications for the Long Term
Number and Severity	21 high severity crashes 27 DSIs[50] (1.54 DSIs per km) 3.26 injury crashes per km High Collective Risk Low Medium Personal Risk	Given the actual risk, this route (after the implementation of the short-term safety works) *is still classified as a High Risk Rural Road.* This provides a high alignment to strategic fit within the assessment profile.
Infrastructure	Star Rating (3.25-3.30)	*The actual and predicted star rating does not meet the aspirations of the customer levels of service for the ONRC* and should be at least a 4 star rating to allow for future traffic growth and reduction in risk
SAAS	80-100km/h High benefit speed management - 100km/h 'Engineer Up'[45]	This route has been identified as being meant for efficient travel but does not have the infrastructure in place to support it. *If the intention is to extend the 110km/h trial sites to other nationally significant routes, then the road environment does not achieve supporting a higher speed limit in its current form.*

Table 4-4: Outcomes and Implications of the Crash Data for Long Term Project

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[49] After those crashes addressed as part of the short term project have been removed
[50] Based on 17.5km length(inclusion of SH1 south and SH29 portions of the scoped area.

5 OUTCOMES AND BENEFITS

5.1 Strategic Outcomes

This section assesses the alignment of the investment benefits identified in this detailed business case to the strategic outcomes identified by Waka Kotahi.

The scheme contributes to the high level strategic drivers and the regional land transport plan objectives as described in section 1.2.1. Further details on how the objectives are aligned to wider transport and government objectives is provided in Appendix D.

Inclusion of Waipa District Council, South Waikato District, Matamata Piako District and Waikato Regional Council representatives has ensured linkages to the local community in the decision-making process.

In addition, this project will contribute to the opportunity to provide a more connected New Zealand Cycle Trail network. The primary objectives of the New Zealand Cycle Trail are "providing a healthy and enjoyable way for Kiwis and international visitors to see the country"[51]. The present state of SH1 within the project area makes this vision hard to achieve due to the high traffic volumes and exposure to risk. This opportunity will be further explored as an adendum to this business case.

5.2 Investment Objectives and Outcomes

The project's investment objectives were developed as part of the strategic activity case and are a combination of the benefits, the measure (KPI) and a target (the KPIs and target including a mixture of quantitative and qualitative measures).

The baseline measures were developed with the assumption that the short-term project was completed and applied the intended benefits for any measures relating to safety, access and level of service. Specific details are provided within the strategic activity case (Appendix A), and a summary is provided below. There has not been a substantial change to the investment objectives as part of the 2020 update.

The investment outcomes are those benefits we can achieve if we address and invest in the problems agreed to by the workshop stakeholders. A summary of the investment objectives (including weighting and the investment outcomes) is shown in Table 5-1.

It must be recognised that upgrading this section of SH1 alone is not going to get the desired results to make SH1/SH29 the preferred route over SH2, as is strategically desired. To achieve this, additional interventions are required on the adjacent sections of highway, particularly in upgrading SH29 to its ONRC standard. Together, C2P and other upgrades to the corridor will attract traffic and freight to this route.

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[51] http://leapbooking.com/blog/what-are-the-nz-cycle-trails/

Investment Objectives	Investment Outcomes	2021 GPS Priorities
• Improve Corridor Customer LoS by-reducing travel time on SH1 on opening for next 20 years (17%) • Improve Corridor Customer LoS by: Improving resilience by reducing risk or consequence of unplanned road disruptions [Qualitative scale in comparison to existing case[52] –on opening for next 20 years (17%) • Improve Corridor Customer level of LoS by improving average daily freight travel time f on opening for next 20 years (17%) • Improve local access and distance travelled to key community features by all transport modes on opening for next 20 years (subjective scale - yes (if improvement/no if the same or worse] (20%) • Improve Safety by: – reducing the number of DSIs by 70% reduction in DSIs on opening (15%) – reducing the Collective Risk (number of high severity crashes per km per road) to no more than a medium on opening for next 20 years (7.5%) – maintaining a low personal risk (High severity crashes by 100 million vehicle km travelled) on opening for next 20 years (7.5%).	• An improvement to the SH1 customer journey experience so that the journey takes a similar amount of time every time they use it • Improving the resilience of the SH1 and SH29 corridor by making it less susceptible to road disruption and/or increasing the availability of alternative routes • A reduction in high severity crashes from 21 (5 years) to 6 per 5 years and those killed or seriously injured from 27 (5 years) to 9 per 5 years on opening for next 20 years Improved and safer local access to community features by reducing community severances and maximising potential for growth in community development and local tourism • Improved CLoS consistent with a National State Highway • Increased use of the SH1/29 corridor as the preferred route by customers travelling between Auckland, Waikato, and Tauranga and south thereby maximising the investments made on the SH1 corridor to date and reducing risk on other less safe highways such as SH2 and SH27 • Providing infrastructure that can allow opportunities for other modes of transport (such as cycle trails) • Improving opportunities for economic growth both locally and nationally.	**S**afety **B**etter Travel Options **I**mproving Freight Connections **C**limate Change

Table 5-1: Investment Objectives and Outcomes (Using Strategic Activity Case findings)

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[52] yes (if improvement/no if the same or worse]

Option Development and Evaluation

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6 OPTION DEVELOPMENT AND EVALUATION APPROACH

6.1 Ideas and Alternatives

Once the problems and benefits were drafted in to a set of investment objectives (section 5.2), a stakeholder workshop was held to develop ideas and alternatives[53] that address those problems and achieve the investment outcomes of safety, traffic efficiency and access.

The ideas developed at the stakeholder workshop were grouped (post-workshop) in to one of three alternatives:

1) **Demand** – does this idea change (increase or decrease) the transport demand, traffic volumes etc
2) **Productivity** – does the idea modify or optimise the operation of the existing situation without investing in major infrastructure (i.e. removal or installation of passing lanes)
3) **Supply** – is the idea related to some type of built infrastructure (e.g. development of new roads).

Once the ideas were put into the three groups of alternatives (a total of 37) they were assessed against the Stage 1 Investment objectives (Section 6.3). This allowed the removal of any ideas that were clearly not aligned to the draft GPS, did not achieve specific investment benefits, or were not feasible. A more detailed assessment of why these alternatives were kept or discarded is provided within the IBC Options Report[54] (Appendix P). The core reasons these alternatives were discarded early were for the following reasons:

1) Limited or no alignment to the investment benefits or makes the problems worse; and/or
2) Significant costs and effects.

Alternative	*Description*	*Keep*	*Discard*
Do Nothing	No change to the existing situation (assumes short term safety improvements completed and these form the do minimum)		●
Demand	Reduce Demand – relocation of facilities, land use change, improve active modes	●	
	Increase Demand – discourage freight from other SH's, service centers	●	
	Reduce traffic – i.e. options include freight on to coastal/rail, shifting traffic to SH2 and alternative freight system		●
	Increase traffic – i.e. discouraging freight from other routes (without SH1 improvements)		●
Productivity	Speed Management (reduce, increase, enforce)	●	
	ITS/ATMS/Autonomous Vehicles/Smart Roads	●	
	Targeted road modifications– special vehicle lanes, safety	●	
	Dedicated Special vehicle lanes – HCVS & Autonomous vehicles		●
	Remove Passing Lanes for a more consistent flow		●
Supply	Various online, offline (east and west of the river), hybrid road and split routes/direction arrangements. Road Layouts included variations of just provision of extra lanes, to 2 + 1 to 4 lane standard expressway standards	●	
	Roundabouts only at key locations		●

Table 6-1: Idea and Alternatives

[53] An alternative is a broad transport planning response to the project problems which is intended to achieve all or part of one or more of the agreed benefits.

[54] IBC Options Report – SH1 Cambridge to Piarere (C2P) Long Term Improvements, Opus Consultants, May 2017(Appendix P)

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The 'kept' alternatives were put into a matrix of primary, sub-options and opportunities and combined in various forms to develop 21 initial long list options (Refer IBC Options Report - Appendix P). A summary of the evaluation and outcome of those 21 options is provided in Section8. Note: the 2020 re-evaluation of the revised investment benefits against the ideas and alternatives showed that two specific 'supply' type alternatives would possibly have not progressed as they are similar in nature to the SNP safety works being undertaken on the existing highway. This is discussed further in section 8.

6.2 ACRE Approach

The geo-spatial nature of the supply alternatives meant that it was appropriate to adopt the ACRE (Area, Corridor, Route, and Easement) approach to progressively narrow the study area and identify the preferred route for designation. The ACRE approach involves progressively detailed investigation and filtering of information to identify, select, and confirm a final route for the project.

An ACRE approach ensures that information from the relevant disciplines (engineering, environmental, planning, property etc.) is well integrated and coordinated within the option development process, in order to achieve the most appropriate outcome. This approach lies across the IBC, DBC and pre-implementation phases of the project and ensures a staged process in option selection through:

- Refinement of the study area (defining feasible areas for investigation and constraint mapping) (Section 7)
- Development of wide study corridors (to connect two points on a map to develop corridors (typically 1km wide) and avoiding constraints), (Section 8)
- Route selection (identification of a route and interchanges within the preferred corridor) (Section 9)
- The final designation (easement) of that route (if needed).

The way in which the ACRE approach was incorporated within the option development, filtering and assessment methodology, is shown in in Figure 6.1. The methodology included high level investigations, constraint mapping (options developed around knowledge of constraints) analysis, multi-criteria assessment (section 6.3) and progressively refined investigation. The methodology also included ongoing engagement including stakeholder workshops, project updates, landowner meetings, information days and other initiatives.

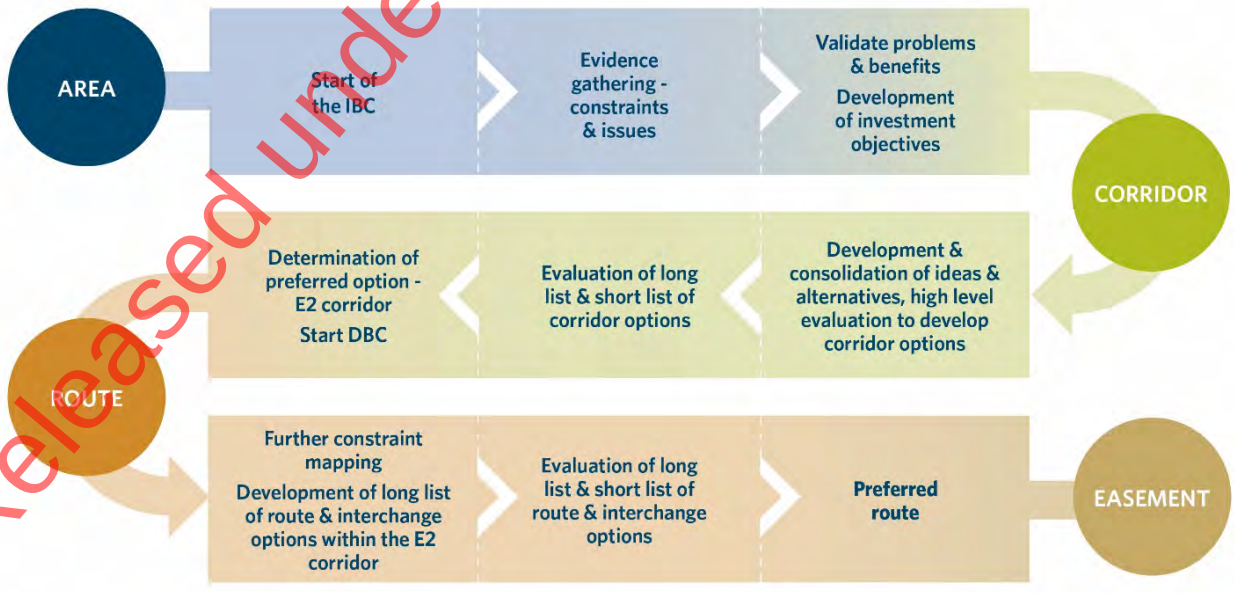

Figure 6-1: IBC/DBC Option Development Process

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. Each of the corridor and route options were assessed using a Multi Criteria Analysis (MCA), and consensus agreement with workshop stakeholders. Option development and evaluation is described in the following sections with further detail provided in both the C2P IBC and DBC Options reports (Appendix P).

6.3 Evaluation Approach

The evaluation approach involved the application of Multi Criteria Analysis. The MCA has been used in the area, corridor and route option development in various forms (simple and complex). The MCA considers three stages of assessment throughout the option development process, including alignment to and/or assessment against:

- Stage 1: Investment Objectives (Table 5-1)
- Stage 2: Technical complexity and risk
- Stage 3: Effects.

A detailed description of the MCA framework used in both the IBC and DBC phases is provided within the IBC and DBC Options reports (Appendix P - section 4 and Section 3 respectively). Each progressive phase of the option development process involved consideration of increasingly detailed assessment criteria and is shown in Table 6-2.

Stage	Evaluation Phase	Total number	Fatal Flaw	Stage 1[55]	Stage 2	Stage 3
IBC (Area to Corridor	Area - Ideas/ Alternatives	37	✓	✓		
	Long-List of Corridor Options	21		✓	✓	
	Short-List of Corridor Options	6		✓	✓	✓
	Preferred Corridor E2	1		✓	✓	✓
DBC (Corridor to Preferred Route	Long List of sub-routes	55		Note [55]	✓	✓
	Short list of sub-routes	12		Note [55]	✓	✓
	Enhanced[56] short list	24		Note [55]	✓	✓
	Preferred Route	1	Full route assessment against the Environmental effects to be undertaken in the Pre-imp phase			

Table 6-2: Summary of MCA approach

The outcomes of the MCA process and the identification of the preferred corridor and route is explained in more detail in Sections 7, 8 and 9.

[55] As the E2 corridor was significantly aligned to achieving the investment objectives (Stage 1), any route developed within that corridor and consistent with the expressway standard design would also significantly align to those objectives and was therefore was assumed to achieve the investment objectives equally.

[56] Includes additional options with location based local roads and connections for each sub-route

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7 AREA ANALYSIS

Although the PBC discussed short term, medium and long-term problems and solutions, it did not define how the long-term problems should be addressed. Given this, the start of the project involved redefining the problems and benefits, analysis of data to validate those problems and confirm that there was a case for investing in this corridor in the long term. The details are provided within the strategic activity case.

7.1 Geographical extent and area characteristics

The study area starts at the southern end of the Cambridge section of the Waikato Expressway on SH1, approximately 15km south of Hamilton through to an area in the vicinity of the SH1 and SH29 intersection.

In terms of the natural environment, this section is dominated by two features – the Waikato River / Lake Karapiro which is immediately to the south of SH1 for most of the length of this section, and the steep Karapiro hills to the north of SH1.

Photo 7-1: Image showing the steep terrain north of the existing SH1 and Lake Karapiro

The land use adjacent to this section is predominantly agricultural and horticultural and sports/recreational based. There are also several small commercial businesses located along the route. Due to the proximity of Lake Karapiro and the Waikato River, there are several rest areas along the corridor which provide access to boat ramps and the lake. In addition to providing a reservoir for the Karapiro Hydro Dam, Lake Karapiro serves as an international rowing venue and home to the National Rowing Academy.

Two kilometres west of the route is Cambridge, the largest centre for residential and commercial growth in the vicinity of the corridor. The Karapiro Village is located mid length along the project study area and accesses SH1 via Hydro Road. Karapiro School is also located adjacent to the State Highway with access via Karapiro Road. A Mobil petrol station is located immediately adjacent to the Karapiro Road intersection.

7.2 Constraints and Issues

In addition to the problems identified in Section 4, other considerations (issues) and constraints have been identified through the workshops with stakeholders, analysis of historical information, and technical specialist knowledge.

It is important to understand how the project development is influenced by these considerations, issues, and constraints, how significant these influences are, and how they are inter-related. Importantly, these issues and considerations are used so that options could be formed to avoid the areas of greatest concern or

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otherwise take particular regard of the issues at hand if options were impacted by the constraint. The key constraints considered included:

- Social
- Urban Design and Landscape
- Contaminated Land
- Archaeology and Heritage
- Geotechnical
- Ecology
- Human Health - Noise, Air and Vibration
- Cultural
- Infrastructure
- Hydrology
- Property.

All these constraints were mapped (area wide) with a simplified (major, moderate and minor) rating system to help guide the option development. A summary of the major and moderate constraints maps is shown in Figure 7-1. All area constraints maps are provided within the C2P Constraints and Issues Report 2016.

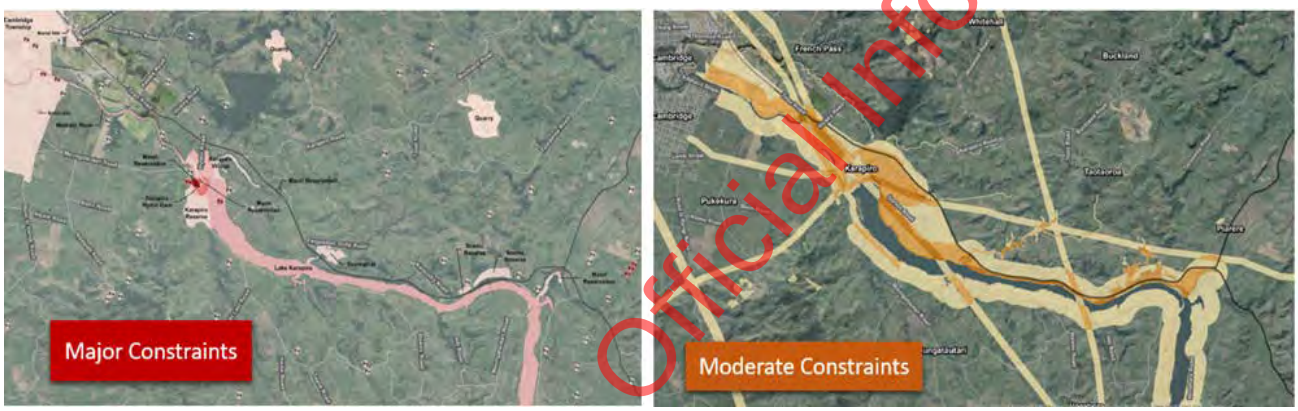

Figure 7-1: Major and Moderate Area Constraint Maps

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8 CORRIDOR OPTION DEVELOPMENT

8.1 Long List (of Alternatives) to Short list of Corridor Options

The corridor option development included a robust evaluation process and involved ongoing engagement with key stakeholders as part of the decision-making process. This process is specifically detailed in section 6 of the IBC options report (Appendix P). The 21 options were reassessed again against the Stage 1 and Stage 2 of the MCA (Section 6.3), and specific reasons for why options were progressed or not and the outcomes are provided in Table 8-1.

Generally, options were discarded at this point because:

- They had none/or low alignment to most of the investment objectives and therefore the Draft GPS priorities) e.g. demand and land use changes, and minor improvements to the highway
- They needed major policy shifts that were outside the scope of the project e.g. wholesale speed management (point to point), replacement of the vehicle flee and moratorium on future land use changes
- They had significant cost and risk e.g. online improvement with no capacity improvements, split direction and route expressways
- They were not a viable primary option, sub-opt on, o an opportunity.

The 'kept' options were all supply type options. However, it was noted that all options provided an opportunity to consider a range of customers in delivering the project. A summary of the key benefits as to why the short list options were chosen is provided after Table 8-2.

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Option	Description	Discussions	Keep	Discard
Do Nothing	This option makes no change from that proposed by the short-term project.	• No alignment to investment objectives, residual efficiency, safety and access risks, and reputational risks for Waka Kotahi.		●
1	Change land use to eliminate future growth options	• Low alignment to travel time and safety benefits and • Fatal flaw as this option creates a significant conflict with the Waipa Growth Strategy. • High risks for consenting and financial fundability		●
2	Change land use to eliminate future growth options, improve local roads to attract more local journeys; and upgrade the Horahora Rd bridge to provide an alternative detour route.	• Low alignment to travel time and safety benefits; • Fatal flaw as this option creates a significant conflict with the Waipa Growth Strategy. • High risks for consenting and financial fundability		●
3	Speed management-Introduce point to point speed enforcement.	• Negative effects on travel time • Low alignment to safety benefits as the existing speeds are already quite low, which affects the effectiveness of the option; • High risks for technical and consenting and acceptability to engagement partners as it provides travel times less than existing, and therefore less than desirable levels of service for this national route		●
4	Autonomous Vehicles: Create environment in which autonomous vehicles can operate and replace existing fleet.	• Excellent alignment to objectives; however • fatal flaw for financial fundability • High risks in terms of technical, consenting and acceptability to engagement partners • The scope of this policy shift is at a national level, not a project level and change may be beyond project horizon.		●
5	Advanced network management-Install ITS/VMS/Smart Roads to enable better efficiency, detours, and network efficiencies by getting the right vehicles on the right road.	• Poor alignment to investment objectives; except to resilience and access • Could be retained as an opportunity to complement other options in the next phase.		●
6	Targeted safety: Install partial length central and side barriers to target run-off road and head on crashes.	• Good alignment to safety, access and resilience objectives; This option is similar to the short-term safety measures (Stage 1 and Stage2) undertaken by SNP now planned for implementation on the existing corridor as part of the baseline (as at 2020 review) • Safety in design risks associated with on-corridor maintenance; • Likely to be low acceptability to engagement partners as it is not seen to address the majority of the issues • Given the work on the existing corridor, Option 9 could achieve better outcomes at similar costs		●

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Option	Description	Discussions	Keep	Discard
7	Targeted Safety-Rationalise and reduce existing access ways, and boat ramp access to left in/left out and provide larger intersection forms and service lanes.	• Low alignment to travel time and safety benefits • Very low investment return in comparison to other options (i.e. less than 50% of benefits being achieved) • Does not address corridor wide issues for future traffic growth with no extra lanes provided nor does it provide the Customer Level of Service (CLOS) desired for a national high-volume highway • Some of this option is already covered in Option 9, which provides better outcomes		●
8	Targeted Safety-Upgrade Hydro Road, Karapiro Road and SH29 to grade separated interchanges.	• Low alignment to travel time and safety benefits • Very low investment return in comparison to other options (i.e. less than 50% of benefits being achieved) • Does not address corridor wide safety issues or accommodate future traffic growth with no extra lanes provided nor does it provide the CLOS desired for a national high-volume highway		●
9	Targeted Safety: Rationalise and reduce existing access ways, boat ramp access to left in/left out, provide larger intersection forms/service lanes, install partial length side & central barriers.	• Good alignment to safety, access, and resilience investment objectives • Low alignment to travel time objectives • Provides a mid-range option into the next phase of assessment • Medium Constructability and Safety in Design risk • This option would be similar to the initial concepts proposed as part of the SNP Stage 3 works. That is to extend the existing central barrier to the full corridor and providing intersection improvements	●	
10	Online Improvements: Install a full three barrier system, turn around facilities and restrict driveways to left in and left out only.	• Good alignment to safety, access and resilience investment objectives • No alignment to travel time benefits • Safety in design risks due to the need for online maintenance. • Option 9 achieves better outcomes at a similar cost		●
11	Online Improvements-Upgrade to 2+1 lane layout and install full three barrier system and turn around facilities and restrict driveways to left in and left out only.	• Very good alignment to safety, access and resilience objectives • Moderate alignment to travel time objectives. • Medium constructability and safety in design risk	●	
12	Online Improvements-Upgrade to 2+1 lane layout, install parallel local road, and install full three barrier system and turn around facilities and restrict driveways to left in and left out only.	• Proceed due to good alignment to safety, access and resilience objectives • Moderate alignment to travel time objectives • Better safety and travel time outcomes than Option 11 but more technical, constructability and consenting risks	●	

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Option	Description	Discussions	Keep	Discard
13	Online Improvements-Widen to four lanes, install full length central barrier, partial length side barriers, restrict driveways to left in and left out only, provide roundabouts at Hydro Road, Karapiro Road, and SH29.	• Very good alignment to safety, access, and resilience investment objectives • No alignment to travel time objectives • Medium technical, constructability and consenting risk • Unlikely to be acceptable to engagement partners as does not provide the travel time benefits nor the CLOS desired for a national high-volume highway		●
14	Online Improvements-Widen to four lanes with layout consistent with the Waikato Expressway.	• Excellent alignment to all investment objectives • Medium technical, constructability and consenting risk	●	
15	Hybrid Alignment-Construct offline 4 lane, 4 star road north of Karapiro and upgrade existing alignment to 4 lane, 4 star layout south of Karapiro.	• Excellent alignment to all investment objectives • Medium technical, constructability, consenting and safety in design risk • higher maintenance requirement and limited additional benefit compared to option 14		●
16	Hybrid Alignment-Construct offline 4 lane, 4 star road north of Kentucky Road and upgrade existing alignment to 4 lane, 4 star layout south of Kentucky Road.	• Excellent alignment to all investment objectives • Medium technical, constructability, consenting and safety in design risk. • Higher maintenance requirements and limited additional benefit compared to option 14		●
17	Offline Alignment-Construct new 4 star route from end of Cambridge Section to a point within 5 km of SH1/29 intersection.	• Excellent alignment to all investment objectives • Medium technical, consenting and safety in design risk. • Medium risk for acceptability to engagement partners if this option follows the E1 route as it likely increases the journey distance for SH1 customers	●	
18	Offline Alignment-Construct new 4 star route from end of Cambridge Section to a point on SH27.	• Excellent alignment to all investment objectives • High risk for constructability, consenting, financial fundability and acceptability engagement partners. Medium risk for Technical and safety in design		●
19	Offline Alignment-Construct new 4 star route from end of Cambridge Section on the western side of the river.	• Excellent alignment to all investment objectives • Highest risk for all of the options across the stage 2 assessment • High risk for consenting, financial fundability and acceptability to engagement partners, particularly Iwi due to the effects on Te Awa • Medium risks for technical and safety in design		●

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Option	Description	Discussions	Keep	Discard
20	Offline Alignment-Construct new 4 star route from end of Cambridge Section to take SH29 traffic and upgrade existing alignment the 4 star standard.	• Excellent alignment to all investment objectives • High risk for unacceptability to engagement partners due to costs of having to upgrade two separate routes to 4 star standard and undertake consenting issues on both. • Medium technical, consenting, safety in design and financial fundability risk		●
21	Offline Alignment-Construct new route to east of existing alignment for southbound traffic and use existing alignment only for westbound traffic with both routes at 4 star level.	• Excellent alignment to all of the investment objectives except for 50% alignment to reduction in travel time (only half traffic gets benefit) • High risk for unacceptability to engagement partners due to costs of having to upgrade two separate routes to 4 star standard, two sets of consents and increases journey time for one direction of travel • Medium technical, consenting, safety in design and financial fundability risk • Higher risk and lower alignment to objectives than option 20		●

Table 8-1: IBC Long List Area Options decisions

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A total of five corridor options were shortlisted, with option 17 (the Offline Alignment-Construct new 4-star route from end of Cambridge Section to a point within 5 km of SH1/29 intersection) broken into two sub-options. For simplicity and engagement purposes, those options were renamed to Options A to E2 (Figure 8-1 and Table 8-2). The options included three online partial upgrade options (A, B and C) and three expressway standard options (D, E1 and E2). The expressway standard options included sections of both on and offline alignments, with D following the existing state highway alignment. A more detailed evaluation of the short-list of options is provided in the IBC Options report.

Figure 8-1: Short List Corridor Option Locations

Option Number	Revised Option name[57]	Description
Option 9	A	ONLINE: Builds on the short-term improvements. Wide (1.5m) centerline with some additional central and roadside barrier and minor intersection improvements where there is risk. This is also similar to Stage 3 of the SNP works or Option B without the passing lanes (Refer section 1.2.3).
Option 11	B	ONLINE: Provides alternating passing lanes and central and roadside barrier through the entire route. More access rationalisation than Option A. Provision of turn around facilities at at-grade intersections.
Option 12	C	ONLINE: Provides alternating passing lanes and central and roadside barrier through the entire route with parallel local roads and turn around facilities. No direct access for properties onto SH1 except at discrete positions. Provision of turn around facilities at at-grade intersections.
Option 14	D	ONLINE Four lane expressway standard corridor with parallel local roads with no direct access on to SH1. Includes interchange style intersections at 2-3 locations.
Option 17a	E1	OFFLINE NEW corridor: Four lane expressway standard corridor with parallel local roads with no direct access on to SH1. Includes interchange style intersections at 2-3 locations. SH1/SH29 intersection connected approximately 3 km north of the current intersection.
Option 17b	E2	OFFLINE NEW corridor: Four lane expressway standard corridor with parallel local roads with no direct access on to SH1. Includes interchange style intersections at 2-3 locations. SH1/SH29 intersection connected close to current intersection.

Table 8-2: Short-List of Corridor Options

In summary, the takeholder group determined that it was unacceptable to:

- 'Do nothing' or have options that barely contributed to the benefits sought for this project
- Consider options that involved significant risks or effects that would be difficult to be mitigated
- Have extremely costly options compared to other options that could provide similar benefits at lower costs.

[57] Numbering has been updated to improve clarity in the description of the shortlisting process.

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The six corridor options were chosen by the stakeholders because:

- They had good to excellent alignment to achieving some or all of benefits; that is, they all provided some alignment to, or achieved:
  - A 70% reduction in DSIs,
  - The desired risk profiles for the function of the route, however noting that some of the lower scale options of A, B and C still left residual safety risk
  - Improvement to accessibility including reduction in the number of access and safety improvements to intersections forms, noting residual risk with Options A, B and C due to them not being consistent with the desired function of the route
  - Travel time benefits, except for Option A
- They provided a good range from options with lower cost and medium alignment to the benefits (utilising the existing route in combination with planned short term safety improvements) through to options providing a completely new route with excellent alignment to the benefits.
- Walking and cycling infrastructure could be included with any of the options which would link up to national cycling strategies.

The six corridor options were endorsed by the key stakeholders and approved by Waka Kotahi[58] (for further assessment.

8.2 Corridor Short List Evaluation

8.2.1 Short List of Corridor Options

In determining the preferred corridor option, the short list of six corridor options were assessed against each of the 3 stages of the MCA (Section 6.3). The results of that evaluation are provided in Table 8-3with the outcomes provided in Table 8-5.

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[58] refer to the VAC National Land Transport Plan Action Group meeting decision 9 March 2017

			OPTION					
			A	B	C	D	E1	E2
Alignment with Investment Benefits and Performance Measures	Reduce the number of DSIs *[70% reduction in DSI's on opening]*							
	Reduce Collective Risk to no more than a medium & maintain a low pers risk on opening for next 20 years							
	Improve local access to community features by all transport modes							
	Reduce travel time by achieving an avg100km/h travel speed on SH1 on opening for next 20 years							
	Maintain freight travel time reliability to no more than +/-2.5mins between Cambridge Section of WEx to 1/29 on opening for next 20 years							
	Improve resilience by reduction in risk or consequence of road disruptions							
	Overall weighted							
Implementability/ Complexity/ Risk of Options	Technical							
	Constructability							
	Consentability/Policy							
	Operation/ Maintenance							
	Safety in Design							
	Financial/Fundability							
	Acceptability to engagement partners							
	Transport System Integration							
	Land Use Integration							
MCA Element	Social - three sub-criteria	Way of life						
		Well being						
		Community						
	Ecological							
	Visual and Landscape							
	Urban Design							
	Cultural							
	Heritage/Archaeology							
	Human Health[59]							
	Property							
Cost $M	Net property cost ($M)		$0.8M	$4.5M	$10M	$24M	$33M	$23M
	PV cost to NZ ($M) [60]		25-40	80-130	90-150	440-710	370-580	390-620
IAF profile	Results Alignment[61]		Very H	Very H	Very H	Very H	Very H	Very H
	Efficiency (BCR range)		<1	1 to 3	<1	<1	<1	<1

Table 8-3: Full short list Corridor Option MCA Comparison

Alignment to Objectives

None (0%) *Low (0-50%)* *Good (50%-70%)* *Very Good (70%-90%)* *Excellent (90% +)*

[59] noise/ vibration/ air quality/ contaminated land

[60] Cost range is undiscounted and includes property, construction, and associated fees as well as a range for uncertainty in scope and costings. Note – these costs have not had a 2020 escalation provided on them, however they have large ranges and they would all scale up accordingly. However, the preferred option in section 11 has an updated 2020 estimate.

[61] All these options achieve a DSI reduction of at least 40% and therefore have a very high results alignment

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Risk and Effects

Major Negative *Medium Negative* *Minor Negative* *Neutral* *Minor Positive* *Medium Positive* *Major Positive*

The base MCA scoring was applied as described in Section 6.3, with equal weighting applied to each of the three criteria stages. This identified the base ranking of options from the MCA as shown in Table 8-4 with E2 being the number one ranked option.

CORRIDOR OPTION					
A	B	C	D	E1	E2
6	5	4	3	2	1

Table 8-4: Base Ranking from MCA comparison

A range of sensitivity tests were applied to the MCA to determine any difference in ranking if various weightings were applied to the assessment. In summary, the MCA outcome did not change with E2 still identified as the top ranked option.

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Criteria	Measures	Base (Do Nothing)	Option A	Option B	Option C	Option D	Option E1	Option E2
Outcomes								
Safety (Approx) (at opening)	DSIs[62]	27	17.6	11.3	10.5	7.6	7.6	7.6
	Collective Risk	H	H	MH	MH	M	M	M
	Personal Risk	LM	L	L	L	L	L	L
	Star Rating (estimate)	3.25-3.30	3.3-3.4	3.4-3.5	3.4-3.6	4.6-4.8	4.6-4.8	4.6-4.8
Access	No. of Property Accesses	-	-5-10%	-5-10%	-20%	-100%	-100%	-100%
S/B Travel time and speed – average Fri 3hr peak period (2060)	Travel Time (mins)	11.9	11.9	11.9	11.1	10.0	11.4 (SH 1 Sth) 8.2 (SH 29)	9.7 (SH1 Sth) 9.1 (SH 29)
	Speed (km/h)	84	84	84	90	100	100	100
Network resilience	Number of Closures	Annual Closures	- 25%	-55%	-80%	- 90%	- 90%	- 90%
	Alternative routes	Alternatives up to 50 km detour, not for HPMVs	No improvement to alternatives	No improvement to alternatives	Potential to use new parallel routes as alternatives	Potential to use new parallel routes as alternatives	Potential to use new parallel routes as alternatives	Potential to use new parallel routes as alternatives
Corridor Characteristics								
Total journey	SH1 – South	16.6 km	16.6 km	16.6 km	16.6 km	16.6 km	19 km (2.4 km longer)	16.2 km (0.4 km shorter)
	SH 29						13.6km (3 km shorter)	15.2 km (1.4 km shorter)
Barriers	Barrier	At high risk roadside locations (short term works)	Central and side barrier based on risk.	Central and side (full corridor)	Central and side (full corridor)	Central and side (full corridor)	Central and side (full corridor)	Central and side (full corridor)
No of lanes (SH only)	Number and Passing	2, with 2 passing lanes each direction	2, with 2 passing lanes each direction	2+1; passing lane alternates - corridor	2+1; passing lane alternates - corridor	4 lanes	4 lanes	4 lanes
Intersections	Number of Intersections and Type	10 [63] - at grade	10[63] at grade	10[63]- at grade	10[63]at grade	3 – Grade Separated	3 – Grade Separated	3 – Grade Separated
Road geometry	Alignment	Straight-curved alignment	No change	No change	No major changes but could be some minor re-alignment	Major modification to online alignment	Major partial online modification and new offline alignment	Major partial online modification and new offline alignment
Active road users	Cyclists	Limited sealed shoulder	Some shoulder improvements	Some shoulder improvements	Some shoulder improvements & local road alternative	Full shoulder provided online and local road alternative	Full shoulder provided online and local road alternative	Full shoulder provided online and local road alternative
Major structures	Bridges	-	None	None	None	>5	>5	3 - 5
Earthworks	Approx. scale (m3)	-	Minor	< 200,000	< 200,000	<2,000,000	< 3,000,000	>3,000,000
Cost	Million ($)[64]	-	27.5-44	88-148.5	99-176	484-858	363-671	396-726
Construction timeframe	Years	-	2	2.5	3	4-5	3.5-4.5	3.5-4.5

Table 8-5: Corridor Options Outcomes Table

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[62] Updated 2020 (using 2015-2019 CAS data)
[63] Hickey, Hydro, Karapiro, Gorton, Tunakawa, Fergusson Gully, Kentucky, Moana Roa, Maungatautari, SH29
[64] Note these costs were completed in2017 and have updated as per the 2020 review with a 10% escalation fee. Noting also that traffic management costs are now substantially more than they were in 2017 and would likely add another $10M except for Corridor D where this could increase to $20M given the fully online corridor.

8.2.2 Stakeholder inputs into the corridor selection process

A workshop was held on 11 April 2017 with key stakeholders to determine a preferred option or options for the C2P transport corridor to progress in future phases of the project. Discussion about the preferred option initially focussed on generating agreement on the options that should not be pursued further and why. Participants agreed that options A and B should not be progressed because they were not expected to deliver on the investment objectives, and some work was already going to be completed as part of the short-term project. Although Option C was seen to perform better against the investment objectives, participants agreed that it should not be considered further. In summary, Options A, B and C were discounted by workshop participants because:

- They do not effectively deliver on the agreed investment objectives
- They are all considered to be short-term (Options A and B) or medium term (Option C) interventions
- Waka Kotahi is already delivering on short term improvements
- Options A, B and C risk locking future transport investment into the existing SH1 corridor (i.e. leading us down a path towards Option D)
- The next steps (beyond the short-term interventions) should be a long-term improvement or solution which these options do not provide.

As part of the 2020 update it was identified as likely that the long-term form will not be implemented for some time. Therefore, a medium-term strategy to address safety and access should be considered. This is discussed further in the triggers and staging section 15.

The latter focus at the workshop was on comparing corridor options D, E1 and E2. Participants considered there was little difference between the potential for these options to deliver on the investment objectives. Participants agreed that the main factors that would differentiate the options were:

- Cost and risk - Option D is riskier and more expensive than either option E1 or E2 due to the constrained physical environment, the requirement to keep the highway open throughout construction, and as it is expected to take longer to build
- Network fit - Option E1 has a negative transport integration effect and does not fit with the existing network as well as E2. This is due to the additional trip length for SH1 traffic to or from the south.

Participants agreed that other than network fit, there was little or no difference between options E1 and E2. They agreed that both E1 and E2 were better than option D. On this basis, and because of option E1's poor network fit, participants agreed that option E2 should be considered the preferred corridor option.

8.2.3 Preferred Corridor

In summary, Option E2 was selected (Figure 8-2) as it strikes the best balance between delivering the outcomes sought for the C2P corridor in a way that has an acceptable level of risk and complexity, whilst ensuring a solution can be developed that minimises potential adverse environmental effects. An outcomes table is provided in Table 8-5A obust decision-making process was undertaken which included engagement and agreement with stakeholders for key decisions on ideas and alternatives, long list of options, short list of options and a preferred corridor (section 8.2.2). A detailed process and outcomes on how the preferred corridor was selected is provided within sections 6, 7 and 8 of the IBC Options report (Appendix P).

Figure 8-2: Preferred Option - Corridor E2

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Corridor Option E2 will deliver the following outcomes:

- Approximately a 2.2-minute travel time saving for SH1 users, by shortening the route and improving average travel speed compared to the existing route thereby contributing to making the SH1 and SH29 corridor the preferred route for travel between Auckland, Waikato and Bay of Plenty.
- Ensuring the journey time for all customers is the same; whatever time of day or time of year they travel along the route.
- 90 percent reduction in unplanned road disruptions, and always having a suitable alternative route available for State highway users.
- Improved access to local community features and maximising the opportunity for future growth in the community and increased local tourism.
- 19.4 fewer deaths and serious injuries (5 years).
- $396M to $726M cost[65] with construction expected over a 3.5 – 4.5-year period.

Corridor E2 was originally endorsed by Waka Kotahi on 25 August 2017. Although this earlier decision was endorsed by Waka Kotahi, the revised DBC work completed in 2021

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[65] Cost range is undiscounted and includes property, construction, and associated fees as well as a range for uncertainty in scope and costings and construction timeframe. This is the 2017 cost with 10% escalation to provide comparison across other corridor options. A revised estimate for the route within corridor E2 is provided later in the document.

9 ROUTE OPTION DEVELOPMENT

Corridor E2 was the recommended and Board endorsed corridor option from the IBC phase. The next phase of the process included the development of a narrower route within the preferred E2 Corridor. This included developing and evaluating a long list of route options to get to a short list of route options for further assessment. Ultimately, this process resulted in a recommended route with interchange form and locations along with local road connections. This section provides details of this process. For more detail on route option development process and technical information, refer to the C2P DBC options report.

9.1 Summary of the process

A summary of the process is described further in this section and in Figure 9-1.

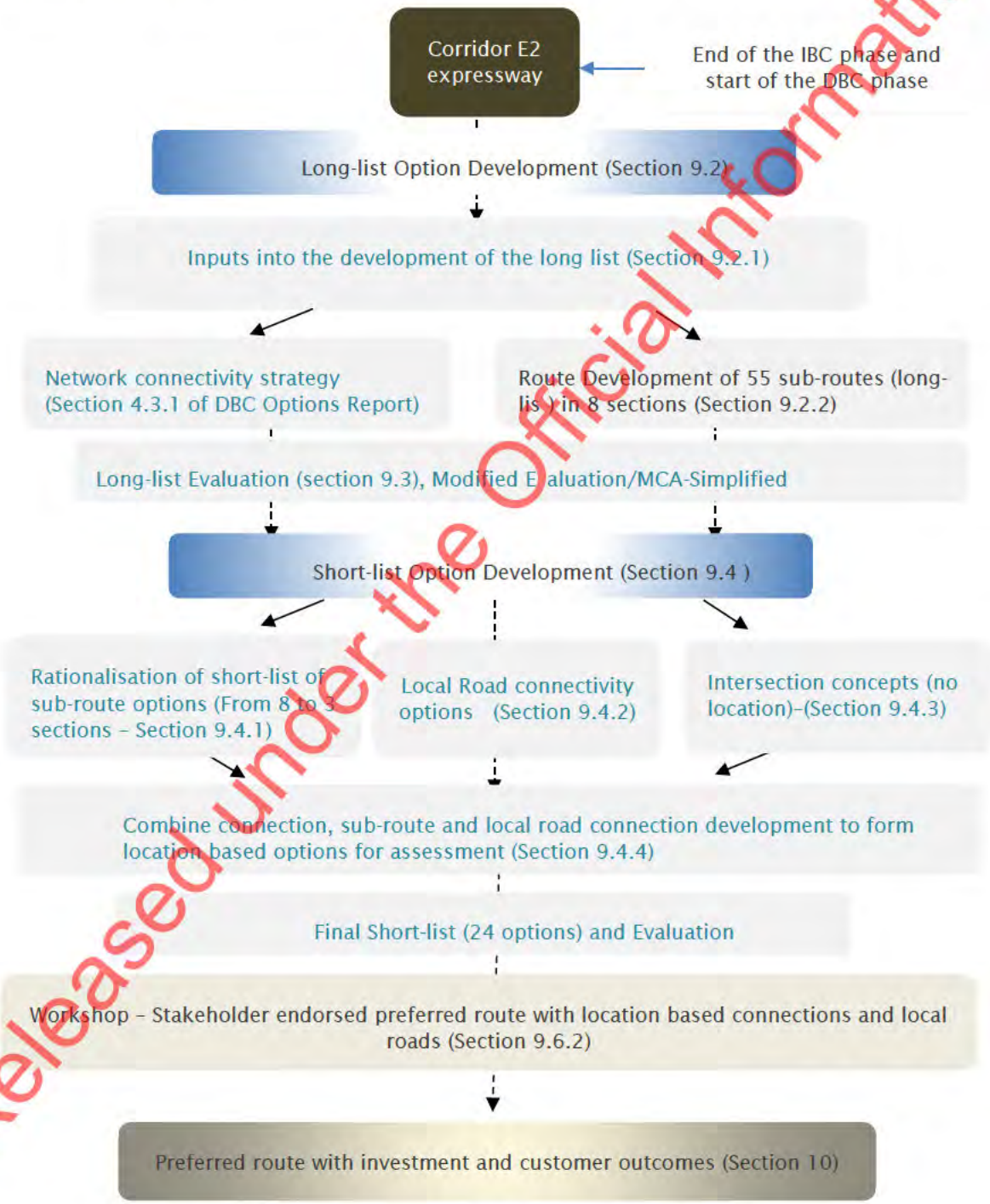

Figure 9-1: Route and Connection Option Development process

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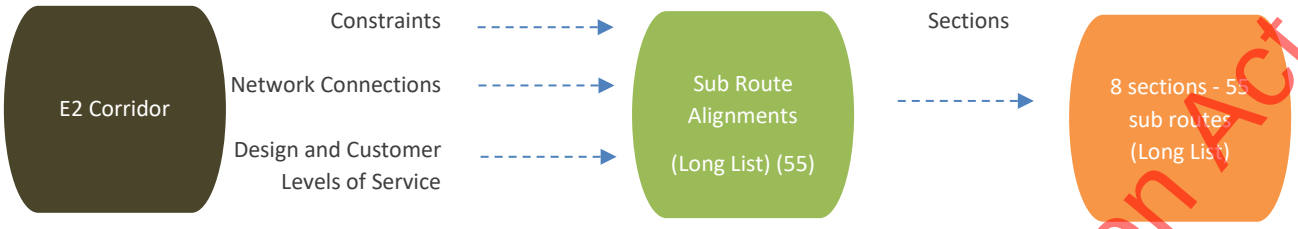
9.2 Development of the Long List of Route Options

9.2.1 Inputs into the Long List Development



The long list of sub-route alignments within Corridor E2 were developed with consideration given to the:

1) Refined constraints (i.e. sub-routes sought to avoid major and moderate constraints where possible) - examples shown in Figure 7-1 of the C2P DBC Options Report (Appendix P)
2) Design standards to meet ONRC customer levels of service (safety, access, travel, speed, amenity, safety in design and resilience) - refer of the DBC Design Philosophy Statement and the DBC Options Report) - section 4.1.2 of the C2P DBC Options Report (Appendix P))
3) Arrangements that achieve the network connectivity strategy (a need for two connections; one in the central area and one at SH29) - section 4.1.3 of the C2P DBC Options Report (Appendix P).

Further details on the processes involved are provided in the C2P DBC Options Report (Appendix P).

Once the E2 corridor was confirmed, the investigation focussed on determining a route within E2 with emphasis on the risks and effects of the form and location. Therefore, as the preferred E2 corridor was aligned to the revised 2020 investment objectives, the route within this corridor would also be largely reflective of the corridor findings in terms of achieving the benefits. In addition, as no further technical investigations were undertaken and no other significant change has occurred in the study area, the optioneering and evaluation process, and results of the investigation to determine the preferred route, remain the same as the original investigation in 2018.

9.2.2 Route Development

The Route option development was undertaken after the network connectivity report and constraint mapping processes were completed. Different stages were involved in completing the option development which are described in the following sections:

- Development of an initial long-list of sub (partial corridor) routes, divided into eight sections
- Simplified MCA evaluation to filter the long-list of options to a short-list of sub routes within the eight sections, and connection with various forms of interchanges (section 6.3).

Using workshops, the project team and specialists canvassed ideas on routes in various locations along the corridor, using their specialist knowledge and the constraints mapping completed on corridor E2 to-date. The route options were then developed to apply desirable design standards whilst avoiding major and moderate constraints wherever possible, minimising the potential adverse effects and risks. The route options developed during this stage formed the long-list of route options. In summary, the sub-route and connection option development and evaluation was largely guided by two main factors including:

- Various types and levels of constraints within the E2 corridor (Appendix P section 6.2 of the C2P DBC Options Report)
- Consideration of customer levels of service and achieving recognised design philosophy, whilst taking regard of the presented constraints (Appendix P Section 4.1.2 of the C2P DBC Options Report).

The sub-route development process resulted in the development of many sub-route options. However, many of these options overlapped through 'chokepoints' between major constraints.

To allow practical comparison between route options, the corridor was divided in to eight sections (Section 1 to Section 8), and 55 sub-route options (across all sections) were assessed independently.

The sub-route options are tabulated in Table 9-1 and illustrated in Figure 9-2. Greater detail between the sub-route options is also provided further in this section with the long-list to short-list evaluation outcomes.

As discussed in Section 4.1.3 of the C2P DBC Options Report (Appendix P), these sub-routes only provided conceptual forms of connection at this stage of the assessment. Specific location based connections were formed in the refinement to the short-list options.

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SECTION	DESCRIPTION	NUMBER OF SUB-ROUTE OPTIONS
1	From the end of the Cambridge Section to Hickey Road	7
2	Hickey Road to Hydro Road	7
3	Hydro Road to Karapiro Road	6
4	Karapiro Road to Gorton Road	9
5	Gorton Road to Fergusson Gully Road	5
6	Fergusson Road to Kentucky Road	9
7	Kentucky Road to Maungatautari Road	7
8	Maungatautari Road to SH1/SH29 tie-in	5
	TOTAL number of sub-routes	55

Table 9-1: Option Development Summary

Figure 9-2 illustrates how the route was split in to eight sections (1 to 8) and a total of 55 sub-routes to allow practical comparison of numerous options.

Figure 9-2: 55 sub routes within 8 sections (Long List)

The evaluation of the long-list of sub-routes is provided in section 9.3.

9.3 Long-list Option Evaluation

This section of the report describes the process and results of the evaluation of the long-list of options for the DBC and the resultant short-list of options.

Table 9-2 shows the sub-route segments (Option 1A to Option 8E) within the eight corridor sections to allow meaningful comparisons between options that shared some portion of common alignment.

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Section	1	2	3	4	5	6	7	8
Sub-route Number	1A	2A	3A	4A	5A	6A	7A	8A
	1B	2B	3B	4B	5B	6B	7B	8B
	1C	2C	3C	4C	5C	6C	7C	8C
	1D	2D	3D	4D	5D	6D	7D	8D
	1E	2E	3E	4E	5E	6E	7E	8E
	1F	2F	3F	4F		6F	7F	
	1G	2G		4G		6G	7G	
				4H		6H		
				4I		6I		

Table 9-2: Long-list of Sub route Options for evaluation

Route options in each section were individually assessed based on a simplified, two level multi-criteria analysis considering only risk and effects (Appendix P section 3.2.1.2 of the C2P DBC Options report). The investment objectives (section 5.2) were assessed as being identical across all the sub-route options with no discernible differences between them.

The purpose of the long-list evaluation was to provide an initial screening process to remove sub-route options for which adverse effects, risks, or technical compromises on the route would not be acceptable.

Some consideration was also given to the interconnectivity of sub-route segments. This included ensuring that short-listed sub-route segments could connect to short-listed sub-route segments in adjoining sections. Assessment using the three-point MCA was discussed in an internal workshop which sought to decide to discard or proceed each sub-route segment within a section. This resulted in a short-list of options for each of the eight sections. The evaluation of each of those eight sections is discussed below in this section.

Note that engagement is included as part of the MCA tables, but did not form one of the specific criteria. This is because it related to a range of criteria which were already assessed by individual specialists.

Once all the assessments were completed, an internal workshop was held with the specialists to discuss their evaluations. The results of their assessments and workshop resulted in either an acceptance of a sub-route for further investigation or that a sub-route should be discarded. The outcomes of those discussions are summarised in Appendix O and illustrated within maps in Figure 9-3 and provided in a the summary table (Table 9-3). These outcomes were also discussed and workshopped with stakeholders on 15 September 2017. At the workshop, the stakeholder group endorsed the short-list of sub-route options for further investigation.

The outcome of the MCA assessment (endorsed by workshop stakeholders) discarded several options because:

- They were the worst for overall risks and effects or worst just for effects
- Had some major risks that resulted in major effects
- Were unable to be connected to an adjoining section because of other options being discarded
- They didn't meet minimum design requirements.

This resulted in a stakeholder agreed short list of 12 sub-route options for further investigation. Illustrations of the endo sed short list options are shown in Figure 9-3. The summary of the outcome of the evaluation of the long-list of sub-routes is provided in section 9.3.1.

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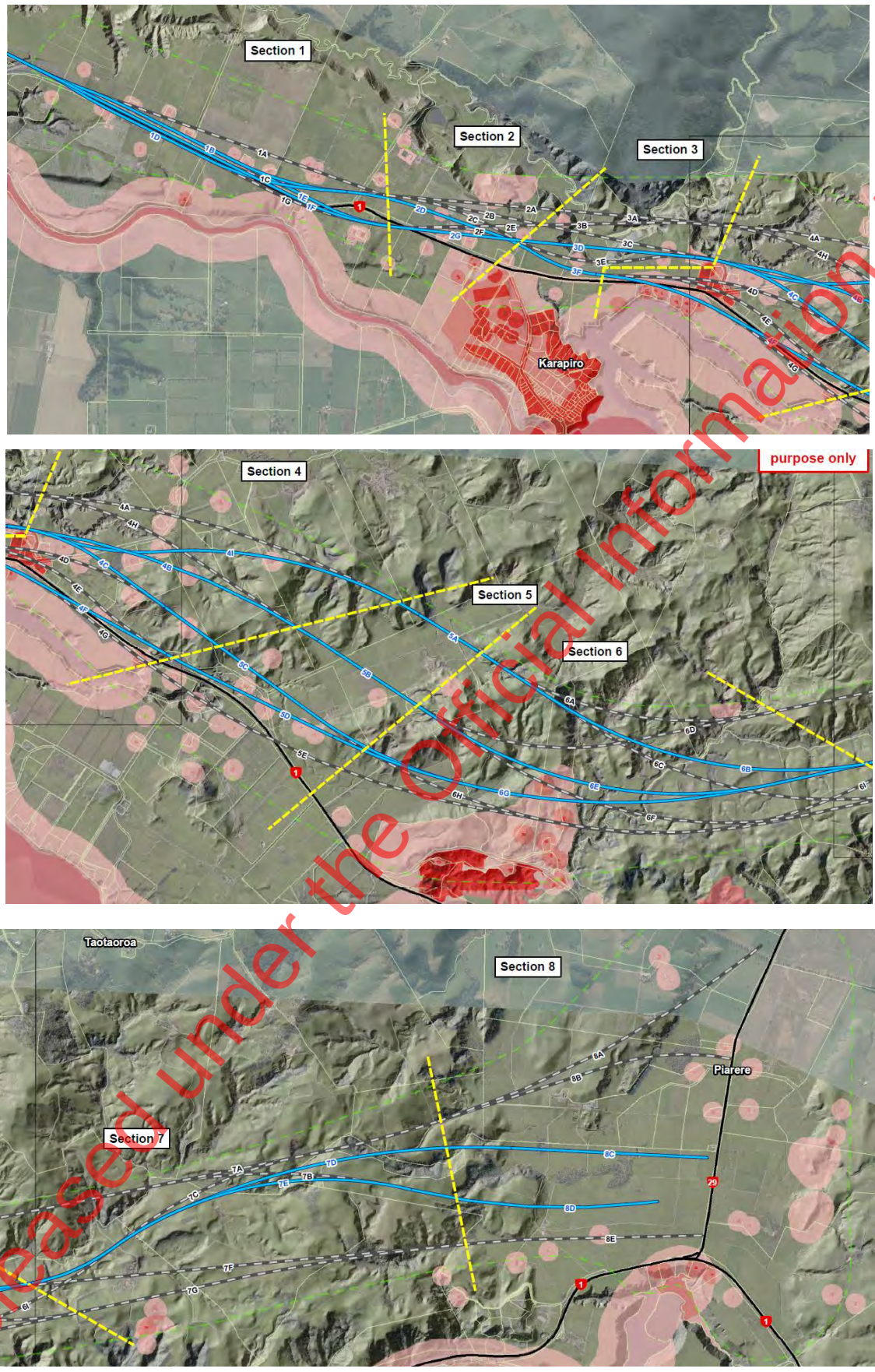

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Figure 9-3: Short List Sub Route Evaluation Results

9.3.1 Recommended Short-list of Options

A summary of why sub-route options were discarded or kept is provided below. Further details on the specific reasons and decision for each individual sub-route are provided in Appendix O.

Sub-route options were discarded because they:

- Were the worst for overall risks and effects
- Had some major risks that resulted in major effects
- Were unable to be connected to an adjoining section because of other options being discarded or didn't meet minimum design requirements.

Sub-route options were retained because they:

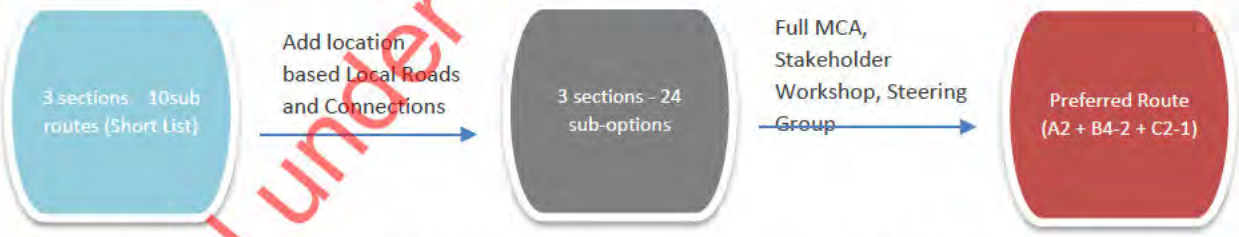
- Were acceptable from a risks and effects outcome, or acceptable based on effects
- Provided an alternative i.e. north or south of the highway, or other key feature to enable a balanced range of options for further consideration
- Were connected to other 'kept' options and needed to retain connectivity between adjoining sections.

A total of 23 sub-route segments were advanced to the short-list stage across the eight sections and are shown in Table 9-3.

Section	Short-list options
1	B, D, E, F
2	D, G
3	D, F
4	B, C, F, I
5	A, B, C, D
6	B, E, G
7	D, E
8	C, D

Table 9-3: Long-list Options to Advance to Short-List

9.4 Short-list Option Development



This section of the report describes the process and results of the evaluation of the short-list of sub-route options for the DBC and the resultant preferred sub-route (with connection) option for each section. When combined, the preferred sub-route option for each section forms the preferred route option for the DBC.

In summary, there were four main areas where the short-listed options were further refined before undertaking more detailed assessments. They were:

1) Rationalising eight sections of the long-list options to three sections
2) Local road connection development
3) Intersection concept development
4) Combining the expressway sub-route options with local roads and intersection connections.

9.4.1 Option Development - Rationalising sub-route sections

In determining the next phase for evaluation, consideration was given to combining all the sub-routes to form full length corridor options. However, this was deemed to be undesirable due to the number of possible scenarios making the evaluation impracticable i.e. combination of all possible sub-route connections provides

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up to 32 possible whole route options, and six possible interchange forms making almost 200 option scenarios.

Instead, the number of sections formed at the long-list phase were reduced from eight to three sections (A, B and C) in the short-list phase. This provided a total of ten sub-route options for evaluation at the short-list phase. Specific details of those options are provided below in this section. The reviewed description of options across three sections (as shown in Figure 9-4) was used for engagement with both the landowners and the community at the public open day (Appendix P Section 6 of the C2P DBC Options Report).

The comparison between the long-list of eight sections and the short-list of three sections is provided in Table 9-4.

Section	Long-list Sections	Sub routes
A	1B + 2C	A1
	1D + 2C	A2
	1F+ 2G	A3
	1E + 2G	A4
B	3D + 4A + 5A + 6B	B1
	3D + 4B + 5B + 6E	B2
	3D + 4C + 5C + 6G	B3
	3F + 4F + 5D + 6G	B4
C	7D + 8C	C1
	7E + 8D	C2

Table 9-4: Short-list of 8 long-list sections compared to short-list of 3 section numbering

Figure 9-4: Indicative Alignments of 3 sections and intersection footprint

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Section A

There are four possible expressway route options within Section A (Figure 9-5). These options include:

- A1: Expressway built to the north of the existing SH1, with a local access road built to the north of the new expressway to serve properties. Existing SH1 becomes a local road on south side of expressway.
- A2: Expressway built to the south of the existing SH1, with a local access road built to the south of the new expressway to serve properties. Existing SH1 becomes a local road on north side of expressway.
- A3: Expressway built over the existing SH1 with local roads to the south and north to serve properties.
- A4: Variation of option A1, which provides an alternative alignment at eastern end of the straight.

Figure 9-5: Section A - Short List sub-route options

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Section B

- Two expressway route options are available west of Karapiro Road (B1 and B4). These are heavily restricted by the Karapiro Gully to the north and the arm of Lake Karapiro (situated to the east of Karapiro Village). Both options avoid the Karapiro School buildings.
- East of Karapiro Road there are a total of four route options (B1, B2, B3 and B4). Each of the options through this section encounter similar topographical constraints, though the southernmost option (B4) is initially close to the route of the existing State Highway.
- Within Section B there is a requirement to provide access from Karapiro Village and Karapiro Road to the expressway. Full access will be provided onto and off the expressway from both directions at this location. The form of the interchange options is discussed in section 9.4.3.

Figure 9-6: Section B - Short List sub-route options

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Section C

- Section C has two route options to choose from (C1 and C2). The northern most option (C1) connects to SH29 in the vicinity of Piarere Hall with option C2 to the south of this.
- Within Section C there is a requirement to provide access from SH29 and SH1 to the expressway. Full access will be provided from these roads onto and off of the expressway from both directions.
- The form of the interchange options is discussed in section 9.4.3. Options include an at-grade roundabout or two variations of a grade separated interchange.

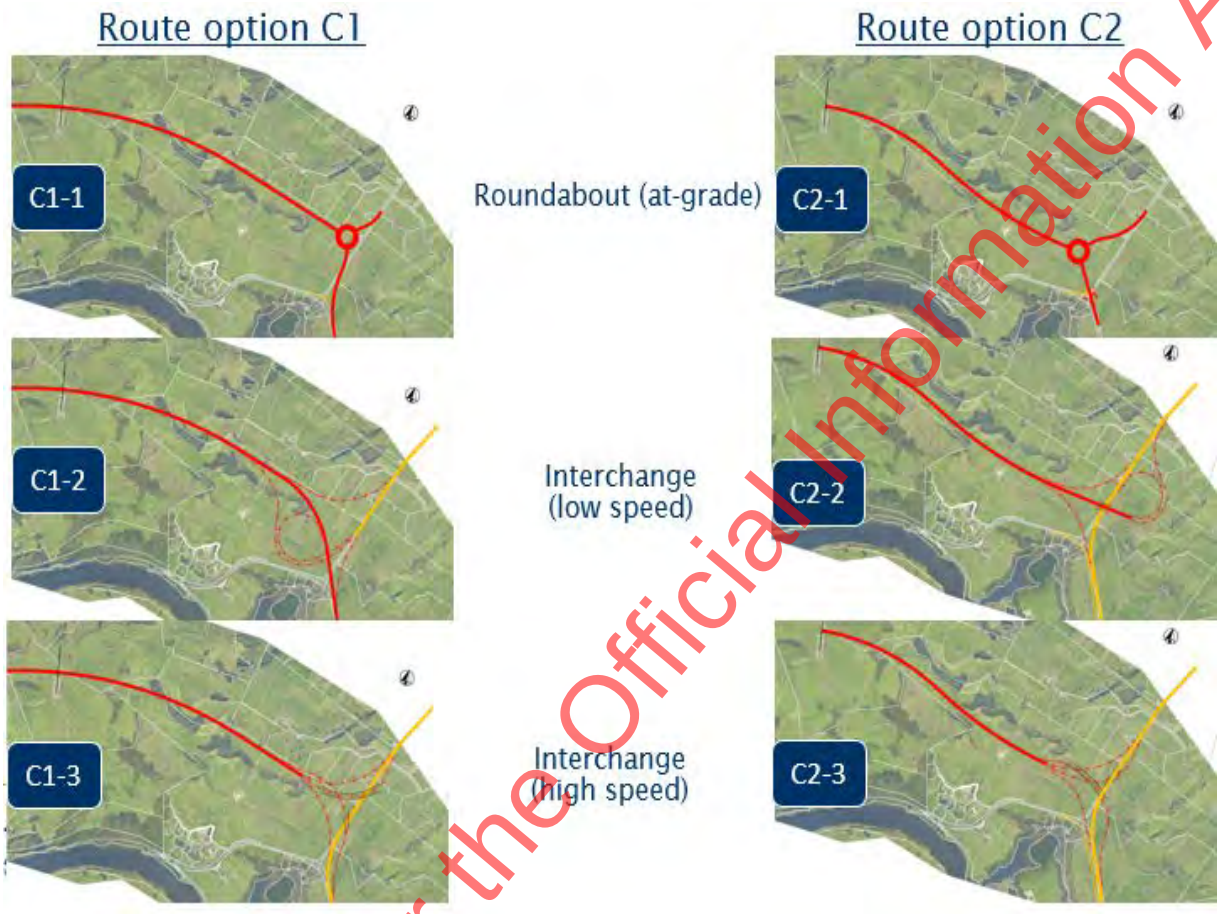

Figure 9-7: Section C- Short List of Options

9.4.2 Option Development - Local Road Connections

As discussed in Appendix P section 4.1 3 of the C2P DBC Options Report, the project team initially developed a network connectivity strategy which discussed various options to provide connectivity between the expressway and local roads. This strategy reconfirmed a need to connect the Karapiro Village community (Hydro Road) with Cambridge, and Karapiro Road (where the school and service station are located) to remain strongly connected to the community. It also reconfirmed the need for both communities to retain connection with the expressway. The Network Connectivity assessment determined that one central interchange was desirable.

A workshop was held to develop initial ideas around the Interchange options (based on short-listed sub routes) and detail how local roads could be connected. This involved the development of ideas around known constraints.

These ideas were workshopped with Waipa District Council (as the main local road controlling authority) to ensure their growth and transport strategies were integrated as part of these options.

9.4.3 Intersection Concept Development

Intersection concepts were developed as part of a workshopping exercise. The concepts were then applied to each of the sub-route options and local road connectivity solutions to provide the location based outcomes for the intersection arrangements.

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Central Connection

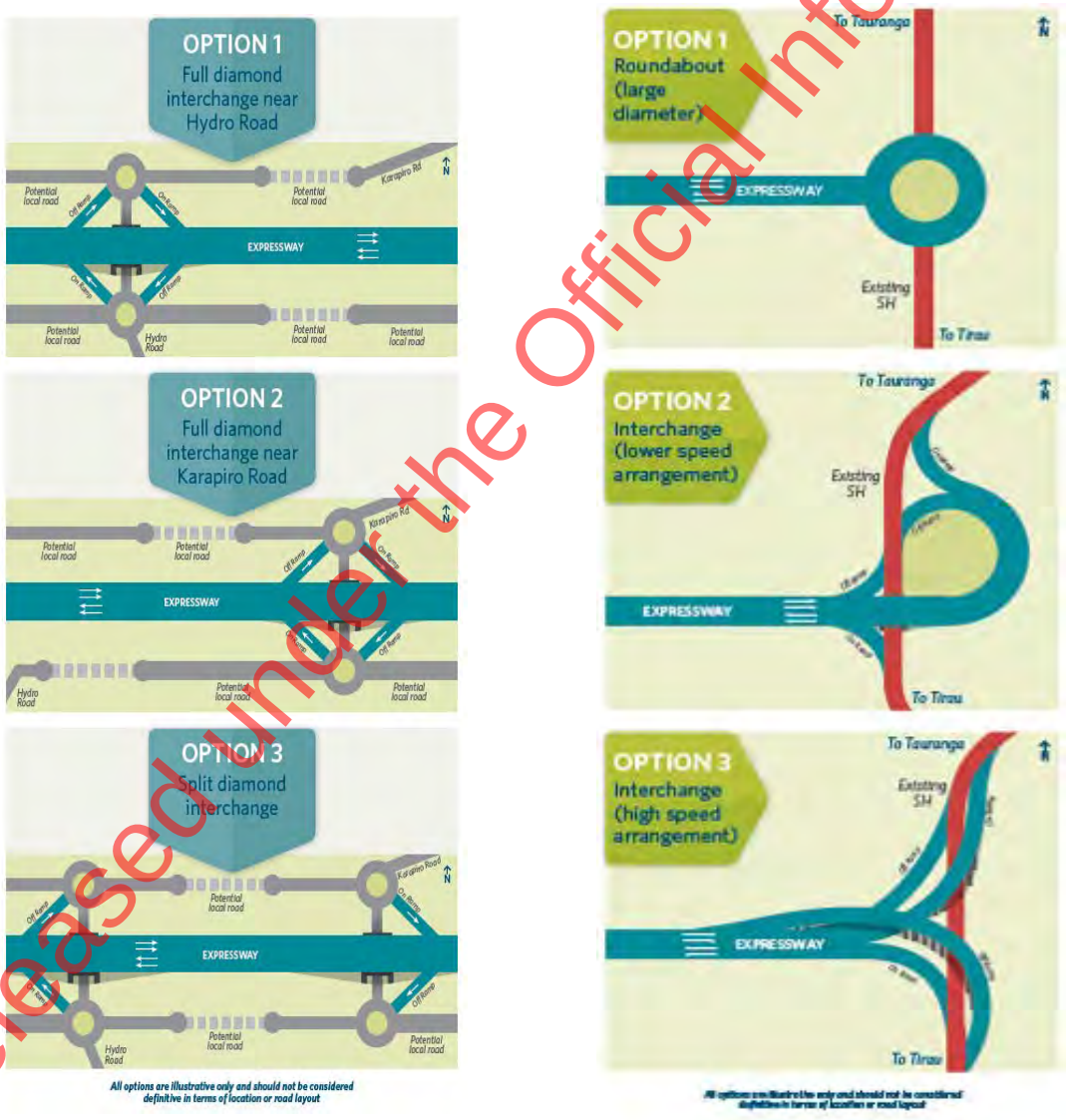
The intersection concepts based on the desire to have full access in a central location are shown in Figure 9-8 and consist of:

- Option 1: Full diamond interchange near Hydro Road or
- Option 2: Full diamond interchange near Karapiro Road; or
- Option 3: Split Diamond interchange.

SH1/SH29 Connection

The intersection concepts were based on the desire to have full access and movements provided where three routes (SH1 north (C2P), SH1 south, SH29) all meet, and all have the same ONRC status. The intersection concepts are shown in Figure 9-8 and consist of:

- Option 1: An at-grade roundabout
- Option 2: Grade-separated, with priority only provided in one direction. Other directions have low speed arrangements. Priority movements could be in an alternative direction
- Option 3: Grade-separated, high speed arrangement with priority of movement provided in all directions.



CENTRAL *SOUTHERN*

Figure 9-8: Central and Southern Connection concepts

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9.4.4 Options for assessment

In combination, within the three sections (A, B and C) sub-route options were developed, comprising combinations of two to four mainline sub-routes, various interchange forms (section 9.4.3) and local road connections. These combinations are summarised in Table 9-5.

In total there were 24 sub-options (4 in section A, 14 in Section B and 6 in Section C) which are mutually exclusive of each other. That is, any sub-route option within Section A can connect to any sub-route option within Section B, which can connect with any sub-route option with Section C to form a total route option within the E2 corridor. The sub-route and connection options drawings that were assessed are provided in Appendix E and were provided to the specialists to undertake their assessments.

	Section A	Section B			Section C		
		Three interchange options			Three interchange options		
	Follow existing alignment	Hydro Diamond	Karapiro Diamond[66]	Split Interchange	Roundabout	Low speed Interchange	High speed Interchange
4 Alignments	A1	B1-1	B1-2	B1-3	2 Alignments (C1, C2) C1-1	C1-2	C1-3
	A2	B2-1	B2-2		C2-1	C2-2	C2-3
	A3		B2-3				
	A4		B2-4				
4 Alignments (B1, B2, B3 B4)		B3-1	B3-2	B3-3			
			B3-4				
		B4-1	B4-2	B4-3			
Total	4	14			6		

Table 9-5: Short-list options for Sections A, B and C

9.4.5 Preliminary Option Evaluation

Within each of the three sections (A, B and C), the sub-route and connection segments were evaluated as a stand-a-lone section for both risks/complexity and effects (assuming reasonable mitigation is in place). The scoring scales used in the evaluation and both criteria are fully described in Appendix P Section 3.2 of the C2P DBC Options Report. In summary, risks and complexity assessments were completed using a five-point scale (neutral to fatal flaw) whilst the effects assessments used a seven-point scale (significant adverse to significant positive). For specialists completing their assessments, the process involved:

[66] With various ramp configurations

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- Site walkovers at specific locations to validate desktop information and help evaluate the risk or effect
- Individual assessments of each of the short-list sub-routes and connections as per the MCA framework (Appendix P section 3.2.2 of the C2P DBC Options Report)
- A workshop with all specialists to discuss their evaluation and assumptions (this was used to confirm the outcomes of all the evaluations across the wider project team and validate the inputs into the MCA)
- Updating comments and MCA scores as a result of any discussion and changes that occurred within the workshop.

The resultant MCA evaluation summarising the specialist's assessments are summarised in Table 9-6, Table 9-8and Table 9-10 with detail provided in Appendix F. This resulted in either an acceptance of an option for further investigation or recommendation that an option should be discarded.

The outcomes of those discussions are summarised in Table 9-7, Table 9-9 and Table 9-11. These outcomes were also discussed and workshopped with stakeholders on 5 December 2017. At the stakeholder workshop, the stakeholder group endorsed the process used to assess the short list, and the outcomes (Refer section 9.6).

Discussion on the evaluation results and outcomes within each section is provided in the following sections.

Section A

Section A consists of four short listed routes (Figure 9-5) the options A1 to A4 wer similar in the overall risks and effects. From a geometric and location perspective the routes were located north of, south of, or on the existing highway. Option A3 was the only option that did not provide a full local road connection between the Karapiro Village and the end of the current expressway and was discarded because it was an obvious outlier in terms of risks and effects. The other options had no differentiation in the MCA outcomes. However, due to option A1 affecting more properties than options A2 and A4 this was also discarded. More detail on the key differentiators and reasons to keep or discard all short-list options in Section A is provided in Table 9-7.

		OPTION			
		A1	A2	A3	A4
Implementability/ Complexity/ Risk of Options	Technical - Geometric				
	Technical - Structures				
	Technical - Geotech				
	Constructability				
	Consentability				
	Safety in Desig				
	Financial/Fundability				
	Sys em Integration				
MCA Element	Traffic				
	Social				
	Ecological				
	Water				
	Visual and Landscape				
	Urban Design				
	Cultural				
	Heritage/Archaeology				
	Noise				
	Vibration				
	Air Quality				
	Contaminated Land				
	Property				

Table 9-6: Section A: MCA Results

Risk and Effects

Major Negative *Medium Negative* *Minor Negative* *Neutral* *Minor Positive* *Medium Positive* *Major Positive*

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In summary, the two options that were taken forward for further discussion were A2 and A4. Specific detail of the risks and effects for the favoured A2 and A4 options is provided in section 9.5. The discussion with stakeholders about the comparisons between options A2 and A4 is provided in section 9.6.

Section A		
Options	**Discard/Keep**	**Comments (key feedback – where there are differences)**
A1 North of Highway	**Discard**	Unable to differentiate from Options A2 and A4 - equally least risks and effects. However, A1 has the highest overall effect on total number of properties and was therefore discarded. Significant positive effects from a traffic point of view. Moderate adverse effects for social, cultural, heritage and archaeology as the option affects known sites (borrow pits), plus potential for significant risk with some unrecorded sites. Some minor risks and complexity items.
A2 South of Highway	**Keep**	Unable to differentiate from Option A4 - equally least risks and effects. Significant positive effects from a traffic point of view. Moderate adverse effects for social, cultural, heritage and archaeology as the option affects known sites (borrow pits), plus potential for significant risk with some unrecorded sites. Some minor risks and complexity items.
A3 On highway	**Discard**	**A clear outlier - Ranked worst** in terms of equal weighting across risks and effects and worst overall in term of effects and therefore discarded. Moderate adverse constructability risks due to staging of works and how existing traffic is dealt with. Moderate adverse effects for social, cultural, heritage and archaeology as the option affects known sites (borrow pits), plus potential for significant risk with some unrecorded sites. Some minor risk in terms of transport and land integration due to some local roads not being connected for full lengths.
A4 North of Highway	**Keep**	Unable to differentiate from Option A2 - equally least risks and effects. Significant positive effects from a traffic point of view. Moderate adverse effects for social, cultural, heritage and archaeology as the option affects known sites (borrow pits), plus potential for significant risk with some unrecorded sites. Some minor risks and complexity items.

Table 9-7: Section A - Short list evaluation outcomes

Section B

Section B included a total of 13 options. This consisted of four route alignments (B1, B2, B3 and B4) with variations of intersection connections. The alignment options are shown in Figure 9-6, and the central (Hydro Road/Karapiro Road) intersection forms are shown in Figure 9-8. Options B1, B2 and B3 are located to the north of the school with varying alignments through the hill country. Option B4 was the only option that was located south of the school and partially follows the existing SH1 between Karapiro Road and Tunakawa Road. The MCA assessments showed that there were a lot of significant and moderate risks and effects for most of the options.

- The outcomes of the MCA showed that there was a preference for options that included the full diamond interchange at the Karapiro location (as opposed to the full diamond at Hydro Road or the Split diamond arrangement). This resulted in options B1-2, B2-2, B3-2 and B4-2 being favoured as they had better outcomes for traffic, urban design, integration with local network, and heritage/archaeology. Stakeholder's endorsed this decision at the workshop on 5 December 2017.
- The B1-2, B2-2 and B3-2 options were compared to determine a decision on an option north of the school. The outcome was that B1-2 was favoured as it had less archaeological and cultural effects. However, option B1-2 still had a significant risk for 'financial fundability' as the option crossed the Karapiro Gully and required a long bridge structure/viaduct. Because of that risk, and the fact that the Karapiro Road interchange was preferred (enabling an alignment adjustment in the Hydro Road area),

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Option B1-2 was modified (to option B1-2a) to avoid crossing the gully and therefore reduced costs significantly. It was determined that option B1-2a was favoured compared to option B1-2.

- The B4 options group located south of the school had some of the best options in terms of overall rank and effects. However, given the preference of the full diamond interchange being located in the Karapiro Road area, B4-2 was the favoured option south of the school.
- With two favoured options in section B (B1-2a and B4-2) they were then determined to have the following key differentiators:
  - B1-2a has lesser cultural effects than B4-2 (less length adjacent to Lake Karapiro)
  - B1-2a costs $35M more than B4-2 (still some additional structures and significantly more earthworks).

The discussion with stakeholders in comparing options B1-2a and B4-2 is provided in section 9.6.

		OPTION												
		B1-1	B1-2	B1-3	B2-1	B2-2	B2-3	B2-4	B3-1	B3-2	B3-3	B3-4	B4-1	B4-2
Implementability/ Complexity/ Risk of Options	Technical - Geometric													
MCA Element	Technical - Structures													
	Technical - Geotech													
	Constructability													
	Consentability													
	Safety in Design													
	Financial Fundability													
	System Integration													
	Traffic													
	Social													
	Ecological													
	Water													
	Visual and Landscape													
	Urban Design													
	Cultural													
	Heritage/Archaeology													
	Noise													
	Vibration													
	Air Quality													
	Contaminated Land													
	Property													

Table 9-8: Section B MCA Results

Risk and Effects

Major Negative *Medium Negative* *Minor Negative* *Neutral* *Minor Positive* *Medium Positive* *Major Positive*

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Section B			
Options	**Sub-option**	**Discard /Keep**	**Comments (key feedback – where there are differences)**
B1 North route over the Gully.	**B1-1** Diamond at Hydro	**Discard**	**One of the worst in terms of overall rank and just for effects.** Significant adverse effect for financial due to cost of constructing viaduct and significant earthworks costs. Could exceed original corridor estimate. Moderate adverse effects for range of risks/complexity. Moderate adverse effects for ecology, cultural, noise, vibration, landscape/visual, urban design, heritage/archaeology, social and property.
	B1-2 Diamond at Karapiro[67]	**Keep**	One of the better options in terms of overall rank and just effects. Significant adverse effect for financial due to cost of constructing viaduct and significant earthworks costs. Could exceed original corridor estimate. Significantly positive traffic effects due to the interchange arrangement – right traffic on right roads. Moderate adverse effects for ecology, cultural, noise, vibration, landscape/visual, heritage/archaeology, social and property. Although significantly more costly than other northern options (B1, B2 and B3 groups), this option is the preferred option north of the school as it the least amount of risks and effects and **avoids the significant adverse effects on the recorded terraced hill and pit complex than is located within other northern B2 route options.**
	B1-3 Split Diamond	**Discard**	**One of the middle options in terms of overall rank and just for effects**. Significant adverse effect for financial due to cost of constructing viaduct and significant earthworks costs. Could exceed original corridor estimate. Moderate adverse effects for most risks/complexity items. Significantly adverse for Cultural due to potential effects on a significant archaeological area near Hydro interchange. Moderate adverse for noise, vibration, heritage/archaeology, and property. Discarded because there are better options which have less risk and effects.

Section B			
Options	**Sub-option**	**Discard /Keep**	**Comments (key feedback – where there are differences)**
B2 Route North of school	**B2-1** Diamond at Hydro	**Discard**	**One of the worst in terms of overall rank and just for effects.** Significant adverse effect for financial due to cost of constructing viaduct and significant earthworks costs. Significant adverse effects for heritage/archaeology and Cultural due to potential effects on recorded terraced hill and pit complex. Significantly adverse for Heritage/Archaeology and Cultural effects due to a significant archaeological area near Hydro interchange. Moderate adverse effects for range of risks/complexity and effects.
	B2-2 Diamond at Karapiro	**Discard**	**One of the better options in terms of overall rank and good for just effects**. This option has significant adverse risk/complexity as it crosses the gully with a long viaduct and has significant expense compared to other options south of the school. Significant adverse effects for heritage/archaeology and Cultural due to potential effects on a recorded terraced hill and pit complex. Significantly positive traffic effects due to the interchange arrangement–right traffic on right roads. This option is lower cost that other northern options (i.e. B1-2) however it is discarded because of there are better options which have less risk and effects.

[67] A variation of this option (B1-2a) (which avoided the need to cross the gully and therefore the need for a viaduct) was one the favoured route in this section and replaced B1-2.

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	B2-3 Diamond at Karapiro (variation)	**Discard**	**One of the worst in terms of overall rank and just for effects.** Significant adverse effect for the complexities of having a long viaduct structure and associated financial fundability. Significant adverse effects for heritage/archaeology and Cultural due to potential effects on recorded terraced hill and pit complex. Discarded because there are better options with less risk/effects.
	B2-4 Diamond at Karapiro (variation)	**Discard**	Middle ranked option in terms of overall rank and effects. Significant risk for financial fundability due to cost of constructing a viaduct. Significant adverse effects for heritage/archaeology and Cultural due to potential effects on recorded terraced hill and pit complex. Significant positive effects for Traffic. Discarded because there are better options which have less risk and effects.
B3 Route north of the school	**B3-1** Diamond at Hydro	**Discard**	**One of the worst in terms of overall rank and just for effects.** Significant adverse effect for financial fundability due to cost of constructing viaduct and a number of other moderate adverse risks. Significant adverse effects for heritage/archaeology and Cultural due to potential effects on a recorded terraced hill and pit complex and a significant archaeological area near Hydro interchange.
	B3-2 Diamond at Karapiro	**Discard**	One of the middle options in terms of overall rank/just effects. Significant adverse effect for financial due to cost of constructing the viaduct. Significant adverse effects for heritage/archaeology and Cultural due to potential effects on a recorded terraced hill and pit complex. Significantly positive traffic effects due to interchange arrangement–right traffic on right roads. Discarded because there are better options which have less risk and effects.
	B3-3 Split Diamond	**Discard**	**One of the worst in terms of overall rank and just for effects.** Significant adverse effect for financial due to the cost of constructing the viaduct. Significant adverse effects for heritage/archaeology and Cultural due to potential effects on recorded terraced hill and pit complex. Discarded because comparatively there are better options which have less risk and effects.
	B3-4 Diamond at Karapiro (variation)	**Discard**	Middle to worse in terms of overall rank and middle rank for just effects. Significant adverse effect for financial due to cost of constructing the viaduct. Significant adverse effects for heritage/archaeology and Cultural due to potential effects on a recorded terraced hill and pit complex. Discarded because there are better options which have less risk and effects.

Section B			
Options	**Sub-option**	**Discard /Keep**	**Comments (key feedback – where there are differences)**
B4 South of the school	**B4-1** Diamond at Hydro	**Discard**	Middle to worse options in terms of overall rank middle rank for just effects. Significant adverse effects for Heritage/Archaeology and Cultural due to a significant archaeological area near Hydro interchange and corridor located in an area of cultural linkage to Lake Karapiro. Discarded because comparatively there are better options which have less risk and effects.
	B4-2 Diamond at Karapiro	**Keep**	The **best option in terms of overall rank** and middle rank for just effects. Significant adverse cultural effects as the corridor is located in an area of cultural linkage to Lake Karapiro. Significantly positive traffic effects due to the interchange arrangement – right traffic on right roads. **This is the preferred option south of Karapiro School.**
	B4-3 Split Diamond	**Discard**	One of the better options in terms of overall rank and middle for just effects. Significant adverse Cultural effects due to a significant archaeological area near Hydro interchange and the corridor is located in an area of cultural linkage to Lake Karapiro. Discarded because comparatively there are better options which have less risk and effects.

Table 9-9: Section B - Short list evaluation outcomes

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For all route options (B1 to B4) the Diamond Interchange at Karapiro ranked better than the alternative interchanges and is therefore deemed the preferable interchange arrangement.

Section C

Section C consisted of six options, including two main alignments and three intersection forms (Figure 9-7). Options C1-3, C2-2 and C2-3 were discarded as they were either clear outliers in terms of risk and effects, or they presented a number of moderate or significant risks and effects.

Although option 1-2 was acceptable in terms of overall risks and effects, there were concerns about this arrangement resulting in crash migration on to the adjacent networks, and potential risk of wasted investment if future improvements to the SH1 south and /or SH29 deemed the interchange to be incompatible to those upgrade works. The incremental benefits showed that a grade separated interchange did not warrant investment over and above a roundabout option.

The two roundabout options C1-1 and C2-1 were better options in terms and risks and effects, and in terms of traffic capacity, the roundabouts met (and exceeded) adequate levels of service for the project horizon. Roundabouts are not the favoured interchange form by some customers (i.e. heavy vehicles), however it is recognised that any slowing or stopping at the intersection is relatively minor in comparison to the overall journey taken, and they provide a good visual cue to a change in driving environment from an expressway to a rural two-lane road.

In summary, the two options that were taken forward for further discussion were the at-grade roundabout options C1-1 and C2-1. Specific detail of the risks and effects for the favoured C1-1 and C2-1 options is provided in section 9.5. The discussion with stakeholders in comparing options C1-1 and C2-1 is provided in section 9.6.

		OPTION					
		C1-1	C1-2	C1-3	C2-1	C2-2	C2-3
Implementability/ Complexity/ Risk of Options	Technical - Geometric						
	Technical - Structures						
	Technical - Geotech						
	Constructability						
	Consentability						
	Safety in Design						
	Financial/Fundability						
	System Integration						
MCA Element	Traffic						
	Social						
	Ecological						
	Water						
	Visual and Landscape						
	Urban Design						
	Cultural						
	Heritage/Archaeology						
	Noise						
	Vibration						
	Air Quality						
	Contaminated Land						
	Property						

Table 9-10: Section C MCA Results

Risk and Effects

Major Negative *Medium Negative* *Minor Negative* *Neutral* *Minor Positive* *Medium Positive* *Major Positive*

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Section C		
Options	**Discard /Keep**	**Comments (key feedback – where there are differences)**
C1-1 Northern route with Roundabout.	Keep	**Best ranked option (equal with C2-1).** Provides more scope for any future changes without jeopardising significant investment. Provides a good transition point to reinforce change in driving environment with downstream links being on to lower volume SH's (although still same road classification). Traffic analysis indicates roundabout will perform well for next 50 years +. C1-1 provides more opportunity to future proof than C2-1.
C1-2 Northern route with partial free flow Grade Separated Intersection	Discard	Middle ranked options in terms of risks and effects. Significant financial risks due to interchange potentially becoming superfluous when SH1 Sth and SH29 long-term plans are confirmed and cost compared to a roundabout option. Difficult to provide for any future proofing on SH1/SH29 (without significant expense) and very difficult to accommodate an integrated network with a multi-lane grade separated interchange connecting to lower design standards adjacent SH's. Discarded because grade separated intersection does not provide significant investment benefits over and above a roundabout option (C1-1 and C1-2). Low incremental benefits in comparison to cost.
C1-3 Northern route with full free flow Grade Separated Intersection.	Discard	Middle ranked options in terms of risks and effects. Significant financial risks due to interchange potentially becoming superfluous when SH1 Sth and SH29 long-term plans are confirmed and cost compared to a roundabout option and a number of moderate risks/complexities. Difficult to provide an integrated network with a multi-lane grade separated interchange connecting to lower level adjacent SH's. Discarded because the grade separated intersection has more effects and does not provide significant investment benefits over and above a roundabout option (C1-1 and C1-2).
C2-1 Southern route with Roundabout.	Keep	**Best ranked option (equal with C1-1).** Provides more scope for any future changes without significant sunk costs but has some geometric challenges. Provides a good transition point on to lower volume SH's (although still same road classification). Traffic analysis indicates roundabout will perform well for next 50 years +. C1-1 provides more opportunity to future proof than C2-1, but C2-1 provides more scope to construct roundabout as an early delivery package (separable portion).
C2-2 Northern route with partial free flow Grade Separated Intersection.	Discard	**One of the worst ranked options in terms of risks and effects.** Significant financial risks due to interchange potentially becoming superfluous when SH1 sth and SH29 long-term plans are confirmed and cost compared to a roundabout option. Difficult to provide for any future proofing (without significant expense) and accommodate integrated network with a multi-lane grade separated interchange connecting to lower level adjacent SH's. Discarded because of significant risk/complexity to meet geometric standards. Grade separated intersection does not provide significant investment benefits over and above a roundabout option (C1-1 and C1-2). Significant adverse cultural effects as could impact area of archaeological significance to the east.
C2-3 Southern route with full free flow Grade Separated Intersection.	Discard	**Worst ranked options in terms of risks and effects.** Significant geometric issues trying to tie back into the local road network in constrained conditions, significant financial risks due to interchange potentially becoming superfluous when SH1 south and SH29 long-term plans are confirmed and cost compared to a roundabout option and a number of moderate risks/complexities. Difficult to provide an integrated network with a multi-lane grade separated interchange connecting to lower level adjacent SH's. Discarded because the grade separated intersection has more effects and does not provide significant investment benefits over and above roundabout options (C1-1 and C1-2).

Table 9-11: Section C - Short list evaluation outcomes

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Sensitivity testing

A range of sensitivity tests of the outcomes were assessed including effects ranking and 50% equal rating for risks and effects. These are detailed in Appendix P section 5.2.5 of the C2P DBC options report. The summary of that evaluation was that regardless of which MCA ranking or sensitivity test used, these favoured options were the top ranked sub-route and connection options in each section for consideration by the stakeholder group (Table 9-12).

SECTION	PREFERRED SUB-ROUTE AND CONNECTION OPTIONS	
A	A2	A4
B	B1-2a	B4-2
C	C1-1	C2-1

Table 9-12: Preferred sub-route and connection options

9.5 Short-list Option Evaluation

Following the internal workshop and evaluation, two options in each of the three sections (A.B and C) were recommended to be presented at the stakeholder workshop. This approach was intended to allow closer comparison between favourable options and seek endorsement of a preferred option within each of the three sections. A more detailed summary of the assessment for the two options in each section is provided in sections 9.5.1, 9.5.2 and 9.5.3.

9.5.1 Section A

The two kept options in Section A (A2 and A4) were presented to the stakeholders in a workshop forum on 5 December 2017. A summary of the key risks and effects for each option is provided in Table 9-13 and Table 9-14. The MCA scoring descriptions are provided in Appendix P section 3.2.2 of the C2P DBC Options Report.

A key to the scoring system for all of the following tables is provided below.

Major Negative
Medium Negative
Minor Negative
Neutral
Minor Positive
Medium Positive
Major Positive

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A2 – Expressway located south of the existing highway

Risks and Complexity				
Technical	GM	S	GT	Route crosses alluvial sands and silts of the Hinuera Formation – potentially liquefiable
Constructability				All work has some additional construction and maintenance risks
Consentability				Some moderate adverse effects for cultural and heritage/archaeology
Safety in Design				Risk for SiD without scheme specific details. Required standard or routine solutions
Financial/Fundability				All options similar construction costs
System integration				Option meets fits with wider Government Policy, ONRC expectations and provides for service, network connectivity and land use development
Effects				
Traffic				Significantly relieves congestion through the provision of additional lanes and safety of all road users, and separates right traffic on to right roads
Social				Cumulative social impact due to property issues
Ecological				Potential for bat roost in trees along the route
Water				Neutral impact as no critical issues in relation to surface water post reasonable mitigation
Visual and Landscape				Some potential to impact on small areas of the Waikato River/Gully
Urban Design				Access, safety, and local road connectivity has been improved
Cultural				Both minor and moderate archaeology sites are affected
Heritage/Archaeology				Option affects recorded borrow pit sites. Potential risk of unrecorded archaeological material associated with these sites. Risk of additional pre-1900 historic use of area.
Noise				Although OGPA assumed, there are some receivers (PPF) with Category B impacts which require some additional mitigation
Vibration				Negligible effects due to proximity to receivers (PPF[68])
Air Quality				Negligible effects due to proximity to receivers (PPF[68])
Contaminated Land				Potential for lead in topsoil and some asbestos from commercial farm
Property				Some risks but largely business as usual

GM – Geometric, S – Structural, GT – Geotechnical

Table 9-13 : A2 - Key Risk and Effects

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[68] PPF = Protected premises and facilities

A4 – Expressway located north of the existing highway

Risks and Complexity				
Technical	GM	S	GT	Route crosses alluvial sands and silts of the Hinuera Formation – potentially liquefiable
Constructability				All work has some additional construction and maintenance risks
Consentability				Some moderate adverse effects for cultural and heritage/archaeology
Safety in Design				Risk for SiD without scheme specific details. Required standard or routine solutions
Financial/Fundability				All options similar construction costs
System integration				Option meets fits with wider Government Policy, ONRC expectations and provides for service, network connectivity and land use development
Effects				
Traffic				Significantly relieves congestion through the provision of additional lanes and safety of all road users, and separates right traffic on to right roads,
Social				Cumulative social impact due to property issues
Ecological				Potential for bat roost in trees along the route
Water				Neutral impact as no critical issues in relation to surface water post reasonable mitigation
Visual and Landscape				Some potential to impact on small areas of the Waikato River/Gully
Urban Design				Access, safety and local road connectivity has been improved
Cultural				Both minor and moderate archaeology sites are affected
Heritage/Archaeology				Option affects recorded borrow pit sites. Potential risk of unrecorded archaeological material associated with these sites. Risk of additional pre-1900 historic use of area.
Noise				Although OGPA assumed, there are some receivers (PPF[68]) with Category B impacts which require some additional mitigation
Vibration				Negligible effects due to proximity to receivers (PPF[68])
Air Quality				Negligible effects due to proximity to receivers (PPF[68])
Contaminated Land				Potential for lead in topsoil and some asbestos from commercial farm
Property				Some risks but largely business as usual

GM – Geometric, S = Structural, GT – Geotechnical

Table 9-14: A4 - Key Risk and Effects

In terms of the differences in A2 and A4, the key differentiators are:

- Property impacts:
  - Option A2 is approximately $1M more than Option A4
  - Option A4 affects approximately six more properties than Option A2
  - Option A2 requires less land area
- Option A4 is cheaper (including property costs), has the same assessed effects, but impacts more individual property owners.

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9.5.2 Section B

The two favoured options in section B were B1-2a and B4-2. Note that B1-2a is a variation of B1-2 without the need for a viaduct across the gully. A summary of the key risks and effects for each option is provided in Table 9-15 and Table 9-16. The MCA scoring descriptions are provided in section 6.3.

B1-2a: Route located north of the Karapiro school with Full Diamond interchange at Karapiro Road

Risks and Complexity				
Technical	GM	ST	GT	Narrow site to build within. Potentially large retaining walls likely at the head of a steep slope to deep gully
Constructability				Construction access limited by route alignment and additional risk in terms of construction and maintenance
Consentability				As range of effects, including significant Cultural and Heritage/Archaeology effects
Safety in Design				Risk for SiD without scheme specific details. Standard or routine solutions. Drainage systems will need regular inspections/maintenance
Financial/Fundability				Route passes through steep topography, requires two retaining structures and additional structures. $40M more than option B4-2 due to earthworks and structures
System integration				Option fits with wider Government Policy, ONRC expectations and provides for service, network connectivity and land use development
Effects				
Traffic				Significantly relieves congestion through the provision of additional lanes and safety of all road users, and separates right traffic on to right roads
Social				Cumulative social impact due to property issues
Ecological				Option crosses Mangahanene Stream and potential impact on stream and riparian ecology and possibly bats.
Water				Minor stream works needed where road/ramps encroach into creek/overland flow path and numerous creeks/flow paths are crossed.
Visual and Landscape				Major earthworks required resulting in benching and fill;
Urban Design				Provides much improved access/movements between school and community, better opportunities for growth, but still a barrier for Karapiro Road residents
Cultural				Minor and moderate ecological and archaeological effects
Heritage/Archaeology				Option affects recorded borrow pit sites. Potential risk of unrecorded archaeological material associated with these sites. Significant risk of additional pre-1900 historic use of area; close proximity to rock shelters/unrecorded caves
Noise				New road cutting in proximity to houses.
Vibration				New road cutting in proximity to houses.
Air Quality				Minor affects for a standoff distance of 10-15m
Contaminated Land				Potential for lead in topsoil and some asbestos from commercial farm. Route runs through a hydroponic facility, stockyards and equine area.
Property				24 properties affected with 7 severed

GM – Geometric, S = Structural, GT – Geotechnical

Table 9-15: B1-2a - Key Risk and Effects

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B4-2: Route located south of the Karapiro school with Full Diamond interchange at Karapiro Road

Risks and Complexity				
Technical	GM	ST	GT	Additional structures and junction needed to deal with Tunakawa Road and realignment of existing highway to local roads challenging. Proximity to steep slope and unknown effects of short term construction on the ridge
Constructability				Route crosses the existing highway twice requiring complex junction, diversion of services and working adjacent to gully system
Consentability				Some urban design and cultural effects
Safety in Design				Risk for SiD without scheme specific details. Required standard or routine solutions
Financial/Fundability				Baseline option so neutral cost compared to other options
System integration				Option meets fits with wider Government Policy, ONRC expectations and provides for service, network connectivity and land use development
Effects				
Traffic				Significantly relieves congestion through the provision of additional lanes and safety of all road users and separates right traffic on to right roads.
Social				Cumulative social impact due to property issues. Greater effects than B1
Ecological				Option crosses Mangahanene Stream and potential impact on stream and riparian ecology and possibly bats
Water				Large structure (bridge/culverts) and stream diversion will be required between Tunakawa Road and Tirau Road that may be challenging
Visual and Landscape				Moderate sized earthworks in shall valleys. Visual effects for properties in Fergusson Gully Road.
Urban Design				Expressway makes the community severance worse, however some opportunities for good outcomes
Cultural				Moderate ecological and potentially archaeological areas affected. Close proximity to Karapiro Lake
Heritage/Archaeology				Option affects recorded borrow pit sites. Potential risk of unrecorded archeological material associated with these sites. Risk of additional pre-1900 quarry historic use of area
Noise				Minor effects small number of properties for noise
Vibration				Some vibration risk with some properties located close to the option
Air Quality				Minor effects on air quality
Contaminated Land				Potential for lead in topsoil of properties with older buildings and asbestos. Option runs through some orchards and farming
Property				26 properties affected, some severed

GM – Geometric, S = Structural, GT – Geotechnical

Table 9-16: B4-2 - Key Risk and Effects

In terms of the differences in B1-2a and B4-2, the key differentiators are:

- B1-2a is $40M more expensive than B4-2 but offers no increase in investment outcomes
- B4-2 increases the existing effect of the highway severing the Karapiro Community
- B4-2 is closer to the Waikato River with associated cultural effects.

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9.5.3 Section C

C1-1: Large at-grade Roundabout on Northern route

Risks and Complexity				
Technical	GM	ST	GT	Combination of bridge, settlements, and embankments
Constructability				All works can be constructed offline with no major influence on existing traffic
Consentability				Mostly moderate effects but can be mitig ted to acceptable levels
Safety in Design				Risk for SiD without scheme specific details. Required standard or routine solutions
Financial/Fundability				Baseline option cost
System integration				Option meets fits with wider Government Policy, ONRC expectations and provides for service, network connectivity and land use development
Effects				
Traffic				More than adequate capacity for the long term (40 years). Easy to accommodate access se. Provides good visual cue for the end of expressway
Social				Private propert is impacted
Ecological				Potential for some bat roost trees
Water				Numerous creeks/flow paths crossed but no critical issues
Visual and Landscape				New feature to a rural landscape. Change in landscape form and land use.
Urban Design				Neutral as advantages for local connectivity
Cultural				Passes through minor ecological and archaeological constraints. Also, close proximity to the existing intersection which is an area of landscape significance
Heritage/Archaeology				No recorded sites but significant risk of additional pre-1900 pre-European and historic use (farming) of the area
Noise				Low noise
Vibration				Most of the PPFs[68] are far from the SH, one may be close enough to receive vibration impacts
Air Quality[69]				Most PPFs[68] are far from the SH, but one may be close enough to that air quality is impacted
Contaminated Land				Route runs through pastoral land. Old buildings may have asbestos
Property				6 properties affected

GM – Geometric, S = Structural, GT – Geotechnical

Table 9-17: C1-1 - Key Risk and Effects

[69] The air quality MCA ratings are based on the same inputs and assumptions as the vibration assessment: primarily the traffic volume and mix, and the number and proximity of PPFs.

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C2-1: Large at-grade Roundabout on Southern route

Risks and Complexity				
Technical	GM	ST	GT	Combination of bridge, settlements, and embankments
Constructability				All works can be constructed offline with no major influence on existing traffic
Consentability				Mostly moderate effects but can be mitigated to acceptable levels
Safety in Design				Risk for SiD without scheme specific details. Required standard or routine solutions
Financial/Fundability				Baseline option cost
System integration				Option meets fits with wider Government Policy, ONRC expectations and provides for service, network connectivity and land use development
Effects				
Traffic				More than adequate capacity for the long term (40 years). Easy to accommodate access use. Provides good visual cue for the end of expressway
Social				Private property is impacted
Ecological				Potential for some bat roost trees
Water				Numerous creeks/flow paths crossed but no critical issues
Visual and Landscape				New feature to a rural landscape. Change in landscape form and land use.
Urban Design				Neutral as advantages for local connectivity
Cultural				Passes through minor ecological/archaeological constraints. Close proximity to existing intersection which is an area of landscape significance
Heritage/Archaeology				No recorded sites but significant risk of additional pre-1900 pre-European and historic use (farming) of the area
Noise				Low noise
Vibration				Most of the PPFs[68] are far from the SH, one may be close enough to receive vibration impacts
Air Quality[69]				Most PPFs[68] are far from the SH, but one may be close enough to that air quality is impacted
Contaminated Land				Route runs through pastoral land. Old buildings may have asbestos
Property				5 properties affected

GM = Geometric, S = Structural, GT = Geotechnical

Table 9-18: C2-1 - Key Risk and Effects

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In terms of the differences in C1-1 and C2-1, the key differentiators are:

- C1-1 has additional earthwork volumes (+ 400k cubic metres)
- C1-1 provides better separation from existing constraints (river and SH1 gully) to enable more flexibility for positioning a junction to suit future needs (particularly if grade-separation desired in the future)
- C2-1 provides better opportunity to allow early construction of a roundabout as a separable portion.

9.6 Discussion and Alignment on Favoured Route and Connections

9.6.1 (DBC - Stakeholder Workshop # 2)

An MCA workshop was held on 5 December 2017, with invitation to key stakeholders:

- Waipa, Matamata-Piako and South Waikato District Councils
- Waikato Regional Council
- Department of Conservation
- Mana whenua
- NZ Police
- Heritage NZ
- Heavy Haulage Association and Road Transport Authority
- Ministry of Education.

The workshop sought to reach agreement from the stakeholders on:

- The process undertaken to date to evaluate the short list of route options and determine two favoured options
- Identification of a favoured route option to progress.

9.6.2 Workshop outcomes

The workshop sought to identify a single route option within the E2 corridor to progress on to the next phase of investigation and consenting. The initial part of the workshop involved summarising how the project has progressed from the IBC and summarising the key outcomes through the process. The discussion covered the further assessment and investigation that had been completed on the short list of sub-routes, local road, and connection options. The workshop involved breakout sessions in which participants were asked to consider:

1) Whether they considered that the option development and evaluation process were robust and logical in determining the two favoured options in each of the three sections (A, B and C)
2) The various merits, dis-benefits and key differentiators between the two favoured options within each of the section and select a favoured option.

In terms of point 1, the stakeholders were all in agreement that the process followed, and the evaluation undertaken to determine the combined resultant two favoured options (per section), was robust and logical.

In terms of point 2, the stakeholders concluded the following:

- Section A: - As a result of the workshop discussion, the stakeholders agreed that Option A2 in Section A was the favoured of the two options because it affected a lower number of landowners.
- Section B - As a result of the workshop discussion, the stakeholders **could not agree on a favoured option between B1-2a and B4-2** and further discussion with Waka Kotahi (as the investors) would be required. Waka Kotahi's project steering group meeting was held on 8 December 2017. Because of this discussion, all present steering group members acknowledged and agreed there were effects for option B4-2, albeit that they could be mitigated to an acceptable level, and that from an investment outcomes perspective, **Option B4-2 was favoured.**
- Section C - As a result of the workshop discussion, the stakeholders **agreed that Option C2-1 in Section C was the favoured** of the two options because it enabled an opportunity for the intersection to be built in a staged approach to address current safety issues.

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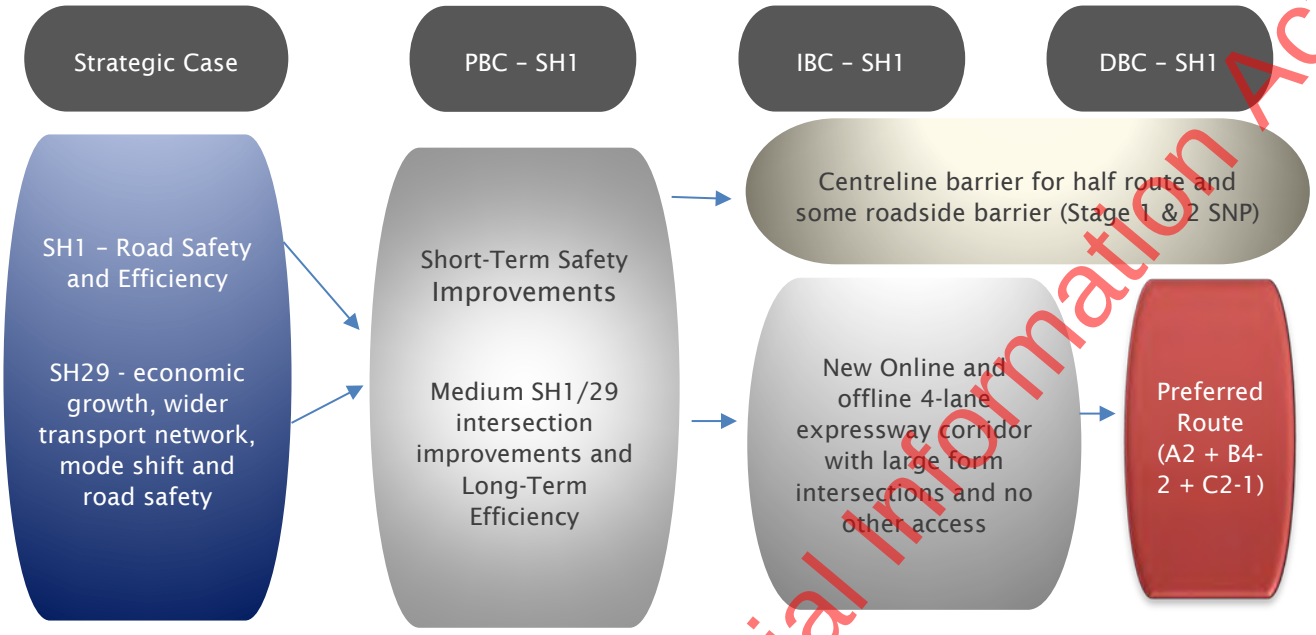
9.7 Recommended Option

The progression of strategic case (+ activity case), recommended programme (PBC), through to corridor and route development and optioneering as part of the IBC/DBC process is shown below.



One route option in each segment was selected as the favoured option. Combined, these options form the preferred route for the corridor. Overall, the preferred route (A2, B4-2 and C2-1 (Figure 9-9)) was recommended because it aligns with the strategic and programme direction, provides significant alignment with the investment objectives (refer section 5.2), has the lowest cost, minimises property impacts, allows some staging of works, and provides less risk compared to other options assessed. Although it has some effects - such as proximity to Karapiro School, community severance, archaeological and cultural issues - these can be mitigated to a reasonable level.

To date, the investigation for the route selection has only comprised desk top studies and brief walkovers of parts of the site where access was available. There is a possibility that more detailed investigations in the next phases of the project could identify constraints (e.g. a previously unrecorded archaeological site or a major ecological feature), which could lead to the route having to be altered and/or a review of the options assessment.

The total route preferred option is shown in Figure 9-9.

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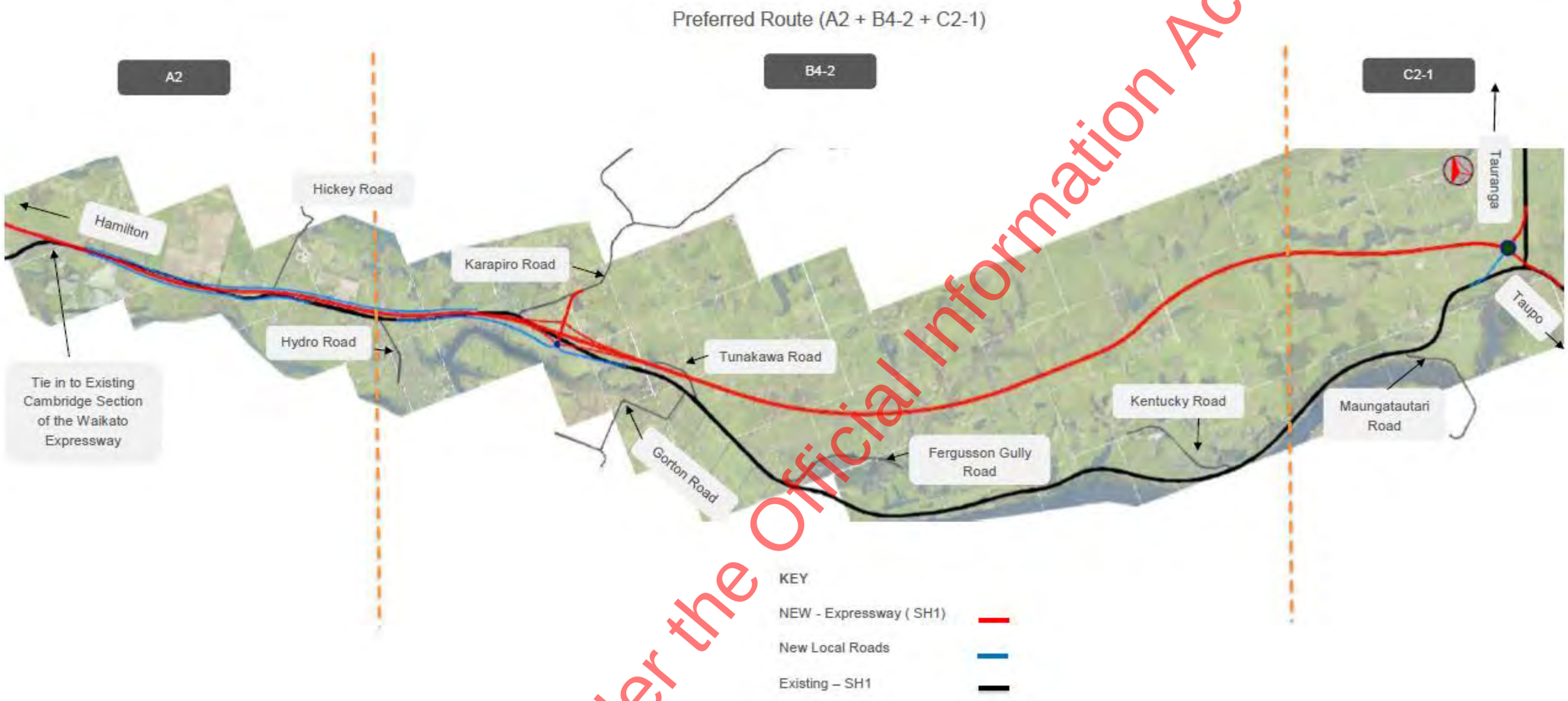

Figure 9-9: Preferred Route

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Recommended Option

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10 DESCRIPTION OF RECOMMENDED OPTION

10.1 Project Scope

This section discusses the scope of the recommended option as presented in Figure 9-9. The recommended option reflects the minimum requirements necessary to deliver the desired outcome for the project. Draft alignment plans can be found in Appendix G.

The recommended option for the Cambridge to Piarere project is a 16 km long, four lane access controlled median divided expressway, from the existing Cambridge Section southern interchange to the junction of SH1 with SH29, near Piarere.

The expressway retains the existing grade separated intersection at the southern end of the Cambridge Section. It includes a new full diamond grade separated interchange near Karapiro Rd and a large diameter roundabout at the southern end where the expressway connects to the existing SH1 and SH29.

The project can be broken down into two parts based on the topography, land use and proposed expressway as per the following sections.

For reference, the alignment chainages have been carried on from the end of the Cambridge section, starting at Ch. 16,000m, and ending at Ch.31,800 (approximately).

10.1.1 Cambridge Section Tie-in to Karapiro Road

In this 5km length of the preferred option the proposed expressway follows the existing SH1 corridor, through mostly flat land comprising typically medium sized farms and lifestyle properties. This section includes the Karapiro School, existing Mobil Service Station, and Hydro Road connection to the Karapiro village.

The existing grade separated interchange at the southern end of the Cambridge expressway is not altered.

The expressway initially runs south of the existing highway, before crossing the highway just prior to Hickey Rd and then again, each side of Karapiro Rd.

The grade separated interchange (GSI) at Karapiro Rd connects the communities otherwise severed by the expressway and enables them to continue to use the local roads for trips within the community. For the community south of the expressway, the interchange also provides safe and convenient access to the Karapiro School, Community Hall, and Mobil Service Station north of the expressway. The current design shows Karapiro Road at grade, with the expressway being formed in cut. The final form of the GSI is yet to be determined.

Although there is a significant land requirement from the Mobil Service Station at Karapiro Rd, it is expected to remain in situ. Access to it and the other community features will be via a realigned section of Karapiro Rd.

Parallel local roads are provided each side of the expressway to connect severed local roads (Hickey Road on the north side, Hydro Rd on the south side) to provide access to properties and an appropriate (non-state highway) route for active modes. Both parallel roads will be extensions of short property access roads created for the Cambridge Section of the Expressway (Newcombe Road to the north, and Lockley Rd to the south). For part of their lengths, they both utilise the existing SH1. Both roads connect back to the offset 'T' intersection west of the Cambridge Southern Interchange near Cambridge Township. To prevent glare and confusion from opposing headlights, screening using fences or bunding will be provided where necessary between the expressway and local roads.

Lockley Rd will run the full length to the Karapiro GSI and connect to the existing SH1. Newcombe Road could run parallel for only part of the length and still achieve its function of providing property access. However, users wanting to head south (to the school for example) would be subject to double-back lengths of up to 8km, which was considered too far, so it was extended to Karapiro Rd.

Other key scope features in this part of the preferred option include:

1) A pedestrian cyclist facility from the intersection of Hydro Road and the existing SH1 to the Karapiro School, including an overbridge, to enable active users to avoid the extra travel distance and conflicts and potential safety issues associated with using the GSI
2) Landscaping and other works to mitigate the potential feeling of increased severance between the north and south side of the Karapiro community
3) Relocation of pylons on the Arapuni to Hamilton A and B 110kv transmission lines or crossing of the Hamilton to Karapiro A 110kv transmission line, without pylon relocation

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4) A significant retaining wall south of the expressway (chainage 20,500), which avoided works on the sensitive northern escarpment of the 'land bridge' to the immediate west. This wall may not be needed if a revised geometric design can push the expressway slightly north in this location, but still avoid the land bridge northern escarpment
5) Deviation of Karapiro Rd to the GSI, and connection of two properties to the realigned road
6) Access to the existing weigh bridge near Hickey Road, or replacement facilities.

10.1.2 Karapiro Rd to SH1/29 Junction

South of Karapiro Rd to the SH1/29 junction the proposed expressway follows a route up to 2km north of the existing SH1 corridor, into the rolling to steep land mainly comprising larger farms.

The key scope features of this part of the preferred route are (from north to south):

1) A large retaining wall to avoid a site of archaeological interest just east of the Karapiro Rd GSI
2) An expressway bridge over an extension of Tunakawa Road for access, with the other end of Tunakawa Road severed
3) A 2km long parallel road on the north of the expressway to provide access to severed properties. Given the steep terrain in this area, it is envisaged that this road would run adjacent to the expressway (e.g. within the cuttings and embankment created for the expressway). Arrangements to amalgamate severed properties will be pursued to reduce the length of this road, and other options for access could also be considered (e.g. underpasses, bridges)
4) Two bridges across streams in deeply incised gullies at chainage 25180 and 25300. Significant retaining walls have also been allowed for in this area, to minimise effects on the gully system
5) A bridge over the expressway - which is in a cutting - to provide access to an otherwise large severed portion of a farm, and to provide access along an easement created to enable Transpower to maintain their transmission lines
6) Southbound threshold treatment to warn drivers of the upcoming end of the Expressway at the SH1/29 interchange
7) A large diameter (e.g. 60m) four leg two lane roundabout providing connection between the expressway, SH1 to Tirau, SH29 to Tauranga, and the old SH1 (to be completed at an earlier stage as part of the New Zealand Upgrade Programme)
8) Deviation off the existing state highway north area to connect into the SH1/SH29 roundabout to avoid the slip area to west of the current SH1 route.

The current cost estimate is based on between 5.7M and 6.3M cubic metres of earthworks being cut. The maximum cut is circa 45m. There is about a 1km portion of the route where cut heights constantly exceeds 20m. Expected cut to waste is approximately 3-3.5M cubic metres. Opportunities for placing cut to waste material exist at the southern end of the project by adopting long batters (6:1 up to 10:1) to transition the expressway into the countryside heading towards Tauranga. Exploration of further cut-to-fill efficiencies and alternative placement locations will be a key focus for the next pre-implementation phase.

The Hinuera-Karapiro 110kv transmission line is crossed three times by the alignment, requiring two pylons to be re-located around Chainage 21000, and another two to be relocated near the SH1/29 roundabout. More detailed design in these locations could see these relocations avoided. The expressway also crosses under the Brownhill to Whakamaru 400kv transmission line, without the need to relocate any pylons.

The expressway crosses many large streams, some of which will enter cuttings part way up the slope, requiring stream diversions.

The existing state highway will be re-purposed as a local road. The scope of this work is yet to be determined but is anticipated to involve removing the passing lanes and reducing the cross section to a size that is more appropriate for the traffic volumes and more affordable to maintain and incorporating appropriate cycling facilities.

10.2 Optional Project Elements

The following are opportunities that could be pursued (separately or as part of the pre-implementation phase) to enhance the project, some in conjunction with other parties:

1) Extension of the pedestrian/cycling facilities along Hydro Road to Karapiro village
2) Extension of the pedestrian/cycling facilities from Hydro Road towards Cambridge
3) Enabling the connection to the following three nearby cycle trails:
    i. Waikato Cycle trail which begins in Horahora Road
    ii. Te Awa Cycle trail on the west side of Lake Karapiro
    iii. Hauraki Rail trail to the east.

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4) Continuing the Newcombe Rd extension to Karapiro Rd, to provide better connections for local community traffic
5) Provisions for a service centre, either at or near the existing Service Station at Karapiro Rd or elsewhere (possibly at the SH1/29 junction)
6) Provision of a rest area, potentially to better utilise the popularity of Lake Karapiro for water-skiing.

Walking and cycling opportunities will be further investigated in an addendum to this business case to be completed by mid-2022.

10.3 Excluded Scope

The following are specifically excluded from the scope of the project and shouldn't be considered for future phases:

1) Grade separation of the SH1/SH29 interchange was considered as part of the option selection and was found to be unnecessary from a capacity perspective. Further, compared to grade separation, the large diameter roundabout[70] provides a clear message to southbound drivers that they are leaving the motorway/expressway driving environment, which they may have been on for over 200km, from Puhoi north of Auckland. Grade separation of the southbound movements could lead to an increase in crashes on SH1 and SH29 south of the junction, as drivers fail to adjust to the different environment.
2) The option selection process considered two locations for the grade separated interchange that was eventually positioned near Karapiro Road. Other locations for the interchange would have to be carefully evaluated and at this stage should be considered out of scope.
3) Alterations to the Cambridge Southern Interchange have not been evaluated as part of this DBC phase and would also be considered outside the scope of the project.

10.4 Wider Project Impacts

Wider project impacts have been considered throughout the entire IBC/DBC ACRE process. This has been through the use of constraint identification, analysis, mapping, and through the MCA.

The Environmental and Social Responsibility Screen (ESR) that was prepared for the IBC has been updated and is included in Appendix I.

These assessments have identified a number of potential impacts for further investigation in the pre-implementation phase. These include property, archaeological, ecological, cultural, social, noise, visual and landscape impacts.

The preferred route will undergo a full 'Assessment of Environmental effects (AEE)" required under the RMA in the pre-implementation phase.

s 9(2)(b)(ii), s 9(2)(j)

[redacted]

[70] Noting that the local position and refinement of location is subject to development in the next stage

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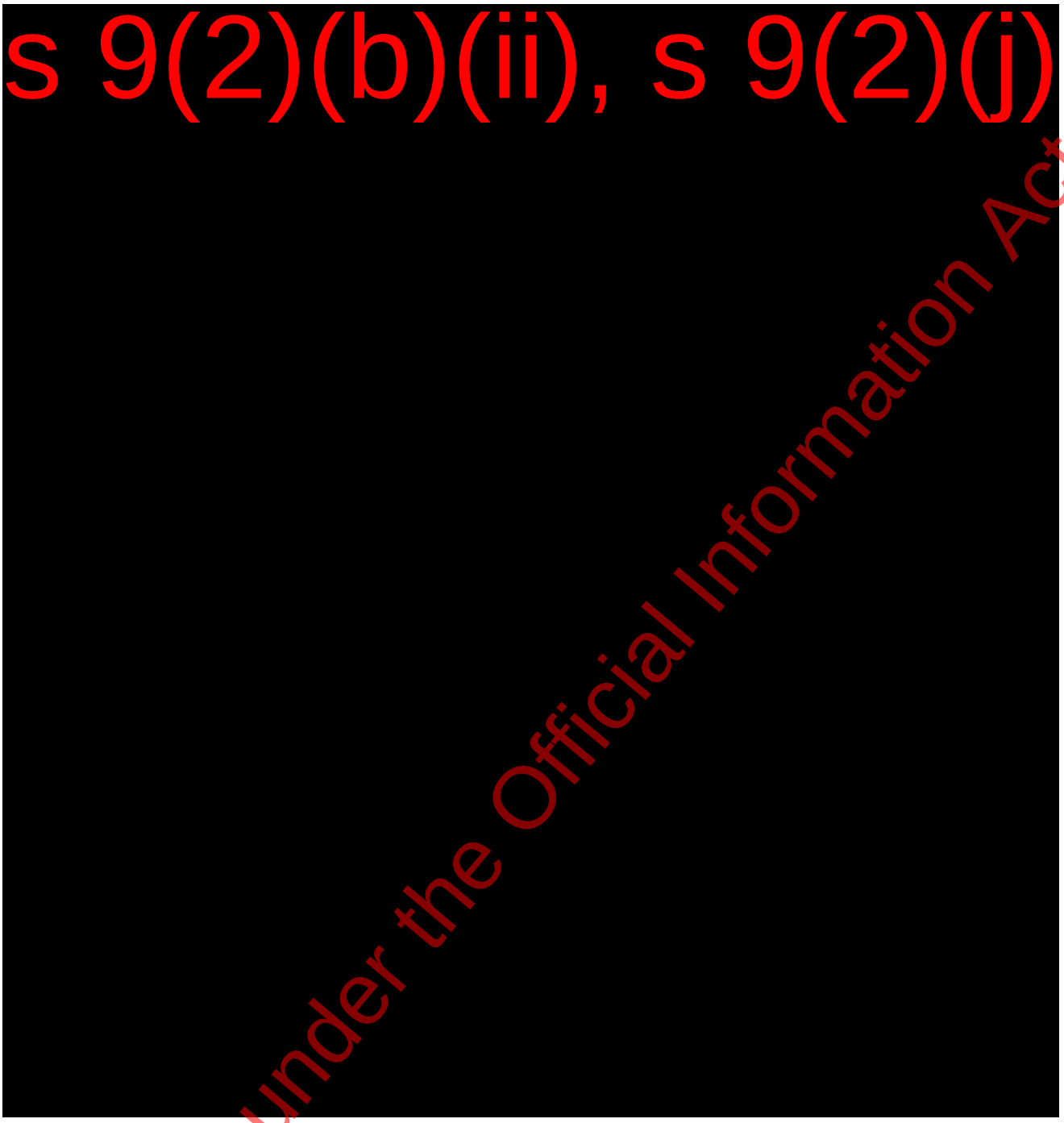

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10.5.1 Project Interdependencies

At the time of the initial DBC in 2018, Waka Kotahi had two adjacent business cases being progressed which have the potential to be impacted by this project. These are:

- SH1 Piarere to Waiouru DBC
- SH29 Piarere to Tauriko DBC.

It is unclear on the timing and recommendations of these projects. Note - 2020 Update - In addition, the Safe Network Programme team are also working on proposals for online safety improvements along both corridors. It is recommended that a Waka Kotahi Steering group (including project managers from adjacent projects) continues to meet to ensure communication and potential impacts or opportunities between the schemes are identified and discussed.

10.5.2 Joint Working Opportunities

There are several opportunities for joint working with Waipa District Council and local cycling interest groups to ensure a consistent, legible, and complete transport network. In particular this includes:

- Revocation of the existing state highway to local road, new local roads and expectations of the ONRC requirements for customer levels of service for Waipa District Council. Refer section 14.4 for further details.
- Improved cycling connections to new cycling facility through working alongside Te Awa, Haruaki and Waikato cycling river trails groups.

10.6 Safety in Design

Safety in Design (SiD) integrates risk management techniques into the design process to identify, assess and treat health and safety risks to people over the life of an asset. SiD is an ongoing process and should be revisited as designs progress through the project design process. The DBC project team has engaged with the following departments of Waka Kotahi for their review and comment, and will continue to raise and seek their approvals during the pre-implementation phase:

- Steering Group
- Transport Planning
- Planning and Investments
- Operations Manager
- Procurement Team.

The following Design Disciplines have been involved in the SiD review process to date:

- Bridging Structures
- Landscape and Urban Design
- Geometrics
- Geotechnical
- Ecology
- Construction / Maintenance
- Hydrology
- Planning, Engagement and Social environment.

The Cambridge to Piarere Project had two key SiD reviews performed at major milestones during the development of the project.

10.6.1 Stage 1 Review

This gave the wider project team the opportunity to review the project at an early stage in development. This assessed the project at "Area stage" and included at a high level all potential health & safety hazards for all possible options that may be developed. This was to set the framework for which all following SiD reviews would be conducted against.

10.6.2 Stage 2 Review

This review was a more focussed SiD workshop on the long-list options to identify any hazards as inputs to the Multi-criteria assessment of potential options.

The SiD assessment reflects the high-level nature of the concept designs developed to-date and should not be considered exhaustive.

A detailed register of SiD risks identified by the project team is included within Appendix J. The Key SiD hazards for the preferred option are given below. All these hazards have the highest risk rating (Level 1) which means they should be mitigated as much as reasonably practicable before the activities commence.

SAFETY HAZARD DESCRIPTION	CURRENT DESIGN TREATMENT
Exposure of staff to live traffic / alignment for maintenance purposes. Lane & shoulder closures impact on both staff and traffic	Landscape treatments that require low / no maintenance - No grass in median, no mowing along alignment sides - no lane closures / reduce mobile ops

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	Design to consider all ancillary maintenance works- sign cleaning, litter collection, spraying (mobile operations)
Known high voltage Services- power lines, transmission towers-expose construction staff to service strike - applies to overhead and in-ground utilities	Constraint mapping carried out during preliminary design phases. Identification of key significant constraints to assist option development and avoidance. DBC design issued to Transpower for involvement and comments. Design has targeted avoidance of main transmission towers as much as practical. Transpowe reviewed and suggested further investigation is required but can carry out minor modifications to accommodate structure conflicts
School access during construction. Local bus drop-off, exposure of children to busier intersection where construction traffic or potential interchange is located	Staging of construction considered the best treatment for the hazards associated with school traffic and construction. Early provision of alternative local road connections will reduce the conflict and improve the situation for both parties
Mainline expressway vertical alignment is in a sag curve under Karapiro overbridge. A pump station (and ancillaries) are required to drain the area, requiring significant ongoing maintenance. Maintenance staff required to enter underground chamber at times	Consider alternative geometric design to remove need for pumping chamber and pumps
Provision for ease of access to maintenance areas- safety risk for maintenance crews getting access from the expressway to specific areas	Specific overlapping barrier openings required for emergency services. Operational access considered during development of local road connectivity and separation from mainline. Typical maintenance bays expected to be developed during next phase of design. Access for maintenance teams from local roads onto expressway developed through connections strategy.

Table 10-2: Key SiD Hazards

10.7 Peer Reviews

The DBC project team has engaged with and worked alongside key specialists within Waka Kotahi through the process, including being part of the Project Steering Group and liaising with technical specialists (such as geotech, safety and design) during the process.

No serious concerns were identified in the road safety audit, and the report is provided in Appendix N which identifies the actions to be undertaken in the next phase of the project development. Note – 2020 Update – as the design has not changed, no further safety audit was undertaken for this DBC as part of the update. Bond Construction's report on the parallel cost estimate reconciliation is included in Appendix L and Richard Paling Consulting reviewed the draft economic analysis presented in this DBC report – their report is in Appendix K. All actions have been resolved.

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11 FINANCIAL CASE

11.1 Project delivery costs

s 9(2)(b)(ii), s 9(2)(j)

The total expected project cost to deliver the remaining Route E2 project (excluding SH1/29 intersection) s 9(2)(b)(ii), s 9(2)(j) **with an expected range of $504M to $721M.** s 9(2)(b)(ii), s 9(2)(j)

s 9(2)(b)(ii), s 9(2)(j)

11.2 Ongoing maintenance and operations costs

The economics analysis (Appendix K) discusses the maintenance costs for the preferred route and compares them to the existing alignment. The maintenance costs for the preferred option are much higher than the existing corridor mainly due to the high costs of regular re-seals with OGPA over the much wider four lane carriageway.

11.3 Project revenues

Tolling of the preferred option south/east of the Karapiro interchange to the SH1/29 Intersection is not considered viable as:

) The current design of the grade separated Karapiro Interchange would require drivers that don't want to use the toll route to negotiate the off ramp, side road and ramp connections to find the alternative route. Although a more direct path to the alternative route could be provided, it would almost certainly be significantly more expensive and require much more land

[71] Including contingency

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2) The intention to re-purpose the existing state highway as a local rural road, means the alternative route would not be very appropriate if large volumes choose to leave the tolled expressway
3) Previous work that considered tolling other sections of the Waikato Expressway found it was not viable.

Given the above, tolling is not being considered. No other sources of potential project revenue have been identified to date.

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12 ECONOMIC ANALYSIS

12.1 Economic summary of recommended option

The economic analysis of the entire C2P project, as scoped in the 2018 DBC, is provided in Appendix K along with detailed information describing the assumptions and methodology. This includes the outcome of the external economic peer review (Appendix K). The analysis is summarised in Table 12-1. Because construction of the SH1/29 intersection is already funded, a second assessment based on removing the intersection from the project scope is also presented. The outcome indicates only a marginal difference in economic efficiency.

PARAMETER DESCRIPTION	ENTIRE PROJECT SCOPE AS PER 2018 DBC	E2 ROUTE EXCLUDING THE SH1/29 INTERSECTION
Earliest Implementation Start Date	October 2022 (economic purposes only)	October 2022 (economic purposes only)
Expected Duration of Construction	5 years	5 years
Option	Offline E2 route + Roundabout at SH1/29	Offline E2 route only
Time zero	1st July for 2020	1st July for 2020
Base date for costs & benefits	1st July for 2019	1st July for 2019
Assessment period	40 years	40 years
Discount factor	6%	6%
Traffic growth	1.1 linear growth from year 2019	1.1 linear growth from year 2019
Present value of total project cost of do minimum	$2.9M	$2.9M
Net Present value project cost of preferred option	$495.5M	$472.8M
Net Present value benefit of preferred option	$310.1M	$306.3M
BCR (exc. Wider economic benefits)	**0.63**	**0.65**
First Year Rate of Return	2.6%	2.7%

Table 12-1: Economic summary table for Recommended Option (E2 Route)

12.2 Cost Summary

The DBC cost estimates are presented in Appendix L and are summarised below with further discussion included in section 11. It provides the costs for both with and without the SH1/29 intersection. Note that there is an identified gap in the DBC for walking and cycling facilities between Karapiro and SH1/29 . The costs provided in Table 12-2 and this DBC do not include walking and cycling costs which will be developed as an addendum to this DBC. The likely implementation costs for walking and cycling facilities between Karapiro and SH1/29 intersection could be between $1M/km to $5M/km with possible length of 13km; resulting in costs in the order of $13M to $65M.

s 9(2)(b)(ii), s 9(2)(j)

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12.3 Benefits

The benefits of the option are summarised in Table 12-3.

BENEFIT	NET PRESENT VALUE	
	ENTIRE PROJECT SCOPE AS PER 2018 DBC	E2 ROUTE EXCLUDING THE SH1/29 INTERSECTION
Travel Time + Reliability	$242M	$244M
Vehicle Operating	-$1M	-$1M
Crashes	$69M	$64M
CO_2	$0	$0
Total	**$310M**	**$306M**

Table 12-3: Summary of benefits (nearest $million)

A significant source of the benefits is derived from travel savings (74%) primarily due to the assumed 110km/h posted speed limit (expected average speed of 105km/h) on the completed C2P expressway and the slight shortening of the route. The other major source are crash benefits representing 22% of total benefits.

The C2P project is not expected to result in agglomeration benefits or other wider economic benefits, based on previous work undertaken as part of the 2017 Waikato Expressway economic evaluation update.

12.4 Comparison with earlier stages

Table 12-4 summarises the key differences in the economics analysis between recent business case assessments.

PROJECT PHASE	PBC[72]	IBC (E2)	THIS DBC – TOTAL SCOPE	THIS DBC – EXC SH1/29
Date of work	July 20 5	April 2017	Sept 2020	Sept 2020
BCR	6	0.65	0.63	0.65
Base date for costs and benefits	2015	2016	2019	2019
Total project[73] costs	$250M to $500M	$439M - $549M[74]	$527M to $758M	$504M to $721M
Present value of costs of do minimum	unknown	$2M	$3M	$3M
Present value of costs of preferred op ion	unknown	$426M	$498M	$476M
Net Present value benefit of preferred option	unknown	$278M	$310M	$306M

Table 12-4: Economics analysis current vs previous stages (nearest $M)

[72] Do Maximum (offline expressway standard route)

[73] Range given represents the Base and 95%ile project costs

[74] The IBC estimate of E2 was originally $460M. However, the estimate was refined further post IBC using model MX alignments.

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With regard to the key differences:

- The PBC assumed the SH1 corridor reached capacity much earlier than assessed in the DBC, hence determined a higher travel time benefit
- The benefits from IBC to the DBC have increased due to the assumption that the average operating speed on the option is 105km/h.

12.5 Sensitivity analysis – Cost Benefit variability

A range of sensitivity tests have been undertaken to gauge the impact on the BCR. These have been limited to the key influencing factors, being the costs, traffic volume growth, posted speed of the bypass, and discount rates. Table 12-5 clearly indicates that regardless of the sensitivity test undertaken the BCR is within the range 0.48 to 1.07.

Scenario	Input Parameters			BCR	Comments
	Discount Rate	Assessment Period	Growth from 2019		
Standard BCR	6%	40	1.1%	0.63	Expected Cost $635M
95%ile Cost Estimate	6%	40	1.1%	0.53	Increased Cost to cover funding risks
Average Speed	6%	40	1.1%	0.59 - 0.67	100km/h or 110km/h on C2P
Traffic Growth	6%	40	0.5% or 2.0%	0.55 - 0.77	Growth changes to reflect uncertainty in forecasting long term growth rate.
Covid-19	6%	40	1.1% from 2026	0.59	Delayed traffic growth to 2026 due to Convid-19 impacts.
Attracted Traffic	6%	40	1.1% growth +500vpd	0.64	Step change in traffic vol on SH1 after Hamilton Section opens attracting traffic from SH27
No SH1/29 intersection	6%	40	1.1%	0.65	Expected Cost $605M
Discount	4%	40	1.1%	0.85	Standard EEM 2018 test
Discount	8%	40	1.1%	0.48	Standard EEM 2018 test
Discount/assessment period	4%	60	1.1% & 0%	1.04 – 1.07	No traffic growth beyond year 40 or continuous growth to year 60

Table 12-5: Sensitivity analysis

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13 ASSESSMENT OF RECOMMENDED OPTION

13.1 Achieving Project Investment Benefits

The assessment of C2P's ability to achieve key outcomes for achieving each of the investment objectives (benefit + measure + target) is provided in Table 13-1.

INVESTMENT BENEFITS	MEASURE + TARGET	C2P
Improve the corridor Level of Service (50%)	Reducing the average travel time between the Cambridge section of WEx and SH 1/29 by increasing average speed to 95km/h on opening for 20 years	Excellent. Current – 88km/h, Predicted Speed = 105 km/h[75]; target = 100 km/h Current = 11.8 min, predicted = 9.5 min for SH1 South.
	Improving resilience by reducing risk or consequence of unplanned road disruptions - Subjective scale in comparison to existing case - yes/no	Reduces the number of closures and unplanned events by 90%. That is from 179[27] (one every 0 days) to 17.9 (one every 102 days). Provides parallel local roads or other side roads which could be used as an alternative route
	Improving average daily freight travel time reliability between the Cambridge section of WEx and SH 1/29 on opening for 20 years	Excellent Current – 1.3mins/trip average (weekday afternoon). Target ONRC = 0.55mins, Predicted no more than 0.55mins/trip
Improve local access and distance travelled to key community features[5] by all transport modes (20%)	Subjective scale in comparison to existing case - yes/no Qualitative community response on opening	Major improvements to intersections and other accesses off parallel local roads and major interchanges connecting to other national highways. Reduces the overall number of intersection and key accesses by 100%
Improve Safety (30%)	Reducing the number of Deaths and Serious Injuries (DSis) by 70% on opening for 20 years	Reduces DSi from 27 to 9 and exceeds the agreed target of 70% reduction. Predicted star rating of 4.8
	Reducing the Collective risk rating to no more than Medium on opening for 20 years	The Collective Risk on opening is predicted to be = LM[76]
	Maintaining a low personal risk rating on opening for 20 years	The Personal Risk on opening is predicted to be low

Table 13-1: Achieving the Outcomes of C2P Investment objectives

13.2 Achieving Customers Outcomes

Waka Kotahi's 10 key Principles[77] for determining customer centricity have been considered as part of the option development and this is provided in Appendix F by taking customers (type, demand, use etc.) into account when developing and evaluating the options. The level of improvement for customers with the preferred option is shown in Figure 13-1 and a customer journey map has also been provided in Figure 13-2. These additional opportunities have not been costed or explored in any further detail in the DBC, however will likely be explored in subsequent phases of the project.

[75] Consistent with the expectations for the ONRC based on posted speed of 110km/h.

[76] Using predicted Fatal and Serious Crashes and traffic volumes of 20,000 vpd in 2020

[77] http://www.nzta.govt.nz/assets/Highways-Information-Portal/Processes/Business-case-bites/BC-Bites-18-02-Customer-Design-Principles-January-2018.pdf

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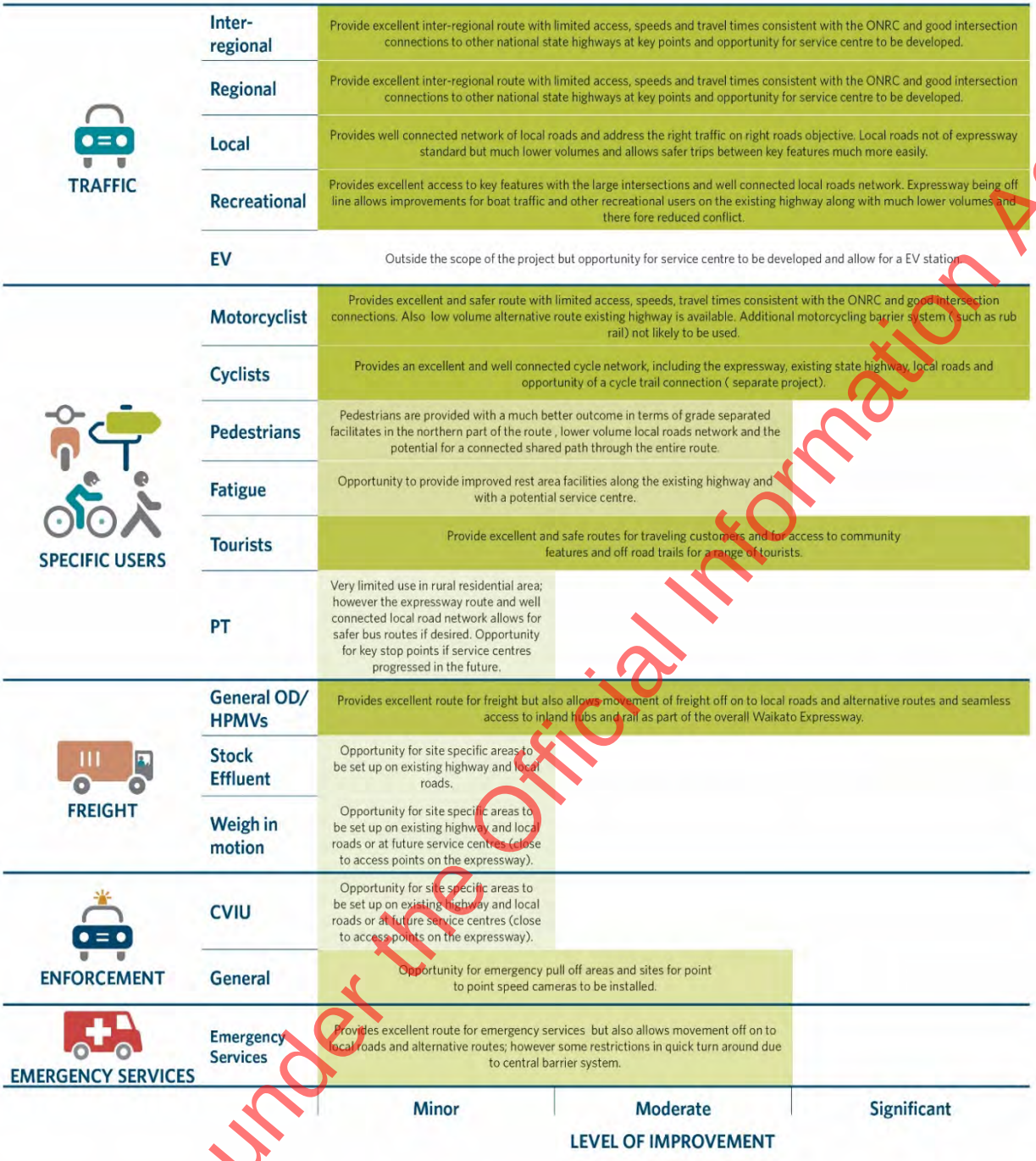

Figure 13-1: Level of Improvement for Customer outcomes from C2P

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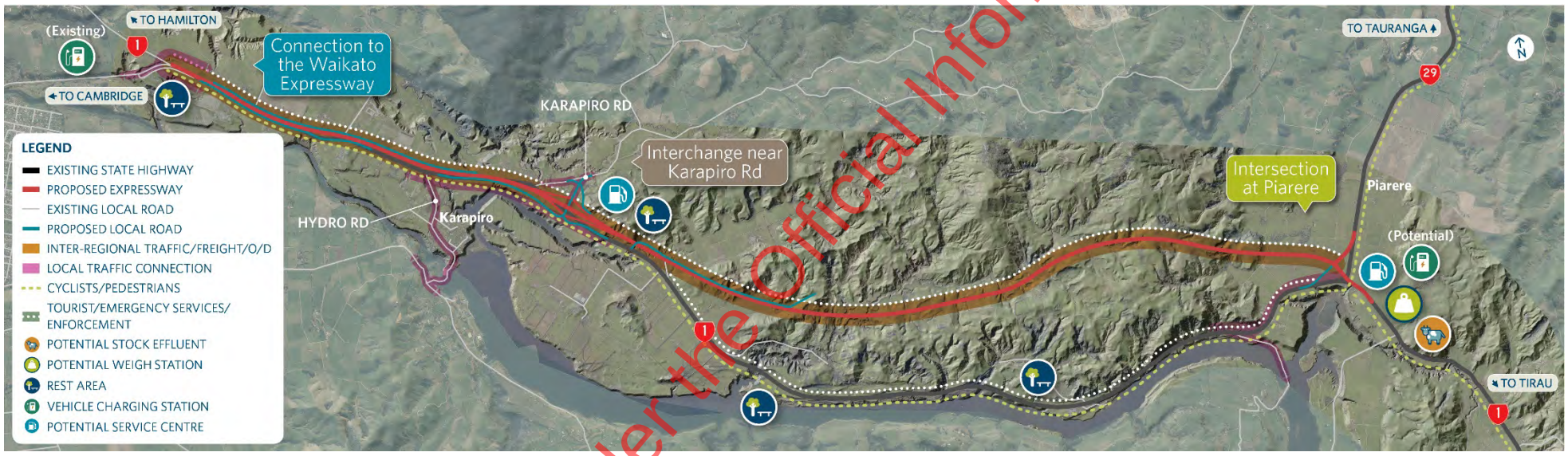

Figure 13-2: C2P Customer Journey Map[78]

[78] Noting that the specific opportunity and the location of these opportunities could be confirmed in any subsequent phases of the project

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13.3 ONRC Outcomes

The C2P preferred option is strongly aligned with ONRC customer levels of service topics as shown in Table 13-2.

TOPIC	WHAT DO WE HAVE (2021 +) [79]	WHAT DOES THE RECOMMENDED OPTION PROVIDE[80] (ON OPENING)	ALIGNMENT
Safety Performance	A high risk rural road with Medium High Collective Risk and a 3.3-star rating	Low to Medium Collective Risk Low Personal Risk 4 + Star Rating	Excellent
Accessibility	Intersections are widely spaced, although clustered in areas and with safety issues. Substantial number of accesses, leading to unsafe movements particularly in the northern portion of project length	A grade separated interchange at Karapiro Road and a Large diameter roundabout at SH1/SH29. There are no other accesses directly on to the highway.	Excellent
Speed and Travel Time	Average daytime speed of 88km/h Projected peak hour average speed (2050) of 83km/h at passing lanes	Average speed of 105km/h (based on a posted speed limit of 110km/h for this corridor which is consistent with the Cambridge Section.	Excellent
Amenity	Journey quality responds to topography, generally good ride and comfort	Journey quality responds to topography, generally a good ride and comfort level	Excellent
Resilience	A viable alternative is not available, particularly for HPMVs and which could accommodate current capacity	Alternative is always available (however level of service of the alternative is less than state highway standard). Unplanned road closures or events disrupting traffic are expected to reduce by 90%. That is from 179[81] unplanned events to 17.9; reducing the average of one unplanned event every 10 days to one every 102 days.	Good

Table 13-2: Recommended Option - ONRC Outcomes

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[79] Post SNP (Stage 1 and 2) safety improvements
[80] Waka Kotahi's One Network Road Classification (ONRC)
[81] Updated unplanned event information from the West Waikato NOC for the period 16 July 2016 to 26 February 2018.

13.4 Investment Assessment Profile

An assessment profile for the C2P route using Waka Kotahi's Assessment Framework for 2018-21 NLTP is outlined below. The profile includes the results alignment and cost/benefit appraisal for investment. The problem, benefits and options have been considered against the draft 2021 GPS for this DBC 2020 update and a GPS assessment profile has been completed on this basis.

The DBC assessment profile on the recommended option is 'very high' with a BCR of 0.58 to 0.63 (including and excluding SH1/29 respectively). A summary has been provided below and more detailed information on Results alignment is provided in Appendix M.

13.4.1 Results Alignment

The Results alignment for the preferred option is **Very High**. This is due to the route:

- Having a high crash risk. The route is classified as being a high risk rural road, a high collective risk and the option ensures a 40% or more reduction in DSI
- Being identified as a high benefit speed management corridor with treatment of 'Engineer Up'[45]. This preferred option provides for efficient travel, and is now designed for the intended function
- Achieving the desired customers levels of service for this ONRC (refer Table 13-2) including:
  - Safety Performance
  - Accessibility
  - Speed and Travel Time
  - Amenity and
  - Resilience
- Being a national (high) volume route
- Being the key link and national freight and tourism route for providing journeys between Auckland, Hamilton, Tauranga and south for employment, access to economic opportunities, tourism and freight. The existing SH1 has gaps for this function of road for customers levels of service and in particular travel time reliability
- Being identified in regional plans for Waikato and Bay of Plenty as being strategically important
- Being part of the strategy that builds on the investment in the Waikato Expressway (WEx).

13.4.2 Efficiency

The efficiency (or BCR) with SH1/29 included is 0.58 or 0.63 with the intersection excluded. As the BCR is less than one, the efficiency rating is a '-' (Nil).

13.4.3 Assessment profile and prioritisation

Based on the above the recommended option has an Investment Assessment Profile of VH/'-'.

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13.5 Alignment with 2021 GPS

The preferred C2P route aligns well to the strategic priorities and themes outlined in the 2021 GPS as shown in Table 13-3.

PRIORITY		OBJECTIVE	C2P ALIGNMENT
Key Strategic Priorities	SAFETY	Develop a transport system where no-one is killed or seriously injured	Provides a 4-star route which will significantly reduce deaths and serious injuries, over and above the gains that are likely to be realised by the short-term improvements.
	Better Travel Options	Provide people with better travel options to access places for earning, learning, and participating in society	The recommended option provides high standard on and off-road facilities to encourage mode-shift to walking and cycling for trips within the local community. To further determine the options for these connections, a separate option development exercise is being undertaken to determine a preferred route for Te Awa Trails and connection from the Waikato Trail from Horahora Road to the SH1/SH29 intersection. One of the key objectives for the project is providing for improved access to community features and to consider all customers. To achieve this with the preferred expressway option, a network connection shared path with grade separated facilities to connect Hydro Rd to Karapiro Rd has been incorporated. This route also provides opportunity for a separate project to connect three cycle trails where they meet at the intersection of SH1/29. In addition, the separation of expressway traffic enables an attractive and safe corridor for alternative modes (i.e. active modes) along the future local highway route to Cambridge and Karapiro School. With the preferred route moving into the next phase, ATMS and ITS will be considered as part of providing an optimised solution for a range of users.
	Improving Freight Connections	Improve freight connections to support economic development	The recommended option improves safety, efficiency and resilience on the SH1 corridor, a nationally important freight route that connects Auckland, Hamilton and Tauranga as well as SH1 to the south. It enables better access to markets and links key production points (Waikato) with the key distribution points (Ports of Auckland and Tauranga). The recommended option provides a much more resilient route, and retains the existing corridor as a good alternative route which can accommodate high productivity motor vehicles
	Climate Change	Transform to a low carbon transport system that supports emissions reductions, aligned with national commitments, while improving safety and access	Although neutral in terms of carbon emissions, the project moves SH1away from the culturally and environmentally sensitive Waikato River, thereby enabling improved environmental outcomes (i.e. stormwater treatment) and reducing cultural effects. The preferred route also significantly improves safety and access.

Table 13-3: Alignment with strategic priorities in 2021 GPS

On the balance this project demonstrates good alignment to the 2021 Government Policy Statement on Land Transport with benefits being delivered in line with the safety, better travel options and improved freight connections strategic priorities with no significant detrimental effect on climate emissions based on the economic evaluation completed.

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13.6 Summary of Outcomes

If we address the problem by investing in those benefits agreed by the workshop stakeholders, the key outcomes of the long-term project will be:

- A safe route and connected network that provides significant improvements and opportunities for a range of customers therefore improving economic growth in the regions and nationally
- A route that provides the corridor that all customers are expecting and demanding for the route
- Approximately a 2.2-minute travel time saving for SH1 users, by shortening the route and increasing the posted speed limit compared to the existing route. These travel time savings make the SH1 and SH29 corridor more attractive as the preferred route for travel between Auckland, Waikato and Bay of Plenty
- Ensuring the journey time for all customers is the same; whatever time of day or time of year they travel along the route
- 90% reduction in unplanned road disruptions, with a suitable alternative route always available for State highway users. This reduction in closures is from 179[82] unplanned events to 17.9; reducing the average frequency of disruptions from one unplanned event occurring every 10 days to one every 102 days
- Improved access to local community features, maximising the opportunity for future growth in the community and increased local tourism
- 19.4 fewer deaths and serious injuries (5 years) compared to the baseline
- Enables the WEx investment made to date to be enhanced and enables expressway termination to be achieved in a logical manner i.e. logical juncture of SH1 and SH29 where traffic volumes split and reduce.

13.6.1 Opportunities:

The following opportunities have been discussed, noting that the specific treatment, cost or location of that opportunity will need to be determined in any subsequent phases.

- Messaging of key cultural and heritage outcomes as part of information sharing back to the community – e.g. could be incorporated in rest areas on the old route etc. as well as cycle trails
- Land use changes – old SH route - opens potential for business to grow
- Service centre potential
- Increases to walking and cycling in many locations – connected network both on (e.g. revoked SH1) and off-road facilities (in particular, the linkages to Te Awa, Waikato and Hauraki cycle trails)
- Improved environmental outcomes and potential enhancement to ecology and stormwater management prior to discharge to the Waikato River.

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[82] Updated unplanned event information from the West Waikato NOC for the period 16 July 2016 to 26 February 2018.

Implementation Pathway

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14 IMPLEMENTATION PATHWAY

14.1 Introduction

The future components of work required to deliver the project are shown in Table 14-1. The following sections summarise the key components, along with the associated complexity and risks. Broadly speaking, the complexities of the project are associated with:

- The northern part of the site is in close proximity to the heavily trafficked existing SH1, with numerous side roads, property entrances, Karapiro School, businesses, and farms
- The southern part of the site being through steep terrain
- The general proximity of the site to the Waikato River/Lake Karapiro.
- The lack of geotechnical and environmental information, as well as other investigation information at this time
- The 50 Landowners that are potentially affected by the route
- Earlier construction (2022) of the SH1/29 intersection as part of the NZ Upgrade programme requiring interface for the longer term C2P Project which has no current committed start date for construction
- The high level of political and stakeholder interest in the project.

PHASE	COMPONENT OF WORK	DESCRIPTION, COMPLEXITY & RISK
DBC	Finalise 2020 DBC Review and Approve	The 2018 and 2020 DBC update have followed a robust and well documented process to select the preferred option and have been developed in conjunction with stakeholders and Waka Kotahi specialists. It is anticipated that the DBC will require Waka Kotahi Board approval after internal Waka Kotahi review. The main risks are associated with the uncertainty surrounding a planned implementation timing for the C2P Long Term corridor given a low BCR and short-term SH1 LOS improvements via proposed Safe Network Programme upgrades.
Pre-implementation	Engagement	s 9(2)(g)(i) [redacted]. Property issues are discussed in section 14.3.
	Consenting & Statutory Processes	These are discussed further in the following section and include corridor protection via designation and various consents.
	Further investigations	Investigations at the site have commenced, and include geotechnical, environmental, and archaeological investigations, along with control and topo survey to supplement the LiDAR ground model.
	Specimen Design	C2P has adopted a two-step design process for the pre-implementation phase to inform consents and a later implementation contract: Consenting Design – enough investigation and design to support the consenting process, with the design effort focused on the consenting issues (e.g. stormwater rather than pavement) • Further specimen design to support a future procurement process. Waka Kotahi wishes to test a lighter level of specimen design than traditionally used to reduce the time/cost for the pre-implementation stage. This two-step approach should result in an efficient design process, minimising the risk of re-work as the project develops. s 9(2)(g)(i) [redacted] There are many complex components to be designed including geometrics, stormwater and erosion and sediment control through steep terrain, road and stream bridges, earthworks, retaining walls, erosion and sediment control, pavement, and landscaping. Complex temporary traffic management will also be required.

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PHASE	COMPONENT OF WORK	DESCRIPTION, COMPLEXITY & RISK
	Contract Documentation and Principal's Requirements	A pre-implementation scope is in place to complete a set of Principal's Requirements in conjunction with the Specimen Design. These requirements will assist in informing the designation and consents and will clearly dictate the scope and standards to which future tenderers must comply. Once a procurement timeline and approach are confirmed for C2P the balance of Contract Documentation for Registration of Interest, SIA, and Request for Tender, Basis of Payment and Schedule of Prices can be prepared s 9(2)(g)(i)
	Land entry and property acquisition.	WSP Property and The Property Group (TPG) have been engaged to obtain land entry agreements for investigations along the route. At this stage the timeline for property acquisition is still to be confirmed. Initial meetings with landowners have identified a few properties that may require a compulsory acquisition process once a designation is in place and there is a committed start date for construction.
	Procurement	Either a Design and Construct, competitive alliance, or hybrid alliance procurement model could be considered. s 9(2)(g)(i) [redacted]. All follow the following indicative steps: • Registration of Interest • SIA and evaluation to a short list of two Tenderers • 16-week Interactive Tendering • Tender evaluation • Pre-letting negotiations and award These are standard procurement models for a contract of this size. The main risks are associated with poor Principal's Requirements and/or not enough information to inform the Tenderer's tender design development.
Implementation	Construction & MSQA	A strategic investment decision will be required if C2P is to be procured and constructed any earlier than circa 2030. Following the above procurement process and a Contract Award the Contractor would commence their detailed design of the works. s 9(2)(g)(i) [redacted] Following completion of the C2P Long-Term Improvement Project a revocation process (Section 14.4) and works will need to be implemented to handover the existing SH1 to local authorities.
Operation	Operation	Key operational complexities are associated with provisions for emergency services and intelligent transport systems.
	Maintenance	The initial design work as part of the DBC and early pre-implementation has already taken maintenance into account, by, for example, minimising areas requiring mowing through planting swales and flattening batter slopes to enable them to be returned to pasture. Maintenance bays will be provided to ensure safe access to features requiring regular or specialist maintenance (e.g. bridges). s 9(2)(g)(i) [redacted]

Table 14-1: Summary of Future Work for C2P Long-Term Improvements

Refer to Section 16 (Commercial Case) for more detail in relation to the pre-implementation and implementation phases.

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14.2 Consenting Strategy

The purpose of the Consenting Strategy is to outline what is likely to support the implementation strategy for the detailed business case and to provide a recommended approach to Waka Kotahi for obtaining approvals under the RMA for the construction, operation and management of the project(s).

A draft Consenting Strategy was developed through the course of the IBC/DBC and is being updated as part of the parallel pre-implementation phase. The Draft 2020 DBC Consenting Strategy is provided in Appendix H. The purpose of this document is to define the strategy that is proposed for obtaining statutory approvals and processes associated with Waka Kotahi's SH1/29 Project and C2P Project.

14.2.1 Existing Designations

The Project area is located within the boundaries of three territorial authorities, being Waipa District Council (WDC), Matamata Piako District Council (MPDC) and South Waikato District Council (SWDC) and within the Waikato region. SH29 and SH1 are designated (D89) on the MPDC Planning Maps with the purpose stated as: State Highways in accordance with Transit NZ Act 1989.

SH1 is designated (D451) on the SWDC Planning Maps with the purpose stated as: To undertake all statutory requirements in accordance with the Land Transport Management Act 2003 and the Government Roading Powers Act 1989.

The proposed location of the roundabout sits within SWDC and MPDC boundaries. The proposed C2P route is within WDC and MPDC boundaries.

14.2.2 Approvals Required for SH1/29

The following approvals are expected to be required:

1) Notice of Requirement to South Waikato District Council (SWDC) and Matamata-Piako District Council (MPDC)
2) Regional resource consent applications to Waikato Regional Council, likely to include:
    a) Land use consent for land disturbance activities including earthworks, roading, tracking, ground improvements, cleanfill and overburden disposal and borrow sites including related discharges during construction
    b) Land use consent to install discharge structures and culverts associated with road construction and operation
    c) Water permit to divert or dam water in watercourses associated with culvert and road construction and operation
    d) Discharge permit for stormwater diversion and discharge to surface water and/or land during road construction and operation
    e) Water permit to divert and use groundwater during road construction.
3) District resource consent applications to SWDC or MPDC - resource consents from the district councils[83] may be required depending on the presence and proposed management of any contaminated soil.

Proposed designation and resource consent lapse and expiry dates – SH1/29

The SH1/29 Project is part of the NZUPT delivery programme with construction set to start early 2022 and completion in 2024. Accordingly, there is a high level of certainty that the designation would be given effect to quickly. Therefore, the standard lapse date of 5 years is considered suitable for this Project.

In relation to the duration of the regional resource consents for operational matters such as long-term discharges, it is recommended that a period of 35 years is sought reflecting the strategic importance of the SH1 network and the long-term assets that are being constructed as part of the Project.

Given it is likely the designation and regional consents would be given effect to within 12 months, the standard lapse date of five years is suitable.

14.2.3 Required RMA approvals for C2P

The following approvals are expected to be required:

1) Notice of Requirement to WDC and MPDC

[83] Under the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011

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2) Regional resource consent applications to Waikato Regional Council, likely to include:

    a) Land use consent for land disturbance activities including earthworks, roading, tracking, ground improvements, cleanfill and overburden disposal and borrow sites including related discharges during construction
    b) Land use consent to install discharge structures, bridges and culverts associated with road construction and operation
    c) Water permit to divert or dam water in watercourses associated with culvert, bridge and road construction and operation
    d) Discharge permit for stormwater diversion and discharge to surface water and/or land during road construction and operation
    e) Water permit to divert and use groundwater during road construction

3) District resource consent applications to WDC or MPDC- resource consents from the district councils[84] may be required depending on the presence and proposed management of any contaminated soil.

Proposed designation and resource consent lapse and expiry dates – C2P

The DBC has identified that the Project would be needed by 2030 with construction expected to take five years. Therefore, an extended lapse period of fifteen years for the designation and regional consents for this project is recommended. In relation to the duration of the regional resource consents for operational matters such as long-term discharges, it is recommended that a period of 35 years is sought reflecting the strategic importance of the SH1 network and the long-term assets that are being constructed as part of the project.

14.2.4 Other Requiring Authority approvals for C2P

The project will involve works in land already designated by another Requiring Authority being Transpower. Approval from Transpower will be required under section 176 and 177 of the RMA.

14.2.5 Heritage New Zealand Pouhere Taonga Act 2014 Authorities for C2P and SH1/29

The Heritage New Zealand Pouhere Taonga Act 2014 (HNZPT Act) makes it unlawful for any person to modify or destroy, or cause to be modified or destroyed, the whole or any part of an archaeological site without the prior authority of Heritage New Zealand Pouhere Taonga (HNZPT). Any work that may affect an archaeological site must be authorised under an authority from HNZPT before beginning.

Work undertaken by the project archaeologist in 2018 noted that there are 22 recorded archaeological sites within the project area. Much of the area was not accessed in 2018 as permission was not granted and as such the initial results are based on desktop research and visual inspection from afar. The area of the project has a long history of Maori occupation, being primarily used by Maori for cultivation, with several recorded archaeological sites in the preferred expressway corridor (i.e. cultivated soils, borrow pits and pā). Pā sites are typically indicators of extensive areas of occupation and it is likely there are extensive unrecorded archaeological sites within the corridor. Once the project archaeologist has undertaken a full archaeological survey of the area, and determines that a general archaeological authority is required, it will be applied for at the appropriate phase in the project.

14.2.6 Wildlife Act 1953 Authorities for C2P and SH1/29

The Wildlife Act 1953 (WA) outlines the protection and control of wild animals and birds and the management of game and is administered by the Department of Conservation (DoC). Part 1 of the WA addressed protection of wildlife and provides varying levels of protection to different species. To catch, hold, release, transfer or kill most wildlife and freshwater species requires permission via a Wildlife Act Authority (WAA) from DoC.

The presence of wild animals and birds is expected within the extent of works for both projects, however the scale of presence is currently unknown. Once the Project Ecologist has undertaken a full ecological survey of the area, and determines that a WAA is required, it will be applied for at the appropriate phase in the projects.

[84] Under the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011

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14.2.7 Packaging and timing of RMA approvals

SH1/29 Project

The NZUPT Programme-Wide Consenting Strategy is to progress SH1/29 as a combined NoR and consent application package to WRC, SWDC and MPDC. This is the recommended pathway for this Project.

C2P Project

While the C2P project does not have any confirmed funding beyond route protection, the DBC has identified it would be needed by 2030 with construction expected to take around five years. Therefore, applying for the regional resource consents with the NoR would avoid opening up the project to opposition again and similar delays at a future date.

It is therefore recommended that the NoR and resource consent applications are applied for together at the same time.

14.2.8 Environmental, social and cultural issues

The purpose of Waka Kotahi's Environmental and Social Responsibility Standard Z19 (ESR) is to provide information to Waka Kotahi Project Managers and their teams on how and where to implement Waka Kotahi's environmental and social requirements in the inception and implementation of any network activities. This is to ensure projects comply with Waka Kotahi's environmental and social legal requirements, policies, plans, standards, specifications and guidelines. ESRs were undertaken in May 2017 for the six route alignment options. The ESR for the preferred route alignment was updated in January 2018. The 2018 ESR has now been separated into the two separate projects and updated in September 2020 as attached in Appendix A of the Consenting Strategy.

Guided by the outcomes of the initial ESRs, and clauses 6 and 7 of the RMA, some technical assessments were undertaken in 2017 and 2018. Both Projects require technical assessments and AEE to support the statutory applications. Further detail in regard to the scope of the technical assessments is provided in section 13 of the Consenting Strategy.

14.2.9 RMA approval pathways

Pathway Options

There are four pathways that the NoR and resource consent applications for each Project can be considered, as follows:

- Traditional Council pathway with appeals to the Environment Court
- Direct referral to the Environment Court
- Environmental Protection Agency/ Board of Inquiry
- Covid 19 Fast Track Legislation.

Section 15 of the Consenting Strategy discusses these pathways in detail, provides the advantage and disadvantages to each pathway, and provides a recommended pathway for each project. The recommended pathways are outlined below.

Pathway recommendation for SH1/29 Project

As this project involves three councils (SWDC, MPDC and WRC) and a minimum of two landowners who may oppose the applications, it is recommended that the traditional Council pathway is initially followed, requesting public notification. If there are several submissions in opposition to the project, that would delay the project, it is recommended that the project then seeks a direct referral to the Environment Court.

Pathway recommendation for C2P Project

As this project involves three councils, being WDC, MPDC and WRC and numerous landowners it is recommended that the traditional Council pathway is followed, requesting public notification.

14.3 Property Strategy

Adequate designation and land requirement will be requested to provide the opportunity for an innovative design and cater for uncertainty with respect to geotechnical conditions (e.g. batter angles). Advance compensation agreements will be considered as an efficient way of achieving the above, while still reducing the overall long-term cost, risk and effect of land purchase. The expectation, however, is that residual land could be disposed of at a later date.

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An alternative to be further explored is an option to lease land from the landowner required for construction, with only the main road corridor and associated infrastructure acquired. Following construction, the leased land would be restored for farming purposes (i.e. could be turned in to flat slopes) and handed back to landowners.

Based on preliminary work undertaken, approximately 490 hectares of land is required from 50 landowners for the SH1 Cambridge to Piarere project. Approximately 5 hectares of land has either previously been acquired for the project or is left over from the Cambridge section. This has been excluded from the 490 hectares referred to.

With no committed construction start for C2P there is currently no proactive property acquisition underway. However, Waka Kotahi will continue to manage any advance applications for purchase under hardship or compassionate grounds. Waka Kotahi's Property Acquisition Consultants (WSP and The Property Group (TPG)) will continue to liaise with landowners along the C2P route for matters such as arranging land entry for further investigations and responding to queries as investigations and consenting progress. A formal property acquisition strategy will be developed for C2P following the release of final land requirement plans.

14.4 Revocation Pathway

Early discussions were undertaken with Waipa District Council[85] to discuss revocation of the existing state highway back to a local road. Waipa District council staff highlighted the following issues that will need to be considered as part of the future revocation process:

- The ONRC is likely to be that of a local collector
- There would be an expectation that the road is fit for purpose and some aspects of the road would need to change to meet its new function. For example, whether passing lanes and ATP would be appropriate
- There would be a reduction in safety issues given reduced through traffic volumes
- The use and need for rest areas
- That cycling facilities could be provided in the wider carriageway or off road
- That the local road will form part of emergency and maintenance diversion, so lanes widths will need to accommodate this use
- There could be a potential speed limit reduction
- Limited access will need to be discussed with Waipa DC planners
- Ensure accesses are maintained in terms of widths for tracking and safety
- Desire for optimum future maintenance costs and expect current maintenance by Waka Kotahi will be ongoing until handover
- The need to hand over any current licences, resources consents, discharge licences etc
- Any boundary changes, particularly at the intersection of SH1/SH29, will require agreement as to the approach Handover dates will need to be determined at a future time.

The Estimate (Appendix L) has allowed for a base cost of $2.8M and an expected cost of $5.6M (with contingency) for anticipated revocation work which relates to resealing, line marking and some pavement removal. This also includes recognition that the SNP works, specifically the additional barrier and any associated pavement widening may not be required by Waipa District council and may have to be removed. Further details on the approach including details of function and final traffic volumes will need to be determined in subsequent pre-implementation phases of the project.

[85] Meeting Minutes 15 January 2018

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15 TRIGGERS AND POSSIBLE PROJECT STAGING

15.1.1 Triggers and Timing of Need

The problem definition and evidence in Section 4 in conjunction with the options evaluation process confirmed that baseline SNP improvements (Stage 1 and 2) do not address the problem statements in full for the C2P corridor. Furthermore, the option evaluation and MCA process, including that as part of the 2020 review and update has confirmed that an offline E2 corridor is the preferred long-term solution to deliver on the problem statements and investment objectives and outcomes.

Given that there is no investment commitment for the long-term C2P Project, further high-level analysis has been undertaken to provide indicators for when further short to medium-term interventions may be needed on SH1, and when CLoS are likely to reach a point at which they are unacceptable (from both a customer and route classification perspective).

Figure 15-1 overlays and illustrates likely CLoS breakdown timeframes for the following key aspects:

1) Average travel speed
2) Mid-block roadway capacity
3) Main Local Road intersections and Karapiro Road and Hydro Road
4) Local property access capacity & median barrier turnaround capacity with Left-in/Left-out arrangements
5) Resilience
6) Safety.

While the roadway capacity timelines are based on simple capacity analysis, the resilience and safety assessments are based on the analysis within Section 4 together with qualitative judgement as to the potential impact should a SNP Stage 3 be considered as a further short-medium term intervention.

Figure 15-1 provides analysis of local access delays, based on trucks[86] making up 10% to 50% of the turning flows, with the same analysis repeated for the median barrier turnarounds. LOS F (> 50sec delay/veh) is likely to be reached between 2030 and circa 2040 depending on the proportion of heavy vehicles turning. The LOS degradation starts to accelerate from 2040 onwards.

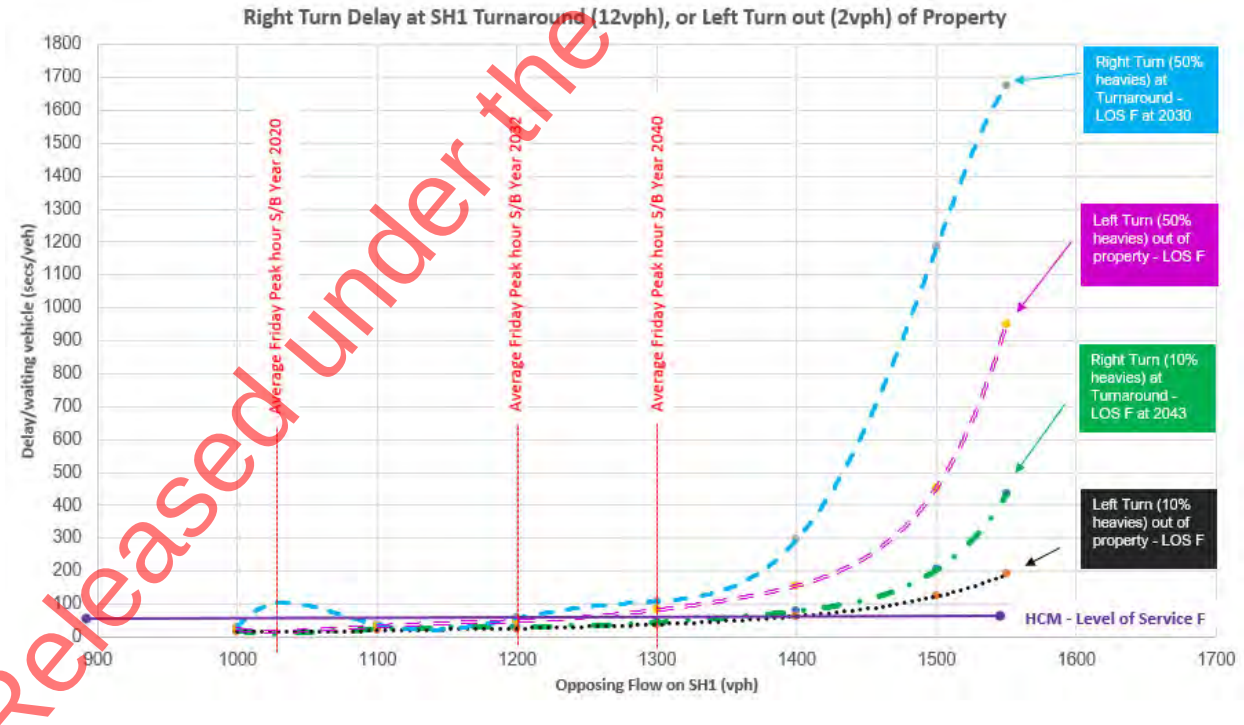

Figure 15-1: Right turn delay at turnaround (12vph), or left turn out (2vph) of property

[86] Considered to also represent cars/SUVs towing heavy boats or horse floats and agriculture vehicles given the proportion of rural and farming properties along the corridor

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Figure 15-2 provides analysis for key existing local roads at Karapiro and Hydro based on an assumed exit flow of 16vph which demonstrates that LOS F is exceeded in 2020 during average Friday peak periods. If the C2P Long-term improvements are delayed for a significant period of time, then these localised intersection capacity (and safety) problems could be addressed via SNP 3 with the addition of at-grade roundabouts. In the event that this approach is taken, the intersections would have sufficient capacity to deliver an acceptable CLoS well beyond 2060 based on a 1% traffic flow growth.

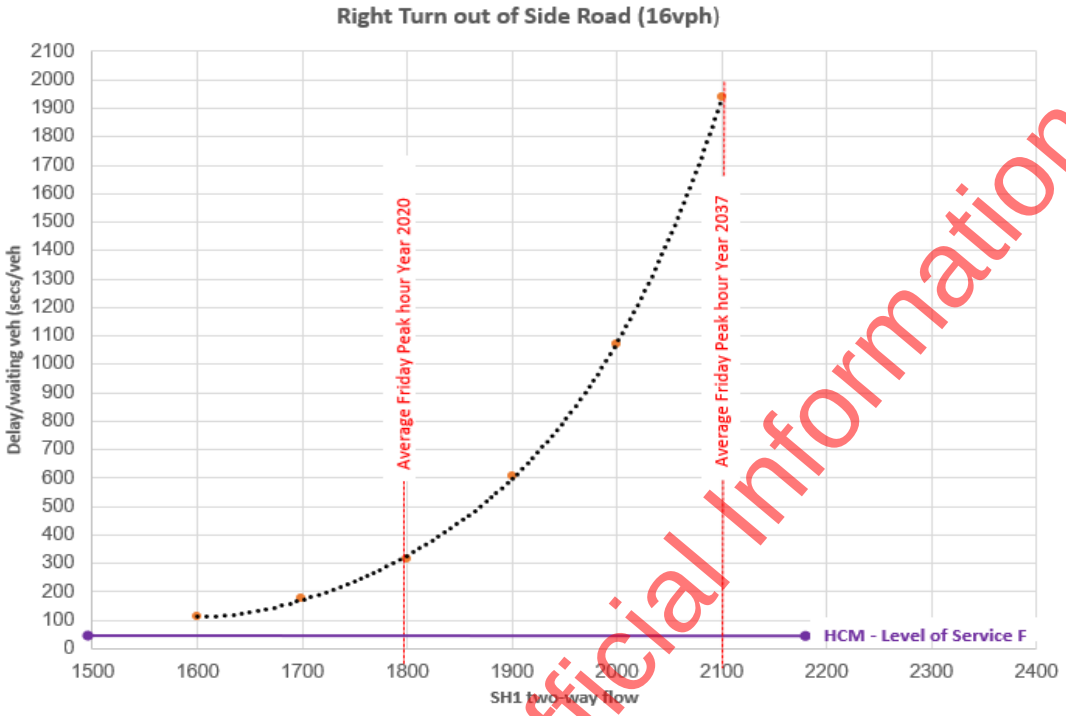

Figure 15-2: Predicted Delay for Right turn out of side road on existing SH1 (16vph)

Figure 15-3 below provides a summary overlay of the various competing cLoS issues along the existing SH1 together with indicative intervention trigger dates associated with the need for investments to address these.

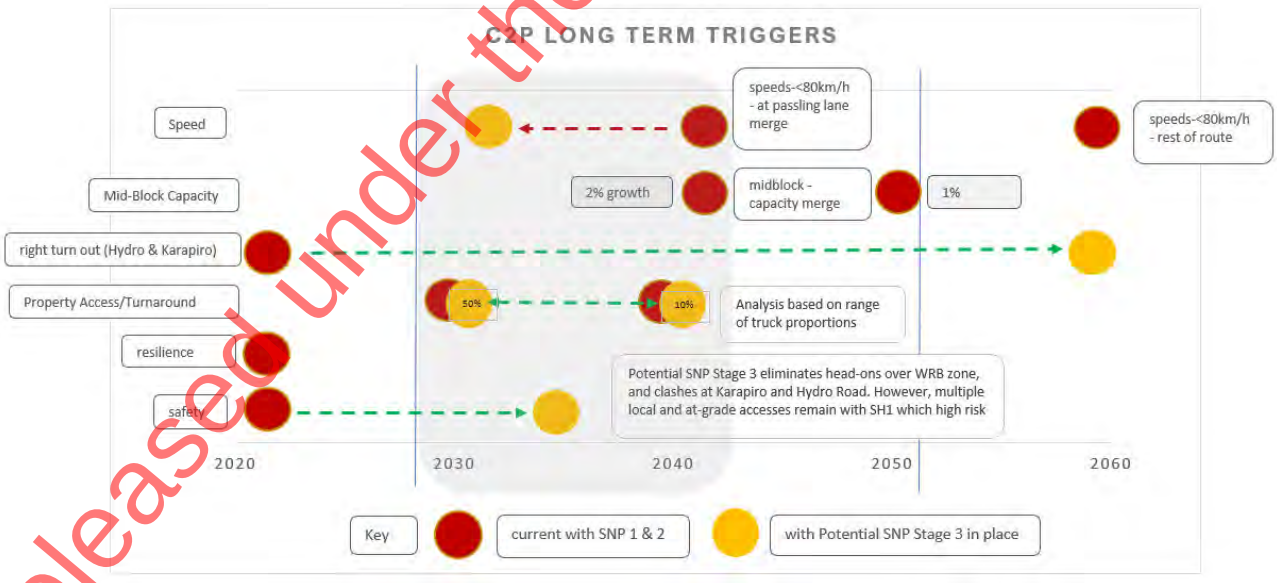

Figure 15-3: Summary of Triggers of need for Long Term Route

Figure 15-3 illustrates the following key points:

1) Despite the step improvements achieved in the baseline SNP 1 and 2, safety remains below CLoS expectations for the route classification i.e. a high-risk rural road. If an investment decision on the C2P Project is delayed for the long-term, investment in SNP Stage 3 would improve safety performance at Karapiro and Hydro Road (illustrated by a shift to the future for CLoS breakdown), however CLoS would

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remain below the preferred safety CLoS and outcomes sought due to the remaining multiple local access and other local road access points and median barrier turnaround points

2) Resilience is improved (fewer head on crashes) but not addressed in full by SNP 1, 2 or 3 Furthermore WRB strikes are likely to occur leading to disruption and a lack of practicable alternative remains. This is addressed by the C2P Long-Term preferred option
3) Local property access is a current safety issue. As traffic flows on SH1 increase, and CLoS worsens (increased waiting for acceptable gaps), the crash risk will likely increase. The above illustrates that LOS F (delays >50 secs) is likely from circa 2030, with acceleration of this delay beyond 2040
4) CLoS at the Hydro and Karapiro intersections remain below target CLoS at 2020 with SNP1 and 2 in place However, if C2P is delayed SNP 3 would address capacity and CLoS at these intersections out to circa 2060 based on 1 percent growth
5) Capacity breakdown at the end of passing lanes is forecast to occur during an average Friday peak from between 2040 and 2050 depending on the actual traffic growth rate
6) Speed – with the SNP 1 and 2 baseline in place the mid-block average travel speed is likely to remain above 80km/h out until circa 2060 (if the passing lanes are closed).

Based on the information and analysis completed the following would seem an intuitive approach:

- Implement SNP 1 and 2 as captured within this DBC baseline
- Progress and secure the designation for the long-term C2P preferred route as this is the long-term solution that will deliver on the problem statements and investment objectives
- While route capacity is not a short or medium-term driver for the long term C2P Project (2040 to 2050 mid-block and 2030 to 2040 for local accesses), the route will remain a high-risk rural road even with SNP in place
- Recommend that C2P Pre-implementation continues, and an investment decision is made to support a long-term C2P implementation prior to 2030 given the low resilience, safety, accessibility CLoS relative to route classification (and the intuitive gap between the Cambridge expressway section and drop-off in volumes/function at SH1/29)
- If C2P investment is to be deferred, then invest in SNP 3 to further address safety and capacity concerns at Hydro and Karapiro Roads for the medium to longer term until such time the C2P long term project can be committed to.

15.1.2 Possible Project Staging

Due to the high safety risk at the intersection of SH1/SH29, the New Zealand Government provided funding[87] as part of the NZUP programme for a new roundabout to be constructed. As a result of this funding, the SH1/29 roundabout is being implemented in advance of the remainder of the Long Term programme and is committed for a construction start by 2022. The solution to be implemented will be future-proofed for the long-term C2P project.

It is envisaged that the preferred long term C2P route could be procured and constructed as a single design and construct, competitive or hybrid alliance contract, without the need for staging. However, if other constraints (e.g. funding) forced consideration of other staging options for the preferred route, a first stage of work could involve construction of just the first 6km of the expressway from the Cambridge Southern Interchange, including the grade separated interchange at Karapiro Road. This staged section would then require a temporary tie-in into the existing highway south of Tunakawa Rd. This stage would be significantly lower cost than the full preferred option and would go some way to achieving the investment objectives, particularly around community access and safety. However, it would not directly address a number of serious problems with the existing state highway, including the remaining intersections (e.g. Ferguson Gully Road). Although some of these issues could be mitigated by further investment in the short-term improvements, constructing just this section of the expressway would also not allow other benefits to be realised such as cycling, land use and business opportunities. This staging option has not been considered in any detail within this report.

In order start construction in 2030, the timeline shown in Figure 15-4 would be needed.

[87] January 2020

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Figure 15-4: C2P Corridor Pre-implementation/Implementation Timeline

However, pre-implementation for the corridor has been started (4 years earlier than otherwise would be required) due to the following reasons:

- the link between SH1/29 NZ Upgrade programme fast track and its connection to the corridor.
- protecting the strategic corridor and provide certainty for landowners and stakeholders.

It is also noted that S188 property purchases are already triggered from earlier activity to progress the corridor. These are likely to continue regardless of when designation is confirmed.

If investment in the preferred C2P long-term project is to be delayed significantly (e.g. later than 2030) further improvements such as a Stage 3 SNP will be required to address safety and accessibility at key local road intersections (particularly Karapiro and Hydro Roads). These further investments on the existing SH1 are not likely to be justified if C2P is committed for construction in the medium-term.

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[88] Based on estimated construction period of 5 1/4 years (section 16.3.2)

16 COMMERCIAL CASE

16.1 Introduction

This chapter provides evidence on the commercial viability for this DBC. The commercial case is considered from the end of the DBC phase through to engaging with industry for construction. The various phases of the project have been considered throughout the project's development to ensure its successful implementation. To be implementation ready, the following stages are required:

1) Pre-implementation (Section 16.2, including consenting and property)
2) Implementation (section 16.3- procurement and construction).

The C2P project was originally fast-tracked with an intended date of starting Construction in 2020 and a Stage 2 Procurement Strategy had been developed at the time to support this. With the C2P project since deferred, a revised Stage 2 Procurement Plan is yet to be developed by Waka Kotahi and is therefore not included with this DBC.

With a committed construction start in 2022 for the SH1/29 intersection, the pre-implementation phase has commenced to run in parallel with the end of the 2020 DBC review phase. This is to enable investigations and assessment of effects to progress so that designation and consent timeframes can be met for the intersection upgrade and to ensure an integrated interface between the short and longer-term solutions. Given the current potential investment triggers for C2P it is likely that there will be a significant gap between the end of the C2P pre-implementation and the start of C2P the implementation phase as illustrated in Figure 16-1.

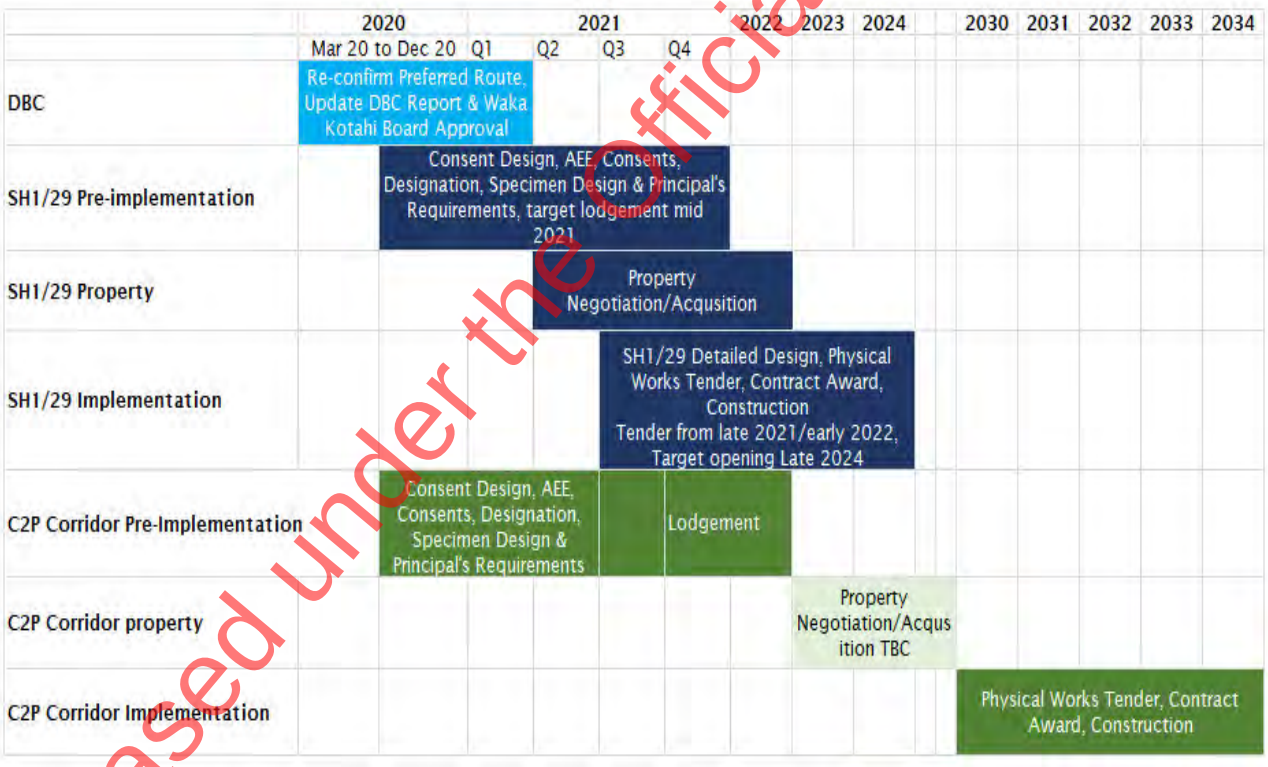

Figure 16-1: Implementation Strategy Timeline

16.2 Pre-implementation

This phase of C2P includes the further development of the DBC design into a consenting design and consent application through to finalisation of a specimen design and draft principal's requirements. Specifically, it includes:

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- Applying and providing support for designation of land and resource consents to protect the corridor and enable future construction
- Completing a Specimen Design (and supporting information) to a level appropriate to inform Consenting and a later procurement process
- Continuing to maintain good working relationships with the project stakeholders and Iwi.

This phase is currently underway to capture further baseline investigation information with the intention to lodge consents in 2021. The pre-implementation phase for the project is likely to take two years from approval dependant on engagement outcomes, statutory requirements and land acquisition.

Some details of constructability and operation are provided on the recommended route in section 16.3.6. A property strategy and acquisition process runs alongside this phase and a summary of the strategy is provided in section 15.3.

16.3 Implementation

There are several options that could be considered for implementation (detail design and construction) of C2P ranging from a Design and Construct (D&C), competitive alliance or hybrid alliance. A Stage 2 Procurement Strategy will be developed by Waka Kotahi at a future date. The strategy purpose will be to:

- Reconfirm the delivery model used for the project
- Provide a brief update on the project status
- Document details of the procurement plan to be applied to the procurement of suppliers for the Physical Works.

16.3.1 Delivery model Options

A Design and Construct (D&C) model could be considered for C2P given the following key factors:

- The project requires high earthworks (given significant cuts and fills and geotechnical uncertainty) with low technical complexity in a greenfield area. However significant opportunity for innovation exists in the constructability (earthworks methodology) and structural components
- Opportunity to source an innovative value for money approach
- Industry capability associated with the D&C delivery model is strong

However, recent trends have seen some D&C contracts drive lowest conforming solutions due to the high focus on price during the tender evaluation process. More recently hybrid alliances have been used to good effect in driving an improved focus on value and whole of life outcomes against a Waka Kotahi stipulated affordability threshold. With some significant bridge (at least two with spans of circa 160m and 130m) and retaining wall elements, and significant capex value it is likely that C2P would be well suited to a hybrid alliance procurement model. This will be confirmed via an updated procurement strategy.

16.3.2 Contract length and schedule

It is expected that the overall project physical works for the long-term C2P project will be completed within approximately 5 years of construction commencing, depending on how this work is packaged.

The anticipated procurement activities from registration of interest through to award of contract are summarised in Table 16-1.

ACTIVITY	INDICATIVE TIMELINE
Registration of Interest	4 weeks
Issue Statement of Interest and Ability	4 weeks
Announce Shortlisted Tenderers	Milestone
Interactive Tender Period	4 – 5 months
Award of Contract	Milestone

Table 16-1: Potential Procurement Programme

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16.3.3 Output based specification

Assuming a D&C, competitive alliance, or hybrid alliance approach will be adopted, a specimen design will be required along with prescribed Principal's Requirements detailing minimum requirements to be implemented during design and construction of the works. There are no unusual processes identified at this time that should complicate the construction process.

16.3.4 Risk allocation and transfer

A D&C procurement model apportions a majority of the risk to the Contractor while the competitive hybrid alliance model allows a more equitable shared risk approach in conjunction with a risk allocation matrix. Regardless of the option, it is recommended that prior to tendering, sufficient information (geotechnical investigation, survey, hydraulic modelling) can be provided to the tenderers to give confidence in their design assumptions. This should reduce contractor contingency allocations, improve certainty and reduce the risk of unforeseen condition claims once final design and construction is underway.

16.3.5 Supplier Selection

Tenderers will need to be NZ Transport pre-qualified to Level 2A (Surfacing), Level 3A (Bridge Construction) and Level 4A (Construction) with the required management, quality, safety and technical support systems.

16.3.6 Construction & Constructability Considerations

Key construction considerations include:

- Managing the impact on traffic in the wider network while construction takes place, while still maintaining access for local roads, businesses and properties
- Ensuring safe construction of the complex works in difficult environments
- Managing significant earthwork operations, with up to 6.3 million cubic metres of cut expected. This is a volume roughly twice what required for the Huntly Section of the Waikato Expressway. This activity is likely to determine the construction duration and poses the greatest programme risk
- Identifying appropriate sites for disposal of unsuitable or surplus soil and rock from the earthworks (potentially up to 3 million cubic metres)
- Constructing bridges in complex topography, particularly the bridges across the streams north of Ferguson Gully Road
- Protecting sensitive waterways that drain to the Waikato River, as well as managing the environmental and ecological effects from construction
- Liaising with utility providers to relocate underground and overhead services, particularly the transmission pylons that are expected to be moved.

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17 MANAGEMENT CASE

17.1 Project Roles and Governance Structure

The project role and governance structure for the next phases of work are still to be determined by Waka Kotahi. This would include confirmation of the involvement of district councils and mana whenua throughout the pre-implementation and implementation processes.

Refer to Appendix B for a description of the key role responsibilities.

17.2 Assurance and acceptance

Project assurance ensures that the project is being conducted appropriately and that the project's acceptance criteria, as developed by Waka Kotahi, are satisfied, along with any other criteria required by other funding partners.

The key project assurance deliverables for the pre-implementation and implementation are shown in the table below:

ITEM	STATUS	COMMENT (AS REQUIRED)
2020 DBC Update Approval & Funding Approval	In progress	
Consents, designation and other statutory approvals	In progress	Applications for Notices of Requirement and Resource Consents are currently scheduled to be lodged during 2021.The information required to put these applications together is currently being gathered.
Design peer review	Yet to start	Critical areas needing peer review yet to be identified.
Road safety audits	In progress	Audit of concept drawings completed. An audit of the specimen design will be undertaken when complete in 2021
Physical Works RFT development	Yet to start	Timing tbc
Property acquisition	In progress	Three properties have been acquired through advance purchase to-date. For the remainder of the C2P route there are no immediate plans to purchase property unless there are specific hardship cases. These will be addressed when required.
Go To Group	Yet to start	TBD

Table 17-1: Assurance Deliverables.

17.3 Change control and Issue Management

Change control and issues will be managed, captured, logged, reviewed and approved in accordance with Waka Kotahi's guidelines. When issues are of a significant level, they will be managed and actioned in accordance with the roles and responsibilities defined in Appendix B. Oversight of key decisions will be provided via a proposed project governance group.

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17.4 Post implementation monitoring - approach and schedule

In meeting the investment outcomes and defining what success looks like an evaluation approach for the investment objectives have been proposed (Table 17-2).

INVESTMENT OBJECTIVE	EVALUATION (METHOD)	TIMEFRAME AND RESPONSIBILITY	BUDGET
Improve Corridor Customer LoS by reducing travel time on SH1 from on opening for next 20 years (13%)	Using Tom Tom data	On Opening and every 5 years for 15-20 years Action – Waka Kotahi	s 9(2)(b)(ii)
Improve Corridor Customer LoS by: Improving resilience via reducing risk or consequence of unplanned road disruptions [Qualitative scale in comparison to existing case - yes/no] on opening for next 20 years (13%)	Qualitative scale in comparison to existing case - yes/no Using TREIS data	Post Opening. 1 and 5 years of closure data Action – Waka Kotahi	
Improve Corridor Customer level of LoS by improving average daily freight travel time on opening for next 20 years (13%)	Using Tom Tom data	On Opening and every 5 years for 15-20 years Action – Waka Kotahi	
Improve local access and distance travelled to key community features by all transport modes on opening	Subjective scale in comparison to existing case - yes/no - using Maptionnaire	Post Opening Action: Waka Kotahi	
Reducing the number of DSIs by 70% reduction in DSIs on opening (15%)	CAS and KiwiRAP (KAT; MegaMaps)	Post Construction – KiwiRAP (IRR) assessment CAS and Risk Review 1 year after opening and every 5 years	
Reducing the Collective Risk (number of high severity crashes per km per road) to no more than a medium on opening for nex 20 years 7.5%)			
Maintaining a low personal risk (High severity crashes by 100 million vehicle km travelled) on opening for next 20 years (7.5%)		Action: Waka Kotahi	

Table 17-2: Monitoring and Evaluation programme

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18 RECOMMENDATION

The recommended Long-term C2P option aligns well with the project investment objectives, meets most policy requirements, provides a high level of customer outcomes and delivers a high-standard long-term solution to this strategically important part of the transport network.

It is recommended that the current C2P Pre-implementation phase continues to progress to enable long-term corridor protection, securing of consents, and to ensure an integrated tie in with the SH1/29 Project being implemented separately as part of the New Zealand Upgrade Programme.

This DBC Report recommends that:

- **The C2P project is designed and constructed in a single stage**. If there are funding limitations, the first 6km of the C2P project from Cambridge Southern Interchange could form a first stage. This stage would be significantly lower cost than the full preferred option but would not directly address a number of serious problems with the existing state highway.
- The **C2P long-term project is funded so that implementation can commence prior to 2030** given the low resilience, safety, and accessibility CLoS on the existing SH1, even once the Safe Network Programme (SNP) Stage 1 and 2 improvements have been implemented
- **Tolling of the route is not pursued** as it is not considered viable
- **Consideration is given to SNP Stage 3 if it is decided the C2P long-term project should not progress** to further address safety and capacity concerns at Hydro and Karapiro Roads for the medium to longer term. Note, that while such investment would likely become a sunk cost, it does not alter the evaluation for the preferred long-term solution.

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Appendices

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APPENDIX A - STRATEGIC ACTIVITY CASE AND ILM

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APPENDIX B - PROJECT ROLES

Waka Kotahi Board

The Waka Kotahi Board has overall responsibility for Waka Kotahi projects. Appointed by the Minister of Transport, the board is responsible for making independent decisions on allocating and investing funds from the National Land Transport Fund. The Board reports directly to the Minister of Transport and is responsible for:

- Land transport planning
- Managing the state highway network
- Regulating access to, and participation in, the land transport network
- Promotion of land transport safety and sustainability.

The Board's approval is required for projects of significance or projects value of $50M and above.

Operational Policy, Planning and Performance(OPPP)

Senior Manager OPPP has the delegation to approve prior to submitting to Waka Kotahi Board. It

Project Steering Group

A Project Steering Group (PSG) was been created to assist the project delivery team answer detailed queries not within the scope of the governance.

The functions of the PSG include:

- Providing opinion and advice on specific technical areas of the project.
- Making recommendations to the governance group, to support any decision that will have a material impact on the project.
- Providing guidance and direction to the project.
- Ensuring that appropriate project assurance activities occur for the most critical aspect of the project's performance and deliverables.
- Managing high level risks.
- Committing the resources required to deliver a successful project outcome.
- Meeting on a regular, approximately monthly basis.

Where required, questions will be raised to the PSG for a decision.

Project Sponsor

The Project Sponsor is a senior management role that involves approving or supporting the allocation of resources for a project, defining its goals and assessing the project's eventual success.

The project sponsor is responsible for:

- Ultimate authority and responsibility for the project.
- Endorsing changes to scope, schedule, budget and quality.
- Endorsing escalation and championing recommendations to the Highways VAC.
- Providing policy guidance to the Project Manager.
- Endorsing the Project Management Plan to confirm that project scope and deliverables are correct.
- Reviewing progress and providing advice on resolution of issues.
- Supporting the Project Manager.
- Resolving issues beyond the Project Managers authority.

Project Manager

The Project Manager's role and responsibilities will include:

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- Overall responsibility for delivery of the project, to time, cost and quality specifications;
- Ensures appropriate approval/sign-off of all project stages and deliverables occur;
- Ensures that project management tools/methods/processes are used;
- Ensure all deliverables meet or exceed agreed quality standards;
- Develops and maintains stakeholder relationships;
- Use best practice procurement approaches to procure suppliers;
- Use best practice project and contract management techniques to oversee the management of all supplier contracts (consultant and contractor); and
- Communication and consultation with the team and external stakeholders.

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APPENDIX C - STAKEHOLDER AND COMMUNITY ENGAGEMENT PLAN

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APPENDIX D - STRATEGIC ALIGNMENT

Strategic Document or Context	C2P contribution to priorities and outcomes	Project Alignment
Government Policy Statement (GPS) (2021/22-30/31)[89] The purpose of the 'draft for engagement' GPS is to provide a transport system that improve peoples' wellbeing, and the liveability of place by contributing to the following outcomes – inclusive access, healthy and safe people, environmental sustainability, resilience and security, and economic prosperity.	As part of addressing the customers expected level of service (for the ONRC), this project will look to improve safety and improved access to core services, resilient, considers the environment through the MCA process which closely match the GPS outcomes; and provide the opportunity to deliver additional benefits through adjacent projects to be realised such as the river trails connection. In addition, using the MCA process has ensured the project returns good value for the money being invested.	✓✓✓
Arataki is Waka Kotahi New Zealand Transport Agencies (Waka Kotahi) 10 year view (2021 to 2031)[90] for land transport system in New Zealand and shows the SH1 corridor as being 'nationally significant' connections for both freight and tourism, and SH29 nationally significant for freight (Figure 1-3). Specifically, that "The road and rail freight routes between Tauranga and Auckland (via Hamilton) form the country's most important freight corridor".	C2P contributes towards providing a strategic freight route and tourist movements in the upper North Island regions by addressing the section of the SH1 at the end of the Cambridge Section of the Waikato Expressway (the end of the total planned Expressway). This approach is also directed as part of agreed problems and benefits to provide significant improvements to safety, access key community features, improvement to freight and resilience, support regional development, and allow wider benefits such as a connection of cycle trails to be realised. It is acknowledged that this section of highway forms only part of the link towards achieving ONRC outcomes based approach for the entire journey on SH1 and SH29 from Auckland through to Tauranga.	✓✓✓
Waikato expressway The main objectives of the expressway are to support SH1 and SH29 and: To enhance inter-regional and national economic growth and productivity To improve journey time reliability and relieve congestion through the main urban centres along SH1 To improve safety and reduce crashes on regional arterials, including SH1 To focus freight movement onto SH1 rather than upgrade alternative routes To provide improved local network operation and opportunities for improved urban design, travel choice and community connectivity within	The outcomes sought by the expressway to support the SH1 and SH29 strategic journey is directly aligned with the C2P project. Whilst this section of SH1 does not relieve congestion through main urban centres the problem and benefit statements allow any outcome of the IBC to be largely aligned to all of the other expressway objectives if the C2P project were to be considered as an extension to the expressway strategy.	✓✓✓

[89] https://www.transport.govt.nz/multi-modal/keystrategiesandplans/gpsonlandtransportfunding/

[90] https://www.nzta.govt.nz/assets/planning-and-investment/docs/arataki/pan-regional-summary-upper-north-island-december-2019.pdf

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Strategic Document or Context	C2P contribution to priorities and outcomes	Project Alignment
the major urban areas bypassed by the expressway.		
Waikato Regional land transport plan (WRLTP) – 2015 to 2045 The WLTP sets out the strategic direction for land transport in the Waikato Region for the next 30 years. The plan builds off the long-standing strategic approach adopted over previous transport strategies by focusing investment and effort into three core components, including: • Strategic corridors and wider network connectivity improvements • Road safety • Managing demand and transport choices. In addition to recognising the ONRC rating for C2P (and therefore its strategic importance), the WRLTP also identifies the C2P corridor as being one of the most important inter-regional corridors for both freight and tourism to both Auckland and to the Bay of Plenty Region. Appendix 3 of the WRLTP includes the joint statement between the Bay of Plenty and Waikato Regional Transport Committees, which confirms the joint approach by both regions to develop and protect a long term strategic transport corridor for the SH1/29 route. 1) **Protecting the function and investing in Strategic corridors** – the RLTP states that "These corridors perform a variety of functions which are of critical importance for facilitating the inter and intraregional movement of people and freight" and "SH1/29, NIMT and ECMT road and rail corridor is the primary freight corridor linking Auckland, Hamilton and Tauranga and associated sea and inland ports". 2) **Improving Road safety** – recognising failures in the system and how user behaviour contributes to risk and a disproportionate number of deaths and serious injuries; and therefore, the need to continue to improve road safety outcomes for the Waikato region. 3) **Providing Access and mobility needs (and greater transport choices) for communities** – recognition that a "changing social, demographic, economic and technological landscape is impacting some communities' ability to access the transport system".	The long term outcome for C2P is directly aligned with the aspirations of the WRLTP, by recognising the nationally strategic importance of the corridor by linking Auckland to the Waikato and Bay of Plenty. The C2P corridor has the opportunity to contribute to all three core components of the WRLTP.	✓✓✓
Waipa 2050 (Waipa District growth strategy) Waipa 2050 provides a clear framework outlining what the District wants to aspire to ensure that planning and managing future growth over the next 40 years is undertaken in a way to retain the character of the Waipa District. The Waipa District expects to have an additional 27,000	Improvements to the C2P corridor are not specifically reflected within the existing Waipa 2050 plan but the inter-regional connections for freight are. In addition, the need for C2P (in the future) is partly based on the forecast growth projections indicated within the plan.	✓✓

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Strategic Document or Context	C2P contribution to priorities and outcomes	Project Alignment
people residing in its district by 2050. Most of this growth is centred around the existing urban areas, and particularly in Cambridge (where almost half the population growth is expected). Within the C2P corridor itself, the only planned residential growth area provides for some 48ha of potential (non-serviced) residential land, which essentially expands the Karapiro Village within the area of land between the existing SH1 corridor and the established village. Waipa 2050 will be undertaking a review process, with an expected notification process in September 2017.	The forecasts are aligned to the predictions proposed by Futureproof (where Waka Kotahi is a partner) and allowed for within the Waikato Regional policy statement. The C2P project creates an opportunity to be well integrated into Waipa DC's plans for land use development. In this way, the focus should be about how the C2P corridor can enhance (and serve) the outcome for land use provision, rather than how the land use development can work around the transport corridor. There is an opportunity for the access provisions of the transport corridor to be planned to enhance accessibility into the community features in a well-controlled/effective manner There is a need to work closely with the Waipa District Council strategic Planning Team to ensure all opportunities are considered.	
Waikato Regional Walking and Cycling Strategy (WRWCS) The WRWCS 2009-2015 includes overarching policies relating to the support and promotion of improved access to, and safer, walking and cycling infrastructure throughout the region (WRWCS; refer to P1 and P2). In addition, the WRWCS specifically identifies walkways and cycle trails that are of national importance. One of these is the NZ Cycle Trail (Nga Haerenga), of which one section is the Waikato River trail (starting from Horahora and extending 30km south along the Waikato River). "The great NZ river ride" (now known as Te Awa) is also identified as a regionally important cycling and walking trail and seeks to link Ngaruawahia to Horahora (to connect with the Waikato River trail) through progressive construction of seven sections alongside the Waikato River banks. The Te Awa Charitable Trust has progressed six of the seven sections through construction (or with construction underway) or undertaken initial planning phases, except for the link between Karapiro and Horahora. It is this missing section that is directly relevant to C2P project. Once complete the Te Awa and the Waikato River Trail will provide approximately 130km of off-road waking/cycle paths alongside the banks of the Waikato River.	The needs for supporting active modes within the C2P project are well recognised and there are numerous ways this can be achieved with both on-road and off-road facilities. It is, however, recognised that most highly strategic transport corridors (such as SH1) prefer to provide physical separation between the active and non-active modes, or providing readily accessible alternative routes on lower volume corridors, in the interests of improving safety, and making the experience (for active modes) more pleasant. The C2P project provides a real opportunity to assist in the planning and integration of the remaining section of trail needed to connect Te Awa to the Waikato River Trail (Karapiro to Horahora). In all option development, the C2P project should identify how the river trail could be integrated into the solutions and ensure that the solution does not preclude the river trail from being developed (at some point of time), nor make the river trail solution very difficult (or impracticable) to construct. Investigations into the C2P project should seek to identify opportunities for assisting the funding of the investigation and/or construction of the river trail as part of any other subsequent infrastructure works.	✓✓

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APPENDIX E - 16 QUESTION FRAMEWORK

Problem	*Benefits*	*Strategic response*	*Solution*
Strategic Activity Case (2017) (Appendix A)		Programme Business case (2015)	Indicative and Detailed business cases (This Report)
Is it clear what the problem is that needs to be addressed (both the cause and the effect)? Yes / Maybe / No	Have the benefits that will result from fixing the problem been adequately defined? Yes / Maybe / No	Have a sufficient range of strategic alternatives and options been explored (demand, productivity and supply)? Yes / Maybe / No	Consistent with the strategic alternatives and options, have a reasonable range of project options been analysed? Yes / Maybe / No
Two problems identified. Both relate to the corridor not meeting the long-term strategic aspirations (or customer expectations) for the corridor and therefore compromising the significant investment made in the SH1 corridor to date. Refer Section 3.1 Strategic Activity Case	Benefits were identified and endorsed by stakeholders. Refer Section 3.2 Strategic Activity Case	Programmes assessed were do min (operation and maintenance), safety online, efficiency (on and off line), local access/use, do max - expressway	A significant amount of ideas and alternatives and subsequent corridor options were developed using the ACRE approach and transport planning - supply, demand and productivity ideas. Section 6.1)
Is there evidence to confirm the cause and effect of the problem? Yes / Maybe / No	Are the benefits of high value to the organisation(s) (furthering its (their) objectives)? Yes / Maybe / No	Is it clear what strategic alternatives and options are proposed and the rationale for their selection? Yes / Maybe / No	Is the proposed solution specified clearly and fully (all business changes and any assets)? Yes / Maybe / No
Includes traffic/crash data, Customer Insight Surveys Online surveys. Refer Section 3.4 Strategic Activity Case	Directly aligned with the Government Policy Statement, and Arataki directly aligned with objectives for investing in the Waikato Expressway, and contributes to the aspirations of the RLTP. Refer Section 3.2 Strategic Activity Case	Programmes are based on strategic need, and understanding, geographical, environment, economic, and transport (rail, walking and cycling, public transport, traffic growth, form, intersections and safety) context.	Yes (Section 10)

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Problem	*Benefits*	*Strategic response*	*Solution*
Does the problem need to be assessed *at this time*? Yes / Maybe / No	Will the KPIs that have been specified provide reasonable evidence that the benefits have been delivered? Yes / Maybe / No	Are the proposed alternatives and options the most effective response to the problem (comprehensive and balanced)? Yes / Maybe / No	Is the proposed solution the best way to respond to the problem and deliver the expected benefits? Yes / Maybe / No
Historic and current investments made in SH1 to date is at risk of being jeopardised if work not undertaken on the SH1/29 corridor in the near future and some CLoS have not been met. However medium term works can be implemented to address some of these concerns. Refer Section 3.4 Strategic Activity Case	KPIs are largely derived from the Waka Kotahi's framework for performance measures and directly aligned to the benefits being sought. Refer Section 3.5 Strategic Activity Case	Programmes assessed were do min (operation and maintenance), safety online, efficiency (on and offline), local access/use, do max – expressway. Some programmes were joined together.	A number of ideas, alternatives and options were assessed using an MCA approach and ongoing engagement with stakeholders to deliver the best outcome with the least risk and effects (sections 6, 7, 8, 9, and 10.
Is the problem specific to this investment (or should a broader perspective be taken)? Yes/Maybe/No	Are the KPIs both *measurable* and *totally attributable* to this investment? Yes/Maybe/No	Are the proposed alternatives and options feasible? Yes / Maybe / No	Can the solution really be delivered (costs, risks, timeframes, governance, etc.)? Yes / Maybe / No
While the investment needs to be considered in regard to the over-arching Waka Kotahi investment direction for SH1 and SH29, the anticipated benefits are specific to this section SH1 Refer Section 3.4 Strategic Activity Case	The KPIs are comprised of 'SMART[91]' measures which have been chosen to measure the benefits achieved for the investment in the C2P corridor alone, but it is acknowledged that wider strategic benefits will be reliant on investment being made on other parts of the SH1 and SH29 corridors. Some refinement to accessibility KPI will need to occur in the DBC phase. Refer Section 3.5 Strategic Activity Case	All options have tradeoffs and key dependencies but could be achieved.	Preferred route is a feasible option in terms of costs, risks timeframe etc. Refer to section 10

[91] SMART measures = Specific, Measurable, Agreed Too, Realistic and Time Based measures

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APPENDIX F – CUSTOMER DESIGN PRINCIPLES

PRINCIPLE	C2P
Start with needs	All customers identified as part of the Strategic Activity Case. The project and preferred route recognised a range of users (traffic, road use, destination etc.), and their respective needs (Figure 9-2). A range of stakeholders covering many aspects of not only the road user community but also the environment were involved in the development of understanding the constraints and problems (as part of the ILM – section 4) that needed to be addressed and those things that needed to be protected.
Understand Context	In determining both the problems and benefits for this route the project team defined what people were using the highway, local roads and surrounding land use for. It was understood that a key part of this project was to better understand what other opportunities could be realised with project; specifically for access to key features within the District and providing for a range of users to increase the types of modes in a safer environment, and not just focusing on getting traffic efficiencies. Maptionnaire surveys were undertaken to better understand community issues and things they like about the area and what they would like access to such as Karapiro Lake.
Do Less	Not only did the highway issues have to be addressed by Waka Kotahi, but there were and are, opportunities for other organisation's to get involved and help develop a coordinated response to addressing the problems and linkages to their local projects. This included Waipa DC in terms of helping them enable their future needs such as providing better connections to their local road network and land use growth areas, and to service links to key features in the District such as the Karapiro events center, all of which provides much wider economic benefits. In addition, an early opportunity was realised to work with the cycling groups in the next phase to enable the ability for them to provide to build on an already developed active path network in the surrounding districts.
Design with Data	As part of the data analysis of where traffic was coming from and who were the road users, Maptionnaire was used to determine needs and helping to better understand the issues. This allowed the investigation to consider and strengthen the project teams understanding of those needs through the entire problem definition and option development process.
Create Services	In better understanding what the customer were trying to do the project team used various data sources (as above). Customer outcomes along with a journey map has also been provided in Figure 9-2. The ACRE approach was used from the start of the process which allowed a range of transport planning options to be considered to address the problems and customer needs.
Do the work to make it simple	The customer needs have been defined through various techniques (above) and the customers have been asked why there is a need to invest in this corridor and what other opportunities can be provided. The key feedback from engagement both with the stakeholders and the community is that the status quo is not acceptable, and something needs to change in regard to safety, access and efficiencies of traffic
Build for inclusion	The project has considered and provided for a range of users including traffic (and their destinations), active road users, vehicle types, and emergency services (Table 4-1)
Iterate, then iterate again	The entire process involved using the ACRE approach section 6.2 and reassessing investment objectives, risks and effects at every stage with the ability to 'loop back' and check the right options were taken through.
Be consistent, not uniform	This project clearly identifies the customers and their needs and provides a tailored design to address those who want to travel through the region. Importantly the project allows for flexibility in route choice, local users, land use opportunities, but also to those that want to visit key features by vehicle or by other modes.
Make things open: it makes things better	This project has allowed the project team to use a new online survey tool called Maptionnaire allowing information flow to be transparent and determine customer's needs. This tool was shared from other successful projects and in turn this information has been more readily shared with the IBC/DBC consultant panel members. In addition this process has proven that thorough engagement with various partners and the community using many different methods (to reach the maximum number of people) has created a seamless and transparent process resulting in strong support and compliance with requests for data and land entry from landowners and very little negative feedback to date.

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APPENDIX G - DBC PREFERED ROUTE DRAWINGS

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APPENDIX H - CONSENTING STRATEGY[92]

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[92] Note – this consenting strategy has been superseded by the pre-implementation consenting strategy

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APPENDIX I - ENVIRONMENTAL AND SOCIAL SCREEN (ESR)

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APPENDIX J - SID AND RISK REGISTER

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APPENDIX K - ECONOMIC ANALYSIS & PEER REVIEW

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APPENDIX L - COST ESTIMATE & PARALLEL ESTIMATE RECONCILLIATION

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APPENDIX M - INVESTMENT ASSESSMENT PROFILE

RESULTS ALIGNMENT ASSESSMENT	COMMENTS
Very High	CLOS gaps • There is a **significant gap in the CLoS for safety** for this route resulting in a lower performance Despite the step improvements achieved in the baseline SNP 1 and 2, safety remains below CLOS expectations for the route classification i.e. a high-risk rural road. If an investment decision on the long term C2P Project is delayed for the long-term, investment in SNP Stage 3 would improve safety performance at Karapiro and Hydro Road (illustrated by a shift to the future for LOS breakdown), however CLOS would remain below the preferred CLOS and outcomes sought due to the remaining multiple local access and other local road access points and WRB turnaround points. • **Resilience is improved (fewer head on crashes) but not addressed** in full by SNP 1, 2 or 3. Furthermore WRB strikes are likely to occur leading to disruption and a lack of practicable alternative remains. This is addressed by the C2P Long-Term preferred option. • **Local property access is a current safety issue**. As capacity and LOS worsen (increased waiting for acceptable gaps) crash risk will likely increase. The above illustrates that LOS F (delays >50 secs) is likely from circa 2030, with acceleration of this delay beyond 2040. • **CLOS at the Hydro and Karapiro intersections remain below CLOS at 2020** with SNP1 and 2 in place. However, if C2P is delayed SNP 3 would address capacity and CLOS at these intersections out to circa 2060 based on 1 % growth. • Mid-block capacity breakdown at passing lanes is forecast to occur on an average Friday peak from between 2040 and 2050 depending on the actual traffic growth rate. • Speed – with the SNP 1 and 2 baseline in place the mid-block average travel speed is likely to remain above 80km/h out until circa 2040. Other • SH1 is national (high volume) route and is integral to connecting the upper North Island, Waikato, and Bay of Plenty with other parts of the central North Island and beyond. It is also critical to connecting a number of major urban populated areas including Hamilton, Tauranga, Auckland, and more locally Cambridge. It provides access for freight to the ports in Auckland and Tauranga, as well as key industrial areas across the region. • Several inland ports are being planned in Hamilton, which will connect Auckland and Tauranga as a central distribution hub. SH1 between Auckland and Cambridge is being upgraded to expressway standard supporting its role as a Road of National Significance (RONS). • The section of SH1 between Cambridge and Piarere connects directly to the Expressway and carrying high volumes similar to the adjacent expressway sections, it has an important role in realising the wider benefits of the Expressway upgrade. This route is therefore key to supporting economic growth and productivity across the region and in particular access to Hamilton's employment centres and surrounding industries. • Land use changes are not expected to change significantly, however, the Waipa 2050 Growth Strategy identifies a desire for future urban development to occur around pre-existing urbanised areas. In this case, an area for potential residential expansion has been identified (for public consideration as part of its Waipa 2050 update) around the Karapiro Village (off Hydro Road) for up to 48ha of staged residential development over the next 30 years. If this occurs, there would be an expected degree of access required for roadside land use, including agricultural, horticultural and sports/recreational, as well as approximately 10 at-grade intersections along this section accommodating turning traffic volumes of between 50 and 800 vehicles per day.

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APPENDIX N – ROAD SAFETY AUDIT

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APPENDIX O – SUB ROUTE EVALUATION

Section 1: From the end of the Cambridge Section to Hickey Road		
Options	**Discard/ Keep**	**Comments (key feedback – where there are differences)**
A	Discard	• Ranked 2nd of 8 options for both risk and effects but worst (equal) for effects • No major risks. Some risks for consentability due to effects on heritage/arch (recorded sites) cultural, property (horse stud), noise, vibration, air quality, and engagement (sterile land)
B	Keep	• **Ranked 1st** out of 8 options for both risk and effects and for just effects (best option). No major risks identified. • Some risks for constructability (due to additional property access) and consentability due to effects on cultural (recorded sites) heritage/arch and noise and engagement (sterile land)
C	Discard	• **Ranked worst** out of 8 options for both risk and effects and for just effects • Major risk with financial fundability (complete new local road and upgrade State highway). • Some risks with constructability, Geometric, SiD, and system integration (due to duplication of the number of roads) and consentability issues due to Traffic (Construction traffic), Visual /Landscape and urban design (proximity to the river). Cultural, heritage/Arch (recorded sites) and engagement (sterile land)
D	Keep	• Ranked 4th for both risk and effects and just effects • Some risks with constructability in terms of dealing with live traffic and construction on-line and need for structures to maintain local connectivity, Geometric, and SiD. • Some consentability issues due to traffic (construction versus local traffic), Visual and Landscape and urban design (proximity to the river), Cultural and Heritage/Arch (recorded sites)
E	Keep	• Ranked 3rd for both risk and effects and just effects. No major risks identified • Some risks with constructability in terms of dealing with live traffic and construction on-line and need for structures to maintain local connectivity, Geometric and SiD. • Some consentability issues due to traffic (construction versus local traffic), Cultural, Heritage/Arch (recorded sites) and noise.
F	Keep	• Ranked 4th for both risk and effects and 1st for effects. • Major risk with financial fundability due to duplication of the number of roads in the network. • Risks with constructability (however better than option C), geometric, SiD, and system integration (affects current business and new roads need building)
G	Discard	• **2nd worst option** in terms of risks and effects and ranked 4th equal in terms of effects • Major risk with financial fundability due to gully crossing. • Risks with constructability in terms of geometric, structures (retaining walls near river), SiD, and system integration (due to duplication of network) • Some consentability issues due to Traffic (increases in distance travelled for local access), Urban Design, Cultural, Heritage/Arch, and noise

Table 18-1: Section 1 - sub-route evaluation decision

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Section 2: - Hickey Road to Hydro Road		
Options	**Discard/ Keep**	**Comments (key feedback – where there are differences)**
A	Discard	• One of the worst options in terms of risk and effects, however ok for just effects • Major risks noted for consentability which relates to cultural, Heritage/Arch (pa sites).
B	Discard	• Best option in terms of risks and effects and ok for just effects. • Some issues around cultural, Heritage/Arch (garden soils, recorded sites) noise, vibration, air quality, and some property severance • Eliminated because connects to adjoining options that have high risk and effects which have been discarded in section 3.
C	Discard	• Ok in terms of risk and effects and just effects • No major risks or effects • Some issues around cultural, Heritage/Arch (garden soils, recorded sites) noise, vibration, air quality, and some property severance • Similar types of options, but Option C is worse than D, due to C having more risk around geometrics
D	Keep	• Best option in terms of risk and effects • No major risks or effects • Similar risk and effects as Option C but better in terms of geometrics, some property severance
E	Discard	• One of the worst options in terms of risk and effect and just effects • No major risks or effects • Some risks for consentability due to effects on urban design (compromises local connectivity), cultural (garden soils) heritage/arch (recorded sites) ad some property severance • Least preferred overall (same as Option F)
F	Discard	• One of the worst options in terms of risk and effect and just effects • No major risks or effects • Some risks for consentability due to effects on urban design (compromises local connectivity), cultural (garden soils) heritage/arch (recorded sites) ad some property severance • Least preferred overall (same as Option E)
G	Keep	• Ok for risk and effects however best option in terms of effects • No major risks or effects • Some geometric, constructability, SID and financial risk. Some risks for consentability due to effects on urban design (compromises local connectivity), cultural (garden soils) heritage/arch (recorded sites) and some property severance

Table 18-2: Section 2 - sub-route evaluation decision

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Section 3 From Hydro Road to Karapiro Road		
Options	**Discard/ Keep**	**Comments (key feedback – where there are differences)**
A	Discard	• Ok for risk and effects and just effects • Major risks around structures (Karapiro gully – 670m structure) and resultan financial fundability. Other risks for geotech and SiD • Consentability risk due to moderate rating for most of the environmental effects and property severance issues
B	Discard	• Ok for risk and effects and just effects • Major risks around structures (two gullies to cross) and resultant financial fundability. Other risks for geotech and SiD • Consentability risk due to moderate rating for most of the environmental effects and property severance issues
C	Discard	• **Worst option** in terms of risk and effects and just effects • Major risks around structures and resultant financial fundability. Other risks for geotech and SiD • Some consentability issues and traffic issues (residual land/limited access), moderate rating for most of the environmental effects and property severance issues
D	Keep	• Ok in terms of risk and effects – just as bad as options A, B and C • Major risks for financial fundability due to presence of major gullies and earthworks • Consentability risk due to moderate rating for most of the environmental effects and property severance issues • 3D is preferable over 3E due to constructability and cost and 3F due to structures
E	Discard	• Ok in terms of risk and effects • Major risk with bridging • Consentability risk due t moderate rating for most of the environmental effects such as potential f ood storage impacts and property severance issues • 3E worse than 3D due to constructability and cost due to geotechnical complexities(sidling design)
F	Keep	• **Best option** in terms of risk and effects and just effects, preferred option • No major risks or effects • Moderate effects of urban design, cultural, heritage/arch and noise. Only option that doesn't go into the gully • 3F needed as it connects to 4F (B, C and I)

Table 18-3 Section 3 - sub-route evaluation decision

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Section 4 Karapiro Road to Gorton Road		
Options	**Discard/ Keep**	**Comments (key feedback – where there are differences)**
A	Discard	• Middle rank of the options in terms of risk and effects and just effects • Major risks in terms of structures and associated financial fundability due to Karapiro gully
B	Keep	• Middle rank of the options in terms of risk and effects and just effects • Major risk around consentability due to noise issues affecting a number of properties • Provides connection to other options in adjoining sections that are favourable
C	Keep	• Middle rank of the options in terms of risk and effects and just effects • Major risk around consentability due to noise issues affecting a number of properties. Some other risks and effects with geometric, financial, social (way if life), cultural (garden soils), arch/heritage • Provides connection to other options in adjoining sections that are favourable
D	Discard	• **Worst option** in terms of risk and effects and just effects • Major risk around consentability due to effects around the school and Karapiro community, and issues with social, visual landscape and urban design
E	Discard	• Close to worst option rank in terms of risk and effects and middle for just effects • Major risk around financial fundability (due to removal/relocation school and petrol station) and major consentability issues due to effects around the school and Karapiro community, and issues with social, visual landscape and urban design
F	Keep	• Close to worst option rank in terms of risk and effects and 2nd worst for just effects. Major risks for geometric (due to crossing State highway twice and realignment) and major issues for consentability due to visual/landscape and urban design (completely new local road increases footprint) • Although similar, Option F has been kept instead of G because it connects to a more favourable route (5D) and G connects to a high risk route 5E that crosses a gully system and more risks and effects
G	Discard	• Close to the worst option rank in terms of risk and effects and 2nd worst for just effects • Major risks for consentability due to visual/landscape and urban design (severs the school from the community and potential visual effects on the lake. • Some risk around constructability as getting close to the river
H	Discard	• Middle rank of the options in terms of risk and effects and just effects • Major risks for structures (due to gully) and associated financial fundability • Major risks for consentability due to the effects of multiple gully crossings, visual and ecological • Some ecological effects, water, visual/landscape, cultural (garden soils), heritage/arch (Recorded sites), Noise and property
I	Keep	• Ranked best option for risks and effects and 2nd best (joint) for just effects • No major risks • Major consentability issues due to noise effects on a large number of dwellings • Some effects on visual and landscape, cultural (garden soils), heritage/arch (recorded sites), vibration, air quality and some property severance.

Table 18-4: Section 4 - sub-route evaluation decision

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Section 5 Gorton Road to Fergusson Gully Road		
Options	**Discard/ Keep**	**Comments (key feedback – where there are differences)**
A	Keep	• **Best ranked equal option** for risks and effects and just effects • No major risks or effects • Some issues for consentability in terms of effects on cultural (risk of pre-European arch being discovered), heritage/arch and property (severance)
B	Keep	• **Best ranked equal option** for risks and effects and just effects • No major risks or effects • Some issues for consentability in terms of effects on cultural (risk of pre-European arch being discovered, heritage/archaeology) and property (severance)
C	Keep	• Middle ranked option in terms of risks and effects and just effects • No major risks or effects • Some issues for consentability in terms of effects on cultural (risk of pre-European arch being discovered), heritage/arch, noise and property (severance) • 5C needed to connect to option 4C which is deemed favourable
D	Keep	• Close to the worst options in terms of risks and effects and just effects • Major risks for financial fundability (due to iwi land crossing, cutting off access to Tunakawa road) • Effects on traffic (multiple road crossings and severed local road), urban design. Some issues for consentability in terms of effects on cultural (risk of pre-European arch being discovered, heritage/arch, noise, and property (severance) • Only option that connects to 4F and retains alternative south of the school. Preferred to option 5E.
E	Discard	• **Worst option** in terms of risks and effects and just effects • Major risk for structures (due to gully) and associated financial fundability. • Effects on traffic (multiple road crossings and severed local road, construction traffic), visual/landscape, urban design (potential for land lock), cultural, heritage/arch (risk of pre-European arch being discovered), noise, vibration, air quality and property

Table 18-5: Section 5 - sub-route evaluation decision

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Section 6 Fergusson Road to Kentucky Road		
Options	**Discard/ Keep**	**Comments (key feedback – where there are differences)**
A	Discard	• **Worst option** in terms of risks and effects and just effects • Major risk with structures (and associated financial fundability) and consenting due to cultural and heritage/archaeology effects - Caves & ecological risk • Some issues around constructability, SiD, ecology, visual and landscape, and property severance
B	Keep	• Middle ranked option in terms of risks and effects; **best option** for just effects • Major risk for financial fundability due to extreme topography (70m cut), associated large scale earthworks and constraints with the gully • Connect into subsequent section and on to the favourable options within section seven.
C	Discard	• Middle ranked option in terms of risks and effects and just effects • Major risk for financial fundability due to extreme topography (70m cut) constraints • Some effects for cultural (ecological) and property severance • Discarded because connects to 7G which has been discarded for being a clear outlier for risk and effects
D	Discard	• 2nd worst option in terms of risks and effects and worst equal for just effects • Major risks for consentability due to cultural and heritage/arch effect (Recorded archaeological site - caves, and moderate ecological risks) and financial fundability (due to extreme topography) • Some property severance, constructability, ecological and visual/landscape effects
E	Keep	• Middle ranked option in terms of risks and effects and just effects • Major risk with consentability due to visual/landscape effects (Major cultural and heritage/archaeology effects: Caves & ecological risk • Some risks and effects with structures and geotech, ecological, cultural and property severance • Connects to subsequent section 5B (the best 'kept' option in section 5).
F	Discard	• Close to the worst option in terms of risks and effects and just effects • Major risk associated with financial fundability (Large scale earthworks/ major bridges over eco-zones) and consentability due to visual and landscape effects • High risks and effects but is also ruled out due to subsequent connection to 7G being discarded.
G	Keep	• One of the better ranked options in terms of risk and effects and just effects. • Major risk associated with consentability due to visual and landscape effects • Other risks with structure and geotech and effects on ecological, cultural (risk of unknown) and property (severance) • From an engineering point of view and ecology is better than others.
H	Discard	• **Best option** in terms of risk and effect and middle rank in terms of just effects • No major risk or effects identified however some issues with bridging, close to a number of properties for noise, goes through stream with multiple catchments, cultural (ecological) and property severance • Although a good option in terms of risks and effects it cannot be connected to the next section - Option 7G – which has been discarded for being a clear outlier for risk and effects
I	Discard	• Middle rank in terms of overall risk and effect and just effects • Major risk with consentability due to visual and landscape effects • Some other risks and effects with bridging, geotech (number of cuts, sidling gullies etc.), ecological (stream impacts), cultural (ecological effects), noise and property severance

Table 18-6: Section 6 - sub-route evaluation decision

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Section 7 Kentucky Road to Maungatautari Road		
Options	**Discard/ Keep**	**Comments (key feedback – where there are differences)**
A	Discard	• Middle rank in terms of overall risk and effect and **best option (equal with 4 others)** in terms of just effects • Major risk for financial fundability (due to earthworks). Other risk issues in terms of constructability, consentability, SiD and property severance • Because 8A discounted (due to it being the worst option for risk and effects) means 7A can't be connected here, and because 6D and 6A discounted previously, this section cannot be connected
B	Discard	• Middle rank in terms of overall risk and effect and **best option (equal with 4 others)** in terms of just effects • Major risk for financial fundability (due to earthworks). Other risk issues in terms of constructability, consentability, SiD and property severance • Because 6D and 6A discounted previously, this section cannot be connected
C	Discard	• **Best equal option** in terms of risk and effects and just effects • No major risks or effects, Some constructability and consenting issues around property severance • However, because 8A and 8B discounted (due to have the worst risk and effects in section 8) means 7C unable to be connected.
D	Keep	• **Best equal option** in terms of risk and effects and just effects • No major risks and effects. Some issues with constructability and consenting issues around property severance • Best performing option and one of a few options that links it to the 'kept' options in section 8
E	Keep	• **Best equal option** in terms of risk and effects and just effects • No major risks and effects. Some issues with constructability and consenting issues around property severance • Best performing option and one of a few options that links in to 'kept' options in section 8. Also located in the gap of power lines between section 6 and 8.
F	Discard	• **One of the worst** options in terms of risks and effects and just effects • Major risks in terms of financial fundability (due to property costs). Some risks around geotech, SiD issues going through ecological areas (regenerating native bush and potential bat habitat), visual and landscape, cultural (ecological and bats), and property severance • Option cannot connect to the 'kept' Section 8 options
G	Discard	• **The worst** option in terms of risks and effects and just effects • No major risk or effects but some risks around geotech, SiD issues going through ecological areas (regenerating native bush and potential bat habitat), visual and landscape, cultural (ecological and bats), noise, vibration, air quality, and property severance • Option cannot connect to the 'kept' Section 8 options

Table 18-7: Section 7 - sub-route evaluation decision

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Section 8 Maungatautari Road to SH1/SH29 tie-in		
Options	**Discard/ Keep**	**Comments (key feedback – where there are differences)**
A	Discard	• **One of the worst options** in terms of overall risks and effects, and 1st equal (5 options) for just effects • Major Risks for financial fundability (due to constructability, geotech and geometric constraints within a 110km/h design speed). • Other risk and effects with geometric, geotech, constructability, consentability, visual and landscape, cultural and heritage/arch (high risk of unrecorded sites), property severance and engagement • One of the few options that has an effect on overall transport system integration with increased travel times for SH1 south traffic.
B	Discard	• **One of the worst options** in terms of overall risks and effects for just effects • Major Risks for financial fundability (due to constructability, geotech and geometric constraints within a 110km/h design speed). • Other risk and effects with, geotech, constructability, consentability, visual and landscape, cultural and heritage/arch (high risk of unrecorded sites), noise, and property severance and engagement • One of the few options that has an effect on overall transport system integration with increased travel times for SH1 south traffic.
C	Keep	• **Best option** for overall risks and effect and just effects • No major risks identified. Some risks around consentability with respect to social 'way of life'. Cultural and heritage/arch effects (high risk of unrecorded sites) and engagement • Severs some properties but still provides for some economic opportunities
D	Keep	• One of the better options for overall risk and effects and just effects • No major risk identified. Some risks around geometric and structures and consentability due to effects on traffic (due to complexity of state highway and local road configuration), cultural and heritage/arch (high risk of unrecorded sites) and property severance and engagement
E	Discard	• Middle ranked option in terms of overall risk and effects however **one of the worst** for just effects • Major risk in terms of geometric issues with connecting back to SH1 and local roads • Some risk with bridging, SiD, consentability due to effects on traffic (due to complexity of state highway and local road configuration), cultural, heritage/arch (high risk of unrecorded sites), noise, property severance and engagement

Table 18 8: Section 8 - sub-route evaluation decision

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APPENDIX P – IBC AND DBC OPTIONS REPORTS

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