

Canterbury Earthquakes Research Strategy
Supplement to the Research Strategy of the
Natural Hazards Research Platform

Kelvin Berryman
Platform Manager

1 Context

The Canterbury earthquake sequence represents the largest natural hazard event in New Zealand's written history, with impacts estimated at 8% of national GDP, much more than the relative impact of Hurricane Katrina on the US economy or the recent Tohoku earthquake and tsunami on the Japanese economy. The Canterbury earthquake sequence has modified the natural environment, provided new perspectives on seismic hazard, caused widespread liquefaction and lateral spreading, devastated infrastructure and buildings, and resulted in major social and economic impacts. As such it provides the first opportunity in modern times in New Zealand to evaluate the performance of both communities and the built environment in a major earthquake, and to assess how this performance compared with public expectations. This knowledge must be applied to other communities, by central and local government, utilities owners, and communities themselves - both within New Zealand and overseas, to establish a sound basis from which to understand our vulnerabilities. Actions appropriate to the balance between protection and costs that our society will tolerate, can then be recommended, in order to minimise the impact of future events and to improve societal resilience to levels acceptable in our communities.

The earthquake has led to a step increase in the volume and quality of information available on earthquake characteristics and impacts. The resilience of the built environment in Christchurch is the result of incorporating the findings from past New Zealand and overseas earthquakes into New Zealand building codes and standards. This has saved billions of dollars in damage avoidance. However the earthquakes have also illustrated the very high financial and social cost of infrastructure and housing damage resulting from liquefaction and ground deformation from what is realistically only a moderate-sized, but proximal earthquake to the second largest population centre in the country. The greater insights and new information now available as a result of the Canterbury earthquakes are a foundation on which those tasked with the Canterbury recovery can build with confidence, and be used by practitioners to provide further and wider benefits for future events throughout New Zealand.

The challenge for scientists is to provide this knowledge in ways that facilitate its easiest conversion to practice by the large panel of users and stakeholders. As intimated above, a decision must be made on what balance between the degree of risk and the costs of achieving that resilience the ultimate stakeholders – members of society – are prepared to tolerate. This decision is for the community to make, but it should be well informed by research and analysis, including lessons learned regarding socio-economic impacts.

2 Relationship to the Platform Research Strategy

The Platform's research strategy is fully aligned with research requirements in Canterbury. The Platform strategy notes that *"as a consequence of [NZ's] physical setting, our society is exposed to a wide range of geological and weather hazards*

ranging from events with frequent, but modest impact, through to rare, but devastating events”.

The desired outcome of Platform research is stated to be: *“to directly contribute to improved economic, infrastructural and social resilience to natural hazards in New Zealand”, and it also note that “the science and engineering capability supported by the Platform will also be available to assist decision makers during significant hazard events.”*

In terms of scope, the research strategy notes that Platform research *“will include long-term basic targeted research as well as more short-term applied research that aligns with identified research user needs. The Platform will support capacity building to achieve research capabilities that provide an ability to understand, identify, predict, avoid or mitigate potential, well-defined catastrophic or cumulative risks (significant economic, social and/or environmental impacts) to New Zealand”.*

A number of guiding principles to achieve the aspirational goals of the Platform notes that *“leadership within science also has a key role to ensure alignment between research outcomes and national strategic objectives”*, and that research will:

- Meet national needs;
- Be responsive;
- Be of the highest quality;
- Support enduring capability;
- Be connected and coordinated, and;
- Be communicated

3 Current situation in Canterbury

Following the September 4th Darfield earthquake response actions by Platform (and beyond Platform) research agencies undertook a range of applied studies to provide rapid advice to stakeholders and to collect perishable data for further analysis. Research effort from existing funding was diverted as much as practicable. This diversion of existing funding continued following the Feb 22nd Christchurch earthquake as well and amounts to nearly \$4M on an annualised basis. Reimbursement of unbudgeted expenditure of \$1M for applied work has been received from MSI and distributed among the platform partners and other agencies.

Following the Feb 22nd earthquake a much larger and more coordinated science response was undertaken, initially under the auspices of MCDEM and the National Controller, and latterly with CERA. Research endeavour has been diverted as much as possible. Demand from end-users for research knowledge to inform response and initial recovery activities has been such that short term funding of \$2M has been made available by MSI to support these applied projects. A series of short term (up to 10 months from Feb 2011) projects were initiated by the Natural Hazards Research Platform (NHRP). The projects (approximately 25 in number) can be grouped into categories with respect to science and engineering topics, and key outcomes (Table

1). A wide range of stakeholders have been consulted, and indeed the majority of projects have been initiated in response to information requests from stakeholders.

Table 1: Summary of NHRP Short Term Recovery Projects (Feb-Dec 2011)

Topic	Stakeholders	Outcome
Likelihood of Future Earthquake Activity	Recovery Minister, CERA, MCDEM EQC, ECAN, CCC, NZIC	Better quantification of Canterbury earthquake hazard and risk
Building & Infrastructure Performance - Codes/ Regulations and Recovery	DBH, NZTA, CCC, Standards NZ Heritage Trust, Insurers, Recovery Minister, CERA	Better performed lifelines and more resilient built environment, in keeping with public risk tolerance and cost
Public Safety	DBH, Insurers, BRANZ, Heritage Trust, HERA, ECAN, CCC, MCDEM DHB, MoH, Fire Service	Assuring public safety
Land Stability	TA's, ECAN, EQC, Recovery Minister CERA, CCC, Canterbury Engineering Lifelines	Better informed land use
Canterbury Recovery Issues	DHB, Emergency Services, Canterbury Business Recovery Group, CERA, Housing NZ, Tourism Industry, TEC	Effective economic recovery
Psycho-Social Support, Education & Risk Communication	MSD, ECAN, CERA, MoE, MoH	Effective social recovery. Future resilience decisions are well informed

Recognising that the Canterbury earthquakes are major events in New Zealand's history of natural hazard impacts, additional funding of \$3M pa was approved in the 2011 Budget for the NHRP to continue into the medium term with fundamental and applied studies to assist Canterbury recovery, and improve hazard assessment and mitigation options that better prepare us for response and recovery in future events.

4 Process for investment of new funding

The 2011 Budget announcement of additional funding to the Platform constitutes a change event under the Platform Contract requiring the reprioritisation process to be utilised with consequent funding changes for parties, and followed by a variation to the Platform Contract.

The research programme that has been developed for commissioning new research has been developed in consultation with key end users and stakeholders including the Platform Strategic Advisory Group, Earthquake Commission, Department of Building and Housing, Ministry of Civil Defence and Emergency Management, Environment Canterbury, CERA, the Canterbury Earthquakes Royal Commission and the Minister for Earthquake Recovery.

4.1 Requirements of the Reprioritisation process are:

- 4.1.1 Assimilation of strategies and other material by the Platform Management Group (PMG) – completed in successive PMG meetings of March 9th and May 19th of this 2011.
- 4.1.2 Evaluation of existing themes and outcome benefits by the PMG – completed in development of the budget bid proposal
- 4.1.3 Additional or varied outcome benefits were approved by the Strategic Advisory Group on 10 March 2011. The outcome benefits are:
- Better informed public and decision makers about the balance that needs to be struck between acceptable levels of risk and costs of mitigation/resilience.
 - Less disruption and damage to buildings through the establishment of clear performance targets and expectations and means of achieving these for all buildings, infrastructure and critical facilities within our communities including life safety, the retention of amenity, and ability to continue to use and occupy buildings;
 - Safer communities and better informed land use planning through improved knowledge of the susceptibility of land to ground deformation;
 - Preservation and greater safety of existing town-scapes and heritage buildings through more appropriate retrofit solutions;
 - Better performing infrastructure including buried services;
 - Mitigation action and social responses to earthquake disaster that more effectively minimise the social and economic disruption to people's lives and to business continuity, from the wider impacts;
 - Better understanding and management of earthquake hazard and risk through an improved knowledge of the likely frequency and characteristics of earthquakes in regions of low to moderate seismicity; and
 - An improved response to future disasters by reviewing the response to the Canterbury earthquake, and applying the lessons nationally.
- 4.1.4 Identified specific changes to research themes were embedded in budget bid proposal and approved by MSI (letter of 20 June 2011).

5. The Canterbury Research Programme

The research programme will have negotiated and contestable components (Tables 2 & 3). Workplans related to topics will be developed with a NZ-wide group of researchers (Table 2). A guide to the relative size of each of the components of the proposed additional applied research is shown by indicative funding levels, the details of which will be developed within existing responsibilities of the NHRP.

Table 2: Research to be Undertaken with Additional NHRP negotiated funding

Title	Funding p.a. (GST excl)
Enhanced earthquake hazard & risk assessments in Canterbury and across New Zealand	\$650,000
Geotechnical engineering studies, particularly associated with liquefaction and slope stability in Canterbury and across New Zealand	\$600,000
Re-assessing building and infrastructure performance objectives and criteria for major earthquakes	\$700,000
Contribution to development of more robust socio-economic impact models using data from the Canterbury earthquake case study	\$300,000
	\$2,250,000

Table 3: Goals of Research to be Undertaken with Additional NHRP contestable funding

Theme	Targeted Outcomes – Lessons Learned from Christchurch
1. Geological Hazards	1.1 Better understanding and management of earthquake hazard through an improved knowledge of the Canterbury earthquake sequence and applying this knowledge to other regions of low to moderate seismicity
2. Engineering/ Geotech Engineering	2.1 Safer communities and better informed land use planning through improved knowledge of the susceptibility of land to ground deformations
	2.2 Less disruption and damage to buildings through the establishment of clear performance targets and expectations and means of achieving these. For all buildings, infrastructure and critical facilities within our communities including life safety, the retention of amenity, and ability to continue to use and occupy buildings
	2.3 Preservation and greater safety of existing town-scapes and heritage buildings through more appropriate retrofit solutions
	2.4 Better performing infrastructure, including buried services
3. Social	3.1 Better informed public about the balance that needs to be struck between acceptable levels of risk and costs of mitigation/resilience
	3.2 Improved mitigation actions, social and organisational responses and recovery from the earthquake events that more effectively minimise the social and economic disruption to people's lives, communities and organisations.
4. Risk	4.1 An improved response to future disasters by analysing the Canterbury earthquake case data, and applying the lessons nationally
Total Funding available: \$3M (GST excl) to invest over 3.25 years	