

**Effective all-hazard warning system development
and community resilience:
Results from ongoing multi-hazard research in
New Zealand, USA and Australia**



**Graham S. Leonard & David M. Johnston,
GNS Science, Lower Hutt, New Zealand
Douglas Paton, Department of Psychology,
University of Tasmania, Australia**

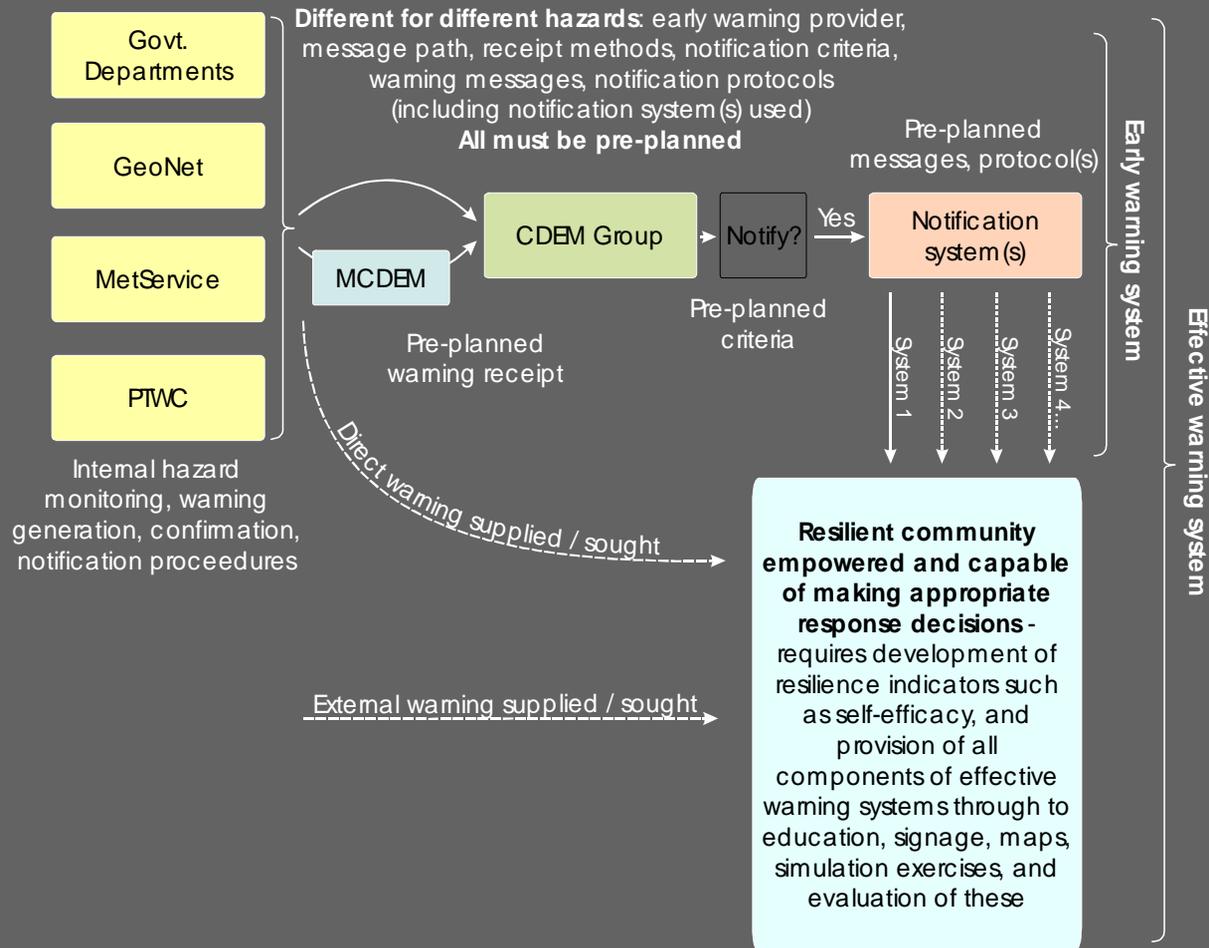


New Zealand's legislative and legal framework

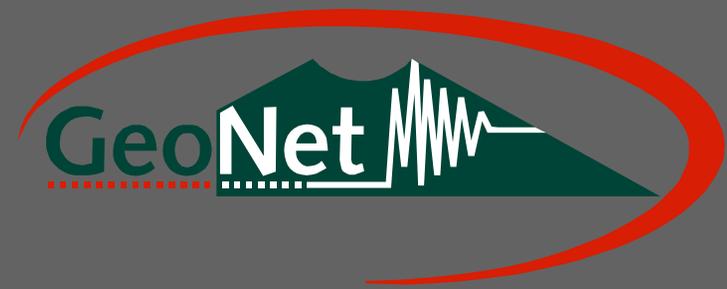
Organizational roles and linkages

- The Ministry of Civil Defence and Emergency Management (MCDEM) has a statutory role operating the **National Warning System**, communicating **multi-hazard warning messages** to regional CDEM Groups. Government agencies, including GNS Science via Geonet, supply early warning messages.
- MCDEM also has a role **providing guidance and resources** for public notification, education and response to warnings.
- **Regional CDEM Groups** have an **obligation to warn the public** and minimise the impact of emergencies, through a range of actions including warnings. Groups include **local government, emergency services and health agencies**.
- **GNS Science** also conducts social research into specific arrangements for end-to-end warning systems that **maximise effective response** to those systems.

New Zealand end-to-end all-hazard National Warning System



Geonet and GNS Science hazard / social research



- **Monitoring** of New Zealand earthquakes, volcanic activity and coordination of PTWC warnings. Development of local/regional-source tsunami monitoring.
- Generation of multi-hazard **warning messages** for national and regional emergency management.
- Natural hazard and risk **research**.
- Research into **effectiveness** of warnings; including practical actions and resilience motivators to **improve this** – the focus of this presentation.

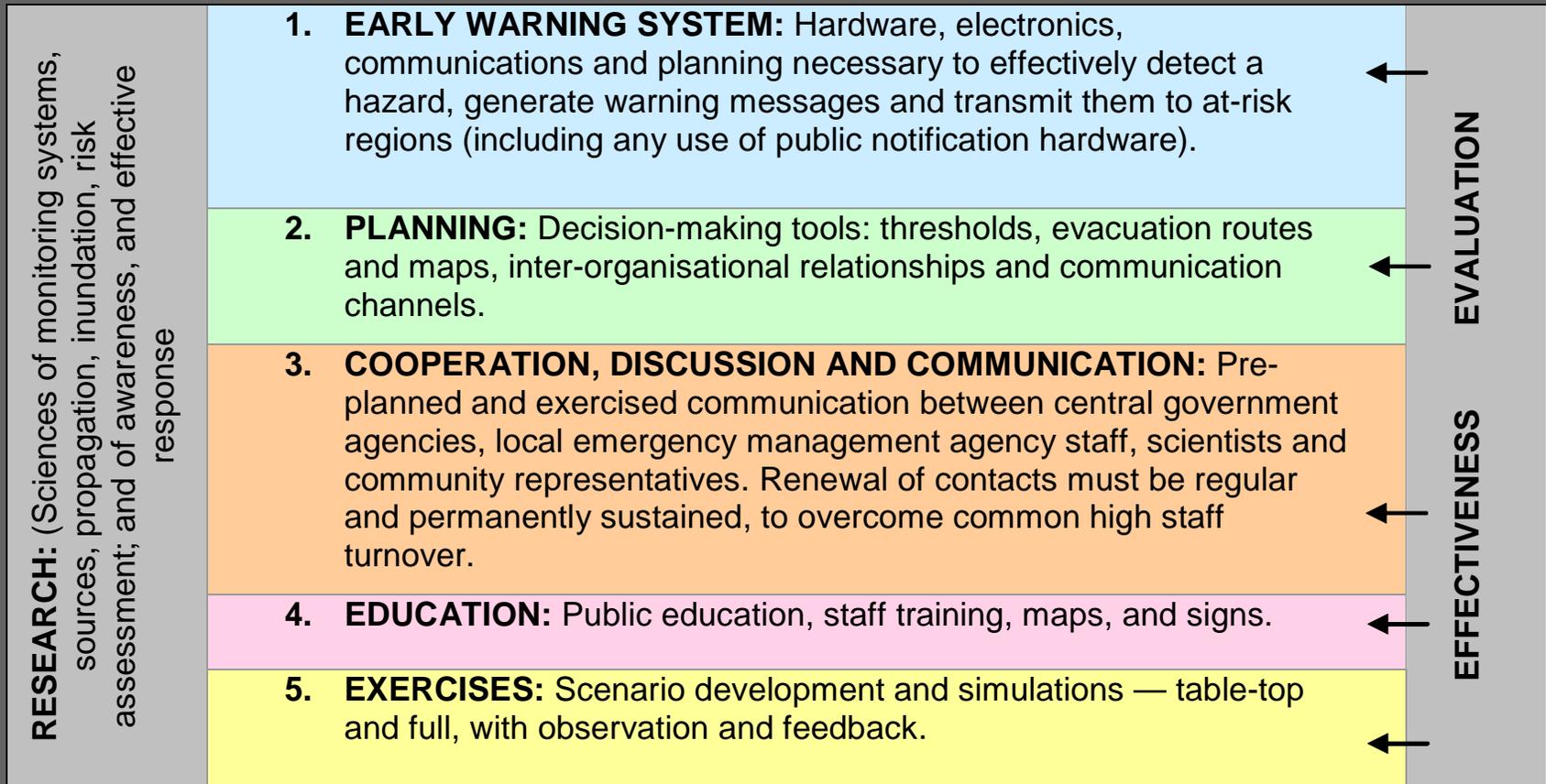
Current social research evaluating and working to improve effectiveness of warning system response

New Zealand: National Warning System improvements, national tsunami risk and preparedness review, volcanic & tsunami warning response evaluation projects (national and specific projects at Auckland, Ruapehu, Napier), Auckland region public notification needs analysis.

Australia: flood warning awareness (New South Wales), wildfire warnings.

USA: Tsunami and lahar warning planning and education (Washington state).

An evolving model of components of an effective end-to-end warning system



Presented in Webb (compiler), 2005, Review of New Zealand tsunami preparedness, GNS SR 2005/162

Resourcing and technical issues

- In New Zealand there is always a **compromise** between warning needs and **effort / finance** available. We have found that **empowering** local groups and the community gives a **high return**.
- Early warning **hardware options** are evolving rapidly, planning for upgrades and the inclusion of mobile technologies is ongoing. Hardware options must be within resource constraints and are **only as effective** as the rest of the components of an end-to-end system. Adequate resourcing for these components is **as important as the hardware itself**. [e.g. New Zealand National Warning System upgrades; national tsunami review].
- Regular ongoing testing and **exercising** is essential to reliability.
- Technology that **addresses social behaviour** is essential to high levels of effective response [e.g. Auckland region].
- **No single end-to-end option** suits all hazards and end-users – a national template must be **locally tailored** involving locals [e.g. New Zealand and Washington coast, USA].



Assessment of Auckland region notification needs: multiple channels for multiple hazards and end-users



Sustainability and maintenance

Capacity building and training

- **Effective end-to-end warning systems** are only possible if all of their components are **sustained** in the long term.
- **Sustained maintenance** (both financial costs and effort) must be **planned for** in the long term and have **local buy-in**. These efforts will at some point in time **eclipse** any start-up costs, this must be allowed for at the outset. [e.g. Ruapehu and Auckland research].
- **Local warning dissemination and response agencies, and community groups, must be involved in planning** of the multi-hazard system. Local system steps must be **tailored to the local needs**. Capacity and training at a local level are then much more **easily sustained**. [e.g. Washington coast, USA].
- **Resilience requires correct action** at the time of warning, which goes beyond awareness and intention to act. Current research is looking at **motivators** of action, and promoting the resilience indicators that predict action – **awareness, self-efficacy and intention** [e.g. Auckland, Australian wildfires].



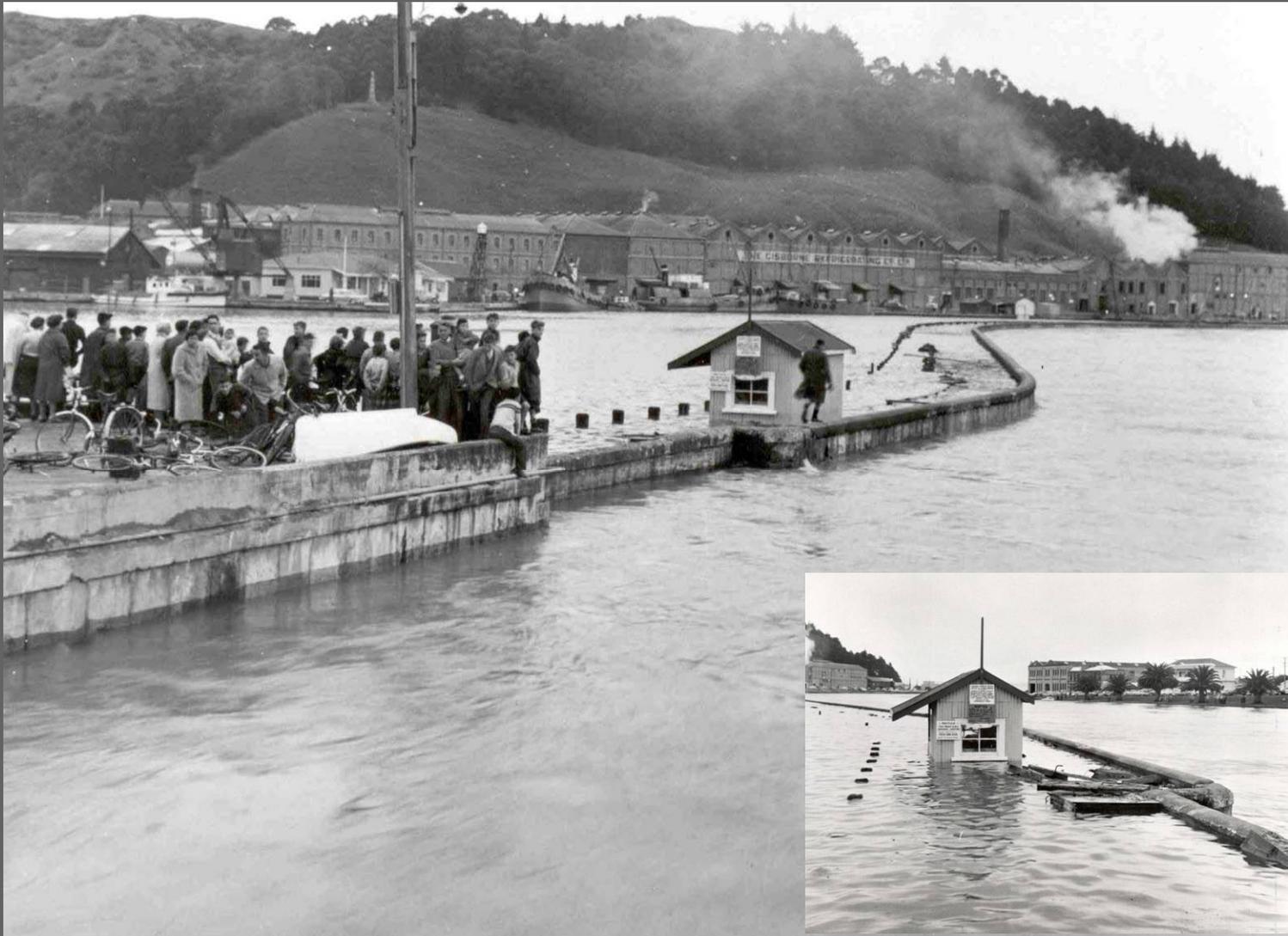
Challenges, benefits, and synergies

- The main challenge is developing and sustaining all components of an effective end-to-end system **indefinitely**.
- Initiatives that motivate **social change** towards improved resilience **operate over decades** [e.g. Auckland resilience project]. Political and funding cycles are much shorter.
- **Regular exercising** of our national multi-hazard system in the context of end-to-end warnings develops **multi-organisational synergies**, relationships and shared understanding.
- The **benefit** of a regularly exercised national multi-hazard system is a **wide awareness** of the mechanism and nature of the system, of a range of warning scenarios and messages, and of the correct **response to them**. Exercising is essential for evaluation and education [e.g. Ruapehu, Napier].

Lessons learned

- **All links** in the end-to-end chain must succeed to get close to 'full' response to a warning.
- The key to effective response to hazard warnings is a **resilient community motivated** to learn, understand and **respond** correctly.
- Warning notification that takes into account **social behaviour** (provides warning message **details directly**) is essential to a **high response** rate in a multi-hazard warning environment.
- Notification of a range of hazards to varied end-users requires **multiple path-ways**, including all of '**natural warnings**', via institutions to '**those in their care**', via community/organisational **networks**', via '**third party hardware**' and '**via warning-dedicated hardware**'.
- The **existence** of early warning system hardware alone does not necessarily promote effective response to it. **Exercising** the full end-to-end system is essential to **evaluate** effectiveness.

1960 Chilean tsunami, Gisborne, New Zealand

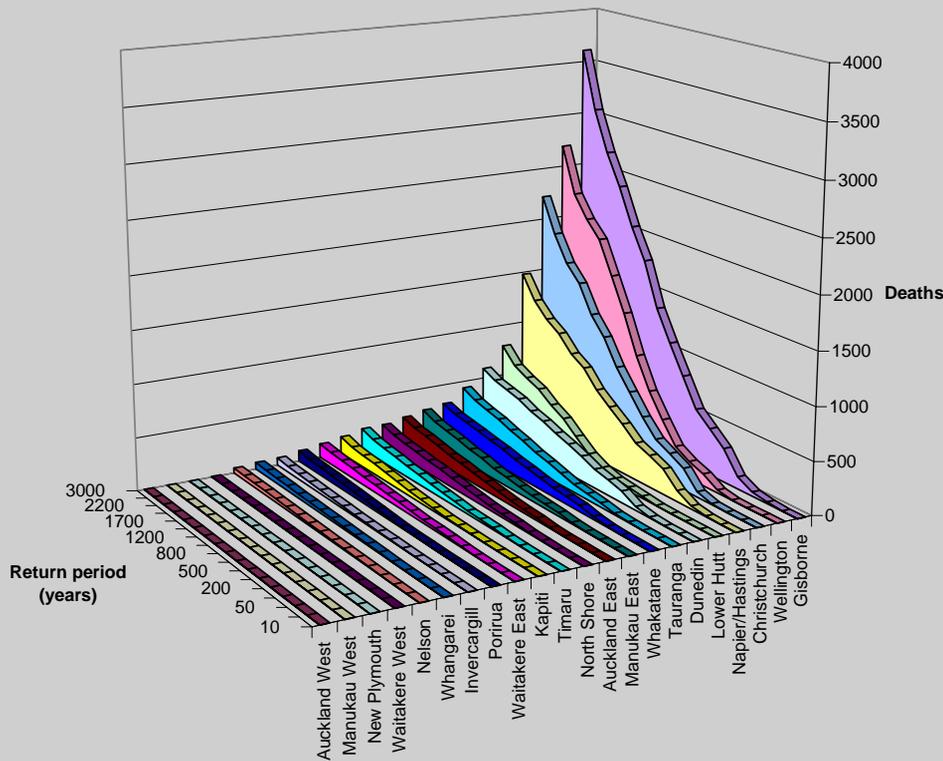


Specific recommendations

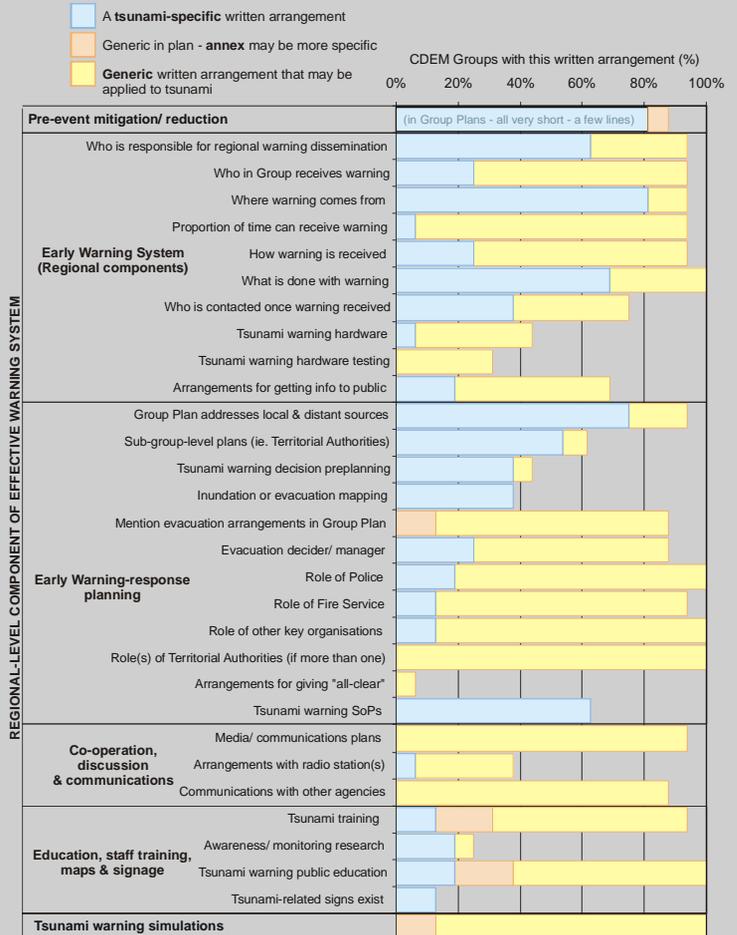
- **Plan all** steps of the end-to-end warning chain in **cooperation**, allowing for **similarities and differences across multiple hazards**, involving the **community** in the planning of other steps. [e.g. Ruapehu, National Warning System]
- Improve **community resilience** - **motivate appropriate actions** in response to warnings for all hazards. Develop resilience indicators to monitor awareness and likely levels of action.
- **Exercise** the system regularly, varying the hazard or using compounding hazards. [e.g. New Zealand national warning system exercises and evaluation; Ruapehu; Napier; tsunami exercise in May 2006]
- **Exercise extreme** situations that will **strain** the system and response. Involve many interest groups, in realistic exercises.
- **Feed back evaluation** of exercising into improved planning

- Develop risk, preparedness and warning effectiveness evaluation measures and apply them in an ongoing way [e.g. NZ national tsunami review – reviewed multi-hazard components that apply to tsunami too; Australian flood warning awareness evaluation]

New Zealand tsunami deaths compared to return period



Regional-level written arrangements, as reviewed from Group plans and documents beyond Group plans



Successful warning is not
the existence of an
early warning system alone,
but **effective response** to it



17 June 1996 Mt Ruapehu eruption, New Zealand

Contact:

Dr Graham Leonard

GNS Science

P.O. Box 30368, Lower Hutt, New Zealand

Ph: +64-4-5701444, Fax +64-4-5701440

www.gns.cri.nz