SH1 Opawa Bridge

9th May 2016

CONSIDERATION OF OPTIONS

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

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EXECUTIVE SUMMARY

The Opawa Bridge is being investigated for potential replacement to provide better vehicle access on SH1 in Blenheim. The project is one of several State Highway projects approved for investigation under the Accelerated Regional Roads Package (ARRP) by the Government in June 2014. The project was identified to improve the journey and in particular provide improved access for high productivity motor vehicles (HPMV) on SH1 in Marlborough.

The Opawa Bridge is located on the northern edge of Blenheim in a 50km/hr speed zone. It is 170m long and carries 9,800 vehicles/day of which 9% are heavy vehicles. It has a narrow carriageway where larger vehicles cannot pass, causing frequent delays and uncertain travel times. The bridge structure has inadequate seismic resistance at less than 33% of National Building Standard and, more critically, is vulnerable to a 1 in 100 year return flooding event. The bridge is a Category 1 heritage place, indicating a place of outstanding significance. Any demolition or modification to the bridge will need to pass a high consenting threshold.

The first phase of the investigation was developed with contribution from key stakeholders and iwi. It found that the bridge is too narrow for two-lane vehicles including modern heavy commercial vehicles and it has inadequate seismic resistance to natural hazard events.

The second phase identified and assessed a long list of potential options that could solve the two problems. These included options that would upgrade the existing structure and replace or duplicate the bridge.

As a consequence of the option assessment process the following preferred option was identified:

- a new parallel 10.8m wide two-lane bridge on the western side of the existing bridge, which would be retained as a pedestrian and cycle bridge. The cost estimate for this option is $14 - 17.5 million, although it would not meet the criteria for National Land Transport Funding.

In January 2016, the Government announced Crown funding for the preferred option.

1. BACKGROUND

The State Highway 1 (SH1) Opawa Bridge project (the Project) is one of several State Highway projects approved for investigation under the Accelerated Regional Roads Package (ARRP) by the Government in June 2014. The Project was identified to improve the journey and provide improved access for high productivity motor vehicles (HPMV) on SH1 in Marlborough.

The New Zealand Transport Agency (the Transport Agency) is responsible for operating, maintaining, renewing and improving the state highway network. The SH1 Opawa River Bridge is integral to the state highway network and a key link to the interisland ferry. The ferry is a vital freight link between the North and South Island. While the bridge has significance to utility service providers and the Marlborough District Council, it is the Transport Agency that has sole responsibility for managing any investments necessary to maintain and improve the asset.

Following the decision to retain the interisland ferry terminal in Picton, addressing issues on the nationally strategic route between Picton and Blenheim regained importance.

The Opawa Bridge is located on SH 1 at RP 18/9.0 between Picton and Blenheim (refer Photo 1 and Figure 1). It sits on the northern edge of the Blenheim in a 50km/hr speed area.

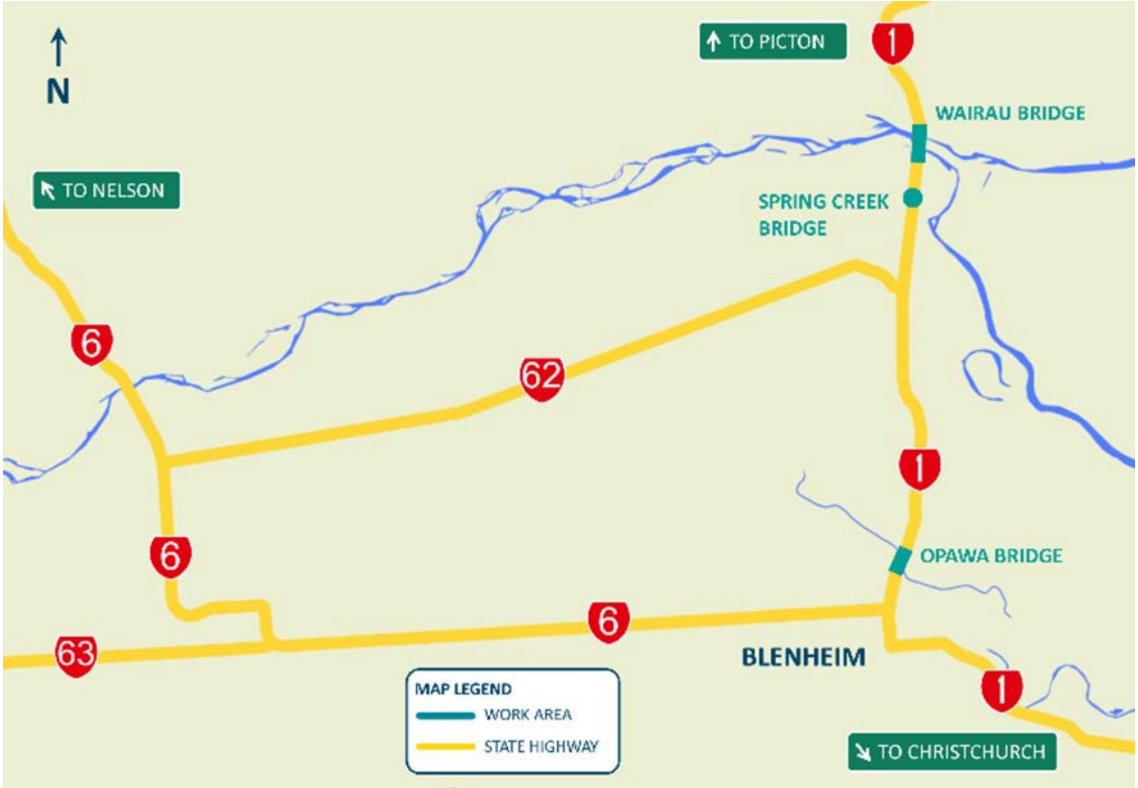
- The photographs on the front cover show the bridge details and are described below, in clockwise order, from the top photograph:
- Side view of the 8 span bow string truss bridge with large top cord beams and short 5m high piers looking downstream from the Blenheim side
- A driver's view of the narrow 5.49m carriageway with high vertical concrete kerbs and the original horizontal pipe safety rails
- The narrow carriageway squeeze when freight vehicles cross the bridge, as they are forced to cross the centreline due the additional width of their side mirrors
- Circa 1920 newly opened bridge with unsealed carriageway and intended traffic.

Little has changed with the bridge over its 100-year life with the exception of carriageway sealing and pavement marking.

The bridge is 170m long and carries 9,800 vehicles/day, with 9% heavy vehicles.

Photograph 1: Opawa Heritage Bridge opened 1917

Figure 1: Opawa bridge location SH1S RP18/9.0



2. OUTLINING THE NEED FOR INVESTMENT

2.1 Organisational strategies and objectives

In recent years, the Transport Agency has focussed on delivering an efficient freight network to reduce the cost of doing business. HPMVs provide productivity benefits that help improve the competitiveness of New Zealand exports, reduce the cost of goods and grow our economy. Bridge upgrades have been a fundamental part of ensuring the State Highway network are capable of handling heavier trucks.

The Transport Agency purpose is to "create transport solutions for a thriving New Zealand." The desired outcomes are:

- Effective – move people and freight where they need to go in a timely manner
- Efficient – deliver the right infrastructure and services to the right level at the best cost
- Safe and responsible – reduce the harms from transport
- Resilient – meet future needs and endure shocks

The long-term organisation goals and medium term objectives that relate to this project are identified in Table 1.

Table 1: Transport Agency long-term goals and medium-term objectives

Long-term (2013-32) Goals	Medium-term (2013-2022) Objectives
Integrate one effective and resilient network for customers	Improve freight supply chain efficiency
Deliver efficient, safe, and responsible highway solutions for customers	Greater resilience of the state highway network
	Deliver consistent levels of customer service that meet current expectations and anticipate future demand
Maximise effective, efficient, and strategic returns for New Zealand	Align investment to agreed national, regional and local outcomes and improve value for money in all we invest in and deliver

Table 2 identifies high-level organisational strategy in support of an efficient and resilient SH1 transport network between Blenheim and Picton.

Table 2: Relevant organisational strategies and plans

Organisation	Organisational Strategies
Government	Government Accelerated Roading Package
NZ Transport Agency	GPS, Statement of Intent, Freight Plans, National Business Cases, National Infrastructure Plan
Marlborough District Council	Draft Regional land Transport Plan

2.2 Defining the problem /opportunity

An investment logic mapping workshop was held on December 2014 with:

- Marlborough District Council, represented by:
  - Councillors Terry Sloan (Chair of Marlborough Regional Transport Committee),
  - Geoff Evans (Deputy Chair of Marlborough Regional Transport Committee),

- Marlborough Automobile Association, represented by:
  - Humphrey Meyers (District Councillor),

- Marlborough Road Transport Association, represented by:
  - Peter Heagney (nominated representative),

- Marlborough Police, represented by:
  - Sergeant Barrie Greenall (Team Leader, Highway Patrol)

It was also attended by Transport Agency staff to gain a better understanding of the current issues and business needs. Further meetings followed in May 2015 to agree to the problems and opportunities for investment.

Two problems and their respective proportional weighting (in brackets) were agreed as:

Problem One (70%): *Narrow Bridge - The bridge at 5.49m wide between kerbs is not suitable for current traffic requirements, particularly heavy commercial vehicles, creating an out of context environment for a nationally strategic state highway.*

The kerb-kerb width of the bridge is 5.49m is significantly below the Austroads recommendation for 7.0m . The narrow carriageway can present larger vehicles as a hazard, particularly if they cross the centreline because opposing vehicles slow down or cannot pass. This causes frequent delays and uncertain travel times. If another wide vehicle is already travelling across the bridge, wide vehicles, freight and trucks are forced to stop in one direction. This creates travel time delays and journey time variations. As freight traffic increases and without intervention, the delays and journey time variations are expected to increase.

Travel time variability was calculated using the Austroads variability formula, which explores the relationship between the mean and the standard deviation. Summarised ERUC data indicates a medium classification (20-30% Variability).

The NZTA MapHUB Efficiency NET geomap indicates a PM peak level of service E at the Opawa Bridge approach. The AM peak level of service is C. The drop in service is considered entirely due to delays caused by large vehicles being unable to pass in either direction at the same time, where generally a level of service A to C is considered acceptable. This narrowness creates public dissatisfaction.

Problem Two (30%): *Poor Structural Resilience - The bridge offers low seismic resistance, is at risk of bridge pier scouring and is significantly vulnerable to structural collapse.*

A detailed structural assessment (DSA) was completed in March 2015 on the Opawa Bridge. This assessment highlighted a number of potential seismic deficiencies with the bridge, including:

- Bridge span failure due to a lack of restraint at the end bearings
- Settlement of the bridge spans due to pier/pile subsidence caused by liquefaction, and the potential for bridge collapse

- Walking of heavy spans under longitudinal seismic shaking causing shearing in abutment piles

The report offers additional comment on flooding risk. The central bridge pier, located in the river channel thalweg, is at risk from scour in a 1 in 100 Annual Exceedance Probability (AEP)Flood. The existing pile depth is 7.57m from construction drawings and it is calculated that the piles could be completely exposed in a 1 in 100 AEP Flood event. With significantly reduced lateral support and additional horizontal pier loading from floodwaters, the central pier(s) could displace, leading to span failure.

2.3 Project benefits and key performance indicators

The benefits (with weighting in parentheses) and key performance indicators (KPIs) for the problems are shown in Table 3.

Table 3: Project benefits and KPIs

Investment Benefit	Measure KPI
Benefit 1 (70%) Increased throughput of freight and light vehicles and greater certainty of SH journey	Reduced coefficient of variation - standard deviation of travel time/average minutes travel time
	Minutes delay per kilometre
	Number of customer complaints
	Number of adverse media articles
Benefit 2 (30%) Greater structural resilience to natural hazard events, resulting in increased availability & access.	Number of resolved significant road closures and detours urban >2hours

3. CONSTRAINTS AND ASSUMPTIONS

Heritage values, archaeology

The Opawa Bridge was designed in 1912 and opened in 1917. The bridge is listed as a category 1 historic place by Heritage New Zealand and is a protected heritage item under the Wairau / Awatere Resource Management Plan (RMP). Any demolition or modifications to the bridge will require resource consent and approval from Heritage New Zealand for demolition or modification.

Hydrology

The current known hydrology is based on that used in the calibrated 2003 MDC MIKE 11 model for the Opawa River. For a 1 in 100 AEP event at this bridge the model indicate that:

- the design flow is 600m3/s
- the design water level is 6.77m above Nelson Vertical Datum 1955 (NVD55)

Geotechnical

The existing river bed geology contains silty layers of highly liquefiable soils to a depth of around 20-25m. This has a significant bearing on the construction estimate with any new bridge option requiring rock column ground improvements of the existing soils to prevent lateral spreading under earthquake loading. This work has been estimated to have a base cost of $1.6M dollars with a risk contingency of $800,000.

Utilities

The assumption has been made that all existing utilities have sufficient cover, but no onsite potholing has been undertaken.

4. ACTIVITY CONTEXT

4.1 Economic

The SH1 Opawa Bridge is a key structure on the National Strategic State Highway transport route enabling and supporting the growth of the New Zealand economy. In particular, the bridge enables freight access via the Port of Picton and the ferry link from the South Island to the North Island and back.

In addition, the structure enables considerable amount of inter-regional traffic. Marlborough is an export-focussed producer of primary products, principally from viticulture, aquaculture, and forestry. Marlborough is New Zealand's largest wine-growing region, and has diversified into manufacturing and other services that support and add value to the primary sector activity.

4.2 Geographic

The Opawa Bridge is located on SH1 near the northern threshold of the Blenheim township. The bridge is located within the 50km/hr speed zone, 300m south of the 100km/h to 50km/hr speed change on the northern urban fringe of Blenheim.

The Opawa River is a meandering silt-bed river bounded by stop banks. The bridge is situated on an S-bend in the river with the piers skewed about 47 degrees to the direction of flow.

The main trunk railway line runs on the eastern side of the highway and the rail overbridge is 100m downstream of the Opawa Bridge.

4.3 Environmental

The river environment at the bridge site is highly modified from its natural state due to manmade infrastructure, including road and rail bridges and the stop bank system.

On the eastern side of the highway is a formed off-road cycle path, which connects Blenheim to Spring Creek. The Opawa Bridge is a key cycleway link.

4.4 Social

The immediate southern approach of the Opawa Bridge passes beside motel accommodation and holiday camp ground accommodation. Further down Grove Road the land use changes to industrial and commercial.

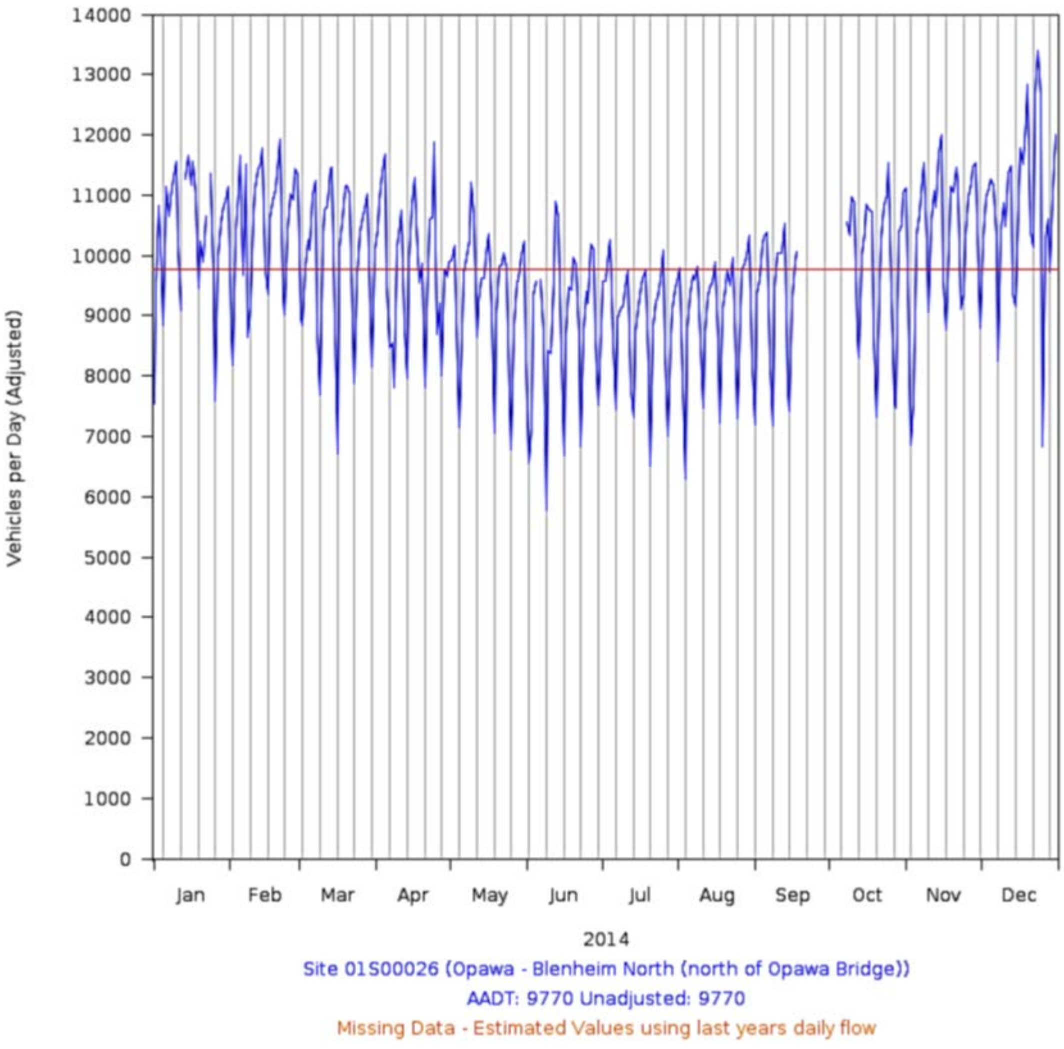
The Opawa Bridge on the northern approach is surrounded by rural agricultural activities, with one nearby residential property and a cluster of industrial/commercial buildings known as the Blenheim Research Centre. Both these properties share a common access point and are set back from the highway.

5. DATA ANALYSIS

5.1 Traffic volumes

A traffic monitoring site is located 100m north of the bridge. This provides classified traffic count information for SH1 for both traffic directions. Figure 2 shows the annual daily traffic data for 2014 and indicates 9,800 average annual daily traffic (AADT), with a summer peak of 13,500 veh/day and a winter low of 5,700 vehicles day. Further analysis indicates there are 9% heavy commercial vehicles. The Wairau Plains Transport Model 2008 forecasts annual traffic growth at this location of approximately 2.2%

Figure 2: Opawa bridge annual daily traffic

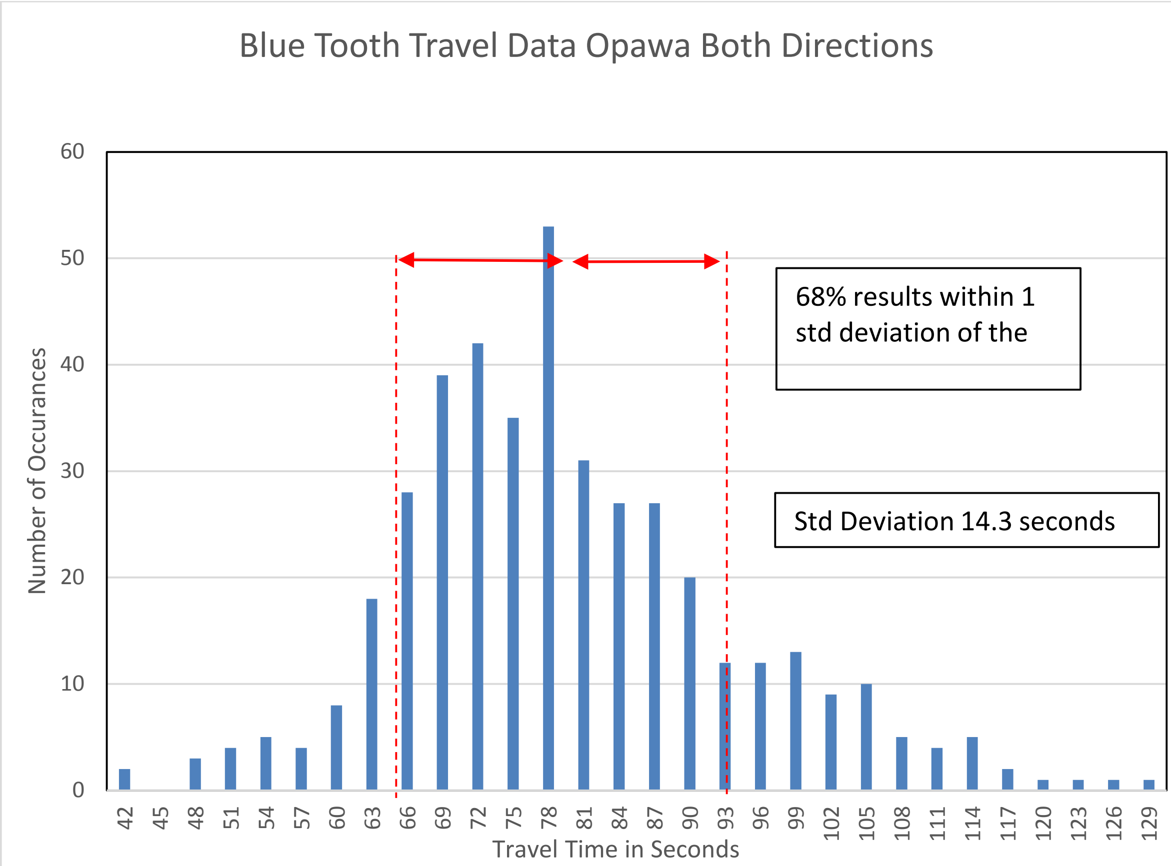


5.2 Journey travel time variation

The Transport Agency installed Bluetooth traffic sensors on this route to record the average travel times through the Opawa Bridge study area. The study area included both 100km/h and 50km/h speed zones. The results of a selected week/day typical hour are shown in Figure 3.

Statistical analysis of this data shows the mean travel time between sensors is 1 minute and 19 seconds with a standard deviation of 14.3 seconds. Sixty-eight percent (68%) of all travel time occurs within 1 standard deviation of the mean or between 1 minute 5 seconds and 1 minute 33 seconds. This measurement allows accurate monitoring of the variation or range of travel times.

Figure 3: Distribution of Bluetooth travel data, weekday hourly average.



5.3 Vehicle travel time delays and queuing

A one-day (8am to 4pm) traffic survey was undertaken on Thursday 12 March 2015. The focus of this survey was to record the frequency of delays created by wide vehicles and vehicles stopping to give way to wide vehicles travelling over the bridge in the opposing direction. The survey showed the following average weekday hourly delays:

- There were 25 delayed groups of vehicles per hour on average in both directions: 36% northbound and 64% southbound
- The average number of vehicles delayed per stoppage varied between 2 to 15 vehicles
- The average delay per stoppage ranged from 8 seconds to 30 seconds.

5.4 Public complaints

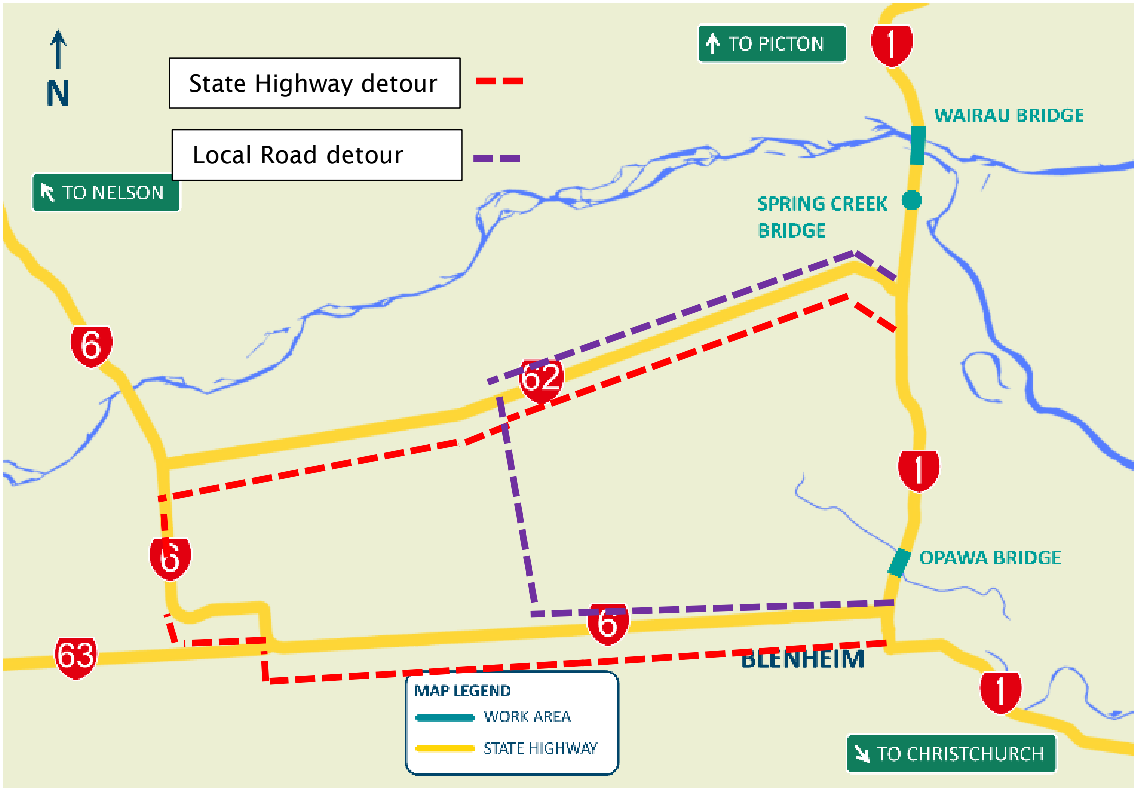
Three public complaints were received by Marlborough Roads concerning the Opawa Bridge in 2014, and eighteen letters were published in the Marlborough Express regarding the bridge between January 2014 and February 2015.

5.5 Detour additional travel time

Figure 4 shows the detour routes for freight and light vehicles if the Opawa Bridge is closed due to a natural hazard event. The detour route along state highways is via SH6 and SH62 and the average additional travel time is 19 minutes to travel this route.

A shorter detour route via local roads (Jacksons Road) exists. The average additional travel time is estimated as 12 minutes in both directions. Several other local roads may be suitable for light vehicles however these contain narrow carriageways, secondary urban streets, and single lane bridges and may result in considerable delays, pavement deterioration, and safety risks, if over used.

Figure 4: Detour route map



6. OPTIONS ASSESSMENT CRITERIA

The assessment criteria used for analysing the draft preferred option are as follows:

- Strategic outcomes - Are we solving the identified problem and achieving the KPIs?
- Cost optimisation - What are the financial and time implications?
- Implementation risks- Which options contain the greatest risks to successful implementation?
- Wider project impacts – Which options contain the greatest risks in terms of environmental and social screening?

7. OPTION DEVELOPMENT

A long list of options was developed to address the two identified problems. Eleven separate options were identified as possible solutions; they are summarised in **Appendices C2 and C3**. Cost estimates are provided in **Appendix D**.

A number of the options involve new bridges. A new bridge would require 10m separation from the existing bridge to ensure it would not be damaged from movement of the existing bridge (assuming the option did not include a structural improvement) during a natural hazard event. This requires land acquisition and designation for 25m either side of the existing bridge.

Consideration of the preferred alignment for a new bridge included:-

- Impact on the Blenheim Top 10 Holiday Park. The Holiday Park has three accommodation blocks that are within the footprint of an eastern bridge alignment and camping sites within the footprint of the western bridge alignment.
- Impact on the Grove Motel. The Motel is partly within the footprint of the western bridge alignment.
- Variable stream width
- Location of overhead power services
- Existing eastern alignment of the footpath on the existing bridge
- Existing eastern alignment of the walk/cycle path to Spring Creek

The western alignment is preferred for all of the new bridge options as it has the least impact on surrounding properties, provides better pedestrian and cycle access, and requires less property acquisition.

This section describes each option and considers the main advantages and disadvantages.

7.1 Do nothing

A do nothing option was considered. The existing bridge with its current lane width restriction has an estimated remaining life of 25-45 years. The bridge requires regular condition inspections on a six-monthly basis and after any moderate seismic event.

A do nothing approach is possible, but the bridge surface ride quality would deteriorate. There is a risk that the bridge joints would have accelerated deterioration and pier scour would continually get more severe. This could potentially shorten the remaining life of the bridge and risk damage to the heritage structure in a seismic or flood event.

7.2 Do minimum

The do minimum option includes undertaking some of the critical work identified in the 2015 detailed seismic assessment (DSA) such as pier scour protection, underpinning of the central piers, bridge resurfacing, and joint repairs.

Undertaking this work will mean the bridge is still at risk from failure in a seismic or flooding event. The rough order cost of this option is $0.7M.

7.3 Option 1: Structural and scour upgrade

The option proposes structural and flood mitigation work to reduce the risk of collapse in a seismic or flood event. This option does not alter the lane widths of the existing bridge.

This option includes a structural upgrade as identified in the 2015 DSA. In addition, a cycle/pedestrian shared path will be created on the eastern side of Grove Road.

Key advantages and disadvantages of option 1 are as follows:

Advantages

- Provides for benefit 2
- Retains the existing bridge
- Retains the 'gateway to Blenheim' benefit and associated traffic slowing effect
- Requires no additional land

Disadvantages

- Does not provide for benefit 1
- The strengthened structure retains the original materials and therefore would have less remaining life than a new structure

The rough order cost of this option is $6M.

7.4 Option 2: Intelligent transport solution with a structural upgrade

The option includes the work proposed in option 1, but in additional proposes an intelligent transport solution with a wide vehicle detection system. The system could alert an approaching wide vehicle of another wide vehicle traveling in the opposite direction on the bridge. A variable messages sign would advise the wide vehicle to pull off the road and wait, allowing the unimpeded flow of light vehicles. Additional road widening would be required to create a safe vehicle pull off area.

Key advantages and disadvantages of option 2 are as follows:

Advantages

- Provides for benefit 1 for light vehicles
- Provides for benefit 2
- Retains the existing bridge

Disadvantages

- Does not provide for benefit 1 for freight
- The strengthened structure retains the original materials and therefore would have less remaining life than a new structure
- High risk as the technology would require some development and implementation
- Approval from Transport Agency for a new traffic control device
- Additional road space would require property purchase

The rough order cost of this option is $8M.

7.5 Option 3: Central widening of existing structure and structural upgrade

The option includes the work proposed in option 1 and also involves cutting the existing structure down the centre of the deck and increasing the width of the deck to 9m. This would preserve the appearance of the heritage structure and resolve the narrow existing traffic lanes. While the option is feasible, it would require widened piers, new piles, and a temporary bridge during construction.

Key advantages and disadvantages of option 3 are as follows:

Advantages

- Provides for benefit 1 and 2
- Retains the existing bridge
- No significant property requirements

Disadvantages

- The strengthened structure retains the original materials and therefore would have less remaining life than a new structure
- Significant technical and engineering construction risk
- Traffic delays and temporary bridge property requirements during construction would be significant
- Environmental effects from widened bridge piers and new piles

The rough order cost of this option is $16M.

7.6 Option 4: Widening of existing structure upstream and structural upgrade

The option includes the work proposed in option 1 and adds an additional 6m width on the upstream side of the existing bridge. This would resolve the narrow traffic lanes and partially preserve the heritage nature and appearance of the bridge side truss.

Key advantages and disadvantages of option 4 are as follows:

Advantages

- Provides for benefit 1 and 2
- Retains the existing bridge
- No significant property requirements

Disadvantages

- The strengthened structure retains the original materials and therefore would have less remaining life than a new structure
- Significant technical and engineering construction risk
- Traffic delays during construction
- Environmental effects from widened bridge piers and new piles
- The visual appearance of the bridge from the west would be altered

The rough order cost of this option is $12M.

7.7 Option 5: New 10.8m wide single lane bridge, operating in tandem with existing bridge with no structural upgrade

The option involves constructing a new 10.8m wide bridge upstream of the existing bridge. The new bridge would operate as one traffic lane with a shared walk/cycle path northbound with southbound traffic and existing shared walk/cyclepath on the existing bridge.

The existing bridge would have no structural upgrade, although a cycle/pedestrian shared path will be formed on the eastern side of Grove Road.

The new bridge could be converted to a two lane facility in the future when the existing bridge's remaining useful life is exceeded or if it is damaged beyond practical repair in a seismic or flooding event. The new bridge has sufficient width to be converted to two traffic lanes and two on-road cycle lanes. It would be necessary to construct a new pedestrian bridge if the existing bridge was unserviceable for pedestrians.

Key advantages and disadvantages of option 5 are as follows:

Advantages

- Provides for benefit 1
- Provides for benefit 2 for the new bridge
- Retains the existing bridge
- Confident cyclists provided with on-road cycle lanes so won't have to cross the road and use the shared path facility
- Minor construction delays
- New bridge can be converted to two traffic lanes in the future

Disadvantages

- Does not improve seismic or flooding risk of existing bridge
- Significant property requirements
- Increased operation and maintenance costs for two bridges
- In the future, the existing bridge may need to be replaced with a new pedestrian bridge at this point additional capital expenditure will be required to move all traffic onto the new bridge

The rough order cost of this option is $16M.

7.8 Option 6: New 7.3m wide single lane bridge, operating in tandem with existing heritage bridge with no structural upgrade

The option is similar to option 5 but involves constructing a narrower 7.3m wide bridge upstream of the existing bridge. The new bridge would operate as a one-lane northbound highway lane with the southbound traffic on the existing bridge.

The new bridge would not have a pedestrian/cycle shared path beside the traffic lane as option 5, but an on-road cycle lane only. This would allow the bridge to be used for two-way traffic in emergencies.

Key advantages and disadvantages of option 6 are as follows:

Advantages

- As option 5, but with reduced land requirements
- The new bridge can be used for two-way traffic in emergencies

Disadvantage

- As option 5

The rough order cost of this option is $15M.

7.9 Option 7: New 13.3m wide bridge, with pedestrian facilities, retaining the existing bridge with no structural upgrade

The option involves constructing a new two lane 13.3m wide bridge with on road cycle lanes and a footpath on one side. The existing bridge would not be structurally upgraded, but would retain the cycle/ pedestrian shared path.

Key advantages and disadvantages of option 7 are as follows:

Advantages

- Provides for benefit 1
- Provides for benefit 2 for the new bridge
- Retains the existing bridge
- Confident cyclists provided with on-road cycle lanes so won't have to cross the road and use the shared path facility
- Minor construction delays
- Operation and maintenance costs reduced from option 5 as existing bridge would not carry traffic

Disadvantages

- Does not improve seismic or flooding risk of existing bridge

- Significant property requirements
- Footpath on side of new bridge unlikely to be utilised and will require additional costs to connect footpaths at either end of the bridge

The rough order cost of this option is $19M.

7.10 Option 8: New 10.8m wide bridge retaining the existing bridge with no structural upgrade

This option is the same as option 7 but does not have a footpath on one side of the new bridge.

Key advantages and disadvantages of option 8 are as follows:

Advantages

- Provides for benefit 1
- Provides for benefit 2 for the new bridge
- Retains the existing bridge for public use
- Confident cyclists provided with on-road cycle lanes so won't have to cross the road and use the shared path facility
- Minor construction delays
- Operation and maintenance costs reduced from option 5 as existing bridge would not carry traffic

Disadvantages

- Does not improve seismic or flooding risk of existing bridge
- Significant property requirements
- In the future the existing bridge may need to be replaced with a new pedestrian bridge

The rough order cost of this option is $16M.

7.11 Option 9: New two lane 13.3m bridge replacing the existing bridge on the current alignment

The option involves demolishing the existing bridge and replacing it with a new two lane 13.3m bridge on the current bridge alignment, the new bridge would have on road cycle lanes and a footpath on one side.

Key advantages and disadvantages of option 9 are as follows:

Advantages

- Provides for benefit 1 and 2
- Confident cyclists provided with on-road cycle lanes
- Operations and maintenance cost reduced

Disadvantages

- Removes the existing bridge

- Traffic delays and temporary bridge property requirements during construction would be significant

The rough order cost of this option is $23M.

7.12 Option 10: Replace the existing bridge with a two lane tunnel

The option involves constructing a two-lane tunnel under the Opawa River to replace the existing Opawa Bridge.

Key advantages and disadvantages of option 10 are as follows:

Advantages

- Provides for benefit 1 and 2
- Would create a distinct 'gateway to Blenheim'

Disadvantages

- High cost
- The existing bridge can be retained without structural upgrade for walking and cycling access
- Significant engineering and technical challenges due to the presence of liquefiable insitu ground
- Significant environmental impact and consenting issues

The rough order cost of this option is over $50M.

7.13 Option 11: Construct a Blenheim by-pass for through Traffic

The option is a complete by-pass on the eastern edge of the Blenheim urban area providing a new link for the Picton to Christchurch route. The bypass option would be in the region of 5km long, and as the Opawa River splits in two downstream of the existing bridge the bypass will include two new significantly-sized bridge structures. The existing bridge could be retained for local traffic and as the SH6 link to Blenheim and Base Woodbourne. The through traffic to the south of Blenheim is 2,600 veh/day, so 7,200 veh/day will still use the existing bridge.

Advantage

- Removes the through freight portion of traffic from the bridge and Blenheim

Disadvantages

- Local traffic would still use the existing narrow bridge therefore the strategic objectives are not fully met
- High cost
- Unlikely to be supported unless considered as part of a network wide investigation
- Challenging property acquisition
- Significant environmental impacts and consenting issues

The rough order cost of this option is over $50M.

8. OPTIONS ASSESSMENT AND EVALUATION

A preliminary options assessment has been undertaken. All options were considered in terms of satisfying the strategic outcomes.

Options 3 through 9 inclusive fully satisfy the strategic outcomes and were assessed against the remaining assessment criteria: cost optimisation, implementation risks, and wider project affects. Their rankings are summarised in Table 4.

Options 1, 2, and 11 do not meet the strategic outcomes and have been excluded from further assessment. Although Option 10 achieves the strategic outcomes, it was dismissed due to poor physical and financial viability.

Table 4: Assessment summary

Option		Score	Rank
Option 3	Widen & upgrade existing bridge	12.3	6
Option 4	Extend & upgrade existing bridge	12.4	5
Option 5	New northbound bridge (10.8m wide) with existing bridge southbound	16.0	2
Option 6	New northbound bridge (7m wide) with existing bridge southbound	14.4	4
Option 7	New 2-way parallel bridge (13.3m wide)	15.7	3
Option 8	New 2-way parallel bridge (10.8m wide)	16.2	1
Option 9	New 2-way replacement bridge (13.3m wide)	11.6	7

Options 5 and 8 were further refined and compared. Option 8 was preferable to option 5 for the following reasons:

- Lower implementation risks,
- Better cost optimisation, and
- Only slightly higher wider project impacts.

An aerial plan and cross section is provided in **Appendix C** as a potential alignment.

The preliminary options assessment documentation is provided in Appendix D.

APPENDICES

APPENDIX A –INVESTMENT LOGIC MAP

Appendix A: Investment Logic Map

INVESTMENT LOGIC MAP
Activity

PROBLEM ▶ **BENEFIT**

Narrow Bridge - The bridge at 5.49m wide between kerbs is not suitable for current traffic requirements

70%

→

Greater certainty of state highway journey

Investment Benefit: Increase reliability
Measure: Reliability – actual vehicles

Investment Benefit: Decrease journey time
Measure: travel time delay – by mode

Greater customer satisfaction.

Investment Benefit: Improve comfort & customer experience
Measure: Number of customer complaints (CRMS)
Measure: Number of adverse media

Poor structural Resilience - Low seismic strength and is at risk of bridge pier scour

30%

→

Greater route resilience to emergency events.

Investment Benefit: Increase availability & access
Measure: Number of resolved significant road closures and detours

APPENDIX B –BENEFIT MAP

BENEFIT MAP

BENEFIT	INVESTMENT BENEFIT	MEASURE	DESCRIPTION	BASELINE	TARGET
Greater certainty of state highway journey **(70%)**	Increase reliability	Reliability – actual vehicles	Coefficient of variation: Standard deviation of travel time / average minutes travel time	Mean travel time 1.3 min, Standard deviation 0.23 min	Mean travel time 1.1min, Standard deviation 0.14 min
	Decrease journey time	Travel time delay	Minutes delay per km	Current delay 0.5 min per km	NIL
	Improve comfort and customer experience	Customer complaints	Number of customer complaints	Existing records show 3 per year and 7 annual plan	NIL
		Media coverage	Number of adverse media articles	Estimated to be 18 letters to editor per year, from Local Transport Agency records	NIL
Greater resilience to emergency	Increase availability and access	Resolved significant road closures and	Number of resolved significant road closures and detours	Minutes delay created over the next 100 years in a major	90% reduction

APPENDIX C – PLAN OF ALIGNMENT

Appendix C2: Plan of Alignment and Options

Option 1

Retain existing heritage bridge and seismic upgrade
- Seismic strengthening, $3.4 M
- Upgrade pedestrian / cycle handrail
- Upgrade drainage
- Upgrade footpath on southern approach
- Rough order cost: $6 M

Option 2

Retain existing heritage bridge with seismic upgrade and wide vehicle pull out system
- Create truck pull off zone both ends with ITS over dimension / wide load detection system, $0.6 M
- Retain heritage bridge
- Rough order cost: $8 M

Option 3

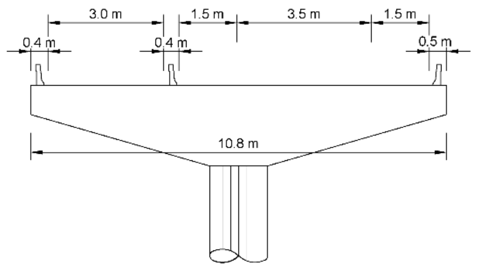
Widen existing bridge by cutting middle of deck and widening piers and deck
- Structural upgrade
- Achieve 9 m deck
- Rough order cost: $16 M

Option 4

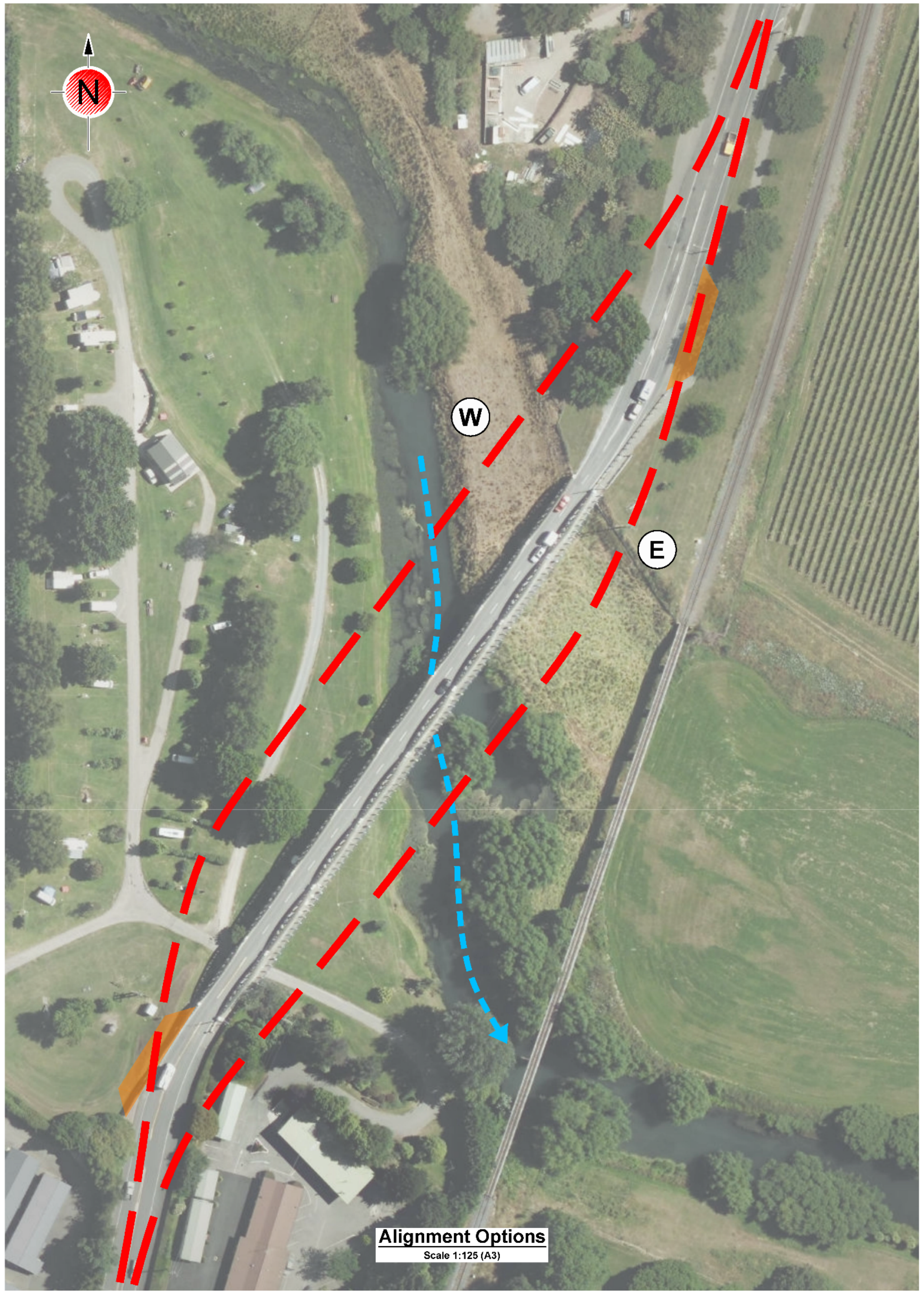
Widening bridge on western side by adding additional lane
- Structural upgrade
- Widen piers
- Add 6 m
- Rough order cost: $12 M

Option 5

Retain existing heritage bridge for southbound, new single lane bridge for northbound traffic 10.8 m wide. No structural upgrade of heritage bridge.
- New structure can operate as two lane bridge in emergencies
- Rough order cost: $16 M

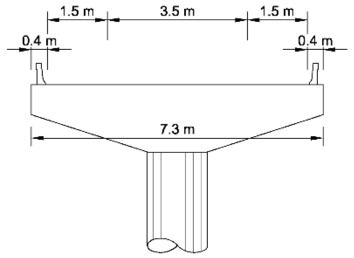


Option 5



Option 6

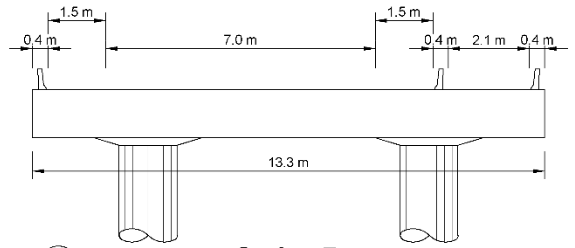
Retain existing heritage bridge for southbound traffic. New single lane bridge for northbound traffic 7.3 m wide (No footpath). Structural upgrade of heritage bridge. •
Rough order cost: $15 M



Option 6

Option 7

New 2 lane bridge 13.3 m wide •
No structural upgrade of old bridge •
Old bridge returned to MDC
- Rough order cost $19 M

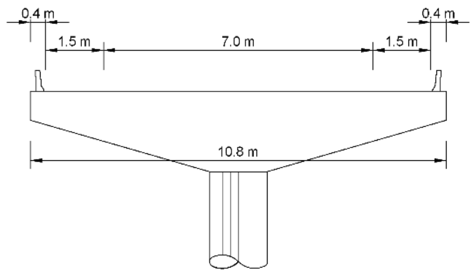


Option 7

Option 8

New 2 lane bridge 10.8 m wide, pedestrian / cycle use old heritage bridge
- No structural upgrade
- Heritage bridge returned to MDC as walk / pedestrian bridge •

Rough order cost $16 M



Option 8

Option 9

New 2 lane structure on existing alignment 13.3 m wide
- Demolish existing bridge
- Rough order cost $23 M

Option 10

Tunnel option
- Rough order cost $50 M

Option 11

By-pass option
- Rough order cost $50 M

APPENDIX D – MULTI CRITERIA ANALYSIS

Project:	**MR223 Opawa Bridge - Multi Criteria Analysis**											
		Option 1	**Option 2**	**Option 3**	**Option 4**	**Option 5**	**Option 6**	**Option 7**	**Option 8**	**Option 9**	**Option 10**	**Option 11**
Strategic Assessment Criteria	**Measurement**	**Upgrade existing bridge**	**Upgrade existing bridge and install ITS system**	**Widen & upgrade existing bridge**	**Extend & upgrade existing bridge**	**New northbound bridge (10.8m wide) with existing bridge southbound**	**New northbound bridge (7m wide) with existing bridge southbound**	**New 2-way parallel bridge (13.3m wide)**	**New 2-way parallel bridge (10.8m wide)**	**New 2-way replacement bridge (13.3m wide)**	**Tunnel**	**Blenheim by-pass**
Strategic Objectives												
Objective 1 (70%) **Increase Reliability & Decrease Journey Time** Greater certainty of State Highway Journey	Reduced coefficient of variation - standard deviation of travel time/average minutes travel time	1	4	7	7	7	7	7	7	7	7	7
	Minutes delay per kilometer	1	4	7	7	7	7	7	7	7	7	7
	Number of customer complaints (CRMS)	1	5	7	7	7	7	7	7	7	7	3
	Number of adverse media articles	1	5	7	7	7	7	7	7	7	7	3
	Reason for score	No widening of Bridge	Removes restriction for light vehicles only	Widens bridge		Duplicates bridge		Replaces bridge				Reliable journey on new SH1 bypass, no change on exisitng link (new SH6A)
Objective 2 (30%) **Increase Availability & Access.** Route resilience to natural events	Number of resolved significant road closures and detours urban >2hours (Vehicles)	7	7	7	7	7	7	7	7	7	7	3
	Reason for score	Strengthens to full seismic and flood loading		Strengthens to full seismic and flood loading		New bridge to full seismic and flood loading					New tunnel to full seismic and flood loading	Resilience on new SH1 bypass, no change on exisitng link (new SH6A)
Other Criterion												
Cost Optimisation												
Investment Cost (Range)				$14 to $16M	$10M to $12M	$13M to $16M	$13M to $15M	$15M to $19M	$13M to $16M	$19M to $23M		
Investment Cost Score				4.6	7.0	4.9	5.2	3.4	4.9	1.0		
Economic BCR (Low Medium High)				2	3	2	2	2	2	1		
	Reason for score			Medium cost solution with marginal benefits								
Operational Costs if significant (Range) - Over next 20-years				4	4	4	4	7	7	7		
	Reason for score			High maintenance costs on aging structure				Low maintenance costs				
Construction Delays (Low Medium High)				1	1	7	7	7	7	1		
	Reason for score			High construction delays		Low construction delays				High construction delays		
Life estimate of solution (short term , medium term , long term)				4	4	7	4	7	7	7		
	Reason for score			Medium term solution		Long term solution	Medium term solution	Long term solution				
	SUBTOTAL Cost Optimisation			3	4	5	4	5	6	3		
Implementation (Risk)												
Technical				1	1	7	7	7	7	7		
	Reason for score			High complexity strengthening and widening/extension design		Low complexity standard bridge design						
Operational				4	4	7	4	7	7	7		
	Reason for score			Standard bridge operation								
Stakeholders/Public/Property				4	3	4	4	5	5	1		
	Reason for score			Would involve more works in waterways than options 1 and 2, and also would involve altering a heritage bridge which may lead to some public / stakeholder opposition. May involve land being required to widen the bridge, and potentially alteration of designation? If so, may be opposed by adjacent landowners.	Would involve more works in waterways than options 1 and 2, and also would involve altering a heritage bridge (altering the visual effect on one side) which may lead to some public / stakeholder opposition. May involve land being required to widen the bridge, and potentially alteration of designation? If so, may be opposed by adjacent landowners.	Additional 25m of land required upstream and would increase noise for adjacent properties which may be opposed by landowners. Would also involve significant works within the waterway - more potential for environmental effects = more potential for public / stakeholder opposition. Retention of heritage bridge without alteration (i.e. no seismic upgrade) would lessen opposition.	Land required upstream to allow for widening and would increase noise for adjacent properties which may be opposed by landowners/occupiers. Would also involve significant works within the waterway - more potential for environmental effects = more potential for public / stakeholder opposition. Retention of heritage bridge (with some changes required for seismic upgrade) would lessen opposition.	Retention of heritage bridge without alteration (i.e. no seismic upgrade) would lessen opposition. Loss of primary function of state highway bridge could be opposed by Heritage NZ, but may be balanced by increased enjoyment of bridge as used for walking and cycling. Additional 20m strip of land required which has potential for landowner opposition.	Retention of heritage bridge without alteration (i.e. no seismic upgrade) would lessen opposition.	Likely to be strong public/Heritage NZ opposition to losing the heritage bridge as it is seen as iconic / gateway to Blenheim.		
Environmental				4	4	3	3	3	3	2		
	Reason for score			Would involve more works in waterways than options 1 and 2, and would alter noise effects as would be closer to properties, but may be neutralised by reducing stop/start noise from vehicles		More impact on waterways than options 1-4 as would involve new piles. Would increase noise for adjacent landowners, but eliminate the stop/start vehicle noise				Demolision of old bridge and installing new piles for new bridge would impact the riverbed and water, and would have noise effects throughout construction and operation		

Safety			6	6	7	6	7	7	7		
Reason for score			Wider carriageway provided								
Accessibility & Social Inclusion			7	7	7	7	7	7	7		
Reason for score			Improved accessibility for all road users								
SUBTOTAL Implementation			4	4	6	5	6	6	5		
Wider Project Impacts (Environmental Impact and Social Responsibility Screen)											
Social			5	5	5	5	5	5	5		
Reason for score			Addresses pedestrian and cyclist issues. Altered designation.								
Natural Environment			5	5	4	4	3	4	2		
Reason for score			Would involve more works in waterways than options 1 and 2		More impact on waterways during construction period than options 1-4 as would involve new piles.		More impact on waterways during construction period than options 1-4 as would involve new piles. Slightly more impact for bridge with twice the amount of piles (13.3m).	More impact on waterways during construction period than options 1-4 as would involve new piles.	Demolision of old bridge and installing new piles for new bridge would impact the riverbed (disturbance / sedimentation / erosion) and water (potential for sedimentation / pollution), and would have noise effects, mainly		
Human Health			5	5	5	5	5	5	5		
Reason for score			No sensitive education or medical facilities nearby. Would alter noise effects as would be closer to properties, but reduce stop/start noise from vehicles, particularly heavy vehicles therefore would marginally reduce traffic congestion and emissions.								
Culture and Heritage			4	3	7	6	6	6	1		
Reason for score			Alteration to heritage bridge which may be of some concern, but would retain visual impact of bridge and functional use as highway	Alteration to heritage bridge which may be of some concern, particularly as it would lose visual effect from the upstream side. Would still retain functional use as highway	Retention of heritage bridge without alteration, and still retained for state highway function	Involves heritage bridge, however work would ensure longer life, and retain functional use as a state highway and retain original visual impact of bridge.	Retention of heritage bridge without alteration (i.e. no seismic upgrade) would lessen opposition. Loss of primary function of state highway bridge could be opposed by Heritage NZ, but may be balanced by increased enjoyment of bridge as used for walking and cycling.		Likely to be strong public/Heritage NZ opposition to losing the heritage bridge as it is seen as iconic / gateway to Blenheim.		
Urban Design			5	4	5	4	3	3	2		
Reason for score			Limited visual effect as assumed existing bridge 'archs' retained; footpath improved	Visual effect of new 'clip-on'; better footpath	Visual effect of new bridge; new 3 m wide ped/cycle path shown on cross-section on upstream side of new bridge; better footpath on existing???	Visual effect of new bridge + no ped/cycle path on new bridge; assume better path on existing bridge	Visual effect of new 'wide' bridge + new 2.1 m wide ped/cycle on downstream side of new bridge; assume all of old bridge becomes a ped/cycle link??? (not sure why you would put a path on new bridge if old bridge serves this purpose???)	Visual effect of new bridge; old bridge fully available as ped/cycle facility	Visual effect of new 'wide' bridge which includes ped/cycle path; loss of visual 'amenity' of old bridge + old bridge not available as ped/cycle link		
SUBTOTAL Wider Project Impacts			5	4	5	5	4	5	3		
Overall Other Criterion Assessment											
TOTAL			12.3	12.4	16.0	14.4	15.7	16.2	11.6		
Ranking (Option to take forward)			6	5	2	4	3	1	7		

Scoring Key

1	Low Benefit / High Cost
3	
5	
7	High Benefit / Low Cost

Completed by	**Initial Compilation (June 2015):** Peter Kortegast (Opus) Transportation Engineer Donna Hills (Opus) Resource Management Planner Martin Crundwell (Opus) Civil & Structural Engineer	**MCA Workshop (5 April 2016) Participants:** 1. Brent Morgan (Opus) Team Leader 2. Frank Westergard (Opus) Deputy TL 3. Donna Hills (Opus) RMA Planner 4. Andrew Adams (NZ Transport Agency) Project Manager Design 5. Frank Porter (NZ Transport Agency) Marlborough Manager 6. Andrew James (NZ Transport Agency) Project Manager IBC/DBC 7. Erik Teekman (Opus) Transportation Planner 8. Martin Crundwell (Opus) Technical Reviewer	**Technical Review (April 2016):** Frank Westergard (Opus) Civil Engineer David McKenzie (Opus) Technical Principal Landscape Architecture Lea Osullivan (Opus) Resource Management Planner Erik Teekman (Opus) Transportation Planner Alan Dinan (Opus) Structural Engineer	