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Department of Prime Minister and Cabinet
Parliament Buildings
Wellington

Via email to infrastructureresilience@dpmc.govt.nz

Critical Infrastructure Phase 1 Consultation

“Strengthening The Resilience of Aotearoa New Zealand’s Critical Infrastructure System”, Discussion Document, June 2023

Submission from the New Zealand Lifelines (Utilities) Council (NZLC)

This submission is on the discussion document “Strengthening the Resilience of Aotearoa New Zealand’s Critical Infrastructure System” issued by the Department of Prime Minister and Cabinet (DPMC) and dated June 2023.

Please note that the New Zealand Lifelines (Utilities) Council consists of a range of organisations. Not all these organisations may be fully supportive of this submission, and it is understood that member organisations may also engage directly with DPMC.

The New Zealand Lifelines Council recognises this focused engagement is intended to inform further policy development as part of the Infrastructure Resilience programme. Our submission provides general feedback and comment responding to areas and questions raised in DPMC’s discussion document, to inform the scoping of the resilience programme.

Given the importance of the matters that this work seeks to address, we ask the Government seeks cross-party support for the proposed resilience programme.

Executive Summary

The New Zealand Lifelines (Utilities) Council agrees that bold changes are needed in the way New Zealand’s critical infrastructure is created and managed, to ensure infrastructure provides for the wellbeing of future generations.

The NZLC’s high-level comments are:

1. The NZLC strongly supports the basis, the intent and proposals in the discussion document.
2. Strengthening infrastructure resilience through regulatory reform is essential.
3. Resilience – regulatory reform must be complemented by other mechanisms to enhance critical infrastructure system resilience.
4. Better defining roles and responsibilities across the infrastructure sector is an essential component of regulatory reform.

5. “Resilience” must more fully reflect New Zealand’s challenging, diverse and unique hazardscape, to ensure New Zealand’s infrastructure is fit for Aotearoa’s purposes.
6. “Criticality” is determined by the consequences of service disruption and not all critical infrastructure is in the form of physical assets e.g., Airways New Zealand services.
7. Operationalising resilience will be key.
8. A Minister and entity responsible for implementation, evaluation, monitoring and enforcement is critical and must be appropriately resourced and mandated.
9. Megatrends are acknowledged but certain other trends such as changing demographics have strong influences on critical infrastructure.
10. Flood protection must be included in critical infrastructure.
11. Critical Infrastructure efforts should include developing a national strategy and governance framework, the regulatory framework forming part of this.
12. Critical Infrastructure, to be fully effective, must include an entity or agency prepared to act on behalf of, and represent, the Critical Infrastructure system in national and local dialogues.

These, and other points, are discussed further in NZLC’s submission.

[The New Zealand Lifelines \(Utilities\) Council](#)

The New Zealand Lifelines (Utilities) Council (NZLC) brings together key national utilities (Transpower, Spark, Waka Kotahi, KiwiRail, Vector, First Gas, and Chorus), along with other organisations with an active interest in promoting infrastructure resilience (National Emergency Management Agency, Land Information New Zealand, Toka Tū Ake EQC, the Ministry of Business Innovation and Employment, Water New Zealand, the National Institute of Water and Atmospheric Research and GNS Science).

The New Zealand Lifelines (Utilities) Council and New Zealand Lifelines Regional Groups have established a unique and extremely valuable position in the New Zealand infrastructure ecosystem. They are the only “boundary organisation” that acts across all infrastructure sectors and at the interface of government and infrastructure service providers. This delivers a unique societal and community perspective, particularly as it relates to hazards, risk management and systemic weaknesses.

This Council is particularly conscious of the dependence of social infrastructure and the community on core ‘lifelines’ infrastructure, consistent with the broader objective of developing more resilient communities, the National Disaster Resilience Strategy (“We all have a role in a disaster resilient nation”) and The Treasury Living Standards framework and the Sendai Framework for Disaster Risk Reduction (New Zealand is a signatory to). The Council works to support regional lifelines activities, assist national lifelines utilities in their resilience work and is a connector with relevant government agencies in their resilience activities.

The Treasury, through the National Infrastructure Unit, and the Infrastructure Commission regularly participate in NZLC activities, as do other parties from time to time.

Lifeline Utilities have status and obligations under section 60 of the Civil Defence Emergency Management Act 2002, including the ability to function to the fullest possible extent (this may be at a reduced level), during and following an emergency. They also have responsibilities in the National Civil Defence Emergency Management Plan 2015 across the 4Rs (reduction, readiness, response, and recovery), including on building operational resilience, developing business continuity plans, response planning, and exercising.

The New Zealand Lifelines (Utilities) Council maintains active insight and engagement across all sectors of energy, transport, telecommunications and water. With proposed changes in the CDEM Act and proposals emerging in documents such as **“Strengthening the Resilience of Aotearoa New Zealand’s Critical Infrastructure System”**, this list is extending into other sectors. We annually hold a National Lifelines Utilities Forum, last year attended by around 200 delegates with presenters across a broad range of infrastructure service providers, end-users and researchers. We actively endeavour that this Forum does not present a financial barrier to participation. In 2022, DPMC presented on the topic of critical infrastructure and immediately gained a very positive response.

Context

The New Zealand Lifelines Council’s comments contained in this submission are largely based on work with infrastructure service providers, researchers and government agencies, with strong evidence deriving from the ground-breaking, “New Zealand Critical Lifelines Infrastructure National Vulnerability Assessment 2020 Edition” (New Zealand Lifelines Council, September 2020).

The vulnerability of New Zealand’s economy, environment and society to adverse events has been well-established through actual events, hazard studies and national simulation exercises. While this work has focused in the main on natural disasters, crises can also develop from equipment failures and malicious intent.

The interconnectivity of all infrastructures now means that the potential for cascading effects of the failure of one sector across other infrastructure sectors is high.

The New Zealand Lifelines (Utilities) Council recognises that many of the infrastructure sectors risks, vulnerabilities and opportunities can be addressed through enhanced capacities and capabilities. New Zealand is currently lacking in fulsome mechanisms to mobilise these.

Key Submission Points

1. The NZLC strongly supports the basis, the intent, and proposals in the discussion document.

As mapped out in the discussion document this isn’t the start of the journey to increasing the resilience of New Zealand’s infrastructure system but is a further step to improve its performance particularly in the face of rapidly changing requirements and expectations.

This is resilience in practice, and right now we don't have the frameworks, the strategic thinking, the mechanisms for adaptability, and the ability to manage across highly interdependent systems, to meet government, community, business, institutional and environmental needs.

These are topics that the NZLC has been highlighting over decades of activity.

2. Strengthening infrastructure resilience through regulatory reform.

It is noted that this discussion document has a focus on regulatory reform and opportunities to strengthen resilience through this mechanism.

There is no doubt that this mechanism is essential and is the only means to achieve a systems wide approach at the highest level. It is therefore extremely important to not only expedite this initiative but also ensure that the system breadth is fully covered in this endeavour.

Essentially the NZLC is warning that any piecemeal approach is less than optimum, and that bold, decisive, and impactful action is required.

3. Resilience

At the same time as any regulatory reform, it must be recognised that other mechanisms to improve infrastructure resilience must continue in parallel. In this submission the NZLC takes the opportunity to reinforce messages it has been delivering for some time.

NZLC recognises there are many facets to infrastructure resilience that include and extend beyond the physical infrastructure characteristics. These can be summarised as:

- robust assets and networks (attributes such as structural integrity, network redundancy, adaptability, integrated use of space (corridors), sharing of assets, etc)
- appropriate resource commitment by infrastructure organisations (to enhance preparedness and speed restoration)
- effective collaboration with all members and stakeholder parties (both pre-event and in emergency response)
- realistic community expectations (informed by understanding of infrastructure system vulnerabilities)

NZLC recommends that 'resilience' in this broader sense is more fully recognised into the future, in particular as it applies to Critical Infrastructure.

To further reinforce this point, the Rockefeller Foundation and the 100 Resilient Cities initiative (which both Christchurch and Wellington were part of) offer strong guidance on best practice through the "City Resilience Framework". This is pertinent in the context of thinking about rural and urban situations. The following is an extract from the framework:

Item 10. Effective leadership and management

Involving government, business and civil society, and indicated by trusted individuals; multi-stakeholder consultation; and evidence-based decision-making.

Item 11. Empowered stakeholders

Indicated by education for all, and access to up-to-date information and knowledge to enable people and organisations to take appropriate action.

Item 12. Integrated development planning

Indicated by the pressure of a city vision; and integrated development strategy; and plans that are regularly reviewed and updated by cross-departmental working groups.

Similar principles could be applied at a national Critical Infrastructure level with some modifications.

4. Better defining *roles and responsibilities* across the infrastructure sector

Implicit in any regulatory reform should be much improved definition of roles and responsibilities. In addition, to support the implementation of top-level policy direction through the sector, will require clear and strong accountability mechanisms.

At the highest levels this should be relatively straight forward and must be focused on an infrastructure systems wide approach for regulatory coordination and leadership. This is discussed further under the Responsible Minister section below.

What has been overlooked for some time are the next levels down and the mechanics of linking regulatory intent with practice, and doing so efficiently and effectively. This is a topic in its own right and the following is merely a demonstration of this.

The NZLC has highlighted for some time that the New Zealand system is weak on the “**Missing Middle**” – the substantial and widening gap between policy settings and ability to implement, as well as the lack of coordinating capacity and capability to materialise efficiency and effectiveness improvements.

Numerous examples exist where valuable national initiatives are stalled due to no central entity willing to support, champion and lead them (**refer Attachment**).

Many of these initiatives, and others, could valuably contribute to defining Critical Infrastructure, the associated hazards, the vulnerabilities and complete the circle of community and business impacts from critical infrastructure failures to deliver the required services. Specific examples include:

- the MERIT (Measuring the Resilience of Infrastructure Tool), a world leading capability.
- RiskScape (<https://riskscape.org.nz/>) and Urban Intelligence initiatives (<https://urbanintelligence.co.nz/>).

5. That ‘resilience’ more fully reflect NZ’s *challenging and diverse hazardscape*.

New Zealand is a hazardous country unlike many of the jurisdictions we have chosen to follow in our evolution of infrastructure policy. Significantly increased recognition needs to be given to this

in our policy and operational settings such that New Zealand's infrastructure is fit for Aotearoa's purposes.

6. Criticality

At this stage it is important to recognise that the determination of critical infrastructure is to a large degree determined by the services delivered and not all critical infrastructure is in the form of physical assets – a specific example is that Airways New Zealand is critical to the operations of all our airports and airspace operations but has very few assets.

In parallel to assessing what infrastructure is critical it would also be wise to actively avoid adding to the list of critical infrastructure.

Examples are where substantial capital investments are being considered there may be opportunities to reduce the criticality of these by perhaps designing in levels of redundancy or installation of numerous smaller elements rather than one large element – rather than one very large police station, two or three distributed stations may be better.

7. Operationalising resilience

Operationalising resilience will be key.

The scale of resilience takes many forms; the knowledge, asset, process, individual, organisational, and community level. Currently, across the infrastructure system there are no consistent measures of resilience, e.g. redundancy, flexibility and diversification. It is likely that centrally determined minimum levels of resilience which provide for local variation will be required.

8. Responsible Minister

The discussion paper seeks feedback about whether there is need for a responsible agency or regulator to support lifting resilience. Given the number of regulators providing oversight of infrastructure establishing another regulator risks confusion, duplication and a lack of coordination.

There is a real need for information sharing and transparency. A responsible agency and the Minister of Infrastructure would likely facilitate this. We note policies affecting infrastructure sectors are spread over many Ministries or agencies.

An absolute key is that the agency must be resourced to do not only the implementation but also, the evaluation, monitoring and enforcement across the infrastructure system.

9. Megatrends

The discussion document considers the four megatrends that pose a risk to critical infrastructure are climate change, national security risks, fragmented global economy, and rapid technological change.

The NZLC acknowledges these pose risks, but for critical infrastructure a further megatrend is capability and capacity of the workforce to deliver. Internationally these demands are the same, so New Zealand is competing in an international context increasingly exposed to weaknesses.

There are other trends to recognise with respect to critical infrastructure and provision of services:

- Changing population demographics also need to be accounted for. This includes urbanisation, aging populations, and immigration, all of which stress existing infrastructure capacities, thereby lessening its resilience to adverse events.
- There is also growing demand and competition for limited resources, such as water, energy, key minerals and commodities. At the same time, there is increasing pressure to move towards more sustainable practices, such as reducing greenhouse gas emissions and responding to the global biodiversity crisis. This tension between sustainability and limited resource availability is another challenge that needs to be navigated for critical infrastructure systems – many of which rely on these resources, or which may lose social licence to operate if sustainability issues are not effectively considered and addressed.
- Cybersecurity risks are significant and increasing. To some extent, such risks could be considered covered under the umbrella of “new technologies”, but the escalating threat of cyber-attacks and the increasing dependence on digital systems and interconnected networks should probably be recognised as its own trend that can affect critical infrastructure directly, as well as trust in critical infrastructure services.
- Changing social and political dynamics are also important. This includes things like social inequality, disenfranchisement, polarisation, and political unrest. In New Zealand, this trend could also include the evolving relationship between Māori and the Crown under Te Tiriti.

Addressing these dynamics, and their influence on infrastructure decision-making, requires inclusive processes, effective communication, and equitable distribution of benefits. Recent events have demonstrated the vulnerability of critical infrastructure to widespread health crises. Pandemics, infectious diseases, and public health emergencies need to be considered in any effort to enhance the resilience of New Zealand’s critical infrastructure. This is clearly very applicable to healthcare systems but extends to other types of critical infrastructure such as transport, communications, computing, etc., which are relevant to rapid response and recovery to health crises.

10. Flood Protection

The 2023 rain events and Cyclone Gabrielle emphasised river corridor management and flood protection schemes are vital to protect economic, environmental and social wellbeing. There is a need to expand the definition of critical water infrastructure to include river control and flood protection schemes, including their flow and rain gauge monitoring network.

This should also extend to include weather forecasting.

Currently there are significant gaps in river and stormwater flood risk information and how its developed, variations between [regional and local] councils' levels of service, design standards and policies related to flooding and protection. A consistent national approach to flood hazard

modelling, definitions and terms, and smarter land use planning controls and design standards is needed.

11. Critical Infrastructure

We recommend that the actions around critical infrastructure be expanded beyond the definition and identification of critical infrastructure to include developing a national strategy and governance framework for critical infrastructure.

The Discussion Document states that there is a need to define and identify critical national infrastructure. We suggest that the resilience programme should recognise the work that has been done by the NZLC and regional lifelines groups to define and identify critical infrastructure as nationally significant, regionally significant and locally significant. Nationally significant infrastructure is further identified and described in the NZLC report *New Zealand Critical Lifelines Infrastructure, National Vulnerability Assessment, 2020 Edition*.

We further note that while the 3-level criticality ratings system is a relatively 'blunt' tool for identifying critical infrastructure, NZLC and Treasury worked together in 2020 to develop and test a more detailed, multi-criteria criticality rating process for infrastructure. We note that this is included in the discussion document, and we recommend that this be considered as a starting point for future work in this area.

12. Critical Infrastructure representation

A major weakness with our current mode of operationalising critical infrastructure is the lack of representation of critical infrastructure as a system. By this we are referring to the fact that no entity currently exists prepared to act on behalf of all, or in support of individual critical infrastructure providers, in national debates or at local levels. Examples arise frequently, with a case in point being port access and egress transport corridors through urban areas.

To support any regulatory initiatives there is an immediate need for institutional support across the infrastructure system.

Other Opportunities

Other opportunities to enhance the effectiveness of the resilience programme include:

- a. **Toka Tū Ake's risk tolerance work** - some of the approach would benefit from alignment with Toka Tū Ake's risk tolerance work, which has now been published here: <https://www.eqc.govt.nz/resilience-and-research/research/search-all-research-reports/risk-tolerance-methodology/>
- b. **Infrastructure's role in facilitating growth and development** – the resilience programme could recognise the role played by critical infrastructure facilitating growth and development but use infrastructure as a mechanism to discourage development in high natural hazard areas.
- c. **Information sharing** – We agree that additional information is especially important in an emergency but need to invest continuously to be sure of having this capability when it is

most needed. Improvements on the current state of play would include (but not be limited to):

- i.* Shared data sets (and data standards) on risks and hazards to ensure consistent approaches to risk management and planning. Shared asset location information particularly in corridors such as roads, rail and transmission corridors.
- ii.* Although utilities are required to provide this information, there is no compulsion to do so.

Summary

The New Zealand Lifelines (Utilities) Council supports the intent and direction as presented in the discussion document “Strengthening the Resilience of Aotearoa New Zealand’s critical infrastructure system.

We look forward to continuing to work with the Government to refine and contribute to critical infrastructure resilience policy, regulation and delivery.

Thank you for the opportunity to comment.

Yours sincerely,



Roger Fairclough

Chair

New Zealand Lifelines (Utilities) Council

roger.fairclough@neoleafglobal.co.nz

Mob 0276 456 225

ATTACHMENT 1

“Missing Middle”

The “missing middle” refers to the substantial and widening gap between policy settings and ability to implement. Implementation is generally not funded and supported. The evidence base continues to expand and demonstrates an embarrassing inability to implement here and now opportunities for productivity, efficiency and effectiveness improvements. Examples follow, supported by related notes:

- Metadata Standards
 - o The ambition is cross sector common metadata standards including road systems, buildings and three waters. This presents significant opportunities to build infrastructure information and common understanding to deliver an improved evidence base.
 - o Development initially recognised and supported by Land Information New Zealand and now struggling to find support
- National Forward Works Viewer
 - o Developed through the Canterbury Earthquake recovery phase to co-ordinate cross utility reinstatement of services (essentially avoid roads being dug up more than once”)
 - o Highly applicable nationally and in “business as usual”. Overall efficiency, effectiveness and community benefits.
 - o Struggling to find support.
- MERIT (Measuring the Resilience of Infrastructure Tool)
 - o Developed under public good funding
 - o Internationally appreciated as a ground-breaking tool
 - o Enables for the first-time economic assessment across all infrastructure types and assesses impact on economic activity
 - o On-going development occurring in ad-hoc fashion
 - o Some take-up (eg. Waka Kotahi) but substantial potential value within sector (eg. electricity and Value of Lost Load (VOLL)) and across sectors challenging to materialise
 - o No on-going funding secured as value is across multiple players.
- ENGAGE
 - o Capability to be prepared for and immediately scale up systems and processes to effect recovery following events
 - o Concept at this stage requiring more work to identify and explain the gap to fill and how it would fit with existing local government/central government arrangements
 - o Potential to apply in “business as usual” across central and local government and elsewhere
 - o As ENGAGE is maturing through a stage gate process from concept definition, confirmation of value proposition, to development of key features, it would need financial support
- Stopbanks Inventory
 - o Until recently New Zealand had no inventory of stopbanks
 - o Researchers recognised the need and an inventory now exists
 - o There is no body at this stage standing up to maintain and leverage the value from this priceless initiative
 - o The recent Ashburton floods present one of many examples of potential value.
- Smart Cities
 - o Potential for delivering an improved built environment for improved well-being
 - o Initiative across Auckland, Christchurch and Wellington started demonstrating value but on-going funding and support missing

- Systematic Threat Assessment
 - There is some work on this in the “New Zealand Lifelines Infrastructure Vulnerability Assessment: Stage 1 September 2017” document but at a generic high level
 - While there is talk of “cascading” and “compounding” risks, these concepts lack real examples or scenarios
 - The OECD are very big now on what they call hybrid threats and lack of redundancy in networks
- New Zealand Geotech Database
 - Developed following the Canterbury Earthquakes and being extended throughout New Zealand
 - Relies on collaborative model and recognised value from sharing information
 - Business case fully developed and currently managed by MBIE and EQC. Has been an on-going struggle to maintain small investment.
 - Value proposition extends nationally particularly as water resources become an increasing issue.
- Inconsistent standards across Local Authorities
 - Many infrastructure contractors, consultants, owners and operators work across local authority boundaries.
 - Different systems and processes and contract conditions and resource consent requirements are applied
 - Most contractors complain about these issues
 - To emphasise the point KiwiRail must paint bridges in one local authority but not in the next
 - No effort is being applied to address this
- Rainfall/Runoff Guidelines
 - New Zealand had the opportunity to leverage A\$50million of investment by Australian agencies, and at costs around NZ\$1million deliver rainfall/runoff guidelines for New Zealand.
 - Despite numerous approaches to different central agencies no support could be carolled to fund the initiative
 - These guidelines will be crucial to achieve national consistency and prepare in advance for climate changes.
- District and Regional Planning
 - For infrastructure owners and operators, \$10’s of millions of dollars are being spent annually retaining infrastructure capability in each council’s District Planning processes with substantial duplication, inconsistent outcomes, lack of central support and lack of coordination
 - Inability to address systemic inconsistencies across the planning environment
- Geospatial
 - Geospatial opportunities abound to improve effectiveness and efficiencies across infrastructure and delivery of services
 - In the emergency management area funds were being deployed to create a “Common Operating Picture” with little ability for a coordinated cross infrastructure view on how business as usual capabilities could be integrated with emergency management needs.
 - Canterbury Region Lifelines are currently implementing a Canterbury only “Common Operating Picture” in the absence of the national coordination.
- Onsite Wastewater Evaluation and Testing (OSET)
 - The Rotorua Waste Water Treatment Plant (WWTP) is the location of the OnSite wastewater Evaluation and Testing (OSET) facility where the treatment component of domestic onsite wastewater management systems (OWMS) are evaluated. The land disposal system is the other half of an OWMS and is not tested nationally, this relies on good design and maintenance.
 - There is no central government oversight or assistance with OWMS at all. It falls between MBIE and the building Act and the MfE with the protection of the environment and the NES for the protection of drinking water. Water New Zealand have been talking to both MBIE and MfE as

- OSET is in dire need of assistance. There is a 2008 document that estimated over 200,000 OWMS exist in NZ. This figure is now much higher, especially with the number of new developments going ahead that are not connected to a municipal water or waste network.
- Resulting from lack of national level support the decision was made in June 2021 to close this valuable facility but maintain it in a state able to be restarted.
 - Flood Inundation National Database (FIND)
 - What is required is a central repository for geospatial data pertaining to flood inundation, in standardised formats and publicly available (where appropriate). This includes the underlying data required to accurately model flood inundation hazard (e.g. hydraulically conditioned DEM (Digital Elevation Models), roughness maps, river networks, stopbanks, bridges, culverts, roads, etc), as well as potentially design storms for given return periods (under current and future climates) and nationally consistent flood hazard layers. The current Flood Endeavour Mā te Haumarū o te Wai is collecting and creating much of this information but in order for this to remain current and useful there needs to be a mechanism for ongoing hosting and curation.
 - Flooding is one of the most costly natural hazards in Aotearoa New Zealand. Our regular floodclean-up bills are topped only by much less frequent earthquakes. And with a warming climate and rising seas, flooding is expected to become more severe and more frequent.
 - Note that this information could have far wider use than Flood Inundation.
 - National Flood Flow Forecasting
 - Work in progress, details being developed.
 - GeoNet
 - Is the national geohazards monitoring programme (earthquake, volcano, tsunami, landslide)
 - Is nationally critical science infrastructure
 - Provides time critical data to support science advice before, during and after geohazards events
 - Provides research quality data to support understanding of our national geohazards environment (feeding into NSHM and other hazard and risk models – see below)
 - Is funded to have 24/7 monitoring of events through the National Geohazards Monitoring Centre
 - Is co-funded by EQC, MBIE, LINZ and NEMA
 - Does not have fully costed funding to cover all services required by government and others
 - National Seismic Hazard Model
 - Brings together knowledge about seismicity and resultant ground motions in Aotearoa New Zealand to provide information on likely shaking over different time periods
 - Is fundamental to ensuring structures are designed for earthquake resistance through the building regulatory system (including infrastructure guidance such as the *Bridge Manual*)
 - Is used extensively by insurers and re-insurers to price earthquake risk in Aotearoa New Zealand
 - There is no sustainable funding beyond 2024 for developing and maintaining the NSHM
 - National geohazard and risk models (beyond seismic)
 - Comprehensive and coherent geohazard and risk models beyond seismic do not exist
 - A critical gap is nationally consistent tsunami inundation modelling; some modelling exists but it has been undertaken at different times, using different methods by individual regional or local authorities
 - Volcanic hazard and risk models are highly complex and tend to focus on a single volcanic phenomenon (eg volcanic ashfall) and/or specific volcanoes
 - Two landslide models are in development: rainfall-induced and earthquake induced. These also have been developed for specific regions or with limited (unsustainable) research funding

- Ideally a suite of nationally consistent hazard and risk models would exist in a common open repository so that stakeholders can access them to support processes such as resource management, evacuation mapping, insurance pricing and recovery planning
- Nationally critical databases
 - Nationally critical datasets underpin assessment of hazard and risk and support evidence-based decision making
 - Systematic data collection and custodianship are not well supported across the science system
 - Critical datasets that do not have any funding include landslide inventories, active fault databases, vulnerability data
 - Other critical datasets are inadequately funded including national volcano monitoring data, geomagnetic data, building and structural data
 - A national science data strategy is required to provide sufficient support to ensure these datasets meet international and national FAIR* standards (* FAIR = findable, accessible, interoperable and reusable)
- Simulation Models
 - A feature of simulation models to inform public policy decisions, including infrastructure investment, that presents a significant challenge is that there are many aspects of the environment and society that one might want to model. Each of these aspects, e.g., economy, demography, land use, climate, agricultural productivity, transport and other infrastructure networks, will usually have its own academic and professional discipline.
 - There is a tendency for research and development of models to remain focused on improving aspects related to a single discipline while system variables that correspond to other disciplines are incorporated into the models as static parameters or greatly oversimplified functions.
 - However, it might be that integrating a set of moderately good models might do a much better job of simulating aspects of the world we are interested in than a stand-alone state of the art model.
 - For example, a reasonably well integrated set of standard economic, land use, transport, and climatology models might be able to tell us much more useful information about how our transport infrastructure can or should adapt to climate change than a stand-alone state of the art model could by itself.
 - One of the things that makes building integrated models a challenge is that there is an apparent dearth of software tools that would make doing so easier. This is in part due to low numbers of modellers having the requisite computer programming skills to build online platforms, user interfaces, and other software tools to build integrated models.
 - Capabilities are improving rapidly. An example is the popularity of Shiny® from RStudios. Shiny® makes it possible for modellers to build a user interface and put their models on the internet without having to learn any additional programming languages or substantial new skills.
 - New Zealand's infrastructure modelling research efforts would benefit from increased investment in development of software tools that will make it easier to integrate models in a similar manner.