
SH10 Taipa Single Lane Bridge

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VERSION A

Single Stage Business Case



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Executive Summary

This business case sets out the context for future investment to improve the single lane SH10 Taipa Bridge. In doing so, it aims to enable SH10 to function as a collector route, supporting regional aspirations for network resilience, improved safety, economic growth and increased productivity. SH10 has additional importance as a resilient alternative to SH1 when SH1 is closed. There is no current investment strategy to address strategic needs of this corridor.

Tourism is a significant contributor to the Northland economy and the Taipa Bridge is located on the Twin Coast Discovery Route, linking the Bay of Islands with Doubtless Bay. It has only limited provision for pedestrians and does not currently provide for cyclists, both of which are important components of the tourist economy. During the peak visitor season, traffic demand is significantly higher than usual and delays occur regularly during that period. This demand is currently actively managed using temporary signal controls because the existing capacity is not adequate at these peak times.

Addressing these issues will contribute to the following priorities identified in the Regional Land Transport Plan (RLTP) 2015:

- Route resilience
- Economic growth and productivity
- Road safety

The following problems have been identified:

- **Problem 1:** The topography and local environment means that SH1 and SH10 are susceptible to closures cutting off access to Kaitia and the Far North. (40%)
- **Problem 2:** The Northland economy under performs compared to other regions and substandard road conditions adversely affect the performance of the region. (30%)
- **Problem 3:** The physical alignment of the road exposes people to an unacceptable risk of injury should they crash (30%)

This business case also examines the resultant benefits that could address these challenges. These benefits include:

- **Benefit 1:** Improved regional economic growth (30%)
- **Benefit 2:** Improved network resilience (20%)
- **Benefit 3:** Increased safety (50%)

The business case analysis has found that there is an opportunity to enhance the economic prospects and safety of the Northland region through long-term investment in this State Highway corridor.

Investment Objectives have been developed with reference to the key benefits sought. These objectives are:

- **Investment Objective 1:** We will facilitate Tai Tokerau growth by providing a simple, legible journey experience for tourists that provides greater resilience for the Far North by 2018”
- **Investment Objective 2:** We will improve safety at the Taipa Bridge so there are no crashes on the bridge (or the approach intersections) by 2018.”

A number of options were developed and assessed to determine those that best perform against these Investment Objectives as well as against a range of other criteria including affordability, feasibility, public / stakeholder perspectives, cultural heritage, social and environmental effects and opportunities.

On the basis of this evaluation, the recommended option for investment is a new two-lane bridge following the existing alignment. This option was selected as the preferred because it has the least property impacts, has the smallest impact on hydrology and the Coastal Marine Area, delivers the best outcomes against the investment objectives and best delivers against the economic assessment criteria.

Two potential construction methodologies are proposed. One involves staged construction following the existing alignment; the second involves construction of a new bridge immediately adjacent to the existing structure. The existing structure would then be removed. It is proposed that both these methodologies are investigated further during the pre-implementation phase to determine the most cost effective solution.

Overall, the corridor has been given a medium strategic fit as the problems and benefits supported by currently available evidence, are aligned with achieving the Government's goals for land transport. They are also consistent with the Transport Agency's commitments on improved network resilience. Without this intervention, the problems will continue to worsen and importantly the benefits associated with the desired tourism and economic growth in the area will not be fully realised.

It is noted that the preferred option achieves a BCR of 0.6 (including WEBs) and therefore may not meet the criteria for funding through the National Land Transport Fund (NLTF).

However, given the strategic benefit to the region associated with this project, it is possible that alternative funding sources may be sought.

This business case seeks approval to move the project to the pre-implementation phase to allow continued project development and progress against wider project benefits and stakeholder expectations.

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THE CASE FOR CHANGE

1. Introduction

The SH10 corridor is an important link in the regional State Highway network, and is part of the Twin Coast Discovery Route connecting the Bay of Islands with Doubtless Bay. In addition to this, SH10 plays an important role as a diversion route if SH1 is closed. There is no current investment strategy to address the strategic needs of this corridor.

There are 15 single lane bridges on the Northland State Highway network; two of these are located on SH10. One single lane bridge is located on the section of SH1 that, if closed, would require a diversion to SH10. This is shown in Figure 1.



Figure 1: Northland Bridges SH1 and SH10

These bridges represent deficiencies on the network. They are often located in low lying areas prone to flooding, representing a route resilience problem. The Northland economy is constrained by this network disruption. When these routes are closed, local communities are isolated, with no access to essential deliveries. Tourist traffic is not able to access its destinations and freight traffic is not able to access key markets to the south, representing high economic costs for local tourist-related businesses and important local primary industries such as logging and dairy.

This business case specifically addresses the Taipa Bridge. Located on the southern shore of Doubtless Bay, at the mouth of the Taipa River, the bridge plays an important role in the Taipa community. It connects the Taipa township with Cable Bay to the east and is a popular swimming and fishing location for visitors and the local community.

The Taipa bridge is a place of importance to the local hapu that share the kaitiakitanga in the Taipa area. A memorial adjacent to the bridge marks the traditional first landing place in New Zealand of the Polynesian explorer, Kupe, demonstrating its importance in terms of local cultural heritage. The river and estuary that the bridge crosses is also a place of significance to the hapu and their ancestors.

The bridge is 107m long and carries approximately 3,800 vehicles per day¹. The bridge is narrow, with limited provision for pedestrians and cyclists. It is not capable of carrying all High Productivity Motor Vehicles (HPMV), which means lengthy detours are required for these vehicles. Figure 2 shows the location of the bridge.



Figure 2: Site Location

¹ TMS Database, 2015 AADT

Tourism is a significant contributor to the Northland economy and the Taipa Bridge is located on the Twin Coast Discovery Route, Northland's main tourist route. It has only limited provision for pedestrians and does not currently provide for cyclists, both of which are important components of the tourist economy. Improving facilities for these users and highlighting its role as a popular swimming and fishing place could encourage more visitors to stop in Taipa, contributing to the local economy and also providing better connectivity for the local community.

During the peak visitor season, traffic demand is significantly higher than usual and delays occur regularly during that period. This demand is actively managed using temporary traffic signals as the existing bridge capacity is not sufficient at these peak times.

There are also safety issues associated with the bridge and adjacent intersections which are exacerbated during periods of peak visitor demand.

Addressing these resilience and capacity issues will contribute to the following priorities identified in the Regional Land Transport Plan (RLTP) 2015:

- Route resilience
- Economic growth and productivity
- Road safety

The strategic case for this project was endorsed in principle by VAC and this business case reconfirms the problems and potential benefits in this corridor. The purpose of the business case is to develop options to maximise the opportunities available and to provide sufficient confidence and detail to allow the project to progress to the pre-implementation phase.

These issues are discussed in the following sections.

1.1 Decision sought

This business case seeks approval to move the project to the pre-implementation phase to allow continued project development and progress against wider project benefits and stakeholder expectations.

2. Partners and Key Stakeholders

The activities and problems relating to the Taipa single lane bridge affect a number of different organisations and customers. In order to confirm the development of the SSBC, meetings were held with the following key partners and stakeholders:

- Partner - NZ Transport Agency - Highway Networks Operations
- Partner - NZ Transport Agency - Planning and Investment
- Stakeholder - Far North District Council
- Stakeholder - Northland Regional Council
- Stakeholder - Department of Conservation
- Local Iwi - Ngati Matakairiri, Ngati Tara and Ngati Whata²

Engagement with the key partners and stakeholders collectively through the development of the strategic case and this SSBC has been important as many of the problems, potential benefits and desired outcomes have required an integrated and collaborative approach.

These partners and stakeholders were identified through their regulatory or customer interest in the project and through previous engagement. Specifically, partners and stakeholders who could make a difference in setting the scene from a problem and benefits perspective were identified. Additionally, those who will be important in the implementation and support for the project moving forward were also identified.

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² Summary of Iwi engagement provided in Appendix A

3. Strategic Assessment - Outlining the Need for Investment

This chapter presents the investment story and confirms the previously identified problems and benefits from the strategic case.

3.1 Defining the Problem / Opportunity

The following problems were identified in the strategic case:

- **Problem 1:** The topography and local environment means that SH1 and SH10 are susceptible to closures cutting off access to Kaitiāia and further north. (40%)
- **Problem 2:** The Northland economy under performs compared to other regions and substandard road conditions adversely affect the performance of the region. (30%)
- **Problem 3:** The physical alignment of the road exposes people to an unacceptable risk of injury should they crash (30%)

The following sections describe these problems in more detail.

3.1.1 Problem 1: Route Resilience

Figure 3 shows the State Highway network in the Far North. It shows that SH1 and SH10 play closely inter-related roles, with one able to act as a diversion route for the other in the event of a closure.

It also indicates that when SH1 and SH10 are closed simultaneously, there are no alternative routes to or from the north due to the location of the Waihou and Mangamuka Rivers and the Omahuta and Pukeiti Forests.



Figure 3: Far North State Highway Network

A Network Resilience Business Case was prepared for the Transport Agency in 2013³ to identify key problems with respect to the Northland State Highway network. This document describes the key resilience problem as “the Northland economy is constrained by State Highway network disruption as a result of significant and/or recurrent weather events”.

The key features affecting the resilience of the network are:

- It traverses difficult terrain that is prone to slipping due to its geological composition. Periods of heavy rain will often mobilise these slippages.
- The frequency and intensity of severe weather events is forecast to increase due to climate change.
- There are many river crossings with rivers that are subject to significant level rises in storm events
- There are limited detour options that provide safe, all-weather alternatives. As a result, detour routes generally involve considerably longer travel times.

The business case identified screenlines across the network and estimated the annual likelihood of full closure across the screenline, i.e. both traffic lanes on all State Highway links being closed simultaneously. It indicated a 66% likelihood that the screenline shown in Figure 3 (which is most relevant for SH10) would be closed on an annual basis, giving just a 34% likelihood that the screenline would be fully open during a typical year.

The business case obtained Gross Domestic Product (GDP) data for the Northland economy from Infometrics and used this information combined with a likelihood assessment to calculate PV benefits of \$42,196,997 associated with the closure of the screenline.

Closure information from the period 2010-2014 shows that SH10 was closed for more than 112 hours over 19 incidents. Of these, two were more than 20 hours in duration, as shown in Figure 4.

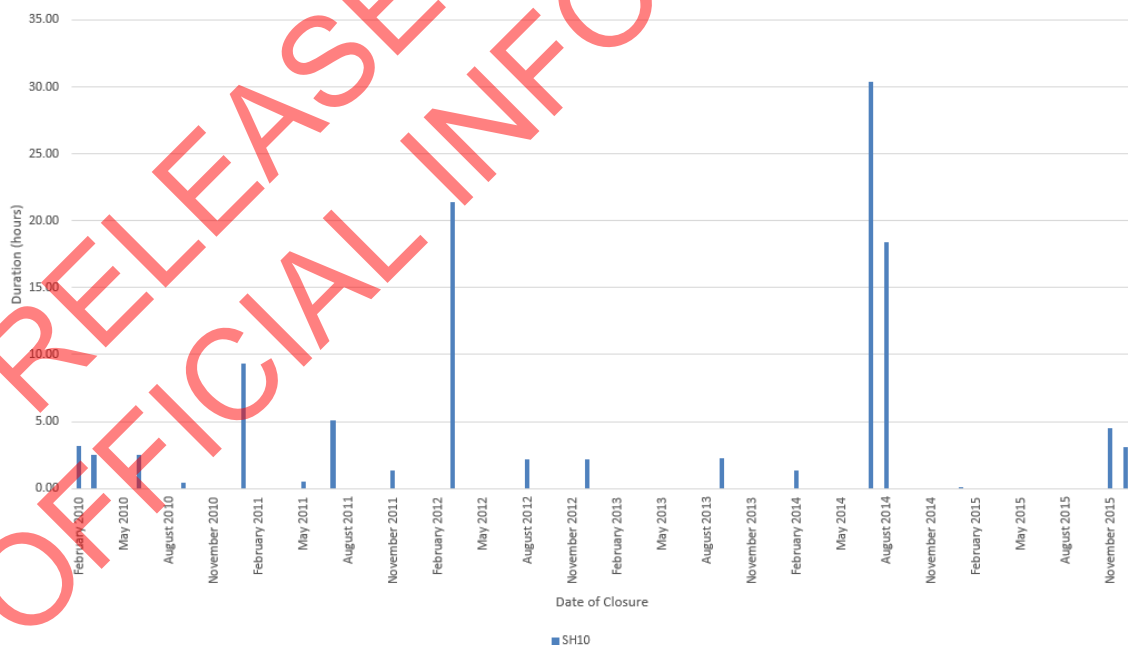


Figure 4: SH10 Closures (2010-2014)

³ Draft Network Resilience Business Case, Opus, June 2013

Over the same period, SH1 between Pakaraka and Awanui was closed for 89 hours over 17 incidents, with an average delay of five hours. Of these, two incidents were more than 19 hours in duration, as outlined in Figure 5. This number and duration of closures indicates that this section of SH1 also has poor resilience.



Figure 5 : SH1 Resilience Data 2010 - 2014

When SH1 is closed, SH10 becomes the only viable route for traffic to the north. It therefore plays a critical role in the resilience of the Far North. Resilience risks are inherent with one way bridges, if they are unavailable for planned or unplanned events there are no other lanes to utilise from a resilience perspective. Replacing the Taipa Bridge will improve the overall resilience of this corridor particularly as it is not currently fully HPMV capable. It means that these vehicles are already required to use alternative routes to reach their destinations.

Due to the location of the Taipa bridge, a significant detour route is required if the bridge is unavailable, as shown in Figure 6. The shortest detour route is on largely unsealed roads not suitable for heavy vehicles and is approximately 6km and 9 minutes longer. As it is not sealed, this route is also unlikely to be suitable during severe weather events.

If a sealed, high quality road is required for heavy vehicle, all-weather access, the diversion route would be via SH10 to Awanui, then SH1 to Kaitaia, returning to SH10 at Pakaraka. The distance of this diversion is 176km, which is estimated to take 2 hours 27 minutes to drive.

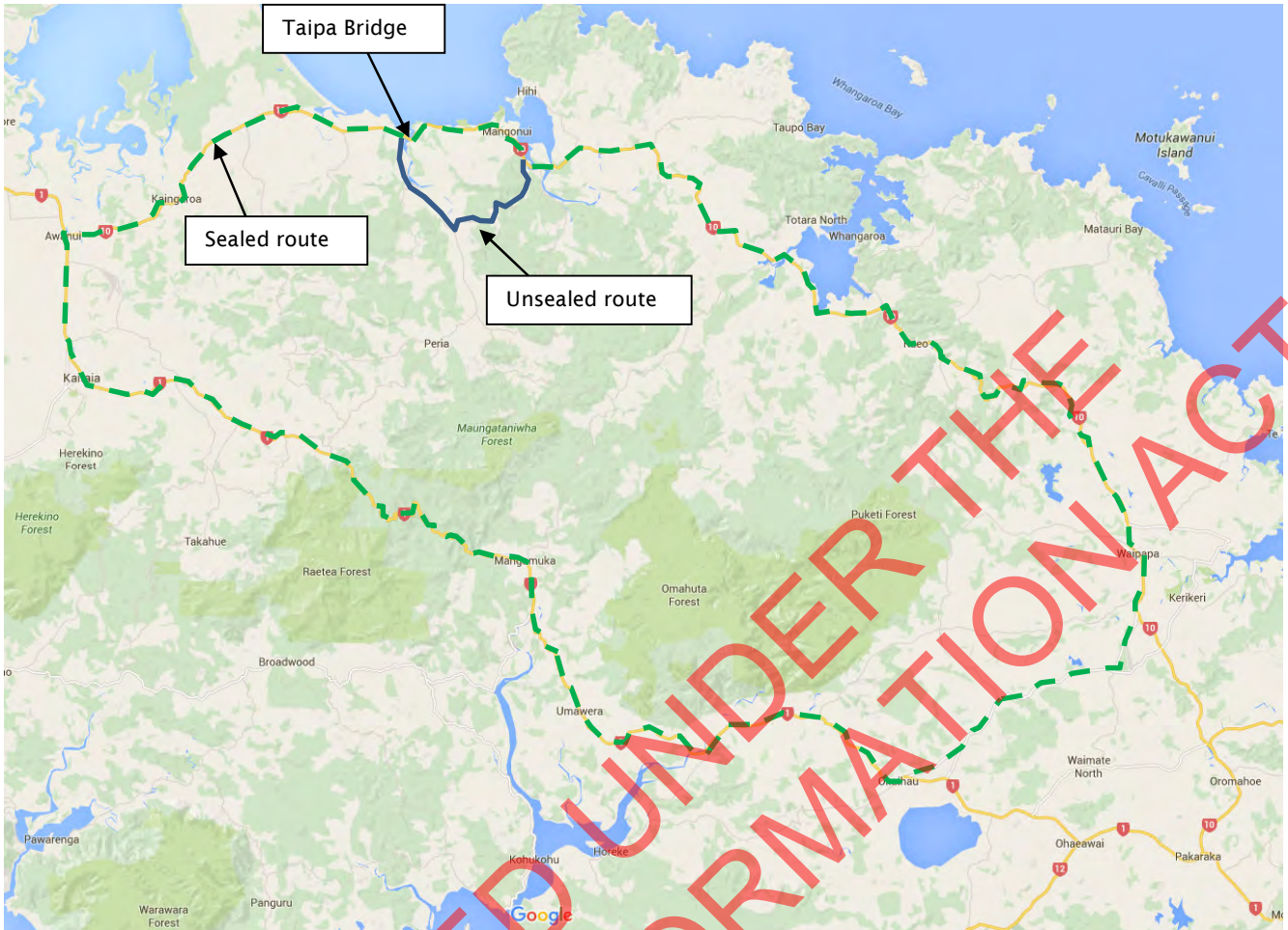


Figure 6: Diversion Route when Taipa Bridge is closed

Importantly from a resilience perspective, the Taipa Area School field is used as an emergency helicopter landing area in emergencies. This is located immediately to the north of the Taipa bridge and as such, it is important that the bridge remains available as consistently as possible.

The Transport Agency has recognised the effects of poor network resilience through a number of documents. The most significant is the Statement of Intent (2012-2015), which aims to create an efficient transport system that supports high levels of economic productivity, provides strong international connections for freight, business and tourism, and meets international obligations. This purpose will be achieved through, amongst other actions, a resilient and secure transport network and more efficient freight supply chains.

For a freight journey in particular, unreliable journey times or delays imposes a very high cost on the economy. In many cases, effective freight logistics chains depend on a high level of certainty of the expected arrival time of freight vehicles.

Longer journey times, higher freight vehicle operating costs (due to poorer quality road infrastructure) and travel time unreliability, all contribute to reducing productivity, and therefore undermining the confidence of firms to invest in this area.

This evidence confirms the following resilience problem: *“The topography and local environment in this area means that SH1 and SH10 are susceptible to closures, cutting off access to Kaitiāia and further north”*

3.1.2 Problem 2: Economic Growth and Productivity

General Growth

The Tai Tokerau Regional Growth Study⁴ describes Northland's economy as small and underperforming relative to other New Zealand regions and its resource base. It indicates that the Far North has a concentration and hence competitive advantage in primary industries. Northland's economy accounts for 2.6% of New Zealand's GDP, despite having 3.6% of its population. Its unemployment rate is 2% higher than the New Zealand average and real GDP per capita is 26% less than the national average.

The report indicates that *“Northland's relatively low population density and geographic remoteness have contributed to its economic underperformance. Even though Northland is in relatively close proximity to the strongly performing Auckland economy, travel times and limitations to transport connections make it difficult to benefit from that proximity.”*

The report identifies a number of major industry development and investment opportunities in Northland including the visitor industry, forestry and related processing, dairy and related processing, aquaculture, marine manufacturing and horticulture.

SH10 plays a particularly important role connecting significant areas of forestry and a number of key tourism destinations with SH1. It also plays an important role as a diversion / alternative to SH1, between Awanui and Okaihau, as this section of SH1 is often closed due to floods and slips. However, there are a number of bridges, including Taipa Bridge, which do not fully support HPMV. It is important that this is addressed to ensure that the corridor is able to effectively carry freight in the future.

The ability of the region to take up the identified investment opportunities depends on a number of cross cutting areas being addressed. One of these key cross cutting areas is improving road and rail infrastructure.

The report identifies that there are areas of poor resilience on key tourism and freight routes. Diversion routes do not always have capacity to accommodate freight vehicles. The interaction of heavy vehicles and tourism traffic impacts on the visitor travel experience.

The report indicates that further investment is needed to ensure that the network will be able to accommodate increased freight and tourism and provide for the dual needs of tourism and primary industries for transport and safety.

The Upper North Island Freight Study highlights that substantial growth of freight movements is expected for the Northland region, with anticipated freight movements increasing by 60-65% between 2006/7 and 2031. Consistent with the Tai Tokerau report, it also indicates that high volumes of heavy vehicles coupled with the need to maintain journey reliability to remain competitive highlights the importance of network resilience for freight movements in Northland.

The construction of improved road and bridge infrastructure, in itself is likely to provide an economic benefit to Northland through increased local employment and improving the technical skill base of the local construction industry.

⁴ Tai Tokerau Northland Growth Study Opportunities Report, Martyn Jenkins, February 2015

Tourism

Tourism is an important industry for Northland and is an important component of its economic growth. The Taipa Bridge is a key local focal point for the Taipa community, visitors from other parts of New Zealand and overseas. Improvements to the bridge offer an opportunity to enhance pedestrian and cycle links to the Taipa township and better connections to a wider network of walking paths and cycle routes.

The SH10 corridor provides access to regionally significant tourist destinations including the Karikari Peninsula, Carrington Resort, Coopers Beach, Mangonui, Whangaroa Harbour, Matauri Bay, Kauri Cliffs Resort. The corridor does not meet desirable customer levels of service for a key tourist route. The high tourism demand in the area is shown by the seasonal differences in traffic count. Data extracted from the TMS database shows that in 2015, traffic demand was 14% higher in the summer months, compared with the rest of the year. Figure 7 shows the demand profile for 2015.

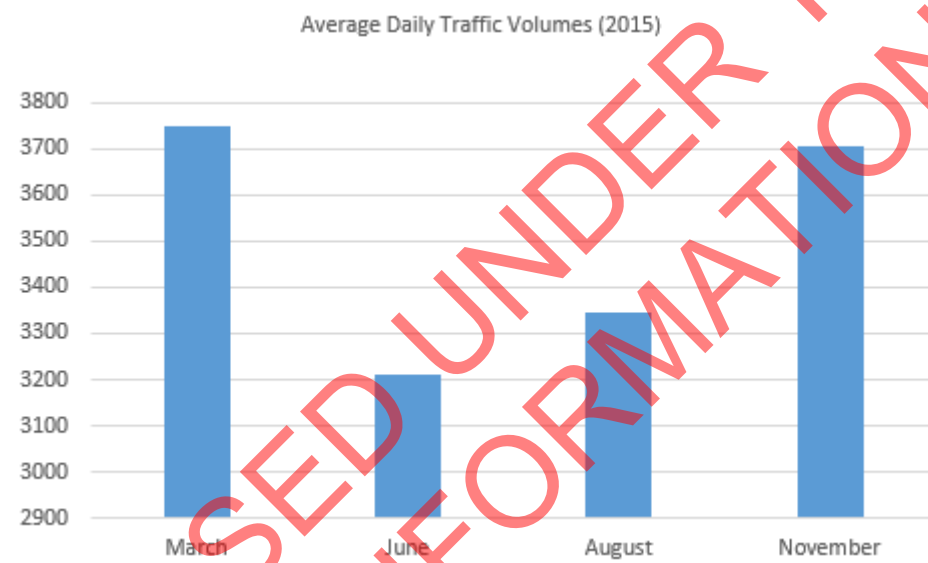


Figure 7: Average daily traffic volume⁵

The Northland Visitors Strategy (2008-2013) was developed by the Tourism Development Group in 2008 to outline the future tourism needs, planning, infrastructure and major initiatives for the region. The strategy highlights the importance of maintaining connectivity with Auckland and the wider North Island to maintain and grow levels of tourism in the area. SH10 plays an important role connecting the south with key destinations on the Twin Coast Discovery tourist route. Figure 8 shows Taipa and other key tourist destinations accessed from SH10.

Investing in improvements to the Taipa Bridge would reduce travel times during peak visitor periods and improve productivity by facilitating the ease of freight (including HPMV) and tourism movements. Improvements to the bridge could enhance its popularity for swimming and fishing, increasing its attractiveness to visitors as well as the local community.

⁵ From TMS database SH10 recorded 500m west of Stratford Drive, 2015

Figure 8: Northland tourism destinations



This evidence supports the problem identified in the strategic case that, *“The Northland economy under performs compared to other regions in the country and substandard road conditions are impacting on the performance of the region”*

3.1.3 Problem 3: Road Safety

At 107m long, Taipa Bridge is one of the longest single lane bridges in Northland. Travelling south it is difficult to see the far end of the bridge, due to its horizontal and vertical alignment. This is particularly a problem during the busy summer period.

Engagement with the Far North District Council (FNDC) and local hapu indicate that road safety is a significant concern for their community. In particular they identified problems with high traffic speeds through the township and the difficulty of safely crossing the road, particularly for school

children walking to Taipa Area School. Maintaining or enhancing accessibility to the township is important. They identified the Oruru Road intersection, which is located on the school bus route, as requiring specific attention due to its close proximity to the bridge and history of crashes.

An assessment of the surrounding area's road safety record has been carried out using the NZTA's CAS database. Crash records around the proposed site have been interrogated for the period 2010-2015.

The study area includes the intersection of Mamaru Road / SH10, Oruru Road / SH10, Taipa Point Road / SH10, Taipa Heights Drive / SH10 and Bush Point Road / SH10. In total, 15 crashes have occurred in this area, resulting in three minor injuries.

- Two crashes occurred on the Taipa Bridge, due to loss of control.
- Two crashes occurred at the intersection of Mamaru Road / SH10 due to failure to give way and failure to notice a car slowing down.
- Four crashes occurred at the intersection of Taipa Point Road / SH10 generally due to failure to give way. Alcohol was a contributing factor in two of these crashes.
- Six crashes occurred at the intersection of Oruru Road / SH10 due to vehicles following too closely, failure to give way and failure to look behind whilst reversing.
- Two crashes occurred at the intersection of Taipa Heights Drive / SH10. Alcohol was a contributing factor in both of these.

Improvements to the alignment at this location would reduce the risk of loss of control crashes and provides stronger clarity of movements through the Taipa township. There is an opportunity to better, and more safely, connect the township, including key community destinations such as Taipa Area School, with the wider road network including walking and cycling routes in the wider area.

This supports the problem statement in the strategic case that *"The physical alignment of the road exposes people to an unacceptable risk of injury should they crash"*.

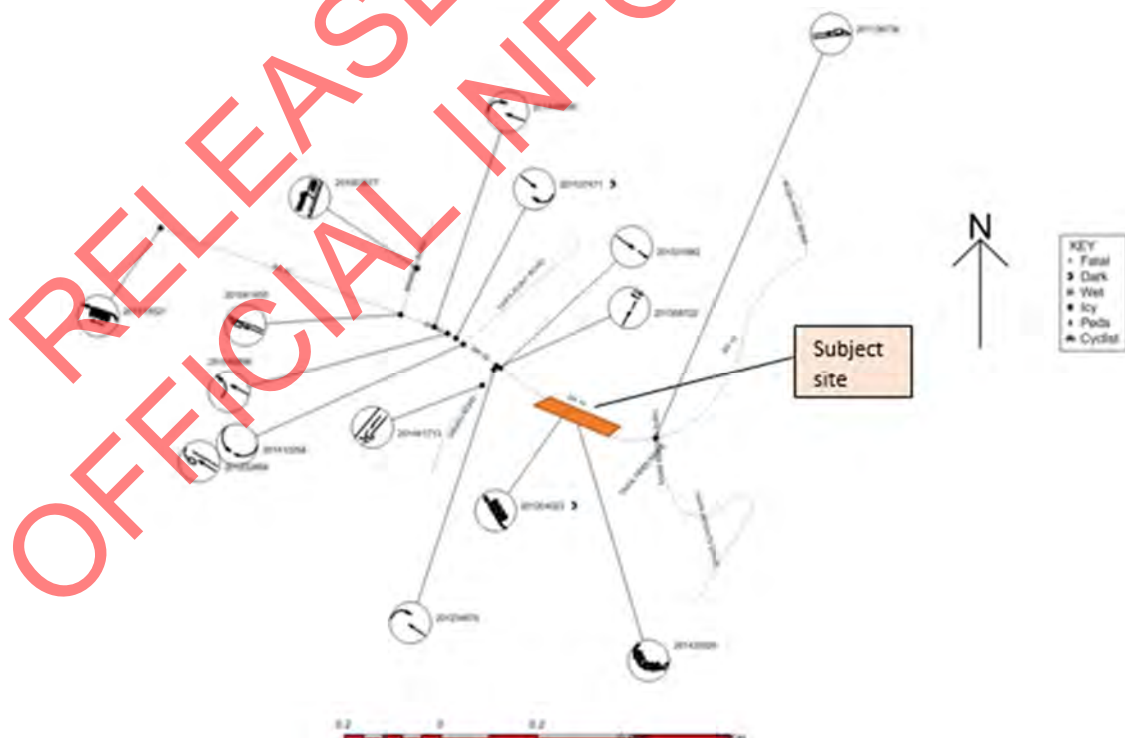


Figure 9: Crash Diagram - Taipa (2010-2015)

3.2 Benefits of Investment

The benefits of successfully investing to address these problems have been identified for the corridor. These are summarised below:

- **Benefit 1:** Improved regional economic growth (50%)
- **Benefit 2:** Improved network resilience (20%)
- **Benefit 3:** Increased safety (30%)

The following sections outline in more detail the benefits identified in this corridor.

3.2.1 Benefit 1: Improved economic growth (50%)

Through investing in improvements to the Taipa Bridge, the Transport Agency has the ability to support stronger economic growth, reduce travel times during peak visitor periods and improve productivity by facilitating the ease of freight, by removing HPMV restrictions, and tourism movements. Construction of the bridge itself will deliver needed jobs and new skills to Northland's construction industry and through this to the local community. This investment will support the recently completed Tai Tokerau Northland Economic Action Plan.

Investment in improvements to the bridge provide a significant opportunity to enhance the connectivity of the local community through safer access to the Taipa Area School and shops in the Taipa township. Improvements to the bridge could enhance its popularity for swimming and fishing, increasing its attractiveness to visitors as well as the local community.

Because of its location on the Twin Coast Discovery Route, investing will directly facilitate improved perceptions by visitors to the area, which includes the Karikari Peninsula and Kauri Cliffs Resort. The Tai Tokerau Growth Study identifies an opportunity to develop the tourism industry in Northland through "developing a more compelling value proposition based on linking cultural and natural advantages and creating a 'round trip' of authentic visitor experiences on both coasts and up to Cape Rēinga". The Taipa Bridge is already an authentic visitor experience in itself, creating the quintessential New Zealand summer image of children jumping off the bridge into the river below. Investment provides the opportunity to enhance that experience, encouraging visitors to stop, swim and stay to visit other local attractions.

Investment in SH10 has the potential to remove roadblocks to tourism travel, allowing the Far North to leverage off the strong tourism numbers already visiting the Bay of Islands and improve the tourism experience for the region as a whole. This can be directly linked to local and regional economic growth.

3.2.2 Benefit 2: Improved network resilience (20%)

SH10 is the main alternative route to SH1 and is particularly important when SH1 is closed due to crashes, flooding, slips and other unplanned events. Investment in the Taipa Bridge will improve the overall resilience of the Northland State Highway network. Investment will also reduce the likelihood that the Taipa, Coopers Beach and Mangonui townships and surrounding areas may not be accessible by road for a period. This lack of accessibility could have serious implications for affected people, including loss of economic productivity, loss of access to public healthcare, loss of access to education, loss of utility provision and increased public security concerns.

Improving the resilience of the State Highway network will support more efficient freight supply chains (including HPMV) and higher levels of economic productivity by reducing the likelihood that a freight journey will be deviated via a longer, more costly route or delayed until the closure is remedied.

3.2.3 Benefit 3: Increased safety (30%)

A safer road is a key benefit sought for the corridor and an issue of importance for local hapu and FNDC. A number of crashes have occurred on or near the bridge over the last five years. Reducing the number and severity of these crashes will significantly improve the safety and customer experience of this corridor and provide an opportunity to enhance the Taipa township, with safer connections for the local community and visitors.

3.3 Key Performance Attributes and Measures

It is important that the potential benefits of successfully investing can be assessed and measured in order to demonstrate optimum option selection. Similarly, it is also important to evaluate the success of addressing the problems or opportunities once an investment has been implemented.

The key performance attributes that will be used to evaluate the success of the selected option are set out below. These KPIs are consistent with the Transport Agency's Investment Performance Measurement: Outcome Classes.

Investment KPI	Measure
Improved resilience along corridor (30%)	Number and duration of closures
Reduce journey time (15%)	Reduced HCV kilometres for detours
Improve journey time reliability (15%)	Travel time variation
Reduced number and severity of crashes (30%)	Number of crashes, number of deaths and serious injuries

3.1 Key Legislation and Documents

This section describes how the proposed outcomes align to relevant national, regional, sector and organisational strategies. The strategies with the most direct impact on this SSBC are outlined below.

3.1.1 Tai Tokerau Economic Action Plan

The Tai Tokerau Northland Economic Action Plan (February 2016) brings into focus a group of projects that together will contribute to transforming Northland's economy. It is an "all of government" action plan to improve the economic performance of Northland.

The Action Plan is short to medium term, covering 10 years and aims to encourage new projects to be included as existing projects come to completion. A broad range of organisations will contribute to the success of the Action Plan, from business and Iwi/Maori through to not-for-profit organisations and local and central government, including the Transport Agency.

The Action Plan focuses around projects that are considered to make the greatest short to medium term difference to economic outcomes in Northland. These projects have been organised together

into common work areas that fall under four broad work streams. The objectives for each are:

1. **Enablers:** To bring Northland's transport, digital infrastructure, skills and capabilities and water resources to a standard that creates an enabling environment for economic development in Northland.
2. **Land & Water:** To identify and develop opportunities for more productive use of land and water resources across a range of primary industry sectors.
3. **Visitor Industry:** To reduce the impact of seasonality, improve product dispersal across the region and enhance tourism promotion.
4. **Specialised Manufacturing & Services:** To support the development of new innovation and specialised manufacturing and service sectors.

The Action Plan has identified that the lack of robust transport accessibility between Northland and the rest of the country is a contributing factor to the area's poor economic situation and has identified four 'game changers' to underpin business growth. The first of these game changers is:

- **1. Transport:** – *better connectivity with Auckland, within the region and with export markets. Northland is a place-based economy. Roading in particular, is critical for Northland to develop and affects virtually every part of the economy.*

A number of sectors, identified in the Tai Tokerau study as potential growth areas, require good links to markets and suppliers in Auckland and beyond. These activities include:-

- Improving dairy and related production and processing
- Tourism
- Forestry and related wood processing, and especially growing wood processing including a new saw and pulp mill at Ngawha.
- Aquaculture (although the scale of this is probably more limited)
- Horticulture

Investment in the SH10 corridor will directly improve links between these key sectors, the Auckland market and beyond.

3.1.2 Northland Regional Policy Statement, 2016 (RPS)

The Regional Policy Statement (RPS) for Northland covers the management of natural and physical resources in the Northland Region. It provides the broad direction and framework for managing the region's natural and physical resources. It identifies significant resource management issues for the region and sets out how resources such as land, water, soil, minerals, plants, animals and structures will be managed.

Policy 5.2.3 promotes the "provision of infrastructure as a means to shape, stimulate and direct opportunities for growth and economic development". It recognises that infrastructure can create opportunities for growth and development, such as those described in this business case related to the Taipa Bridge.

Policy 5.3.2 recognises regionally significant infrastructure and allows it to be protected from adverse effects.

3.1.3 Land Transport Management Act 2003 (LTMA)

The LTMA requires the Transport Agency to assess all potential projects against the GPS, the relevant Regional Land Transport Strategy (RLTS) and Connecting New Zealand's three key areas of focus across the transport system:

- economic growth and productivity
- road safety
- value for money.

In developing this SSBC, a number of key problems and potential benefits were identified using the knowledge and data that was available. A number of issues emerged from the process that were considered significant to this project including:

- the economic impact of significant delay and poor reliability associated with road closures on the movement of people and freight in Northland.
- The risk of death or serious injury as a result of poor alignment and intersection arrangement.

The resolution of these problems through investment in the SH10 corridor and Taipa Bridge would contribute to these GPS key areas of focus.

3.1.4 Northland Regional Land Transport Plan, 2015–2021

The current Northland Regional Land Transport Plan (RLTP) identifies seven key strategic outcomes that the region seeks to achieve. These are:

- A sustainable transport system that enhances the growth and existing economic development of Northland and New Zealand.
- All road users are safe on Northland's roads.
- Northland is well connected to Auckland and to the rest of New Zealand.
- Northland's roading network is developed and maintained so that it is fit for purpose (including route resilience).
- Our people have transport choices to access jobs, recreation and community facilities.
- The transport system enhances the environmental and cultural values of Northland.
- Effective ports servicing Northland and New Zealand.

Five of the eight main outcomes are key to supporting the desired outcomes of the SH10 corridor and the Taipa Bridge.

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4. Investment Objectives and Outcomes

SMART objectives were developed with reference to the key benefits sought. Investment objectives must provide enough information to enable an investor to make a sound investment decision. Two investment objectives were identified as outlined below.

4.1.1 Investment Objective 1: Resilience and Economic Growth

Problem 2 relates to the need for increased economic growth in Northland and specifically the importance of tourism as a sector of the Northland economy. Benefit 1 directly relates to this problem. Problem 1 addresses the robustness of the wider Northland economy and the challenge this creates for access to the Far North. The improved resilience outlined in Benefit 2 would also be an outcome of addressing Problem 1. Linking these problems and benefits, the following investment objective was identified:

“We will facilitate Tai Tokerau growth by providing a simple, legible journey experience for tourists that provides greater resilience for the Far North by 2018”

Important considerations for this investment objective were:

- The focus on tourists is deliberate as SH10 is a key route for tourists and an identified part of the Twin Coast Discovery tourist route. Tourism is identified as a key sector in the Tai Tokerau Northland Economic Action Plan with potential to stimulate economic growth for Northland.
- Taipa currently offers an authentic visitor experience, as envisaged for the Twin Coast Discovery Route that could be further enhanced through investment that focuses on its cultural heritage and local identity.
- SH1 and SH10 provide two alternate routes between Pakaraka and Awanui, however both routes are susceptible to closures. Improved resilience on SH10 will provide greater resilience for both SH10 and SH1 in the area, improving the accessibility of the Far North, including Cape Reinga and Kaitaia.
- The year 2018 was chosen as this is considered the earliest date to achieve this outcome

4.1.2 Investment Objective 2: Safety

Problem 3 identified the unsafe nature of the road in this area of the network. Benefit 3, which directly relates to safety is therefore directly applicable to this problem. Given the nature of the traffic on the route (being an identified tourist route) Benefit 2 also applies to this problem and improved safety also results in increased resilience being Benefit 3. Linking this problem with the applicable benefit statements the following investment objective was identified:

“We will improve safety at the Taipa Bridge so there are no crashes on the bridge (or the approach intersections) by 2018.”

Important considerations for this investment objective were:

- The approach intersections were also included as they contribute to the safe operation of the bridge and were raised as a specific concern by the local community
- The year 2018 was chosen as addressing safety problems is an urgent concern and this is considered the earliest date to achieve this outcome

- An aspiration of no crashes is the target as it is considered this is achievable and should be the aim of investing

4.2 Strategic Outcomes

When the project problems, benefits and investment objectives are considered together, this sets out the desired strategic outcomes of investment. Figure 10 outlines these linkages and shows that the following outcomes will be delivered:

- **Safer road:** This section of SH10 will be safer as a result of this project.
- **Stronger Northland economy:** The improvement in SH10 will enhance the experience and safety of the key tourism sector. As part of the Northland Twin Coast Discovery Route (which is an important Northland tourism route and experience) Taipa and the wider SH10 corridor provide a substantive input into the Northland economy and improving this experience for tourists in particular will provide greater economic opportunities for the Northland economy.
- **More resilient transport network:** The transport network will be inherently more resilient with this project in place. Not only will this section of SH10 be more resilient, but SH10 as an alternate route to SH1 is also strengthened.

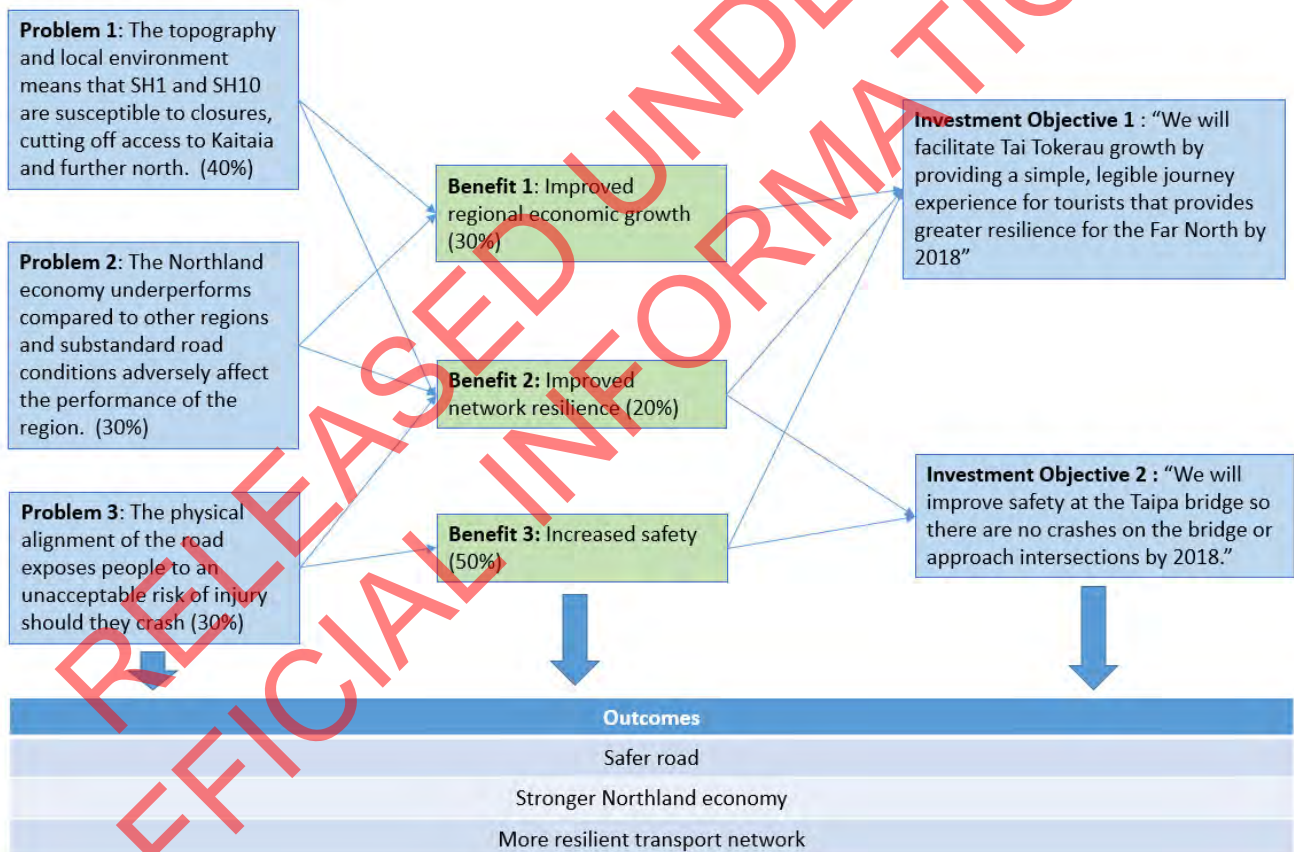


Figure 10 : Outcomes delivered

5. Options Assessment

5.1 Option Design Considerations

In developing high-level options to improve the Taipa Bridge, a number of key design principles were considered. Importantly, this SSBC represents the first stage in a more detailed design process, where key principles are acknowledged, but not developed in detail. As design progresses, these details will become more developed. This section briefly summarises these high level principles.

- The bridge itself as well as the river and estuary are places of significance to local hapu and their ancestors. Option designs should aim to minimise the effect of the project on the environment and specifically on tidal currents and water quality. Option designs should specifically address the consequences any change would have to the river beds, fish / shellfish patterns and the ability of the community to use the area as they currently do.
- Because of its prominent location at the mouth of the Taipa River, consideration should be given to landscape and visual effects and the way that options integrate with the local context.
- Local hapu should be included in the design process and given the opportunity to develop culturally relevant design features on the new bridge.
- The bridge is a key focal point and provides a strong sense of place for the local community. It is important to ensure that local cultural heritage and history is sensitively captured and that connections to community assets such as the Taipa Area School maximised.

Because of the close proximity of the bridge to the Taipa township, the interface between the bridge and township is an important consideration for option development. The following considerations have been taken into account in the development of the options:

- Safe pedestrian connection between the bridge and township is important. Adequate road space should be allocated to on-road cyclists as well as off-road facilities for pedestrians and less confident cyclists.
- The bridge is very popular for fishing and swimming. Maintaining this functionality and providing safe pedestrian access is important.
- Design should encourage safe traffic speeds through the township
- Options should be cognisant of the location of Taipa Area School and likelihood of children crossing SH10
- There have been a high number of crashes at intersections on the approaches to the bridge, particularly the intersection of Oruru Road / SH10. Crashes have also occurred at Mamaru Road / SH10 and Taipa Point Road / SH10. The predominant cause of crashes is failure to give way. Option designs should seek to address this issue.
- CPTED (Crime prevention through environmental design) principles should be adhered to and the under bridge environment included in design considerations, particularly if public access along the coast is included.

These elements are captured qualitatively in the multi-criteria option evaluation process.

In addition to these high level principles, a number of other more detailed elements will be considered as design proceeds through pre-implementation and implementation project phases including:

- The Transport Agency's Urban Design Manual: Bridging the Gap contains a number of detailed recommendations with respect to good practice urban design that should be addressed at more detailed option development stages.
- As option design develops, it will become increasingly important to describe the kit of parts that affects bridge aesthetics, e.g. form, elements, lighting etc.
- More developed option designs should address expected sea level increases associated with climate change.

5.1.1 Proposed Cross Section

A carriageway / shared path cross section was developed to be compliant with the Transport Agency's draft State Highway Geometric Design Manual requirements for roads with AADT between 2,000-4,000 vehicles and Austroads Guide to Road Design: Part 3 Geometric Design. All widening options were designed using this cross section, as follows:

- Two 3.5m traffic lanes;
- 2.5m shared path on northern side of bridge;
- 1.5m shoulder on southern side of bridge;
- 0.75m shoulder on northern side of bridge.

Figure 11 indicates the proposed cross section. It is noted that this cross section may vary in some locations.



Figure 11: Roadway Westbound Option Cross Section

FNDC design standards require a 12m sealed carriageway for this type of road. The design will match these requirements on the western and eastern bridge approaches.

A design speed of 70 km/h has been adopted, based on the existing 60 km/h posted speed limit.

In addition to these widening options, an option was also considered where traffic signals were provided on the bridge approaches and a single-lane bridge arrangement retained.

These options were compared against a do-minimum option where no improvements were made to the existing bridge.

5.2 Long List Options

A number of options have been considered in the corridor. The range of potential routeing options is constrained by the local terrain and the alignment of the Taipa harbour. Alignments to the north, to the south, and generally following the alignment of the existing bridge were considered. An option to provide traffic signals on the existing bridge was also considered as follows:

- Do Minimum: no change to existing
- Option A: Two-lane bridge, northern alignment
- Option B: Two-lane bridge, southern alignment
- Option C: Two-lane bridge, existing alignment
- Option D: One-lane bridge, traffic signal operation.

Figure 12 shows the long list option alignments.



Figure 12: Long List Options

The plan shows the previous location of the bridge (pre-1940): Option B, the current location and a potential alternative alignment to the north (Option A).

Technical investigation and reporting has been developed to evaluate these options at a high level. This information is provided in the following reports:

- Taipa Preliminary Technical Report to inform Business Case, Opus, June 2016

5.3 Option Evaluation Process

The methodology adopted for the option evaluation process was:

- Collate options
- Review technical reporting to confirm adequate information is available
- Prepare assessment criteria

- Assess and rank options using input from technical reports
- Endorse criteria and assessment outcomes

The long list of options was assessed at a high level against the following criteria:

- Investment objectives
- Ability to be implemented
 - Feasibility
 - Affordability
 - Public / Stakeholder considerations
- Assessment of Effects and Opportunities
 - Cultural, Social and Environmental
 - Economy
 - Safety

This assessment allowed the long-list options to be ranked. That process then informed the short-listing of options for further and more detailed assessment. Appendix A outlines the evaluation criteria developed by the project team and endorsed by the stakeholder team.

5.4 Long List Option Assessment

The technical assessments developed to support each long list option provide more detail with respect to the benefits and dis-benefits of each option. The following information provides a summary of the key aspects of those investigations relevant to this evaluation:

- The main differentiating factor at this high-level assessment stage is with respect to alignment;
- Alignments that affect the land to the north of the existing western abutment encroach into known archaeological sites, including burial sites;
- High value waterfront properties would need to be purchased for any deviation to the existing alignment on the western approach;
- There is a Marine Management Area 4 (Mooring) in the area to the north of the bridge on the western side of the channel. This would be affected by alignments to the north;
- The river and surrounding land use are subject to coastal hazards (sea level rise and resulting storm surge rise). The structure will be impacted by coastal hazards (i.e. design needs to account for increased flooding hazard) but the structure can also impact on coastal hazards (i.e. design needs to account for possible worsening or deflection of hazards elsewhere);
- Any change in alignment would require a new bridge (or bridge and causeway) to be constructed in the Coastal Marine Area. This would change the local hydrology, which would affect the existing sand bar, pipi beds, etc.
- There are geotechnical issues on the eastern approach, where a number of slip repairs have been carried out in the past.
- It is important to consider the likely visual effects on existing residential properties. All new structures will be designed to minimise adverse visual effects.
- Traffic signals could be used to address safety concerns but would also increase travel time.
- Traffic signals alone would not offer improved provision for cyclists and pedestrians.

Based on the detailed information gathered and generally summarised above, a qualitative assessment was undertaken using the criteria described above. A seven point assessment criteria was used.

The following key conclusions were drawn from the application of these criteria:

- Alignments to the north would require a longer structure with potentially higher adverse visual effects.
- Alignments to the north would affect known archaeological sites, including burial sites, and the Marine Management 4 (Mooring) Area and have greater impact on the general Coastal Marine Area.
- Alignments to the north would require purchase of high-value waterfront properties.
- Alignments to the south would result in a longer, more circuitous route, adding considerable travel time and cost.
- Alignments to the south would require a detour to reach the township, potentially adversely affecting businesses within the township and adding travel time to the route.
- Alignments to the south would require a shorter structure.
- Any change to the existing alignment would require significant changes to local hydrology and be both impacted by and impact on coastal hazards.
- Traffic signals alone would not sufficiently address the Investment Objectives.

Table 1 summarises the evaluation of each option. Appendix C describes the rationale for evaluating each long list option in more detail.

Taipa Bridge	DoMin	Existing alignment - two-lanes	New alignment - South	New alignment - North	Signalise existing bridge
Objective 1 – economic growth through tourism and resilience	0	+++	+	+++	+
Objective 2 – reduce deaths and serious injuries	0	++	+	++	+
Feasibility	0	0	0	-	0
Affordability	0	-	--	--	-
Public / Stakeholders	0	+	-	-	-
Cultural, Social and Environmental Effects	0	0	-	--	0
Safety	0	++	+	++	+
Economy	0	++	0	+	+
Ranking	4	1	5	2	3

Table 1: Long List Evaluation Summary Table

All options offer an improvement with respect to the identified Investment Objectives, but the existing alignment and alignment to the north are considered to better deliver, particularly with respect to economic growth.

It is noted that the southern alignment scores poorly as a result of a high cost (additional road construction would be required in addition to a new bridge structure) combined with likely low benefits to the economy as a result of increased travel times.

The northern alignment scores well against both investment objectives but is relatively high cost and likely to affect sites of significance to local iwi. It may also have greater visual and environmental effects than other options. The new bridge options enhance the connectivity of the local community. Signalising the existing bridge does not meet the Investment Objectives as well as other options.

Options following the existing alignment are more affordable, more likely to be publicly acceptable and are likely to have significantly less effect on local hydrology, known archaeological sites and adjacent properties. They are also expected to deliver greater economic benefits than the alternative options considered.

On this basis, it is concluded that a new two-lane bridge following the existing alignment is the recommended short-list option.

5.5 Recommended Short List Options

Based on the above summary and detailed assessment outlined in Appendix C, **Two-lane bridge - existing alignment**, has been identified as the short-listed option. This option is shown in Figure 13.



Figure 13: Short Listed Option

The key reasons for this being the short-listed option include:

- Has the least property and community impacts
- Supports existing urban development and built form and structure of Taipa township
- Has the smallest impact on hydrology and CMA area
- Remains in pre-disturbed envelope and road reserve, resulting in fewer environmental effects and consenting constraints
- Delivers the best outcomes against the investment objectives
- Best delivers against the economic assessment criteria

Table 2 summarises the key features of this option. This option has been developed in more detail in Section 5.6.

Table 2: Recommended Short-List Option

CRITERIA	DESCRIPTION
Investment Objective 1	This option offers an improvement against the Do Minimum through reduced travel time and increased resilience for SH10 directly, and the wider Northland region by improving the performance of SH10 such that it is a viable alternative to SH1 when that route is closed. It also offers increased legibility of the SH10 route for tourists.
Investment Objective 2	The option performs well from a safety perspective with a two lane bridge providing greater clarity of movement and priority. It removes delays and confusion associated with a single lane bridge.
Feasibility	<p>The option is considered feasible to implement, makes good use of existing infrastructure, is relatively straightforward to construct and has the least impact on the township.</p> <p>Property risks are relatively low for this option, which can be constructed largely within the existing road designation. There is some risk associated with consenting in a coastal environment. However this is considered to be relatively minor and manageable, in comparison with other options.</p>
Affordability	This option is the cheapest of the new bridge long-list options and provides the shortest, most cost effective two-lane bridge option that requires the least property. However there are likely to be affordability risks.
Stakeholders	<p>The options have not been made public however, feedback from Iwi, NRC and FNDC indicates that there will be a largely positive reaction to this option from stakeholders.</p> <p>This is based on the 'obvious' nature of this option, being that the most straightforward approach to two laning is to widen in the existing alignment.</p>
Cultural, Social and Environmental	<p>This options best balances the effects on the environment of a new bridge with the least impact on the social and cultural constraints in the area.</p> <p>Some minor impacts on sites of significance to Māori along the existing alignment will need to be addressed, and works will be required in the CMA. Some land take and impact on adjacent land uses is likely, but to a lesser degree than other options.</p> <p>An improvement to connectivity and accessibility in the Taipa township is expected, as well as improved resilience, and best use of existing infrastructure.</p>
Economy	This options provides the most direct route, whilst having the least impact on the township, resulting in the greatest positive impact economically.
Safety	This option performs well from a safety perspective.

To investigate the recommended short list option – *Two Lane Bridge, Existing Alignment* in more detail, four sub-options were considered as follows:

- Option 1a: Retention of the existing structure and construction of a new single lane structure adjacent.
- Option 1b: Retention and widening of the existing structure
- Option 2: New two-lane bridge construction, on the same horizontal alignment, using staged construction.
- Option 3: New two-lane bridge construction, immediately to the south of the existing structure.

5.6 Short List Option Assessment

The technical assessments developed to support each sub-option provide significant detail with respect to the benefits and dis-benefits of each option. The following information provides a summary of the key aspects of those investigations relevant to the evaluation of each option:

All options:

- Improvements within the Taipa township will be provided with all options, in order to maximise safety within the township and pedestrian and cyclist connections with the bridge and surrounding community.
- Basic left turn and channelised right turn treatments are proposed at the intersection with Oruru Road in all options.
- Right turning bays are also proposed at Taipa Point Road and Mamaru Road
- A pedestrian refuge is proposed, adjacent to Taipa Area School to improve safety for pedestrians in all options.

Retaining the existing structure (Options 1a and 1b):

- There is a relatively high whole-of-life cost attached to options that retain the existing bridge, due to its existing age (25 years useful life expected to remain) and associated maintenance requirements.
- The existing bridge would need to be upgraded to full HPMV capability if retained.
- Existing bridge levels do not take account of climate change and potential sea level rise.
- Retention of the existing bridge is considered to increase the risks associated with increased construction and maintenance costs in the near term.
- Retaining the existing bridge is considered an inferior outcome in comparison with options that provide a new structure.

New structure; same alignment, staged construction (Option 2):

- There would be no change from the existing alignment with options 1B and 2.
- It is likely that public / stakeholder support would be stronger for a new bridge than for options that retain the existing bridge.
- A new bridge is expected to be more resilient to flooding and other coastal hazards
- Costs to retain, maintain and upgrade the existing bridge are relatively similar to costs associated with construction of a new bridge.
- The costs of Option 2 and Option 3 are expected to be relatively similar, within the limits of estimating accuracy for this level design that has been developed.

New structure immediately to the south of the existing bridge (Option 3):

- Constructing a new bridge immediately to the south of the existing bridge results in a less satisfactory, although still adequate, alignment requiring a reverse curve to tie into the existing alignment.
- Shifting the alignment to the south would require relocation of the monument in the Taipa township. It is understood that this is preferred by iwi, to enable it to be located in a more prominent position.
- The causeway on both sides of the bridge requires widening to accommodate the carriageway width required.

Table 3 summarises the evaluation of each sub-option. Appendix C describes the rationale for evaluating each sub-option in more detail.

Taipa Bridge		Existing structure, New 1-lane bridge adjacent	Widen existing structure	New structure staged construction	New structure, adjacent
Objective 1 – economic growth through tourism and resilience		++	+++	+++	+++
Objective 2 – reduce deaths and serious injuries		++	++	++	++
Feasibility		0	0	0	0
Affordability		-	-	-	-
Public / Stakeholders		0	0	+	+
Cultural, Social and Environmental Effects		0	0	0	0
Safety		++	++	++	++
Economy		++	++	++	++
Ranking		3	4	1	2

Table 3: Short List Evaluation Summary Table

All options are considered to deliver similarly against the Investment Objectives. The options that retain the existing structure are significantly inferior from an engineering perspective. It is noted that the options requiring a new structure score higher than those on the existing structure as more benefit can be derived from a new structure for a similar cost.

A new structure on the existing alignment is the best performing option as it does not require tighter radii reverse curves and does not require widening of the causeway in comparison with a new structure immediately adjacent. It also has a slightly lower cost, although the costs of these options are considered to be similar within the limits of estimating accuracy.

The differences between these options are relatively minor with respect to the benefits that they deliver; the main differentiator being cost. Therefore, it is possible that during the pre-implementation phase when designs and construction methodologies are developed in more detail, that these differences may be addressed.

On this basis, it is concluded that a Two-Lane Bridge following the existing alignment is the recommended option. Two potential construction methodologies (staged construction and new adjacent structure) are indicated for further investigation during the pre-implementation phase.

5.7 Recommended Option

The recommended option is a two-lane bridge on a new structure, following the existing alignment. Two potential construction methodologies (staged construction and new adjacent structure) are indicated for further investigation during the pre-implementation phase.

The new bridge will be wider than the existing structure, to provide a consistent journey experience for tourists, with increased resilience and improved safety. The existing bridge is very popular for swimming and fishing and this important functionality will be retained and safety improved with the recommended option.

Providing a new two lane bridge removes the give way priority on the existing bridge, which can be confusing for tourists. The recommended option will better provide for pedestrians and cyclists than the existing situation, with a 2.5m wide shared walking/cycling path. This facility could be linked to a wider network of walking / cycling trails between Taipa, Cable Bay and beyond.

The recommended option will provide better network resilience, aiming to ensure that journeys on the State Highway are less likely to be interrupted by storm events or crashes. The new bridge will be constructed to enable use by HPMV. Currently it is only capable of use by 50MAX heavy vehicles. This will significantly improve its functionality for freight traffic.

The new bridge will be designed to ensure current safety standards are met. Compliant traffic lanes, dedicated space for cyclists and wider pedestrian provision will also act to improve safety. Within the township, a range of intersection improvements are being considered to address existing safety problems and tie the new structure into the existing road network.

Table 4 summarises the key benefits of the recommended option with respect to the investment objectives and agreed evaluation criteria.

Plans of the recommended option are provided in Appendix D.

Table 4: Recommended Option

CRITERIA	DESCRIPTION
Investment Objective 1	<p>This option provides a new two lane bridge, reducing travel times and improving legibility for tourists and other users, whilst also preserving the function and access to the township.</p> <p>This option enhances the important place function of the bridge with a 2.5m wide shared pedestrian / cycle area that can also be utilised for swimming and fishing. The option will be designed to maximise its visual appeal.</p>
Investment Objective 2	<p>This option improves safety with a shared pedestrian / cycle path, 1.5m westbound shoulder to better enable cycling and two traffic lanes with adequate width to enable vehicles to safely pass cyclists and other vehicles.</p> <p>Improvements within the Taipa township will improve safety through better delineation of turning bays at intersections, a pedestrian refuge and footpaths that connect the township to the bridge.</p>
Feasibility	<p>The option is considered feasible to implement, makes good use of existing infrastructure and has the least impact on the township.</p>
Affordability	<p>The costs of the new bridge options are considered similar, within the limits of estimating accuracy. As a result two potential methodologies are recommended for further development during the pre-implementation phase.</p> <p>Although options that retain the existing bridge are slightly less expensive, retaining the existing structure requires significant</p>

CRITERIA	DESCRIPTION
	expenditure on maintenance, with a limited lifespan, in comparison with a new structure and notably increases risks associated with cost.
Stakeholders	This option is considered likely to be most favoured by stakeholders, given it is the most obvious and has the least impact on the adjacent environment.
Cultural, Social and Environmental	<p>This option allows the bridge to remain within the road reserve and within previously disturbed areas and therefore minimises the effects on the environment associated with a new bridge. This option also provides the least impact with respect to cultural constraints in the area.</p> <p>This option improves the accessibility of the Taipa township.</p>
Economy	This option provides the most direct route (and therefore travel time saving) whilst having the least impact on the township, resulting in the greatest positive impact economically.
Safety	<p>This option improves safety with a shared pedestrian / cycle path, 1.5m westbound shoulder to better enable cycling and two traffic lanes with adequate width to enable vehicles to safely pass cyclists and other vehicles.</p> <p>Improvements within the Taipa township will improve safety through better delineation of turning bays at intersections, a pedestrian refuge and footpaths that connect the township to the bridge.</p>

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6. Economic Case

Fortnightly workshops have been held with attendees from the project team and NZ Transport Agency. The purpose of these workshops was to develop options and endorse a recommended option through consideration of the evidence base and stakeholder involvement.

Option 2 – Two Lane Bridge – Existing Alignment is recommended as the preferred option.

Table 5 summarises the economic evaluation undertaken for the preferred option. Full economic evaluation is provided in Appendix E. Economic benefits have been developed in accordance with the Economic Evaluation Manual (EEM) and include benefits associated with travel time savings, vehicle operating cost savings, accident cost savings and benefits derived from providing a more resilient alternative to SH1 when that route is closed.

Table 5: Preferred Option – Economic Evaluation Summary

TIMING	
Earliest implementation start date	2017
Expected duration of implementation	15-18 months
ECONOMIC EFFICIENCY	
Time Zero	July 2015
Base date for costs and benefits	July 2016
Present value of Total Project Cost (do minimum)	\$1,564,000
Present value Net Total Project Cost (recommended option)	\$10,830,000
Present value Net Benefit (recommended option excluding WEBs)	\$5,309,000
Present value Net Benefit WEBs (recommended option)	\$6,206,000
BCR (excluding WEBs)	0.5
BCR (including WEBs)	0.6

Table 6: Preferred Option – P50 Costs and Benefits

P50 COSTS	DO MIN	PREFERRED
Property	\$0	\$30,000
Project Development	\$0	\$0
Pre-Implementation	\$0	\$718,850
Construction / Implementation	\$0	\$11,058,403

P50 COSTS	DO MIN	PREFERRED
External impact mitigation	\$0	
Other capital (e.g. insurances)	\$0	
Capital risk management	\$0	
TOTAL IMPLEMENTATION COST		\$11,807,253
Maintenance		
Renewal		
Operating		
Other ongoing costs		
Post project evaluation		
ONGOING COSTS		
Project Contingency		\$2,291,354
TOTAL P50 PROJECT COSTS		\$14,098,607
BENEFITS (PRESENT VALUE)		
Travel time savings	\$0	\$3,606,000
Vehicle operating cost savings	\$0	\$221,000
Accident cost savings	\$0	\$1,482,000
Network resilience	\$0	\$891,000
WEBs (reduced closures)	\$0	\$6,000
Vehicle emissions reductions		
Reduced driver frustration		
Walking and cycling (EEM)		
Travel behaviour change		
PV TOTAL NET BENEFITS		\$6,206,000

In addition to the transport benefits discussed above, which are able to be captured and monetised in accordance with EEM requirements, it is considered that a significant number of non-monetised benefits will also be derived from the implementation of this project. These benefits have been captured in the Investment Objectives developed for this business case and the strategic outcomes expected from the successful implementation of this project.

Specifically, the outcomes expected for this project are:

- **Safer road:** This section of SH10 will be safer as a result of this project.
- **Stronger Northland economy:** The improvement in SH10 will enhance the experience and safety of the key tourism sector. As part of the Northland Twin Coast Discovery Route (which is an important Northland tourism route and experience) Taipa and the wider SH10 corridor provide a substantive input into the Northland economy and improving this experience for tourists in particular will provide greater economic opportunities for the Northland economy.
- **More resilient transport network:** The transport network will be inherently more resilient with this project in place. Not only will this section of SH10 be more resilient, but SH10 as an alternate route to SH1 is also strengthened.

The monetised transport benefits described above capture the “safer road” and “more resilient transport network” outcomes but do not fully address the “stronger Northland economy” outcome. The likely measures of success against this desired outcome include:

- Increased sense of place and community pride:
 - A landmark new bridge that incorporates the cultural heritage of the local area can play a powerful role to increase community pride
 - Incorporation of a diving / fishing platform creates a focal point for locals and visitors
 - The Taipa township is located immediately adjacent to the bridge. An improved pedestrian / cycle connection to the town will encourage activity
- Increased attractiveness for tourists, particularly if accompanied by good urban landscape design in the township, as planned
 - More road users likely to stop and spend money there
 - Increased demand for tourist accommodation and other local services
- Local construction employment opportunities:
 - It is expected that a number of Northland businesses and residents will be employed during the construction of this significant project.
 - Workers are expected to become permanently upskilled as a result of on-the-job training and are better placed for subsequent work opportunities (financial gain and wellbeing).
 - During construction, local accommodation, food and other service providers will also benefit from an increased local workforce.

6.1 Outcomes Table

Option 2 has been selected as the recommended option, to be progressed to the pre-implementation phase. Table 7 summarises the outcomes that this option delivers in comparison with other options and indicates the relative differences in benefits and costs.

Table 7: Outcomes Table

OPTION	TRAVEL TIME SAVINGS	SECONDS SAVED / VEHICLE	ACCIDENT SAVINGS	TOTAL BENEFITS (NPV)	DSI SAVED	COST (P50)
Option 2	\$3,606,000	13	\$1,482,000	\$6,206,000	0.05	\$14,099,000
Option 1a	\$3,606,000	13	\$1,482,000	\$6,206,000	0.05	\$14,645,000
Option 1b	\$3,606,000	13	\$1,482,000	\$6,206,000	0.05	\$14,088,000

OPTION	TRAVEL TIME SAVINGS	SECONDS SAVED / VEHICLE	ACCIDENT SAVINGS	TOTAL BENEFITS (NPV)	DSI SAVED	COST (P50)
Option 3	\$3,606,000	13	\$1,482,000	\$6,206,000	0.05	\$14,145,000
Signalise existing bridge	-\$1,328,000	-11	\$1,812,000	\$1,602,000	0.06	\$300,000
Northern Alignment	\$3,606,000	13	\$1,482,000	\$6,206,000	0.06	\$31,950,000

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7. Assessment Profile

The investment profile has been determined using the Transport Agency's Investment Assessment Framework, as described below.

The indicative investment profile overall for the Taipa Bridge has been assessed as **MH**.

Strategic Fit = Medium

Overall, the corridor has been given a **medium** strategic fit as the problems and benefits defined by the stakeholder panel, and supported by the currently available evidence "*provide a **secure and resilient** transport network to ensure national and regional connectivity for economic growth and productivity*" are aligned with achieving the Government's goals for land transport and are significant from a regional perspective.

The identified problems and benefits are also consistent with the Transport Agency's commitments on improved network resilience. Without this intervention, the problems will continue to worsen and importantly the benefits associated with the desired tourism and economic growth in the area will not be fully realised.

Effectiveness = High

Overall, the corridor has been given a **high** effectiveness rating. This is based on the intent and potential scope of the preferred option to deliver against the range of effectiveness criteria set out in the current Investment and Revenue Strategy and summarised below.

Component	Rating
Outcomes focused	H - The preferred option will improve journey time reliability, provide more efficient and productive freight supply chains, improve the resilience and safety of the route.
Integrated	H - The preferred option is in keeping with the long term strategic plan for the state highway. A 'one system' approach is taken to improving transport infrastructure, including state highway and local road networks but also incorporating the needs of pedestrians, cyclists and freight users into the solution.
Correctly scoped	H - When arriving at the preferred option, a range of potential alternatives and options have been considered. The scale of the intervention is appropriate to achieve the benefits that have been identified.
Affordable	H - This project is included in the RLTP and a number of funding options have been identified.
Timely	H - The project is expected to deliver enduring benefits. It is important to proceed now as the project is consistent with the priorities of the Tai Tokerau Economic Action Plan. Completion of this project along with Kaeo Bridge will remove all single lane bridges from SH10. This will provide a more reliable / resilient route beneficial for tourism and freight industries. Particularly with the alternative, SH1, running through one of the most winding, hilly sections of SH1 in the country, the Mangamuka Gorge.
Confidence	H - Preferred option progressed through the NLTP and there is a high degree of expectations around investment in this area.

Efficiency = _

The benefit cost ratio calculated using EEM criteria for the preferred option is **0.6** (including WEBs) or 0.5 (excluding WEBs).

Combined with strategic fit and effectiveness ratings of **MH**, the project's priority order is **Priority X**.

It is noted that the preferred option may not meet the criteria for funding through the National Land Transport Fund (NLTF). However, given the strategic benefit to the region associated with this project, it is possible that alternative funding sources may be sought.

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8. Financial Case

8.1 Project Delivery Costs

The key assumptions for the preferred option are set out in the Economic Case, in section 6. Cost estimates for each option are provided in Appendix F.

8.2 Pre-Implementation Costs

ITEM	DISCUSSION
Timing assumptions	All construction costs incurred in Year 1 of economic analysis.

8.3 Implementation Costs

ITEM	DISCUSSION
Property purchase	Negligible costs associated with property acquisition for the preferred option. Option able to be contained within existing road reserve.
Design costs	Design costs have been calculated and included in the estimate.
Construction costs	Costs are based on a concept design. Appropriate contingency sums are included in the estimate to allow for uncertainties associated with this early stage in the design process.

8.4 Post-Implementation Costs

ITEM	DISCUSSION
Operating costs	There are no operating costs associated with the project.
Maintenance costs	Compared with the do-minimum there are likely to be lower maintenance costs as a result of the provision of a new bridge structure. The existing structure is nearing the end of its useful life and requires significant investment in maintenance, in comparison with a new structure.
Other costs	No additional costs identified.
Post-project evaluation costs	Post-construction crash data will be analysed to assess the effectiveness of the project in reducing DSI's and to identify any other benefits or dis-benefits

9. Commercial Case

9.1 Procurement

The proposed construction procurement basis will be Competitive Early Contractor Involvement (ECI).

The strategy has been developed using the NZ Transport Agency's standard procurement approach, with contractors tendering for a Competitive ECI contract. ECI tenders are evaluated on a quality basis and as such engagement of an independent parallel estimate peer review is recommended.

A market briefing was held in March 2016. Six consortia have lodged Statements of Interest and Ability (SIA) to undertake this programme of work.

9.2 Funding

It is anticipated that this project will be partially funded from the National Land Transport Fund (NLTF), subject to meeting overall thresholds for investment. However, it is likely that a proportion of funding will be required from alternative sources.

9.3 Risk Management

Risk will be allocated in accordance with the ECI procurement model and will be transferred in accordance with relevant standard conditions of contract (CCCS and NZS3910:2013).

Risk associated with Safety in Design will be developed using a formal process to inform design outcomes.

Formal Risk Assessment in accordance with Z/44 will be undertaken to identify the most appropriate entity / person to manage each risk. Start and end of phase risk assessments will be completed for design, tendering and construction.

The proposed risk allocation is consistent with the cost estimate including provisional items and suitable contingency.

10. Management Case

10.1 Project Management Planning

An independent Road Safety Audit will be carried out on the detailed design of this project in accordance with the Agency's Road Safety Audit Procedures for Projects – Guidelines (Interim Release May 2013).

A detailed pre-implementation report will be developed, including any departures to be applied for. Approvals at the appropriate level will be sought when required, these are likely to include internal Transport Agency approvals, NRC and FNDC consents.

The key project assurance deliverables for the pre-implementation and implementation phases are summarised in Table 8.

Table 8: Pre-Implementation and Implementation Deliverables

PHASE	DELIVERABLE	APPROVAL PROCESS	PERSON RESPONSIBLE
Detailed Design	2016	Auckland / Northland State Highway Manager	Jacque Bell
Tender Phase	2016	Auckland / Northland State Highway Manager	Jacque Bell

10.2 Risk Management Planning

The Project Manager will be responsible for managing project risk and will maintain the risk register. Risk will be managed in accordance with Z/44 – NZTA Minimum Standard for Risk Management, General Approach.

The key risks identified to date are:

- **Funding.** The proposed option does not meeting NLTF funding requirements. It is anticipated that this project will only be partially funded from the NLTF and it is likely that a proportion of funding will be required from alternative sources.
- **Management of stakeholder expectations.** This will be managed and addressed through focused stakeholder engagement during the pre-implementation stage.
- **Departures.** A Road Safety Audit will be undertaken to identify any departure requirements.
- **Archaeological artefacts.** There is a risk that archaeological sites may be found within the project extents. The works are expected to impact on the known shell midden. However, the recommended option will impact on these sites to a lesser degree than other options following new alignments as it is largely within the existing carriageway. There is a risk that new alignments could pass through new, potentially more valuable, previously undisturbed sites (e.g. burial sites). As initial investigations have identified sites in the adjacent area, the construction team will be made aware of the necessary actions to implement if artefacts are discovered.

10.3 Post-Project Evaluation Planning

The outcome of the project will be measured on the number of deaths and serious injuries that are saved across this project extent.

Crash records will be reviewed each year following implementation, although meaningful trends cannot be established until at least 3 years have passed since implementation.

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APPENDIX A. SUMMARY OF IWI ENGAGEMENT

From: Sebastian Reed [mailto:Sebastian.Reed@nzta.govt.nz]
Sent: Monday, 23 May 2016 10:23 PM
To: Ida Dowling <Ida@commute.kiwi>
Cc: Jacque Bell <Jacque.Bell@nzta.govt.nz>
Subject: Taipa Iwi update

Below is a brief summary of the hui with the local Hapu.

On the 31st of March Rewi Spraggon and I met with three Hapu that share kaitiakitanga in the Taipa area. Ngati Matakairiri, Ngati Tara and Ngati Whata. The meeting took place at 6pm at Karepori marae, Taipa.

At our hui we discussed the importance of the Taipa bridge to the Hapu and the significance of the river / estuary in relationship to the Hapu and their ancestors.

A significant concern raised by the Hapu was safety in the township (especially for children especially given the proximity to Taipa Area School). Their main concerns related to high speed of vehicles using this part of SH10 which will likely increase with any widening of the bridge and the Oruru Road intersection immediately adjacent the bridge. Oruru road is a relatively high use local road including by school buses and any bridge upgrade would need to ensure ongoing safe use of the intersection. The hapu wanted to ensure that accessibility of the area retained (or enhanced).

We talked about the importance of the environment and their concerns the project may impact tidal currents and water quality. And the consequences any change would have on the river beds, fish / shellfish patterns and the ability of the community to uses the area as they currently do.

The possibility of moving, if need be, the monument in front of the local shops that acknowledges the many waka that have landed in the area. The Hapu would be open to the idea of relocating the monument if a suitable location could be found. The group also referenced a large pou that used to be in the area and were interested in the ability to include culturally relevant design features to the new bridge.

We raised the process of Geo-Tech testing and the role of kaitiaki / monitoring. The three Hapu were happy to share this role when this commences.

Find the latest transport news, information, and advice on our website:

www.nzta.govt.nz

APPENDIX B. ASSESSMENT CRITERIA

OBJECTIVES	CONSIDERATIONS	MEASURES
Investment Objective 1	We will facilitate Tai Tokerau growth by providing a simple, legible journey experience for tourists that provides greater resilience for the Far North by 2018	Qualitative assessment based on tourist journey experience
Investment Objective 2	We will improve safety at the Taipa Bridge so there are no crashes on the bridge (or the approach intersections) by 2018	Number and severity of crashes by 2018
IMPLEMENTABILITY APPRAISAL		
Feasibility	How straightforward is it to implement this alternative / option?	Level of complexity. I.e. tunnelling, community consultation, challenging ground condition
	Are innovative technologies involved?	Level of innovation
	Are there significant hazards that may pose a health, safety in design risk?	Level of hazards
	Are there significant effects on property?	Impact of project on property
	Are other infrastructure providers affected?	Other organisations beside NZTA
	Are there consenting risks that could affect delivery or cost risk?	Level of consenting risk for option
	Are there factors likely to affect the ability to operate / maintain the option over its projected life without major additional costs?	Maintenance and operation costs
Affordability	What are the funding risks of the alternative/option?	Included in the RLTP to no funding allocation
	Can the alternative be funded traditionally? (economic efficiency)	Estimated economic efficiency of project
	Are alternative funding mechanisms required?	yes / no
	Are there cashflow risks that might affect the delivery programme?	yes / no
	Are there ongoing operating cost risks?	Level of operating costs
	Are operating subsidies required? How will these be funded?	Tolling / PQP procurement
Public / Stakeholders	Has the alternative been made public?	Yes / no
	How acceptable is the alternative?	Level of anticipated acceptance
	Are there real or anticipated objections from the community or stakeholders?	Level of anticipated acceptance by stakeholders
ASSESSMENT OF EFFECTS		
Cultural heritage, environmental, social and	Are there any sites or features (including their setting) of significance to Maori (archaeological or existent) affected?	

OBJECTIVES	CONSIDERATIONS	MEASURES
community wellbeing	Are there any historic heritage places (including their setting) (e.g. archaeological or buildings, sites, remnants) affected?	
	Are any (first tier) outstanding landscapes or natural features, or (second tier) significant/special landscape or natural features affected?	Environmental mapping
	Are there any ecological areas, or areas with habitat value (including large areas of native vegetation) affected?	
	Are there any coastal marine areas, wetlands, lakes, rivers, streams or their margins affected?	Environmental mapping
	Are there any areas of contaminated land affected?	
	Are there community facilities (park/schools/hospitals etc), or residential or other sensitive land uses in the area that could be affected by adjacency effects (eg noise, disruption, vibration, air quality etc)?	Assessment of proximity to settlements
	Are there potential effects from hazards or risks (including from future climate change) from erosion, flooding, fault lines, sea level rise	
	Extent to which the option integrates transport and land use to make best use of existing networks and infrastructure.	Extent of integration with land use aspirations
	Are there any communities affected by reduced cohesion, connectivity or accessibility?	Qualitative assessment of access to the road network
	Are there opportunities to enhance the active travel modes - cycling and walking and/or linkages to other national or regional recreational cycle networks for longer distance cyclists?	Qualitative assessment of access to alternative modes
	Extent and significance of land take, severance; negative and positive opportunities	Severance / connectivity
Economy	How will the alternative/option affect traffic volumes?	Level of growth catered for?
	Does the option provide an opportunity to reduce vehicular travel time on SH1 between the Auckland and Northland regions?	Qualitative evaluation
	Does the option improve journey time reliability?	Qualitative evaluation
	Are there gainers and losers (modes / regions)? What is the overall effect?	Qualitative assessment of overall benefits to surrounding communities
	Does the option provide for more efficient freight supply chains between the Auckland and Northland regions	Route quality
	How well does the option integrate with land use with reference to regional growth strategies	Consistency with regional growth strategies
	How well does the option enhance the development potential of adjacent land / attract new jobs / help existing businesses?	Qualitative assessment of access to land use
	How well does the option preserve the function of SH12 as a collector route, consistent with ONRC	Qualitative evaluation

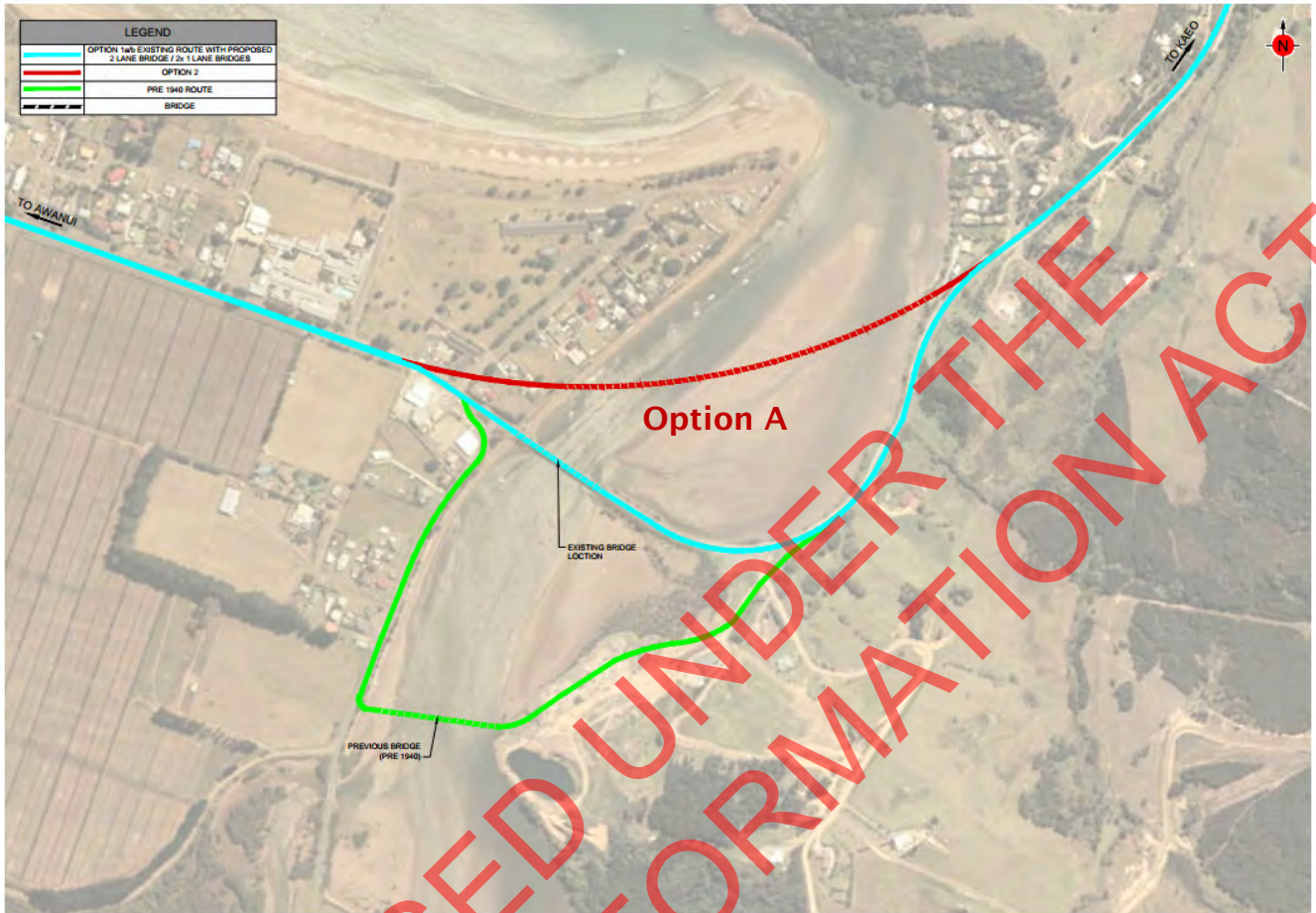
OBJECTIVES	CONSIDERATIONS	MEASURES
	How well does the option address route security, resilience and flexibility	Extent to which the option improves route resilience
Safety	How will the alternative enhance safety for different types of transport users?	Alternative mode safety
	Will it involve gainers and losers in terms of safety?	Adverse safety effects from the option
	Are there impacts on personal safety / security?	Assessment of the reduction in crash risk
	What is the impact on fatal / serious injuries?	Assessment of reduction in DSI

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APPENDIX C. OPTION ASSESSMENT

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Option Assessment Summary Table (Option A)



PROPOSAL DETAILS			
Business case name:	SH10 Taipa Bridge	Name of Project Manager & Region:	Sebastian Reed, Auckland / Northland
Business case purpose:	To upgrade the Taipa bridge to improve the resilience and economic performance of the Northland region.		
Option A - Two-Lane Bridge - Northern Alignment			
Option description:	This option recommends upgrading the Taipa Bridge to two lanes, following an alignment to the north of the existing one lane bridge. This option is shown in the covering picture to this note. This option also includes a shared path for cyclists and pedestrians. Dependencies : None		
Estimated total public sector funding requirement:		Lower	Upper
	Capital cost (\$m):		
	Net property cost (\$m):		
	Opex (\$m/30yr):		
	Maintenance (\$m/30yr):		
	Present value of cost to govt. (\$m):		
Estimated BCR range:			
Timing of need:	Optimal programme:		Likely:
IAF profile:	Strategic fit: H/M/L	Effectiveness: H/M/L	Efficiency: H/M/L

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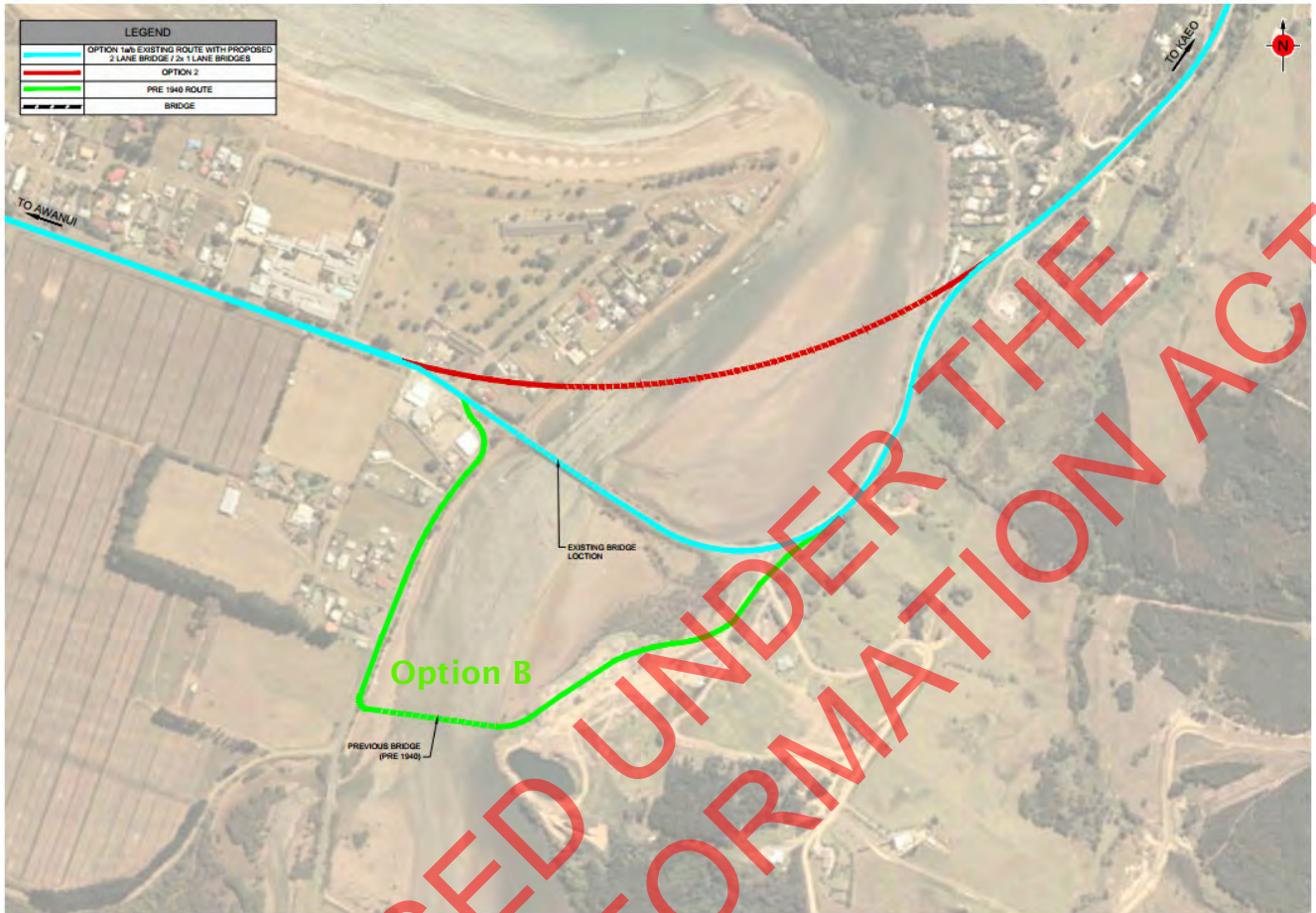
MULTI CRITERIA ASSESSMENT – OPTION A		
Criterion	Score	Discussion
Objective 1: Economic Growth and Resilience	+++	This option offers an improvement against the Do Minimum. It reduces travel time and increases the resilience of SH10 and the wider Northland region. It improves the legibility of the SH10 route for tourists. This results in a +++ rating.
Objective 2: Safety	++	The option performs well from a safety perspective with a two lane bridge providing greater clarity of movement and priority. It removes the congestion and confusion associated with a single lane bridge, giving a strong ++ score. It also provides shoulders for cycling and a shared pedestrian / cycle path, reducing likely conflicts with vehicles.
Feasibility:	-	This option scored - overall with respect to feasibility. Risks associated with property and consenting were high but the construction method is considered straightforward and whole of life costs were relatively low, compared with other options.
Affordability:	--	This option scored -- overall for affordability. This was largely due to a combination of adverse impacts, ranging from 0 to ---. This implies there are affordability risks. In particular, given the likely economic efficiency of this option, this option may not be fully fundable through the NLTF and alternative funding mechanisms will likely be required.
Public/Stakeholders:	-	The options have not been made public. However, a largely negative reaction is likely, based on the impact to property and the estuary area when compared to the existing alignment.
Environmental and social:	--	This alignment will affect sites of significance to Māori, including burial sites. Substantial amount of work required within previously undisturbed areas of the CMA. Works would cut through an existing Mooring Area. Significant land take and impact on existing land uses would occur.
Safety:	++	The option performs well from a safety perspective with a two lane bridge providing greater clarity of movement and priority. It removes the congestion and confusion associated with a single lane bridge, giving a strong ++ score. It also provides shoulders for cycling and a shared pedestrian / cycle path, reducing likely conflicts with vehicles.

MULTI CRITERIA ASSESSMENT – OPTION A

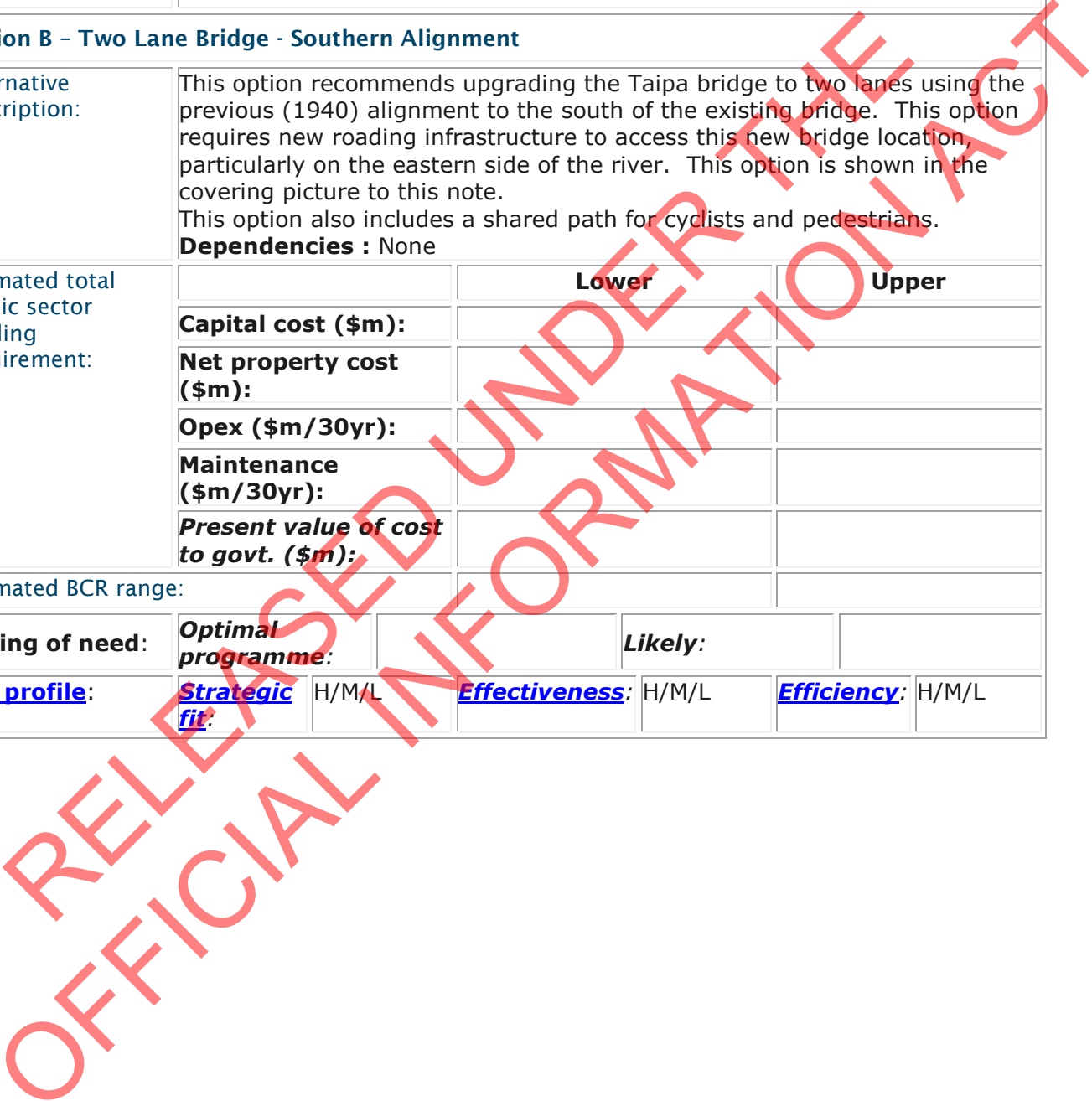
<p>Economy:</p>	+	<p>This option will enable the forecast traffic forecasts to be met. Journey times will be reduced and travel time reliability is assessed to improve as a result of the option.</p> <p>These benefits are in part offset by the impact on the town centre and property owners in the area.</p>
<p>Environmental opportunities</p>	<p>A new bridge alignment may offer the opportunity to improve the adjacent estuary</p>	
<p>Social opportunities</p>	<p>This option may provide an opportunity to strengthen the Taipa township through improved clarity of transport movements and substantive changes to property in the township.</p>	
<p>Rationale for selection or rejection of alternative:</p>	<p>This option ranked 2nd of those assessed as it largely met the investment objectives sought for this project. The option enhances resilience and economic opportunities in the area and increases the legibility of the travel route.</p> <p>However, this option has the largest effect on the adjacent environment, including site of significance to local iwi. It also has a high cost, particularly with respect to property purchase requirements.</p>	

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Option Assessment Summary Table (Option B)



PROPOSAL DETAILS			
Business case name:	SH10 Taipa Bridge	Name of Project Manager & Region:	Sebastian Reed, Auckland / Northland
Business case purpose:	To upgrade the Taipa bridge to improve the resilience and economic performance of the Northland region.		
Option B – Two Lane Bridge - Southern Alignment			
Alternative description:	<p>This option recommends upgrading the Taipa bridge to two lanes using the previous (1940) alignment to the south of the existing bridge. This option requires new roading infrastructure to access this new bridge location, particularly on the eastern side of the river. This option is shown in the covering picture to this note.</p> <p>This option also includes a shared path for cyclists and pedestrians.</p> <p>Dependencies : None</p>		
Estimated total public sector funding requirement:		Lower	Upper
	Capital cost (\$m):		
	Net property cost (\$m):		
	Opex (\$m/30yr):		
	Maintenance (\$m/30yr):		
	Present value of cost to govt. (\$m):		
Estimated BCR range:			
Timing of need:	Optimal programme:		Likely:
IAF profile:	Strategic fit: H/M/L	Effectiveness: H/M/L	Efficiency: H/M/L



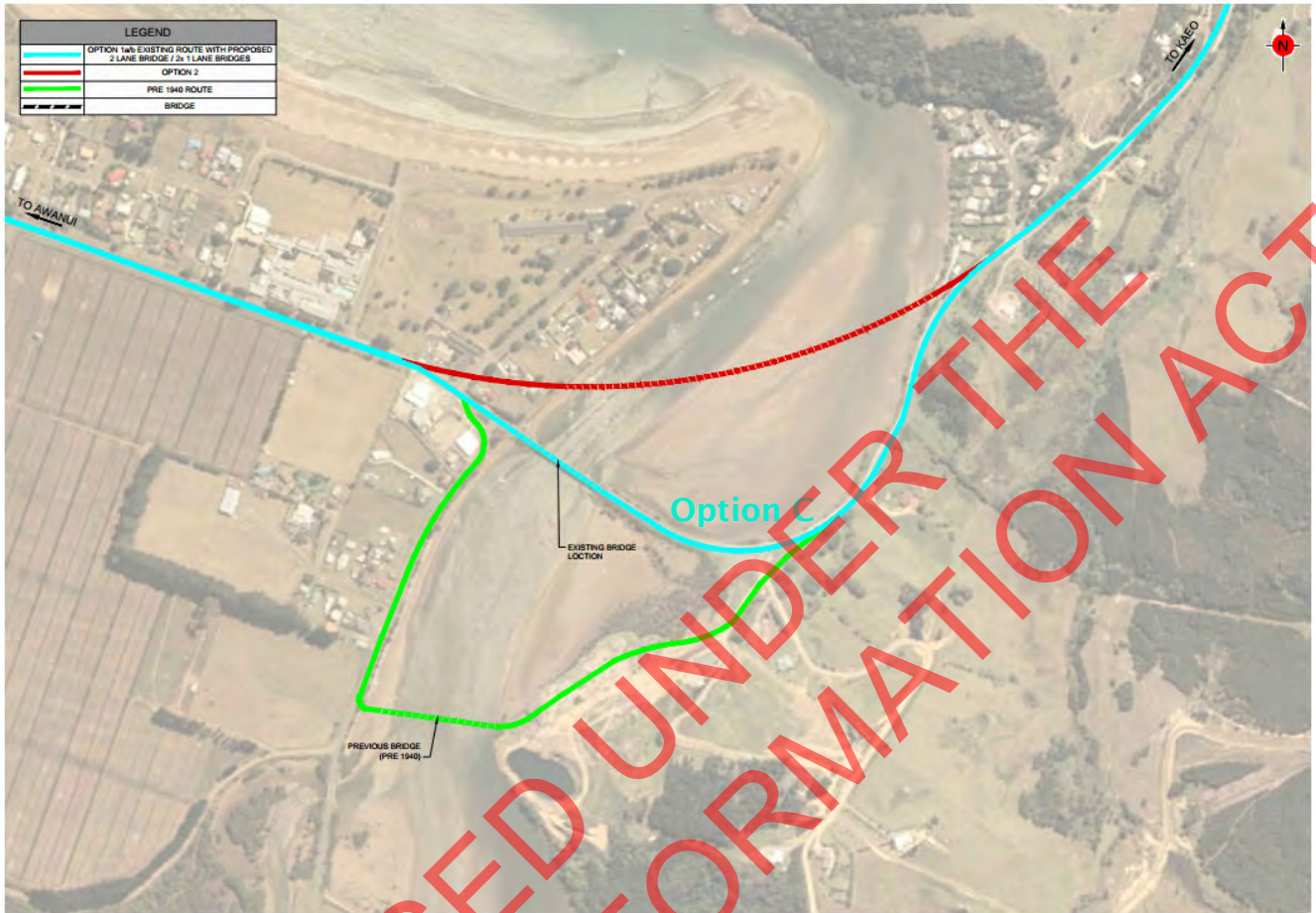
MULTI CRITERIA ASSESSMENT – OPTION B		
Criterion	Score	Discussion
Objective 1: Economic Growth and Resilience	+	This option offers a slight improvement against the Do Minimum. It increases travel time as a result of its increased length, but also improves the resilience of SH10 and the wider Northland region. It improves the legibility of the SH10 route for tourists. This results in a + rating.
Objective 2: Safety	+	The option performs better from a safety perspective than the existing situation, with a two lane bridge providing greater clarity of movement and priority. It removes the congestion and confusion associated with a single lane bridge, however, the lengthy and circuitous new route, including a number of new curves, results in a + score
Feasibility:	0	<p>This option scored 0 overall. Within this headline score, there were a combination of adverse impacts and some relatively positive effects. This implies there are some implementation risks, but relatively few in comparison with other options.</p> <p>The greatest risks are associated with consenting and property impacts. However these are considered to be relatively moderate in comparison with other options.</p>
Affordability:	-	<p>This option scored - overall. This implies there are some significant affordability risks.</p> <p>Given the likely economic efficiency of this option, alternative funding mechanisms will likely required.</p>
Public/Stakeholders:	-	The options have not been made public. However, a largely negative reaction is likely, based on the significantly (relatively speaking) longer alignment.
Environmental and social:	-	Some impacts on sites of significance to Māori and on the natural landscape are expected and would need to be addressed. Works/impacts in the CMA are expected but primarily contained within previously disturbed areas. Some land take and impact on adjacent land uses would occur.
Safety:	+	The option performs better from a safety perspective than the existing situation, with a two lane bridge providing greater clarity of movement and priority. It removes the congestion and confusion associated with a single lane bridge, however, the lengthy and circuitous new route, including a number of new curves, results in a + score

MULTI CRITERIA ASSESSMENT – OPTION B

Economy:	0	<p>This options provides additional capacity, meeting future demand forecasts, but also requires a longer travel distance and therefore time. It also offers poorer accessibility for pedestrians and cyclists than the existing situation.</p> <p>This alignment does not connect as well with the Taipa township as other options, which may adversely affect its economic performance.</p>
Environmental opportunities	<p>This option provides the opportunity to enhance the local estuary areas as it locates the bridge further from the estuary mouth.</p>	
Social opportunities	<p>This option provides a significant opportunity to strengthen the Taipa town centre through improved accessibility and clarity of transport movements.</p>	
Rationale for selection or rejection of alternative:	<p>This option ranked 5th of those assessed, scoring worse than the Do Minimum. This is because it increases the expected travel time, at considerable cost, without fully meeting the investment objectives sought.</p>	

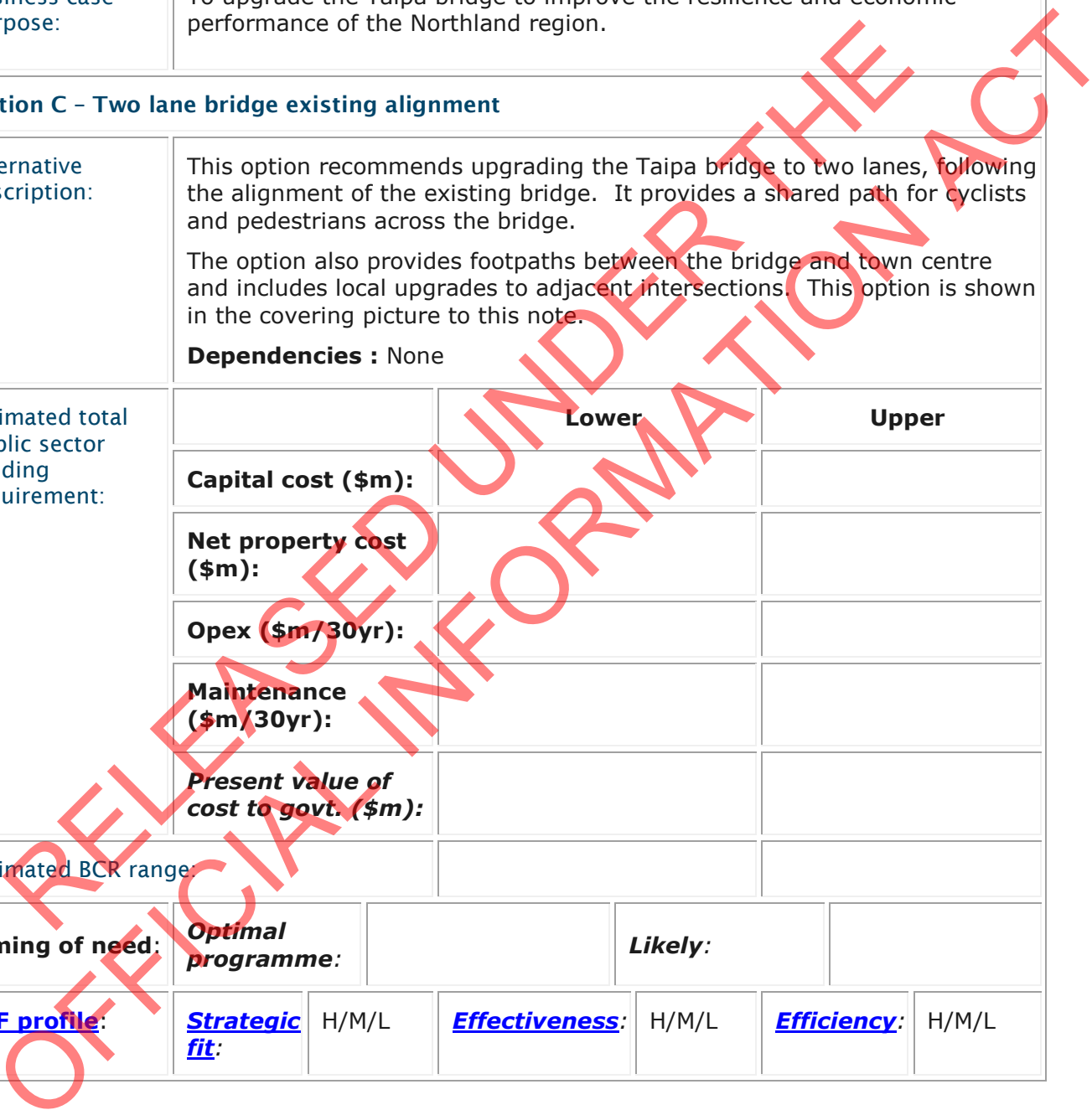
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Option Assessment Summary Table (Option C)



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PROPOSAL DETAILS					
Business case name:	SH10 Taipa Bridge	Name of Project Manager & Region:	Sebastian Reed, Auckland / Northland		
Business case purpose:	To upgrade the Taipa bridge to improve the resilience and economic performance of the Northland region.				
Option C - Two lane bridge existing alignment					
Alternative description:	<p>This option recommends upgrading the Taipa bridge to two lanes, following the alignment of the existing bridge. It provides a shared path for cyclists and pedestrians across the bridge.</p> <p>The option also provides footpaths between the bridge and town centre and includes local upgrades to adjacent intersections. This option is shown in the covering picture to this note.</p> <p>Dependencies : None</p>				
Estimated total public sector funding requirement:		Lower	Upper		
	Capital cost (\$m):				
	Net property cost (\$m):				
	Opex (\$m/30yr):				
	Maintenance (\$m/30yr):				
	Present value of cost to govt. (\$m):				
Estimated BCR range:					
Timing of need:	Optimal programme:		Likely:		
IAF profile:	Strategic fit:	H/M/L	Effectiveness:	H/M/L	Efficiency: H/M/L

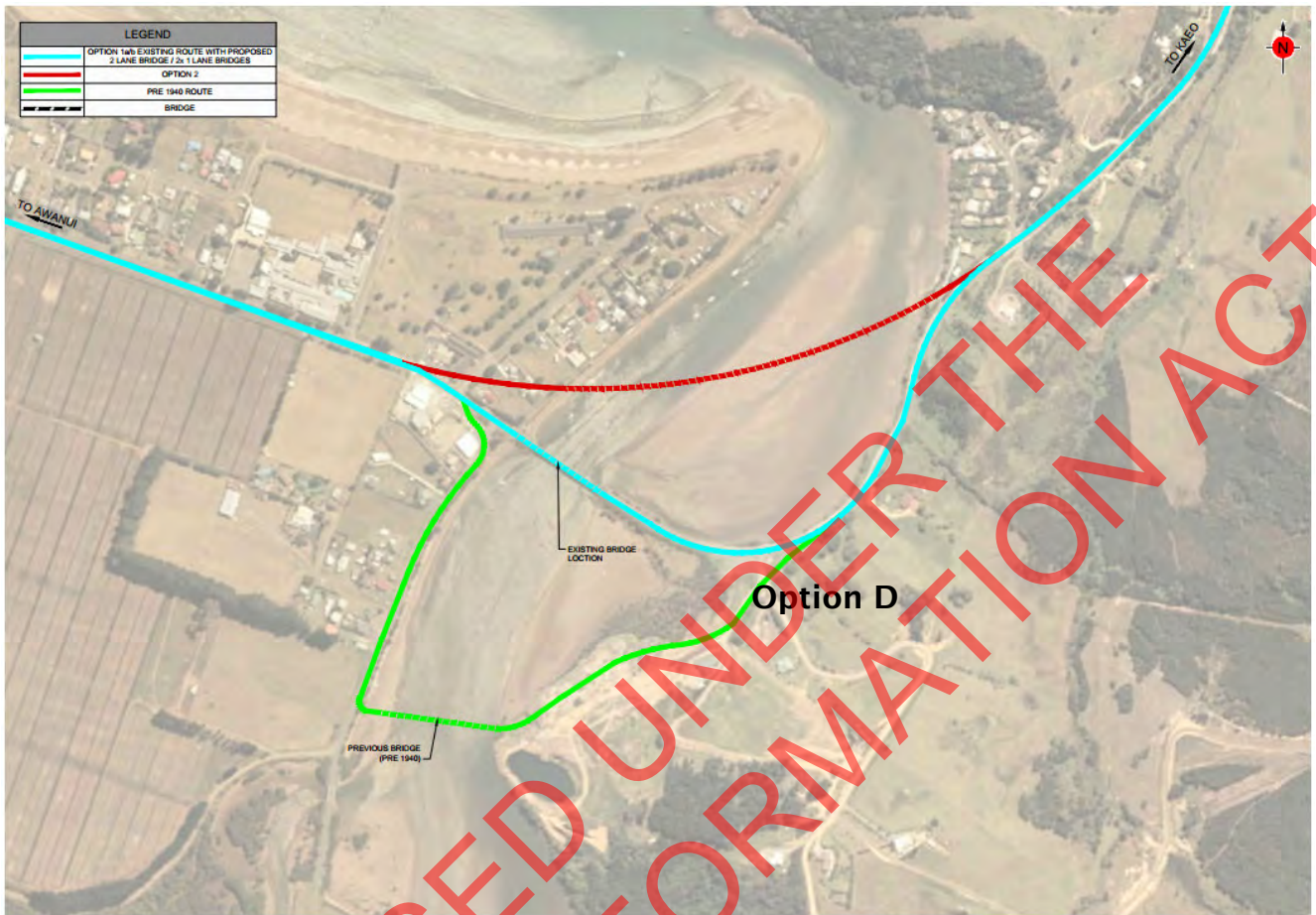


MULTI CRITERIA ASSESSMENT – OPTION C		
Criterion	Score	Discussion
Objective 1: Economic Growth and Resilience	+++	This option offers an improvement against the Do Minimum through reduced travel time and increased resilience for SH10 directly, and the wider Northland region by improving the performance of SH10 such that it is a viable alternative to SH1 when that route is closed. It also offers increased legibility of the SH10 route for tourists. This results in a +++ rating.
Objective 2: Safety	++	The option performs well from a safety perspective with a two lane bridge providing greater clarity of movement and priority. It removes delays and confusion associated with a single lane bridge, giving a strong ++ score
Feasibility:	0	This option scored 0 overall. This was due to a combination of adverse impacts (ranging from 0 to -) balanced against its relatively straight forward constructability. Property risks are relatively low for this option, which can be constructed largely within the existing road designation. This implies there are implementation risks, however none of real significance. There is some risk associated with consenting in a coastal environment. However this is considered to be relatively minor and manageable, in comparison with other options.
Affordability:	-	This option scored “-” overall implying that there are affordability risks. The likely economic efficiency of this option is Low and as a result, may not be fully fundable through the NLTF. Alternative funding mechanisms will likely be required. However, this option has a lower cost than other new bridge options.
Public/Stakeholders:	+	The options have not been made public however, feedback from Iwi and FNDC indicates that there will be a largely positive reaction to this option from stakeholders. This is based on the ‘obvious’ nature of this option, being that the most straightforward approach to two laning is to widen in the existing alignment.
Safety:	++	The option performs well from a safety perspective with a two lane bridge providing greater clarity of movement and priority. It removes delays and confusion associated with a single lane bridge, giving a strong ++ score
Economy:	++	This option will enable forecast traffic demand to be met. Journey times will be reduced and travel time reliability is likely to improve as a result of the option. Generally a greater level of accessibility and land use development potential is provided over the Do Minimum with this option.

MULTI CRITERIA ASSESSMENT – OPTION C		
Environmental and social:	0	<p>Some minor impacts on sites of significance to Māori along the existing alignment will need to be addressed, and works will be required in the CMA although this would be confined to previously disturbed areas. Some land take and impact on land uses would occur, but to a lesser degree than other options.</p> <p>An improvement to connectivity and accessibility in the Taipa township is expected, as well as improved resilience, and best use of existing infrastructure.</p>
Environmental opportunities		This option provides the opportunity to enhance the local estuary, swimming and recreation areas as it largely follows the existing alignment and doesn't result in changes to the already popular facilities in the area.
Social opportunities		This option provides an opportunity to strengthen the Taipa township through improved accessibility and clarity of transport movements.
Rationale for selection or rejection of alternative:		This option ranked 1 st of those assessed as it has the least impact on the adjacent environment, whilst meeting the investment objectives sought for this project. The option enhances resilience and economic opportunities in the area and increases the legibility of the travel route for the least impact.

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Option Assessment Summary Table (Option D)



PROPOSAL DETAILS							
Business case name:	SH10 Taipa Bridge		Name of Project Manager & Region:	Sebastian Reed, Auckland / Northland			
Business case purpose:	To upgrade the Taipa bridge to improve the resilience and economic performance of the Northland region.						
Option D – Signalise the existing bridge							
Alternative description:	<p>This option recommends upgrading the existing one-lane Taipa bridge with signals at each end. This would allow the traffic to be better controlled. Two traffic lanes would not be provided. This option is shown in the covering picture to this note.</p> <p>Dependencies: None</p>						
Estimated total public sector funding requirement:			Lower			Upper	
	Capital cost (\$m):						
	Net property cost (\$m):						
	Opex (\$m/30yr):						
	Maintenance (\$m/30yr):						
	Present value of cost to govt. (\$m):						
Estimated BCR range:							
Timing of need:	Optimal programme:			Likely:			
IAF profile:	Strategic fit:	H/M/L	Effectiveness:	H/M/L	Efficiency:	H/M/L	



MULTI CRITERIA ASSESSMENT – OPTION D		
Criterion	Score	Discussion
Objective 1 : Economic Growth and Resilience	+	This option offers an improvement against the Do Minimum, providing slightly reduced travel time for most travellers. No real additional resilience is provided with this option. This resulted in a + rating.
Objective 2: Safety	+	The option provides minor safety improvements by formally controlling opposing traffic flows, reducing the likelihood of head-on crashes on the bridge.
Feasibility:	0	This option scored 0 overall for feasibility. The option is simple to install as there are already temporary signals in operation during the summer holiday peak. There will be an increase in operating costs associated with this option in comparison with the existing situation.
Affordability:	-	This option scored - overall. This was largely due to a combination of minor adverse impacts, ranging from 0 to -. This implies there are minor affordability risks. Given the likely economic efficiency of this option, some alternative funding mechanisms could be required.
Public/Stakeholders:	-	The options have not been made public. However, a largely negative reaction is likely, based on community expectation of a new bridge.
Environmental and social:	0	This option will result in no real impact on the environmental and cultural areas near the site.. Additional queuing could have a small impact on the township, particularly during the summer peak period.
Safety:	+	The option provides minor safety improvements by formally controlling opposing traffic flows, reducing the likelihood of head-on crashes on the bridge.
Economy:	+	This option will enable forecast traffic demand to be met, albeit with increasing delay. Journey times will be slightly reduced and travel time reliability will improve slightly as a result of the option.
Environmental opportunities		This operational option provides limited opportunities for environmental enhancement.
Social opportunities		This operational option provides limited opportunities for social enhancement. It represents a missed opportunity to encourage walking and cycling over the bridge, building on its popularity for swimming.
Rationale for selection or rejection of alternative:		This option ranked 3 rd of those assessed as it did not fully meet the investment objectives sought for this project. However, it has little impact on the adjacent environment.

APPENDIX D. RECOMMENDED OPTION DRAWINGS

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DRAWING IN PROGRESS
 PROTECTIVE OVERLAY OPTION
 FOR INFORMATION

NZ TRANSPORT AGENCY
 TAIPA ONE LANE BRIDGE SH 10 R/P 19/04/17-2/38
 TAIPA ONE LANE BRIDGE

OPUS
 Wellington Office
 481 04 0300

NZ TRANSPORT AGENCY
 ROAD MANAGEMENT

NO.	DESCRIPTION	DATE	BY

DATE: 15/04/17
 DRAWN BY: [Name]
 CHECKED BY: [Name]

PROJECT: SH10 Taipa Bridge Business Case
 DRAWING: PROTECTIVE OVERLAY OPTION FOR INFORMATION

SCALE: 1:500
 NORTH: True North

PROJECT NO: 17/04/001
 DRAWING NO: 17/04/001-2/38

DATE: 15/04/17
 DRAWN BY: [Name]
 CHECKED BY: [Name]

PROJECT: SH10 Taipa Bridge Business Case
 DRAWING: PROTECTIVE OVERLAY OPTION FOR INFORMATION

SCALE: 1:500
 NORTH: True North

PROJECT NO: 17/04/001
 DRAWING NO: 17/04/001-2/38

DATE: 15/04/17
 DRAWN BY: [Name]
 CHECKED BY: [Name]

PROJECT: SH10 Taipa Bridge Business Case
 DRAWING: PROTECTIVE OVERLAY OPTION FOR INFORMATION

APPENDIX E. ECONOMIC EVALUATION

RELEASED UNDER THE
OFFICIAL INFORMATION ACT

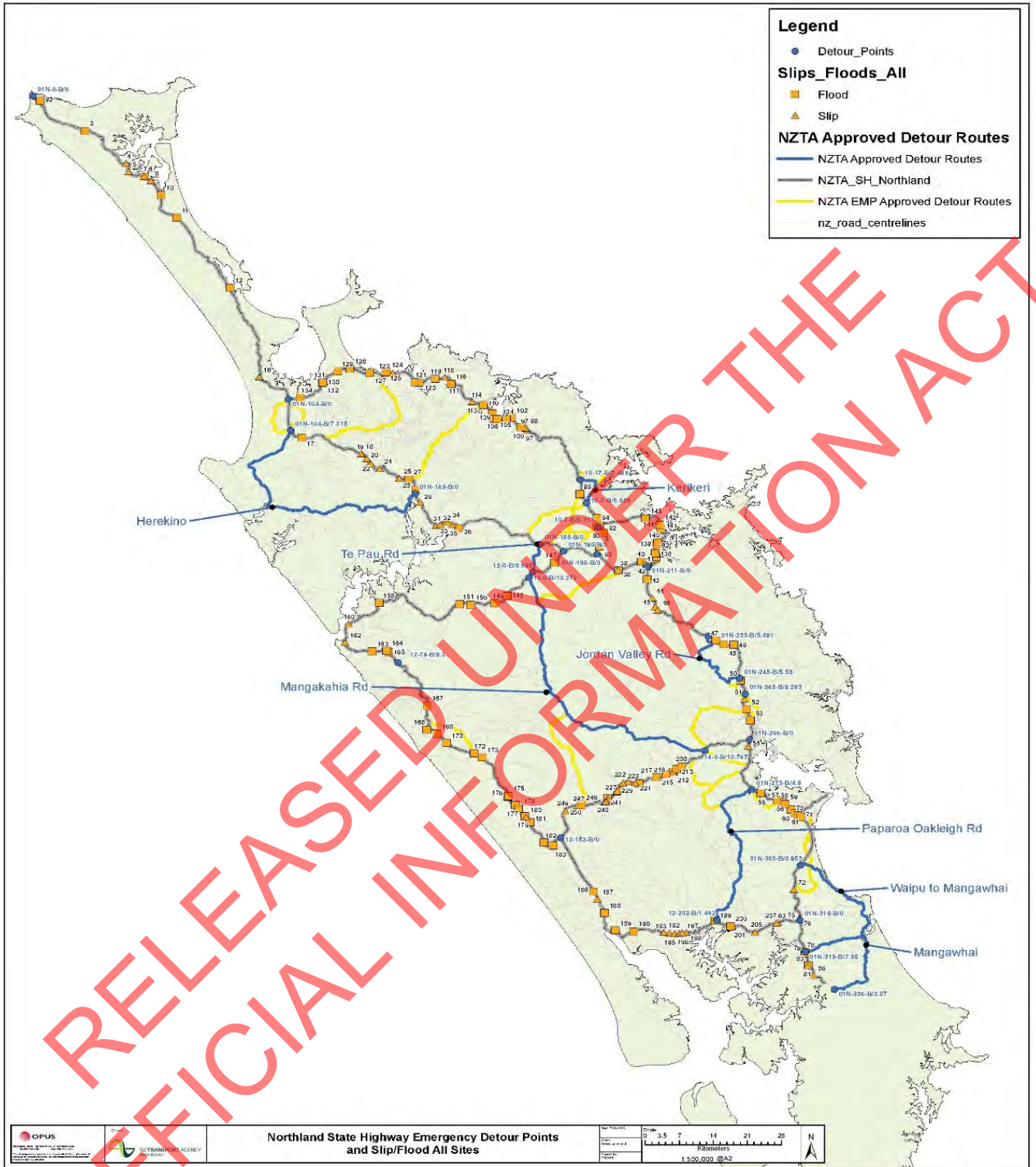
Taipa One Lane Bridge Economics Summary

NPV Benefits	NPV \$	Comment
Travel Time Costs - Delays at Bridge	\$ 3,501,915	Methodology as per "Delays and Conflicts at One Lane Bridges, (Saunders, 1988)
Travel Time Costs - Detours for Closures	\$ 104,178	Detours as per Fig.13 NZTA Approved Detours
Vehicle Operating Costs - Delays at Bridge	\$ 149,270	Methodology as per "Delays and Conflicts at One Lane Bridges, (Saunders, 1988)
Vehicle Operating Costs - Detours for Closures	\$ 72,012	Detours as per Fig.13 NZTA Approved Detours
Crash benefits 1-Lane vs 2-Lane	\$ 1,386,323	As per EEM
Crash Costs - Detours for Closures	\$ 95,310	Additional Traffic on network
Network Resilience	\$ 891,315	HPMV Waiting time during SH1 Closures
Wider Economic Benefits of reduced closures	\$ 5,674	Used Results from 2013 Network resilience case
Total Benefits	\$ 6,205,997	
NPV Costs	NPV \$	
Do-Min - New Bridge in Year 25	\$ 3,284,956	Assumed 25 year life in existing bridge
Do-Min - Residual Value of Bridge in Year 40	-\$ 749,501	
Do-Min: Increased Maintenance Costs	\$ 13,550	Extra \$1k pa for years 1-25
Subtotal: NPV Do-Min Costs	\$ 2,535,455	
Option - New Bridge in Year 0	\$ 14,098,607	Includes approach works
Option - Residual Value of Bridge in Year 40	-\$ 732,951	
Subtotal: NPV Option Costs	\$ 13,365,656	
Net Costs	\$ 10,830,201	
Indicative BCR	0.6	

Taipa Bridge - Site Location, SH10 RP 79/3.59, 110m long bridge



NZTA Approved Detours



RELEASED UNDER THE OFFICIAL INFORMATION ACT

Taipa Bridge - SH1 HPMV closures							
#	State Highway	Start Location	End Location	Impact	Description	Event Comments	Event Duration (hh.mm)
57	1N	01N-0000/15.63	01N-0000/15.63	Road Closed	Flooding	Road Closed By Flooding, At Te Paki	17.41
43	1N	01N-0020/13.31	01N-0020/13.31	Road Closed	Washout	Washout At The Mitimiti Stream Bridge	32.37
56	1N	01N-0020/21.96	01N-0020/21.96	Road Closed	Flooding	Road Closed At The Te Kao Stream Bridge	20.4
52	1N	01N-0083/14.69	01N-0083/14.69	Road Closed	Crash	Police Have Reported A Serious Crash On The State Highway. Caution Advised	10.38
37	1N	01N-0104/06.95	01N-0104/06.95	Road Closed	Flooding	Motorists Are Advised That Due To Severe Weather Conditions There Are Road Closures In The Area	12.31
68	1N	01N-0104/13.36	01N-0104/13.36	Road Closed	Crash	A Lime Truck Has Run Off The Road, About 3km South Of Kaitaia.	1.41
116	1N	01N-0119/02.56	01N-0119/02.56	Road Closed	Object/Obstruction	Due To A Serious Incident In This Area The Road Is Closed. Emergency Services Are On Site. Please Delay Your Journey Or Use An Alternative Route.	2.48
81	1N	01N-0119/02.74	01N-0119/02.74	Road Closed	Crash	Road Reopened.	4.06
13	1N	01N-0119/04.03	01N-0119/04.03	Road Closed	Crash	Logging Truck Rolled Off The Side Of The Road / Diversions In Place	16.23
3	1N	01N-0149/14.29	01N-0149/14.29	Road Closed	Flooding	Rangiahua Bridge Is Closed Due To Flooding	21.09
44	1N	01N-0149/14.45	01N-0149/14.45	Road Closed	Flooding	The Rangiahua Bridge Is Under Water, & Impassable	21.17
50	1N	01N-0149/14.81	01N-0149/14.81	Road Closed	Flooding	Severe Flooding	3.42
11	1N	01N-0149/15.00	01N-0149/15.00	Road Closed	Flooding	This Is A Low Lying Bridge That Is Flooding. Tidal Flooding - Will Be Updated As Soon As The Tide Changes.	4.21
90	1N	01N-0149/15.57	01N-0149/15.57	Road Closed	Flooding	Due To Flooding This Section Of State Highway 1 Is Closed. Expect Delays. Avoid The Area Or Delay Your Trip If Possible.	16.2
62	1N	01N-0167/12.01	01N-0167/12.01	Road Closed	Crash	Due To A Crash In This Area Okaihau, Expect Long Delays. Avoid The Area If Possible Or Delay Your Trip.	5.45
29	1N	01N-0167/15.82	01N-0167/15.82	Road Closed	Crash	Crash On Sh1 And Police Needs Sh1 To Be Closed From The Intersection Of Sh1 And Te Pua Road To The Intersection Of Sh1 And Wehirua Road	25.23
49	1N	01N-0190/02.30	01N-0190/02.30	Road Closed	Crash	Due To An Incident, Sh1 Is Closed In Pakaraka Between Old Bay Rd And Sh10. Expect Delays, Avoid The Area If Possible.	4.09
38	1N	01N-0190/07.41	01N-0190/07.41	Road Closed	Flooding	Motorists Are Advised That Due To The Severe Weather Conditions In The Region There Will Be Roads Closed	9.57
96	1N	01N-0190/07.62	01N-0190/07.62	Road Closed	Crash	Road Now Open.	2.07
14	1N	01N-0198/00.96	01N-0198/00.96	Road Closed	Other	Police Scene Examination Of Crash Site; Accident 26.07.09	0.34
55	1N	01N-0198/05.58	01N-0198/05.58	Road Closed	Flooding	Otiria Stream Bridge Is Closed, Flooding	5.1
4	1N	01N-0198/06.10	01N-0198/06.10	Road Closed	Flooding	Flooding Has Closed Sh 1n At The Otiria Stream Bridge, Just North Of Moerewa	1.46
92	1N	01N-0198/06.38	01N-0198/06.38	Road Closed	Flooding	Due To Flooding At Otiria Stream Bridge This Section Of Highway Is Closed. Expect Delays Or Avoid The Area If Possible	12.31
111	1N	01N-0198/06.85	01N-0198/06.85	Road Closed	Crash	**road Now Open** Due To A Serious Incident In This Area The Road Is Closed. Emergency Services Are On Site. Please Delay Your Journey Or Use An Alternative Route.	4.32
99	1N	01N-0198/09.52	01N-0198/09.52	Road Closed	Crash	Road Now Open. Due To An Incident, This Section Of State Highway 1 Is Closed.	3.11
58	1N	01N-0198/12.00	01N-0198/12.00	Road Closed	Crash	Long Delays Are Expected Avoid The Area Or Delay Your Trip If Possible.	2.52
118	1N	01N-0198/12.58	01N-0198/12.58	Road Closed	Crash	A Serious Crash Involving Several Vehicles Just North Of The Kawakawa Township.	4.12
93	1N	01N-0215/07.04	01N-0215/07.04	Road Closed	Washout	Due To A Slip This Section Of The State Highway Is Closed. Long Delays Are Expected. Avoid The Area Or Delay Your Trip If Possible.	155.17
67	1N	01N-0215/07.96	01N-0215/07.96	Road Closed	Crash	Due To An Incident, The State Highway Is Closed At The Intersection Of Callaghan Rd. Delays Are Expected. Avoid The Area Or Delay Your Trip If Possible.	10.02
110	1N	01N-0215/12.61	01N-0215/12.61	Road Closed	Crash	A Serious Incident Has Been Reported In This Area. Emergency Services Are On Site. An Update Will Be Provided As Soon As More Information Is Available.	1.3
6	1N	01N-0215/14.52	01N-0215/14.52	Road Closed	Crash	Motor Vehicle Accident, 2kms South Of Towai. Both Lanes Are Closed	0.43
53	1N	01N-0215/17.57	01N-0215/17.57	Road Closed	Crash	Due To An Incident On The Intersection Of Sh1 And Rusk Road South Of Kawakawa, Diversions Are In Place Onto Paiaka Road And Rusk Road. Expect Possible Delays	3.03
40	1N	01N-0233/00.52	01N-0233/00.52	Road Closed	Crash	Due To An Earlier Incident This Section Of Highway Is Closed. Expect Delays	3.49
8	1N	01N-0233/02.69	01N-0233/02.69	Road Closed	Other	Road Closed Due To Scheduled Road Works To Allow For Repairs From 7am Till 7pm	13.11

Worksheet A1 - Discounting

YEAR	TIME	Growth SPPWF	3% AADT	DM TTC (Delays)				DM TTC (Detours)				TTC (HPMV Detours)			
				COST	PV COST	UPDATE FACTOR	SUBTOTAL	COST	PV COST	UPDATE FACTOR	SUBTOTAL	COST	PV COST	UPDATE FACTOR	SUBTOTAL
2016	0	1	3797	\$ 101,204.28	\$ 101,204.28	1.44	\$ 145,734.16	\$4,196.09	\$ 4,196.09	1.44	\$ 6,042.36	\$ 35,906.59	\$ 35,906.59	1.44	\$ 51,705.49
2017	1	0.943396226	3911	\$ 108,505.27	\$ 102,363.46	1.44	\$ 147,403.38	\$4,322.07	\$ 4,077.42	1.44	\$ 5,871.49	\$ 36,983.79	\$ 34,890.37	1.44	\$ 50,242.13
2018	2	0.88999644	4025	\$ 116,066.93	\$ 103,299.15	1.44	\$ 148,750.78	\$4,448.05	\$ 3,958.75	1.44	\$ 5,700.60	\$ 38,060.99	\$ 33,874.14	1.44	\$ 48,778.76
2019	3	0.839619283	4139	\$ 124,556.61	\$ 104,580.13	1.44	\$ 150,595.39	\$4,574.03	\$ 3,840.45	1.44	\$ 5,530.24	\$ 39,138.18	\$ 32,861.17	1.44	\$ 47,320.09
2020	4	0.792093663	4253	\$ 133,046.29	\$ 105,385.13	1.44	\$ 151,754.58	\$4,700.01	\$ 3,722.85	1.44	\$ 5,360.91	\$ 40,215.38	\$ 31,854.35	1.44	\$ 45,870.26
2021	5	0.747258173	4367	\$ 141,535.98	\$ 105,763.91	1.44	\$ 152,300.04	\$4,826.00	\$ 3,606.26	1.44	\$ 5,193.02	\$ 41,292.58	\$ 30,856.22	1.44	\$ 44,432.95
2022	6	0.70496054	4481	\$ 150,025.66	\$ 105,762.17	1.44	\$ 152,297.52	\$4,951.98	\$ 3,490.95	1.44	\$ 5,026.97	\$ 42,369.78	\$ 29,869.02	1.44	\$ 43,011.39
2023	7	0.665057114	4595	\$ 158,515.34	\$ 105,421.75	1.44	\$ 151,807.33	\$5,077.96	\$ 3,377.13	1.44	\$ 4,863.07	\$ 43,446.97	\$ 28,894.72	1.44	\$ 41,608.40
2024	8	0.627412371	4709	\$ 167,005.02	\$ 104,781.02	1.44	\$ 150,884.66	\$5,203.94	\$ 3,265.02	1.44	\$ 4,701.63	\$ 44,524.17	\$ 27,935.02	1.44	\$ 40,226.42
2025	9	0.591898464	4823	\$ 175,494.70	\$ 103,875.05	1.44	\$ 149,580.07	\$5,329.92	\$ 3,154.77	1.44	\$ 4,542.87	\$ 45,601.37	\$ 26,991.38	1.44	\$ 38,867.59
2026	10	0.558394777	4937	\$ 183,984.39	\$ 102,735.92	1.44	\$ 147,939.72	\$5,455.91	\$ 3,046.55	1.44	\$ 4,387.03	\$ 46,678.57	\$ 26,065.07	1.44	\$ 37,533.70
2027	11	0.526787525	5051	\$ 193,084.52	\$ 101,714.52	1.44	\$ 146,468.90	\$5,581.89	\$ 2,940.47	1.44	\$ 4,234.28	\$ 47,755.76	\$ 25,157.14	1.44	\$ 36,226.28
2028	12	0.496969364	5165	\$ 202,938.74	\$ 100,854.34	1.44	\$ 145,230.24	\$5,707.87	\$ 2,836.64	1.44	\$ 4,084.76	\$ 48,832.96	\$ 24,268.49	1.44	\$ 34,946.62
2029	13	0.468839022	5279	\$ 212,792.96	\$ 99,765.64	1.44	\$ 143,662.53	\$5,833.85	\$ 2,735.14	1.44	\$ 3,938.60	\$ 49,910.16	\$ 23,399.83	1.44	\$ 33,695.76
2030	14	0.442300964	5393	\$ 222,647.18	\$ 98,477.06	1.44	\$ 141,806.97	\$5,959.83	\$ 2,636.04	1.44	\$ 3,795.90	\$ 50,987.36	\$ 22,551.76	1.44	\$ 32,474.53
2031	15	0.417265061	5507	\$ 232,501.40	\$ 97,014.71	1.44	\$ 139,701.18	\$6,085.82	\$ 2,539.40	1.44	\$ 3,656.73	\$ 52,064.56	\$ 21,724.72	1.44	\$ 31,283.60
2032	16	0.393646284	5621	\$ 242,355.62	\$ 95,402.39	1.44	\$ 137,379.44	\$6,211.80	\$ 2,445.25	1.44	\$ 3,521.16	\$ 53,141.75	\$ 20,919.05	1.44	\$ 30,123.44
2033	17	0.371364419	5735	\$ 252,209.84	\$ 93,661.76	1.44	\$ 134,872.94	\$6,337.78	\$ 2,353.63	1.44	\$ 3,389.22	\$ 54,218.95	\$ 20,134.99	1.44	\$ 28,994.38
2034	18	0.350343791	5849	\$ 262,064.06	\$ 91,812.52	1.44	\$ 132,210.03	\$6,463.76	\$ 2,264.54	1.44	\$ 3,260.94	\$ 55,296.15	\$ 19,372.66	1.44	\$ 27,896.63
2035	19	0.33051301	5963	\$ 271,918.28	\$ 89,872.53	1.44	\$ 129,416.44	\$6,589.74	\$ 2,178.00	1.44	\$ 3,136.31	\$ 56,373.35	\$ 18,632.12	1.44	\$ 26,830.26
2036	20	0.311804727	6077	\$ 281,772.51	\$ 87,858.00	1.44	\$ 126,515.52	\$6,715.73	\$ 2,094.00	1.44	\$ 3,015.35	\$ 57,450.54	\$ 17,913.35	1.44	\$ 25,795.23
2037	21	0.294155403	6191	\$ 291,626.73	\$ 85,783.58	1.44	\$ 123,528.35	\$6,841.71	\$ 2,012.53	1.44	\$ 2,898.04	\$ 58,527.74	\$ 17,216.25	1.44	\$ 24,791.40
2038	22	0.277505097	6305	\$ 301,480.95	\$ 83,662.50	1.44	\$ 120,474.00	\$6,967.69	\$ 1,933.57	1.44	\$ 2,784.34	\$ 59,604.94	\$ 16,540.67	1.44	\$ 23,818.57
2039	23	0.261797261	6419	\$ 311,335.17	\$ 81,506.69	1.44	\$ 117,369.64	\$7,093.67	\$ 1,857.10	1.44	\$ 2,674.23	\$ 60,682.14	\$ 15,886.42	1.44	\$ 22,876.44
2040	24	0.246978548	6533	\$ 321,189.39	\$ 79,326.89	1.44	\$ 114,230.72	\$7,219.65	\$ 1,783.10	1.44	\$ 2,567.66	\$ 61,759.33	\$ 15,253.23	1.44	\$ 21,964.65
2041	25	0.232998631	6647		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2042	26	0.219810029	6761		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2043	27	0.207367952	6875		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2044	28	0.195630143	6989		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2045	29	0.184556739	7103		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2046	30	0.174110131	7217		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2047	31	0.16425484	7331		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2048	32	0.154957397	7445		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2049	33	0.146186223	7559		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2050	34	0.137911531	7673		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2051	35	0.130105218	7787		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2052	36	0.122740772	7901		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2053	37	0.115793181	8015		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2054	38	0.10923885	8129		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -
2055	39	0.103055519	8243		\$ -	1.44	\$ -		\$ -	1.44	\$ -		\$ -	1.44	\$ -

\$ 3,501,914.54

\$ 104,177.71

\$ 891,314.97

Worksheet A1 - Discounting

YEAR	TIME	Growth SPPWF	3% AADT	DM VOC (Delays)				DM VOC (Detours)				Crash Cost Difference @ Bridge			
				COST	PV COST	UPDATE FACTOR	SUBTOTAL	COST	PV COST	UPDATE FACTOR	SUBTOTAL	COST	PV COST	UPDATE FACTOR	SUBTOTAL
2016	0	1	3797	\$ 6,758.82	\$ 6,758.82	1	\$ 6,758.82	\$ 4,176.74	\$ 4,176.74	1	\$ 4,176.74	\$ 93,799.33	\$ 93,799.33	1	\$ 93,799.33
2017	1	0.943396226	3911	\$ 7,187.63	\$ 6,780.78	1	\$ 6,780.78	\$ 4,302.14	\$ 4,058.62	1	\$ 4,058.62	\$ 94,737.32	\$ 89,374.83	1	\$ 89,374.83
2018	2	0.88999644	4025	\$ 7,624.19	\$ 6,785.50	1	\$ 6,785.50	\$ 4,427.54	\$ 3,940.50	1	\$ 3,940.50	\$ 95,675.31	\$ 85,150.69	1	\$ 85,150.69
2019	3	0.839619283	4139	\$ 8,088.35	\$ 6,791.13	1	\$ 6,791.13	\$ 4,552.94	\$ 3,822.74	1	\$ 3,822.74	\$ 96,613.31	\$ 81,118.40	1	\$ 81,118.40
2020	4	0.792093663	4253	\$ 8,552.50	\$ 6,774.38	1	\$ 6,774.38	\$ 4,678.34	\$ 3,705.69	1	\$ 3,705.69	\$ 97,551.30	\$ 77,269.77	1	\$ 77,269.77
2021	5	0.747258173	4367	\$ 9,016.66	\$ 6,737.77	1	\$ 6,737.77	\$ 4,803.74	\$ 3,589.64	1	\$ 3,589.64	\$ 98,489.29	\$ 73,596.93	1	\$ 73,596.93
2022	6	0.70496054	4481	\$ 9,480.82	\$ 6,683.60	1	\$ 6,683.60	\$ 4,929.14	\$ 3,474.85	1	\$ 3,474.85	\$ 99,427.29	\$ 70,092.31	1	\$ 70,092.31
2023	7	0.665057114	4595	\$ 9,944.98	\$ 6,613.98	1	\$ 6,613.98	\$ 5,054.55	\$ 3,361.56	1	\$ 3,361.56	\$ 100,365.28	\$ 66,748.64	1	\$ 66,748.64
2024	8	0.627412371	4709	\$ 10,409.14	\$ 6,530.82	1	\$ 6,530.82	\$ 5,179.95	\$ 3,249.96	1	\$ 3,249.96	\$ 101,303.27	\$ 63,558.93	1	\$ 63,558.93
2025	9	0.591898464	4823	\$ 10,873.29	\$ 6,435.89	1	\$ 6,435.89	\$ 5,305.35	\$ 3,140.23	1	\$ 3,140.23	\$ 102,241.27	\$ 60,516.45	1	\$ 60,516.45
2026	10	0.558394777	4937	\$ 11,337.45	\$ 6,330.77	1	\$ 6,330.77	\$ 5,430.75	\$ 3,032.50	1	\$ 3,032.50	\$ 103,179.26	\$ 57,614.76	1	\$ 57,614.76
2027	11	0.526787525	5051	\$ 11,821.54	\$ 6,227.44	1	\$ 6,227.44	\$ 5,556.15	\$ 2,926.91	1	\$ 2,926.91	\$ 104,117.25	\$ 54,847.67	1	\$ 54,847.67
2028	12	0.496969364	5165	\$ 12,330.26	\$ 6,127.76	1	\$ 6,127.76	\$ 5,681.55	\$ 2,823.56	1	\$ 2,823.56	\$ 105,055.25	\$ 52,209.24	1	\$ 52,209.24
2029	13	0.468839022	5279	\$ 12,838.98	\$ 6,019.41	1	\$ 6,019.41	\$ 5,806.95	\$ 2,722.53	1	\$ 2,722.53	\$ 105,993.24	\$ 49,693.77	1	\$ 49,693.77
2030	14	0.442300964	5393	\$ 13,347.69	\$ 5,903.70	1	\$ 5,903.70	\$ 5,932.35	\$ 2,623.89	1	\$ 2,623.89	\$ 106,931.23	\$ 47,295.79	1	\$ 47,295.79
2031	15	0.417265061	5507	\$ 13,856.41	\$ 5,781.80	1	\$ 5,781.80	\$ 6,057.76	\$ 2,527.69	1	\$ 2,527.69	\$ 107,869.23	\$ 45,010.06	1	\$ 45,010.06
2032	16	0.393646284	5621	\$ 14,365.13	\$ 5,654.78	1	\$ 5,654.78	\$ 6,183.16	\$ 2,433.98	1	\$ 2,433.98	\$ 108,807.22	\$ 42,831.56	1	\$ 42,831.56
2033	17	0.371364419	5735	\$ 14,873.85	\$ 5,523.62	1	\$ 5,523.62	\$ 6,308.56	\$ 2,342.77	1	\$ 2,342.77	\$ 109,745.21	\$ 40,755.47	1	\$ 40,755.47
2034	18	0.350343791	5849	\$ 15,382.56	\$ 5,389.19	1	\$ 5,389.19	\$ 6,433.96	\$ 2,254.10	1	\$ 2,254.10	\$ 110,683.21	\$ 38,777.17	1	\$ 38,777.17
2035	19	0.33051301	5963	\$ 15,891.28	\$ 5,252.27	1	\$ 5,252.27	\$ 6,559.36	\$ 2,167.95	1	\$ 2,167.95	\$ 111,621.20	\$ 36,892.26	1	\$ 36,892.26
2036	20	0.311804727	6077	\$ 16,400.00	\$ 5,113.60	1	\$ 5,113.60	\$ 6,684.76	\$ 2,084.34	1	\$ 2,084.34	\$ 112,559.19	\$ 35,096.49	1	\$ 35,096.49
2037	21	0.294155403	6191	\$ 16,908.71	\$ 4,973.79	1	\$ 4,973.79	\$ 6,810.16	\$ 2,003.25	1	\$ 2,003.25	\$ 113,497.19	\$ 33,385.81	1	\$ 33,385.81
2038	22	0.277505097	6305	\$ 17,417.43	\$ 4,833.43	1	\$ 4,833.43	\$ 6,935.56	\$ 1,924.65	1	\$ 1,924.65	\$ 114,435.18	\$ 31,756.35	1	\$ 31,756.35
2039	23	0.261797261	6419	\$ 17,926.15	\$ 4,693.02	1	\$ 4,693.02	\$ 7,060.96	\$ 1,848.54	1	\$ 1,848.54	\$ 115,373.17	\$ 30,204.38	1	\$ 30,204.38
2040	24	0.246978548	6533	\$ 18,434.86	\$ 4,553.02	1	\$ 4,553.02	\$ 7,186.37	\$ 1,774.88	1	\$ 1,774.88	\$ 116,311.17	\$ 28,726.36	1	\$ 28,726.36
2041	25	0.232998631	6647		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2042	26	0.219810029	6761		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2043	27	0.207367952	6875		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2044	28	0.195630143	6989		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2045	29	0.184556739	7103		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2046	30	0.174110131	7217		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2047	31	0.16425484	7331		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2048	32	0.154957397	7445		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2049	33	0.146186223	7559		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2050	34	0.137911531	7673		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2051	35	0.130105218	7787		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2052	36	0.122740772	7901		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2053	37	0.115793181	8015		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2054	38	0.10923885	8129		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -
2055	39	0.103055519	8243		\$ -	1	\$ -		\$ -	1	\$ -		\$ -	1	\$ -

\$ 149,270.26

\$ 72,012.05

\$ 1,386,323.42

Worksheet A1 - Discounting

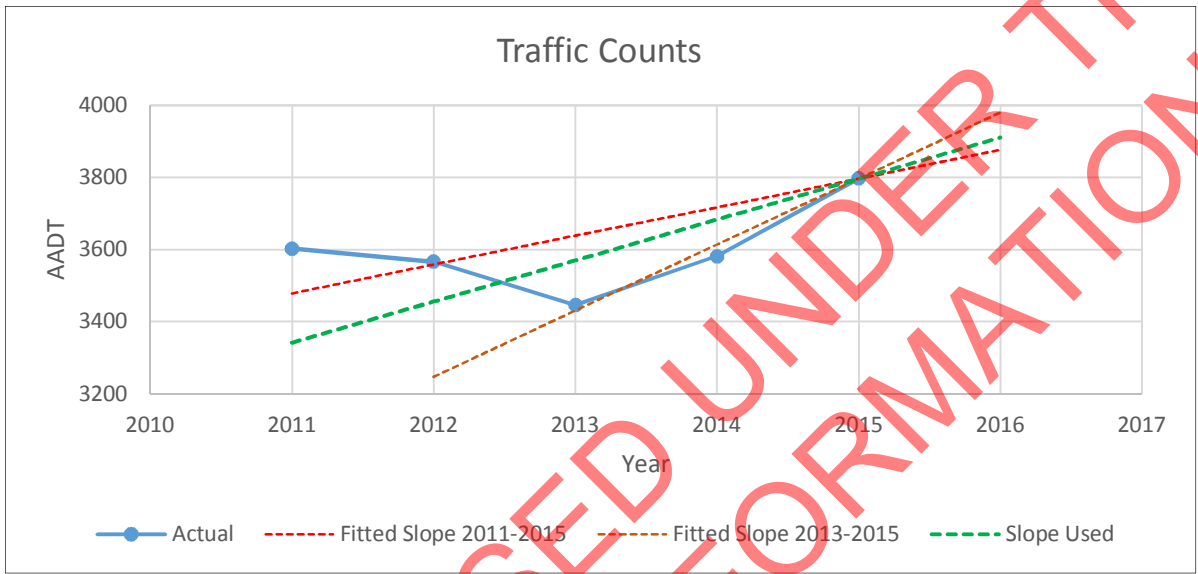
YEAR	TIME	Growth SPPWF	3% AADT	Detour Crash Benefits				DM CONSTRUCTION		OPT CONSTRUCTION	
				COST	PV COST	UPDATE FACTOR	SUBTOTAL	COST	PV COST	COST	PV COST
2016	0	1	3797	\$ 6,448.73	\$ 6,448.73	1	\$ 6,448.73	\$ 1,000.00	\$ 1,000.00	\$ 14,098,607.00	\$ 14,098,607.00
2017	1	0.943396226	3911	\$ 6,513.22	\$ 6,144.55	1	\$ 6,144.55	\$ 1,000.00	\$ 943.40	\$ -	\$ -
2018	2	0.88999644	4025	\$ 6,577.71	\$ 5,854.14	1	\$ 5,854.14	\$ 1,000.00	\$ 890.00	\$ -	\$ -
2019	3	0.839619283	4139	\$ 6,642.19	\$ 5,576.91	1	\$ 5,576.91	\$ 1,000.00	\$ 839.62	\$ -	\$ -
2020	4	0.792093663	4253	\$ 6,706.68	\$ 5,312.32	1	\$ 5,312.32	\$ 1,000.00	\$ 792.09	\$ -	\$ -
2021	5	0.747258173	4367	\$ 6,771.17	\$ 5,059.81	1	\$ 5,059.81	\$ 1,000.00	\$ 747.26	\$ -	\$ -
2022	6	0.70496054	4481	\$ 6,835.66	\$ 4,818.87	1	\$ 4,818.87	\$ 1,000.00	\$ 704.96	\$ -	\$ -
2023	7	0.665057114	4595	\$ 6,900.14	\$ 4,588.99	1	\$ 4,588.99	\$ 1,000.00	\$ 665.06	\$ -	\$ -
2024	8	0.627412371	4709	\$ 6,964.63	\$ 4,369.70	1	\$ 4,369.70	\$ 1,000.00	\$ 627.41	\$ -	\$ -
2025	9	0.591898464	4823	\$ 7,029.12	\$ 4,160.52	1	\$ 4,160.52	\$ 1,000.00	\$ 591.90	\$ -	\$ -
2026	10	0.558394777	4937	\$ 7,093.61	\$ 3,961.03	1	\$ 3,961.03	\$ 1,000.00	\$ 558.39	\$ -	\$ -
2027	11	0.526787525	5051	\$ 7,158.09	\$ 3,770.79	1	\$ 3,770.79	\$ 1,000.00	\$ 526.79	\$ -	\$ -
2028	12	0.496969364	5165	\$ 7,222.58	\$ 3,589.40	1	\$ 3,589.40	\$ 1,000.00	\$ 496.97	\$ -	\$ -
2029	13	0.468839022	5279	\$ 7,287.07	\$ 3,416.46	1	\$ 3,416.46	\$ 1,000.00	\$ 468.84	\$ -	\$ -
2030	14	0.442300964	5393	\$ 7,351.56	\$ 3,251.60	1	\$ 3,251.60	\$ 1,000.00	\$ 442.30	\$ -	\$ -
2031	15	0.417265061	5507	\$ 7,416.04	\$ 3,094.46	1	\$ 3,094.46	\$ 1,000.00	\$ 417.27	\$ -	\$ -
2032	16	0.393646284	5621	\$ 7,480.53	\$ 2,944.68	1	\$ 2,944.68	\$ 1,000.00	\$ 393.65	\$ -	\$ -
2033	17	0.371364419	5735	\$ 7,545.02	\$ 2,801.95	1	\$ 2,801.95	\$ 1,000.00	\$ 371.36	\$ -	\$ -
2034	18	0.350343791	5849	\$ 7,609.50	\$ 2,665.94	1	\$ 2,665.94	\$ 1,000.00	\$ 350.34	\$ -	\$ -
2035	19	0.33051301	5963	\$ 7,673.99	\$ 2,536.35	1	\$ 2,536.35	\$ 1,000.00	\$ 330.51	\$ -	\$ -
2036	20	0.311804727	6077	\$ 7,738.48	\$ 2,412.89	1	\$ 2,412.89	\$ 1,000.00	\$ 311.80	\$ -	\$ -
2037	21	0.294155403	6191	\$ 7,802.97	\$ 2,295.28	1	\$ 2,295.28	\$ 1,000.00	\$ 294.16	\$ -	\$ -
2038	22	0.277505097	6305	\$ 7,867.45	\$ 2,183.26	1	\$ 2,183.26	\$ 1,000.00	\$ 277.51	\$ -	\$ -
2039	23	0.261797261	6419	\$ 7,931.94	\$ 2,076.56	1	\$ 2,076.56	\$ 1,000.00	\$ 261.80	\$ -	\$ -
2040	24	0.246978548	6533	\$ 7,996.43	\$ 1,974.95	1	\$ 1,974.95	\$ 1,000.00	\$ 246.98	\$ -	\$ -
2041	25	0.232998631	6647	\$ -	\$ -	1	\$ -	\$ 14,098,607.00	\$ 3,284,956.12	\$ -	\$ -
2042	26	0.219810029	6761	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2043	27	0.207367952	6875	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2044	28	0.195630143	6989	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2045	29	0.184556739	7103	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2046	30	0.174110131	7217	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2047	31	0.16425484	7331	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2048	32	0.154957397	7445	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2049	33	0.146186223	7559	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2050	34	0.137911531	7673	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2051	35	0.130105218	7787	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2052	36	0.122740772	7901	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2053	37	0.115793181	8015	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2054	38	0.10923885	8129	\$ -	\$ -	1	\$ -	\$ -	\$ -	\$ -	\$ -
2055	39	0.103055519	8243	\$ -	\$ -	1	\$ -	\$ 7,272,791.78	\$ 749,501.33	\$ 7,112,192.69	\$ 732,950.71

\$ 95,310.16

\$ 2,549,005.15

\$ 13,365,656.29

Traffic Counts	
Year	AADT
2011	3602
2012	3566
2013	3446
2014	3581
2015	3797
2016	
Best Fit Slope for 2011-2015	79.7
Best Fit Slope for 2013-2015	183.6
% Growth (2011-2015)	2.10%
% Growth (2013-2015)	4.84%
% Growth Used	3.00%



Delays & Conflicts at One Lane Bridges

Table 3: Total Delay in minutes per day				
Interpolated figures for 110m Bridge				
AADT	3500	4000	5000	7000
100m	627	877	1464	2840
120m	705	974	1594	3020
110m	666	925.5	1529	2930

Table 4: Total waiting time in minutes per day				
AADT	3500	4000	5000	7000
100m	130	186	327	715
120m	159	224	385	813
110m	144.5	205	356	764

Table 5: Total number of stops per day				
AADT	3500	4000	5000	7000
100m	824	1091	1645	2765
120m	914	1192	1762	2891
110m	869	1141.5	1703.5	2828

Year	AADT	Delay (mins per day)	Wait (mins per day)	Total Stops
2016	3797	820.14	180.44	1,030.87
2017	3911	879.31	194.23	1,093.00
2018	4025	940.59	208.78	1,155.55
2019	4139	1,009.39	225.99	1,219.62
2020	4253	1,078.19	243.20	1,283.69
2021	4367	1,146.98	260.42	1,347.75
2022	4481	1,215.78	277.63	1,411.82
2023	4595	1,284.58	294.85	1,475.89
2024	4709	1,353.38	312.06	1,539.96
2025	4823	1,422.18	329.27	1,604.03
2026	4937	1,490.98	346.49	1,668.09
2027	5051	1,564.73	366.40	1,732.17
2028	5165	1,644.58	389.66	1,796.27
2029	5279	1,724.44	412.92	1,860.37
2030	5393	1,804.30	436.17	1,924.46
2031	5507	1,884.15	459.43	1,988.56
2032	5621	1,964.01	482.68	2,052.66
2033	5735	2,043.87	505.94	2,116.75
2034	5849	2,123.72	529.20	2,180.85
2035	5963	2,203.58	552.45	2,244.95
2036	6077	2,283.44	575.71	2,309.04
2037	6191	2,363.30	598.96	2,373.14
2038	6305	2,443.15	622.22	2,437.24
2039	6419	2,523.01	645.48	2,501.33
2040	6533	2,602.87	668.73	2,565.43

Worksheets A4: Travel time cost savings, continued



Worksheet A4.1 - Travel time cost savings

Option (1)	Direction (2)	Period (3)	No./Year (4)	Road Category (5)	Period Volume (6)	TT (mins) (7)	TTC (\$/hr) (8)	Congest (\$/hr) (9)	Reliability (\$/hr) (10)	Annual Cost (\$) (11)
DM - Bridge Delays	Both	2016	245	RS	3,797	820.1430	\$25.34	\$4.88	\$0.00	\$101,204
DM - Bridge Delays	Both	2017	245	RS	3,911	879.3090	\$25.34	\$4.88	\$0.00	\$108,505
DM - Bridge Delays	Both	2018	245	RS	4,025	940.5875	\$25.34	\$4.88	\$0.00	\$116,067
DM - Bridge Delays	Both	2019	245	RS	4,139	1009.3865	\$25.34	\$4.88	\$0.00	\$124,557
DM - Bridge Delays	Both	2020	245	RS	4,253	1078.1855	\$25.34	\$4.88	\$0.00	\$133,046
DM - Bridge Delays	Both	2021	245	RS	4,367	1146.9845	\$25.34	\$4.88	\$0.00	\$141,536
DM - Bridge Delays	Both	2022	245	RS	4,481	1215.7835	\$25.34	\$4.88	\$0.00	\$150,026
DM - Bridge Delays	Both	2023	245	RS	4,595	1284.5825	\$25.34	\$4.88	\$0.00	\$158,515
DM - Bridge Delays	Both	2024	245	RS	4,709	1353.3815	\$25.34	\$4.88	\$0.00	\$167,005
DM - Bridge Delays	Both	2025	245	RS	4,823	1422.1805	\$25.34	\$4.88	\$0.00	\$175,495
DM - Bridge Delays	Both	2026	245	RS	4,937	1490.9795	\$25.34	\$4.88	\$0.00	\$183,984
DM - Bridge Delays	Both	2027	245	RS	5,051	1564.7255	\$25.34	\$4.88	\$0.00	\$193,085
DM - Bridge Delays	Both	2028	245	RS	5,165	1644.5825	\$25.34	\$4.88	\$0.00	\$202,939
DM - Bridge Delays	Both	2029	245	RS	5,279	1724.4395	\$25.34	\$4.88	\$0.00	\$212,793
DM - Bridge Delays	Both	2030	245	RS	5,393	1804.2965	\$25.34	\$4.88	\$0.00	\$222,647
DM - Bridge Delays	Both	2031	245	RS	5,507	1884.1535	\$25.34	\$4.88	\$0.00	\$232,501
DM - Bridge Delays	Both	2032	245	RS	5,621	1964.0105	\$25.34	\$4.88	\$0.00	\$242,356
DM - Bridge Delays	Both	2033	245	RS	5,735	2043.8675	\$25.34	\$4.88	\$0.00	\$252,210
DM - Bridge Delays	Both	2034	245	RS	5,849	2123.7245	\$25.34	\$4.88	\$0.00	\$262,064
DM - Bridge Delays	Both	2035	245	RS	5,963	2203.5815	\$25.34	\$4.88	\$0.00	\$271,918
DM - Bridge Delays	Both	2036	245	RS	6,077	2283.4385	\$25.34	\$4.88	\$0.00	\$281,773
DM - Bridge Delays	Both	2037	245	RS	6,191	2363.2955	\$25.34	\$4.88	\$0.00	\$291,627
DM - Bridge Delays	Both	2038	245	RS	6,305	2443.1525	\$25.34	\$4.88	\$0.00	\$301,481
DM - Bridge Delays	Both	2039	245	RS	6,419	2523.0095	\$25.34	\$4.88	\$0.00	\$311,335
DM - Bridge Delays	Both	2040	245	RS	6,533	2602.8665	\$25.34	\$4.88	\$0.00	\$321,189

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Worksheets A4: Travel time cost savings, continued



Worksheet A4.1 - Travel time cost savings

Option (1)	Direction (2)	Period (3)	No./Year (4)	Road Category (5)	Period Volume (6)	TT (mins) (7)	TTC (\$/hr) (8)	Congest (\$/hr) (9)	Reliability (\$/hr) (10)	Annual Cost (\$) (11)
DM - Diversions	Both	2016	-	RS	3,797.00	9935.4833	\$25.34	\$0.00	\$0.00	\$4,196
DM - Diversions	Both	2017	-	RS	3,911.00	10233.7833	\$25.34	\$0.00	\$0.00	\$4,322
DM - Diversions	Both	2018	-	RS	4,025.00	10532.0833	\$25.34	\$0.00	\$0.00	\$4,448
DM - Diversions	Both	2019	-	RS	4,139.00	10830.3833	\$25.34	\$0.00	\$0.00	\$4,574
DM - Diversions	Both	2020	-	RS	4,253.00	11128.6833	\$25.34	\$0.00	\$0.00	\$4,700
DM - Diversions	Both	2021	-	RS	4,367.00	11426.9833	\$25.34	\$0.00	\$0.00	\$4,826
DM - Diversions	Both	2022	-	RS	4,481.00	11725.2833	\$25.34	\$0.00	\$0.00	\$4,952
DM - Diversions	Both	2023	-	RS	4,595.00	12023.5833	\$25.34	\$0.00	\$0.00	\$5,078
DM - Diversions	Both	2024	-	RS	4,709.00	12321.8833	\$25.34	\$0.00	\$0.00	\$5,204
DM - Diversions	Both	2025	-	RS	4,823.00	12620.1833	\$25.34	\$0.00	\$0.00	\$5,330
DM - Diversions	Both	2026	-	RS	4,937.00	12918.4833	\$25.34	\$0.00	\$0.00	\$5,456
DM - Diversions	Both	2027	-	RS	5,051.00	13216.7833	\$25.34	\$0.00	\$0.00	\$5,582
DM - Diversions	Both	2028	-	RS	5,165.00	13515.0833	\$25.34	\$0.00	\$0.00	\$5,708
DM - Diversions	Both	2029	-	RS	5,279.00	13813.3833	\$25.34	\$0.00	\$0.00	\$5,834
DM - Diversions	Both	2030	-	RS	5,393.00	14111.6833	\$25.34	\$0.00	\$0.00	\$5,960
DM - Diversions	Both	2031	-	RS	5,507.00	14409.9833	\$25.34	\$0.00	\$0.00	\$6,086
DM - Diversions	Both	2032	-	RS	5,621.00	14708.2833	\$25.34	\$0.00	\$0.00	\$6,212
DM - Diversions	Both	2033	-	RS	5,735.00	15006.5833	\$25.34	\$0.00	\$0.00	\$6,338
DM - Diversions	Both	2034	-	RS	5,849.00	15304.8833	\$25.34	\$0.00	\$0.00	\$6,464
DM - Diversions	Both	2035	-	RS	5,963.00	15603.1833	\$25.34	\$0.00	\$0.00	\$6,590
DM - Diversions	Both	2036	-	RS	6,077.00	15901.4833	\$25.34	\$0.00	\$0.00	\$6,716
DM - Diversions	Both	2037	-	RS	6,191.00	16199.7833	\$25.34	\$0.00	\$0.00	\$6,842
DM - Diversions	Both	2038	-	RS	6,305.00	16498.0833	\$25.34	\$0.00	\$0.00	\$6,968
DM - Diversions	Both	2039	-	RS	6,419.00	16796.3833	\$25.34	\$0.00	\$0.00	\$7,094
DM - Diversions	Both	2040	-	RS	6,533.00	17094.6833	\$25.34	\$0.00	\$0.00	\$7,220

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Worksheets A4: Travel time cost savings, continued



Worksheet A4.1 - Travel time cost savings

Option (1)	Direction (2)	Period (3)	No./Year (4)	Road Category (5)	Period Volume (6)	TT (mins) (7)	TTC (\$/hr) (8)	Congest (\$/hr) (9)	Reliability (\$/hr) (10)	Annual Cost (\$) (11)
DM - HPMV Delays	Both	2016	-	RS	50.00	893.9400	\$48.20	\$0.00	\$0.00	\$35,907
DM - HPMV Delays	Both	2017	-	RS	51.50	893.9400	\$48.20	\$0.00	\$0.00	\$36,984
DM - HPMV Delays	Both	2018	-	RS	53.00	893.9400	\$48.20	\$0.00	\$0.00	\$38,061
DM - HPMV Delays	Both	2019	-	RS	54.50	893.9400	\$48.20	\$0.00	\$0.00	\$39,138
DM - HPMV Delays	Both	2020	-	RS	56.00	893.9400	\$48.20	\$0.00	\$0.00	\$40,215
DM - HPMV Delays	Both	2021	-	RS	57.50	893.9400	\$48.20	\$0.00	\$0.00	\$41,293
DM - HPMV Delays	Both	2022	-	RS	59.00	893.9400	\$48.20	\$0.00	\$0.00	\$42,370
DM - HPMV Delays	Both	2023	-	RS	60.50	893.9400	\$48.20	\$0.00	\$0.00	\$43,447
DM - HPMV Delays	Both	2024	-	RS	62.00	893.9400	\$48.20	\$0.00	\$0.00	\$44,524
DM - HPMV Delays	Both	2025	-	RS	63.50	893.9400	\$48.20	\$0.00	\$0.00	\$45,601
DM - HPMV Delays	Both	2026	-	RS	65.00	893.9400	\$48.20	\$0.00	\$0.00	\$46,679
DM - HPMV Delays	Both	2027	-	RS	66.50	893.9400	\$48.20	\$0.00	\$0.00	\$47,756
DM - HPMV Delays	Both	2028	-	RS	68.00	893.9400	\$48.20	\$0.00	\$0.00	\$48,833
DM - HPMV Delays	Both	2029	-	RS	69.50	893.9400	\$48.20	\$0.00	\$0.00	\$49,910
DM - HPMV Delays	Both	2030	-	RS	71.00	893.9400	\$48.20	\$0.00	\$0.00	\$50,987
DM - HPMV Delays	Both	2031	-	RS	72.50	893.9400	\$48.20	\$0.00	\$0.00	\$52,065
DM - HPMV Delays	Both	2032	-	RS	74.00	893.9400	\$48.20	\$0.00	\$0.00	\$53,142
DM - HPMV Delays	Both	2033	-	RS	75.50	893.9400	\$48.20	\$0.00	\$0.00	\$54,219
DM - HPMV Delays	Both	2034	-	RS	77.00	893.9400	\$48.20	\$0.00	\$0.00	\$55,296
DM - HPMV Delays	Both	2035	-	RS	78.50	893.9400	\$48.20	\$0.00	\$0.00	\$56,373
DM - HPMV Delays	Both	2036	-	RS	80.00	893.9400	\$48.20	\$0.00	\$0.00	\$57,451
DM - HPMV Delays	Both	2037	-	RS	81.50	893.9400	\$48.20	\$0.00	\$0.00	\$58,528
DM - HPMV Delays	Both	2038	-	RS	83.00	893.9400	\$48.20	\$0.00	\$0.00	\$59,605
DM - HPMV Delays	Both	2039	-	RS	84.50	893.9400	\$48.20	\$0.00	\$0.00	\$60,682
DM - HPMV Delays	Both	2040	-	RS	86.00	893.9400	\$48.20	\$0.00	\$0.00	\$61,759

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Additional VOC due to delays

Assumptions

- Additional VOC due to stops (Cents per speed change cycle), Table A5.41 of EEM
- Additional VOC due to waiting time (Cents per min), Table A5.23 of EEM

Year	Total vehicle stops per day	Additional VOC	Total waiting time (min per day)	Additional VOC (c/min)	Days per year	Annual Cost
2016	1030.865	2.151	180.437	3	245	\$ 6,758.82
2017	1092.995	2.151	194.231	3	245	\$ 7,187.63
2018	1155.55	2.151	208.775	3	245	\$ 7,624.19
2019	1219.618	2.151	225.989	3	245	\$ 8,088.35
2020	1283.686	2.151	243.203	3	245	\$ 8,552.50
2021	1347.754	2.151	260.417	3	245	\$ 9,016.66
2022	1411.822	2.151	277.631	3	245	\$ 9,480.82
2023	1475.89	2.151	294.845	3	245	\$ 9,944.98
2024	1539.958	2.151	312.059	3	245	\$ 10,409.14
2025	1604.026	2.151	329.273	3	245	\$ 10,873.29
2026	1668.094	2.151	346.487	3	245	\$ 11,337.45
2027	1732.17475	2.151	366.404	3	245	\$ 11,821.54
2028	1796.27125	2.151	389.66	3	245	\$ 12,330.26
2029	1860.36775	2.151	412.916	3	245	\$ 12,838.98
2030	1924.46425	2.151	436.172	3	245	\$ 13,347.69
2031	1988.56075	2.151	459.428	3	245	\$ 13,856.41
2032	2052.65725	2.151	482.684	3	245	\$ 14,365.13
2033	2116.75375	2.151	505.94	3	245	\$ 14,873.85
2034	2180.85025	2.151	529.196	3	245	\$ 15,382.56
2035	2244.94675	2.151	552.452	3	245	\$ 15,891.28
2036	2309.04325	2.151	575.708	3	245	\$ 16,400.00
2037	2373.13975	2.151	598.964	3	245	\$ 16,908.71
2038	2437.23625	2.151	622.22	3	245	\$ 17,417.43
2039	2501.33275	2.151	645.476	3	245	\$ 17,926.15
2040	2565.42925	2.151	668.732	3	245	\$ 18,434.86

Additional VOC due to Detours

Assumptions

- 1 Bridge closure in last 5 years = 20% annual probability of closure
- 4 hour closure to clear site, inspect structure
- Assumed average detour is 99.1km, 78.5 min (=76km/h)
- VOC cost Table A5.9, 75km/h, 2% grade

Year (1)	AADT (2)	% AADT affected (3)	P (Diversion) (4)	Number of Veh Diverted (5) = (2)x(3)x(4)	Additional Journey Distance (6)	VOC Cost, cents per km (7)	Annual Cost
2016	3,797	16.67%	0.2000	126.57	99.1	33.3	\$ 4,176.74
2017	3,911	16.67%	0.2000	130.37	99.1	33.3	\$ 4,302.14
2018	4,025	16.67%	0.2000	134.17	99.1	33.3	\$ 4,427.54
2019	4,139	16.67%	0.2000	137.97	99.1	33.3	\$ 4,552.94
2020	4,253	16.67%	0.2000	141.77	99.1	33.3	\$ 4,678.34
2021	4,367	16.67%	0.2000	145.57	99.1	33.3	\$ 4,803.74
2022	4,481	16.67%	0.2000	149.37	99.1	33.3	\$ 4,929.14
2023	4,595	16.67%	0.2000	153.17	99.1	33.3	\$ 5,054.55
2024	4,709	16.67%	0.2000	156.97	99.1	33.3	\$ 5,179.95
2025	4,823	16.67%	0.2000	160.77	99.1	33.3	\$ 5,305.35
2026	4,937	16.67%	0.2000	164.57	99.1	33.3	\$ 5,430.75
2027	5,051	16.67%	0.2000	168.37	99.1	33.3	\$ 5,556.15
2028	5,165	16.67%	0.2000	172.17	99.1	33.3	\$ 5,681.55
2029	5,279	16.67%	0.2000	175.97	99.1	33.3	\$ 5,806.95
2030	5,393	16.67%	0.2000	179.77	99.1	33.3	\$ 5,932.35
2031	5,507	16.67%	0.2000	183.57	99.1	33.3	\$ 6,057.76
2032	5,621	16.67%	0.2000	187.37	99.1	33.3	\$ 6,183.16
2033	5,735	16.67%	0.2000	191.17	99.1	33.3	\$ 6,308.56
2034	5,849	16.67%	0.2000	194.97	99.1	33.3	\$ 6,433.96
2035	5,963	16.67%	0.2000	198.77	99.1	33.3	\$ 6,559.36
2036	6,077	16.67%	0.2000	202.57	99.1	33.3	\$ 6,684.76
2037	6,191	16.67%	0.2000	206.37	99.1	33.3	\$ 6,810.16
2038	6,305	16.67%	0.2000	210.17	99.1	33.3	\$ 6,935.56
2039	6,419	16.67%	0.2000	213.97	99.1	33.3	\$ 7,060.96
2040	6,533	16.67%	0.2000	217.77	99.1	33.3	\$ 7,186.37

Worksheets A6: Accident cost savings continued



Worksheet A6.4a - Accident rate analysis

Option		Taipa - New 2 Lane Bridge	
Posted speed limit	100km/h near rural	Traffic growth rate	3%
Road category	Rural Strategic	Time zero	Jul-15
Accident prediction model			
1	Table used		3.4
2	Parameter b_0		8.283425368
3	Parameter b_1		
4	Parameter b_2		
5	Lowest or side road AADT (Q_{minor})		
6	Highest or primary AADT (Q_{major})		3797
7	Typical accident rate (accidents per year), A_T (formula from crash compendium)		0.114879037
			Go to step 8
Exposure-based accident prediction equation			
1a	Table used		
2a	Coefficient b_0 ($/10^8$ veh-km or $/10^8$ vehicles)		
3a	Cross section adjustment factor from crash compendium table 5 (1.0 for no adjustment)		
4a	Adjusted coefficient (2a) x (3a)		
5a	Exposure at time zero (10^8 veh-km or 10^8 vehicles)		
7	Typical accident rate (accidents per year), A_T (4a) x (5a)		
8	Accident trends factor for adjusting typical accident rate (appendix A6.5 method B)		-0.02
9	Adjustment factor for accident trend ($1 + (8) \times (\text{time zero year} - 2006)$) (appendix A6.5 B)		0.82
10	Typical accident rate per year adjusted for accident trends, A_T (7) x (9)		0.09420081
11	Cost per reported injury accident (table A6.5)	\$	570,000
12	Total accident cost per year (10) x (11)	\$	53,694.46

Worksheets A6: Accident cost savings continued



Worksheet A6.4a - Accident rate analysis

Option		Taipa - Detour Route Crashes	
Posted speed limit	100km/h near rural	Traffic growth rate	3%
Road category	Rural Strategic	Time zero	Jul-15
Accident prediction model			
1	Table used		3.0
2	Parameter b_0		22
3	Parameter b_1		
4	Parameter b_2		
5	Lowest or side road AADT (Q_{minor})		
6	Highest or primary AADT (Q_{major})		632.8333333
7	Typical accident rate (accidents per year), A_T (formula from crash compendium)		0.013797032
			Go to step 8
Exposure-based accident prediction equation			
1a	Table used		
2a	Coefficient b_0 ($/10^8$ veh-km or $/10^8$ vehicles)		
3a	Cross section adjustment factor from crash compendium table 5 (1.0 for no adjustment)		
4a	Adjusted coefficient (2a) x (3a)		
5a	Exposure at time zero (10^8 veh-km or 10^8 vehicles)		
7	Typical accident rate (accidents per year), A_T (4a) x (5a)		
8	Accident trends factor for adjusting typical accident rate (appendix A6.5 method B)		-0.02
9	Adjustment factor for accident trend ($1 + (8) \times (\text{time zero year} - 2006)$) (appendix A6.5 B)		0.82
10	Typical accident rate per year adjusted for accident trends, A_T (7) x (9)		0.011313567
11	Cost per reported injury accident (table A6.5)	\$	570,000
12	Total accident cost per year (10) x (11)	\$	6,448.73

Worksheets A6: Accident cost savings continued



Worksheet A6.5a - Weighted accident procedure - do minimum

Option	Taipa - Existing 1 Lane Bridge		
Posted speed limit	100km/h near rural	Traffic growth rate	3%
Road category	Rural Strategic	Time zero	Jul-15
Site-specific accident rate			
1	Number of years of accident records		5
2	Number of reported injury accidents over period		1
3	Number of accidents per year (2) / (1)		0.2
4	Trend adjustment factor (table A6.1(a))		1.06
5	Site specific accident rate (accidents per year), A_S (3) x (4)		0.212
Accident prediction model			
6	Table used		3.3
7	Parameter b_0		103.1220248
8	Parameter b_1		
9	Parameter b_2		
10	Lowest or side road AADT (Q_{minor})		
11	Highest or primary AADT (Q_{major})		3797
12	Typical accident rate (accidents per year), A_T (formula from crash compendium)		1.430152184
			Go to step 13
Exposure-based accident prediction equation			
6a	Table used		
7a	Coefficient b_0 ($/10^8$ veh-km or $/10^8$ vehicles)		
8a	Cross section adjustment factor from table A6.13 (1.0 for no adjustment)		
9a	Adjusted coefficient (7a) x (8a)		
10a	Exposure at time zero (10^8 veh-km or 10^8 vehicles)		
12	Typical accident rate (accidents per year), $A_{T,dm}$ (9a) x (10a)		
13	Accident trend factor for adjusting typical accident rate, f_t (appendix A6.5 method B)		-0.02
14	Adjustment factor for accident trend ($1 + (13) \times (\text{time zero} - 2006)$) (app. A6.5 method B)		0.82
15	Typical accident rate per year adjusted for accident trends, $A_{T,dm}$ (12) x (14)*		1.17272479
* For all mid-block analyses, the typical accident rate (15) must be divided by the mid-block length (in km)			
Weighting factor			
16	k value (from Crash Compendium)		0.3
17	Weighting factor, w , (16) / [(16) + (15) x (1)]		0.048672664
18	Do-minimum weighted accident rate, $A_{W,dm}$ [(17) x (15)] + [1 - (17)] x (5)		0.258761035
19	Cost per reported injury accident (table A6.5)	\$	570,000
20	Total accident cost per year (18) x (19)	\$	147,493.79

Network Resilience: Detour Calculations

Assumptions:-

- 1 Bridge closure in last 5 years = 20% annual probability of closure
- 4 hour closure to clear site, inspect structure
- Assumed Average Detour = 99.1km, 78.5 mins

Year (1)	AADT (2)	% AADT affected (3)	P (Diversion) (4)	Number of Veh Diverted (5) = (2)x(3)x(4)	Additional Journey Time (6)
2016	3,797	16.67%	0.2000	126.5667	78.5
2017	3,911	16.67%	0.2000	130.3667	78.5
2018	4,025	16.67%	0.2000	134.1667	78.5
2019	4,139	16.67%	0.2000	137.9667	78.5
2020	4,253	16.67%	0.2000	141.7667	78.5
2021	4,367	16.67%	0.2000	145.5667	78.5
2022	4,481	16.67%	0.2000	149.3667	78.5
2023	4,595	16.67%	0.2000	153.1667	78.5
2024	4,709	16.67%	0.2000	156.9667	78.5
2025	4,823	16.67%	0.2000	160.7667	78.5
2026	4,937	16.67%	0.2000	164.5667	78.5
2027	5,051	16.67%	0.2000	168.3667	78.5
2028	5,165	16.67%	0.2000	172.1667	78.5
2029	5,279	16.67%	0.2000	175.9667	78.5
2030	5,393	16.67%	0.2000	179.7667	78.5
2031	5,507	16.67%	0.2000	183.5667	78.5
2032	5,621	16.67%	0.2000	187.3667	78.5
2033	5,735	16.67%	0.2000	191.1667	78.5
2034	5,849	16.67%	0.2000	194.9667	78.5
2035	5,963	16.67%	0.2000	198.7667	78.5
2036	6,077	16.67%	0.2000	202.5667	78.5
2037	6,191	16.67%	0.2000	206.3667	78.5
2038	6,305	16.67%	0.2000	210.1667	78.5
2039	6,419	16.67%	0.2000	213.9667	78.5
2040	6,533	16.67%	0.2000	217.7667	78.5

Network Resilience: HPMV Waiting Time

HPMV Waiting Time on SH1 if no HPMV route available

- Last 10 years = 15 closures (RS 104-198)
- Total Closure time = 148.99 Hours
- Average Closure time per year = 14.899 hours
- SH1 RP 119/11.46 AADT = 1085 with 14%HCV
- 150 HCV per year, assumed 50 HPMV (local advice) with 3% growth rate
- EEM TTC Costs, used \$20.1 for driver, \$28.1 for HCV2 = \$48.2

Network Resilience : Layer 2 Benefits

Figures from Network Resilience Business Case (Opus,2013)

- Layer 1 = Traditional EEM Benefits
- Layer 2 = Extended Benefits from wider economy effects
- Layer 2 Benefits were from 48 Hour Closure
- Layer 2 benefits peer reviewed by ASCARI Partners
- Recognising that link severances have wider economy effects, propose to use results from 2013 stu

Layer 1 Benefit:	63000000
Layer 2 Benefit:	15800000
%	25.08% For 48 hour closures
Adjustment	2.09% For 4 Hour Closure

TTC Detour Benefits	\$ 104,177.71
VOC Detour Benefits	\$ 72,012.05
ACC Detour Benefits	\$ 95,310.16
Layer 2 Benefits	\$ 5,674.20

RELEASED UNDER THE OFFICIAL INFORMATION ACT

APPENDIX F. COST ESTIMATES

This appendix contains the following items:

- Elemental Estimate for Option 2
- Elemental Estimate for Option 3
- Detailed Business Case Estimate (DBE)
- Risk Register used to describe and calculate the risk adjustment
- Email from Richard Landon-Lane (Opus) who has completed the BCR calculation based on the Expected Estimate.

The following notes provide a brief summary of the methodology used to develop the cost estimates:

1. Elemental breakdown cost estimation has been undertaken for Options 2 and 3. There are several differences between these options which is apparent in the subtotals for each section of the costing.
2. Elemental costs for Option 2 have been used to populate the Base Estimate column of the DBE worksheet, giving the **Project Base Estimate of \$11,807,253**.
3. The difference between Option 2 and Option 3 has been added to 10% for variation in the quantities/rates and populated in the Contingency column. This gives the **Project Expected Estimate of \$14,098,607**.
4. In the Funding Risk Contingency column, 25% is added to the property cost, 10% to the pre-implementation and implementation fees and 10% to the physical works items.
5. A Risk Cost (Item 13 of the Physical Works) has been added based on the project risks identified in the Risk Register (attached), weighed against the Likelihood of the risk occurring. This is used to work out the **95th Percentile Project Estimate of \$15,813,832**.

Project Estimate - Form C

DBE

Northland One Lane Bridges Replacement - Taipa

Detailed Business Case Estimate

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	Nett Project Property Cost	30,000	7,500	7,500
	Project Development Phase			
	- Consultancy Fees			
	- NZTA Managed Costs			
B	Total Project Development	Nil	Nil	Nil
	Pre-implementation Phase			
	- Consultancy Fees			
	- NZTA Managed Costs			
C	Total Pre-implementation	718,850	71,885	71,885
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	315,000		
	- NZTA Managed Costs	100,000		
	- Construction Monitoring Fees	300,000		
	Sub Total Base Implementation Fees	715,000	143,000	71,500
	Physical Works			
1	Environmental Compliance	90,000	29,000	9,000
2	Earthworks	688,700	960,456	68,870
3	Ground Improvements	20,000	2,000	2,000
4	Drainage	73,157	10,772	7,316
5	Pavement and Surfacing	168,294	216,829	16,829
6	Bridges	7,300,000	-170,000	730,000
7	Retaining Walls and Fencing	9,920	10,912	992
8	Traffic Services	414,600	41,460	41,460
9	Service Relocations	300,000	30,000	30,000
10	Landscaping	40,000	11,000	4,000
11	Traffic Management and Temporary Works	260,000	170,060	26,000
12	Preliminary and General	978,732	756,480	97,873
13	Extraordinary Construction Costs	0	0	530,000
	Sub Total Base Physical works	10,343,403	2,068,969	1,564,340
D	Total for Implementation Phase	11,058,403	2,211,969	1,635,840
E	Project Base Estimate (A+C+D)	11,807,253		
F	Contingency (Assessed/Analysed) (A+C+D)		2,291,354	
G	Project Expected Estimate (E+F)		14,098,607	
	Nett Project Property Cost Expected Estimate		37,500	
	Project Development Phase Expected Estimate		Nil	
	Pre-implementation Phase Expected Estimate		790,735	
	Implementation Phase Expected Estimate		13,270,372	
H	Funding Risk Contingency (Assessed/Analysed) (A+C+D)			1,715,225
I	95th percentile Project Estimate (G+H)			15,813,832
	Nett Project Property Cost 95th percentile Estimate			45,000
	Project Development Phase 95th percentile Estimate			Nil
	Pre-implementation Phase 95th percentile Estimate			862,620
	Implementation Phase 95th percentile Estimate			16,975,181
Date of Estimate		19/05/2016	Cost Index (Qtr/Year)	
Estimate prepared by		Naushaba Todd-Jones	Signed <i>N Todd-Jones</i>	
Estimate internal peer review by		Chris Parker	Signed <i>CParker</i>	
Estimate external peer review by			Signed	
Estimate accepted by NZTA			Signed	

Note: (1) These estimates are exclusive of escalation and GST.
 (2) Project Development Phase Estimates are set to Nil as these are now sunk costs.

Appendix B: Elemental Breakdown for Physical Works Form

Northland One Lane Bridges Replacement - Taipa

Elemental Breakdown for Physical Works - Option 2

Item	Description	Sub-Element Totals (\$)	Element Totals (\$)
	Project Development Phase Fees		
	Project investigation fees		\$ -
	Planning and consents	\$ 7,350.00	\$ 7,350.00
	Iwi consultation	\$ 20,000.00	\$ 20,000.00
	Designation and resource consent preparation and lodgement (including hearings)	\$ 4,000.00	\$ 4,000.00
	Fees (designation, environment court)		\$ -
	Legal costs (including environment court)		\$ -
	Mana Whenua, Waahi Tapu, Koiwi and Mauri fees and costs		\$ -
	Reviews and audits		\$ -
	Geotechnical elements	\$ 4,500.00	\$ 4,500.00
	Survey elements	\$ 18,200.00	\$ 18,200.00
	Public relations		\$ -
	The consultant's input before contract award (D&C contracts only, include specimen design)	\$ 138,490.00	\$ 138,490.00
	Speed surveys		\$ -
	Council costs/expenses		\$ -
	Heritage costs		\$ -
	Mitigation costs		\$ -
	Supplementary investigation during the investigation phase		\$ -
			\$ 192,540.00
	Pre-implementation Phase Fees		
	Design fees		
	Mana Whenua, Waahi Tapu, Koiwi and Mauri fees and costs		
	Professional fees (project management, risk management, value management, peer reviews)	\$ 161,500.00	\$ 161,500.00
	Geotechnical - Initial investigation	\$ 105,850.00	\$ 105,850.00
	Geotechnical - Supplementary investigation during the detailed design	\$ -	\$ -
	Legal fees		\$ -
	Resource consent costs (including fees)		\$ -
	Building consent costs		\$ -
	Reviews and audits		\$ -
	Public relations		\$ -
	Contractor's detailed design (D&C contracts only)	\$ 400,000.00	\$ 400,000.00
	Advertising (radio, newspapers)		\$ -
	Economic assessments		\$ -
	Heritage costs		\$ -
	Mitigation costs	\$ 50,000.00	\$ 50,000.00
	Land requirement plans	\$ 1,500.00	\$ 1,500.00
			\$ 718,850.00
	Implementation Phase fees		
	Consultant construction monitoring and contract administration fees	\$ 250,000.00	\$ 250,000.00
	Legal fees		\$ -
	Iwi liaison (during construction)	\$ 50,000.00	\$ 50,000.00
	Regional council monitoring		\$ -
	Archaeological fees		\$ -
	Reviews and audits	\$ 7,500.00	\$ 15,000.00
	Public relations		\$ -
	The consultant's input following contract award (D&C contracts only)	\$ 300,000.00	\$ 300,000.00
	Advertising (radio, newspapers)		\$ -
	Newsletters (copying and delivery)		\$ -
	Noise monitoring		\$ -
	Addressing complaints		\$ -
	Heritage costs		\$ -
	Mitigation costs		\$ -
	Geotechnical - Supplementary investigation during the construction phase		\$ -
	NZTA Managed Costs	\$ 100,000.00	\$ 100,000.00
	Consent monitoring fees		\$ -
			\$ 715,000.00

Appendix B: Elemental Breakdown for Physical Works Form

Northland One Lane Bridges Replacement - Taipa

Elemental Breakdown for Physical Works - Option 2

Item	Description	Sub-Element Totals (\$)	Element Totals (\$)
1	Physical Works		
	Environmental Compliance	\$ 40,000.00	\$ 40,000.00
1.1	Management of environmental compliance requirements		\$ -
1.2	Preparation and management of compliance managements plans		\$ -
1.3	Construct permanent erosion and sediment control measures, maintenance and monitoring		\$ -
1.4	Noise attenuation		\$ -
1.5	Stormwater treatment	\$ 50,000.00	\$ 50,000.00
1.6	Bunds		\$ -
1			\$ 90,000.00
2	Earthworks		
2.1	Site clearance - greenfield such as small trees, shrubs, hedging etc.	\$ 20,000.00	\$ 20,000.00
2.2	Demolition - building demolition, structures, fences, retaining walls, utility services, stormwater pipe, manholes, cesspits, surfacing, kerbs, lights, signs, temporary works etc.		\$ -
2.3	Temporary fencing		\$ -
2.4	Topsoil stripping	\$ 5.00	\$ -
2.5	Cut to fill		\$ -
2.6	Cut to waste		\$ -
2.7	Borrow to fill		\$ -
2.8	Imported fill	\$ 30.00	\$ -
2.9	Undercutting soft spots		\$ -
2.10	Excavation in rock (state types)		\$ -
2.11	Conditioning of cut and/or fill materials		\$ -
2.12	Preloading, additional preload materials, settlement monitoring and removal of preload materials		\$ -
2.13	Respreading topsoil	\$ 5.00	\$ -
2.14	Imported topsoil	\$ 5.00	\$ -
2.15	Reclamation works		\$ -
2.16	Foreshore works		\$ -
2.17	Temporary earthworks		\$ -
2.18	Temporary haul roads		\$ -
2.19	Construct, maintain & remove temporary sediment control measures, temporary sediment control ponds, including temporary hydroseeding, rock check dams, silt fencing	\$ 50.00	\$ -
2.20	Dust control		\$ -
2.21	Archaeological treatment/mitigation works		\$ -
2.22	Lifting bridge soffit level due to climate change from 3.1m to 3.3m Embankments		\$ -
	Causeway extension - Option 2		\$ 668,699.70
2.23	Boardwalk on cable bay side, northern side of road - Option 2	\$ 1,250.00	\$ 500,000.00
2.24	Gabion baskets	\$ 200.00	
2.25	Northern Embankment Core - Fill/Gravel	\$ 50.00	\$ 4,500.00
2.26	Northern Embankment Rock Armour	\$ 100.00	\$ 4,500.00
2.27	Northern Geotextile wrap for fill (all sides)	\$ 15.00	\$ 6,937.38
2.28	Northern Topsoil & hydroseeding	\$ 5.00	\$ 503.12
2.29	Southern Embankment Core - Fill/Gravel	\$ 50.00	\$ 9,000.00
2.30	Southern Embankment Rock Armour	\$ 100.00	\$ 6,000.00
2.31	Southern Geotextile wrap for fill (all sides)	\$ 15.00	\$ 9,405.00
2.32	Southern Topsoil & hydroseeding	\$ 5.00	\$ 670.82
2.33	Northern Embankment Core - Fill/Gravel	\$ 50.00	\$ 6,000.00
2.34	Northern Embankment Rock Armour	\$ 100.00	\$ 12,000.00
2.35	Northern Geotextile wrap for fill (all sides)	\$ 15.00	\$ 17,299.69
2.36	Northern Topsoil & hydroseeding	\$ 5.00	\$ 1,340.00
2.37	Southern Embankment Core - Fill/Gravel	\$ 50.00	\$ 20,250.00
2.38	Southern Embankment Rock Armour	\$ 100.00	\$ 27,000.00
2.39	Southern Geotextile wrap for fill (all sides)	\$ 15.00	\$ 40,275.00
2.4	Southern Topsoil & hydroseeding	\$ 5.00	\$ 3,018.69
2			\$ 688,699.70

Appendix B: Elemental Breakdown for Physical Works Form

Northland One Lane Bridges Replacement - Taipa

Elemental Breakdown for Physical Works - Option 2

Item	Description	Sub-Element Totals (\$)	Element Totals (\$)
3	Ground Improvements	\$ 20,000.00	\$20,000.00
3.1	Site decontamination (removal/treatment of managed, contaminated, hazardous materials etc.)		\$ -
3.2	Ground improvement (e.g. drainage blankets, wick drains geotextiles, stone columns, deep soil mixing)	\$ 15.00	\$ -
3.3	Geotechnical monitoring (inclinometers, piezometers)		\$ -
3.4	Dewatering bores, buttress drains		\$ -
3.5	Temporary works associated with ground improvements		\$ -
3			\$ 20,000.00
4	Drainage		
4.1	Stormwater drainage, temporary stream diversion and culverts including headwalls, chambers and rip-rap		\$ -
4.2	Kerb blocks, incl. subsoil	\$ 93.26	\$ 66,682.94
4.3	Single sump catchpit	\$ 1,618.64	\$ 6,474.55
4.4	Surface water channel		\$ -
4.5	Erosion control		\$ -
4.6	Flumes		\$ -
4.7	Rain gardens		\$ -
4.8	Permanent ponds		\$ -
4.9	Wetlands		\$ -
4.10	Grassed swales		\$ -
4.11	Treatment devices		\$ -
4			\$ 73,157.49
5	Pavement and Surfacing		
5.1	Subgrade stabilisation/improvement (aggregate, lime or cement)		\$ -
5.2	Subgrade preparation and testing		\$ -
5.3	Sub-basecourse including improvement (lime, cement)	\$ 59.68	\$ 95,482.67
5.4	Base course including improvement (lime, cement)	\$ 3.98	\$ 15,880.20
5.5	Surfacing (chip seal, asphaltic concrete, Stone Mastic Asphalt, deep lift asphalt, OGPA)	\$ 5.97	\$ 23,800.35
5.6	Upgrade existing carriageway(s)		\$ -
5.7	Sawcutting		\$ -
5.8	Joints		\$ -
5.9	Relocate monument	\$ 20,000.00	\$ 20,000.00
5.10	Conc. Footpath	\$ 49.55	\$ 13,130.75
5			\$ 168,293.97

RELEASED UNDER THE OFFICIAL INFORMATION ACT

Appendix B: Elemental Breakdown for Physical Works Form

Northland One Lane Bridges Replacement - Taipa

Elemental Breakdown for Physical Works - Option 2

Item	Description	Sub-Element Totals (\$)	Element Totals (\$)
6	Bridges		
6.1	New structure - 1.5m LH shoulder, 0.6m RH shoulder, 2.5m footway, 12.18m deck, 112 metres length	\$ 6,800,000.00	\$ 6,800,000.00
6.2	Demolish existing structure	\$ 500,000.00	\$ 500,000.00
6.3	Temporary works in association with bridge construction (launching gantry, access platform)		\$ -
6.4	Underpasses		\$ -
6.5	Rip-rap scour protection to abutments		\$ -
6			\$ 7,300,000.00
7	Retaining Walls and Fencing	\$ 992.00	\$ 9,920.00
7.1	Timber-piled walling		\$ -
7.2	Concrete-piled walling including ground anchors		\$ -
7.3	Gabion walling		\$ -
7.4	Crib walling		\$ -
7.5	Mechanically stabilised earth (MSE) walling		\$ -
7.6	Backfill behind retaining walls where the estimator is to consider the provisions included in the earthworks element and allow extra for special materials and/or placement requirements behind retaining walls)		\$ -
7.7	Stone strong walling		\$ -
7.8	Diaphragm walling		\$ -
7.9	Precast concrete facing panels		\$ -
7.10	Drainage in association with retaining walls		\$ -
7.11	Temporary works associated with retaining walls		\$ -
7.12	Fencing		\$ -
7.13	Fencing gates		\$ -
7			\$ 9,920.00
8	Traffic Services		
8.1	Barrier (wire/concrete median barrier and verge barrier)	\$ 500.00	\$ 335,000.00
8.2	Pavement markings, pavement markers		
8.3	Road signs, gantries	\$ 800.00	\$ 8,000.00
8.4	Traffic signals	\$ 800.00	\$ 1,600.00
8.5	Marker posts	\$ 800.00	\$ -
8.6	Lighting	\$ 7,000.00	\$ 70,000.00
8.7	Emergency cross-overs and phones		\$ -
8.8	Variable Message Signs		\$ -
8.9	Intelligent Traffic Signals/ATMS		\$ -
8.10	Bus/cycleway green paint marking		\$ -
8.11	Guardrails		\$ -
8.12	Leading and trailing end terminals		\$ -
8.13	Crash cushions		\$ -
8			\$ 414,600.00
9	Service Relocations	\$ 300,000.00	\$ 300,000.00
9.1	NZTA cost of all local authority and utility companies (after cost share) and contractor's on-costs		\$ -
9.2	Civil works associated with utility services such as trenching		\$ -
9.3	Temporary works associated with utility services		\$ -
9			\$ 300,000.00

Appendix B: Elemental Breakdown for Physical Works Form

Northland One Lane Bridges Replacement - Taipa

Elemental Breakdown for Physical Works - Option 2

Item	Description	Sub-Element Totals (\$)	Element Totals (\$)
10	Landscaping & Urban Design		
10.1	Landscaping (aesthetic and environmental)	\$ 40,000.00	\$ 40,000.00
10.2	Grassing, hydroseeding, planting, revegetation, mulch		\$ -
10.3	Architecture		\$ -
10.4	Fencing		\$ -
10.5	Streetscaping		\$ -
10.6	Land accommodation costs (also refer to project property cost funding)		\$ -
10.7	Footpaths and cycleway		\$ -
10.8	Building relocations		\$ -
10.9	Traffic islands		\$ -
10.10	Pram crossings with kerb and tactile pavers		\$ -
10.11	Urban design features to bridges, structures, barriers, retaining walls etc.		\$ -
10			\$ 40,000.00
11	Traffic Management and Temporary Works		
11.1	Temporary traffic diversions	\$ -	\$ -
11.2	Traffic management physical works costs	\$ 1,000.00	\$ 250,000.00
11.3	Temporary roads	\$ 10,000.00	\$ 10,000.00
11			\$ 260,000.00
12	Preliminary and General		
12.1	Establishment, temporary accommodation, clean up, disestablishment and other site operating costs	\$ 100,000.00	\$ 100,000.00
12.2	Contractor's supervision, on site staffing, prescribed specialists and other time related costs	\$ 458,000.00	\$ 458,000.00
12.3	Insurances, bonds, warranties/guarantees, as-built requirement plans and other non time-related costs	\$ 90,000.00	\$ 90,000.00
12.4	Temporary works design and traffic management planning	\$ 1,000.00	\$ 1,000.00
12.5	Project plans, quality assurance, traffic management plans, environmental management plans, programming and reporting, consent fees, stakeholder management, health and safety, security management, contractor's escrow tender documents	\$ 219,821.22	\$ 219,821.22
12.6	Network maintenance	\$ -	\$ -
12.7	QA systems	\$ 109,910.61	\$ 109,910.61
12.8	Testing		\$ -
12			\$ 978,731.83
13	Extraordinary Construction Costs		
13.1	Extraordinary costs may include special items such as rock avalanche cover, tunnels, rail bridges, rail level crossings, mine hazard mitigation i.e. this item is for significant non- roadway expenses. Note: This is not for miscellaneous items		\$ -
13			\$ -
Base Estimate			\$ 11,969,792.99

Date of Estimate	19/05/2016	Cost Index	
Estimate prepared by	Naushaba Todd-Jones	Signed	<i>N Todd Jones</i>
Estimate internal peer review by	Chris Parker	Signed	<i>Chris Parker</i>
Estimate external peer review by		Signed	
Estimate accepted by NZTA project manager		Signed	

Note: These estimates are exclusive of Contingency, Funding Risk Contingency, Escalation and GST.

Project Estimate - Form C			DBE Option 2			Option North	
Northland One Lane Bridges Replacement - Taipā timate							
Item	Description	Base Estimate	Contingency	Funding Risk Contingency	Base Estimate	Contingency	
A	Nett Project Property Cost	30,000	7,500	7,500	3,000,000	750,000	
	Project Development Phase						
	- Consultancy Fees						
	- NZTA Managed Costs						
B	Total Project Development	Nil	Nil	Nil	Nil	Nil	
	Pre-implementation Phase						
	- Consultancy Fees						
	- NZTA Managed Costs						
C	Total Pre-implementation	718,850	71,885	71,885	718,850	71,885	
	Implementation Phase						
	Implementation Fees						
	- Consultancy Fees	315,000			315,000		
	- NZTA Managed Costs	100,000			100,000		
	- Construction Monitoring Fees	300,000			300,000		
	Sub Total Base Implementation Fees	715,000	143,000	71,500	715,000	143,000	
	Physical Works						
1	Environmental Compliance	90,000	29,000	9,000	90,000	31,700	
2	Earthworks	688,700	960,456	68,870	110,000	14,300	
3	Ground Improvements	20,000	2,000	2,000	20,000	2,600	
4	Drainage	73,157	10,772	7,316	62,432	8,116	
5	Pavement and Surfacing	168,294	216,829	16,829	110,941	14,422	
6	Bridges	7,300,000	-170,000	730,000	19,860,000	2,581,800	
7	Retaining Walls and Fencing	9,920	10,912	992	0	0	
8	Traffic Services	414,600	41,460	41,460	319,600	41,548	
9	Service Relocations	300,000	30,000	30,000	1,500,000	195,000	
10	Landscaping	40,000	11,000	4,000	40,000	5,200	
11	Traffic Management and Temporary Works	260,000	170,060	26,000	260,000	33,800	
12	Preliminary and General	978,732	756,480	97,873	1,105,498	143,715	
13	Extraordinary Construction Costs	0	0	530,000	0	0	
	Sub Total Base Physical works	10,343,403	2,068,969	1,564,340	23,478,472	3,072,201	
D	Total for Implementation Phase	11,058,403	2,211,969	1,635,840	24,193,472	3,215,201	
E	Project Base Estimate (A+C+D)	11,807,253			27,912,322		
F	Contingency (Assessed/Analysed) (A+C+D)		2,291,354		(A+C+D)	4037086.296	
G	Project Expected Estimate (E+F)		14,098,607		(E+F)	31,949,408	
	Nett Project Property Cost Expected Estimate		37,500				
	Project Development Phase Expected Estimate		Nil				
	Pre-implementation Phase Expected Estimate		790,735				
	Implementation Phase Expected Estimate		13,270,372				
H	Funding Risk Contingency (Assessed/Analysed) (A+C+D)			1,715,225			
I	95th percentile Project Estimate (G+H)			15,813,832			
	Nett Project Property Cost 95th percentile Estimate			45,000			
	Project Development Phase 95th percentile Estimate			Nil			
	Pre-implementation Phase 95th percentile Estimate			862,620			
	Implementation Phase 95th percentile Estimate			16,975,181			