INFRASTRUCTURE A KEY CONTRIBUTOR TO RESILIENT NATIONS

Roger Fairclough, Chair New Zealand Lifelines (Utilities) Council

World Engineering Day For Sustainable Development

9/10 March 2021

New Zealand Lifelines Council

WFEO-CDRM

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INTERNACIONAL WEBINAR

WORLD ENGINEERING DAY FOR SUSTAINABLE DEVELOPMENT

TOWARD RESILIENT SOCIETIES:
THE ENGINEERING CONTRIBUTION

Content …

- New Zealand features
- Lifelines (Utilities)
- National Lifelines Infrastructure Vulnerability Study
- Canterbury Earthquakes







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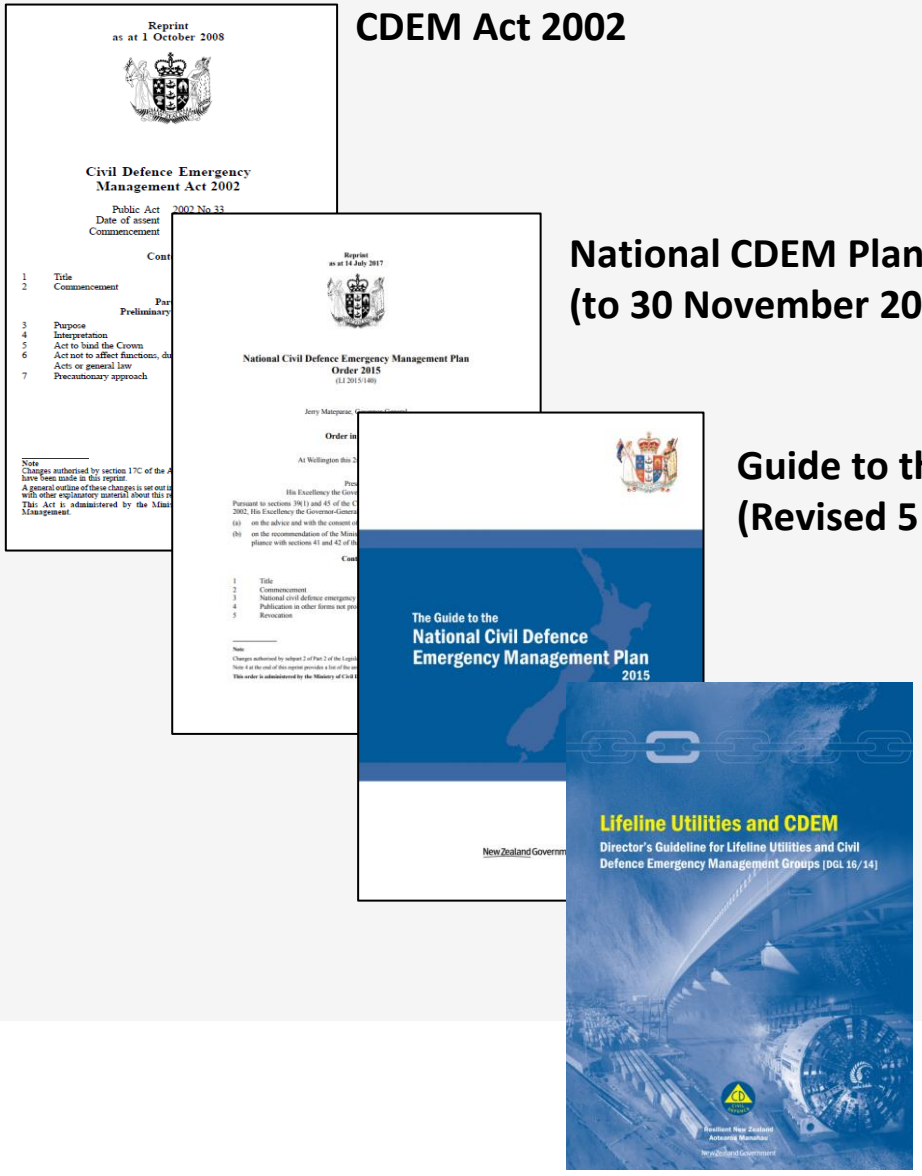
NZ features …

- Isolated – long way from markets
- Heavily dependent on primary products
- More urbanised than France and Germany
- Challenging geography
- Hazardous

The Three Key Elements of Infrastructure Resilience

1. Robust physical assets with alternative routes for key networks
2. Effective relationships (pre- and post-event)
3. End-users with appropriate backup arrangements

Lifeline Utilities
Civil Defence Emergency Management Act (CDEM)



CDEM Act 2002

National CDEM Plan Order 2015
(to 30 November 2020)

Guide to the National CDEM Plan 2015
(Revised 5 May 2017)

Director's Guideline for Lifeline Utilities

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New Zealand Lifelines (Utilities) …

- Energy, Transport, Telecommunications, & Water
- Supporting resilient communities
- Supporting regional Lifelines Groups
  - Focused on improving regional vulnerability assessments
- Providing information to national lifeline utilities in their resilience work
- Liaising with Government agencies on infrastructure resilience

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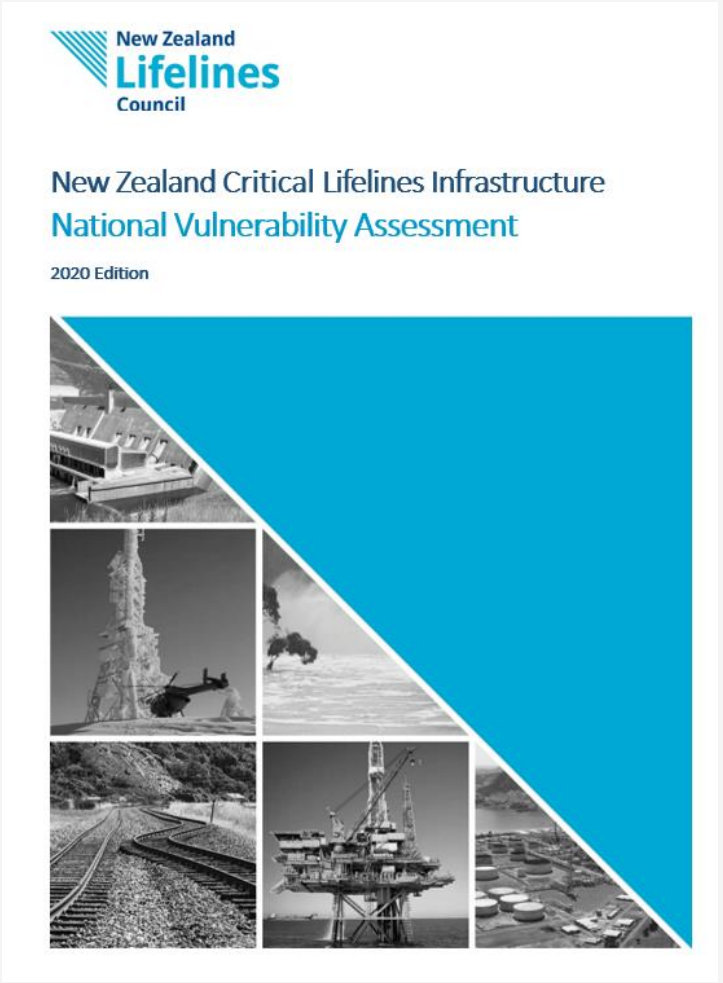
National Lifelines Infrastructure Vulnerability Assessment

- What is nationally significant infrastructure?
- What is our national Infrastructure's vulnerability and resilience to hazards.



http://www.nzlifelines.org.nz/ to:

- Download the Summary
- Download the Full Report

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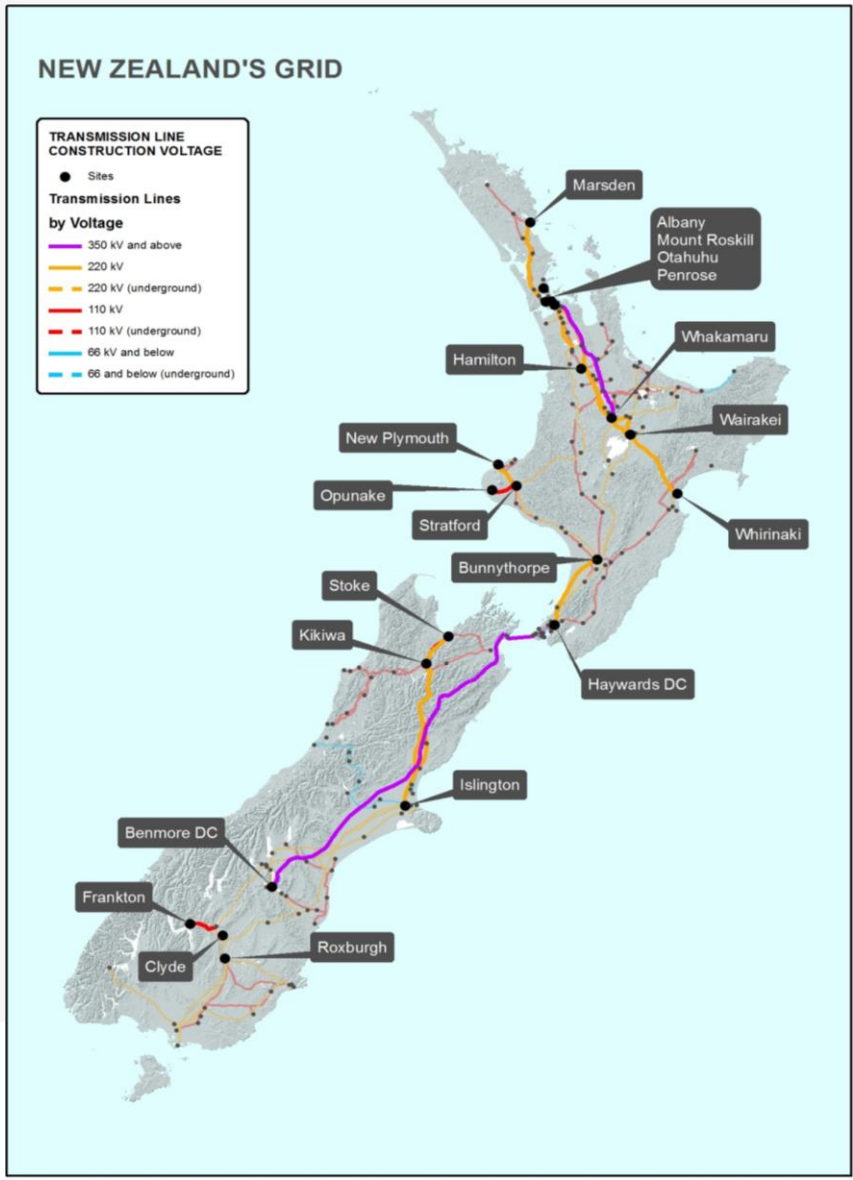
Regional 'Lifelines 'Vulnerability" Studies

- 'To assess the potential impacts of hazards on lifelines infrastructure and identify mitigation strategies to reduce that risk.'

- The national assessment builds its base from the regional work and supplements it with a 'top-down' view.

Key Sector Resilience Findings - Electricity

- **Changing generation sources** affecting the resilience profile of the overall national network.
- **Small distribution networks:** Typically less resilient design. Less resources to manage and renew networks. Network condition and reliability is a concern for some communities.
- **Climate Change**: More frequent high-wind storm events impacting distribution system reliability.

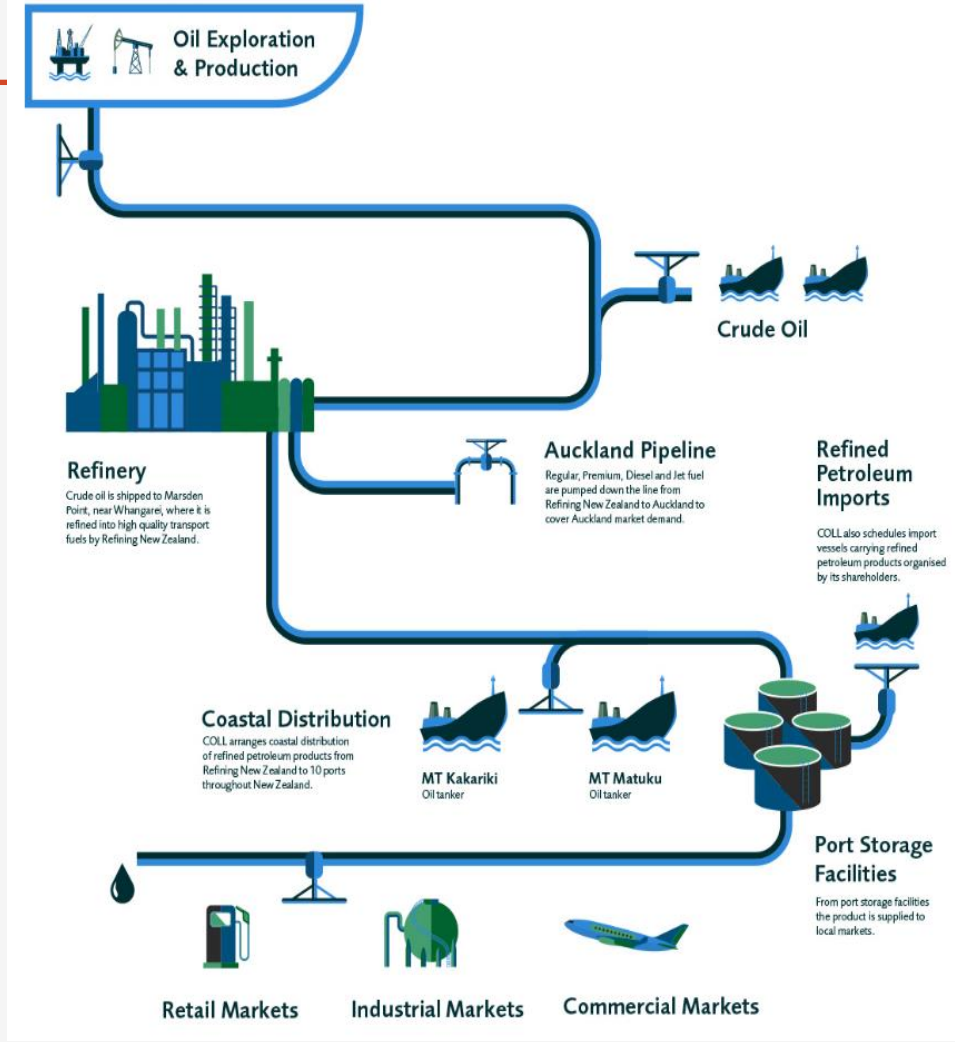


Key Sector Resilience Findings - Gas

- **Criticality of key transmission lines**: Main vulnerabilities are coastal erosion, land slips, and third-party damage (e.g. accidental damage by diggers). The 2019 *Government Fuel Inquiry* made several recommendations relating to establishing higher levels of control and enforcement when working near fuel and gas lines.
- **Reducing national production:** Ceasing new permit issues for offshore gas exploration will likely result in a reduction in national gas production over time.

Key Sector Resilience Findings - Fuel

- **Tight supply chain and dependence on road network:** Fuel distribution within NZ is heavily dependent on the road network and limited storage around the regions.
- **Jet fuel storage at Auckland Airport:** No logistical options if supply through the Marsden Refinery pipeline fails.
- Most **regional fuel storage tanks** are on the east coast and are potentially vulnerable to tsunami. Damage to multiple ports would have devastating impacts on the fuel sector.



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Key Sector Resilience Findings – Land Transport

- **Weather and climate change impacts** - increasing emergency response costs and higher frequency high impact storms. Significant mitigation investments are likely to be needed.
- **Slope instability and landslides** are an ongoing issue, with often inadequate local road alternate routes.
- **Developing evidence-based mitigation programmes**: Many road resilience improvement projects occur reactively when major damage occurs. Moving to proactive mitigation programmes.

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Key Sector Resilience Findings – Air and Sea Transport

- **Volcanic ashfall can cause prolonged air traffic disruptions** - ongoing work to improve ashfall modelling following an eruption to minimise airspace closures.
- **Vulnerability to earthquakes:** Most NZ ports are located to some extent on reclaimed land that varies both in age and construction quality.
- **Ports** are vulnerable to tsunami, and sea level rise is a key issue for this sector.
- **Climate change -**13 of the 28 international or domestic airports exposed to extreme coastal flooding, groundwater rise and sea-level rise.

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Key Sector Resilience Findings – 3 Waters (Potable, Waste, Storm)

- **Highly variable levels of resilience and preparedness between water authorities:** Major industry changes are underway to address sector capacity and capability issues.
- **Climate change and increasing drought conditions**
- **Climate change and increasing high intensity rainfall -** Stormwater networks
- **Dependence on electricity with limited backup capacity**
- **Pipe networks vulnerable to land movement**:

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Key Sector Resilience Findings – Telecommunications

- **Dependence on electricity with limited backup capacity:** Critical sites have on-site generators and fuel storage, most others rely on battery backups.
- **Commercial drivers do not support capital investment in resilience:** Sector focused on preparedness and response arrangements with little investment in risk mitigation.
- **Increased isolation risk for some communities:** as traditional local switching exchanges are progressively being shut down

Understanding Infrastructure Interdependencies

Business as Usual

The degree to which the utilities listed to the right are dependent on the utilities listed below	Roads	Rail	Sea Transport	Air Transport	Water Supply	Wastewater	Stormwater	Electricity	Gas	Fuel Supply	Broadcasting	VHF Radio	Telecomms	**Total Dependency**
Electricity	2	2	3	3	3	3	2		2	2	3	3	3	**31**
Roads		3	3	3	2	2	2	2	2	3	2	2	2	**28**
Fuel	2	3	3	3	2	2	2	2	2		2	2	2	**27**
Tele-comms	2	2	2	2	2	2	2	2	2	2	2	3		**25**
Water Supply	1	1	1	2		3	1	1	1	1	1	1	2	**16**
VHF Radio	2	2	2	2	1	1	1	1	1	1	1		1	**16**
Stormwater	2	1	1	2	1	1		1	1	1	1	1	1	**14**
Wastewater	1	1	1	2	1		1	1	1	1	1	1	1	**13**
Rail	1		1	1	1	1	1	1	1	1	1	1	1	**12**
Sea Transport	1	1		1	1	1	1	1	1	1	1	1	1	**12**
Air Transport	1	1	1		1	1	1	1	1	1	1	1	1	**12**
Gas	1	1	1	1	1	1	1	2		1	1	1	1	**13**
Broadcasting	1	1	1	1	1	1	1	1	1	1		1	1	**12**

3: Required for Service to Function,
2: Important but can partially function and/or has full backup,
1: Minimal requirement for service to function.

During / Post Disaster

The degree to which the utilities listed to the right are dependent on the utilities listed below	Roads	Rail	Sea Transport	Air Transport	Water Supply	Wastewater	Stormwater	Electricity	Gas	Fuel Supply	Broadcasting	VHF Radio	Telecomms	**Total Dependency**
Fuel	3	3	3	3	3	3	3	3	3		3	3	3	**36**
Roads		3	3	3	3	3	3	3	3	3	2	2	3	**34**
Tele-comms	3	2	2	2	3	3	3	3	3	2	2	3		**31**
Electricity	2	2	3	3	3	3	2		2	2	3	3	3	**31**
VHF Radio	2	2	3	3	2	2	2	2	2	2	2		2	**26**
Broadcasting	2	2	2	2	2	2	2	2	2	2		2	2	**24**
Air Transport	2	1	1		2	2	2	2	2	2	2	2	2	**22**
Water Supply	1	1	1	2		3	1	1	1	1	1	1	2	**16**
Stormwater	2	1	1	2	1	1		1	1	1	1	1	1	**14**
Wastewater	1	1	1	2	1		1	1	1	1	1	1	1	**13**
Rail	1		1	1	1	1	1	1	1	1	1	1	1	**12**
Sea Transport	1	1		1	1	1	1	2	1	1	1	1	1	**13**
Gas	1	1	1	1	1	1	1	1		1	1	1	1	**12**

Recent Earthquake Impacts

Canterbury Earthquakes 2011 land and housing impacts:

- 8,000 residential properties red zoned (4% of total residential properties)

Kaikoura Earthquake 2016 national infrastructure impacts:

- Main arterial highway and rail link cut for more than a year

Canterbury Earthquakes 2010 +, now Kaikoura

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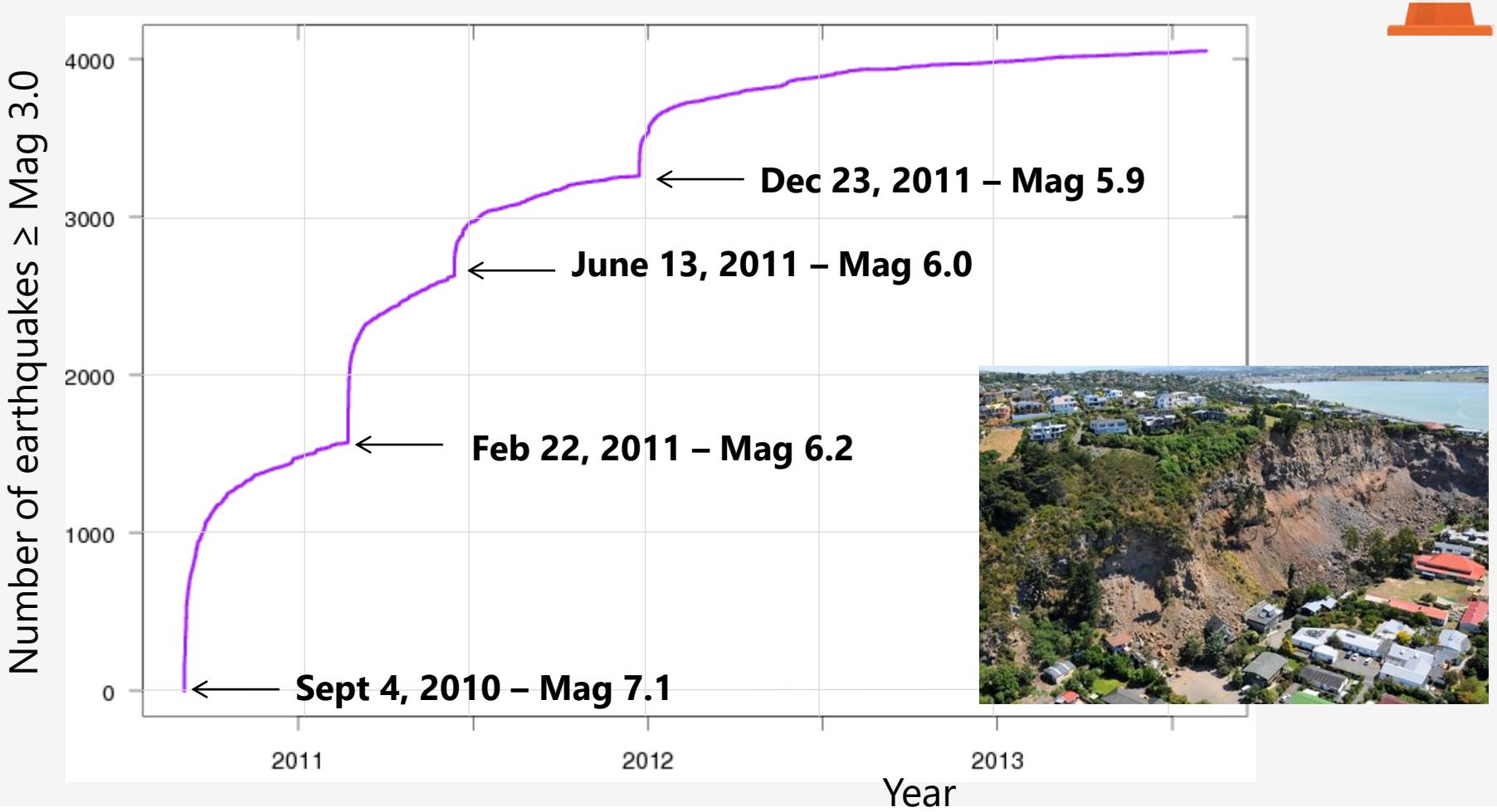
Canterbury Earthquake Delay Curve



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Christchurch City Damage

- **Residential**
- **100,000 homes damaged**
- **7,860 homes in red zone**

Central City

- **70% commercial buildings**
- **3000 businesses displaced**
- **Cordon – 387ha**

Social

- **185 casualties from 20 countries**
- **6,800 treated for injuries**

Infrastructure

- **52% road network (1000km)**
- **31% sewer network (528km)**

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THANK YOU FOR YOUR ATTENTION

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