

Measures to Evaluate Post-Disaster Trip Resilience

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Research Project

Project:

Post-Disaster Road Network Resilience Assessment

Funding:



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Outline

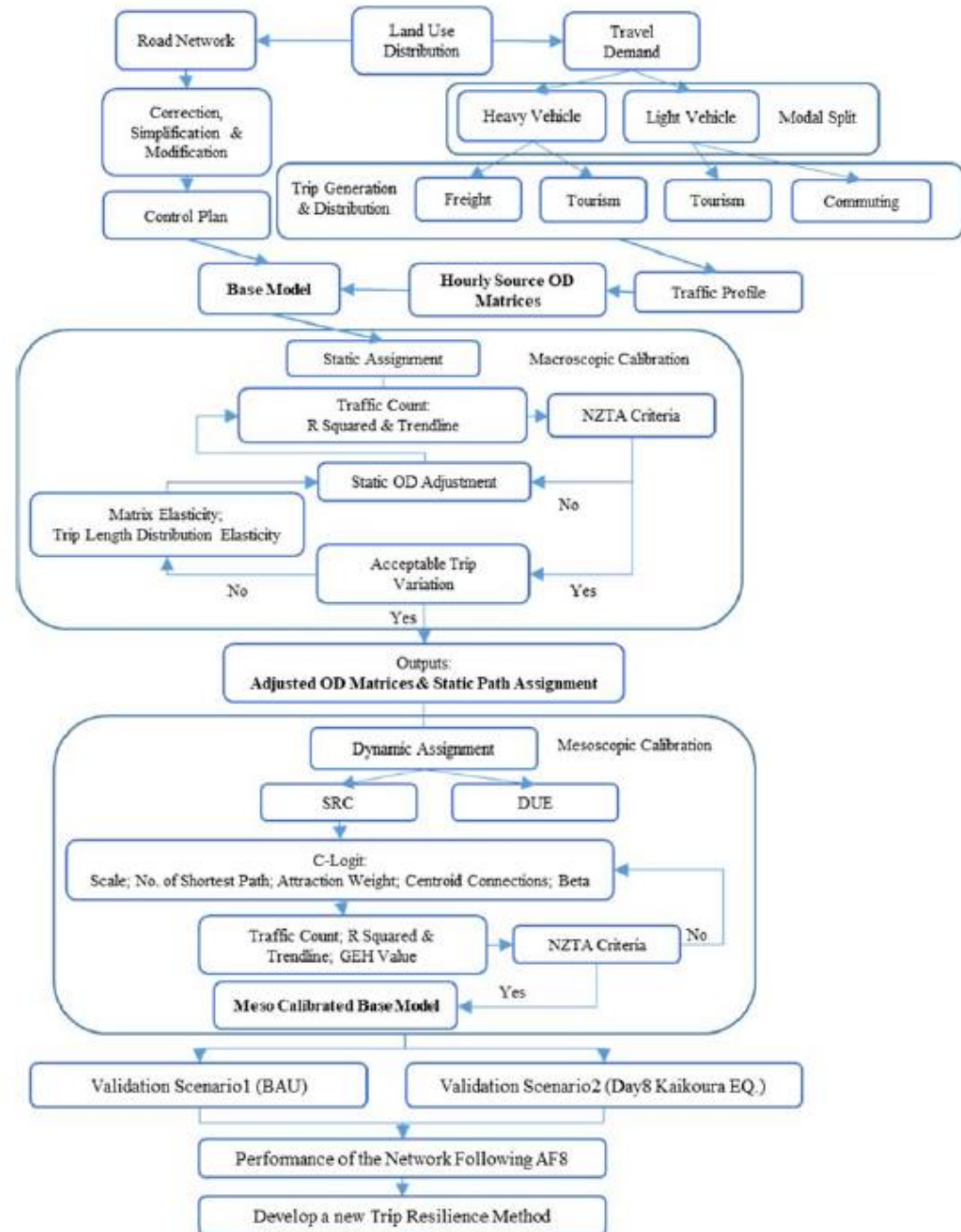
- Introduction
- Trip Resilience Measure
- AF8 Trip Resilience

Introduction



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Step 1
Obj. No. 1

Step 2
Obj. No. 2

Step 3
Obj. No. 3-4

Step 4
Obj. No. 5

Step 5
Obj. No. 6-7

Typical Resilience Concept

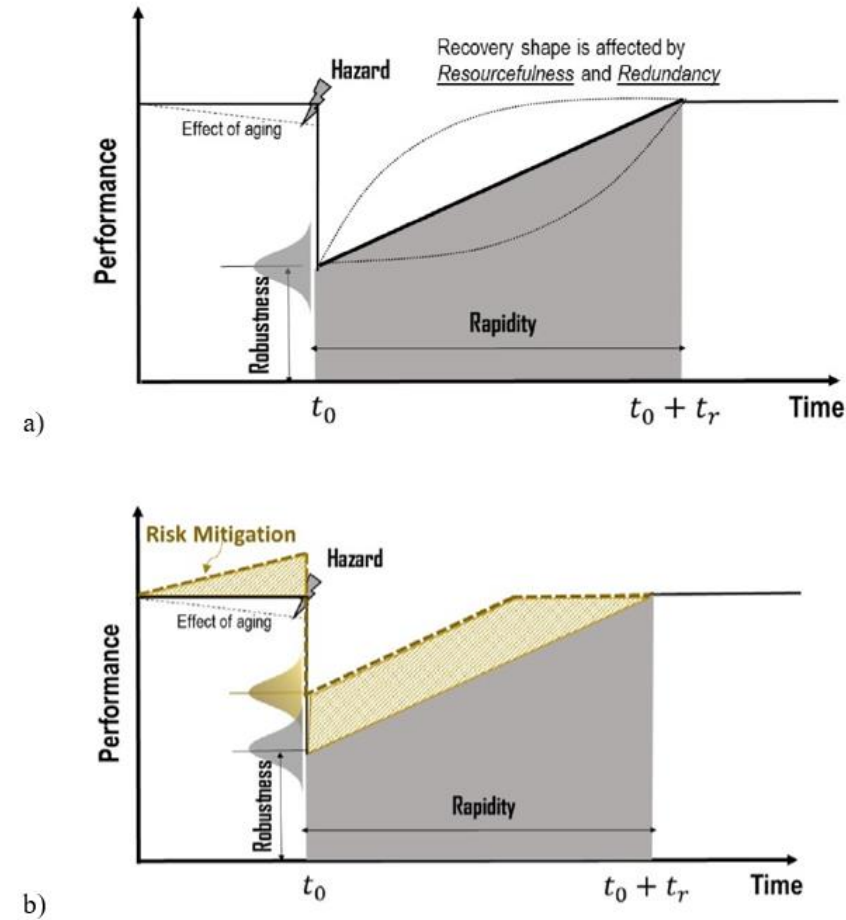


Figure 2-5: (a) The Concept of Resilience and (b) The Effect of Risk Mitigation Plan (Zhang and Wang (2016))

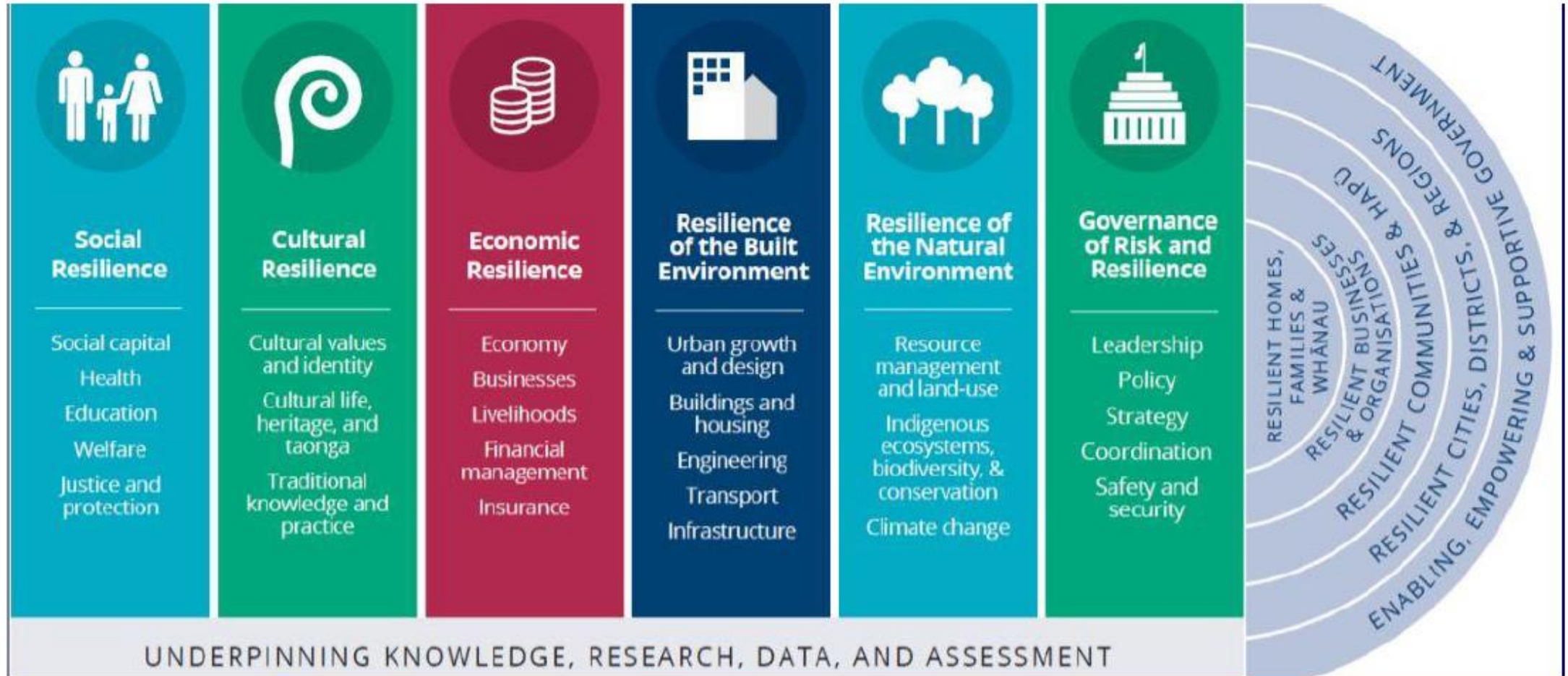
Trip Resilience



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Proposed Transportation Resilient System

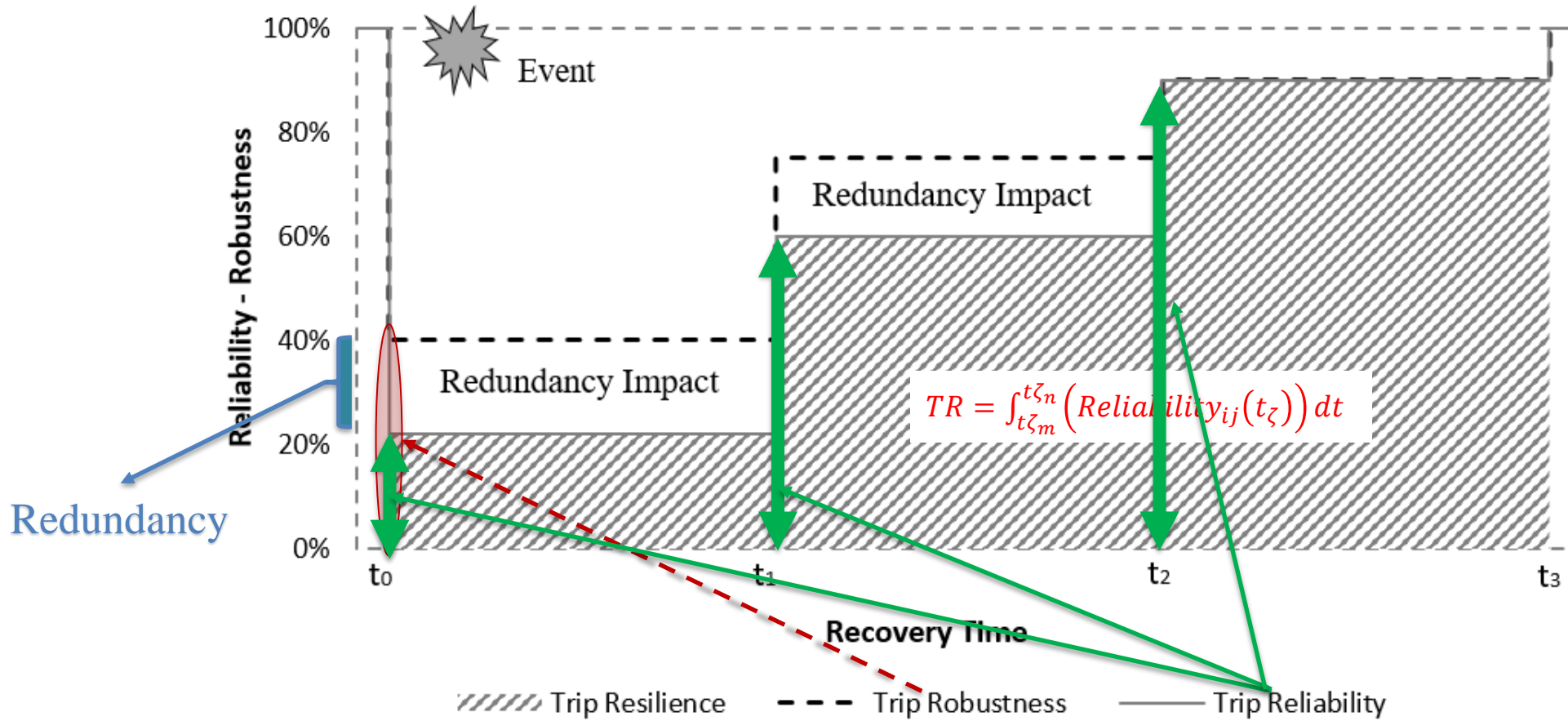


Department of the Prime Minister and Cabinet - 2018

Existing Measures

Studies	Resilience Concepts		
	Robustness	Redundancy	Recovery
Zhang and Wang (2016)		•	
Pokharel and Ieda (2016)		•	
Muriel-Villegas et al. (2016)	•		
Zhang et al. (2015)†	•	•	•
Soltani-Sobh et al. (2015)	•	•	
El-Rashidy and Grant-Muller (2014)	•	•	
Balijepalli and Oppong (2014)		•	
Omer et al. (2013)		•	•
Chen et al. (2012)	•		
Miller-Hooks et al. (2012)	•		•
Chen and Miller-Hooks (2012)	•		•
Luathep et al. (2011)		•	
Erath et al. (2009)		•	
Jenelius et al. (2006)	•		

Trip Resilience Concept



AF8 Scenario and Transportation Impacts

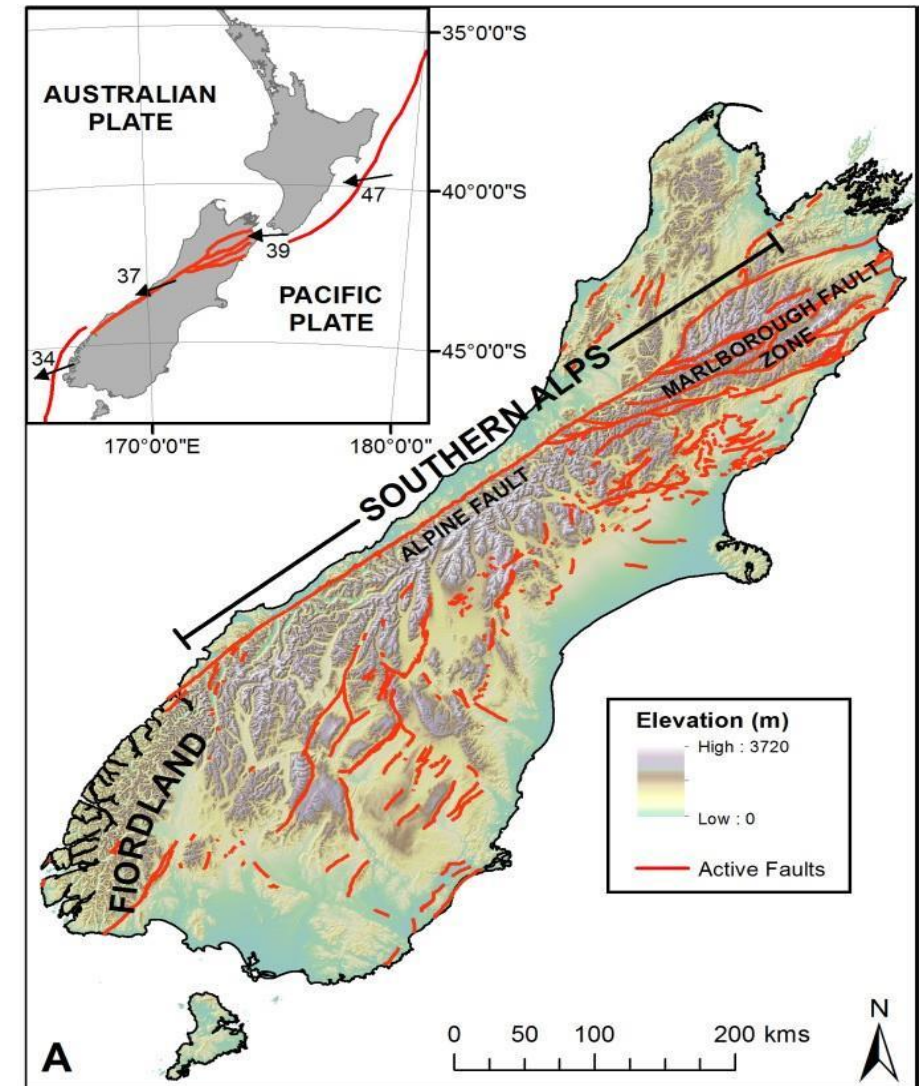


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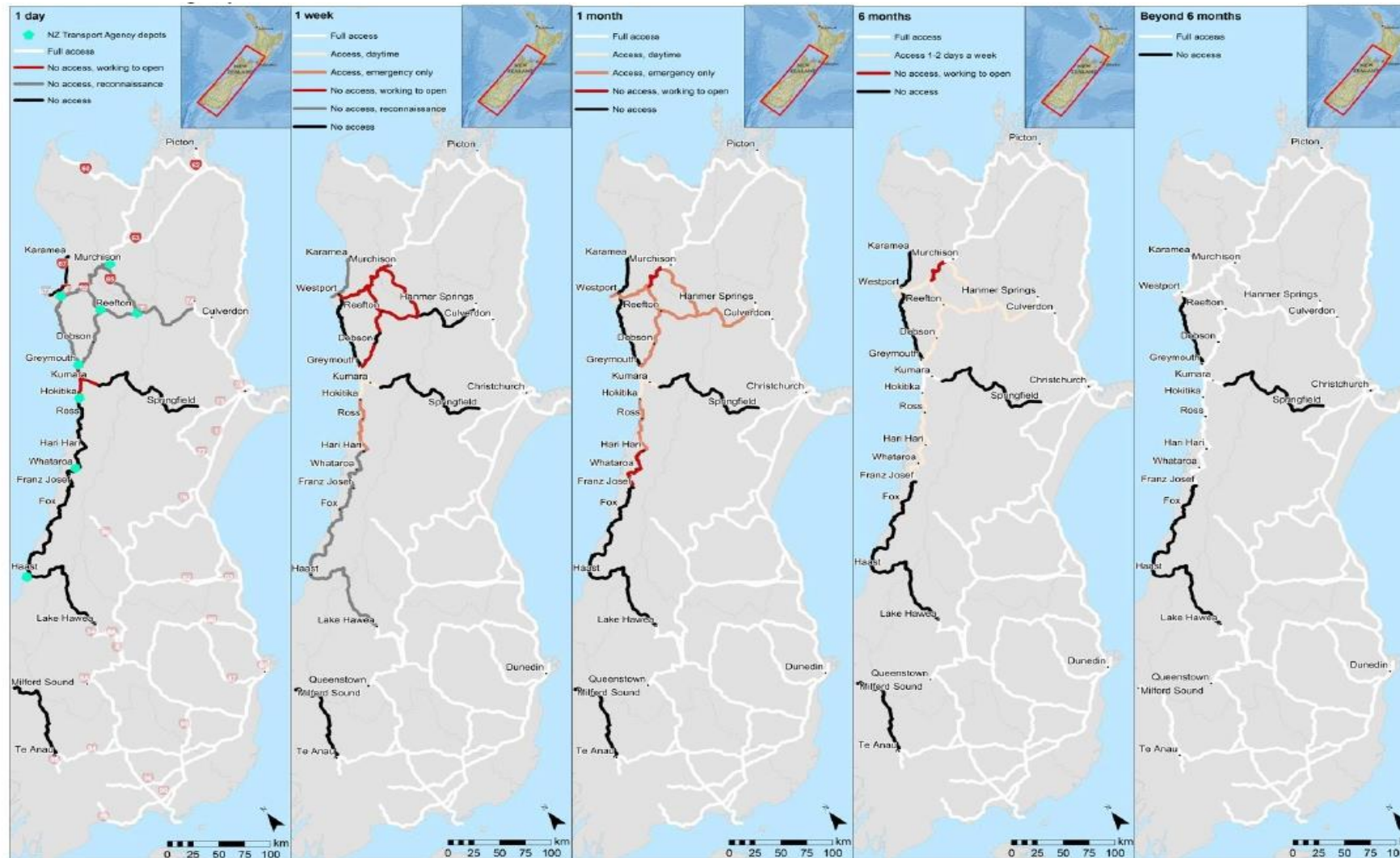
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AF8 Earthquake

The Alpine fault is one of the **major fault** systems in New Zealand and extends all through the west coast. Given the **high possibility** of an Alpine fault rupture in the next 50 years and the **consequential severe damage to lifelines**, McCahon et al. (2006) stated that the effects of the AF8 earthquake will **not be limited to only the West Coast** and will, instead, influence the **whole of the central South Island**, including the **main transportation corridors**.

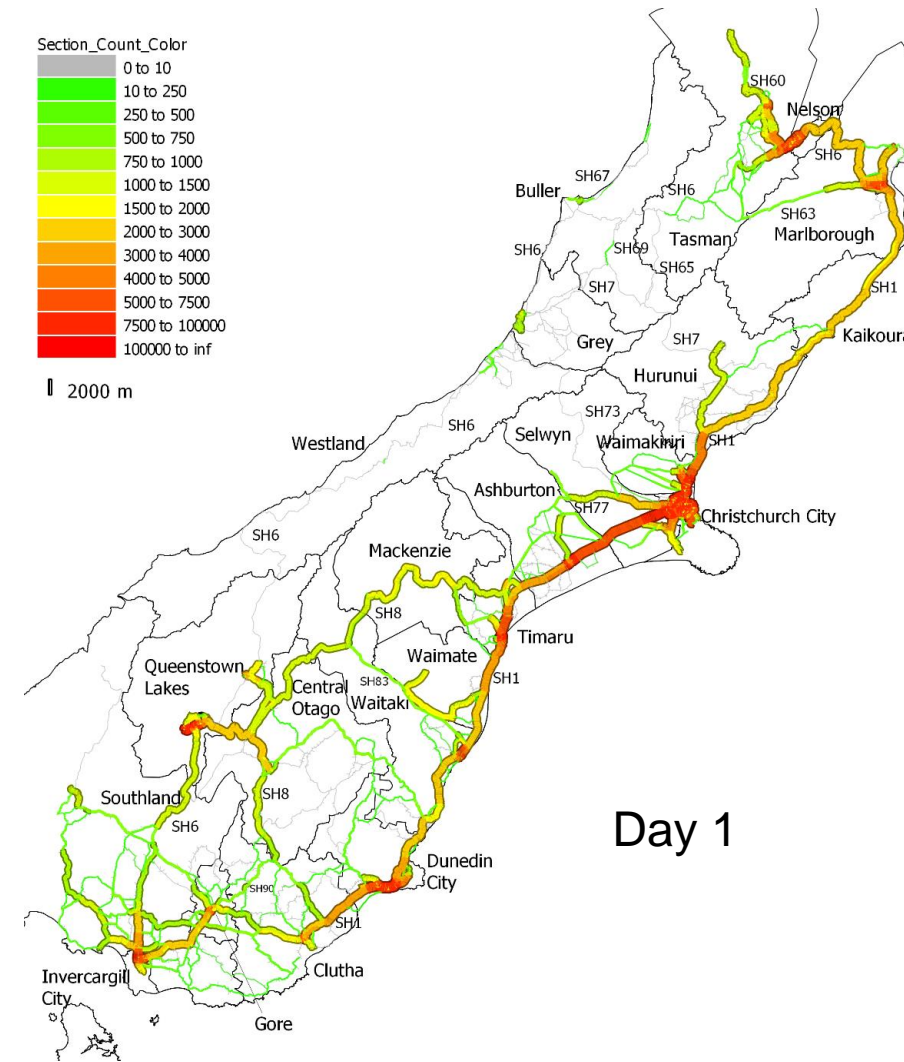
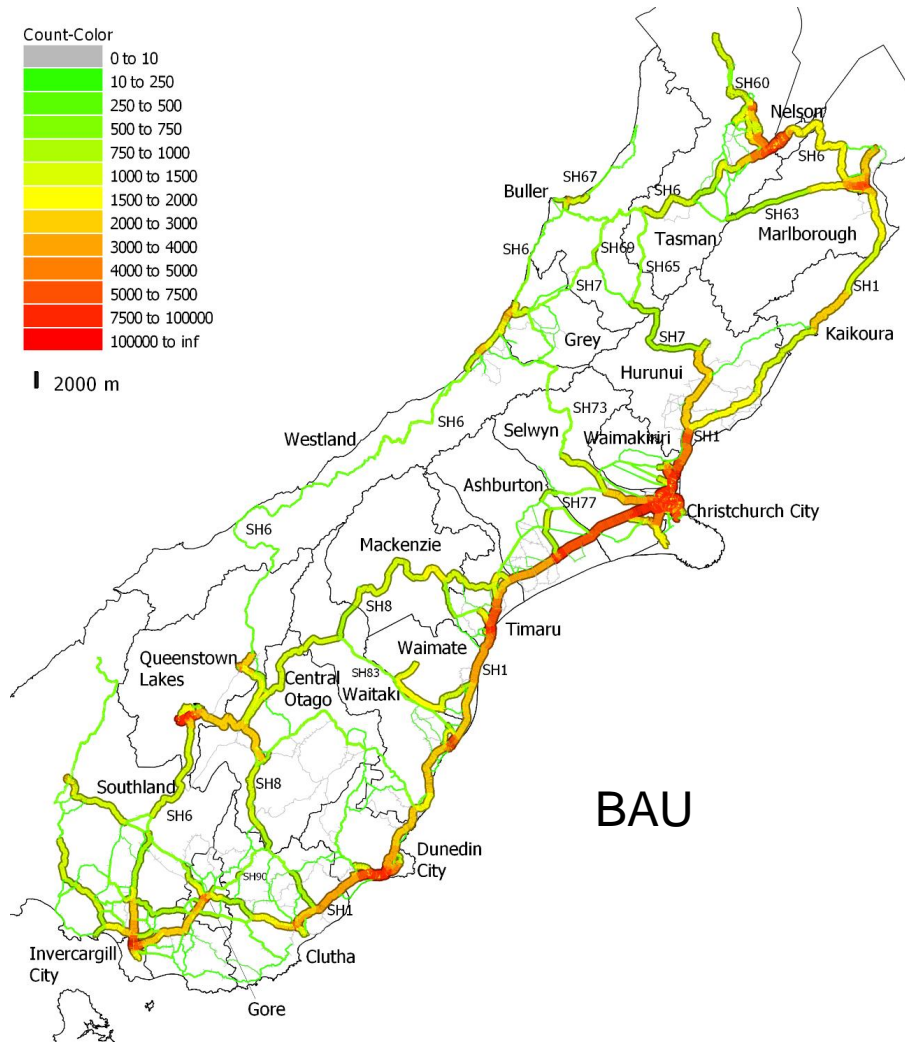


AF8 Scenario



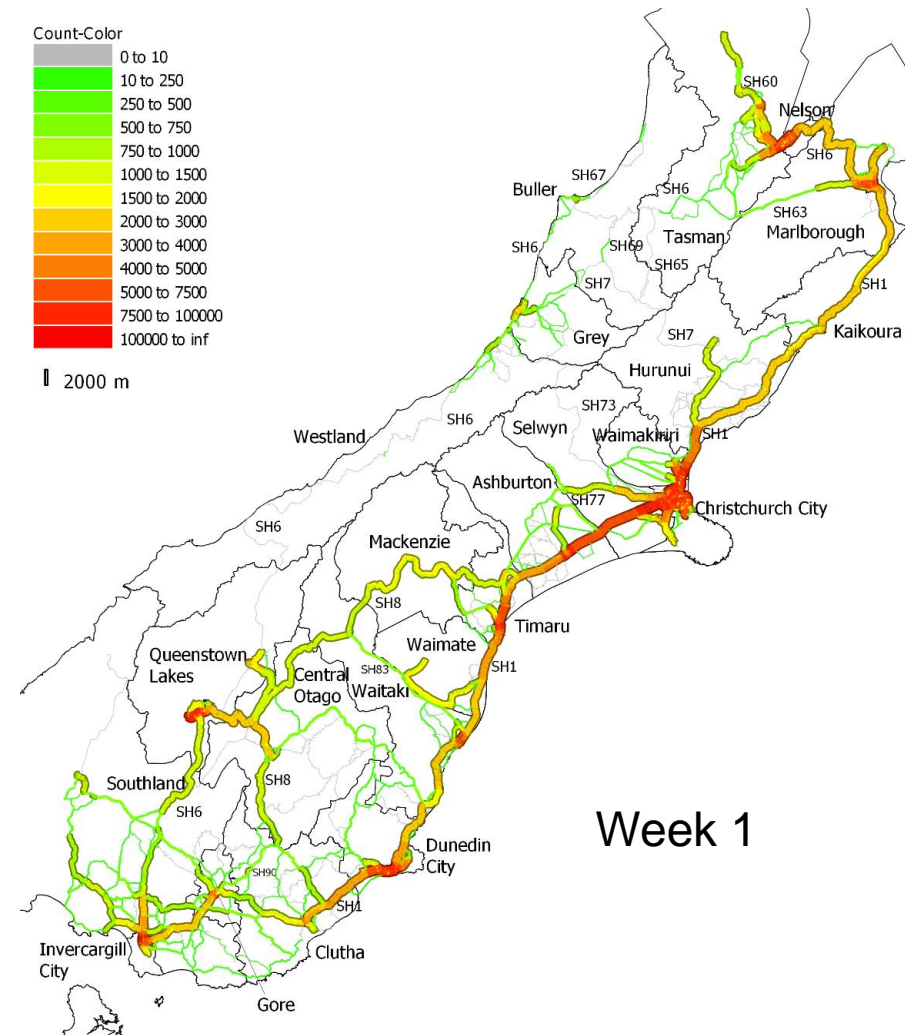
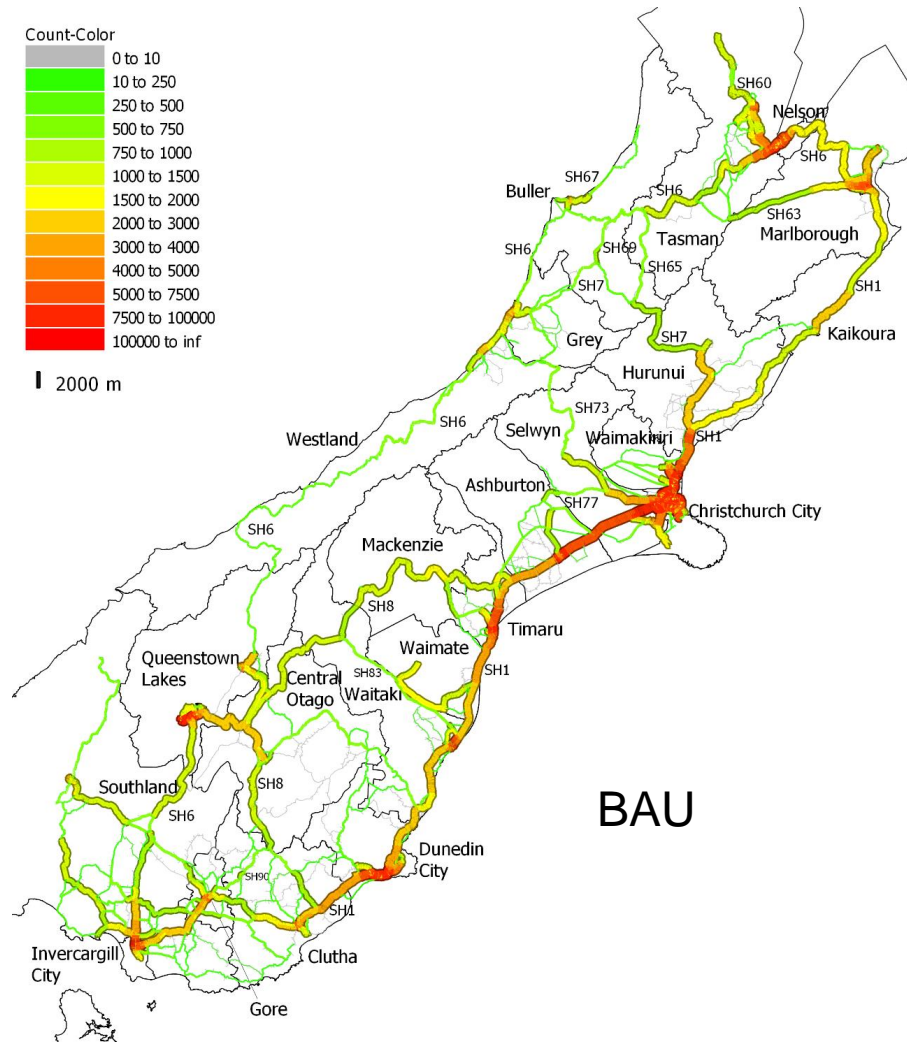
Source: Davies, A. (2019). Increasing the disaster resilience of remote communities through scenario co-creation. Doctor of Philosophy, University of Canterbury

Day 1



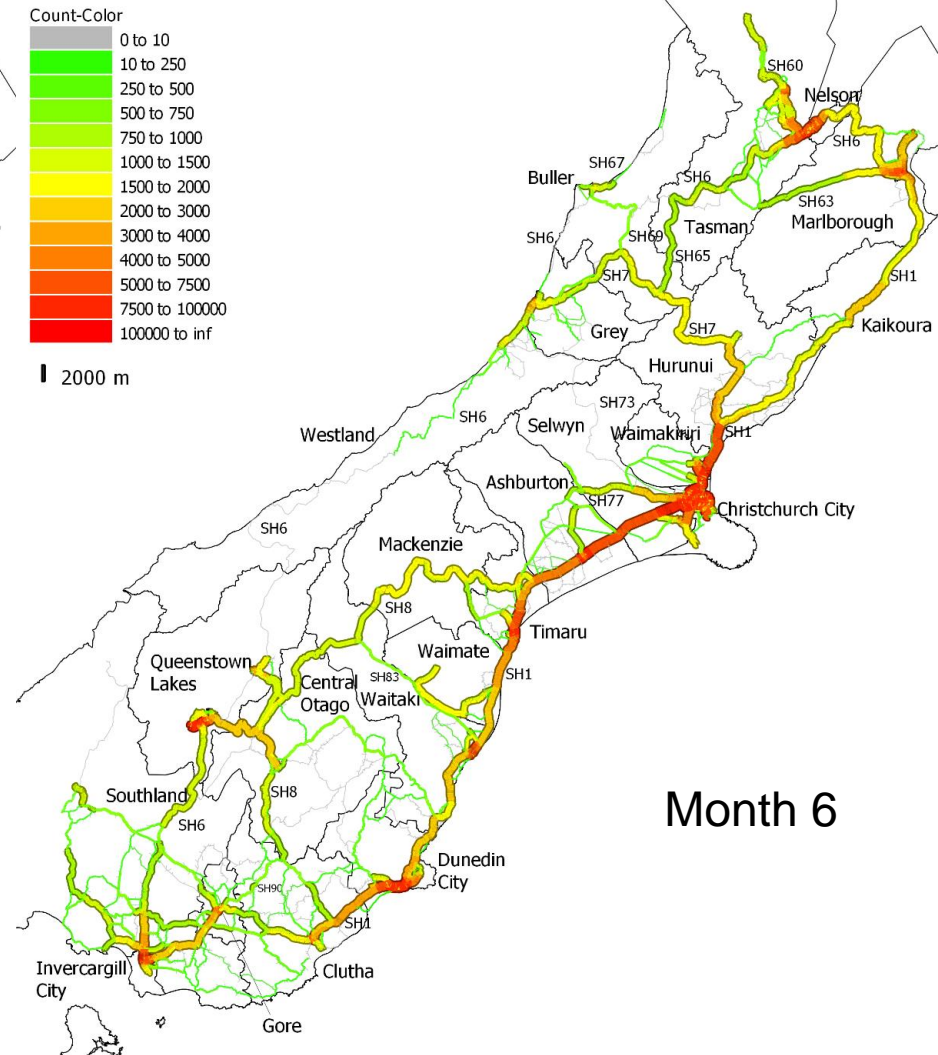
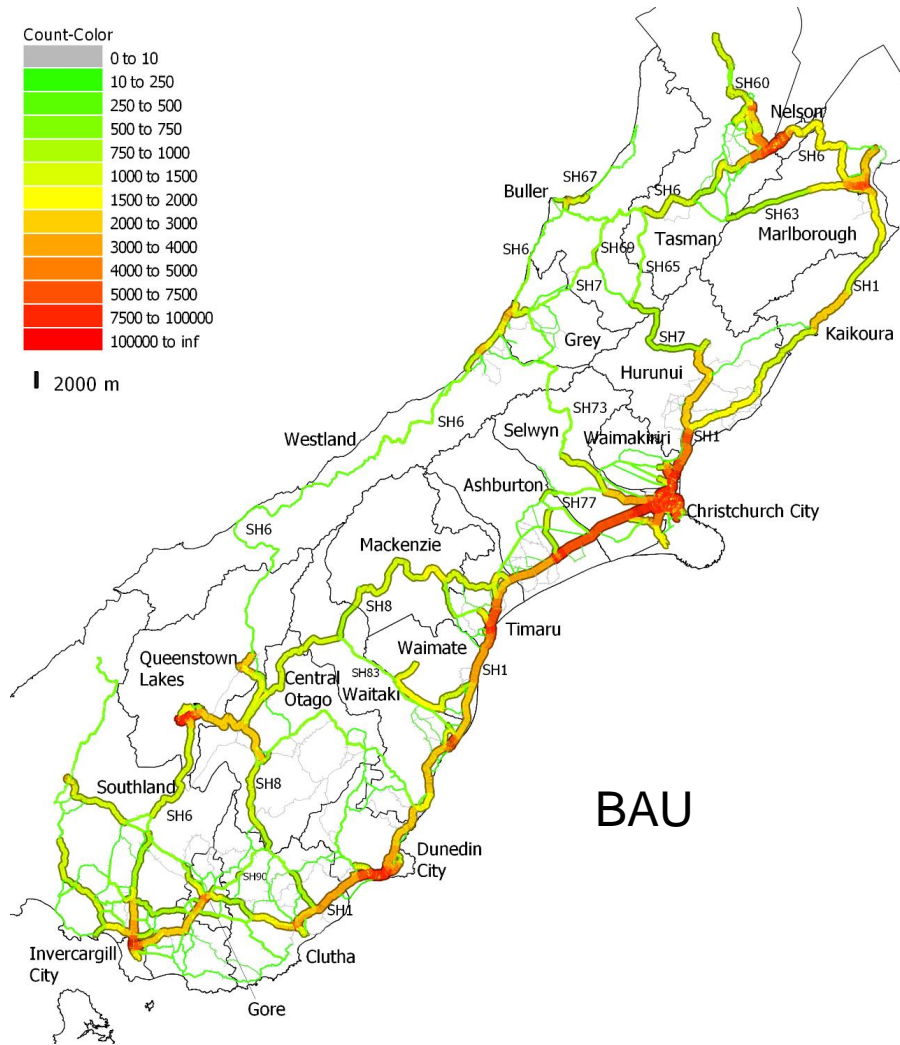
Source: M Aghababaei, SB Costello, P Ranjitkar (2020). Transportation impact assessment following a potential Alpine fault earthquake in New Zealand. Transportation Research Part D: Transport and Environment 87, 102511

Week 1/Month 1



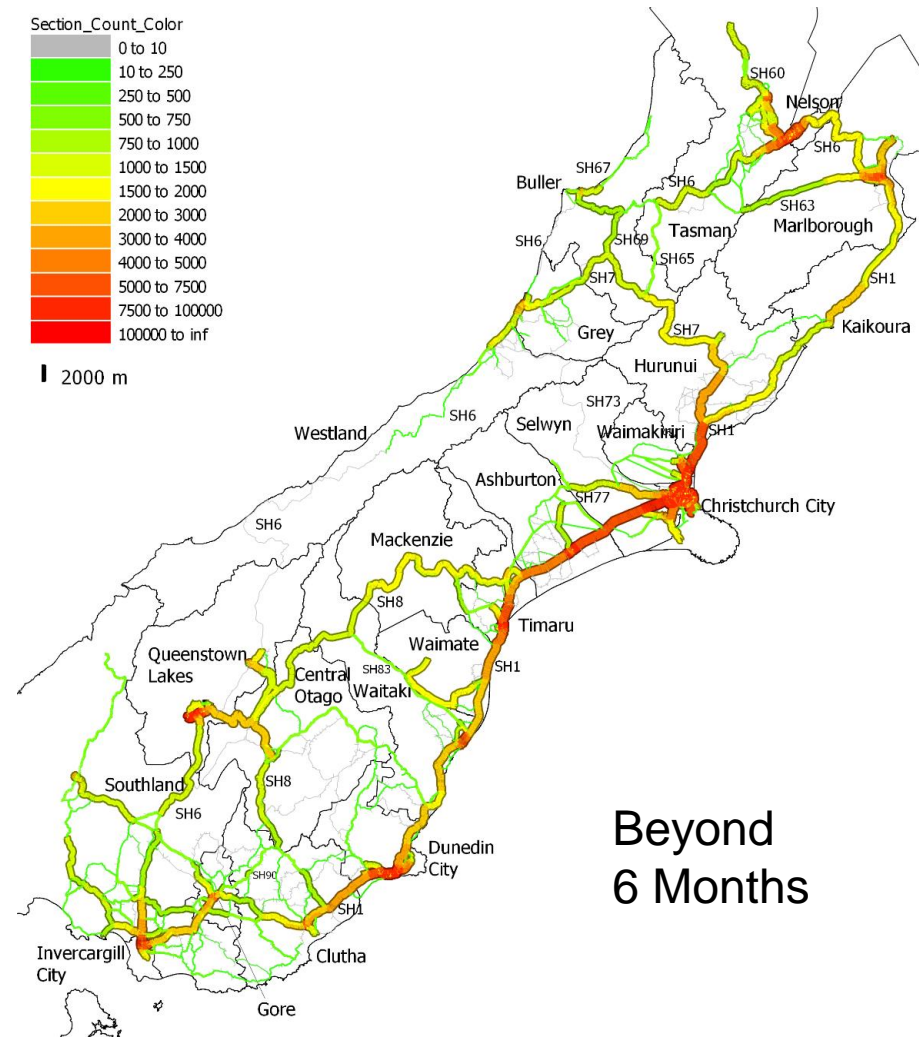
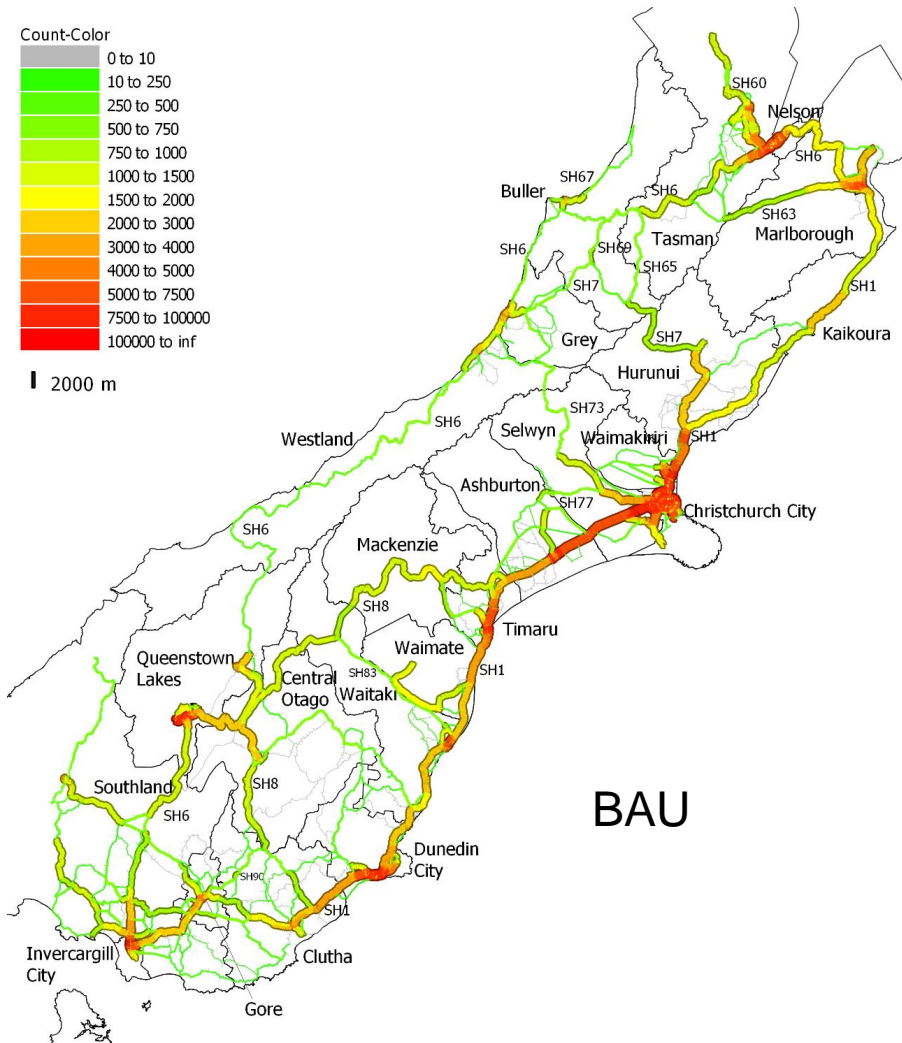
Source: M Aghababaei, SB Costello, P Ranjitkar (2020). Transportation impact assessment following a potential Alpine fault earthquake in New Zealand. Transportation Research Part D: Transport and Environment 87, 102511

Month 6



Source: M Aghababaei, SB Costello, P Ranjitkar (2020). Transportation impact assessment following a potential Alpine fault earthquake in New Zealand. Transportation Research Part D: Transport and Environment 87, 102511

Beyond 6 Months



Source: M Aghababaei, SB Costello, P Ranjitkar (2020). Transportation impact assessment following a potential Alpine fault earthquake in New Zealand. Transportation Research Part D: Transport and Environment 87, 102511

AF8 Trip Resilience

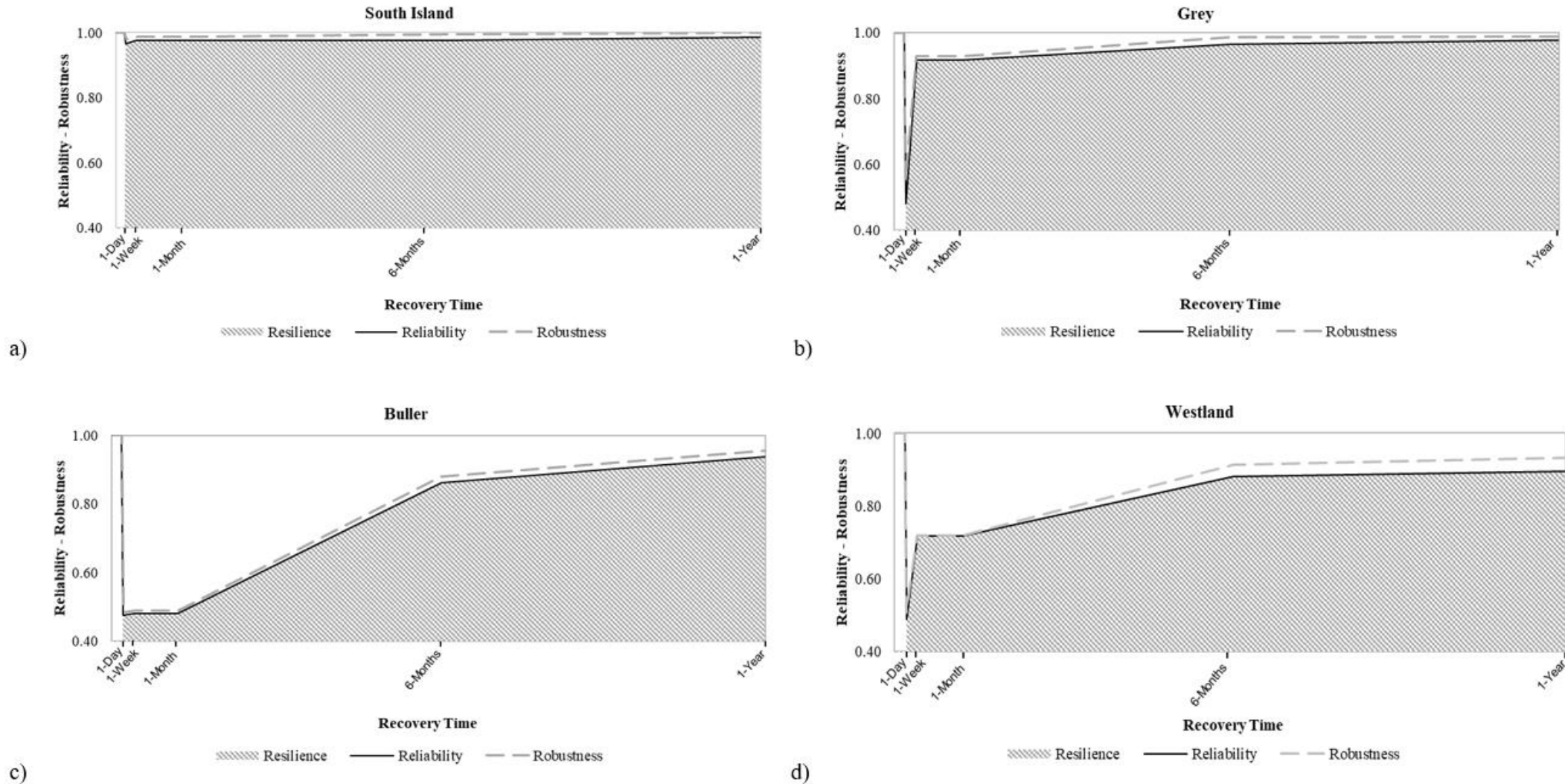


Figure 4: Robustness, Reliability and Resilience of Trips a) on the whole network b) from Grey District c) from Buller District d) from Westland District

Districts	Grey			Buller			Westland		
	BAU Trips (#)	<i>NTR</i>	<i>EIT</i>	BAU Trips (#)	<i>NTR</i>	<i>EIT</i>	BAU Trips (#)	<i>NTR</i>	<i>EIT</i>
Grey	11,211	98%	174	216	39%	132	692	91%	61
Buller	213	35%	138	4,267	86%	611	294	38%	181
Westland	668	92%	56	319	42%	185	1,785	97%	48
Christchurch	296	53%	139	308	56%	136	201	47%	107
Queenstown	103	51%	51	70	40%	42	44	3%	43
Marlborough	77	61%	30	145	51%	71	72	62%	27
Hurunui	35	69%	11	5	69%	2	16	65%	6
Nelson	29	67%	10	46	36%	30	32	58%	13
Selwyn	22	41%	13	23	44%	13	21	34%	14
Tasman	12	65%	4	24	39%	15	19	63%	7
Waimakariri	7	55%	3	15	54%	7	15	52%	7
Mackenzie	2	36%	1	2	52%	1	8	46%	4
Timaru	7	71%	2	4	65%	1	-	-	-
Kaikoura	5	67%	2	-	-	-	2	67%	1
Southland	2	25%	1	-	-	-	10	11%	9
Ashburton	-	-	-	12	21%	9	2	22%	2
Otago	-	-	-	7	19%	6	-	-	-
Dunedin	-	-	-	4	12%	4	1	47%	1
Invercargill	-	-	-	2	34%	1	-	-	-
Waitaki	-	-	-	-	-	-	5	70%	1
Overall	12,689	95%	635	5,469	77%	1265	3,219	83%	534

Application of Proposed New Method

- To support the **increase of resilience** in transport infrastructure,
 - Comparing different recovery plan (order of reopening or shorter recovery period)
- To assist with the **prioritisation of proposed resilience mitigation** measures
- To determine the **relative criticality** of particular road links.

Paper

M. Aghababaei, S.B. Costello, P. Ranjitkar (2020). ***Measure to evaluate post-disaster trip resilience***. Journal of Transport Geography, Volume 95, July 2021, 103154; <https://doi.org/10.1016/j.jtrangeo.2021.103154>

Thank you

Question?



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