

New Zealand Transport Agency Waka Kotahi

# SPEED MONITORING ECONOMIC ASSESSMENT 2024

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CONFIDENTIAL



SPEED MONITORING  
ECONOMIC ASSESSMENT 2024

New Zealand Transport Agency Waka Kotahi

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This report ('Report') has been prepared by WSP exclusively for New Zealand Transport Agency ('Client') in relation to Establishing the Economic Impacts of a sample of speed limit changes ('Purpose') and in accordance with the email from Fabian Marsh of 25 January 2024 and the subsequent offer of service from Mason 30 January 2024. The work is undertaken in accordance with the National Safety and Environment Support Contract 18 May 2022. The findings in this Report are based on and are subject to the assumptions specified in the Offer of Service and as outlined in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.



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# ABBREVIATIONS AND GLOSSARY

MBCM	Monetised Benefits and Costs Manual
AADT	Annualised Average Daily Traffic
DSI	Death and Serious Injury
CAS	Crash Analysis System
BCR	Benefit Cost Ratio
ROI	Return on Investment (see Benefit Cost Ratio below)
F+S	Fatal and Serious crashes
PSL	Posted Speed Limit
h	hour
m	minute
s	second
SH	State Highway
RS	Reference Station
RP	Route Position
NPV	Net Present Value
Death and Serious Injury	Causality numbers from fatal and serious injury outcome crashes.
Fatal crash	Crashes with fatal injuries (where deaths is within 30 days and was as a result of the crash).
Serious crash/Serious injury crash	Crashes with serious injuries (includes broken bones, concussion, etc) where injured person is removed to and detained in hospital, but not fatal injuries.
Minor crash / Minor injury crash	Crashes with minor injuries (includes cuts, sprains, bruises, etc), but not serious or fatal injuries.
Non-Injury crash	Crashes where no injuries occur, but property damage occurs.
Injury crashes	Refers to all crashes resulting in death or injury.
Annualised Average Daily Traffic	Traffic volumes measured and adjusted to represent an average daily value throughout a year.
Reference Station	Fixed points on the highway network used in identifying linear locations.
Route Position	Running distance in kilometres or metres from a fixed point known as a Reference Station to describe a location.
Benefit Cost Ratio	Change in user costs from the project divided by the change in implementation and maintenance costs. This is the equivalent of the return on investment.
Negative BCR	A negative BCR is where there are net disbenefits to user costs.
Posted Speed Limit	The legal maximum speed for a section of road.
Mean Speed	The average speed for all users for a section of road.
Present Value	The value of costs adjusted to a set year. In this report costs were adjusted to 2022 equivalents.

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## LIMITATIONS

This report ('Report') has been prepared by WSP exclusively for New Zealand Transport Agency ('Client') in relation to Establishing the Economic Impacts of a sample of speed limit changes ('Purpose') and in accordance with the email from Fabian Marsh of 25 January 2024 and the subsequent offer of service from Mason 30 January 2024. The work is undertaken in accordance with the National Safety and Environment Support Contract 18 May 2022. The findings in this Report are based on and are subject to the assumptions specified in the Offer of Service and as outlined in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

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# EXECUTIVE SUMMARY

This report details the economic evaluation of posted speed limit reductions on eleven state highway corridors identified by the New Zealand Transport Agency Waka Kotahi (NZTA). Nine corridors had a decrease in the posted speed limit (PSL), typically 100km/h to 80km/h, and two corridors had an increase. One site was urban while the other 10 were rural. Nine of these corridors had speed limits changed within the last 5 years.

This evaluation uses a methodology developed by WSP that is based on the procedures and values outlined in NZTA's Monetised Benefits and Costs Manual (MBCM)<sup>1</sup> and Treasury economic assessments using the CBAX Tool<sup>2</sup>. NZTA provided WSP with before and after mean speeds sourced from TomTom and death and serious injury (DSI) outcomes for most corridors (and/or sub-section of corridor), along with the cost of implementation for speed limit changes on corridors.

In terms of key findings for changes in mean speeds, crash, and risk outcomes:

- In most cases where the posted speed limit was lowered, there was a reduction in mean speeds of between 5% and 9%.
- The actual DSI change from the speed limit changes was greater than the predicted DSI change.
- For corridors where there was a reduction in posted speed limit, there was a saving of almost 27 DSIs/year (between 0.7 and 9.0 DSI/year/corridor). For corridors where there was an increase in the posted speed limit, there was an additional 1.3 DSIs/year (between 0.5 and 0.8 DSI/year/corridor).
- There are very small increases in journey time per vehicle for corridors which have a reduced posted speed limit. Overall travel time increases between 12s to 4m 04s (2.3 to 5.5 s/km time lost) for these corridors. Where posted speed limits have increased, there were travel time savings of between 24s and 1m 3s (between 1.7 and 2.8 s/km time saved).

An economic assessment of the speed limit changes using both MBCM BCR assessment and Treasury ROI approach methods along with various sensitivity tests was undertaken on each of the corridors. The MBCM considered travel time, vehicle operating costs, vehicle emissions costs, and crash costs. Results reporting the 10-year BCR (or equivalent) for each are summarised in table below. These results show:

- The crash cost savings generally outweigh the travel time disbenefits by a factor of 2 to 10 (or more) where there has been a reduction in the posted speed limit. Where there has been an increase in the posted speed, the travel time savings have not always been sufficient to outweigh the increase crash costs.
- All corridors that had a reduction in the posted speed limit showed a positive BCR (using the MBCM). The 10-year BCRs ranged from 101 for Carterton to Featherston to 597 for the SH 51 Marine Parade Corridor.
- Corridors on the Waikato Expressway which had an increase in the posted speed limit, show inconsistent BCRs. On these corridors, the analysis showed that there are increases to

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<sup>1</sup> <https://www.nzta.govt.nz/resources/monetised-benefits-and-costs-manual>

<sup>2</sup> <https://www.treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/investment-planning/treasury-cbax-tool>

vehicle operating costs and vehicle emissions costs of around 45-50% of the travel time costs gained due to the increased in operating speeds.

- Sensitivity tests for the project show that if either crash benefits were reduced or costs for the project increased there would still be a positive BCR for most projects.

Consideration of the costs and benefits of speed limit changes help assess a range of impacts including fuel efficiency, vehicle operating costs and emissions alongside travel times and safety. With the increase in speeds, travel time is reduced. In a lot of cases however, this reduction in time is generally not substantial due to issues such as congestion and the presence of intersections which interrupt the flow of traffic. In addition, affecting some of the positive travel time benefits gained there are, costs for fuel consumption, pollutants, and increases in road crashes which are taken into consideration. The MBCM methodology adopts a recognised best-practice approach that incorporates these multiple factors that are fundamental to sustainable mobility. Whereas the Treasury methodology approach has limited default values to be applied which are limited to safety and travel time impacts. This difference results in lower BCR values using the Treasury method compared to the MCBM. However overall, these BCR results are still positive.

Table of a Summary of BCR (10-yr) between evaluation approaches and tests

#	Corridor Name	PSL Before PSL After	Net Benefit (1 year) – Present Cost	MBCM BCR	Treasury ROI	Sensitivity Tests Ranges (BCR)
1	SH6 Blenheim to Nelson	100* 90*	\$18.6M	117	73.0	16 - 112
2	SH51 Marine Parade to Waipatu	100 80	\$13.1M	597	321.9	186 – 587
3	SH5 and SH30 Rotorua	80* 50	\$0.5M	406	Negative	Negative - 905
4	SH3 Napier Road	100 80	\$1.9M	223	381.3	56 - 216
5	SH1 Waikato Expressway - Cambridge	100 110	\$2.0M	126	209.8	63 - 330
6	SH1 Waikato Expressway - Taupiri	100 110	\$-4.5M	Negative	3.3	Negative – 3.4
7	SH11 Puketona to Pahia	100 80	\$4.3M	213	96.5	61 - 201
8	SH22 Drury to Paerata	100* 80*	\$6.8M	414	Negative	15 - 399
9	SH5 Rangitaiki to Esk Valley	100 80	\$16.9M	254	18.4	Negative- 244
10	SH2 Carterton to Featherston (Rural)	100 80	\$1.9M	101	101.3	Negative - 67
11	SH2 Pōkeno to Mangatarata	100 90	\$24.0M	558	252.2	279 - 558



*\* Various speeds on subsections.*

In summary, for most of the corridors, a reduction in posted speed and mean speeds shows that the crash costs savings far outweighed the travel time disbenefits, resulting in positive BCR's. For most of the corridors with a speed limit reduction, vehicle operating costs and emissions costs made up 2% to 8% of the net benefits. For the corridors that had an increase in the posted speed limit, it is not currently clear if benefits resulting from the increases in mean speeds outweigh the increase in crash, vehicle operating, and emissions costs.

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# 1 INTRODUCTION

## 1.1 PURPOSE

The purpose of this document is to report and discuss the results of an economic evaluation carried out on a number of state highway corridors where the posted speed limit has been changed.

This report provides an overview of which corridors are considered, what measurable changes occurred on those corridors before and after the speed limit change, the economic impact of those changes, and a discussion of the outcomes.

Within the Appendices, the assessment methodology is detailed, together with a discussion on technical considerations, and additional tables of outcomes.

## 1.2 SCOPE

Nine corridors had a decrease in the posted speed limit (typically 100km/h to 80km/h), and two corridors had an increase. One site was urban while the other 10 were rural. Nine of these corridors had posted speed limits changed within the last 5 years. The corridors project descriptions and extent references are shown in Table 1 and an overview of the methodology for this work is provided in section 1.3.

Table 1 – Corridor Projects

#	Corridor Name	PSL Before PSL After	Project Overview	Project Extents (SH/RS/RP)
1	SH6 Blenheim to Nelson	100* 90*	<a href="https://www.nzta.govt.nz/projects/sh6-blenheim-to-nelson-speed-limits/">https://www.nzta.govt.nz/projects/sh6-blenheim-to-nelson-speed-limits/</a>	006/0000/7.77 to 006/0099/12.63
2	SH51 Marine Parade to Waipatu	100 80	<a href="https://www.nzta.govt.nz/projects/sh51-permanent-speed-limits/">https://www.nzta.govt.nz/projects/sh51-permanent-speed-limits/</a>	051/0002/2.85 to 051/0002/9.50
3	SH5 and SH30 Rotorua	80* 50	<a href="https://nzta.govt.nz/projects/sh5-sh30-rotorua-new-permanent-speed-limits/">https://nzta.govt.nz/projects/sh5-sh30-rotorua-new-permanent-speed-limits/</a>	005/0050/3.11 to 005/0056/1.27 & 030/0131/11.97 to 030/0147/1.07
4	SH3 Napier Road	100 80	<a href="https://www.nzta.govt.nz/projects/sh3-napier-road-speed-review-and-infrastructure-improvements/speed-review/">https://www.nzta.govt.nz/projects/sh3-napier-road-speed-review-and-infrastructure-improvements/speed-review/</a>	003/0474/1.07 to 003/0474/3.08
5	SH1 Waikato Expressway - Cambridge	100 110	The Cambridge section of the Waikato Expressway opened in December 2015. The Cambridge section of the Waikato Expressway speed limit increased to 110km/h on 11 December 2017.	01N/0546/11.2 to 01N/0574/2.3
6	SH1 Waikato Expressway - Taupiri	100 110	Speed limits changed 13 July 2022. Huntly section of the Waikato Expressway opened on 9th March 2020.	01N/0513/1.0 to 01N/0513/15.3

#	Corridor Name	PSL Before PSL After	Project Overview	Project Extents (SH/RS/RP)
7	SH11 Puketona to Paihia	100 80	<a href="https://nzta.govt.nz/projects/sh11-puketona-to-paihia-permanent-speed-limits/">https://nzta.govt.nz/projects/sh11-puketona-to-paihia-permanent-speed-limits/</a>	011/0014/3.60 to 011/0014/15.41
8	SH22 Drury to Paerata	100* 80*	<a href="https://nzta.govt.nz/projects/sh22-drury-to-paerata-permanent-speed-limits/">https://nzta.govt.nz/projects/sh22-drury-to-paerata-permanent-speed-limits/</a>	022/0000/0.0 to 022/0000/12.87
9	SH5 Rangitaiki to Esk Valley	100 80	<a href="https://www.nzta.govt.nz/projects/sh5-permanent-speed-limits/">https://www.nzta.govt.nz/projects/sh5-permanent-speed-limits/</a>	005/0169/8.73 to 005/0249/7.03
10	SH2 Carterton to Featherston (Rural)	100 80	<a href="https://www.nzta.govt.nz/projects/sh2-wairarapa-highway-improvements/speed-review/">https://www.nzta.govt.nz/projects/sh2-wairarapa-highway-improvements/speed-review/</a>	002/0883/14.57 to 002/0905/14.57
11	SH2 Pōkeno to Mangatarata	100 90	<a href="https://www.nzta.govt.nz/media-releases/safety-improvements-being-investigated-on-sh2-between-pokeno-to-mangatarata/">https://www.nzta.govt.nz/media-releases/safety-improvements-being-investigated-on-sh2-between-pokeno-to-mangatarata/</a>	002/0000/0.0 to 002/0032/0.90

\* Various speeds on subsections.

## 1.3 METHODOLOGY OVERVIEW

This evaluation uses a methodology developed by WSP that is based on the procedures and values outlined in NZTA's Monetised Benefits and Costs Manual (MBCM)<sup>3</sup> and economic assessments using the CBAX Tool<sup>4</sup>.

Consideration of the costs and benefits of speed limit changes ideally assesses a range of impacts including fuel efficiency, vehicle operating costs and emissions alongside travel times and safety. With the increase in speeds, travel time is reduced (although generally not as much as many think due to issues such as congestion, presence of intersections, and so forth), but at the same time, costs for fuel consumption, pollutants, and road crashes increase. The MBCM methodology adopts a recognised best-practice approach that incorporates these multiple factors that are fundamental to sustainable mobility. Whereas the Treasury methodology approach has limited default values within the tool to be applied that just considers crashes and travel time.

### 1.3.1 DATA INPUTS

In preparing the data for analysis, NZTA provided WSP with corridor before and after mean speeds, and death and serious injury (DSI) outcomes on each corridor (and/or sub-section of corridor), along with the cost of implementation for speed limit changes on corridors (Table 2). The mean speed data has been sourced from TomTom and is considered a representative sample of traffic speeds. Crash data has been sourced from NZTA's Crash Analysis System (CAS). Other sources of data are outlined in Appendix A, the Economic Analysis Methodology.

<sup>3</sup> <https://www.nzta.govt.nz/resources/monetised-benefits-and-costs-manual>

<sup>4</sup> <https://www.treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/investment-planning/treasury-cbax-tool>

Table 2 - Project implementation costs, speed change, and speed change date

#	Corridor Name	Implementation Cost (& year)	PSL Before	Change Date	PSL After
1	SH6 Blenheim to Nelson	\$1,200,000 (2020)	100*	18/12/2020	90*
2	SH51 Marine Parade to Waipatu	\$163,140 (2021)	100	29/10/2021	80
3	SH5 and SH30 Rotorua	\$11,000 (2022)	80*	3/10/2022	50
4	SH3 Napier Road	\$74,817 (2022)	100	23/06/2022	80
5	SH1 Waikato Expressway - Cambridge	Estimated* \$126,900 (2021)	100	11/12/2017	110
6	SH1 Waikato Expressway - Taupiri	\$2,450,000* (2022)	100	13/07/2022	110
7	SH11 Puketona to Paihia	\$145,789 (2020)	100	24/08/2020	80
8	SH22 Drury to Paerata	\$117,713 (2020)	100	30/06/2020	80
9	SH5 Rangitaiki to Esk Valley	\$568,377 (2022)	100	18/02/2022	80
10	SH2 Carterton to Featherston (Rural)	\$172,000 (2023)	100	27/01/2023	80
11	SH2 Pōkeno to Mangatarata	Estimated* \$319,500 (2021)	100	15/12/2011	90

\* Various speeds on subsections.

^ Cost estimated, see Appendix A for methodology.

# Only part of the Waikato Expressway 110 km/h project extent was included, costs reported directly relate to the speed limit change.

### 1.3.2 OVERVIEW OF THE EVALUATION

The data described in section 1.3.1 was used to calculate the net annual benefits. Net benefits are the change in all calculated user costs from before and after the speed limit change. A net positive benefit is a decrease in the total user costs. Net benefits have been reported by user cost type (travel time, vehicle operating costs, vehicle emissions costs, and crash costs). Refer to Section 3 for Economic Impacts and Appendix A Economic Analysis Methodology for a more detail discussion of the approach used.

The Treasury assessment methodology applied has only considered travel time costs and fatal and serious crash costs. The CA

Net benefits were divided by the implementation costs to identify a benefit cost ratio (BCR). The BCR represents the return on investment based on expenditure.

Where user costs have increased as a result of a change in the speed limit, this is a disbenefit to the country as a whole, a BCR value no longer makes sense and so have been reported as "negative". 1-year Benefit Cost Ratio (BCR), and 10-year BCR have been calculated for each corridor for the change in posted speed limit.

## 2 SPEED AND CRASH CHANGES

This section outlines the changes to the corridors which have had a significant impact on the economic evaluation. The discussion includes considerations around changes to the mean speeds, changes to crash numbers and the severity of the crashes occurring on each corridor. It also describes changes to the road risk profile based on the changes to the crash numbers.

### 2.1 MEAN SPEED CHANGES

In calculating the BCR, mean speed data is essential. Table 3 shows the changes in mean speeds resulting from the change in posted speed limit on each corridor. Also included are the predicted changes in mean speeds. These predicted mean speeds were based on relationship between mean speeds and posted speed limit using NZTA's High Risk Rural Roads Guide. The actual mean speeds were based on 1-year of TomTom data before and after the speed limit change. A number of assumptions have been made in the consideration of mean speeds. These are described further in Appendix B.

Where posted speed limits were lowered, *IN MOST CASES, THERE WAS A REDUCTION IN MEAN SPEEDS OF BETWEEN 5% AND 9%.*

Although the SH5 and SH30 corridor in Rotorua had a larger reduction in posted speed limit (80km/h to 50km/h) it had a smaller percentage speed limit change. This is likely due to the fact that despite the posted speed limit, the mean operating speeds were already constrained by road characteristics such as signalised intersections, roundabouts, and congestion.

On the Waikato Expressway corridors, there was a greater than anticipated increase in mean speed. With at least two lanes provided in each direction (four-lane road), faster vehicles are able to pass slower vehicles resulting in a higher mean speed than on a two-lane road.

The largest drop in mean speeds was on SH2 Carterton to Featherston corridor showing a 11.8% reduction, which could be due to the shortening of existing passing lanes and conversion to Slow Vehicle Bays.

Table 3 - Speed Limit, Mean Speed, and predicted and actual changes

#	Corridor Name	PSL Before	PSL After	Actual Mean Speed After <sup>#</sup>	Actual Mean Speed Before <sup>#</sup>	Predicted Mean Speed Change	Actual Mean Speed Change
1	SH6 Blenheim to Nelson	100*	90*	76.1	80.5	-4 to -8%	-5.5%
2	SH51 Marine Parade to Waipatu	100	80	77	82.8	-8%	-7.0%
3	SH5 and SH30 Rotorua	80*	50	41.7	43.3	-4 to -8%	-3.7%
4	SH3 Napier Road	100	80	73.8	80	-8%	-7.8%
5	SH1 Waikato Expressway - Cambridge	100	110	101.0	93.5	+2%	+7.9%

#	Corridor Name	PSL Before	PSL After	Actual Mean Speed After <sup>#</sup>	Actual Mean Speed Before <sup>#</sup>	Predicted Mean Speed Change	Actual Mean Speed Change
6	SH1 Waikato Expressway - Taupiri	100	110	105.9	100.9	+2%	+4.9%
7	SH11 Puketona to Paihia	100	80	69.9	75.4	-8%	-7.3%
8	SH22 Drury to Paerata	100*	80*	66.5	72.2	-8%	-7.8%
9	SH5 Rangitaiki to Esk Valley	100	80	79.6	83.8	-8%	-5.0%
10	SH2 Carterton to Featherston (Rural)	100	80	78.0	88.4	-8%	-11.8%
11	SH2 Pōkeno to Mangatarata	100	90	86.9	95.6	-4%	-9.0%

\* Various speeds on subsections

<sup>#</sup> Length weighted mean speed when separate speeds for subsections available.

A wider discussion of the assumptions and considerations employed when establishing the mean speed changes is given in Appendix B.

## 2.2 DEATH AND SERIOUS INJURY AND RISK CHANGES

### 2.2.1 DSI OUTCOMES

The DSIs (both actual and predicted) associated with the above posted and mean speed limit changes are shown in Table 4. No control sites have been included to within this analysis.

The predicted DSI outcomes have been calculated based on the change in mean speeds. When comparing the predicted and actual changes in DSIs per year, corridors with a reduced speed limit have **ACTUAL DSI REDUCTIONS THAT ARE MUCH GREATER THAN PREDICTED REDUCTIONS.**

Where reductions in DSI were noted, these were between 21% to 100%. However, those corridors that have a 100% reduction in DSIs have a limited time-period after the speed limit change and hence this may not be very statistically robust and could change over time. In addition, The Waikato Expressway corridors had increases in DSIs with an increase in the posted speed limit, noting these corridors have a limited before change crash period and numbers to analyse.

The Cambridge section of the Waikato Expressway had an increase in DSIs. There has been a similar increase in all injury crashes per year (see Table 5 below) as well as fatal and serious injury crashes. There were limited crashes on the Taupiri Section of the Waikato Expressway and therefore changes in DSI and injury crashes are less reliable.

Table 4 - Death and Serious injury outcome changes.

#	Corridor Name	Before DSI/year	After DSI/year	After months*	Predicted DSI change <sup>5</sup>	Actual Change
1	SH6 Blenheim to Nelson	11.0	2.0	36	-22%	-82%
2	SH51 Marine Parade to Waipatu	3.0	0.0	25	-31%	-100%
3	SH5 and SH30 Rotorua	1.6	0.9	12	-6%	-34%
4	SH3 Napier Road	1.2	0.0	17	-35%	-100%
5	SH1 Waikato Expressway - Cambridge	0.5	1.0	60	+52%	+133%
6	SH1 Waikato Expressway - Taupiri	0.0	0.8	16	+42%	+0.8 DSI/year*
7	SH11 Puketona to Paihia	2.4	0.6	39	-27%	-74%
8	SH22 Drury to Paerata	4.8	3.8	41	-26%	-21%
9	SH5 Rangitaiki to Esk Valley	10.4	6.3	21	-22%	-40%
10	SH2 Carterton to Featherston (Rural)	1.2	0.0	11	-48%	-100%
11	SH2 Pōkeno to Mangatarata	9.8	5.2	60	-45%	-47%

\*Presented as absolute change as no crashes in the before period.

Table 5 - Crash Outcome rate changes (per kilometre per year)

#	Corridor Name	Before (/km/year)			After (/km/year)			Change (%)		
		DSI	F+S	Injury	DSI	F+S	Injury	DSI	F+S	Injury
1	SH6 Blenheim to Nelson	0.113	0.079	0.28	0.020	0.013	0.18	-82%	-83%	-35%
2	SH51 Marine Parade to Waipatu	0.586	0.320	0.91	0.000	0.000	0.58	-100%	-100%	-36%
3	SH 5 and 30 Rotorua	0.352	0.302	1.81	0.232	0.232	1.39	-34%	-23%	-26%
4	SH3 Napier Road	0.471	0.294	0.71	0.000	0.000	1.04	-100%	-100%	+47%

<sup>5</sup> Using GRSF tools

#	Corridor Name	Before (/km/year)			After (/km/year)			Change (%)		
		DSI	F+S	Injury	DSI	F+S	Injury	DSI	F+S	Injury
5	SH1 Waikato Expressway - Cambridge	0.022	0.022	0.18	0.052	0.037	0.20	+133%	+67%	+10%
6	SH1 Waikato Expressway - Taupiri	0.000	0.000	0.03	0.262	0.052	0.42	+0.26 DSI/year*	+0.05 F+S/year*	+1200%
7	SH11 Puketona to Paihia	0.195	0.163	0.44	0.050	0.050	0.33	-74%	-69%	-26%
8	SH22 Drury to Paerata	0.369	0.338	1.25	0.293	0.158	0.99	-21%	-53%	-21%
9	SH5 Rangitaiki to Esk Valley	0.135	0.081	0.28	0.082	0.067	0.19	-40%	-17%	-34%
10	SH2 Carterton to Featherston (Rural)	0.085	0.085	0.18	0.000	0.000	0.00	-100%	-100%	-100%
11	SH2 Pōkeno to Mangatarata	0.370	0.226	0.61	0.196	0.136	0.37	-47%	-40%	-40%

\*Presented as absolute change as no crashes in the before period.

A wider discussion of the assumptions and considerations employed in the calculation of the crash changes is given in Appendix B.

## 2.2.2 CHANGES IN CRASH RISK PROFILES

Collective and personal risk profiles have been developed for the before and after speed and crash changes using NZTA's High Risk Rural Roads Guide<sup>6</sup>. Collective risk is based on fatal and serious crashes per year per kilometre. Although DSIs have reduced substantially, there is a much smaller reduction in all injury crashes (Fatal, Serious, and Minor combined) than there is for just fatal and serious injury crashes across most corridors. This is for two reasons; there are less crashes occurring as fewer drivers make mistakes and road users have more time to react when a mistake occurs at lower speeds, and crashes which still occur are less severe outcomes because of reduced kinetic energy absorbed by people.

Risk bands contain approximately 20% of rural State Highways when the guide was developed in 2011.

Using the change in Fatal and Serious injury resulting from the speed limit changes, Table 6 shows the before and after risk metrics and risk bands of each corridor.

All except the two Waikato Expressway corridors show a reduction in collective risk. However, in some cases although collective risk was substantially reduced, the corridors remained within the High or Medium-High risk bands e.g. SH22 Drury to Paerata and SH2 Pōkeno to Mangatarata. The Waikato Expressway corridors rose from Low or Low-Medium Risk to Medium Risk.

<sup>6</sup> <https://www.nzta.govt.nz/assets/Uploads/High-risk-rural-roads-guide-September-2011.pdf>

Table 6 – Collective Risk Change (High Risk Rural Roads Guide)

#	Corridor Name	Before F+S / km / yr	Before Collective Risk	After F+S / km / yr	After Collective Risk	Actual Change
1	SH6 Blenheim to Nelson	0.081	Medium-High	0.013	Low/Low-Medium	-84%
2	SH51 Marine Parade to Waipatu	0.320	High	0.000	Low	-100%
3	SH5 and SH30 Rotorua	0.251	Urban*	0.232	Urban*	-8%
4	SH3 Napier Road	0.294	High	0.000	Low	-100%
5	SH1 Waikato Expressway - Cambridge	0.031	Low-Medium	0.052	Medium	+67%
6	SH1 Waikato Expressway - Taupiri	0.000	Low	0.050	Medium	N/A
7	SH11 Puketona to Paihia	0.163	High	0.050	Medium	-69%
8	SH22 Drury to Paerata	0.338	High	0.158	High	-53%
9	SH5 Rangitaiki to Esk Valley	0.081	Medium-High	0.067	Medium	-17%
10	SH2 Carterton to Featherston (Rural)	0.085	Medium-High	0.000	Low	-100%
11	SH2 Pōkeno to Mangatarata	0.226	High	0.136	High	-40%

\*High Risk Rural Roads Guide collective risk is not applicable to urban corridors..

In summary, most corridors which had a reduction in fatal and serious injury crashes had a smaller reduction in all injury crashes. The reduction in all injury crashes is largely driven by changes in fatal and serious crashes with a few exceptions. SH5 and SH30 within Rotorua have a much larger reduction in minor injury crashes than fatal and serious injury crashes. SH3 Napier Road (see note below) has had an increase in minor injury crashes, and SH5 Rangitaiki to Esk Valley had a larger reduction in minor injury crashes than fatal and serious injury crashes.

The two Waikato Expressway corridors show an increase in injury crashes with increased speed however they have inconsistent outcomes with a much larger increase in fatal and serious injury crashes at Cambridge, and a much larger increase in minor injury crashes at Taupiri.

## 2.3 OVERVIEW OF SPEEDS, JOURNEY TIMES, TRAFFIC VOLUMES, AND DSI OUTCOMES

Speeds and DSI outcomes have been discussed in the commentary above. Travel time (journey) changes have been calculated using travel time information provided by NZTA. Table 7 provides a summary of the key findings for each of the corridors. This shows that:

- There is a mean speed reduction (on most corridors) of between 4 and 9 km/h.

- DSIs saved per year of between 0.1 to 9.0 DSI with the exception of the Waikato Expressway corridors, which show an increase of between 0.5 to 0.8 DSI per year.
- Journey time changes per vehicle for each of the corridors result in very small increases of time between 12s to 4m 04s. The latter being the SH6 Blenheim to Nelson corridor, which has 100km of route length with speed limit changes.

All of this information has been used to undertake the economic analysis of each corridor which is detailed further in section 3.

Table 7 -Speed, Journey Times, Traffic Volumes and DSIs Outcomes Table

#	Corridor Name	Length (km)	Before Change Mean Speed	After Change Mean Speed	Journey time change	Traffic Volume & Percent Heavy Vehicle	Before Change Fatal & Serious / year	After Change Fatal & Serious / year	DSI Change / year
1	SH6 Blenheim to Nelson	101	80.5	76.1	+4m 04s (+2.4s/km)	3,764 19%	8.2	1.3	-9.0
2	SH51 Marine Parade to Waipatu	7.51	82.8	77	+24s (+3.2s/km)	12,801 3%	2.4	0.0	-3.0
3	SH5 and SH30 Rotorua	3.98	43.3	41.7	+12s (+3s/km)	14,835 11%	1.0	0.9	-0.1
4	SH3 Napier Road	3.40	80	73.8	+13s (+3.8s/km)	11,138 5%	1.0	0.0	-1.2
5	SH1 Waikato Expressway - Cambridge	22.3	93.5	101.0	-1m 03s (-2.8s/km)	23,140 11%	0.5	0.8	+0.5
6	SH1 Waikato Expressway - Taupiri	14.3	100.9	105.9	-24s (-1.7s/km)	23,475 13%	0.0	0.8	+0.8
7	SH11 Puketona to Paihia	12.3	75.4	69.9	+47s (+3.8s/km)	5,003 4%	2.0	0.6	-1.8
8	SH22 Drury to Paerata	13.0	72.2	66.5	+58s (+4.5s/km)	18,634 6%	4.4	2.0	-1.0
9	SH5 Rangitaiki to Esk Valley	77.0	83.8	79.6	+2m 55s (+2.3s/km)	4,397 18%	6.2	5.1	-4.1
10	SH2 Carterton to Featherston (Rural)	14.1	88.4	78.0	+1m 17s (+5.5s/km)	8,922 6%	1.2	0.0	-1.2
11	SH2 Pōkeno to Mangatarata	26.5	95.6	86.9	+1m 40s (+3.8s/km)	11,715 11%	6.0	3.6	-4.1

### 3 ECONOMIC IMPACTS

Table 8 has a summary of the MBCM assessment completed, along with a Treasury Approach, and various sensitivity test results reporting the 10-year BCR (or equivalent) for each.

Sensitivity tests have been carried out with modifications to the MBCM assessment, a summary of the various sensitivity tests are described below.

- Sensitivity Test 1: Only travel time and crash change benefits counted.
- Sensitivity Test 2: Predicted change in crashes used to calculate crash change benefits (rather than actual crash changes observed)
- Sensitivity Test 3: One additional fatal crash added to the after change in posted speed limit included in the assessment of crash change benefits (on corridors with less than 5 years of crash history after the change in posted speed limit).
- Sensitivity Test 4: Implementation Costs doubled.

Table 8 – Summary of BCR (10-yr) between approaches and a BCR range.

#	Corridor Name	MBCM	Treasury Approach*	Sensitivity Test 1	Sensitivity Test 2	Sensitivity Test 3	Sensitivity Test 4
1	SH6 Blenheim to Nelson	117	73.0	112	16	112	58
2	SH51 Marine Parade to Waipatu	597	321.9	587	186	550	298
3	SH5 and SH30 Rotorua	406	Negative	905	Negative	Negative	203
4	SH3 Napier Road	223	381.3	216	99	56	111
5	SH1 Waikato Expressway - Cambridge	126	209.8	330	146	126	63
6	SH1 Waikato Expressway - Taupiri	Negative	3.3	Negative	3.4	Negative	Negative
7	SH11 Puketona to Paihia	213	96.5	201	61	181	107
8	SH22 Drury to Paerata	414	Negative	399	15	398	207
9	SH5 Rangitaiki to Esk Valley	254	18.4	244	69	Negative	127
10	SH2 Carterton to Featherston (Rural)	101	101.3	67	Negative	Negative	50
11	SH2 Pōkeno to Mangatarata	558	252.2	511	393	558	279

\*Treasury Approach, Return on Investment reported and not Benefit Cost Ratio due to different definitions.

### 3.1 MBCM DETAILED ASSESSMENT RESULTS

Table 9 to Table 11 in sections 3.2, 3.3, and 3.4 provide the economic results and sensitivity tests of all eleven corridors and sub sections. The methodology for approach including costs is detailed further in the Appendix A.

Costs and benefits for travel time, vehicle operating, air pollution, greenhouse gases, crashes have been summarised along with a 1-year and 10-year benefit cost ratio (BCR).

In summary:

- All corridor corridors with a reduction in the posted speed limit showed a positive BCR. The 1-year BCRs ranged from 12 for Carterton to Featherston to 72 for the SH 51 Marine Parade Corridor.
- Corridors on the Waikato Expressway which have had an increase in the posted speed limit. They show positive travel time benefits, and negative crash, vehicle operating cost, and emissions benefits. Net benefits from these sections were inconsistent.
- The Waikato Expressway corridor at Taupiri showed a negative BCR. This is due largely to the lower travel time benefits achieved because this corridor had a very high mean speed before to the speed limit change.
- Although positive overall, some sub sections on routes such as SH6 Blenheim to Nelson show a negative BCR. These negative subsections tend to be around urban areas. This is due to urban air pollution costs and low crash numbers due to a short length.
- Sensitivity tests for the project show that if either crash benefits were reduced or costs for the project increased there would still be a positive BCR for most projects. For SH5 Rangitaiki to Esk Valley, and SH5 and SH30 Rotorua, one additional fatal crash after speed limit change would reduce the BCR to Negative.

## 3.2 OVERALL

Table 9 - Economic Assessment Results (Rounded \$000)

#	Corridor Name	Net annual Benefit					Total Annual Benefit	Present Value Cost	BCR (1 yr)	BCR (10 yr)
		Travel Time	Vehicle Operating	Air Pollution	Greenhouse Gas	Crash				
1	SH6 Blenheim to Nelson	-\$5,784,000	\$893,000	-\$114,000	\$6,000	\$24,984,000	\$19,986,000	\$1,416,000	14	117
2	SH51 Marine Parade to Waipatu	-\$1,257,000	\$201,000	\$9,000	\$5,000	\$14,346,000	\$13,302,000	\$184,000	72	597
3	SH5 and SH30 Rotorua	-\$1,211,000	\$0	-\$653,000	-\$10,000	\$2,414,000	\$539,000	\$11,000	49	406
4	SH3 Napier Road	-\$572,000	\$59,000	\$1,000	\$1,000	\$2,523,000	\$2,012,000	\$75,000	27	223
5	SH1 Waikato Expressway - Cambridge	\$7,413,000	-\$3,232,000	-\$196,000	-\$109,000	-\$1,685,000	\$2,192,000	\$143,000*	15	126
6	SH1 Waikato Expressway - Taupiri	\$2,863,000	-\$1,227,000	-\$254,000	-\$199,000	-\$3,256,000	-\$2,072,000	\$2,450,000	Negative	Negative
7	SH11 Puketona to Paihia	-\$1,173,000	\$122,000	\$52,000	\$80,000	\$5,352,000	\$4,434,000	\$172,000	26	213
8	SH22 Drury to Paerata	-\$5,377,000	\$336,000	-\$36,000	-\$41,000	\$12,076,000	\$6,958,000	\$139,000	50	414
9	SH5 Rangitaiki to Esk Valley	-\$3,896,000	\$707,000	-\$42,000	\$10,000	\$20,691,000	\$17,470,000	\$568,000	31	254
10	SH2 Carterton to Featherston (Rural)	-\$3,468,000	\$657,000	\$22,000	\$15,000	\$4,865,000	\$2,091,000	\$172,000	12	101
11	SH2 Pōkeno to Mangatarata	-\$6,065,000	\$1,728,000	\$177,000	\$145,000	\$28,370,000	\$24,355,000	\$361,000*	67	558

\*Estimated Costs

### 3.3 SUBSECTIONS

Several corridors included subsections with different speed limit changes and the supplied travel time data. Four routes had subsections considered, SH6 Blenheim to Nelson, SH11 Puketona to Paihia, SH22 Drury to Paerata, and SH2 Pōkeno to Mangatarata. Subsection names are indicative of the area of the sub-section.

Table 10– SH6 Blenheim to Nelson subsection results (Rounded \$000)

#	Subsection	Subsection Name	Net annual Benefit					Total Annual Benefit	Present Value Cost (Proportion)	BCR (1 yr)	BCR (10 yr)
			Travel Time	Vehicle Operating	Air Pollution	Greenhouse Gas	Crash				
1	A	Blenheim to Woodburn	-\$774,000	\$98,000	\$2,000	\$2,000	\$3,608,000	\$2,935,000	\$90,000	32	269
1	B	Renwick to Havelock	-\$1,696,000	\$285,000	\$2,000	\$8,000	\$5,114,000	\$3,712,000	\$174,000	21	176
1	C	South Havelock	-\$86,000	\$1,000	-\$114,000	-\$3,000	\$38,000	-\$162,000	\$77,000	Negative	Negative
1	D	Havelock to Canvastown	-\$199,000	\$67,000	\$19,000	\$20,000	\$1,164,000	\$1,072,000	\$107,000	10	83
1	E	Canvastown	-\$23,000	\$7,000	\$26,000	\$1,000	\$98,000	\$109,000	\$75,000	1.5	12
1	F	Canvastown to Pelorus Bridge	-\$243,000	\$52,000	\$1,000	\$1,000	\$367,000	\$179,000	\$108,000	1.7	14
1	G	Pelorus Bridge	-\$1,000	\$0	\$0	\$0	-\$32,000	-\$33,000	\$77,000	Negative	Negative
1	H	Pelorus Bridge to Rai Valley	-\$78,000	\$41,000	-\$1,000	-\$0	\$683,000	\$645,000	\$101,000	6.4	53
1	I	Rai Valley to Whangamoā Saddle	-\$421,000	\$131,000	-\$27,000	-\$21,000	\$9,724,000	\$9,387,000	\$149,000	63	521
1	J	Whangamoā Saddle to Hira	-\$84,000	\$0	\$0	\$0	\$3,288,000	\$3,204,000	\$109,000	29	244
1	K	Hira	-\$24,000	\$4,000	-\$14,000	-\$0	-\$134,000	-\$169,000	\$75,000	Negative	Negative
1	L	Hira to Atawhai	-\$410,000	\$49,000	-\$3,000	\$0	\$775,000	\$412,000	\$101,000	4.1	34
1	M	Atawhai	-\$607,000	\$49,000	-\$4,000	-\$2,000	\$690,000	\$126,000	\$81,000	1.6	13
1	N	Atawhai to Nelson	-\$1,138,000	\$109,000	-\$2,000	-\$0	-\$399,000	-\$1,431,000	\$92,000	Negative	Negative
1		SH6 Blenheim to Nelson	-\$5,784,000	\$893,000	-\$114,000	\$6,000	\$24,984,000	\$19,986,000	\$1,416,000	14	117
7	A	Puketona (SH10) to Haruru	-\$841,000	\$89,000	\$2,000	\$1,000	\$3,165,000	\$2,414,000	\$68,000	36	295
7	B	Haruru	-\$244,000	\$15,000	\$4,000	\$6,000	-\$134,000	-\$353,000	\$51,000	Negative	Negative

#	Subsection	Subsection Name	Net annual Benefit					Total Annual Benefit	Present Value Cost (Proportion)	BCR (1 yr)	BCR (10 yr)
			Travel Time	Vehicle Operating	Air Pollution	Greenhouse Gas	Crash				
7	C	Haruru to Paihia	-\$87,000	\$19,000	\$47,000	\$73,000	\$2,321,000	\$2,373,000	\$53,000	45	368
7		SH11 Puketona to Paihia	-\$1,173,000	\$122,000	\$52,000	\$80,000	\$5,352,000	\$4,434,000	\$172,000	26	213
8	A	Pukekohi to Paerata	-\$1,293,000	\$27,000	-\$9,000	-\$7,000	\$1,402,000	\$121,000	\$43,000	2.8	23
8	B	Paerata to Great South Road	-\$3,339,000	\$357,000	-\$21,000	-\$28,000	\$7,258,000	\$4,226,000	\$55,000	77	634
8	C	Great South Road to Southern Motorway (SH1)	-\$744,000	-\$49,000	-\$5,000	-\$6,000	\$3,415,000	\$2,610,000	\$40,000	65	535
8		SH22 Drury to Paerata	-\$5,377,000	\$336,000	-\$36,000	-\$41,000	\$12,076,000	\$6,958,000	\$139,000	50	414
11	A	Pōkeno (SH1) to Mangatawhiri Bypass	-\$2,303,000	\$584,000	\$98,000	\$98,000	\$16,346,000	\$14,823,000	\$93,000	159	1315
11	B	Mangatawhiri Bypass to Maramarua	-\$1,142,000	\$297,000	\$30,000	\$19,000	-\$1,531,000	-\$2,326,000	\$84,000	Negative	Negative
11	C	Maramarua	-\$792,000	\$138,000	\$13,000	\$7,000	\$8,300,000	\$7,667,000	\$81,000	94	779
11	D	Maramarua to Mangatarata (SH25)	-\$1,828,000	\$709,000	\$36,000	\$20,000	\$5,255,000	\$4,192,000	\$103,000	41	338
11		SH2 Pōkeno to Mangatarata	-\$6,065,000	\$1,728,000	\$177,000	\$145,000	\$28,370,000	\$24,355,000	\$361,000	67	558

### 3.4 SENSITIVITY TESTS

Four sensitivity tests were applied to show any differences to the BCRs if different factors change. These include considering only travel time and crash user costs, using predicted crash change as an estimate of crash cost savings, one additional fatal crash after change on corridors with less than 5-year crash history, and doubling the implementation costs.

Test 1 only considers travel time and crash benefits and has similar BCRs except for Corridor 3 (Urban Rotorua) and Corridor 5 (Cambridge). For Test 2 where predicted crash changes were used instead of actual, the 1-year BCRs were generally positive but substantially lower, and in some case negative than the base test. Test 3, where an extra fatal crash was added on corridors with less than 5-years crash history, provided similar results to the base case except for the SH3 Napier corridor where is reduced from 27 to 6.7 (as there were no fatal or serious injury crashes after speed limit change) and on SH5 Rangitikei to Esk Valley where is went from a BCR of 31 to a negative result (as with one additional fatal crash, three fatal crash would have occurred after speed limit change and so fatal crashes were not considered with consideration of serious injury crashes). Where cost increases of 100% were tested, all (except for the Negative Corridor 5) corridors BCRs were halved but were still positive.

Table 11 - BCR Sensitivity Test Results

#	Corridor Name	Base Crash Cost & 1-year BCR (Table 5)		Test 1 – Trave time and Crash user costs only & Net Benefit & 1-year BCR		Test 2 – Predicted Crash sensitivity Crash Cost & 1-year BCR		Test 3 – Extra Fatal crash on corridors with less than 5years history Crash Cost & 1-year BCR		Test 4 – Cost increase of 100% Project Cost & 1-year BCR	
1	SH6 Blenheim to Nelson	\$24,984,000	14	\$19,200,000	14	\$7,754,000	1.9	\$24,984,000	14	\$2,832,000	7.1
2	SH51 Marine Parade to Waipatu	\$14,346,000	72	\$13,088,000	71	\$5,185,000	22	\$13,298,000	66	\$369,000	36
3	SH5 and SH30 Rotorua	\$2,414,000	49	\$1,203,000	109	\$265,000	Negative	\$1,604,000	Negative	\$22,000	25
4	SH3 Napier Road	\$2,523,000	27	\$1,952,000	26	\$1,407,000	12	\$1,015,000	6.7	\$150,000	13
5	SH1 Waikato Expressway - Cambridge	-\$1,685,000	15	\$5,729,000	40	-\$1,351,000	18	-\$1,685,000	15	\$287,000	7.6
6	SH1 Waikato Expressway - Taupiri	-\$3,256,000	Negative	-\$393,000	Negative	-\$163,000	0.4	-\$5,616,000	Negative	\$4,900,000	Negative
7	SH11 Puketona to Paihia	\$5,352,000	26	\$4,179,000	24	\$2,196,000	7.4	\$5,352,000	26	\$344,000	13
8	SH22 Drury to Paerata	\$12,076,000	50	\$6,699,000	48	\$5,363,000	1.8	\$11,800,000	48	\$278,000	25
9	SH5 Rangitaiki to Esk Valley	\$20,691,000	31	\$16,795,000	30	\$7,953,000	8.3	\$1,892,000	Negative	\$1,137,000	15
10	SH2 Carterton to Featherston (Rural)	\$4,865,000	12	\$1,398,000	8.1	\$2,384,000	Negative	\$4,865,000	12	\$344,000	6.1
11	SH2 Pōkeno to Mangatarata	\$28,370,000	67	\$22,305,000	62	\$21,178,000	48	\$28,370,000	67	\$722,000	34

Additional assessment outcome tables are included in Appendix C.

### 3.5 TREASURY ECONOMIC APPROACH

A Treasury Approach to the economic evaluation has also been included in this assessment, this assessment used the Treasury CABx model tool<sup>7</sup>. See Table 12 for BCR's of corridors.

The differences between MCBM and treasury are:

- 5% discount rate.
- Only considered travel time, and direct change in fatal and serious crash numbers.
- Use of CABx values for user costs: travel time, serious injury crashes, and the value of life (lowest source value) for fatal crashes.

A high-level summary of the analysis shows that:

- Corridor 3 (SH5 and SH30 Rotorua) and Corridor 8 (SH22 Drury to Paerata) both have negative BCR values, below describes why these corridors are different:
- Corridor 3 (SH5 and SH30 Rotorua); with high traffic volumes emphasising travel time changes and no fatal crashes in the before change crash history had a modest benefit from reduced crashes.
- Corridor 8 (SH22 Drury to Paerata) in the 5-years before the speed limit changes had 22 fatal and serious injury crashes, however there was only 1 fatal crash. In the 3.5-years following the speed limit change, there has been seven fatal and serious injury crashes, however four of these resulted in a fatality. The MCBM approach "recognises that the differences between occurrences of a fatal or serious crash at a corridor is influenced by random chance" and redistributes in accordance with given ratios.

Table 12 - Treasury approach assessment

#	Corridor Name	10-year BCR (ROI)	Net Annual Benefits (Real)	Proportion Travel Time Change	Proportion Change in Fatalities	Proportion Change in Serious Injury Crashes
1	SH6 Blenheim to Nelson	73.0	\$12.7M	-20%	85%	35%
2	SH51 Marine Parade to Waipatu	321.9	\$7.3M	-12%	94%	18%
3	SH5 and SH30 Rotorua	Negative	-\$0.5M	(-154%)	(0%)	(+0.54%)
4	SH3 Napier Road	381.3	\$3.5M	-12%	97%	14%
5	SH1 Waikato Expressway - Cambridge	209.8	\$3.7M	+111%	0%	-11%

<sup>7</sup> <https://www.treasury.govt.nz/information-and-services/state-sector-leadership/investment-management/investment-planning/treasurys-cbax-tool>

#	Corridor Name	10-year BCR (ROI)	Net Annual Benefits (Real)	Proportion Travel Time Change	Proportion Change in Fatalities	Proportion Change in Serious Injury Crashes
6	SH1 Waikato Expressway - Taupiri	3.3	\$1.0M	+158%	0%	-58%
7	SH11 Puketona to Paihia	96.5	\$2.0M	-33%	84%	49%
8	SH22 Drury to Paerata	Negative	-\$8.3M	(-37%)	(-97%)	(+33%)
9	SH5 Rangitaiki to Esk Valley	18.4	\$1.3M	-169%	206%	63%
10	SH2 Carterton to Featherston (Rural)	101.3	\$2.1M	-90%	160%	31%
11	SH2 Pōkeno to Mangatarata	252.2	\$11.2M	-30%	122%	7%

## 4 DISCUSSION OF FINDINGS

In analysing the 11 corridors there have been changes in mean speeds, crashes, travel times and risks.

Corridors with a speed limit reduction typically result in much larger reductions in deaths and serious injuries than predicted. Only two corridors with speed limit reductions had a reduction in actual DSI similar to the predicted DSI: SH22 Drury to Pukekohe, and SH2 Pōkeno to Mangatarata. Of those nine corridors that had a speed limit reduction, 26.6 DSI / year were saved.

On the Waikato Expressway, decreases in travel time costs do not always outweigh the crash cost increases. For the Cambridge section where there is an adequate crash history following the speed limit change, the speed limit increase lifts the corridor from Low to Medium Collective Risk; effectively an average highway in terms of deaths and serious injuries per kilometre, Taupiri is also a Medium Collective Risk highway after the increase in speed.

The economic evaluation (for those sites that had a posted speed limit reduction) showed that for most of the corridors and irrelevant of the method or test applied, that the crash benefits far outweigh (2 to 10+ times greater) the travel time disbenefits, resulting in positive BCR's. For corridors with an increase in posted speed limit, it is not currently clear if benefits from increasing in mean speed outweigh the increase in crash costs. Where posted speed limits have increased, vehicle operating costs and vehicle emissions disbenefits are 45-50% of the travel time benefits.

# APPENDIX A: ECONOMIC ANALYSIS METHODOLOGY

## OUTLINE

A limited full procedures evaluation has been completed. This approach was chosen due to the limitations of the simplified procedures spreadsheets. Five user costs have been considered when identifying benefits: travel time costs, vehicle operating costs, vehicle emissions (air pollution and greenhouse gas emissions), and crash costs.

- 1 The New Zealand Transport Agency Waka Kotahi Monetised Benefits and Costs Manual version 1.6.1 was used as the basis of this economic assessment.
- 2 Base date of 2022 was used. 2022 update factors for user costs are the latest available.
- 3 Discount rate of 4% was used when developing the 1-year and 10-year BCR.
- 4 A first-year rate of return has not been calculated as corridors typically have either a negative BCR or a 1-year BCR of greater than 1, consequently a FYRR greater than 100%.
- 5 Where a corridor has negative net benefits, the BCR has been reported as “Negative”.
- 6 Assessment Period is short where there has been a new road constructed prior to the speed limit change, or limited time since the speed limit change. Project benefits may change as more crash data becomes available.

## INFORMATION PROVIDED

NZTA provided the following information, WSP has not separately verified this information.

- Corridor/sub-section length.
- Speed limit change date.
- Posted speed limits before and after the speed limit change.
- Mean speed for one year before and after the speed limit change.
- Deaths and Serious Injury numbers before and after the speed limit change.

## REPORTING FIGURES

A 1-year BCR was provided rather than the first-year rate of return. First-year rate of return indicate the return of investment after one year as a percentage. Due to the relatively low cost of the improvements compared with the change in user costs, the first-year rate of return are all much greater than 100% (the lowest being approximately 1200%).

A 10-year BCR was provided to compare with “Low-Cost Low Risk” project categories.

A 40-year BCR, typically reported for transport projects, was not considered for two reasons:

- It was considered inappropriate as several corridors would show a BCR of over 1,000; dramatically higher than the “very high” BCR efficiency category (greater than 10) used in the 2021-2024 National Land Transport Plan prioritisation.
- To simplify the calculations by excluding maintenance costs and potential ambiguity in the methodology. Most of these projects consist of threshold treatments for speed reductions and posted speed limit repeater signs, maintenance costs of improvements (sign cleaning,

sign replacement) were considered to be low. Full replacement of infrastructure would after 10-years would maintain the BCR value, replacing or repairing defective elements would increase the BCR over a longer time period.

## TRAVEL TIME

- 7 Traffic volume has used the Annual Average Daily Traffic (AADT). For before change and after change the same value as been used for corridors/sub-sections, it has been taken from Mobile Road, typically 2023 reported values. Values used are the average reported at the start and end of the corridor/sub-section. This AADT has been used in Vehicle Operating Costs and Vehicle Emissions Costs.
- 8 Travel Time user costs only considered composite value of time (MBCM Table 16).
- 9 Corridors have used either Rural Strategic or Urban Arterial traffic compositions (MBCM Table A46) for determining travel time user costs for All Periods from Table 16. This cost has not changed based on changes in sub-section speeds. It has been chosen on general environment of the corridor. Vehicle type and trip purpose are considered within the composite values. The composite traffic mix has been used in Vehicle Operating Costs.
- 10 Outside the impact of congestion on observed travel times specific congestion analysis has not been undertaken, or user costs attributed to corridors/sub-sections.
- 11 Mean observed operating speeds were provided for the complete corridor/sub-section. No consideration of speeds within a corridor/sub-section has occurred. No assessment of the speed change cycles within a corridor/sub-section has occurred.
- 12 Mean speeds were sourced by NZTA from TomTom using one year of period either side of the change in speed limit for most of the Corridors.
  - a Corridor 5 and Corridor 6 mean speed data was sourced by WSP from TomTom.
  - b Corridor 11, which has a speed limit change in 2011, used historical speed survey data to compare change in mean speed, not TomTom.

Additional discussion on speed change cycles is included in the Economic Assessment Limitations below.

## VEHICLE OPERATING COSTS

- 13 Simplified procedures spreadsheets simplify 70 to 90 km/h into a single cost value, this lack of sensitivity has resulted in a full procedures assessment.
- 14 Vehicle operating costs only considered speed-gradient user costs. Vehicle operating costs associated with speed change cycles, roughness, congestion and bottle neck delay have not been considered.
- 15 MBCM Table A85 and MBCM Table A87 were used in the speed-gradient assessment.
- 16 Corridors or subsection speeds were rounded up to the nearest 5 km/h for the determination of user costs in Table A85 or Table A87. Where the pre and after speeds rounded to the same value, judgement was used to round down one value or keep both values the same. For example, 48.2 km/h and 48.1 km/h were both kept at 50 km/h, whereas 82.4 km/h and 80.6 km/h were rounded to 85 and 80 respectively – this rounded was done to achieve a difference in vehicle operating costs.
- 17 Average gradient of the entire route was used. At 85 to 80 km/h the change in user costs varied between 1.1% and 1.5% for gradients between 0% and 12% for Rural Strategic traffic compositions.
- 18 Average gradient was determined via Google Maps cycling journey information on elevation change.

- a Corridor 5 and Corridor 6 did not have available cyclist journeys. Corridor 5 was assumed to be 0% gradient. Corridor 6 uses maximum elevation change to estimate average gradient.

Additional discussion on speed change cycles is included in the Economic Assessment Limitations below.

## VEHICLE EMISSION COSTS

- 19 Vehicle Emissions were reported under two categories, air pollution and the impacts to health; Carbon Monoxide - CO, volatile organic compounds (VOC), Nitrogen Oxides - NO<sub>x</sub>, Particulate Matter (PM<sub>2.5</sub>), and Greenhouse gas emissions and the impact to the climate (CO<sub>2</sub>-equivalents). Section 3.3 and 3.4 of MBCM.
- 20 Proportion of heavy and light vehicles for before change and after change has used the same value for corridors/sub-sections, it has been taken from Mobile Road, typically 2023 reported values. Values used are the average reported at the start and end of the corridor/sub-section.
- 21 Quantities of various emissions were taken from the Vehicle emissions prediction model (VEPM)<sup>8</sup> database for heavy and light vehicles with.
  - a Year = 2023
  - b Before or after change mean speed was rounded to the nearest whole km/h.
- 22 SO<sub>2</sub> emissions quantities are not provided within the VEPM database and so were excluded.
- 23 Gradient adjustment factors for all emissions used the CO emissions relative to 0% gradient for Euro 3 petrol cars.<sup>9</sup> These values were chosen as they were readily available and reduced the complexity of the assessment for little loss in fidelity.
- 24 Average gradient was rounded to the nearest whole percent, gradients without a factor took the average of the two adjacent factors. This would overestimate the low impact downhill factors and underestimate the high impact uphill factors.
- 25 Adjustment values used the nearest 10 km/h.
- 26 Greenhouse gas emissions costs used the Middle Shadow Price of Carbon for 2023.

Additional discussion on the emissions costs is included in the Economic Assessment Limitations below.

## CRASH COSTS

- 27 Crash costs used Method A do minimum calculations for the pre and after speed limit change user costs calculation. This was considered the most appropriate method as it considers real crashes which there is a crash history for.
- 28 CAS data was exported for up to 5-years of CAS for each period up to the end of 2023. There might some under-reporting of crashes due to the delay in crash records incorporated into CAS. This delay has the greatest impact on non-injury crash numbers, and a moderate impact on minor injury crash numbers.
- 29 All crashes reported within the corridors were used based on worst injury outcomes.

<sup>8</sup> <https://www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/environment-and-sustainability-in-our-operations/environmental-technical-areas/air-quality/vehicle-emissions-prediction-model/>

<sup>9</sup> <https://www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Air-quality/Planning-and-assessment/Vehicle-emissions-prediction-model/VEPM-7.0-technical-report-FINAL.pdf>

- 30 Traffic Growth Rate of 0% was assumed for Crash Trend Adjustment Factor.
- 31 Where there were less than three fatal crashes within a corridor/sub-section, All Movements ratios from MBCM Tables A23, A24, and A25 were used to distribute fatal and serious injury crashes.
- 32 Under-reporting factors used Other rather than Pedestrian factors. Rural Remote was not used as all roads have more than 1,000 vehicles per day. Motorway was used for 4-lane divided state highways. MCBM Table A26 and A27.
- 33 Crashes were annualised based on the number of months since available prior or since the speed limit change.
- 34 Crash costs used All Vehicles and All Movement values for each crash severity from MBCM Tables A28, A29, A30, A31, A32, A33, A34, and A35.

Additional discussion on the costs of crashes is included in the Economic Assessment Limitations below.

## CAPITAL EXPENDITURE AND MAINTENANCE COSTS

- 35 Costs were supplied by NZTA have been used.

Table 13 - Corridor Costs and Net Present Value

#	Corridor Name	Provided Cost	Cost Year	Net Present Value (\$2022)
1	SH6 Blenheim to Nelson	\$1.2M	2020	\$1,416,000.00
2	SH51 Marine Parade to Waipatu	\$163,140	2021	\$184,348.20
3	SH5 and SH30 Rotorua	\$11,000	2022	\$11,000.00
4	SH3 Napier Road	\$74,817	2022	\$74,817.00
5	SH1 Waikato Expressway - Cambridge	NOT PROVIDED	-	-
6	SH1 Waikato Expressway - Taupiri	\$2.45M	2022	\$2,450,000.00
7	SH11 Puketona to Paihia	\$145,789	2020	\$172,031.02
8	SH22 Drury to Paerata	\$117,713	2020	\$138,901.34
9	SH5 Rangitaiki to Esk Valley	\$568,377	2022	\$568,377.00
10	SH2 Featherston to Carterton	\$172,000	2023	\$172,000.00
11	SH2 Pōkeno to Mangatarata	NOT PROVIDED	-	-

- 36 Costs Provided include actual costs incurred. This could include: Consultation, Assessment, Design, Gazetting, Physical works, Monitoring and reporting, and Project Management Costs.
- 37 Lacking costs, the following assumptions have been made:
- a Threshold treatments at each corridor are assumed to be \$60,000 (\$2021)
  - b Variable speed limit corridors were assumed to cost \$60,000 per corridor (\$2021)
  - c General speed limit changes were assumed to cost \$3,000 per kilometre (\$2021)
- 38 Maintenance costs have not been considered.

## TREASURY APPROACH METHODOLOGY

The approach considered:

- Base year of 2022, to align with MBCM assessment.
- A 10-year period for assessments was chosen to be comparable with the MBCM assessment and the sensitivity tests.
- 5% discount rate (treasury value), compared with 4% used in the MBCM.
- Social cost of loss of life, Value of Statistical Life (low source value) (\$8,574,350/crash, 2022)
- Social cost of serious road crashes (\$831,100/crash, 2022)
- 1-hour citizen compliance burden (\$27.92/h, 2022)
- Corridor implementation cost occurs in 2022.
- Change in fatal crashes, assuming single loss of life outcomes per fatal crash, uses net change in fatal crashes per year. This underestimates casualty numbers within crashes.
- Change in serious injury crashes, uses net change in serious crashes per year.
- Change in travel time based on mean speed changes for all road users throughout the year.

This approach has not considered:

- Value of vehicle time (included within the Waka Kotahi travel time values)
- Vehicle operating costs (included within the MBCM assessment).
- Vehicle emissions costs on health and the environment (included within the MBCM assessment).
- Changes in minor injury and non-injury crashes (included within the MBCM assessment).

## ECONOMIC ASSESSMENT LIMITATIONS

### SECTION LENGTH

Corridors/sub-sections have been considered in whole for traffic volume/AADT, percentage heavy, and gradients. Some of these are very long (77km) and have changes in gradient and mean speed throughout. Assessment of speed and gradient on smaller lengths improves resolution of user costs.

## SPEED CHANGE CYCLES

Speed change cycles from curves, towns, intersections, and one lane bridges impact travel time, vehicle operating costs, and vehicle emissions costs. Travel time impacts of speed change cycles are included within the mean operating speed calculations. The increased vehicle operating costs and vehicle emissions costs of slowing down and regaining speed have not been included within this assessment.

## VEHICLE EMISSIONS COSTS

VEPM uses an average speed model, which considers a laboratory “driving cycle” considering real-world operating conditions including different ranges of speeds, acceleration, and periods of idling. Limitations of average speed models are summarised below:

- Trips of the same average speed have different operational characteristics.
- Modern catalyst equipped vehicles, a large proportion of all emissions occur during short sharp peaks such as gear change and high acceleration.
- The typical U-shape of emissions curves is not fundamental but relies on the “driving cycles” included.
- Average driving models do not allow for detailed spatial resolution.

At lower average speeds, driving cycles are dominated by stop-start urban environments which are not reflective of relatively consistent rural highway vehicle use.

## COST OF CRASHES

The Monetised Benefits and Costs Manual cost of crashes is outlined in Tables below. These values were adjusted for each corridor to reflect mean speed and into \$2022. Crashes with the MBCM are classified based on the most severe outcome.

Table 14 - Base cost of crashes (Updated to \$July 2022), All Vehicles, All Movements

Base Speed	Fatal crash	Serious crash	Minor crash	Non-Injury crash
50 km/h	\$15,052,000	\$800,300	\$84,800	\$3,286
100 km/h	\$15,794,000	\$892,520	\$91,160	\$3,710

Te Manatū Waka Ministry of Transport (MOT) Social cost of road crashes and injuries methodology and user guide May 2023 outlines a methodology for the cost of crashes.<sup>10</sup> Cost of crashes include a value of statistical life, loss of productivity, medical resource costs, legal and justice resource costs, and vehicle servicing and repair costs. The value of statistical life is the largest component of costs, the value is \$12.5M (\$2021) based on a willingness to pay methodology which produced a range of \$8.1M to \$16.9M.

MOT tables report the value of life in \$2022 per crash (assumed all crashes are known) and per reported crash.

<sup>10</sup> <https://rules.transport.govt.nz/area-of-interest/safety/social-cost-of-road-crashes-and-injuries/>

Table 15 - Social Cost per crash (MoT \$2022)

Severity	Fatal crash	Serious crash	Minor crash
All	\$15,392,800	\$831,100	\$98,500
Urban	\$14,488,700	\$797,900	\$96,200
Rural	\$15,791,800	\$865,900	\$102,200

Table 16 - Social Cost per reported crash (MoT \$2022)

Severity	Fatal crash	Serious crash	Minor crash
All	\$15,392,500	\$1,552,200	\$300,000
Urban	\$14,488,700	\$1,460,300	\$292,700
Rural	\$15,791,900	\$1,652,600	\$311,100

The MBCM crash values are similar to the values per crash from the MOT. The cost per reported by MoT for serious and minor crashes are much higher than the MBCM values. This is because the MBCM crashes are adjusted to account for under-reporting separately.

# APPENDIX B: TECHNICAL CONSIDERATIONS

## *CORRIDOR CHANGE COMMENTS*

In terms of some of the differences in the corridors and outcomes

- Corridor 4 SH3 Napier Road; SH3 immediately north of Palmerston North has speed limit changes on the urban fringe of Palmerston North and approaching Ashhurst. The permanent speed limits were adopted in 2022, however an 80 km/h temporary speed limits were put in place on the southern end through to Stoney Creek Road since 2014. The crash and speed profiles reflect this lower speed limit.
- Corridor 6 SH1 Waikato Expressway Taupiri; occurred as part of a larger project to raise the posted speed limit on the Waikato Expressway. We have only considered the section past Huntly (SH1 RS513 RP1.0 – 15.3) under this assessment. The total project cost was approximately \$30M and included road safety upgrades to other sections of the corridor where the raised speed limit was implemented. Adjacent sections where the speed limit has increased were not included in the assessment due to the other road safety infrastructure improvements.
- Corridor 9 The SH5 Rangitaiki to Esk Valley; speed limit change occurred approximately 1 year prior to Cyclone Gabrielle and so speed impacts and road closures would have minimal impact in overall mean speeds.
- Corridor 10 SH2 Carterton to Featherston; SH2 has had significant physical work and temporary speed limits between Masterton and Carterton which has consequently been excluded from the assessment.

## *REGARDING MEAN SPEED CHANGE*

The data provided in Table 4 has an underlying assumption that changes in mean speed are largely the result of posted speed limit reductions and no other impacts, it is assumed that:

- Corridors with significant roadworks have been excluded (such as Masterton to Carterton). Minor (short length and short duration) road-work sites on long corridors were not identified or considered in impacting an annual average speed. Delays due to routine maintenance works within a long corridor is part of an annual average speed.
- There has been no consideration of increase in speed limit enforcement following speed limit change.
- There are no delays introduced through changes in priority or control at intersections or crossings.
- There are no other changes to the corridors which may have impacted mean speeds.

Other considerations regarding the change in mean speed are:

- TomTom mean speed data is representative of all road users. No consideration has been given to changes in mean speed based on road user type. E.g. changes in speed for heavy vehicles (with a 90 km/h maximum speed limit), or school buses (with an 80 km/h maximum speed limit), compared with other vehicles.
- No consideration of changes in the speed profile have been made. The change in speed of the fastest users has not been evaluated or considered.

- No consideration of the change in traffic volumes has been made on mean speed. Increases in traffic volumes decrease mean speed. Any changes in traffic volumes were assumed to result in negligible impacts on mean speed.
- Localised changes in speed have not been considered, speed has only been considered on a corridor basis.

Analysis of the entire speed profile change would illustrate how people travelling at above average speeds experience speed changes. Changes in for people travelling above average speeds may have a greater influence on DSI changes.

### *REGARDING CHANGES IN CRASHES*

Predicted crash changes based on changes to mean speed were made using the Global Road Safety Facility Speed Impact Tool<sup>11</sup>.

Road vehicle crashes are low frequency events, typically a minimum of 3 years of a reliable crash history is used when evaluating crashes and desirably 5 years. Other than Corridor 11, no corridor has five years of reliable crash history before and after the change in speed limit (SH1 Waikato Expressway corridors lack five years of reliable crash history before the speed limit change). Corridor 1 only has three years of reliable crash history.

Crash data reported in CAS up to the end of December 2023 was considered in mid-February 2024. There is a delay in crashes occurring and being reported within CAS, this delay is longer for lower severity crashes such as minor injury and non-injury crashes. We believe that all fatal and serious injury crashes were within CAS for the period ending December 2023 when crash data was extracted in mid-February.

It is assumed that there were no other safety improvements, and changes in crash rates are purely due to reduction in posted speed limit and associated work (such as area threshold treatments).

### *REGARDING TRAFFIC VOLUMES*

Traffic volumes and heavy vehicle numbers are fixed for before and after the change in posted speed limit. Using the same traffic volumes before and after removes changes in the number of users which would impact on before and after summed total user costs.

There are negligible impacts of traffic growth on mean speed, traffic growth can also impact crash numbers, noting that crashes are discrete low frequency events.

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<sup>11</sup> [Speed Impact Tool | GRSF \(roadsafetyfacility.org\)](https://roadsafetyfacility.org/)

## APPENDIX C: OTHER TABLES

Table 17 – Corridor Overview and summary.

#	Corridor Name	Project Overview	Cost	Corridor Length (km)	Speed Limit (km/h)		
					Before change	Change Date	After change
1	SH6 Blenheim to Nelson	<a href="https://www.nzta.govt.nz/projects/sh6-blenheim-to-nelson-speed-limits/">https://www.nzta.govt.nz/projects/sh6-blenheim-to-nelson-speed-limits/</a>	\$1.2M	101	100*	18/12/2020	90*
2	SH51 Marine Parade to Waipatu	<a href="#">SH51 permanent speed limits   Waka Kotahi NZ Transport Agency (nzta.govt.nz)</a>	\$163k	7.51	100	29/10/2021	80
3	SH5 and SH30 Rotorua	<a href="https://nzta.govt.nz/projects/sh5-sh30-rotorua-new-permanent-speed-limits/">https://nzta.govt.nz/projects/sh5-sh30-rotorua-new-permanent-speed-limits/</a>	\$11k	3.98	80*	3/10/2022	50
4	SH3 Napier Road	<a href="https://www.nzta.govt.nz/projects/sh3-napier-road-speed-review-and-infrastructure-improvements/speed-review/">https://www.nzta.govt.nz/projects/sh3-napier-road-speed-review-and-infrastructure-improvements/speed-review/</a>	\$75k	3.40	100	23/06/2022	80
5	SH1 Waikato Expressway - Cambridge	The Cambridge section of the Waikato Expressway opened in December 2015. The Cambridge section of the Waikato Expressway speed limit increased to 110km/h on 11 December 2017.	-	22.3	100	11/12/2017	110
6	SH1 Waikato Expressway - Taupiri	Speed limits changed 13 July 2022. Huntly section of the Waikato Expressway opened on 9th March 2020.	\$2.45M <sup>#</sup>	14.3	100	13/07/2022	110
7	SH11 Puketona to Paihia	<a href="https://nzta.govt.nz/projects/sh11-puketona-to-paihia-permanent-speed-limits/">https://nzta.govt.nz/projects/sh11-puketona-to-paihia-permanent-speed-limits/</a>	\$146k	12.3	100	24/08/2020	80
8	SH22 Drury to Paerata	<a href="https://nzta.govt.nz/projects/sh22-drury-to-paerata-permanent-speed-limits/">https://nzta.govt.nz/projects/sh22-drury-to-paerata-permanent-speed-limits/</a>	\$118k	13.0	100	30/06/2020	80
9	SH5 Rangitaiki to Esk Valley	<a href="https://www.nzta.govt.nz/projects/sh5-permanent-speed-limits/">https://www.nzta.govt.nz/projects/sh5-permanent-speed-limits/</a>	\$238k	77	100	18/02/2022	80
10	SH2 Carterton to Featherston (Rural)	<a href="https://www.nzta.govt.nz/projects/sh2-wairarapa-highway-improvements/speed-review/">https://www.nzta.govt.nz/projects/sh2-wairarapa-highway-improvements/speed-review/</a>	\$172k	14.1	100	27/01/2023	80
11	SH2 Pōkeno to Mangatarata	<a href="https://www.nzta.govt.nz/media-releases/safety-improvements-being-investigated-on-sh2-between-pokeno-to-mangatarata/">https://www.nzta.govt.nz/media-releases/safety-improvements-being-investigated-on-sh2-between-pokeno-to-mangatarata/</a>	-	26.5	100	15/12/2011	90

Table 18 - Sensitivity Test – Crash benefits based on predicted crash change

#	Corridor Name	Net annual Benefit		Actual Annual Crash Cost Benefit	Total Annual Benefit	Present Value Cost	BCR (1 yr)	BCR (10 yr)
		All Other User Costs	Predicted Crash Cost Benefit					
1	SH6 Blenheim to Nelson	-\$4,999,000	\$7,754,000	\$24,984,000	\$2,756,000	\$1,416,000	1.9	16
2	SH51 Marine Parade to Waipatu	-\$1,043,000	\$5,185,000	\$14,346,000	\$4,141,000	\$184,000	22	186
3	SH 5 and 30 Rotorua	-\$1,874,000	\$265,000	\$2,414,000	-\$1,610,000	\$11,000	Negative	Negative
4	SH3 Napier Road	-\$511,000	\$1,407,000	\$2,523,000	\$896,000	\$75,000	12	99
5	SH1 Waikato Expressway - Cambridge	\$3,876,000	-\$1,351,000	-\$1,685,000	\$2,525,000	\$143,000*	18	146
6	SH1 Waikato Expressway - Taupiri	\$1,184,000	-\$163,000	-\$3,256,000	\$1,021,000	\$2,450,000	0.4	3.4
7	SH11 Puketona to Paihia	-\$918,000	\$2,196,000	\$5,352,000	\$1,278,000	\$172,000	7.4	61
8	SH22 Drury to Paerata	-\$5,118,000	\$5,363,000	\$12,076,000	\$245,000	\$139,000	1.8	15
9	SH5 Rangitaiki to Esk Valley	-\$3,221,000	\$7,953,000	\$20,691,000	\$4,732,000	\$568,000	8.3	69
10	SH2 Carterton to Featherston (Rural)	-\$2,774,000	\$2,384,000	\$4,865,000	-\$390,000	\$172,000	Negative	Negative
11	SH2 Pōkeno to Mangatarata	-\$4,015,000	\$21,178,000	\$28,370,000	\$17,163,000	\$361,000	48	393

\*Estimated Cost

Table 19 - Sensitivity Test – One additional Fatal Crash After Change (when less than 5 years of data).

#	Corridor Name	Net annual Benefit		Actual Annual Crash Cost Benefit	Total Annual Benefit	Present Value Cost	BCR (1 yr)	BCR (10 yr)
		All Other User Costs	Predicted Crash Cost Benefit					
1	SH6 Blenheim to Nelson	-\$4,999,000	\$24,232,000	\$24,984,000	\$19,233,000	\$1,416,000	14	112
2	SH51 Marine Parade to Waipatu	-\$1,043,000	\$13,298,000	\$14,346,000	\$12,255,000	\$184,000	66	550
3	SH 5 and 30 Rotorua	-\$1,874,000	\$1,604,000	\$2,414,000	-\$270,000	\$11,000	Negative	Negative
4	SH3 Napier Road	-\$511,000	\$1,015,000	\$2,523,000	\$504,000	\$75,000	6.7	56
5	SH1 Waikato Expressway - Cambridge	\$3,876,000	-\$1,685,000^	\$1,685,000	\$2,192,000	\$143,000*	15	126
6	SH1 Waikato Expressway - Taupiri	\$1,184,000	-\$5,616,000	-\$3,256,000	-\$4,432,000	\$2,450,000	Negative	Negative
7	SH11 Puketona to Paihia	-\$918,000	\$4,680,000	\$5,352,000	\$3,762,000	\$172,000	22	181
8	SH22 Drury to Paerata	-\$5,118,000	\$11,800,000	\$12,076,000	\$6,682,000	\$139,000	48	398
9	SH5 Rangitaiki to Esk Valley	-\$3,221,000	\$1,892,000	\$20,691,000	-\$1,329,000	\$568,000	Negative	Negative
10	SH2 Carterton to Featherston (Rural)	-\$2,774,000	\$2,386,000	\$4,865,000	-\$388,000	\$172,000	Negative	Negative
11	SH2 Pōkeno to Mangatarata	-\$4,015,000	\$28,370,000^	\$28,370,000	\$24,355,000	\$361,000*	67	558

\*Estimated Cost

^ 5 years crash history.

Table 20 - Sensitivity Test – Doubling Cost

#	Corridor Name	Net annual Benefit		Total Annual Benefit	Present Value Cost	Double Present Value Cost	BCR (1 yr)	BCR (10 yr)
		All Other User Costs	Predicted Crash Cost Benefit					
1	SH6 Blenheim to Nelson	-\$4,999,000	\$24,984,000	\$19,986,000	\$1,416,000	\$2,832,000	7.1	58
2	SH51 Marine Parade to Waipatu	-\$1,043,000	\$14,346,000	\$13,302,000	\$184,000	\$369,000	36.1	298
3	SH 5 and 30 Rotorua	-\$1,874,000	\$2,414,000	\$539,000	\$11,000	\$22,000	25	203
4	SH3 Napier Road	-\$511,000	\$2,523,000	\$2,012,000	\$75,000	\$150,000	13.4	111
5	SH1 Waikato Expressway - Cambridge	\$3,876,000	-\$1,685,000	\$2,192,000	\$143,000*	\$287,000	7.6	63
6	SH1 Waikato Expressway - Taupiri	\$1,184,000	-\$3,256,000	-\$2,072,000	\$2,450,000	\$4,900,000	Negative	Negative
7	SH11 Puketona to Paihia	-\$918,000	\$5,352,000	\$4,434,000	\$172,000	\$344,000	12.9	107
8	SH22 Drury to Paerata	-\$5,118,000	\$12,076,000	\$6,958,000	\$139,000	\$278,000	25.0	207
9	SH5 Rangitaiki to Esk Valley	-\$3,221,000	\$20,691,000	\$17,470,000	\$568,000	\$1,137,000	15.4	127
10	SH2 Carterton to Featherston (Rural)	-\$2,774,000	\$4,865,000	\$2,091,000	\$172,000	\$344,000	6.1	50
11	SH2 Pōkeno to Mangatarata	-\$4,015,000	\$28,370,000	\$24,355,000	\$361,000*	\$722,000	33.7	279

\*Estimated Cost

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