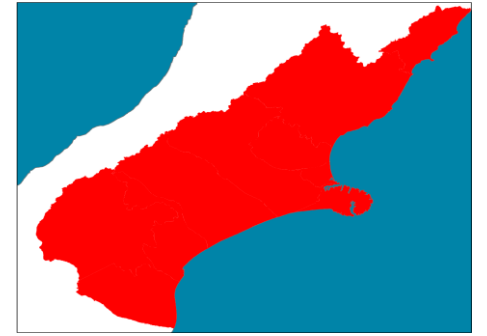# Infrastructure Research Day – Canterbury Lifelines Research Opportunities

22 November 2022

Mark Gordon
Canterbury Lifelines Group Project Manager

# Canterbury Lifelines Beginnings
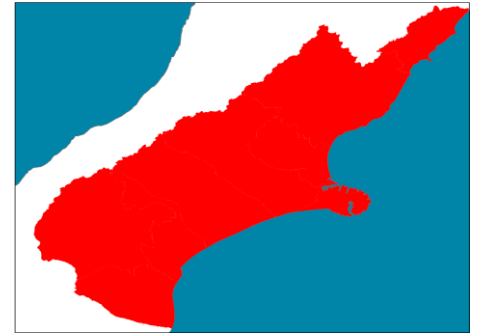

Preparedness – from the mid 90's

- Understanding of how different hazards could affect infrastructural assets in ChCh
- Mitigations planned and many undertaken
- Experience with other events

Canterbury Lifeline Utilities Group

- Investigatory projects
- Established relationships between LL utilities and emergency services
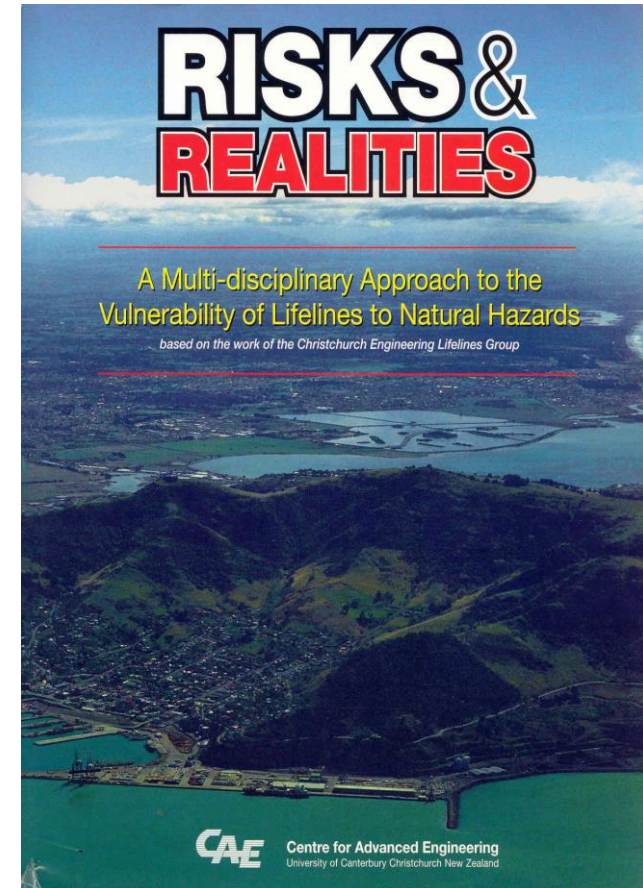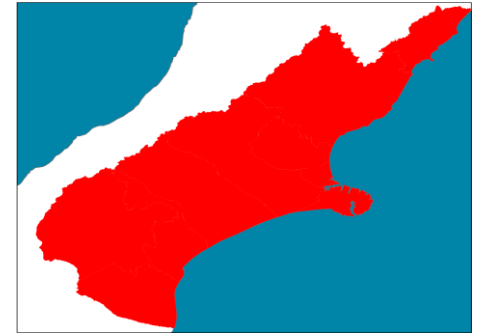
Historical Projects

- Lifelines Inventory (spare parts)
- Hazard Assessment for Petroleum Storage, Transportation and Supply
- Priority Routes and Sites
- Lifelines Interdependencies
- Critical Infrastructure Manual Backup
- Lifelines Engineering & AMP's
- Reconnaissance Plan

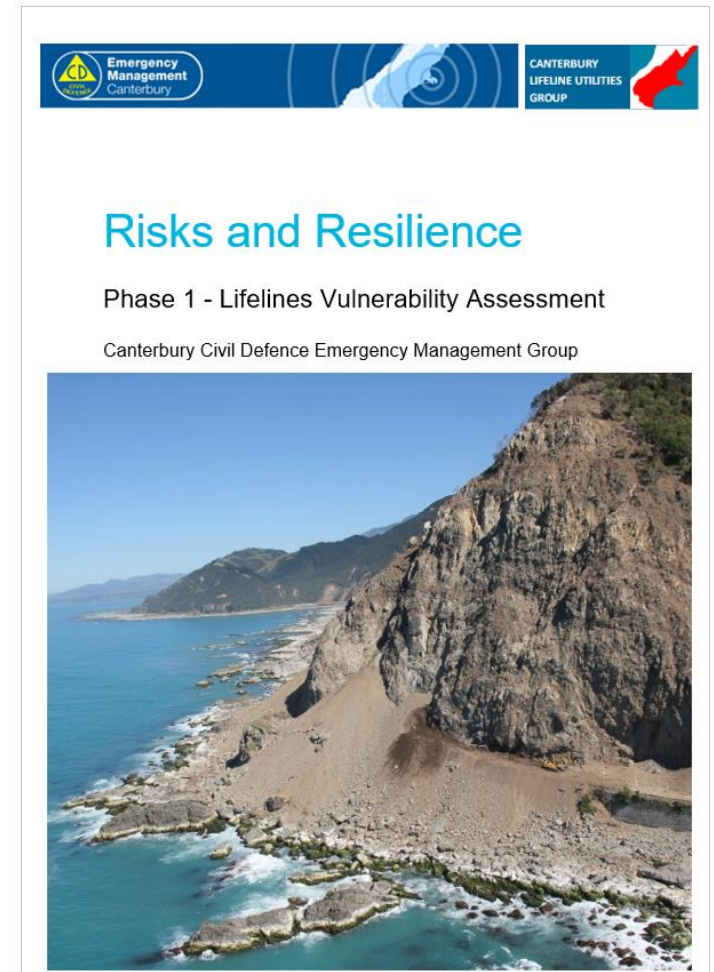# Risks & Resilience Phase 1 – Vulnerability Assessment

Hazards mapped (GIS / snapshot) and/or described:

- Earthquake, Liquefaction, Landslide, Tsunami / Seiche / Storm Surge, Rain & Flooding, Snow, Wind, Drought, Extreme Heat & Heat Dome, Wildfire, Pandemic, Space Disruption, Terrorism (later)

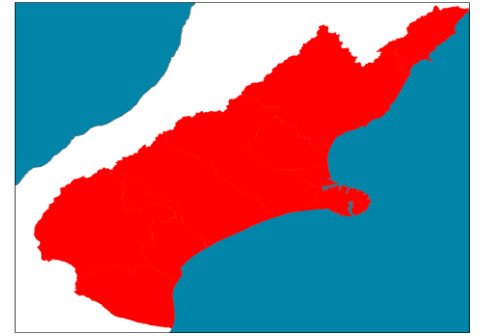Lifelines sectors mostly mapped and/or described:

- Telecommunications, Electricity, Fuel & Gas, Transport, Three Waters, Other (e.g., Military bases, Stopbanks, Irrigation Schemes)

Have done some "overlays" of the two – being progressed using the GIS portal and "Phase 2"

Risks and Resilience

Phase 1 - Lifelines Vulnerability Assessment

Canterbury Civil Defence Emergency Management Group

Risks & Resilience Phase 2:
# NEMA Resilience Fund

Risks & Resilience: Using a new GIS portal and existing body of knowledge base to standardise and advance the maturity of vulnerability assessments and resilience-focussed investment business cases

We are working with the research and science community to develop a pilot, proof-of-concept strategic approach to evaluating the benefits of resilience mitigation investment – by better understanding the economic and social impacts of disaster events on our infrastructure networks

Pilot area – North Canterbury: Electricity, Telecommunications, Roads, Waters

Hazard Scenarios – Flooding, Tsunami

These are examples of existing software applications – both were used in the WBC
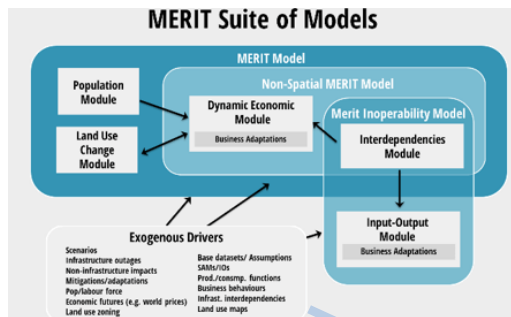
RiskScape: A Direct Loss Modelling Framework

MERIT Suite of Models

"Highly Quantitative"

Advanced practice – Wellington Business Case
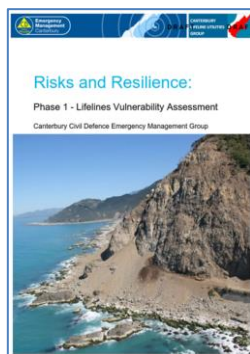
"Intermediate practice – what does it look like?

Core practice – current vulnerability assessments

Lifelines GIS Portal

Science and Research
Hazards information
Infrastructure information

"Qualitative"

Maturity Pathway

1. • Improve understanding of hazards and climate change and their impacts
2. • Enhance and expand the application of GIS and the level of detail captured / reported
3. • Improve assessment of physical damage to infrastructure
4. • Quantify hazard impacts on interdependent infrastructure networks
5. • Assess how damaged infrastructure disrupts levels of service
6. • Describe infrastructure recovery pathways over time
7. • Assess social and cultural impacts due to service disruptions
8. • Assess economic impacts of service disruption to communities
9. • Loss modelling to determine infrastructure financial losses and recovery costs
10. • Integrated economic evaluation - service disruption & loss modelling
11. • Business case development - mitigation scenarios, analysis, programme case

Infrastructure Data

Sector Types
Airfields
Electricity
Fast Moving Consumer Goods
Flood Protection
Fuel
Gas
Irrigation
Ports
Rail
Roads
Solid Waste
Stormwater
Telecommunications
Wastewater
Water Supply

Electricity

Sub-sector	Asset Class	GIS	Fragility Ref	Attributes - draft
Generation	AC/DC Pole	Point	Electricity Infrastructure	
	Canals	Linear		
	Comms Systems	Network		Type
	Control Centres	Point	Buildings*	Material, foundation height, number of storeys
	Control Structures	Point		
	Generation Sites	Point		
Transmission	Comms Systems	Network		Type
	Control Centres	Point	Buildings*	Material, foundation height, number of storeys
	Grid Exit Points	Point		Circuits
	Towers	Point		
	Transmission Lines	Linear		Voltage, Circuits
Distribution	Comms Systems	Network		Type
	Control Centres	Point	Buildings*	Material, foundation height, number of storeys
	Distribution Lines	Linear		Voltage
	Substations	Point		

UC / Urban Intelligence Modelling and Dashboard Reporting
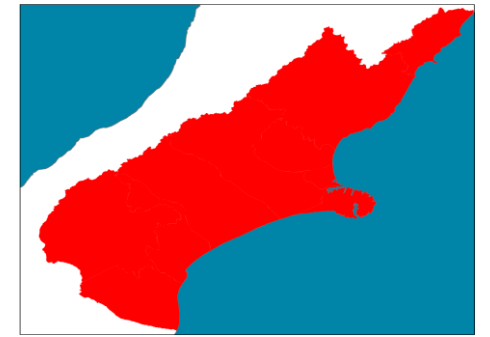
Uses GIS-based hazards and infrastructure layers and models to assess impacts, examples below are for another project commissioned by CCC. Model outputs are then exported to MERIT.

Interdependent Infrastructure

Objective:
- To understand cascading failures through local interdependent infrastructure

Approach:
- Simulated tsunami (or any hazards)
- So far: electricity, water supply, and wastewater
- Identify homes/areas indirectly impacted
- Evaluate criticality

Tsunami inundation extent

Properties that lose electricity, water supply and/or wastewater services due to **cascading failures**

Properties that lose electricity, water supply and/or wastewater services due to **exposure** to the hazard
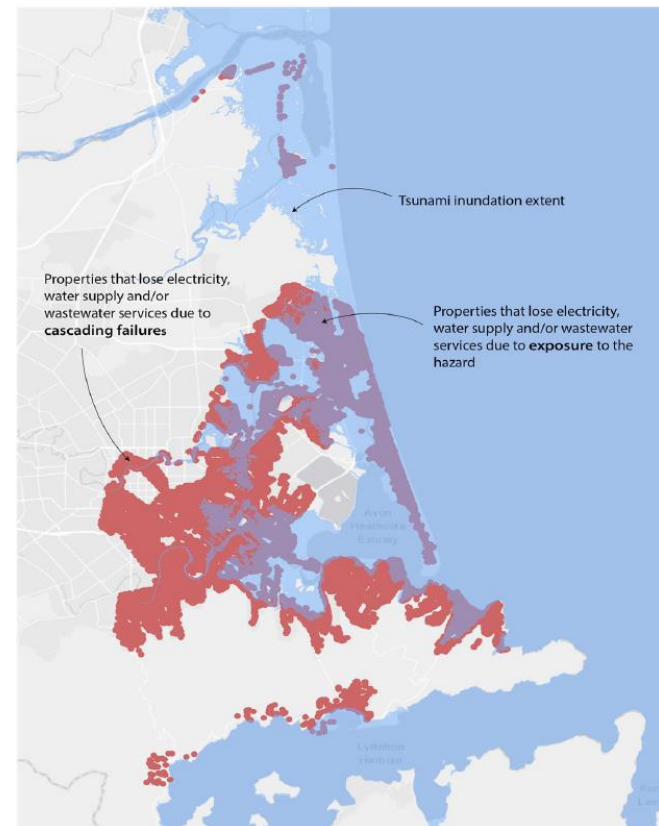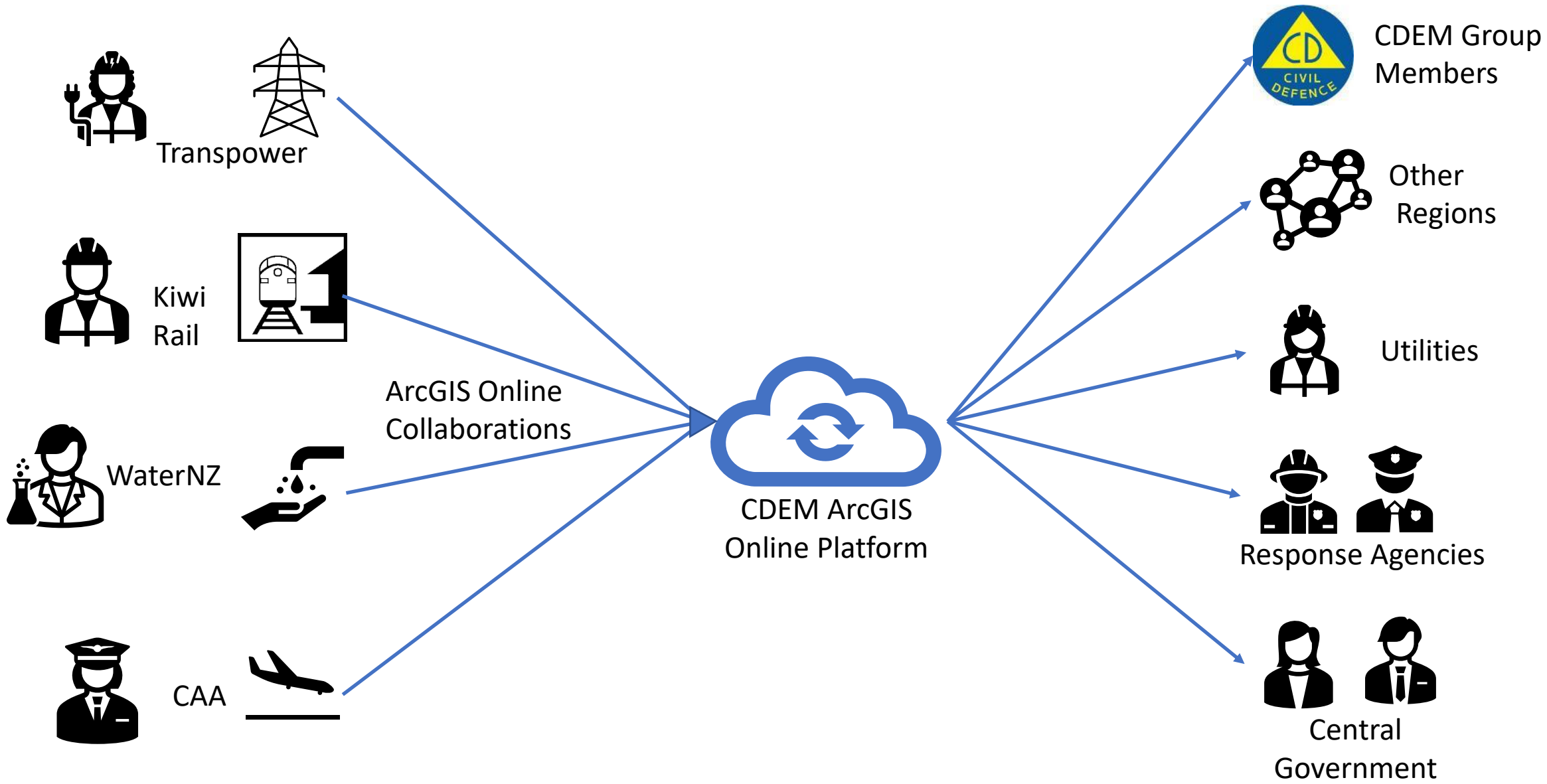
| Owner/Publisher | Federation Hub | Consumer |

AF 8 Programme

Inputs	Activities	Outputs

Knowledge and resources — **Response Planning Groups** — **AF8 Supporting Plans** — **National Workstreams**

- —— 2022 Planning Priorities
- ----- Planning Dividends

Inputs (Knowledge and resources):

- Communities
- SI CDEM
- Science
- Partner Agencies
- NEMA

AF8 Planning Process:

- AF8 Scenario
- SAFER Framework
- AF8 Regional Profiles GIS
- AF8 webinars and workshops
- AF8 planning toolkit and guidance
- AF8 risk comms toolkit and guidance

Response Planning Groups:

- Emergency Services RPG
- Lifelines RPG
- Welfare RPG
- Health RPG
- Duty of Care RPG
- Public Ed / PIM RPG
- Communities

AF8 Supporting Plans:

- C3
- Alt Comms
- Logistics
- Evacuation
- Intel / Recon
- PIM
- Health
- Welfare
- Emergency Services
- Restoration Lifelines

National Workstreams:
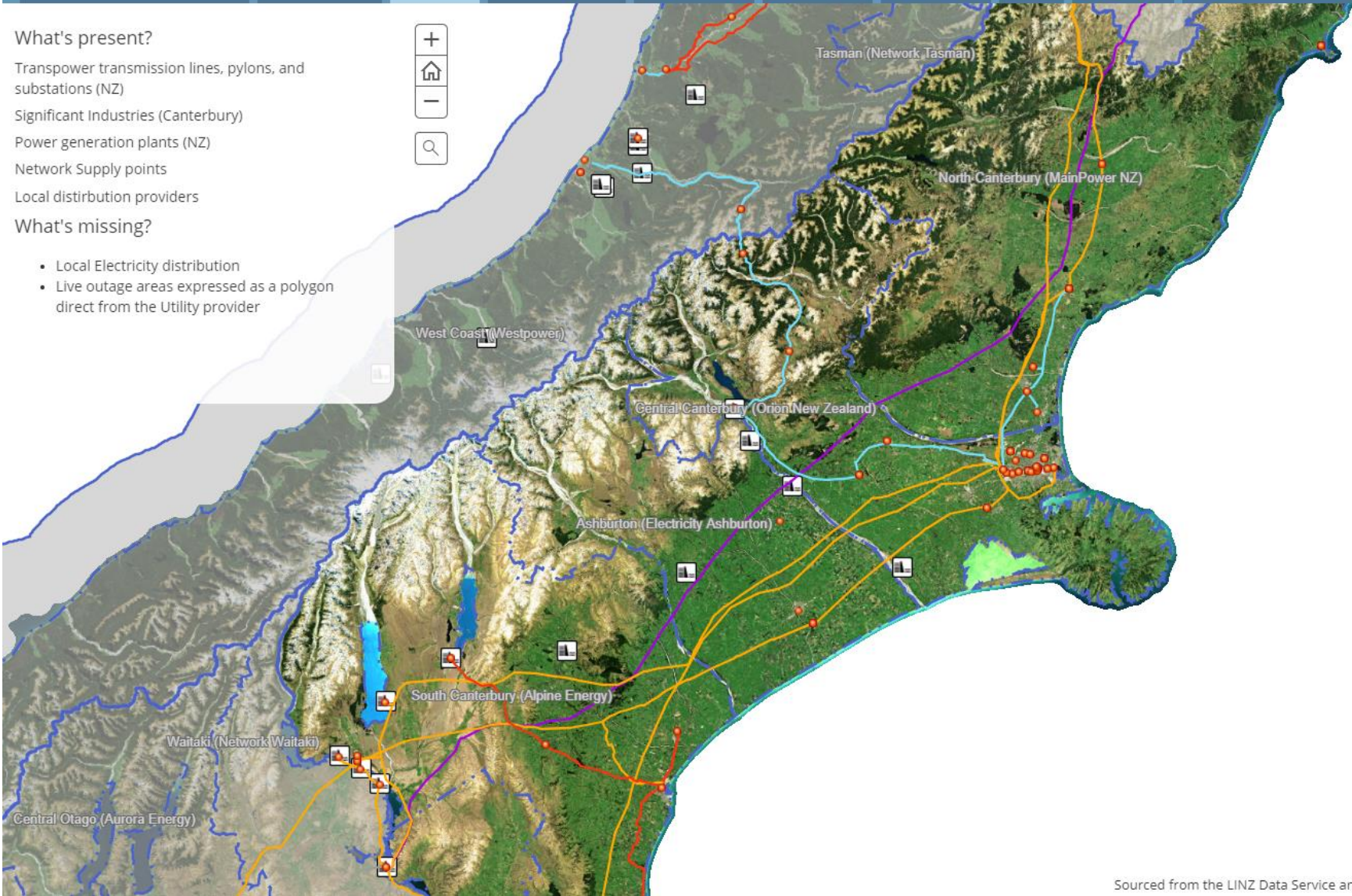
- C4
- Emergency Supply chain and movement of people
- Critical resources and capabilities
- Intel / Recon
- PIM
- Health
- Welfare Services
- Emergency Services
- Restoration of Lifelines Utilities
- International Assistance
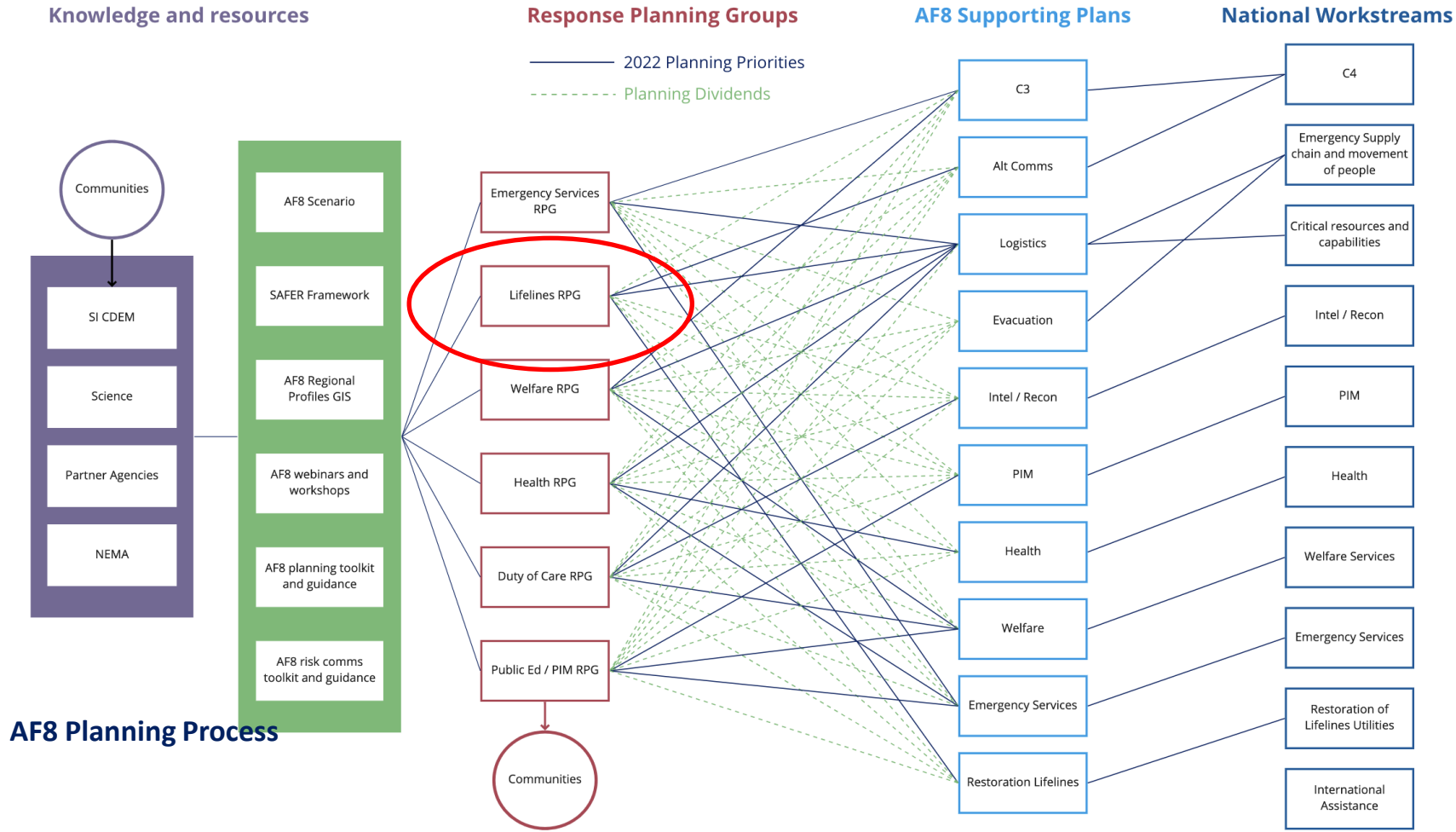
Priority Routes 2022
Approach

1. Identify Priority Sites
- Sites that are critical to the recovery of the community following a disaster.

2. Assess Road Network Vulnerability
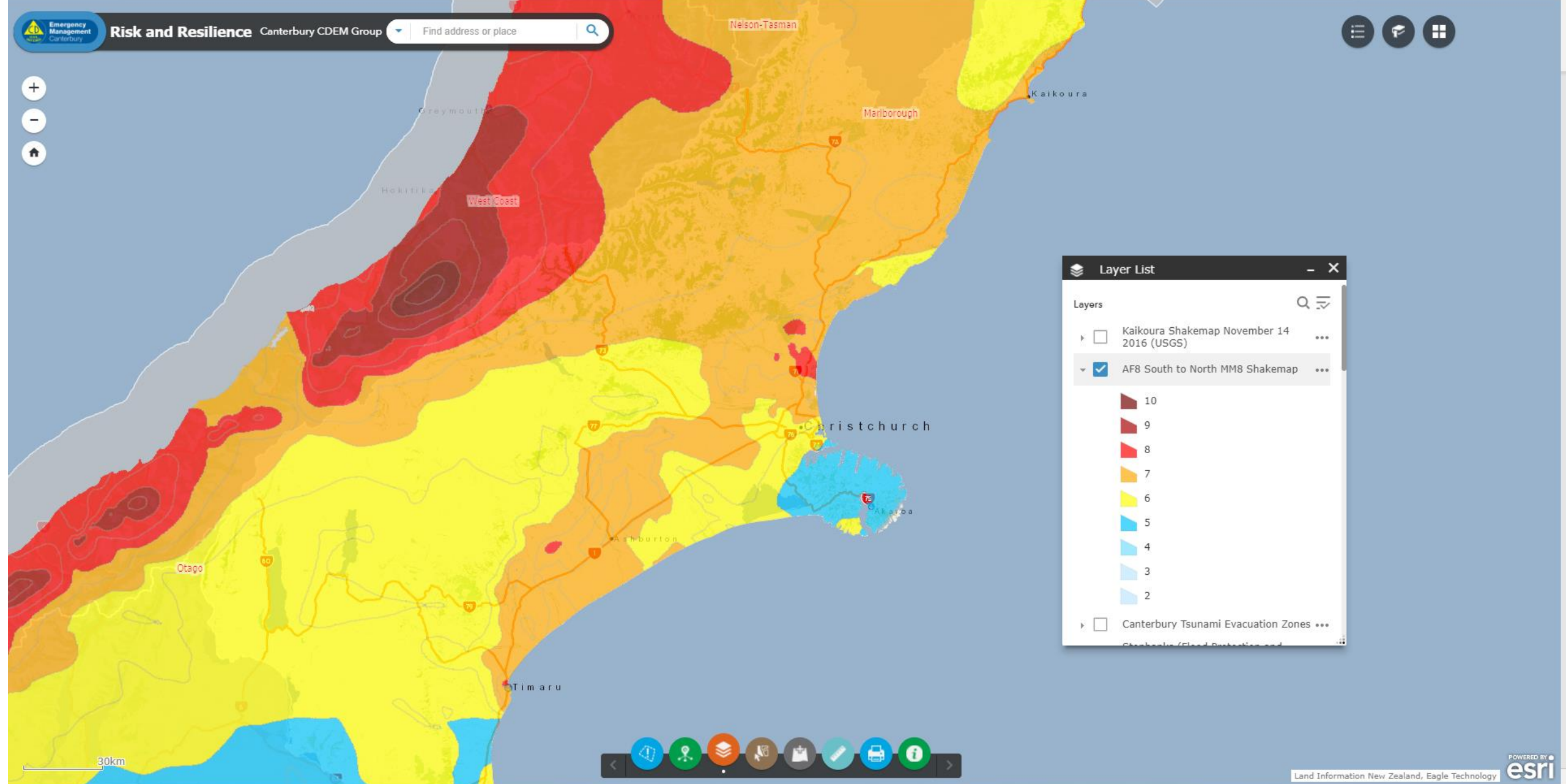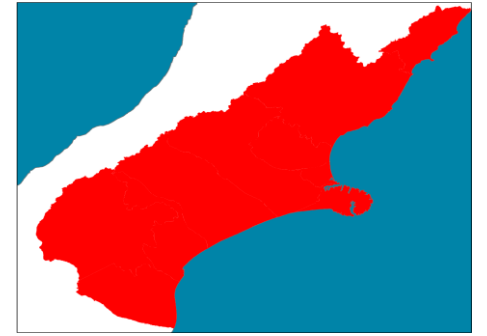- Using available hazard and asset information to understand *exposure* and *vulnerability* to hazards.

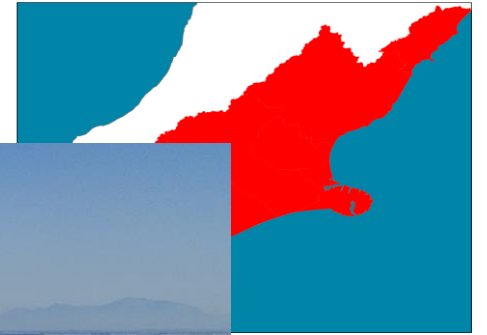**3. Identify Priority Routes by region/area**
- Considering movement of freight, access to priority sites, alternate routes for vulnerable roads.

4. Collate and Moderate
- Bring together all information, moderate assessments across areas, ensure connectivity of whole South Island network.

Canterbury Climate Change Risk Assessment

Briefing to Canterbury Lifelines Group

Rangitata River, Canterbury
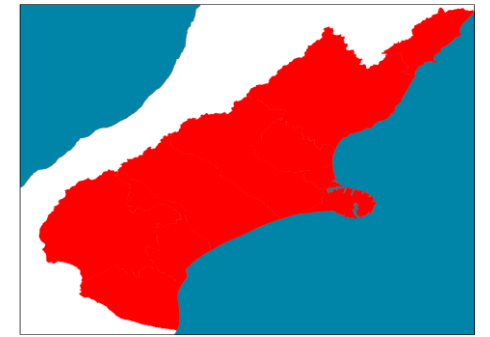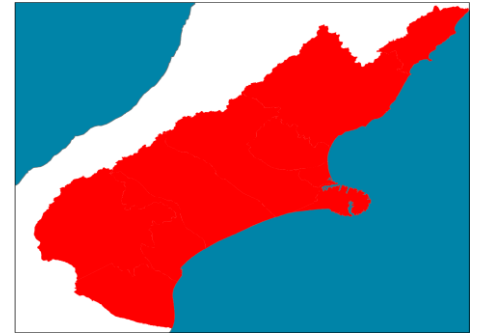
Risks to Infrastructure

Table 11.1: Risks to Ngā waihanga (infrastructure services)

Using RCP8.5	Higher mean temperatures			Change in mean annual rainfall			Drought			River and surface flooding			Coastal flooding			Increased coastal erosion			Sea-level rise and salinity stresses			Storms and wind			Increased fire-weather			Increasing landslides and soil erosion			Extreme weather events			Reduced snow & ice			Ocean chemistry changes			Marine heatwaves			Climate change		
	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L	P	M	L
Airports										M	H	E																																	
Marine facilities																			L	M	H	M	H	E																					
Rail	L	M	H													H	H	E	L	M	H							M	H	E															
Roads and bridges										L	H	E				M	H	E	L	M	H																								
Solid waste management and contamination sites										M	M	H				M	E	E	M	E	E																								

Key

I	Insignifcant		P	Present day
L	Low		M	Mid (2050)
M	Moderate		L	Long (2100)
H	High			
E	Extreme			

Future Opportunities

- Improve the modelling assumptions – damage curves, recovery timeframes, interdependencies, infrastructure valuation and repair costs

- Expanding our North Canterbury pilot to a wider area – e.g., South Island – what does it look like?

- Build on the AF8 road vulnerability modelling – other networks? Cascading impacts?

- Use of other tools – e.g., RiskScape

- Climate change impacts on vulnerability assessments

- Researchers – include lifelines people in your teams!