

# **Security of New Zealand's Strategic Roding System**

**Transfund New Zealand Research Report No 147**



# **The Security of New Zealand's Strategic Roding System**

MONTGOMERY WATSON NEW ZEALAND LTD

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PO Box 2331, Lambton Quay, Wellington, New Zealand  
Telephone (04) 477-0220; Facsimile (04) 499-0733

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## EXECUTIVE SUMMARY

The reliable operation of New Zealand's road network is critical to the country's economic success and its social development. Disruption to some parts of the network may therefore have a large negative impact on these.

This report outlines a systematic "desktop" approach which by reviewing the importance of individual links in the network, and the actual risk of travel disruption.

The approach developed included:

1. Defining and establishing the national strategic roads network,
2. Valuing the strategic links within the network considering a combination of commercial, mobility, lifeline and tourism values,
3. Assessing the vulnerability of the links to disruption and, then
4. Assessing the impact of any disruption for each link.

This allowed the whole network to be prioritised in terms of importance, risk and disruption impact.

A more detailed analysis of four links within the network was then carried out to "calibrate" the results. The results from this indicated:

- That the general approach appeared sufficient to determine a coarse ranking of the links.
- Further work is still required to fine tune the weightings used to combine the values.
- That individual link analysis was likely to lead to significant changes in ranking but that these changes were primarily due to improved knowledge of the link's risks and importance.
- There needs to be further research on developing consistent methodologies for the determination of the loss of business costs, to the nation, as a result of link disruption.

## **ABSTRACT**

The reliable operation of New Zealand's road network is critical to both its economic success and its social development. Disruption to some parts of the network may therefore have a large negative impact on these.

The report outlines a systematic "desktop" approach which by reviewing the importance of individual links in the network, and the actual risk of travel disruption. It then identifies which sections of New Zealand's Road Network should be accorded priority in either reducing the risk of disruption or accommodating the disruption better within the network, and recommends some developments to Transfund's Project Evaluation Manual to address disruption and service issues.



## 1. INTRODUCTION

The reliable operation of New Zealand's road network is critical to both its economic success and its social development. Disruption to some parts of the network may therefore have a large negative impact on these. This study therefore sought to:

- Gain an improved understanding of which sections of New Zealand's Road Network should be accorded priority in either reducing the risk of disruption or accommodating the disruption better within the network, and
- Consider of the best means of determining and analysing potential improvements to the security of the network within the framework of the Project Evaluation Manual.

This work was completed by a desktop study with tables of importance, vulnerability and impact produced. These were then "calibrated" using inputs from Transit New Zealand's project steering committee and Transfund's and Transit New Zealand's regional offices and a combined Importance-Risk-Impact Table developed.

Once calibrated a more detailed desktop analysis was undertaken for four links that ranked highly for different reasons. The aim of this additional analysis was to review how the assumed factors which were used to determine importance, impact and risk stood up to further detailed analysis.

The additional analysis confirmed:

- That the general approach appeared sufficient to determine a coarse ranking of the links
- That individual link analysis was likely to lead to significant changes in ranking but that these changes were primarily due to improved knowledge of the link's risks and importance.
- There needs to be further research on developing consistent methodologies for the determination of the loss of business costs, to the nation, as a result of link disruption.

## **2. ESTABLISHMENT OF THE NETWORK**

New Zealand's Strategic Roding System was generally taken to be represented by the State Highway Network. However the following alterations were made to the network:

- Generally the network was considered only to the outside boundaries of urban areas as in most cases local systems provided adequate alternatives and backup.
- Exceptions to this were motorway systems which provided high speed alternatives for large traffic volumes (especially the Auckland and Wellington systems) and where local streets might not cope well with the large increases in volume.
- Additional links were considered where a single road provided sole access to a major population centre (eg Wainuiomata) or a major industry (eg Tiwai Point Aluminium Smelter).

## **3. THE PROPOSED MODEL**

Three separate parameters were considered and quantified to determine an overall ranking for each link. These were:

- The level of each links "strategicness",
- The risk that each link had of being severed and the length of time that the link would be disrupted for, and
- The impact that severance would have on the operation of the network.

A final score for each link was determined by multiplying the above three factors together. These scores were then used to rank the links.

How each parameter was quantified for each link is outlined below. It is important to note that at this stage definitive values for each parameter were not determined. Instead the focus was on establishing relativity between the links for each parameter. To help achieve this each parameter was evaluated by only one person (where possible in a single day), the values so obtained were then given a general peer overview which concentrated on the "outliers".

### **3.1 "Strategicness"**

In most developed countries roads play more than just a transportation role. Accordingly the following definition was determined for New Zealand's Strategic Roding System.

*“New Zealand’s strategic rooding system is an interconnected system of road links which:*

- *Provide significantly for the commercial needs of the community in the movement of goods.*
- *Provide significantly for the needs of tourism and the transport of tourists.*
- *Act as “Lifelines” in emergencies for the conveyance of health and welfare needs to communities.*
- *Contribute significantly to the desire of the community for a high level of mobility.*
- *Excludes duplicate roads where such roads offer reasonable travel alternatives”.*

After some discussion it was considered that the value a road to the community could be stated in terms of the following four key factors:

- Contribution to commerce,
- Provision of mobility to the community,
- Life line (or health and welfare) values, and
- Contribution to international tourism routes

All these factors were scored on a grade of 0-10 and calibrated accordingly. The basis for how the scores were determined is outlined in the following sections.

It was acknowledged that each of the attributes probably contained elements of the other attributes. However it was considered appropriate to take account of this in how the various factors were combined by the application of weighting factors.

### **3.1.1 Commerce and Mobility Factors**

In a free market society, travel is essential for the functioning of the economy. While human interaction can now be achieved effectively by electronic means for certain activities this does not apply to commodities. Movement of goods is necessary for production, manufacturing and sale.

The Commerce and Mobility factors were considered to relate directly to traffic volume on each link.

Heavy traffic volume was considered to provide the best indication of a link’s commercial value. The link with the greatest volume of heavy traffic was scored nine and the other links graded accordingly. An additional score of one point was given to links which provided sole access to a change in transportation mode or to a major commercial enterprise (eg to a port or the Tiwai Point Aluminium Smelter).

New Zealand society has high levels of vehicle (particularly car) ownership by world standards, and high mileage per vehicle. Personal private mobility is highly rated by New Zealanders. A strategic transport network provides opportunities for this high level of mobility to be exercised beyond the immediate community.

The balance of the traffic volume (no HCV) was therefore used to indicate the degree of Mobility that the link provided. The link with the greatest volume of the non HCV traffic was scored ten and the other links graded accordingly

Traffic Volumes on the links were determined from TNZ's traffic counting summary report. However after difficulties getting consistent data from the National Traffic Database on traffic mix it was decided that this should be determined using the traffic mixes for the Road Categories determined from research for the December 1995 review of the Project Evaluation Manual.

### **3.1.2 Lifeline or Health and Welfare Factors**

Some communities do not have the range of health and welfare services which would provide for essential basic needs in an emergency. Such communities are generally the smaller and more remote communities, where a connecting road is a lifeline.

The communities selected as 'vulnerable' were individual townships. To qualify as vulnerable, communities needed to:

- Have more than 500 people; and
- Have a single 'lifeline' road connecting the community to hospital services or alternative routes that are too long to be useful in a civil emergency - ie: Opotiki, Akaroa, Picton. The Ministry of Health was consulted to determine which communities were serviced by hospitals. A number of communities, such as Collingwood/Takaka and Coromandel were left out because it transpired that they had hospital facilities; and
- Not have a viable alternative means of access to hospital facilities. Two centres with rail links (Bluff, Picton) have been included because it was decided that their rail links are equally vulnerable as they are located next to the road.

The links were graded by population size into four steps, namely 0, 4, 7 and 10, i.e. <500 (which gets a zero rating), 500 - 1 000, 1 000 - 5 000, and > 5 000 (which gets the maximum rating out of 10).

Where population fluctuated on a seasonal basis (eg Whakapapa and Milford) the population weighting was halved. In these instances only those links between the population centres and the first viable alternative route are assessed. However if the seasonal peak occurred over only very short duration these communities were ignored.

One point was added for every 30km distance between the vulnerable community and the first viable alternative route. Gravel roads were not counted as an alternative when looking for the first intersection.

Small airfields were also counted as viable alternatives for small communities. For populations of <1 000, two points were deducted if an airfield is present, while for populations between 1 000 and 5 000 one point was deducted.

### 3.1.3 Tourism Factors

New Zealand's tourism sector is an expanding part of the economy based particularly on natural assets such as scenery, and opportunities for activities such as skiing, diving and boating. Figures recently issued by Tourism New Zealand indicate that 22% of international tourists travel on organised coach tours. Others use private or rental car. A proportion combines these modes.

Strategic tourist routes were identified on the basis of two considerations:

- Links that accessed key tourist destinations or linked key destinations to the rest of the "strategic network", and
- Routes that are "scenic" and have a high level of use by tourist buses and rental cars.

It was not possible to get information on rental car routes other than pick-up and drop-off points. Significant bus routes were identified from brochures of bus companies catering to international tourists, the international visitor survey, phone and personal interviews.

Depending on the number of buses and bus companies catering to international tourists that used each link, grades of 0, 4, 7 and 10 were assigned.

## 3.2 Defining Risk

The following matrix, Table 1, was developed to assist in the initial assessment of risk of disruption to the network. Each identified link in the network was assessed in accordance with the matrix for the various events (earthquakes, volcanic eruptions, floods, landslides, snow, coastal erosion and tsunami). The scores achieved were then aggregated to determine an overall risk rating.

**Table 1**

Return Period/ Impact Duration	< 2 years	2-10 years	10-20 Years	20 - 100 Years	>100 Years
<12hrs	25	8	3	1	0
12-24hrs	50	17	7	3	0
1-7 days	175	58	23	9	1
7-28 days	875	292	117	44	12
>20 days	2000	667	267	100	27

The factors included in the table have been determined as the multiple of 100 times the inverse of the average return period and the average number of days of disruption.

### 3.3 Defining Impact

Disruption to the network was considered to have differing impacts on each of the separate attributes. The following systems were used to categorise the level of impact for each attribute.

**Table 2 Mobility and Commerce Importance Factors**

Impact Grade	Basis of Grade or Comment
0	No impact, adequate <sup>1</sup> alternative and delays < half an hour
2	Delays on alternatives 0.5 - 2 hrs
4	Delays on alternatives 2 - 4 hrs
6	Delays on alternatives 4 - 6 hrs
8	Delays on alternatives 6 - 8 hrs
10	Delays on alternatives > 8 hrs or no alternative

**Table 3 Lifeline Health and Welfare Factors**

Impact Grade	Basis of Grade or Comment
10	A grade of 10 will be applied to all impacts as it was considered that the original method for determining the importance criteria also considered the level of impact

**Table 4 Tourism Importance Factors**

Impact Grade	Basis of Grade or Comment
0	No impact or adequate alternative or delays less than 1/2 an hour
2	Delays to tourism 0.5 to 3hrs
4	Delays to tourism greater than 3 hours
6	Delays to tourism greater than 8 hours or destination avoided
8	Road closed: no alternatives, no impact on national tourism
10	Road closed: no alternatives, potential impact on national tourism

<sup>1</sup> The adequacy of the alternatives was considered on a case by case basis. Judgement was used to consider costs and effectiveness of alternatives considering items such as surface, alignment, hierarchy and additional length.

#### 4. SUMMARY OUTPUT PRIORITY LIST

A final combined grade for each link was then determined by combining the importance, impact and risk factors for each link in accordance with the following formula:

- $OG = (CF * CImp * CW + MF * MImp * MW + TF * TImp * TW + HF * HImp * HW) * RISK$

where OG = Overall Grade, CF = commerce factor, CImp = commerce impact , CW = commerce weighting etc.

A variety of different mixes of weighting were used to develop tables of the Overall Grade. The outcomes from these mixes were then compared and the most appropriate mix is given in Table 5.

**Table 5**

Factor	Weightings
Commerce (CW)	40
Mobility (MW)	50
Tourism (TW)	5
Health and Welfare (HW)	5

A ranked report showing the overall grade for the individual links is provided in Appendix 1. It is important to recognise that the overall grade shown does not just reflect the importance of a link but the combination of importance, impact and risk. A comparison of the top three items highlights this.

- Cascade Creek to Milford (Milford Road) ranks highly primarily as a result of the high risk factor but also as it has a high tourism impact and value. This is reflected in the current policy of providing an Avalanche Protection Programme.
- Ngauranga to Petone features as a result of its susceptibility to earthquake and its high commerce and mobility values.
- The Auckland Harbour bridge makes the top three primarily on its high commerce and mobility values.

## 5. ADDITIONAL INVESTIGATIONS

### 5.1 Introduction

More detailed analysis was completed on four links. The aims of this analysis were:

- To review the assumptions made with regard to importance, risk and impact.
- To compare economic costs in terms of the Project Evaluation Manual and to compare these with the relative ranking in Appendix 1.
- To recommend on practices for valuing and assessing measures for reducing either the risk or impact of disruption to strategic links.

To this end the following four links were chosen for more detailed analysis.

**Table 6**

<b>Link</b>	<b>Reason for selection</b>
The Auckland Harbour Bridge	High impact and high commercial and mobility grades
Milford Road Falls Creek to Cascade Creek	High risk and high tourism grades
The Wainuiomata Hill Road	High lifeline requirement
SH 1 Levin to Otaki River	A combination of medium risk, importance and impact in the initial assessment

Two sets of calculations were made. The first was based on the assumption that risk could be reasonably removed. This allowed a comparison to be made with the ranking determined in the initial analysis. The second analysis was based on either removing the risk of closure or just reducing its subsequent impact. The majority of the assumptions made for this analysis were bold. However they were made more with the intention of reviewing the system rather than providing a robust analysis for the individual link. Accordingly they alone should not be taken as justification for further works.

A description of the assumptions made and the additional analysis for each link is attached in Appendix 2. Despite the additional investigations undertaken for each the level of detail is intended to be at a similar level to that required for a Project Feasibility Report.



## 5.2 Risk Removal and Comparison with Earlier Ranking

If the assessments of importance grade, impact, risk and weightings were all correct it would be possible to make a direct comparison between the **Total Net Value of Exposure** in each case and the **Risk x Importance** values calculated earlier.

Table 7 shows those values for each link and compares the ratios of each to the value for the Milford to Te Anau link.

**Table 7**

<b>Link</b>	<b>Risk x Importance</b>	<b>Ratio to Milford to Te Anau</b>	<b>Total Net Value of Exposure</b>	<b>Ratio to Milford to Te Anau</b>
Milford Road <sup>1</sup>	11794	1	\$31M	1
Auckland Harbour Bridge <sup>2</sup>	1699	6.9	\$15M	2.1
Levin to Otaki <sup>3</sup>	1132	10.4	\$0.8M	39
Wainuiomata Hill <sup>4</sup>	962	12.2	\$0.9M	34

1. It appears that the assessment of risk and the importance of tourism impacts in the initial assessment are about right. The analysis also appears to confirm the merit of operating the existing avalanche monitoring programme.
2. The cost of the impact for this link appeared to be higher than the original assessment allowed. This may not be general to all motorway links as the additional travel distance for this link is greater than for other links. The additional analysis also had to make assumptions about the susceptibility of the bridge approaches to earthquake damage and the length of time that the disruption would last for. Changes in these assumptions would result in large changes in the Total Net Value of Exposure.
3. It appears that the risk was over stated. This could be expected considering the manner in which the initial assessments of risks were determined.
4. The analysis of disruption costs for both mobility and commerce has been subject to a large number of assumptions and considerations. It also appears that in this case the lifeline costs were not as high as perhaps the weighting applied to it warranted. This may be "link sensitive" though. It would not be possible to resolve individual link issues without detailed investigation.

The detailed analysis was carried out as far as possible in accordance with guidelines from the recently published TNZ Project Evaluation Manual. Items which the manual did not adequately cover included assessment of isolation, and factors associated with the 'lifeline' effects. This is covered briefly in the manual under the 'intangible effects' section, however no methodology is given for assessing the value of isolation.

The PEM appears to be suitable for assessing the costs and benefits of risk-based elements (for example the probabilities and implications of repairing a bridge following an event). Importance-based factors, such as the effects of tourism and local business due to road closure, are less well defined. The PEM calculates costs based upon the AADT value, and 'time savings' based upon the AADT. This approach works well

when vehicles are able to travel, however if a route is completely closed, and no alternatives exist, the PEM provides no mechanism for analysis.

For this reason, in the detailed analysis vehicle-related costs were assessed in cases where alternative routes exist, but 'cost of alternative access' and 'cost through loss of business' were calculated based on a series of assumptions.

Costs of alternative routes were estimated based on assumptions of the proportion of traffic that would still make the trip and the additional road user costs for that traffic using the alternative route.

Loss-of-business costs were assessed for each option. In general these were assessed as being proportional to the traffic volume that would not travel as a result of any closure. A simplified approach was that the loss to the nation was equal to 30% of the travel time value for half of the traffic over an eight hour day. The traffic volume was halved because most of the traffic would have been double counted (for example on the way to and from work) and 30% was assessed as a reasonable expectation of return on investment.

The level of detail in the additional assessment is low. Assumptions have been made for some very complicated scenarios and occurrences. However, the analysis has provided an alternative assessment to the initial study.

### **5.3 Analysis of Risk or Impact Reduction**

The analysis above is based on the premise that risk can be removed completely and the associated impact avoided. In most instances this will not be the case and some risk or impact will remain. In some instances it will be possible to plan or design to reduce the impact from a known risk while in others it may be possible to reduce the risk itself. In the majority of cases a combination of risk and impact reduction will be the most feasible.

The calculations of the level of exposure for each of the case studies above were based on risk and impact removal (Table 8).

**Table 8 Implications of risk and impact reduction for each exposure level.**

<b>Link</b>	<b>Current Risk and Impact</b>	<b>Potential Changes to Risk or Impact</b>
Auckland Harbour Bridge	<p><b>Risk</b> from earthquake or tsunami on the integrity of the approaches.</p> <p><b>Impact</b> includes road closure and disruption on alternative routes</p>	<p>While the <b>risk</b> of the event itself remains unchanged the impact may be reduced</p> <p><b>Impact</b> can be reduced by either reducing the severity of the closure or by reducing the disruption on alternatives.</p>
Milford Road	<p>The <b>Risk</b> on this road comes from unstable conditions as a result of weather conditions. At the moment the risk is managed by a combination of monitoring and control.</p> <p>The <b>Impact</b> is basically the length of time that the risk of avalanche is considered serious enough to close the road.</p>	<p><b>Risk</b> may be reduced by either increasing the level of control by either increasing monitoring or by constructing avalanche deflection structures.</p> <p>This <b>Impact</b> may be reduced with alternative monitoring systems or by structures which reduce the number of days that the road is close due to risk.</p>
Wainuio-mata Hill	<p>The <b>Risk</b> on this link comes from closure due to slips as a result of either weather conditions or earthquakes.</p> <p>The <b>Impact</b> comes from road closure and the potential to have costs due to the loss of life and business.</p>	<p>The <b>Risk</b> can be reduced by changing the factor of safety for the slopes.</p> <p>The <b>Impact</b> will be reduced by having less of the road exposed to the risk and so having a shorter clean up time.</p>
Levin to Otaki	<p>The <b>Risk</b> to and <b>Impacts</b> on this link comes primarily from exposure of bridges to flood and the lack of a viable alternative.</p>	<p>The <b>Risks</b> and <b>Impacts</b> may be reduced by increasing the factor of safety at the bridges and providing a viable alternative.</p>

**Table 9 Summary of information for each of the links investigated.**

<b>State Highway 94 – Milford Road</b>								
Scenario	Return Period/Impact					NPV of Exposure	Change from base	Fundable Project @ B/C = 4
	2	5	10	20	30			
Base Impact (days)	5	10	20	40	60	\$30.7M	-	-
Scenario One (days)	3	7	15	22	35	\$21.8M	\$8.9M	\$2.2M or \$0.23M pa
Scenario Two (days)	3	7	12	15	20	\$14.5	16.6	\$4.1M or \$0.43M pa
Risk/Impact Removal	-	-	-	-	-	0	30.7	\$7.7M or \$0.43M pa

<b>State Highway 1 - Auckland Harbour Bridge</b>								
Scenario	Return Period/Impact					NPV of Exposure	Change from base	Fundable Project @ B/C = 4
	2	10	20	50	100			
Base Impact (days)	-	-	-	5	20	\$14.7M	-	-
Scenario One (days)	-	-	-	1	9	\$5.9M	\$8.8M	\$2.2M
Scenario Two (days)	-	-	-	0	20	\$9.8M	\$4.9M	\$1.2M
Risk/Impact Removal	-	-	-	-	-	0	\$14.7M	\$3.6M

<b>Wainuiomata Hill Road</b>								
Scenario	Return Period/Impact					NPV of Exposure	Change from base	Fundable Project @ B/C = 4
	2	10	20	50	100			
Base Impact (days)	-	0.5	1	2	3	\$0.8M	-	-
Scenario One (days)	-	-	-	2.5	1	\$0.4M	\$0.2M	\$61,000
Risk/Impact Removal	-	-	-	-	-	0	\$0.6M	\$250,000

<b>State Highway 1 - Levin to Otaki</b>								
Scenario	Return Period/Impact					NPV of Exposure	Change from base	Fundable Project @ B/C = 4
	2	10	20	50	100			
Base Impact (days)	-	0.5	1	2	3	\$0.8M	-	-
Scenario One (days)	-	-	-	1	2	\$0.4M	\$0.4M	\$100,000
Risk/Impact Removal	-	-	-	-	-	0	\$0.8M	\$200,000

## 6. CONCLUSION

This investigation has determined a mechanism for quantifying the importance, impact and risk associated with New Zealand's Strategic Roding Network.

The importance of a link has been defined as a combination of its contribution to commercial, mobility, lifeline and tourism interests. The relative importance of these interests was determined and agreed after consultation within the Project Steering Committee. A priority table was then determined using a superficial desktop analysis. Further evaluation of these measures and weightings may be of some benefit but they are essentially "political" decisions. The detailed analysis of four options highlighted that some further work might be required in fine tuning the weightings.

When considering improvements to the security of individual links the benefits need to be considered in terms of:

- Reducing their importance by providing alternatives
- Reducing the impact of any disruption
- Reducing the risks to the links

Consideration needs to be given to developing and adopting standard guidelines in the Project Evaluation Manual for the estimation of non-road user costs associated with road closure.

The results from the more detailed desk top analysis indicated:

- That the general approach appeared sufficient to determine a coarse ranking of the links;
- That individual link analysis was likely to lead to significant changes in ranking but that these changes were primarily due to improved knowledge of the link's risks and importance; and
- There needs to be further research on developing consistent methodologies for the determination of the loss of business costs, to the nation, as a result of link disruption.

## **Appendix One - Importance and Risk Tables**

# Draft Output - Sorted by Risk x Importance

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Te Anau Downs-Cascade Creek	Cascade Creek-Milford	Southland District	0.0	0.0	10	0.21	10	10	4	2	7.21	36.00	11794
Wellington-Featherston	Ngaranga to Petone	Wellington City	4.1	4.6	10	39.15	0	0	0	0	39.15	65.30	2557
Albany to Mt Eden	Harbour Bridge	Auckland City	8.4	9.6	8	65.17	10	2	2	1	67.17	25.30	1699
Paekakariki-Wellington	Ngaranga-Aotea	Wellington City	3.8	4.3	6	22.08	10	4	0	0	24.08	62.30	1500
Mt Eden-Drury	Mt Eden-Wellington	Auckland City	9.0	10.0	6	51.60	10	4	0	0	53.60	25.30	1356
Albany-Mt Eden	Auckland H/Bridge-Mt Eden	Auckland City	8.4	9.6	6	48.88	10	6	0	0	51.88	25.30	1313
Albany-Mt Eden	Paremoremo-Auckland H/Bridge	Auckland City	8.4	9.6	6	48.88	10	4	0	0	50.88	25.30	1287
Levin-Paekakariki	Otaki-Waikanae	Horowhenua District	2.1	1.1	10	13.89	10	8	0	0	17.89	65.30	1168
Paekakariki-Wellington	Porirua-Ngaranga	Wellington City	3.2	3.0	6	16.86	10	4	0	0	18.86	60.30	1137
Levin-Paekakariki	Levin-Otaki	Horowhenua District	2.1	1.1	10	13.89	10	8	0	0	17.89	63.30	1132
Paekakariki-Wellington	Aotea-Terrace	Wellington City	2.2	2.9	6	13.80	10	4	0	0	15.80	62.30	984
Kawatiri-Nelson	Richmond-Nelson	Nelson City	1.3	1.7	8	11.16	10	8	0	0	15.16	64.30	975
Special	Wainui Hill	Lower Hutt City	1.1	0.8	10	8.35	0	0	10	5	13.35	72.00	962
SH47-Chatcau	SH47-Chatcau	Ruapehu District	0.0	0.1	10	0.43	7	8	5	2.5	5.73	62.30	930

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Hawea-Haast Town	Hawea-Makarora	Queenstown Lakes District	0.1	0.0	10	0.34	10	10	0	0	5.34	62.30	866
Turangī-Waiouru	Rangipo-Waiouru	Ruapehu District	0.2	0.2	4	0.74	10	2	0	0	1.74	80.00	837
Wellington-Featherston	Petone to Lower Hutt	Lower Hutt City	2.2	2.5	6	12.77	0	0	0	0	12.77	65.30	834
Palmerston-Pine Hill	Pigeon Flat-Pine Hill	Dunedin City	0.7	0.4	10	4.84	7	10	0	0	8.34	97.00	809
Palmerston-Pine Hill	Waitati-Pigeon Flat	Dunedin City	0.7	0.3	10	4.51	7	10	0	0	8.01	97.00	777
Auckland SW M'way	Mangere Bridge	Auckland City	6.8	4.0	6	28.32	0	0	0	0	28.32	26.30	745
Nelson-Blenheim	Nelson to Atiwhai	Nelson City	1.5	0.7	8	7.36	10	8	0	0	11.36	64.30	731
Blenheim-Kaikoura	Ward-Clarence River	Kaikoura District	0.2	0.1	10	1.17	10	8	0	0	5.17	30.00	672
SH2-Taupo	Te Horoto-Taupo	Whakatane District	0.4	0.2	10	2.46	4	6	0	0	3.66	80.00	659
Levin-Paekakariki	Waikanae-Paekakariki	Kapiti District	1.3	1.4	6	7.19	10	6	0	0	10.19	63.30	645
Auckland SW M'way	Onelunga	Auckland City	5.9	3.3	6	24.08	0	0	0	0	24.08	26.30	633
Haast Town-Kumara Junction	Harihari-Hokitika	Westland District	0.1	0.1	10	0.67	10	10	0	0	5.67	06.00	601
Mt Eden-Drury	Mt Wellington-Otahuhu	Auckland City	5.9	6.5	4	22.41	10	2	0	0	23.41	25.30	592
Haast Town-Kumara Junction	Franz Josef-Harihari	Westland District	0.1	0.0	10	0.58	10	10	0	0	5.58	06.00	592
Blenheim-Kaikoura	Clarence River-Kaikoura	Kaikoura District	0.0	0.1	10	0.52	10	8	0	0	4.52	30.00	588
Special	Cobham Drive	Wellington City	2.8	1.6	5	9.52	0	0	0	0	9.52	61.30	583
Haast Town-Kumara Junction	Haast Town-Fox Glacier	Westland District	0.1	0.0	10	0.46	10	10	0	0	5.46	06.00	578



Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Haast Town-Kumara Junction	Fox Glacier-Franz Josef	Westland District	0.1	0.0	10	0.46	10	10	0	0	5.46	06.00	578
Pine Hill-Clarksville	Green Island-Mosgiel	Dunedin City	2.0	2.3	4	7.93	7	2	0	0	8.63	64.30	555
Hawea-Haast Town	Makarora-Haast Town	Queenstown Lakes District	0.1	0.0	10	0.46	10	10	0	0	5.46	99.30	542
Hammer Springs	Hammer Springs	Waimakariri District	0.4	0.5	10	4.31	0	0	4	2	6.31	81.00	511
Paekakariki-Wellington	Plimmerton-Porirua	Porirua City	1.7	2.2	4	7.09	10	2	0	0	8.09	62.30	504
One Tree Hill-Papatoetoe	One Tree Hill-Papatoetoe	Manakau City	3.2	3.8	6	19.14	0	0	0	0	19.14	25.30	484
SH2-Thames	Kopuarahi-Thames	Thames Coromandel	0.9	0.5	6	3.59	10	6	0	0	6.59	71.00	468
Nelson-Blenheim	Atawhai to RaiValley	Marlborough District	0.3	0.1	8	1.49	10	8	0	0	5.49	83.60	459
Waiouru-Bulls	Taihape-Mangaweka	Rangitikei District	0.7	0.4	4	1.83	10	4	0	0	3.83	17.00	448
Mt Eden-Drury	Otauhu-Papatoetoe	Manakau City	4.3	4.8	4	16.45	10	2	0	0	17.45	25.30	442
Waiouru-Bulls	Mangaweka-Hunterville	Rangitikei District	0.6	0.3	4	1.62	10	4	0	0	3.62	17.00	423
SH1-Te Ngae	Rotorua-Te Ngae	Rotorua District	4.3	2.1	2	5.55	10	2	0	0	6.55	63.30	415
Opotiki-Whakatane	Opotiki-Kutarere	Opotiki District	0.1	0.2	6	0.90	0	0	6	3	3.90	06.00	413
Westport-Karamea	Westport-Waimangaroa	Buller District	0.5	0.2	10	3.08	0	0	0	0	3.08	34.00	413
Waiouru-Bulls	Waiouru-Taihape	Ruapehu District	0.7	0.4	2	0.95	10	2	0	0	1.95	10.00	410
Wellington-Featherston	Upper Hunt to Kaitoke	South Wairarapa	0.7	0.8	10	6.57	0	0	0	0	6.57	60.30	396
Inangahua Junction-	Murchison-Kawatiri	Tasman District	0.1	0.1	10	0.67	10	8	0	0	4.67	84.00	392

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Greymouth-Westport	Greymouth-Punakaiki	Westland District	0.1	0.1	8	0.58	10	6	0	0	3.58	06.00	380
Inangahua Junction	O'Sullivan's Bridge-Murchison	Tasman District	0.0	0.1	10	0.49	10	8	0	0	4.49	84.00	378
Greymouth-Westport	Punakaiki-Westport	Buller District	0.1	0.1	8	0.55	10	6	0	0	3.55	06.00	376
Wanganui-National Park	Horopito-National Park	Ruapehu District	0.1	0.1	10	0.97	7	8	0	0	3.77	99.30	374
Te Anau-Milford Sound	Te Anau-Te Anau Downs	Southland District	0.0	0.0	10	0.21	10	10	0	0	5.21	71.30	371
Nelson-Blenheim	Havelock-Renwick	Marlborough District	0.3	0.2	8	1.77	10	8	0	0	5.77	63.30	365
Yaldhurst-Otira	Springfield-Otira	Selwyn District	0.1	0.1	8	0.50	4	6	0	0	1.70	14.00	363
Nelson-Blenheim	Rai Valley-Havelock	Marlborough District	0.3	0.2	8	1.61	10	8	0	0	5.61	63.30	355
Blenheim-Kaikoura	Seddon-Ward	Marlborough District	0.3	0.1	10	1.86	10	8	0	0	5.86	60.30	353
Waiapara-Springs Junction	Hammer Springs (7a)-Lewis Pass	Hurunui District	0.1	0.1	10	0.52	7	6	0	0	2.62	34.00	351
Waiapara-Springs Junction	Lewis Pass-Springs Junction	Buller District	0.1	0.1	10	0.52	7	6	0	0	2.62	34.00	351
Special	Westport Cement	Buller District	1.3	0.1	10	5.80	0	0	0	0	5.80	60.30	350
Westport-Inangahua	Westport-Buller	Buller District	0.0	0.0	8	0.30	10	6	0	0	3.30	96.30	318
Kawatiri-Nelson	Kawatiri-Hope Saddle	Tasman District	0.1	0.1	10	0.69	10	8	0	0	4.69	67.60	317
Special	Whangaparaoa	Rodney	0.7	0.8	10	6.57	0	0	10	5	11.57	26.30	304
Mt Eden-Drury	Papatoetoe-Papakura	Manakau City	2.8	3.1	4	10.54	10	2	0	0	11.54	25.30	292
Inangahua Junction-Reefton	Cronadun-Reefton	Grey District	0.3	0.2	6	1.23	7	6	0	0	3.33	84.00	280

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Inangahua Junction-	Inangahua Junction-O'Sullivan's Bridge	Buller District	0.0	0.0	8	0.30	10	6	0	0	3.30	84.00	278
Westport-Inangahua	Buller-Inangahua Junction	Buller District	0.0	0.0	8	0.30	10	6	0	0	3.30	84.00	277
Picton Blenheim	Tuamarina-Spring Creek	Marlborough District	0.4	0.2	2	0.50	10	2	5	2.5	4.00	66.00	264
Picton Blenheim	Picton Tuamarina	Marlborough District	0.5	0.3	2	0.65	10	2	5	2.5	4.15	63.30	263
Tauranga-Waihi	Te Puna-Aongatete	Western Bay Of Plenty	1.2	0.5	10	7.44	0	0	0	0	7.44	35.30	263
Alexandra-Cromwell	Clyde-Cromwell	Central Otago District	0.3	0.1	8	1.47	7	6	0	0	3.57	73.30	262
Springs Junction-Reefton	Springs Junction-Reefton	Buller District	0.0	0.0	10	0.26	7	6	0	0	2.36	09.00	258
Wellington-Featherston	Kaitoke-Featherston	South Wairarapa	0.3	0.3	10	2.43	0	0	0	0	2.43	05.30	255
Wharara-Springs Junction	Hurunui-Hammer Springs (7a)	Hurunui District	0.1	0.2	10	1.25	7	6	0	0	3.35	74.00	248
Kaikoura-Cheviot	Kaikoura-Oaro	Kaikoura District	0.0	0.1	6	0.31	10	4	0	0	2.31	05.00	243
Whakatane-Tauranga	Paenagroa-Te Puke	Western Bay Of Plenty	1.3	0.6	4	3.36	0	0	0	0	3.36	72.00	242
Kingston-Cromwell	Kingston-Frankton	Central Otago District	0.2	0.1	8	0.96	10	6	0	0	3.96	61.00	241
Special	Piha/Karekare	Rodney	0.5	0.2	10	2.96	0	0	7	3.5	6.46	37.30	241
Auckland SW Mt'way	Queenstown	Auckland City	3.0	2.2	4	9.04	0	0	0	0	9.04	26.30	238
Wellsford-Albany	Silverdale-Dairy Flat	Auckland City	2.1	2.3	4	7.87	10	0	0	0	7.87	30.00	236
Lumsden-Te Anau	The Key-Te Anau	Southland District	0.2	0.1	2	0.25	10	4	0	0	2.25	03.00	232
Ingangahua Junction-Reefton	Ingangahua Junction-Rotokohu	Grey District	0.1	0.1	6	0.58	7	6	0	0	2.68	84.00	225

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Ingangahua Junction-Reefton	Rotokohu-Cronadun	Grey District	0.1	0.1	6	0.58	7	6	0	0	2.68	84.00	225
Kingston-Cromwell	Arrow Junction-Cromwell	Central Otago District	0.3	0.1	8	1.45	10	6	0	0	4.45	50.30	224
Paekakariki-Wellington	Paekakariki-Pukerua Bay	Kapiti District	1.2	1.3	2	2.24	10	2	0	0	3.24	69.00	224
Paekakariki-Wellington	Pukerua Bay-Plimmerton	Kapiti District	1.2	1.5	2	2.42	10	2	0	0	3.42	63.30	217
Special	Marsen Point	Whangarei District	1.7	0.1	10	7.61	0	0	0	0	7.61	28.30	215
Thames-Coromandel	Thames-Ahimia	Thames Coromandel	0.1	0.2	6	0.92	7	6	0	0	3.02	71.00	215
Wellington-Featherston	Lower Hutt to Haywards	Lower Hutt City	1.8	2.1	2	3.55	0	0	0	0	3.55	60.30	214
Paramoremo-SH1	Paramoremo-Riverhead	North Shore City	3.1	1.5	4	8.00	0	0	0	0	8.00	26.30	211
Taupo-Turangi	Te Rangita-Turangi	Taupo District	0.3	0.3	4	1.05	10	2	0	0	2.05	02.30	210
SH6-Westport	SH6-Westport	Buller District	0.5	0.3	10	3.31	0	0	0	0	3.31	63.30	210
Tauranga-Waihi	Aongatete-Katikati	Western Bay Of Plenty	0.9	0.5	10	5.92	0	0	0	0	5.92	35.30	209
Taupo-Turangi	Taupo-Te Rangita	Taupo District	0.2	0.3	4	1.01	10	2	0	0	2.01	02.30	206
Napier-Wairoa	Bay View-Ruapunga	Hastings District	0.1	0.1	10	1.10	4	10	0	0	3.10	66.00	205
Wellsford-Albany	Puhuehue-Puhoi	Auckland City	1.2	0.6	4	3.07	10	6	0	0	6.07	33.00	200
Thames-Coromandel	Ahimia-Coromandel	Thames Coromandel	0.1	0.2	6	0.72	7	6	0	0	2.82	71.00	200
Paramoremo-SH1	Coatsville-SH1	Rodney	3.0	1.4	4	7.60	0	0	0	0	7.60	26.30	200
Bulls-Wanganui	Turakina-Kaitoke	Wanganui District	0.7	0.3	4	1.72	7	4	0	0	3.12	63.30	197

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Tarras-Oamarua	Tarras-Lindis-Oamarua	Waitaki District	0.1	0.1	8	0.59	10	6	0	0	3.59	54.30	195
Te Ngae-Whakatane	Te Ngae-Rotoehu	Rotorua District	1.2	0.6	4	3.07	0	4	0	0	3.07	63.30	194
Waiouru-Bulls	Hunterville-Bulls	Rangitikei District	0.7	0.3	2	0.87	10	2	0	0	1.87	04.00	194
Rotorua-Tirau	Rotorua-Tapapa	South Waikato	0.5	0.3	4	1.32	10	2	0	0	2.32	83.60	194
Bulls-Levin	Bulls-Sanson	Rangitikei District	1.5	0.7	2	1.96	10	2	0	0	2.96	65.30	193
Blenheim-Kaikoura	Blenheim-Seddon	Marlborough District	0.4	0.2	4	0.98	10	4	0	0	2.98	64.30	192
Whakatane-Tauranga	Papamoa-Tauranga	Tauranga City	3.3	1.6	2	4.24	0	0	0	0	4.24	45.00	191
Makaraka-Opotiki	Ormond-Te Karaka	Gisborne District	0.3	0.1	10	1.83	0	0	0	0	1.83	04.00	190
Kaikoura-Cheviot	Oaro-Parnassus	Hurunui District	0.2	0.1	6	0.78	10	4	0	0	2.78	66.00	184
Waiphai-Bluff	Woodend-Bluff	Southland District	0.5	0.2	10	2.90	0	0	6	3	5.90	31.00	183
Wanganui-Hawera	Westmere-Patea	South Taranaki	0.4	0.2	10	2.89	0	0	0	0	2.89	63.30	183
Reefton-Greymouth	Reefton-Mawheraiti	Buller District	0.1	0.1	10	0.95	4	6	0	0	2.15	84.00	180
SH2-Taupo	Te Pohue-Te Horoto	Hastings District	0.2	0.1	10	1.62	4	6	0	0	2.82	64.00	180
SH2-Taupo	Eskdale-Te Pohue	Hastings District	0.2	0.1	10	1.62	4	6	0	0	2.82	64.00	180
Tauranga-Waihi	Katikati-Waimata	Hauraki District	0.8	0.4	10	5.00	0	0	0	0	5.00	35.30	177
Waihi-SHI	Maramara-Mangatawhiri	Franklin	1.1	0.5	2	1.41	10	2	0	0	2.41	72.00	173
Waihi-SHI	Mangatarata-Maramara	Hauraki District	1.1	0.5	2	1.41	10	2	0	0	2.41	72.00	173

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Christchurch-Little River	Kaituna-Little River	Banks Peninsula	0.2	0.1	10	1.38	0	0	8	4	5.38	31.00	167
Special	Tiwai Point	Southland District	1.3	0.1	10	5.80	0	0	0	0	5.80	28.30	164
New Plymouth-Waitara	New Plymouth-Bell Block	Plymouth	2.5	0.6	2	2.58	0	0	0	0	2.58	63.30	164
Paramoremo-SHI	Riverhead-Coatsville	Rodney	2.5	1.1	4	6.17	0	0	0	0	6.17	26.30	162
Invercargill-Kingston	Lumsden-Kingston	Southland District	0.2	0.1	8	0.96	10	6	0	0	3.96	41.00	162
Lumsden-Te Anau	Mossburn-The Key	Southland District	0.0	0.1	4	0.16	10	4	0	0	2.16	75.00	162
Kawhia-Te Kuiti	Kawhia-Otorohanga	Otorohanga District	0.0	0.0	2	0.05	0	0	5	2.5	2.55	63.30	161
Kawatiri-Nelson	Motupiko-Kohatu	Tasman District	0.1	0.1	4	0.35	10	4	0	0	2.35	67.60	159
National Park-Turangi	National Park-Taurewa	Ruapehu District	0.1	0.1	4	0.25	7	4	0	0	1.65	94.60	156
Kawatiri-Nelson	Hope Saddle-Motupiko	Tasman District	0.1	0.1	4	0.27	10	4	0	0	2.27	67.60	154
Helensville-Mt Eden	Henderson-Mt Eden	Waitakere	2.3	1.2	4	6.01	0	0	0	0	6.01	25.30	152
Special	Glenbrook	Franklin	1.3	0.1	10	5.78	0	0	0	0	5.78	26.30	152
Kumara Junction-Greymouth	Kumara Junction-Greymouth	Westland District	0.3	0.2	2	0.42	10	2	0	0	1.42	06.00	151
Raglan-Hamilton	Raglan-Whatawhata	Waikato	0.3	0.1	8	1.49	0	0	7	3.5	4.99	30.00	150
Wanganui-National Park	Otoko-Oreore	Wanganui District	0.3	0.1	4	0.66	7	4	0	0	2.06	71.30	147
Makaraka-Opotiki	Wairoa-Whakaki	Wairoa District	0.2	0.1	10	1.31	0	0	0	0	1.31	12.00	147
National Park-Turangi	Rangipo-Turangi	Taupo District	0.0	0.1	4	0.18	7	2	0	0	0.88	62.30	143

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Motueka to Collingwood	Motueka to Upper Takaka	Tasman District	0.0	0.1	10	0.49	0	0	0	0	0.49	75.60	136
Oira-Kumara Junction	Oira-Kumara	Grey District	0.1	0.1	8	0.40	4	6	0	0	1.60	84.00	134
Whakatane-Tauranga	Te Puke-Papamoa	Western Bay Of Plenty	1.4	0.7	2	1.85	0	0	0	0	1.85	72.00	133
Westport-Karamea	Waimangaroa-Waimarie	Buller District	0.2	0.1	10	0.99	0	0	0	0	0.99	34.00	132
Little River-Akaroa	Barrys Bay-Akaroa	Banks Peninsular	0.2	0.1	2	0.26	0	0	8	4	4.26	31.00	132
Little River-Akaroa	Hill Top-Barrys Bay	Banks Peninsular	0.2	0.1	2	0.22	0	0	8	4	4.22	31.00	131
SH4-Waiouru	Rangataua-Tangiawai	Ruapehu District	0.1	0.1	4	0.36	7	4	0	0	1.76	73.90	130
Little River-Akaroa	Little River-Hill Top	Banks Peninsular	0.1	0.1	2	0.18	0	0	8	4	4.18	31.00	130
Wanganui-National Park	Oroere-Raetihi	Ruapehu District	0.2	0.1	4	0.41	7	4	0	0	1.81	71.30	129
Haast Town-Kumara Junction	Hokitika-Kumara Junction	Westland District	0.2	0.1	2	0.20	10	2	0	0	1.20	06.00	127
Wellsford-Albany	Orewa-Silverdale	Auckland City	1.7	1.9	2	3.24	10	2	0	0	4.24	30.00	127
Napier-Hastings	Napier-Faradale	Napier City	1.1	1.2	2	2.11	0	0	0	0	2.11	60.30	127
Taunumarunui-Eight Mile	Taunumarunui-Mangatupoto	Ruapehu District	0.7	0.3	4	1.78	0	0	0	0	1.78	71.30	127
Omarama-Fairlie	Tekapo-Burke - Fairlie	Mackenzie District	0.1	0.1	4	0.32	10	4	0	0	2.32	54.30	126
Whangarei-Wellsford	Topuni-Te Hana	Kaipara District	0.9	0.4	4	2.21	10	2	0	0	3.21	39.00	125
Makaraka-Opotiki	Morere-Makaraka	Waioa District	0.2	0.1	10	1.19	0	0	0	0	1.19	04.00	124
Coromandel-Waihi	Whitianga-Whangamata	Thames Coromandel	0.1	0.1	4	0.34	7	4	0	0	1.74	71.00	124

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Waitara-Te Kuiti	Urenui-Awakino	Waitomo District	0.3	0.1	10	1.83	0	0	0	0	1.83	65.30	120
Pukeuri-Palmerston	Hampden-Shap Point	Waitaki District	0.5	0.2	2	0.63	7	2	0	0	1.33	87.30	116
Frankton-Queenstown	Frankton-Queenstown	Queenstown Lakes District	1.3	0.6	2	1.66	10	2	0	0	2.66	43.30	115
Hamilton-Tirau	Hamilton-Tamahere	Hamilton City	2.0	0.9	2	2.51	10	2	0	0	3.51	32.30	113
Wairakei-Rotorua	Waiotapu-Rotorua	Rotorua District	0.7	0.3	2	0.87	10	2	0	0	1.87	60.30	112
Wairakei-Rotorua	Puakohurea-Waiotapu	Rotorua District	0.7	0.3	2	0.87	10	2	0	0	1.87	60.30	112
Pukeuri-Palmerston	Herbert-Hampden	Waitaki District	0.5	0.2	2	0.60	7	2	0	0	1.30	85.30	111
Turangi-Waiouru	Turangi-Rangipo	Taupo District	0.3	0.3	2	0.53	10	2	0	0	1.53	72.60	111
Mt Eden-Drury	Papakura-Drury	Papakura City	1.7	1.9	2	3.20	10	2	0	0	4.20	25.30	106
Drury-Hamilton	Drury-Pokeno	Papakura City	1.7	1.9	2	3.20	10	2	0	0	4.20	25.30	106
Whangarei-Wellsford	Whangarei-Puwera	Kaipara District	1.3	0.7	2	1.72	10	2	0	0	2.72	39.00	106
Bulls-Wanganui	Kaitoke-Wanganui	Wanganui District	0.7	0.4	2	0.96	7	2	0	0	1.66	63.30	105
Whangarei-Wellsford	Puwera-Oakleigh	Kaipara District	1.3	0.6	2	1.69	10	2	0	0	2.69	39.00	105
Tokoroa-Taupo	Tokoroa-Kinleith	South Waikato	1.2	0.6	2	1.55	1	2	0	0	1.65	63.30	104
Tauranga-Mt Maunganui	Tauranga-Mt Maunganui	Western Bay Of Plenty	2.5	1.3	2	3.25	0	0	0	0	3.25	32.00	104
Palmerston-Bulls	Newbury-Sanson	Manawatu District	0.9	0.5	2	1.22	4	2	0	0	1.62	63.30	103
Hamilton-Tirau	Tamahere-Cambridge	Waikato	1.7	0.8	2	2.14	10	2	0	0	3.14	32.30	102



Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Kingston-Cromwell	Frankton-Arrow Junction	Central Otago District	0.8	0.4	2	1.01	10	2	0	0	2.01	50.30	101
Waipukurau-Napier	Waipukurau-Pukehou	Central Hawkes Bay	0.9	0.4	2	1.14	4	2	0	0	1.54	64.00	99
Ashburton-Washdyke	Ashburton-Tinwald	Ashburton District	1.9	1.0	2	2.48	10	2	0	0	3.48	28.30	99
Wellsford-Albany	Waiwera-Orewa	Auckland City	1.5	0.7	2	1.92	10	2	0	0	2.92	33.00	96
Makaraka-Opotiki	Waioeka-Opotiki	Opotiki District	0.1	0.1	10	0.90	0	0	0	0	0.90	06.00	96
Masterton-Woodville	Masterton-Opaki	Masterton District	1.2	0.5	2	1.49	0	0	0	0	1.49	64.00	95
Wairakei-Rotorua	Wairakei-Golden Springs	Taupo District	0.4	0.2	2	0.52	10	2	0	0	1.52	60.30	92
Wairakei-Rotorua	Golden Springs-Puakohurea	Taupo District	0.4	0.2	2	0.52	10	2	0	0	1.52	60.30	92
SH1-Te Ngae	Guthrie-Rotorua	Rotorua District	0.3	0.2	2	0.44	10	2	0	0	1.44	63.30	91
Raes Junction-Alexandra	Roxburgh-Alexandra	Central Otago District	0.3	0.1	8	1.32	7	6	0	0	3.42	26.30	90
Te Kuiti-Hamilton	Kiokio-Kihikihii	Otorohanga District	0.8	0.4	2	1.04	10	2	0	0	2.04	44.00	90
SH1-Te Ngae	SH1-Guthrie	South Waikato	0.3	0.2	2	0.40	10	2	0	0	1.40	63.30	88
Albany-Mt Eden	Albany-Paremoremo	Auckland City	1.3	1.4	2	2.49	10	2	0	0	3.49	25.30	88
Whangarei-Wellsford	Oakeight-Ruakaka	Kaipara District	1.0	0.5	2	1.26	10	2	0	0	2.26	39.00	88
Woodville-Waipukurau	Dannevirke-Matamau	Taranaki District	0.7	0.3	2	0.94	4	2	0	0	1.34	64.00	86
Christchurch-Little River	Christchurch-Halswell	Christchurch City	1.2	1.4	2	2.36	0	0	0	0	2.36	36.00	85
Pukaki-Hermitage	Pukaki-Hermitage	MacKenzie District	0.0	0.0	10	0.22	4	8	0	0	1.82	46.00	84

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Te Kuiti-SH1	Bennydale-Waikamuru	South Waikato	0.1	0.0	4	0.19	10	4	0	0	2.19	38.00	83
Drury-Hamilton	Meremere-Rangirir	Waikare	1.7	0.8	2	2.17	10	2	0	0	3.17	26.30	83
Drury-Hamilton	Pokeno-Meremere	Franklin	1.7	0.8	2	2.17	10	2	0	0	3.17	26.30	83
Makaraka-Opotiki	Whakaki-Nuhaka	Wairoa District	0.1	0.1	10	0.80	0	0	0	0	0.80	04.00	83
Whangarei-Wellsford	Kaiwaka-Topuni	Kaipara District	0.9	0.4	2	1.11	10	2	0	0	2.11	39.00	82
SH1-SH2	Pauatahanui-SH2	Porirua City	0.7	0.8	2	1.33	0	0	0	0	1.33	61.30	81
Clarksville-Raes Junction	Beaumont-Raes Junction	Ciutha District	0.2	0.1	4	0.52	7	4	0	0	1.92	42.30	81
Kawatiri-Nelson	Kohatu-Wakefield	Tasman District	0.1	0.1	2	0.20	10	2	0	0	1.20	67.60	81
SH2-Thames	SH2-Waitakanuru	Hauraki District	0.4	0.2	2	0.56	10	2	0	0	1.56	52.00	81
Te Ngae-SH2	Mourea-Okere	Rotorua District	0.5	0.2	4	1.28	0	0	0	0	1.28	63.30	81
Waipukurau-Napier	Pukehou-Te Hauke	Hastings District	0.7	0.3	2	0.86	4	2	0	0	1.26	64.00	81
Helensville-Mt Eden	Kumeu-Henderson	Waikare	2.3	1.2	2	3.01	0	0	0	0	3.01	26.30	79
Cheviot-Waipara	Cheviot-Waipara	Hurunui District	0.2	0.1	2	0.26	10	2	0	0	1.26	62.30	79
Motueka to Collingwood	Takaka to Collingwood	Tasman District	0.1	0.1	10	0.58	0	0	0	0	0.58	32.60	77
Rolleston-Ashburton	Rolleston-Ashburton	Selwyn District	0.9	0.4	2	1.19	10	2	0	0	2.19	34.30	75
Te Ngae-SH2	Okere-SH2	Western Bay Of Plenty	0.5	0.2	4	1.18	0	0	0	0	1.18	63.30	75
Kaikoura-Cheviot	Parnassus-Cheviot	Hurunui District	0.2	0.1	2	0.26	10	2	0	0	1.26	59.30	75

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SH1-Tauranga	Te Poi-Tauriko	Tauranga City	0.8	0.4	4	2.11	0	0	0	0	2.11	35.30	74
SH2-Thames	Waitakaruru-Kopuarahi	Hauraki District	0.4	0.2	2	0.56	10	2	0	0	1.56	46.00	72
Whangarei-Wellsford	Ruakaka-Kaiwaka	Kaipara District	0.6	0.3	2	0.79	10	2	0	0	1.79	39.00	70
Makaraka-Opotiki	Matawai-Waioeka	Opotiki District	0.1	0.0	10	0.65	0	0	0	0	0.65	04.00	68
Makaraka-Opotiki	Te Karaka-Matawai	Gisborne District	0.1	0.0	10	0.65	0	0	0	0	0.65	04.00	68
Coromandel-Waihi	Coromandel-Whitianga	Thames Coromandel	0.1	0.2	2	0.24	7	2	0	0	0.94	71.00	67
Reefton-Greymouth	Brunner-Greymouth	Grey District	0.3	0.1	2	0.38	4	2	0	0	0.78	84.00	65
Cromwell	Cromwell	Central Otago District	0.4	0.2	2	0.49	10	2	0	0	1.49	43.30	64
SH1-Tauranga	Tauriko-Tauranga	Western Bay Of Plenty	1.3	0.6	2	1.66	0	0	0	0	1.66	38.00	63
Waitara-Te Kuiti	Awakino-Piopio	Waitomo District	0.2	0.1	10	1.41	0	0	0	0	1.41	44.00	62
Ashburton-Washdyke	Temuka-Washdyke	Timaru District	1.1	0.6	2	1.47	7	2	0	0	2.17	28.30	61
National Park-Taumarunui	Manunui-Taumarunui	Ruapehu District	0.2	0.3	4	0.86	0	0	0	0	0.86	71.30	61
Wellsford-Helensville	Kaukapakapa-Helensville	Rodney	1.2	0.6	2	1.59	0	0	0	0	1.59	38.00	60
SH4-Waiouru	Tangiwai-Waiouru	Ruapehu District	0.1	0.1	2	0.23	7	2	0	0	0.93	64.60	60
Tokomaru-Gisborne	Tolaga Bay-Whangara	Gisborne District	0.1	0.1	10	0.89	0	0	0	0	0.89	66.00	59
Paeroa-Hamilton	Paeroa-Te Aroha	Hauraki District	0.5	0.2	2	0.64	10	2	0	0	1.64	35.30	58
Pine Hill-Clarksville	Allanton-Waihola	Dunedin City	0.9	0.4	2	1.15	7	2	0	0	1.85	31.30	58

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
National Park-Turangi	Taurewa-Rangipo	Taupo District	0.1	0.1	2	0.10	7	2	0	0	0.80	68.60	55
Cromwell-Tarras	Cromwell-Tarras	Central Otago District	0.1	0.1	2	0.15	10	2	0	0	1.15	47.30	54
Omararama-Fairlie	Omararama-Twizel	Waikati District	0.1	0.1	2	0.15	10	2	0	0	1.15	47.30	54
Napier-Port of Napier	Napier-Port of Napier	Napier City	0.5	0.5	2	0.87	0	0	0	0	0.87	60.30	52
Napier-Wairoa	Raupunga-Wairoa	Wairoa District	0.2	0.1	6	0.73	0	0	0	0	0.73	72.00	52
Tokomaru-Gisborne	Whangara-Gisborne	Gisborne District	0.1	0.1	10	0.79	0	0	0	0	0.79	66.00	52
Tokoroa-Taupo	Atiamuri-Wairakei	Taupo District	0.5	0.3	2	0.70	1	2	0	0	0.80	63.60	51
Lumsden-Te Anau	Lumsden-Mossburn	Southland District	0.1	0.1	2	0.15	10	2	0	0	1.15	43.30	50
Te Ngae-SH2	Te Ngae-Mourea	Rotorua District	0.6	0.3	2	0.78	0	0	0	0	0.78	63.30	49
Pine Hill-Clarksville	Waiholo-Milton	Clutha District	0.6	0.3	2	0.82	7	2	0	0	1.52	31.30	48
Te Kuiti-SH1	Te Kuiti-Benneydale	Waikato District	0.1	0.0	4	0.23	10	2	0	0	1.23	38.00	47
Tirau-Tokoroa	Putaruru-Tokoroa	South Waikato	0.9	0.5	2	1.21	1	2	0	0	1.31	35.30	46
Napier-Wairoa	Napier-Bay View	Napier City	0.4	0.4	2	0.70	4	0	0	0	0.70	66.00	46
Clarksville-Raes Junction	Clarksville-Lawrence	Clutha District	0.3	0.1	2	0.39	7	2	0	0	1.09	42.30	46
Ruatahuna-SH5	Rotomahana-SH5	Rotorua District	0.3	0.1	4	0.69	0	0	0	0	0.69	66.00	46
Ruatahuna-SH5	Murupara-Rotomahana	Whakatane District	0.3	0.1	4	0.69	0	0	0	0	0.69	66.00	46
Waipara-Springs Junction	Waipara-Hurunui	Hurunui District	0.1	0.2	2	0.27	7	2	0	0	0.97	46.00	44

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Dunedin-Port Chalmers	Dunedin-Port Chalmers	Dunedin City	1.4	0.5	2	1.62	0	0	0	0	1.62	27.30	44
Oira-Kumara Junction	Kumara-Kumara Junction	Grey District	0.1	0.1	2	0.12	4	2	0	0	0.52	84.00	43
Reefon-Greymouth	Mawheraiti-Brunner	Buller District	0.1	0.1	2	0.11	4	2	0	0	0.51	84.00	43
Opotiki-Tokomaru	Opotiki-Torere	Opotiki District	0.1	0.1	10	0.66	0	0	0	0	0.66	65.30	43
Opotiki-Tokomaru	Torere-Mauhgaroa	Opotiki District	0.1	0.1	10	0.66	0	0	0	0	0.66	65.30	43
Christchurch-Little River	Taitapu-Kaituna	Banks Peninsular	0.2	0.1	10	1.38	0	0	0	0	1.38	31.00	43
Waihi-SHI	Waikino-Paeroa	Hauraki District	0.5	0.2	4	1.18	0	0	0	0	1.18	36.00	43
Wanganui-Hawera	Patea-Hawera	South Taranaki	0.5	0.3	2	0.67	0	0	0	0	0.67	63.30	42
Featherston-Masterton	Greytown-Carterton	Carterton District	0.3	0.3	2	0.57	0	0	0	0	0.57	74.00	42
Clarksville-Raes Junction	Lawrence-Beaumont	Clutha District	0.2	0.1	2	0.26	7	2	0	0	0.96	42.30	41
Cromwell-Hawea	Albert Town-Hawea	Queenstown Lakes District	0.1	0.0	2	0.08	10	2	0	0	1.08	37.50	40
Te Kuiti-SHI	Whakamau-SHI	South Waikato	0.1	0.1	2	0.14	10	2	0	0	1.14	35.30	40
Washdyke-Pukeuri	Glenavy-Pukeuri	Waitaki District	0.7	0.3	2	0.84	7	2	0	0	1.54	25.30	39
Whakatane-Tauranga	Mataia-Paeangaroa	Whakatane District	0.4	0.2	2	0.53	0	0	0	0	0.53	72.00	38
Tokoroa-Turangī	Kuratau-Tokaanu	Taupo District	0.1	0.1	4	0.22	0	0	0	0	0.22	70.00	37
Pukeuri-Palmerston	Shag Point-Palmerston	Waitaki District	0.6	0.3	2	0.72	7	2	0	0	1.42	26.30	37
Christchurch-Lyttelton	Christchurch-Lyttelton	Banks Peninsular	0.5	0.7	2	1.09	0	0	0	0	1.09	34.00	37

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Palmerston-Pine Hill	Palmerston-Waitati	Dunedin City	0.6	0.3	2	0.72	7	2	0	0	1.42	25.30	36
Westport-Karamea	Waimarie-Karamea	Buller District	0.0	0.0	10	0.26	0	0	0	0	0.26	34.00	35
Kopu-SH25	Kopu-SH25	Thames Coromandel	0.4	0.1	4	0.90	0	0	0	0	0.90	37.30	34
National Park-Taumarunui	National Park-Owhango	Ruapehu District	0.1	0.1	4	0.37	0	0	0	0	0.37	90.30	33
National Park-Taumarunui	Owhango-Manunui	Ruapehu District	0.1	0.1	4	0.44	0	0	0	0	0.44	71.30	32
Mosgiel-Middlemarch	Outram-Middlemarch	Dunedin City	0.1	0.0	8	0.43	0	0	0	0	0.43	71.30	31
Masterston-Woodville	Opaki-Hamua	Taranua District	0.4	0.2	2	0.47	0	0	0	0	0.47	64.00	30
Stratford-Ohura	Stratford-Douglas	Stratford District	0.2	0.1	4	0.46	0	0	0	0	0.46	66.00	30
North Clyde-Waikaremoana	Frasertown-Tuai	Wairoa District	0.1	0.0	10	0.45	0	0	0	0	0.45	66.00	30
Te Ngae-Whakatane	Rotoehu-Te Teko	Whakatane District	0.3	0.2	2	0.45	0	2	0	0	0.45	63.30	29
Tokomaru-Gisborne	Tokomaru Bay-Tolaga Bay	Gisborne District	0.1	0.0	10	0.42	0	0	0	0	0.42	66.00	28
Waitara-Te Kuiti	Eight Mile Junction-Te Kuiti	Waitomo District	0.5	0.2	2	0.61	0	0	0	0	0.61	44.00	27
Taumarunui-Eight Mile	Mangatupoto-Eight Mile	Waitomo District	0.2	0.1	4	0.61	0	0	0	0	0.61	43.30	27
Raes Junction-Alexandra	Raes Junction-Millers Flat	Central Otago District	0.2	0.1	2	0.28	7	2	0	0	0.98	26.30	26
Palmerston-Kyeburn	Palmerston-Dunback	Waitaki District	0.1	0.1	8	0.72	0	0	0	0	0.72	35.30	25
Waitara-Te Kuiti	Piopio-Eight Mile Junction	Waitomo District	0.2	0.1	4	0.56	0	0	0	0	0.56	44.00	25
Coromandel-Waihi	Wangamata-Waihi	Thames Coromandel	0.1	0.1	4	0.32	0	4	0	0	0.32	71.00	23

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Renwick-Kawatiri	Renwick-Waihopai River	Marlborough District	0.0	0.1	8	0.34	0	0	0	0	0.34	64.60	22
Fairlie-Washdyke	Pleasant Point-Washdyke	Timaru District	0.4	0.2	2	0.48	0	2	0	0	0.48	42.30	20
Stratford-Ohura	Douglas-Kohuratahi	Stratford District	0.1	0.0	6	0.29	0	0	0	0	0.29	66.00	19
Kurow-Omarama	Kurow-Otemataa	Waitaki District	0.1	0.0	8	0.46	0	0	0	0	0.46	40.00	18
O'Sullivan Bridge-Springs	Maruia-Springs Junction	Buller District	0.0	0.0	6	0.20	0	0	0	0	0.20	90.00	18
North Clyde-Waikaremoana	North Clyde-Frasertown	Wairoa District	0.1	0.0	6	0.27	0	0	0	0	0.27	66.00	18
Drury-SH23	Glen Murray-Dunmore	Franklin	0.5	0.2	2	0.61	0	0	0	0	0.61	29.30	18
Drury-SH23	Dunmore-SH23	Waikato	0.5	0.2	2	0.61	0	0	0	0	0.61	29.30	18
Drury-SH23	Pukekawa-Glen Murray	Franklin	0.5	0.2	2	0.61	0	0	0	0	0.61	29.30	18
Opotiki-Tokomaru	Hicks Bay-Tokomaru Bay	Gisborne District	0.0	0.0	10	0.26	0	0	0	0	0.26	66.00	17
Opotiki-Tokomaru	Mauligaroa-Hicks Bay	Opotiki District	0.0	0.0	10	0.26	0	0	0	0	0.26	65.30	17
Lorneville-Riverton	Waimatuku-Riverton	Southland District	0.4	0.2	2	0.47	0	0	0	0	0.47	35.30	17
Makaraka-Opotiki	Nuhaka-Moree	Wairoa District	0.1	0.1	2	0.16	0	0	0	0	0.16	04.00	17
Tokoroa-Turangi	Tokaanu-Turangi	Taupo District	0.1	0.1	4	0.27	0	0	0	0	0.27	60.30	16
O'Sullivan Bridge-Springs	O'Sullivan Bridge-Marua	Tasman District	0.0	0.0	6	0.17	0	0	0	0	0.17	90.00	15
Middlemarch-Kyeburn	Middlemarch-Kyeburn	Central Otago District	0.1	0.0	6	0.21	0	0	0	0	0.21	71.30	15
Motueka to Collingwood	Upper Takaka to Takaka	Tasman District	0.0	0.1	4	0.20	0	0	0	0	0.20	75.60	15

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Fairlie-Washdyke	Cave-Pleasant Point	Timaru District	0.2	0.1	2	0.29	0	2	0	0	0.29	42.30	12
Fairlie-Washdyke	Fairlie-Albury	Mackenzie District	0.1	0.1	4	0.28	0	4	0	0	0.28	42.30	12
Renwick-Kawatiri	Waihapai River-Branch River	Marlborough District	0.0	0.0	8	0.18	0	0	0	0	0.18	64.60	12
Ruatahuna-SH5	Te Whaiti-Murupara	Whakaitane District	0.0	0.0	10	0.18	0	0	0	0	0.18	66.00	12
Stratford-Ohura	Tatu-Ohura	Ruapehu District	0.1	0.0	4	0.17	0	0	0	0	0.17	66.00	11
Invercargill-Kingston	Winton-Dipton	Southland District	0.2	0.1	2	0.24	0	0	0	0	0.24	41.00	10
Maruni-Kuratau	Maruni-Moerangi	Ruapehu District	0.1	0.1	2	0.14	0	0	0	0	0.14	66.00	9
Wellsford-Helensville	Wellsford-Kakanui	Rodney	0.2	0.1	2	0.24	0	0	0	0	0.24	38.00	9
Culverden-Waiatu	Culverden-Waiatu	Waimate District	0.0	0.0	4	0.11	0	0	0	0	0.11	81.00	9
Fairlie-Washdyke	Albury-Cave	Mackenzie District	0.2	0.1	2	0.19	0	2	0	0	0.19	42.30	8
Ranfurlly-Alexandra	Omakau-Alexandra	Dunedin City	0.1	0.1	2	0.17	0	0	0	0	0.17	46.00	8
Stratford-Ohura	Kohuratahi-Tatu	Ruapehu District	0.0	0.0	6	0.12	0	0	0	0	0.12	66.00	8
Palmerston-Kyeburn	Dunback-Kyeburn	Central Otago District	0.1	0.0	4	0.16	0	0	0	0	0.16	43.30	7
North Clyde-Waikaremoana	Tuai-Waikaremoana	Waioata District	0.0	0.0	10	0.11	0	0	0	0	0.11	66.00	7
Ruatahuna-SH5	Ruatahuna-Te Whaiti	Waioata District	0.0	0.0	10	0.11	0	0	0	0	0.11	66.00	7
Renwick-Kawatiri	Branches River-St Arnaud	Marlborough District	0.0	0.0	8	0.09	0	0	0	0	0.09	81.00	7
Gore-Lumsden	Gore-Mandeville	Southland District	0.2	0.1	2	0.24	0	0	0	0	0.24	29.30	7



Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Riverton-Clifden	Riverton-Colac	Southland District	0.1	0.1	2	0.17	0	0	0	0	0.17	37.00	6
Kurow-Oamarua	Otematata-Oamarua	Waitaki District	0.0	0.0	8	0.13	0	0	0	0	0.13	46.00	6
Renwick-Kawatiri	St Arnaud-Kawatiri	Tasman District	0.0	0.0	4	0.06	0	0	0	0	0.06	81.00	5
Maruni-Kuratau	Moerangi-Kuratau	Ruapehu District	0.0	0.0	2	0.07	0	0	0	0	0.07	66.00	5
Kyeburn-Ranfurly	Kyeburn-Ranfurly	Central Otago District	0.1	0.0	2	0.10	0	0	0	0	0.10	46.00	5
Tapanui-Raes Junction	Tapanui-Raes Junction	Clutha District	0.1	0.0	2	0.11	0	0	0	0	0.11	41.30	5
Pukeuri-Kurow	Pukeuri-Duntroon	Waitaki District	0.1	0.1	2	0.15	0	0	0	0	0.15	29.30	4
Ashburton-Waddington	Mount Hutt-Colgate	Selwyn District	0.1	0.0	2	0.09	0	0	0	0	0.09	46.00	4
Mataura-Winton	Mataura-Browns	Southland District	0.1	0.0	2	0.12	0	0	0	0	0.12	29.30	4
Ranfurly-Alexandra	Ranfurly-Omakau	Central Otago District	0.1	0.0	2	0.08	0	0	0	0	0.08	46.00	3
Tokoroa-Turangī	Whakamaru-Kuratau	Taupo District	0.0	0.0	2	0.06	0	0	0	0	0.06	60.30	3
Winton-Ohai	Nightcaps-Ohai	Southland District	0.1	0.0	2	0.07	0	0	0	0	0.07	43.60	3
Pukeuri-Kurow	Duntroon-Kurow	Waitaki District	0.0	0.0	4	0.11	0	0	0	0	0.11	29.30	3
Riverton-Clifden	Colac-Tuatapere	Southland District	0.1	0.0	2	0.07	0	0	0	0	0.07	37.00	3
Luggate-Tarras	Luggate-Tarras	Queenstown Lakes District	0.0	0.0	2	0.06	0	0	0	0	0.06	43.30	2
Tokoroa-Taupo	Kinleith-Atiamuri	South Waikato	0.5	0.3	0	0.00	1	0	0	0	0.00	63.30	0
Tokoroa-Turangī	Tokoroa-Whakamaru	South Waikato	0.1	0.1	0	0.00	0	0	0	0	0.00	60.30	0

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Tirau-Tokoroa	Tirau-Putaruru	South Waikato	0.9	0.4	0	0.00	1	0	0	0	0.00	35.30	0
Drury-SH23	Pukehohe-Tuakau	Franklin	1.2	0.6	0	0.00	0	0	0	0	0.00	29.30	0
Raglan-Hamilton	Whatawhata-Hamilton	Waikato	0.5	0.2	0	0.00	0	0	0	0	0.00	26.30	0
Drury-SH23	Tuakau-Pukekawa	Franklin	0.6	0.3	0	0.00	0	0	0	0	0.00	29.30	0
Wellsford-Albany	Dairy Flat-Albany	Auckland City	1.1	1.2	0	0.00	10	0	0	0	0.00	30.00	0
Tatuanui-Tirau	Waharoa-Matamata	Matamata Piako District	0.8	0.4	0	0.00	10	0	0	0	0.00	35.30	0
Bulls-Levin	Foxton-Levin	Horowhenua District	1.0	0.5	0	0.00	10	0	0	0	0.00	63.30	0
Rotorua-Tirau	Tapapa-Tirau	South Waikato	0.5	0.3	0	0.00	10	0	0	0	0.00	71.30	0
Wellsford-Albany	Puhoi-Waiwera	Auckland City	1.3	0.7	0	0.00	10	0	0	0	0.00	33.00	0
Paeroa-Hamilton	Morrinsville-Hamilton	Waikato	0.9	0.5	0	0.00	0	0	0	0	0.00	35.30	0
Tatuanui-Tirau	Tatuanui-Waharoa	Matamata Piako District	0.8	0.4	0	0.00	0	0	0	0	0.00	35.30	0
Drury-Hamilton	Te Rapa-Hamilton	Hamilton City	2.0	1.1	0	0.00	10	0	0	0	0.00	26.30	0
Tatuanui-Tirau	Matamata-Tirau	Matamata Piako District	0.8	0.4	0	0.00	10	0	0	0	0.00	35.30	0
Tokoroa-Taupo	Wairakei-Taupo	Taupo District	0.8	0.5	0	0.00	10	0	0	0	0.00	63.60	0
Wellsford-Helensville	Kakanui-Kaukapakapa	Rodney	0.4	0.2	0	0.00	0	0	0	0	0.00	38.00	0
Paeroa-Hamilton	Te Aroha-Morrinsville	Matamata Piako District	0.2	0.1	0	0.00	10	0	0	0	0.00	35.30	0
Drury-Hamilton	Rangiriri-Huntly	Waitakere	1.7	0.8	0	0.00	10	0	0	0	0.00	26.30	0

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
SH4-Waiouru	Ohakune-Rangataua	Ruapehu District	0.1	0.2	0	0.00	7	0	0	0	0.00	73.90	0
Te Kuiti-Hamilton	Kihikihi-Te Awamutu	Waipa District	0.8	0.4	0	0.00	10	0	0	0	0.00	35.30	0
Te Kuiti-Hamilton	Te Awamutu-Ohaupo	Waipa District	1.1	0.5	0	0.00	10	0	0	0	0.00	35.30	0
Helensville-Mt Eden	Waimaiku-Kumeu	Rodney	1.2	0.6	0	0.00	0	0	0	0	0.00	26.30	0
Newbury-Mangaweka	Kimbolton-Mangaweka	Rangitikei District	0.1	0.0	0	0.00	0	0	0	0	0.00	60.30	0
Te Kuiti-Hamilton	Ohaupo-Hamilton	Waipa District	1.3	0.6	0	0.00	10	0	0	0	0.00	35.30	0
Helensville-Mt Eden	Helensville-Waimaiku	Rodney	0.5	0.3	0	0.00	0	0	0	0	0.00	26.30	0
Newbury-Mangaweka	Cheltenham-Kimboltou	Rangitikei District	0.1	0.1	0	0.00	0	0	0	0	0.00	60.30	0
Hamilton-Tirau	Piarere - Tirau	Matamata Piako District	0.8	0.4	0	0.00	10	0	0	0	0.00	37.00	0
Drury-Hamilton	Huntly-Ngaruawahia	Waitakere	2.0	1.0	0	0.00	10	0	0	0	0.00	26.30	0
Newbury-Mangaweka	Feilding-Cheltenham	Manawatu District	0.3	0.1	0	0.00	0	0	0	0	0.00	60.30	0
Drury-Hamilton	Ngaruahahia-Te Rapa	Waitakere	2.0	1.0	0	0.00	10	0	0	0	0.00	26.30	0
SH4-Waiouru	SH4-Ohakune	Ruapehu District	0.1	0.2	0	0.00	7	0	0	0	0.00	73.90	0
Himitangi-Palmerston North	Himitangi-Rangitoto	Manawatu District	0.4	0.2	0	0.00	0	0	0	0	0.00	60.30	0
Bulls-Levin	Himitangi-Foxton	Manawatu District	0.9	0.5	0	0.00	10	0	0	0	0.00	63.30	0
Bulls-Levin	Sanson-Himitangi	Manawatu District	1.5	0.7	0	0.00	10	0	0	0	0.00	63.30	0
Palmerston North-Levin	Linton-Shannon	Manawatu District	0.7	0.4	0	0.00	0	0	0	0	0.00	60.30	0

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Himitangi-Palmerston North	Rangiotu-Loughburn	Manawatu District	0.8	0.4	0	0.00	0	0	0	0	0.00	60.30	0
Newbury-Mangaweka	Newbury-Feilding	Manawatu District	0.8	0.4	0	0.00	0	0	0	0	0.00	60.30	0
Drury-SH23	Drury-Pukekohe	Papakura City	1.7	0.9	0	0.00	0	0	0	0	0.00	25.30	0
Hamilton-Tirau	Cambridge-Piarere	Waipa District	1.4	0.7	0	0.00	10	0	0	0	0.00	32.30	0
Waahi-SH1	Mangatawhiri-SH1	Franklin	1.3	0.6	0	0.00	10	0	0	0	0.00	72.00	0
Wanganui-National Park	Raetihi-Horopito	Ruapehu District	0.1	0.1	0	0.00	7	0	0	0	0.00	80.30	0
Bulls-Wanganui	Bulls-Turakina	Rangitikei District	0.8	0.4	0	0.00	7	0	0	0	0.00	63.30	0
Palmerston North-Levin	Palmerston North-Linton	Palmerston North City	0.8	0.4	0	0.00	0	0	0	0	0.00	60.30	0
Hawera-New Plymouth	Ingleswood-Egmont Village	New Plymouth	0.9	0.4	0	0.00	0	0	0	0	0.00	63.30	0
Ingleswood-Waitara	Ingleswood-Waitara	New Plymouth	0.3	0.2	0	0.00	0	0	0	0	0.00	63.30	0
Hawera-New Plymouth	Stratford-Tariki	Stratford District	0.9	0.4	0	0.00	0	0	0	0	0.00	63.30	0
Hawera-New Plymouth	Eltham-Stratford	Stratford District	1.0	0.5	0	0.00	0	0	0	0	0.00	63.30	0
Hawera-New Plymouth	Hawera-Manaia	South Taranaki	0.4	0.2	0	0.00	0	0	0	0	0.00	66.00	0
Hawera-New Plymouth	Hawera-Normanby	South Taranaki	0.7	0.4	0	0.00	0	0	0	0	0.00	63.30	0
Hawera-New Plymouth	Opunake-Pungarehu	South Taranaki	0.2	0.1	0	0.00	0	0	0	0	0.00	66.00	0
Hawera-New Plymouth	Manaia-Pihama	South Taranaki	0.2	0.1	0	0.00	0	0	0	0	0.00	66.00	0
Hawera-New Plymouth	Pihama-Opunake	South Taranaki	0.2	0.1	0	0.00	0	0	0	0	0.00	66.00	0

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Hawera-New Plymouth	Normanby-Eitham	South Taranaki	0.9	0.4	0	0.00	0	0	0	0	0.00	63.30	0
Wanganui-Hawera	Wanganui-Westmere	Wanganui District	0.5	0.3	0	0.00	0	0	0	0	0.00	63.30	0
Wanganui-National Park	Wanganui-Otoko	Wanganui District	0.4	0.2	0	0.00	7	0	0	0	0.00	71.30	0
Himitangi-Palmerston North	Loughburn-Palmerston North	Palmerston North City	0.7	1.0	0	0.00	0	0	0	0	0.00	60.30	0
Whakatane-Tauranga	Whakatane-Thornton	Whakatane District	0.2	0.1	0	0.00	0	0	0	0	0.00	73.00	0
SH1-Tauranga	Hinuera-Te Poi	Tauranga City	0.5	0.2	0	0.00	0	0	0	0	0.00	35.30	0
Featherston-Masterton	Carterton-Masterton	Masterton District	1.1	0.5	0	0.00	0	0	0	0	0.00	74.00	0
Opotiki-Whakatane	Kutarere-Taneatua	Whakatane District	0.1	0.1	0	0.00	0	0	0	0	0.00	72.00	0
Te Ngae-Whakatane	Te Teko-Awakeri	Whakatane District	0.5	0.3	0	0.00	0	0	0	0	0.00	63.30	0
Te Ngae-Whakatane	Awakeri-Whakatane	Whakatane District	1.8	0.9	0	0.00	0	0	0	0	0.00	64.30	0
Whakatane-Tauranga	Thornton-Matata	Whakatane District	0.4	0.2	0	0.00	0	0	0	0	0.00	73.00	0
Palmerston-Bulls	Palmerston-Newbury	Palmerston North City	1.1	0.6	0	0.00	4	0	0	0	0.00	63.30	0
Tauranga-Waihi	Tauranga-Te Puna	Tauranga City	1.7	0.8	0	0.00	0	0	0	0	0.00	35.30	0
Woodville to Palmerston	Manawatu Gorge	Palmerston North City	0.8	0.4	0	0.00	4	0	0	0	0.00	74.00	0
Tauranga-Waihi	Waimata-Waihi	Hauraki District	0.5	0.3	0	0.00	0	0	0	0	0.00	35.30	0
Waihi-SHI	Ngatea-Mangatarata	Hauraki District	0.8	0.4	0	0.00	10	0	0	0	0.00	72.00	0
Waihi-SHI	Waihi-Waikino	Hauraki District	0.6	0.3	0	0.00	0	0	0	0	0.00	36.00	0

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Waihi-SHI	Paeora-Ngatea	Hauraki District	0.5	0.2	0	0.00	0	0	0	0	0.00	72.00	0
SH2-Tatuanui	SH2-Tatuanui	Hauraki District	0.5	0.2	0	0.00	0	0	0	0	0.00	29.30	0
Hawera-New Plymouth	Oakura-New Plymouth	New Plymouth	0.7	0.3	0	0.00	0	0	0	0	0.00	66.30	0
SH1-Tauranga	SH1-Hinuera	Tauranga City	0.5	0.2	0	0.00	0	0	0	0	0.00	35.30	0
Kawatiri-Nelson	Wakefield-Brightwater	Tasman District	0.3	0.4	0	0.00	10	0	0	0	0.00	83.00	0
Hawera-New Plymouth	Tariki-Inglewood	New Plymouth	0.9	0.4	0	0.00	0	0	0	0	0.00	63.30	0
Cromwell-Hawea	Cromwell-Luggate	Central Otago District	0.3	0.1	0	0.00	10	0	0	0	0.00	37.30	0
Alexandra-Cromwell	Alexandra-Clyde	Central Otago District	0.7	0.3	0	0.00	7	0	0	0	0.00	32.30	0
Raes Junction-Alexandra	Millers Flat-Roxburgh	Central Otago District	0.3	0.1	0	0.00	7	0	0	0	0.00	26.30	0
Cromwell-Hawea	Luggate-Albert Town	Queenstown Lakes District	0.2	0.1	0	0.00	10	0	0	0	0.00	37.30	0
Invercargill-Kingston	Dipton-Lumsden	Southland District	0.2	0.1	0	0.00	0	0	0	0	0.00	41.00	0
Richmond to Motueka	Richmond to Tasman	Tasman District	0.2	0.3	0	0.00	0	0	0	0	0.00	72.30	0
Invercargill-Kingston	Lorneville-Winton	Southland District	0.5	0.2	0	0.00	0	0	0	0	0.00	41.00	0
Kawatiri-Nelson	Brightwater-Richmond	Tasman District	0.4	0.5	0	0.00	10	0	0	0	0.00	64.30	0
Richmond to Motueka	Tasman to Motueka	Tasman District	0.2	0.3	0	0.00	0	0	0	0	0.00	72.30	0
Oamarua-Fairlie	Twizel-Lake Pukaki	MacKenzie District	0.1	0.1	0	0.00	10	0	0	0	0.00	47.30	0
Oamarua-Fairlie	Lake Pukaki-Tekapo	MacKenzie District	0.1	0.1	0	0.00	10	0	0	0	0.00	47.30	0

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Kopu-Paeroa	Kopu-Paeroa	Thames Coromandel	0.4	0.2	0	0.00	10	0	0	0	0.00	37.30	0
Kawerau-SH30	Kawerau-SH30	Kawerau District	0.6	0.3	0	0.00	0	0	0	0	0.00	63.30	0
Albert Town-Wanaka	Albert Town-Wanaka	Queenstown Lakes District	0.1	0.1	0	0.00	0	0	0	0	0.00	36.60	0
Gore-Lumsden	Balfour-Lumsden	Southland District	0.1	0.1	0	0.00	0	0	0	0	0.00	43.30	0
Makaraka-Opotiki	Makaraka-Ormond	Gisborne District	0.3	0.1	0	0.00	0	0	0	0	0.00	04.00	0
New Plymouth-Waitara	Bell Block-Waitara	New Plymouth	1.3	0.7	0	0.00	0	0	0	0	0.00	65.30	0
Hawera-New Plymouth	Egmont Village-New Plymouth	New Plymouth	1.0	0.5	0	0.00	0	0	0	0	0.00	63.30	0
Kawhia-Te Kuiti	Otorohanga-Te Kuiti	Waikato District	0.2	0.1	0	0.00	0	0	0	0	0.00	60.30	0
Te Kuiti-Hamilton	Te Kuiti-Hangatiki	Waikato District	0.5	0.2	0	0.00	10	0	0	0	0.00	44.00	0
Gore-Lumsden	Mandeville-Balfour	Southland District	0.1	0.0	0	0.00	0	0	0	0	0.00	29.30	0
Te Kuiti-Hamilton	Hangatiki-Otorohanga	Otorohanga District	0.6	0.3	0	0.00	10	0	0	0	0.00	44.00	0
Waitara-Te Kuiti	Waitara-Urenui	New Plymouth	0.6	0.3	0	0.00	0	0	0	0	0.00	65.30	0
Mataura-Winton	Browns-Winton	Southland District	0.1	0.1	0	0.00	0	0	0	0	0.00	35.30	0
Lorneville-Riverton	Wallacetown-Waimatuku	Southland District	0.5	0.2	0	0.00	0	0	0	0	0.00	35.30	0
Lorneville-Riverton	Lorneville-Wallacetown	Southland District	0.6	0.3	0	0.00	0	0	0	0	0.00	35.30	0
Riverton-Clifden	Tuatapere-Clifden	Southland District	0.0	0.0	0	0.00	0	0	0	0	0.00	36.00	0
Winton-Ohai	Wreys Bush-Nightcaps	Southland District	0.1	0.1	0	0.00	0	0	0	0	0.00	43.60	0

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Winton-Ohai	Winton-Wreys Bush	Southland District	0.1	0.1	0	0.00	0	0	0	0	0.00	35.30	0
Te Kuiti-Hamilton	Otorohanga-Kiokio	Otorohanga District	0.7	0.4	0	0.00	10	0	0	0	0.00	44.00	0
Ashburton-Waddington	Methven-Mount Hutt	Ashburton District	0.1	0.0	0	0.00	0	0	0	0	0.00	46.00	0
Mosgiel-Middlemarch	Mosgiel-Outram	Dunedin City	0.3	0.2	0	0.00	0	0	0	0	0.00	71.30	0
Pine Hill-Clarksville	Pine Hill-Green Island	Dunedin City	1.6	1.8	0	0.00	7	0	0	0	0.00	64.30	0
Pine Hill-Clarksville	Mosgiel-Allanton	Dunedin City	1.0	0.5	0	0.00	7	0	0	0	0.00	31.30	0
Pukeuri-Palmerston	Pukeuri-Oamaru	Waitaki District	0.8	0.4	0	0.00	7	0	0	0	0.00	25.30	0
Pukeuri-Palmerston	Oamaru-Maheno	Waitaki District	0.7	0.3	0	0.00	7	0	0	0	0.00	85.30	0
Pukeuri-Palmerston	Maheno-Herbert	Waitaki District	0.6	0.3	0	0.00	7	0	0	0	0.00	85.30	0
Washdyke-Pukeuri	St Andrews-Studholme	Waimate District	0.4	0.2	0	0.00	7	0	0	0	0.00	25.30	0
Washdyke-Pukeuri	Studholme - Glenavy	Waimate District	0.4	0.2	0	0.00	7	0	0	0	0.00	25.30	0
Washdyke-Pukeuri	Parcora-St Andrews	Waimate District	0.6	0.3	0	0.00	7	0	0	0	0.00	25.30	0
Ashburton-Washdyke	Orari-Winchester	Timaru District	0.9	0.4	0	0.00	7	0	0	0	0.00	28.30	0
Washdyke-Pukeuri	Washdyke-Timaru	Timaru District	1.6	0.8	0	0.00	7	0	0	0	0.00	25.30	0
Washdyke-Pukeuri	Timaru-Parcora	Timaru District	0.8	0.4	0	0.00	7	0	0	0	0.00	27.30	0
Ashburton-Washdyke	Winchester-Temuka	Timaru District	0.9	0.4	0	0.00	7	0	0	0	0.00	30.00	0
Opotiki-Whakatane	Taneatua-Whakatane	Whakatane District	0.1	0.1	0	0.00	0	0	0	0	0.00	72.00	0



Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Belfast-Rolleston	Belfast-Harewood	Christchurch City	0.8	0.9	0	0.00	10	0	0	0	0.00	34.30	0
Picton Blenheim	Spring Creek-Blenheim	Marlborough District	0.9	0.5	0	0.00	10	0	0	0	0.00	67.30	0
Nelson-Blenheim	Renwick-Blenheim	Marlborough District	0.8	0.4	0	0.00	10	0	0	0	0.00	64.30	0
Waipara-Belfast	Waipara-Amberley	Hurunui District	0.7	0.3	0	0.00	10	0	0	0	0.00	34.30	0
Waipara-Belfast	Leithfield-Waimakariri	Waimakariri District	0.5	0.5	0	0.00	10	0	0	0	0.00	34.30	0
Waipara-Belfast	Amberley-Leithfield	Waimakariri District	0.7	0.3	0	0.00	10	0	0	0	0.00	34.30	0
Ashburton-Washdyke	Tinwald-Orari	Ashburton District	0.6	0.3	0	0.00	10	0	0	0	0.00	28.30	0
Belfast-Rolleston	Harewood-Yaldhurst Rd	Christchurch City	0.8	0.9	0	0.00	10	0	0	0	0.00	34.30	0
Ashburton-Waddington	Ashburton-Medhven	Ashburton District	0.2	0.1	0	0.00	0	0	0	0	0.00	46.00	0
Waipara-Belfast	Waimakariri River-Belfast	Christchurch City	0.8	0.9	0	0.00	10	0	0	0	0.00	34.30	0
Yaldhurst-Otira	Yaldhurst-Darfield	Christchurch City	0.7	0.4	0	0.00	4	0	0	0	0.00	46.00	0
Ashburton-Waddington	Colgate-Waddington	Selwyn District	0.0	0.0	0	0.00	0	0	0	0	0.00	46.00	0
Christchurch-Little River	Halswell-Taitapu	Selwyn District	0.7	0.8	0	0.00	0	0	0	0	0.00	37.00	0
Yaldhurst-Otira	Darfield-Springfield	Selwyn District	0.1	0.1	0	0.00	4	0	0	0	0.00	46.00	0
McNab-Tapanui	Waoikoiko-Tapanui	Clutha District	0.1	0.1	0	0.00	0	0	0	0	0.00	41.30	0
Belfast-Rolleston	Yaldhurst - Rolleston	Christchurch City	0.6	0.7	0	0.00	10	0	0	0	0.00	34.30	0
Waipukurau-Napier	Te Hauke-Pakipaki	Hastings District	0.7	0.3	0	0.00	4	0	0	0	0.00	64.00	0

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Importance	Total Risk	Risk x Importance
Clarksville-McNab	Clinton-McNab	Clutha District	0.3	0.1	0	0.00	0	0	0	0	0.00	31.30	0
Woodville-Waipukurau	Woodville-Dannevirke	Tararua District	0.7	0.3	0	0.00	4	0	0	0	0.00	64.00	0
Masterton-Woodville	Pahiatua-Woodville	Tararua District	0.6	0.3	0	0.00	0	0	0	0	0.00	64.00	0
Masterton-Woodville	Humua-Pahiatua	Tararua District	0.4	0.2	0	0.00	0	0	0	0	0.00	64.00	0
Woodville-Waipukurau	Norsewood-Waipukurau	Central Hawkes Bay	0.4	0.2	0	0.00	4	0	0	0	0.00	64.00	0
Woodville-Waipukurau	Matamau-Norsewood	Tararua District	0.4	0.2	0	0.00	4	0	0	0	0.00	64.00	0
Waipukurau-Napier	Pakipaki-Hastings	Hastings District	0.7	0.3	0	0.00	4	0	0	0	0.00	64.00	0
Featherston-Masterton	Featherston-Greytown	Carterton District	0.3	0.3	0	0.00	0	0	0	0	0.00	74.00	0
Waipukurau-Napier	Hastings-Clive	Hastings District	1.0	0.6	0	0.00	4	0	0	0	0.00	64.00	0
Napier-SH2	Fernhill-SH2	Napier City	0.1	0.0	0	0.00	0	0	0	0	0.00	60.30	0
Napier to Hastings	Taradale to Hastings	Napier City	0.7	0.8	0	0.00	0	0	0	0	0.00	60.30	0
Napier to Hastings	Taradale to Hastings	Napier City	0.7	0.8	0	0.00	0	0	0	0	0.00	60.30	0
Waipukurau-Napier	Clive-Napier	Napier City	1.0	0.6	0	0.00	4	0	0	0	0.00	64.00	0
Hawera-New Plymouth	Pungarehu-Oakura	Wairoa District	0.3	0.1	0	0.00	0	0	0	0	0.00	66.00	0
SH2-Taupo	SH2-Eskdale	Hastings District	0.3	0.1	0	0.00	4	0	0	0	0.00	64.00	0
Invercargill-Kingston	Invercargill-Lorneville	Invercargill City	0.7	0.8	0	0.00	0	0	0	0	0.00	37.00	0
Palmerston North-Levin	Shannon-Levin	Horowhenua District	0.7	0.3	0	0.00	0	0	0	0	0.00	60.30	0

Link Name	Sublink Name	Local Authority	Commerce Grade	Mobility Grade	M and C Impact	M and C Importance	Tourism Grade	Tourism Impact	Lifeline Grade	Lifeline Importance	Total Risk Importance	Total Risk	Risk x Importance
Clarksville-McNab	Clarksville-Balclutha	Clutha District	0.5	0.3	0	0.00	0	0	0	0	0.00	30.00	0
Clarksville-McNab	Nth Balclutha-Rosebank	Clutha District	1.8	0.9	0	0.00	0	0	0	0	0.00	31.30	0
Pine Hill-Clarksville	Milton-Clarksville	Clutha District	0.6	0.3	0	0.00	7	0	0	0	0.00	30.00	0
Waiphat-Bluff	Gore-Mataura	Invercargill City	1.6	0.7	0	0.00	0	0	0	0	0.00	30.00	0
McNab-Tapamui	McNab-Waokoikoi	Gore District	0.2	0.1	0	0.00	0	0	0	0	0.00	41.30	0
Waiphat-Bluff	Edendale - Invercargill	Invercargill City	0.5	0.3	0	0.00	0	0	0	0	0.00	30.00	0
Clarksville-McNab	Rosebank-Clinton	Clutha District	0.3	0.2	0	0.00	0	0	0	0	0.00	31.30	0
Waiphat-Bluff	Invercargill-Woodend	Invercargill City	0.6	0.3	0	0.00	0	0	0	0	0.00	30.00	0
Waiphat-Bluff	Mataura-Edendale	Invercargill City	0.5	0.2	0	0.00	0	0	0	0	0.00	30.00	0
SH1-SH2	SH1-Pauatahanui	Lower Hutt City	0.5	0.5	0	0.00	0	0	0	0	0.00	63.30	0
Wellington-Featherston	Haywards to Silverstream	Upper Hutt City	1.2	1.3	0	0.00	0	0	0	0	0.00	60.30	0
Wellington-Featherston	Silverstream to Upper Hutt	Upper Hutt City	0.9	1.0	0	0.00	0	0	0	0	0.00	60.30	0
Featherston-Martinborough	Featherston-Martinborough	South Wairarapa	0.2	0.1	0	0.00	0	0	0	0	0.00	74.00	0
McNab to Bluff	McNab-Gore	Invercargill City	0.3	0.1	0	0.00	0	0	0	0	0.00	31.30	0

## **Appendix Two - Detailed Analysis**

SH 94 Cascade Creek to Milford

Auckland Harbour Bridge

Wainuiomata Hill Road

SH 1 Levin to Otaki

# **The Security of New Zealand's Strategic Roding Network**

## **Secondary Analysis**

### **Milford Road - Falls Creek to Cascade Creek**

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#### **Introduction**

This link was chosen for further analysis due to its high risk component from avalanche and landslides. The importance factor is also high due to the number of tourists using the route, and the frequency that the road is closed.

#### **Basic assumptions**

- AADT of 325 vpd
- Assume 30 year R.I. corresponds to a severe avalanche/landslide. For analysis purposes an event or risk of event of this magnitude is assumed to close the road for 60 days. This assumption is based upon historic road closure records for the last 17 years.
- The existing \$500,000 - \$700,000 spent on avalanche control and ice gritting per year is assumed to protect the road from 2 year R.I interval avalanches.
- There are no alternative routes into Milford Sound by road
- Milford has a permanent residence of approximately 30 people during the avalanche season of June through November.
- Annual tourist volume is assumed to be 120,000. (Tourist information from NZ Tourism Board survey)
- Contribution to national tourist revenue assumed to be \$1,000/person.

#### **Effect on National tourism and business**

The assumed effects of road closure and perceived danger to tourists as a result of avalanche has been evaluated based upon the estimated number of tourists that would not travel to NZ due to the Milford Sound destination being unavailable. The \$1000 per person allowed for is considered sufficient to cover all lost business costs.

#### **Travel time costs**

With no alternative routes available, extra travel time costs are assumed to be nil.

#### **Vehicle operating costs and Environmental costs**

Same argument as for travel time costs.

#### **Lifeline costs**

Milford Sound is regularly serviced by aircraft and has a substantial airfield capable of handling medium size aircraft. Also, the number of helicopters operating in Southland per capita population is higher than elsewhere in the country. Hence, it has been assumed that any emergency evacuations as a result of the road link being cut off will be made by airlift. It is assumed that air evacuation would occur in any case due to the distance from hospitals. The value attached to the lifeline loss has been assumed to be zero.

# The Security of New Zealand's Strategic Roding Network

## Secondary Analysis

### Milford Road - Falls Creek to Cascade Creek

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#### **Cost of alternative access**

Vital supplies for permanent population remaining at Milford Sound is assumed to be carried in by air. The assumed cost of this has been included in the analysis.

#### **Unplanned disruption costs**

Costs associated with repair of the road, and reopening the link following avalanche have been assumed and included in the analysis. These costs are highly dependent on where the avalanche occurs, and what assets are damaged as a result.

#### **Existing annual maintenance costs**

Actual costs derived from Contractors records for previous 17 years.

#### **Level of Exposure**

The current level of exposure assumes that the road is closed for approximately 10 days per year. This level of exposure is assumed to include protection from 2 year R.I. avalanches. The analysis indicates that significant extra revenue could be generated by extra tourism if the road was maintained in trafficable condition for more of the year. The 10 year R.I. avalanche causes the greatest cost, due to the higher probability of the occurrence. Hence, protection from the 10 year event will provide the greatest gains. Options for reducing the probability of closure are listed below:

#### **Options**

1. Increase avalanche control spending
2. Construct avalanche deflection structures over road
3. Improve Milford Sound airport to provide serviceability to large aircraft
4. Construct alternative road access to Milford (Tunnel from Greenstone valley)

Of these options, option 2 would appear to be the most viable. The majority of the weighting for this link is derived from the risk component. However, when assessed further the impact on national tourism causes potentially substantial losses in revenue. For the assumptions made in this analysis, and the current B/C cut-off of 4.0, the assessed costs of \$M30.7 allow for approximately \$M7.7 to be spent improving the security of the link.

However because of the size of the events it is also unlikely that even the risk of an annual event can be completely eliminated. Therefore two additional sets of analysis were completed. These were NOT based on undertaking a specific course of action but rather assuming a reduction in risk could be achieved and then identifying the benefits attributable. Taking this approach there are innumerable options available but the analysis does give some feeling for whether significant improvements in the reliability of the link are likely to be economically justified.

**The Security of New Zealand's Strategic Roding Network**  
**Secondary Analysis**  
**Milford Road - Falls Creek to Cascade Creek**

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The detail of this analysis is shown in the attached sheets however they indicate that because of the frequency of events on the pass between \$2M and \$4M in capital works is justifiable to bring about a relatively small reduction in impact. Similarly annual expenditure of between \$0.2M and 0.4M can be justified to bring about the same reduction.

Link Name: SH94-03 Cascade Creek to Milford  
 Risk Element: Avalanche and landslide

Recurrence interval of event  
 Probability of occurrence in one year  
 Effect of event (assumed)

**Annual Cost summary due to event**

Annual tourist volume  
 Percent change in tourist volume  
 Reduction in tourist numbers  
 Effective cost per tourist lost  
 Cost to National tourism  
 Cost through loss of business  
 Environmental cost (CO2)  
 Extra travel time costs  
 Additional vehicle operating costs  
 Life:line costs  
 Cost of alternative access  
 Unplanned disruption costs  
 Estimated annual cost  
 Expected value for each event  
 Sum of Expected values of each event  
 Net present value of total cost over 25 year period.

Existing annual maintenance costs to retain link  
 Net present value of maintenance over 25 years  
 Total Net present value of exposure:

- 1) R.L. of 5 includes 3.5-7.5 year R.L.'s.
- 2) R.L. of 10 includes 7.5 - 15 year R.L.'s.
- 3) R.L. of 20 includes 15 - 25 year R.L.'s.
- 4) R.L. of 30 includes 25 - 35 year R.L.'s.

	2	5	10	20	30
Annual tourist volume	120,000	120,000	120,000	120,000	120,000
Percent change in tourist volume	-0.01	-0.02	-0.05	-0.08	-0.10
Reduction in tourist numbers	-1,200	-2,400	-6,000	-9,600	-12,000
Effective cost per tourist lost	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Cost to National tourism	\$1,200,000	\$2,400,000	\$6,000,000	\$9,600,000	\$12,000,000
Cost through loss of business	\$20,000	\$40,000	\$60,000	\$80,000	\$100,000
Environmental cost (CO2)	\$0	\$0	\$0	\$0	\$0
Extra travel time costs	\$0	\$0	\$0	\$0	\$0
Additional vehicle operating costs	\$0	\$0	\$0	\$0	\$0
Life:line costs	\$0	\$0	\$0	\$0	\$0
Cost of alternative access	\$5,000	\$10,000	\$20,000	\$40,000	\$60,000
Unplanned disruption costs	\$20,000	\$40,000	\$60,000	\$80,000	\$100,000
Estimated annual cost	\$1,245,000	\$2,490,000	\$6,140,000	\$9,800,000	\$12,260,000
Expected value for each event	\$622,500	\$498,000	\$614,000	\$490,000	\$408,667
Sum of Expected values of each event	\$2,633,167				
Net present value of total cost over 25 year period.	\$25,078,279				
Existing annual maintenance costs to retain link		\$600,000			
Net present value of maintenance over 25 years		\$5,714,400			
Total Net present value of exposure:		\$30,792,679			



Link Name: SH94-03 Cascade Creek to Milford  
 Risk Element: Avalanche and landslide  
 Reduced Risk/Impact - Scenario One

Recurrence interval of event  
 Probability of occurrence in one year  
 Effect of event (assumed)

**Annual Cost summary due to event**

	2	5	10	20	30
Annual tourist volume	120,000	120,000	120,000	120,000	120,000
Percent change in tourist volume	-0.01	-0.02	-0.02	-0.05	-0.08
Reduction in tourist numbers	-720	-1,680	-4,500	-5,280	-7,000
Effective cost per tourist lost	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Cost to National tourism	\$720,000	\$1,680,000	\$4,500,000	\$5,280,000	\$7,000,000
Cost through loss of business	12,000	28,000	45,000	44,000	58,333
Environmental cost (CO2)	\$0	\$0	\$0	\$0	\$0
Extra travel time costs	\$0	\$0	\$0	\$0	\$0
Additional vehicle operating costs	\$0	\$0	\$0	\$0	\$0
Lifeline Cost	\$0	\$0	\$0	\$0	\$0
Cost of alternative access	\$3,000	7,000	15,000	22,000	35,000
Unplanned disruption costs	12,000	28,000	45,000	44,000	58,333
Estimated annual cost	\$747,000	\$1,743,000	\$4,605,000	\$5,390,000	\$7,151,667
Expected value for each event	\$373,500	\$348,600	\$460,500	\$269,500	\$238,389
Sum of Expected values of each event	\$1,690,489				
Net present value of total cost over 25 year period.	\$16,100,216				

Existing annual maintenance costs to retain link  
 Net present value of maintenance over 25 years

Total Net present value of exposure: \$21,814,616

Change in NPV \$8,978,063  
 Justifiable Project Cost to reduce risk @ B/C = 4.0 \$2,244,516  
 or Justifiable additional annual extra cost @ B/C = 4 \$235,274

Milford

Link Name: SH94-03 Cascade Creek to Milford  
 Risk Element: Avalanche and landslide  
 Reduced Risk/Impact - Scenario Two

	2	5	10	20	30
Recurrence interval of event	2	5	10	20	30
Probability of occurrence in one year	0.50	0.20	0.10	0.05	0.03
Effect of event (assumed)	3	7	12	15	20
<b>Annual Cost summary due to event</b>					
Annual tourist volume	120,000	120,000	120,000	120,000	120,000
Percent change in tourist volume	-0.01	-0.015	-0.02	-0.04	-0.05
Reduction in tourist numbers	-432	-1,176	-2,700	-1,980	-2,333
Effective cost per tourist lost	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Cost to National tourism	\$432,000	\$1,176,000	\$2,700,000	\$1,980,000	\$2,333,333
Cost through loss of business	\$7,200	\$19,600	\$27,000	\$16,500	\$19,444
Environmental cost (CO2)	\$0	\$0	\$0	\$0	\$0
Extra travel time costs	\$0	\$0	\$0	\$0	\$0
Additional vehicle operating costs	\$0	\$0	\$0	\$0	\$0
Lifeline Cost	\$0	\$0	\$0	\$0	\$0
Cost of alternative access	\$1,800	\$4,900	\$9,000	\$8,250	\$11,667
Unplanned disruption costs	\$7,200	\$19,600	\$27,000	\$16,500	\$19,444
Estimated annual cost	\$448,200	\$1,220,100	\$2,763,000	\$2,021,250	\$2,383,889
Expected value for each event	\$224,100	\$244,020	\$276,300	\$101,063	\$79,463
Sum of Expected values of each event	\$924,945				
Net present value of total cost over 25 year period.	\$8,809,181				
Existing annual maintenance costs to retain link		\$600,000			
Net present value of maintenance over 25 years		\$5,714,400			
Total Net present value of exposure:		\$14,523,581			

Change in NPV \$16,269,099  
 Justifiable Project Cost to reduce risk @ B/C = 4.0 \$4,067,275  
 or Justifiable additional annual extra cost @ B/C = 4 \$426,339

# The Security of New Zealand's Strategic Roding Network

## Secondary Analysis

### Auckland Harbour Bridge Link

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#### Introduction

This link was chosen for further analysis as it ranked highly for importance and low for risk in the initial analysis.

#### Assumptions

The following assumptions have been made in order to carry out this cost analysis:

- AADT of 125,100 vpd
- Assume 100 year R.I corresponds to MMVIII earthquake. (Regional ground velocities 0.3g). Auckland Harbour Bridge will probably not be damaged by an event of this magnitude, however it is likely that the link will be closed due to landslides and liquefaction of land either side of the bridge. For analysis purposes, it has been assumed that the link in question will be closed for 20 days following the disaster.\*
- The 50 year R.I. event assumes a smaller earthquake, which may cause some damage to the highway, however disruption to the road is assumed be in the order of one day.\*
- Alternative route exists via Great North Road/Auckland-Kumeu motorway (approx. 25km extra travel distance)
- Capacity of alternative route assumed to be 15,000 vpd (From AADT data)
- It is likely that the alternative parallel routes will be affected to a similar degree to the main route (SH1). (From A. J. Nicholson paper (1996))

\* Recurrence intervals and the effects have been assumed as 'best guesses' for the purposes of this analysis.

#### Effect on National tourism

It is assumed that tourists will not decide to stay away from New Zealand as a result of the bridge link being disrupted. Effects will invariably be seen as a result of the disaster, however these cannot be directly attributed to the link failure.

#### Travel time costs

Assuming the harbour bridge is closed, SH1 traffic will be diverted west around Waitemata harbour. Highways in this area carry approximately 15,000 vehicles per day at present. During bridge closure, a proportion of the 125,000 vehicles that use SH1 per day will use the alternate route.

In the event of a major disaster, it is assumed that 30% of businesses will resume operating soon after. Hence, approximately 40% of vehicles will remain travelling.

# The Security of New Zealand's Strategic Roding Network

## Secondary Analysis

### Auckland Harbour Bridge Link

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Due to probable disruption of the alternate routes, assumed to reduce capacity by 50%, average travel times are assumed to take 3 hrs longer than usual. (This represents an average travel speed of about 10kph over the extra 25km distance).

Hence, the cost of the extra travel per day is calculated as follows:

$(15000\text{vpd} + 125000\text{vpd}) \times 50\% = 70,000\text{vpd}$  using alternate route

$70,000\text{vpd} \times 3\text{hrs extra travel time} \times \$14.40/\text{hr}^{(1)} = \$3,024,000/\text{day}$  in travel time costs.

#### Vehicle operating costs.

Extra costs are incurred as a result of the extra distance travelled.

$70,000\text{vpd} \times (25\text{km}-5\text{km})^{(2)} \times \$0.36/\text{km}^{(3)} = \$504,000/\text{day}$  in extra vehicle operating costs.

#### Environmental costs

Extra environmental costs are incurred due to the higher emissions of CO<sub>2</sub> resulting from the extra distance travelled.

$\$504,000 \times 1.5\% = \$7,500/\text{day}$  in extra CO<sub>2</sub> emissions.<sup>(4)</sup>

#### Loss of Business

It is difficult to assess these costs accurately. However the following assumptions were made;

Approximately half of the traffic will stay home.	70,000 vpd
The traffic is two way so assume double count.	35,000 vpd
Assume 30% of travel time value for an 8 hour day is the value added portion.	$\$0.3 \times 8 \times 14.4/\text{day}$
Therefor lost business to the country is approximately	\$1.2M/day

#### Lifeline cost

No costs have been attributed to loss of life due to the link being disabled, due to the fact that there are hospital facilities on both sides of the Harbour Bridge. Lifeline costs are likely to be seen due to degradation of the general roading network as a result of the event. These costs have not been incorporated into the analysis as they are not solely attributable to the disruption of this link.

#### Cost of alternative access

Some cost has been attributed to alternative access to allow for extra ferry travel across the harbour, helicopter use for travel within the city etc.

# The Security of New Zealand's Strategic Roding Network

## Secondary Analysis

### Auckland Harbour Bridge Link

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#### Unplanned disruption costs

Costs associated with reinstatement of the road following the disaster. These costs have been assumed, but will depend highly on the nature of the event and damage caused.

#### Existing annual maintenance costs

Assumed costs applicable to maintaining susceptible sections of the link.

Costs are summarised and discounted to net present value over the 25 year analysis period in the attached tables.

- <sup>(1)</sup> \$14.40 from TNZ Project Evaluation Manual for travel time costs for all periods for Urban Arterial road. (Table A4.3)
- <sup>(2)</sup> Difference in travel distance between main route and alternative
- <sup>(3)</sup> Cost per km for 10km/hr and average 0 gradient (Table A5.13a)
- <sup>(4)</sup> Formulae for calculating CO<sub>2</sub> costs. (Para. 8.3.4a)

#### Options

For an event of sufficient magnitude to incapacitate the Auckland Harbour Bridge, severe damage will also occur to the road structure either side of the bridge. In addition, other routes that could be used during closure of the main link stand a high probability of being damaged to a similar or worse extent.

There are several options available for the Auckland Harbour Bridge link. These are listed as follows:

1. Provide extra traffic capacity on alternative routes for use when bridge link is cut
2. Improve security of the existing link to prevent closure for a specific design event
3. Allow for ferry transport for vehicles across the harbour
4. Construct a tunnel beneath the harbour
5. Accept that the link will fail during/following the disaster, and accept associated costs.

Of these options, number 2 would appear to be the most feasible. The Harbour Bridge is currently being strengthened to resist greater than 1/5000 year earthquake loads. For the current B/C cut-off of 4.0 the \$M14.7 assessed cost represents \$M3.7 available to be spent to reduce either the risk, or the impact. Due to the impact being high, and the risk low, it is apparent that money would be more wisely spent to further reduce the risk of closure. Providing extra capacity to the alternate link for instance will cost significantly more than protecting the bridge approaches from liquefaction, but the reduction in the risk x impact value will be greater for the latter.

**The Security of New Zealand's Strategic Roding Network**  
**Secondary Analysis**  
**Auckland Harbour Bridge Link**

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Two additional sets of analysis were completed. These were NOT based on undertaking a specific course of action but rather assuming a reduction in risk could be achieved and then identifying the benefits attributable. Taking this approach there are innumerable options available but the analysis does give some feeling for whether significant improvements in the reliability of the link are likely to be economically justified.

The detail of this analysis is shown in the attached sheets however they indicate that ;

- only approximately \$1.5M is justifiable to remove the risk of a 1:50 year event, while
- up to \$2.2M may be justifiable to halve the impact of a 1:100 year event.

Although no detailed assessment has been completed it is considered unlikely that these amounts will be sufficient to complete the scale of physical works that would be necessary to bring about the identified reduction in risk and impact.

The approach for assessing the economic effects of a major disaster on this link was to identify the costs associated with the event, and determine the funds that would be available for spending with the current B/C cut-off at 4.0.

The assessments were carried out without detailed information regarding the vulnerability of the link, for instance the actual liquefaction susceptibility of the approaches, or the actual effects of forcing 70,000 vehicles onto a different route. Assumptions have been made regarding these factors to allow the analysis to be undertaken.

Harbour Bridge

Link Name: SH 01-08 Auckland Harbour Bridge  
 Risk Element: Earthquake and/or Tsunami

Recurrence interval of event	2	10	20	50	100
Probability of occurrence in one year	0.50	0.10	0.05	0.02	0.01
Effect of event (assumed)	0	0	0	5	20
<b>Annual Cost summary due to event</b>					
Annual tourist volume	0	0	0	0	0
Percent change in tourist volume	0.00	0.00	0.00	0.00	0.00
Reduction in tourist numbers	0	0	0	0	0
Effective cost per tourist lost	\$0	\$0	\$0	\$0	\$0
Cost to National tourism	\$0	\$0	\$0	\$0	\$0
Cost through loss of business	\$0	\$0	\$0	\$6,000,000	\$24,000,000
Extra travel time costs	\$0	\$0	\$0	\$15,120,000	\$60,048,000
Additional vehicle operating costs	\$0	\$0	\$0	\$2,520,000	\$1,008,000
Environmental cost (CO2)	\$0	\$0	\$0	\$37,500	\$150,000
Lifeline costs	\$0	\$0	\$0	\$40,000	\$60,000
Unplanned disruption costs	\$0	\$0	\$0	\$2,000,000	\$8,000,000
Estimated annual cost	\$0	\$0	\$0	\$25,717,500	\$93,266,000
Expected value for each event	\$0	\$0	\$0	\$514,350	\$932,660
Sum of Expected values of each event	\$1,447,010				
Net present value of total cost over 25 year period.	\$13,781,323				
Existing annual maintenance costs to retain link	\$100,000				
Net present value of maintenance over 25 years	\$952,400				
Total Net present value of exposure:	\$14,733,723				

- 1) R.I. of 5 includes 3.5-7.5 year R.I.'s.
- 2) R.I. of 10 includes 7.5 - 15 year R.I.'s.
- 3) R.I. of 20 includes 15 - 25 year R.I.'s.
- 4) R.I. of 30 includes 25 - 35 year R.I.'s.

Harbour Bridge

Link Name: SH 01-08 Auckland Harbour Bridge      Reduced Impact through improved design and increased factor of safety  
 Risk Element: Earthquake and/or Tsunami

Recurrence interval of event	2	10	20	50	100
Probability of occurrence in one year	0.50	0.10	0.05	0.02	0.01
Effect of event (assumed)	0	0	0	1	9
<b>Annual Cost summary due to event</b>					
Annual tourist volume	0	0	0	0	0
Percent change in tourist volume	0.00	0.00	0.00	0.00	0.00
Reduction in tourist numbers	0	0	0	0	0
Effective cost per tourist lost	\$0	\$0	\$0	\$0	\$0
Cost to National tourism	\$0	\$0	\$0	\$0	\$0
Cost through loss of business	\$0	\$0	\$1,200,000	\$10,800,000	\$10,800,000
Extra travel time costs	\$0	\$0	\$3,024,000	\$27,021,600	\$27,021,600
Additional vehicle operating costs	\$0	\$0	\$504,000	\$453,600	\$453,600
Environmental cost (CO2)	\$0	\$0	\$7,500	\$67,500	\$67,500
Lifeline costs	\$0	\$0	\$8,000	\$27,000	\$27,000
Unplanned disruption costs	\$0	\$0	\$400,000	\$3,600,000	\$3,600,000
Estimated annual cost	\$0	\$0	\$5,143,500	\$41,969,700	\$41,969,700
Expected value for each event	\$0	\$0	\$0	\$102,870	\$419,697
Sum of Expected values of each event	\$522,567				
Net present value of total cost over 25 year period.	\$4,976,928				
Existing annual maintenance costs to retain link	\$100,000				
Net present value of maintenance over 25 years	\$952,400				
Total Net present value of exposure:	\$5,929,328				
Change from Base	\$8,804,395				
Value to Achieve change in risk/impact at B/c =4.0	\$2,201,099				



Harbour Bridge

Link Name: SH 01-08 Auckland Harbour Bridge  
 Risk Element: Earthquake and/or Tsunami

Reduced Impact through improved design and increased factor of safety

	2	10	20	50	100
Recurrence interval of event	2	10	20	50	100
Probability of occurrence in one year	0.50	0.10	0.05	0.02	0.01
Effect of event (assumed)	0	0	0	0	20
<b>Annual Cost summary due to event</b>					
Annual tourist volume	0	0	0	0	0
Percent change in tourist volume	0.00	0.00	0.00	0.00	0.00
Reduction in tourist numbers	0	0	0	0	0
Effective cost per tourist lost	\$0	\$0	\$0	\$0	\$0
Cost to National tourism	\$0	\$0	\$0	\$0	\$0
Cost through loss of business	\$0	\$0	\$0	\$0	\$0
Extra travel time costs	\$0	\$0	\$0	\$240,000	\$24,000,000
Additional vehicle operating costs	\$0	\$0	\$0	\$0	\$60,048,000
Environmental cost (CO2)	\$0	\$0	\$0	\$0	\$1,008,000
Lifeline costs	\$0	\$0	\$0	\$0	\$150,000
Unplanned disruption costs	\$0	\$0	\$0	\$0	\$60,000
Estimated annual cost	\$0	\$0	\$0	\$0	\$8,000,000
Expected value for each event	\$0	\$0	\$0	\$0	\$93,266,000
Sum of Expected values of each event	\$932,660				\$932,660
Net present value of total cost over 25 year period.	\$8,882,654				
Existing annual maintenance costs to retain link					\$100,000
Net present value of maintenance over 25 years					\$952,400
Total Net present value of exposure:					\$9,835,054
Change from Base					\$4,898,669
Value to Achieve change in risk/impact at B/c =4.0					\$1,224,667

# The Security of New Zealand's Strategic Roding Network

## Secondary Analysis

### Wainuiomata Hill Road

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#### Introduction

Wainuiomata Hill was chosen for further analysis due to the risk of isolating approximately 20,000 people should the link be closed. The importance of this link was high due to the Lifeline factor, although the risk of closure is relatively low.

#### Assumptions

- AADT 10,800 vpd
- Approximately 20,000 population
- Assume 100 year R.I. event will cause landslides of sufficient volume to close the road completely for 3 days.
- No alternative routes exist
- The route is of no significance to tourism

#### Travel time costs

There is no alternative route to Wainuiomata. During road closure, there will be no traffic using the route. Travel time costs have been assumed to be zero.

#### Vehicle operating costs

Same argument as for travel time costs. Vehicle operating costs have been assumed to be zero.

#### Environmental costs

Same argument as for travel time costs. Environmental costs have been assumed to be zero.

#### Loss of Business

It is difficult to assess these costs accurately. However the following assumptions were made;

All the traffic will be affected	10,800 vpd
The traffic is two way so assume double count.	5,400 vpd
Assume 30% of travel time value for an 8 hour day is the value added portion.	$\$0.3 * 8 * 14.4 / \text{day}$
Therefor lost business to the country is approximately	$\$0.2 \text{M} / \text{day}$

#### Lifeline costs

Due to the large population of Wainuiomata, and the lack of hospital facilities, there is some risk that medical help may not be readily available in times of emergency. There are also no airport facilities nearby, hence, any air evacuation will be by helicopter. During and following a high recurrence interval disaster, helicopters are assumed to be in short supply. It has been assumed for the sake of this analysis that a human life is worth \$1,000,000. It has also been assumed that closure of the link for a 3 day period will cause the loss of one life. This will occur in combination with the disruption a large scale disaster will bring.

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**Secondary Analysis**  
**Wainuiomata Hill Road**

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**Cost of alternative access**

Alternative access by helicopter or other means has been assumed to be possible, however at high cost. In this case the cost may overlap with the lifeline cost outlined above. It is assumed that vital supplies will be airlifted into the area.

**Unplanned disruption costs**

These costs are associated with clearing the road and re-establishing access. For a major landslide, there will be a substantial amount of debris to remove, and costs will be commensurably high.

**Existing annual maintenance costs**

Assumed costs based upon similar sections of highway in Coastal Otago area.

**Options**

There are limited options for available for this link. The length of road likely to be affected by closure is approximately 3.5km. It is therefore assumed that protection work in the form of slope stabilisation will provide the greatest benefits. Other alternatives include:

1. Construct a tunnel beneath the hill
2. Construct an alternative route
3. Provide airport/ air evacuation facilities at Wainuiomata
4. Provide hospital facilities at Wainuiomata

From the analysis, the net present value of the expected costs over the 25 year analysis period is less than \$1,000,000. Hence, the maximum funding that would be available assuming the proposed work had a B/C ratio of 4.0 is \$200,000. Hence, only a small amount of work could be carried out to reduce the exposure of the link to closure.

An additional analysis was completed, NOT based on undertaking a specific course of action but rather assuming a reduction in risk and impact that might be achieved and then identifying the benefits attributable. Taking this approach there are innumerable options available but the analysis does give some feeling for whether significant improvements in the reliability of the link are likely to be economically justified.

The detail of this analysis is shown in the attached sheets however it indicates that less than \$100,000 can be justified to remove the risk of a 1:10 year event and reduce the impacts of larger events.

Although no detailed assessment has been completed it is considered unlikely that this amount would be sufficient to complete the scale of physical works that would be necessary to bring about the targeted reduction in risk and impact.

Wainui Hill

Link Name: Special section - Wainui Hill  
 Risk Element: Landslide

	2	10	20	50	100
Recurrence interval of event		10	20	50	100
Probability of occurrence in one year	0.50	0.10	0.05	0.02	0.01
Effect of event (assumed)	0	0.50	1	2	3
<b>Annual Cost summary due to event</b>					
Annual tourist volume	0	0	0	0	0
Percent change in tourist volume	0.00	0.00	0.00	0.00	0.00
Reduction in tourist numbers	0	0	0	0	0
Effective cost per tourist lost	\$1,100	\$1,100	\$1,100	\$1,100	\$1,100
Cost to National tourism	\$0	\$0	\$0	\$0	\$0
Cost through loss of business	\$0	\$92,500	\$185,000	\$370,000	\$555,000
Environmental cost (CO2)	\$0	\$0	\$0	\$0	\$0
Extra travel time costs	\$0	\$0	\$0	\$0	\$0
Additional vehicle operating costs	\$0	\$0	\$0	\$0	\$0
Lifeline costs	\$0	\$0	\$0	\$0	\$1,000,000
Cost of alternative access	\$0	\$0	\$15,000	\$30,000	\$45,000
Unplanned disruption costs	\$0	\$0	\$40,000	\$80,000	\$150,000
Estimated annual cost	\$0	\$92,500	\$240,000	\$480,000	\$1,750,000
Expected value for each event	-	\$9,250	\$12,000	\$9,600	\$17,500
Sum of Expected values of each event					\$48,350
Net present value of total cost over 25 year period.					\$460,485
Existing annual maintenance costs to retain link					\$15,000
Net present value of maintenance over 25 years					\$142,860
Total Net present value of exposure:					\$603,345

Total Net present value of exposure:

- 1) R.I. of 2 includes 0-7.5 year R.I.'s.
- 2) R.I. of 10 includes 7.5 - 15 year R.I.'s.
- 3) R.I. of 20 includes 15 - 35 year R.I.'s.
- 4) R.I. of 50 includes 35 - 75 year R.I.'s.
- 5) R.I. of 100 includes 75 - 25 year R.I.'s.

Mainui Hill

Link Name: Special section - Mainui Hill  
 Risk Element: Landslide

Reduced Risk/Impact Scenario One

	2	10	20	50	100
Recurrence interval of event	0.50	0.10	0.05	0.02	0.01
Probability of occurrence in one year	0.0	0.0	0.5	1.0	2.0
Effect of event (assumed)					
<b>Annual Cost summary due to event</b>					
Annual tourist volume	0	0	0	0	0
Percent change in tourist volume	0.00	0.00	0.00	0.00	0.00
Reduction in tourist numbers	0	0	0	0	0
Effective cost per tourist lost	\$1,100	\$1,100	\$1,100	\$1,100	\$1,100
Cost to National tourism	\$0	\$0	\$0	\$0	\$0
Cost through loss of business	\$0	\$0	\$92,500	\$185,000	\$370,000
Environmental cost (CO2)	\$0	\$0	\$0	\$0	\$0
Extra travel time costs	\$0	\$0	\$0	\$0	\$0
Additional vehicle operating costs	\$0	\$0	\$0	\$0	\$0
Lifeline costs	\$0	\$0	\$0	\$0	\$666,667
Cost of alternative access	\$0	\$0	\$7,500	\$15,000	\$30,000
Unplanned disruption costs	\$0	\$0	\$20,000	\$40,000	\$100,000
Estimated annual cost	\$0	\$0	\$120,000	\$240,000	\$1,166,667
Expected value for each event	-	\$0	\$6,000	\$4,800	\$11,667
Sum of Expected values of each event					\$22,467
Net present value of total cost over 25 year period.					\$213,973
Existing annual maintenance costs to retain link					\$15,000
Net present value of maintenance over 25 years					\$142,860
<b>Total Net present value of exposure:</b>					<b>\$356,833</b>
Change from Base					\$246,513
Value to Achieve change in risk/impact at B/c =4.0					\$61,628

# The Security of New Zealand's Strategic Roding Network

## Secondary Analysis

### State Highway 1 - Levin to Otaki River

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#### **Introduction**

This link was chosen for further analysis as it has both medium risk and importance factors from the initial analysis. However, on closer inspection of the link, the majority of the risk element is derived from the earthquake hazard. The link is situated on the plain below the Tararua ranges and is generally more than 5km from the sea. The assessed earthquake risk, and the realistic earthquake risk are possibly quite different.

#### **Assumptions**

- AADT 14500 vpd
- Alternative route exists (via SH2 Upper Hutt - Masterton - Palmerston North). This route is approximately 200km in length.
- The 100 year R.I event will cause disruption to the Otaki river bridge for three days.
- The route is of no significance to tourism.

#### **Travel time costs**

The extra travel time costs are based upon 200km travel around the alternative route.

It is assumed that 5% of vehicles will make the journey during the days of closure. It is assumed that the Otaki river bridge is the asset that will be affected by closure, due to washout of the abutments. This river has historically flooded, and has received treatment in the past for flood damage.

$725\text{vpd} \times 2.5\text{hrs} \times \$20.10^{(1)} = \$36,400/\text{day}$  in extra travel time costs.

#### **Vehicle operating costs**

$725\text{vpd} \times 200\text{km} \times \$0.30/\text{km}^{(3)} = \$43,500/\text{day}$  in extra vehicle operating costs.

#### **Environmental costs**

Environmental costs are assumed to be negligible for the rural highways involved.

#### **Lifeline costs**

Lifeline costs are assumed to be zero, due to hospital facilities being available on both sides of the link.

#### **Cost of alternative access**

These costs are assumed to be covered in the extra vehicle operating costs and extra travel time costs outlined above.

**The Security of New Zealand's Strategic Roothing Network**  
**Secondary Analysis**  
**State Highway 1 - Levin to Otaki River**

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**Unplanned disruption costs**

Costs associated with repairing damage caused by the disaster.  
In this case, repair of bridge approaches due to flood damage.

**Loss of Business**

It is difficult to assess these costs accurately. However the following assumptions were made;

Almost all the traffic will be affected	(14,500-725) vpd
The traffic is two way so assume double count.	7,000 vpd
Assume 30% of travel time value for an 8 hour day is the value added portion.	\$0.3*8*14.4/day
Therefor lost business to the country is approximately	\$0.25M/day

**Existing annual maintenance costs**

Assumed costs based upon similar sections of highway in Coastal Otago area.

The initial analysis assumptions identified areas of earthquake risk in terms of the New Zealand building code. This code is applicable to structures, however was used as an initial assumption for the purposes of the study. The risk weighting attached to the Levin - Otaki link is significantly higher than it realistically should be. The area is not thought to be susceptible to liquefaction, and the section is along the flat, therefore landslides are not expected to be of concern.

Tsunami risk is low, with the majority of the link being greater than 5km from the coast.

**Options**

Flooding of the Otaki river poses the greatest risk of closure for this link. Hence, any spending to reduce the exposure would be well spent on reducing the probability of closure of the bridge. There are limited other options available. However, an alternative route (other than the existing SH2 route) would obviously offer some redundancy to the existing case. There are very few options for alternative routes, with the simplest being a move towards the coast. This is likely to present other potential problems, for example Tsunami risk.

From the assessed \$760 present net worth of exposure, the B/C ratio of 4.0 allows for approximately \$190,000 to be spent on improvement works. As indicated above, strengthening of the Otaki river bridge is likely to provide the greatest benefits.

An additional analysis was completed, NOT based on undertaking a specific course of action but rather assuming a reduction in risk and impact that might be achieved and then identifying the benefits attributable. Taking this approach there are innumerable options available but the analysis does give some feeling for whether significant improvements in the reliability of the link are likely to be economically justified.

The detail of this analysis is shown in the attached sheets however it indicates that less than \$100,000 can be justified to remove the risk of a 1:10 and 1:20 year events and reduce the impacts of larger events.

Link Name: SH01-18 Levin - Otaki river  
 Risk Element: Floods

Recurrence interval of event	2	10	20	50	100
Probability of occurrence in one year	0.50	0.10	0.05	0.02	0.01
Effect of event (assumed)	0	0.50	1	2	3
<b>Annual Cost summary due to event</b>					
Annual tourist volume	0	0	0	0	0
Percent change in tourist volume	0.00	0.00	0.00	0.00	0.00
Reduction in tourist numbers	0	0	0	0	0
Effective cost per tourist lost	\$1,100	\$1,100	\$1,100	\$1,100	\$1,100
Cost to National tourism	\$0	\$0	\$0	\$0	\$0
Cost through loss of business	\$0	\$120,000	\$240,000	\$480,000	\$360,000
Environmental cost (CO2)	\$0	\$0	\$0	\$0	\$0
Extra travel time costs	\$0	\$18,200	\$36,400	\$72,800	\$109,200
Additional vehicle operating costs	\$0	\$21,750	\$43,500	\$87,000	\$130,500
Cost of loss of life due to link removal	\$0	\$0	\$0	\$0	\$0
Cost of alternative access	\$0	\$0	\$0	\$0	\$0
Unplanned disruption costs	\$0	\$0	\$40,000	\$80,000	\$120,000
Estimated annual cost	\$0	\$159,950	\$359,900	\$719,800	\$719,700
Expected value for each event	-	\$15,995	\$17,995	\$14,396	\$7,197
Sum of Expected values of each event					\$55,583
Net present value of total cost over 25 year period.					\$529,372
Existing annual maintenance costs to retain link					\$25,000
Net present value of maintenance over 25 years					\$238,100
<b>Total Net present value of exposure:</b>					<b>\$767,472</b>

- 1) R.I. of 2 includes 0-7.5 year R.I.'s.
- 2) R.I. of 10 includes 7.5 - 15 year R.I.'s.
- 3) R.I. of 20 includes 15 - 35 year R.I.'s.
- 4) R.I. of 50 includes 35 - 75 year R.I.'s.
- 5) R.I. of 100 includes 75 - 25 year R.I.'s.



Link Name: SH01-18 Levin - Otaki river  
 Risk Element: Floods

Reduced Risk/Impact Scenario

	2	10	20	50	100
Recurrence interval of event	0.50	0.10	0.05	0.02	0.01
Probability of occurrence in one year	0	0.00	0	1	2
Effect of event (assumed)					
<b>Annual Cost summary due to event</b>					
Annual tourist volume	0	0	0	0	0
Percent change in tourist volume	0.00	0.00	0.00	0.00	0.00
Reduction in tourist numbers	0	0	0	0	0
Effective cost per tourist lost	\$1,100	\$1,100	\$1,100	\$1,100	\$1,100
Cost to National tourism	\$0	\$0	\$0	\$0	\$0
Cost through loss of business	\$0	\$0	\$0	\$240,000	\$240,000
Environmental cost (CO2)	\$0	\$0	\$0	\$0	\$0
Extra travel time costs	\$0	\$0	\$0	\$36,400	\$72,800
Additional vehicle operating costs	\$0	\$0	\$0	\$43,500	\$87,000
Cost of loss of life due to link removal	\$0	\$0	\$0	\$0	\$0
Cost of alternative access	\$0	\$0	\$0	\$0	\$0
Unplanned disruption costs	\$0	\$0	\$0	\$40,000	\$80,000
Estimated annual cost	\$0	\$0	\$0	\$359,900	\$479,800
Expected value for each event	-	\$0	\$0	\$7,198	\$4,798
Sum of Expected values of each event					\$11,996
Net present value of total cost over 25 year period.					\$114,250
Existing annual maintenance costs to retain link					\$25,000
Net present value of maintenance over 25 years					\$238,100
Total Net present value of exposure:					\$352,350
Change from Base					\$415,123
Value to Achieve change in risk/impact at B/c =4.0					\$103,781