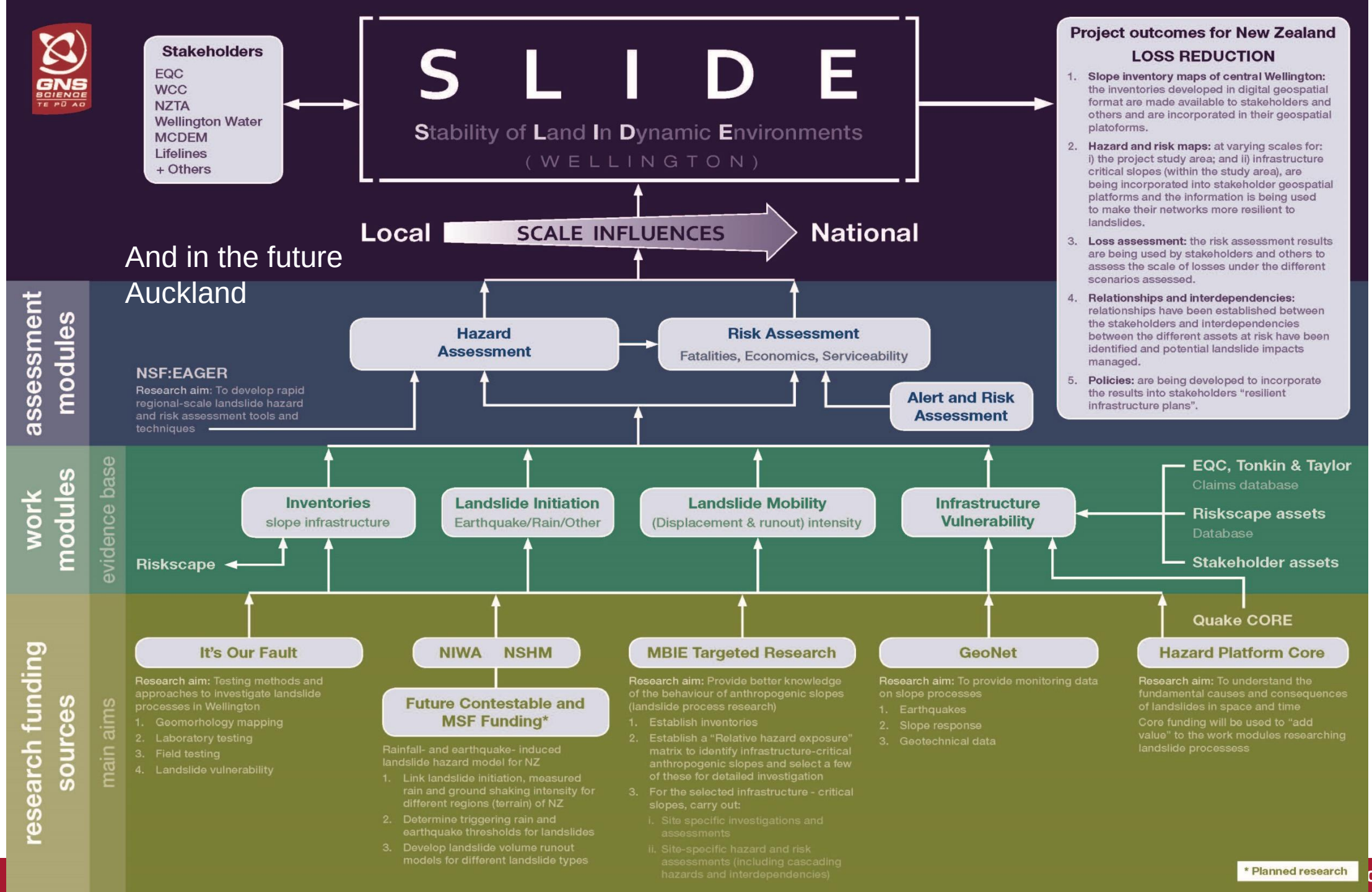
Landslide research at GNS

S. Dellow and C. Massey on behalf of the Engineering Geology team and others

Research Environment

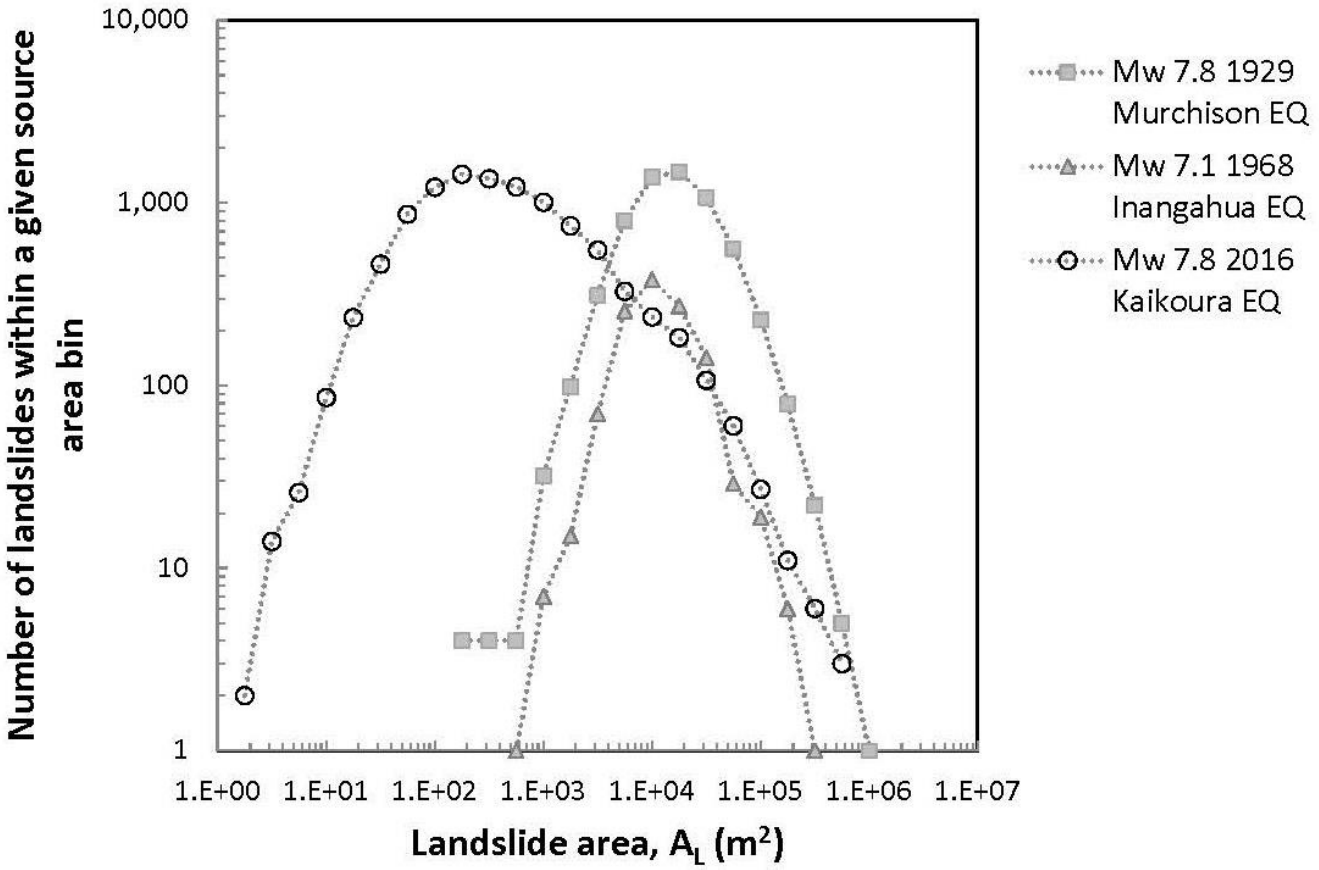
- Rich and diverse funding
- Requires a good team to mine
- Not a competition – welcome collaboration and complementary research
- Researchers control the process
- Listen to stakeholders and end-users
- Play a long game
- Pass the research on (use others to ‘turn the handle’)


Stakeholders
EQC
WCC
NZTA
Wellington Water
MCDEM
Lifelines
+ Others
SLIDE
Stability of Land In Dynamic Environments
(WELLINGTON)
Project outcomes for New Zealand
LOSS REDUCTION
1. Slope inventory maps of central Wellington: the inventories developed in digital geospatial format are made available to stakeholders and others and are incorporated in their geospatial platoforms.
2. Hazard and risk maps: at varying scales for: i) the project study area; and ii) infrastructure critical slopes (within the study area), are being incorporated into stakeholder geospatial platforms and the information is being used to make their networks more resilient to landslides.
3. Loss assessment: the risk assessment results are being used by stakeholders and others to assess the scale of losses under the different scenarios assessed.
4. Relationships and interdependencies: relationships have been established between the stakeholders and interdependencies between the different assets at risk have been identified and potential landslide impacts managed.
5. Policies: are being developed to incorporate the results into stakeholders "resilient infrastructure plans".
Local
SCALE INFLUENCES
National
And in the future
Auckland
assessment modules
Hazard Assessment
Risk Assessment
Fatalities, Economics, Serviceability
Alert and Risk Assessment
NSF:EAGER
Research aim: To develop rapid regional-scale landslide hazard and risk assessment tools and techniques
work modules
evidence base
Inventories
slope infrastructure
Landslide Initiation
Earthquake/Rain/Other
Landslide Mobility
(Displacement & runout) intensity
Infrastructure Vulnerability
EQC, Tonkin & Taylor
Claims database
Riskscape assets
Database
Stakeholder assets
Riskscape
research funding sources
main aims
Quake CORE
It's Our Fault
Research aim: Testing methods and approaches to investigate landslide processes in Wellington
1. Geomorhology mapping
2. Laboratory testing
3. Field testing
4. Landslide vulnerability
NIWA NSHM
Future Contestable and MSF Funding*
Rainfall- and earthquake- induced landslide hazard model for NZ
1. Link landslide initiation, measured rain and ground shaking intensity for different regions (terrain) of NZ
2. Determine triggering rain and earthquake thresholds for landslides
3. Develop landslide volume runout models for different landslide types
MBIE Targeted Research
Research aim: Provide better knowledge of the behaviour of anthropogenic slopes (landslide process research)
1. Establish inventories
2. Establish a "Relative hazard exposure" matrix to identify infrastructure-critical anthropogenic slopes and select a few of these for detailed investigation
3. For the selected infrastructure - critical slopes, carry out:
i. Site specific investigations and assessments
ii. Site-specific hazard and risk assessments (including cascading hazards and interdependencies)
GeoNet
Research aim: To provide monitoring data on slope processes
1. Earthquakes
2. Slope response
3. Geotechnical data
Hazard Platform Core
Research aim: To understand the fundamental causes and consequences of landslides in space and time
Core funding will be used to "add value" to the work modules researching landslide processess
* Planned research

Portfolio approach to research

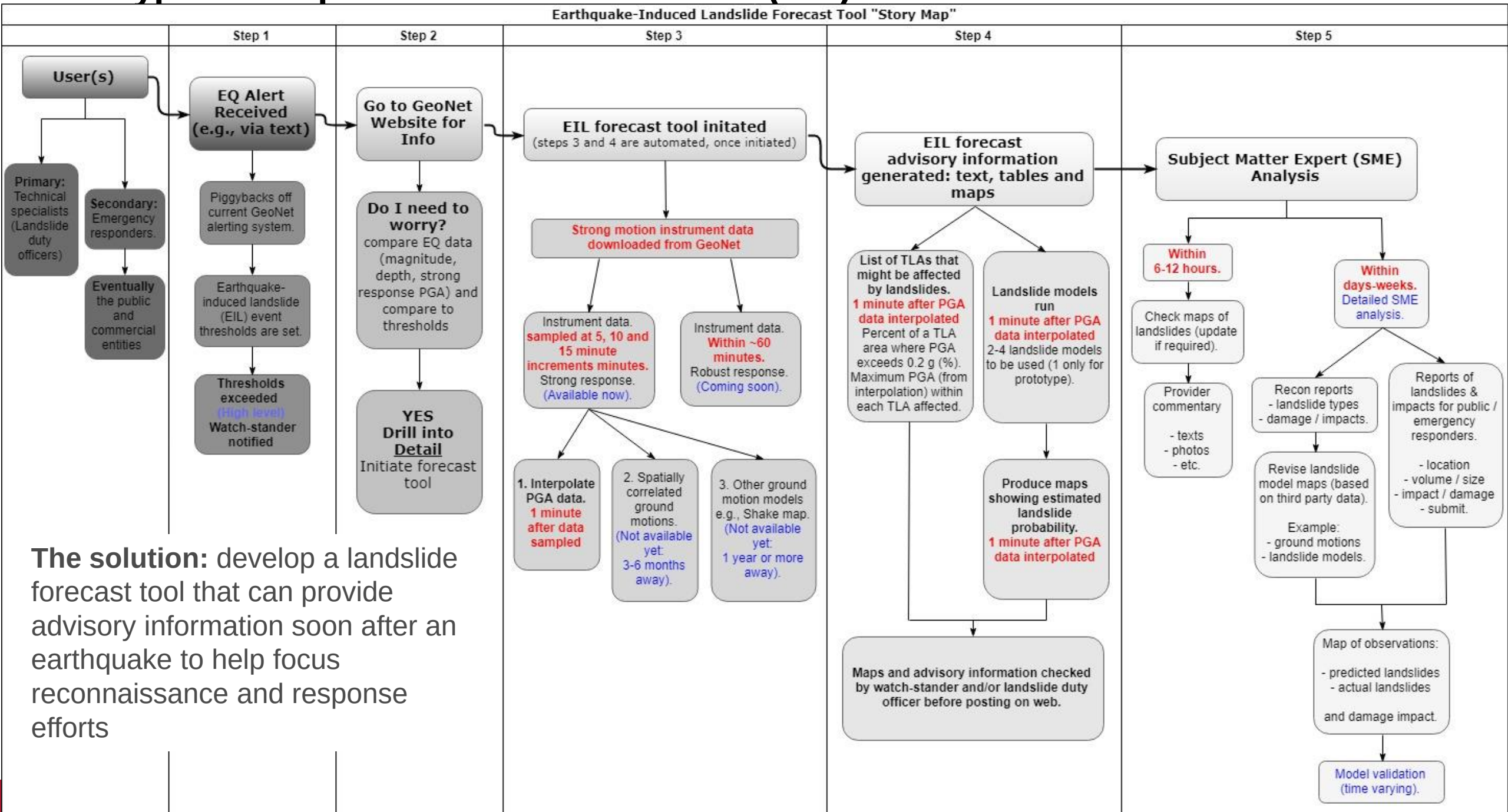
- **SSIF**
- **GeoNet**
- **Endeavour**
- **Smart ideas**
- **EQC**
- **Sectors (applied research)**
  - Central and local government agencies
  - Network operators
  - Industry

Comparison of landslides: Murchison, Inangahua and Kaikoura



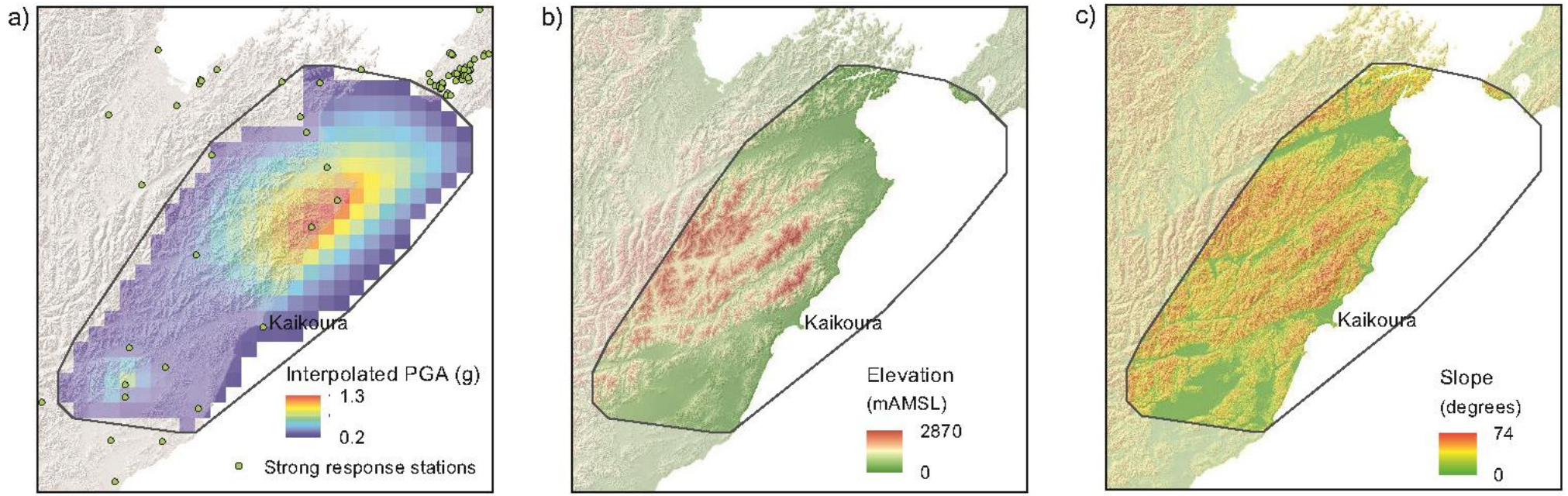
Kaikoura earthquake triggered less large landslides (>10,000 m^2) than the 1929 Murchison EQ.

Prototype Earthquake-induced Landslide (EIL) forecast tool for NZ



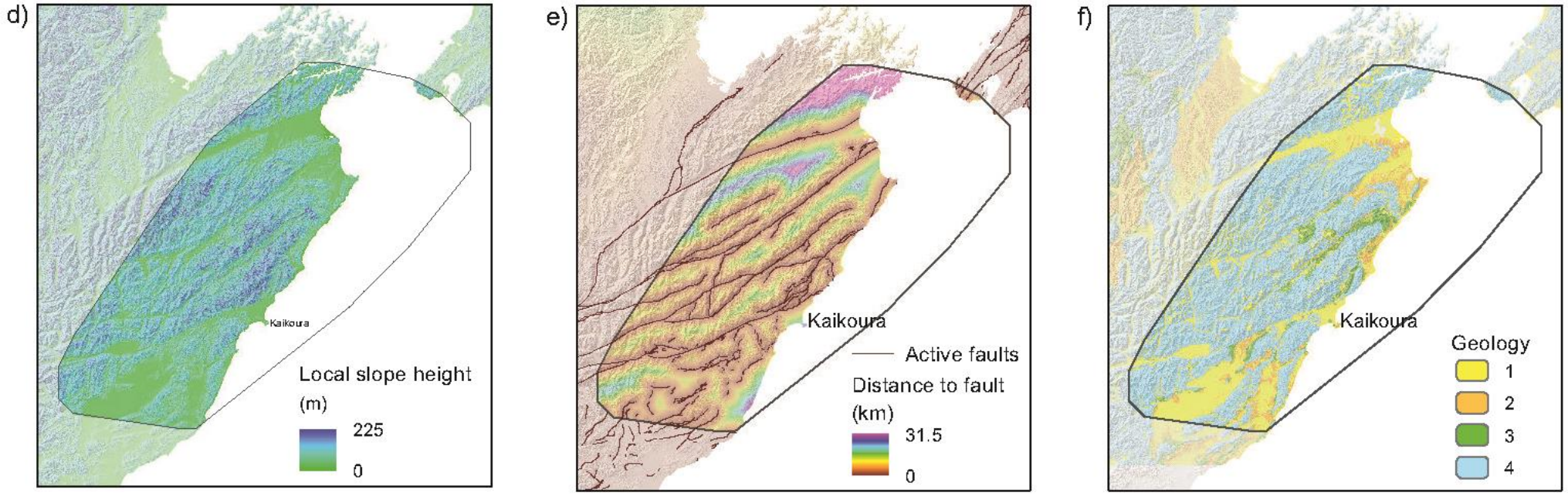
The solution: develop a landslide forecast tool that can provide advisory information soon after an earthquake to help focus reconnaissance and response efforts

Landslide model variables: Example using the 2016 Kaikoura EQ



a) Instrument PGA (streamed data sampled 5 mins after EQ), bounding polygon – PGA 20%g, 8km grid
b) Elevation (mAMSL), 32 m grid
c) Slope angle (deg), 32 m grid

Landslide model variables: Using the 2016 Kaikoura EQ

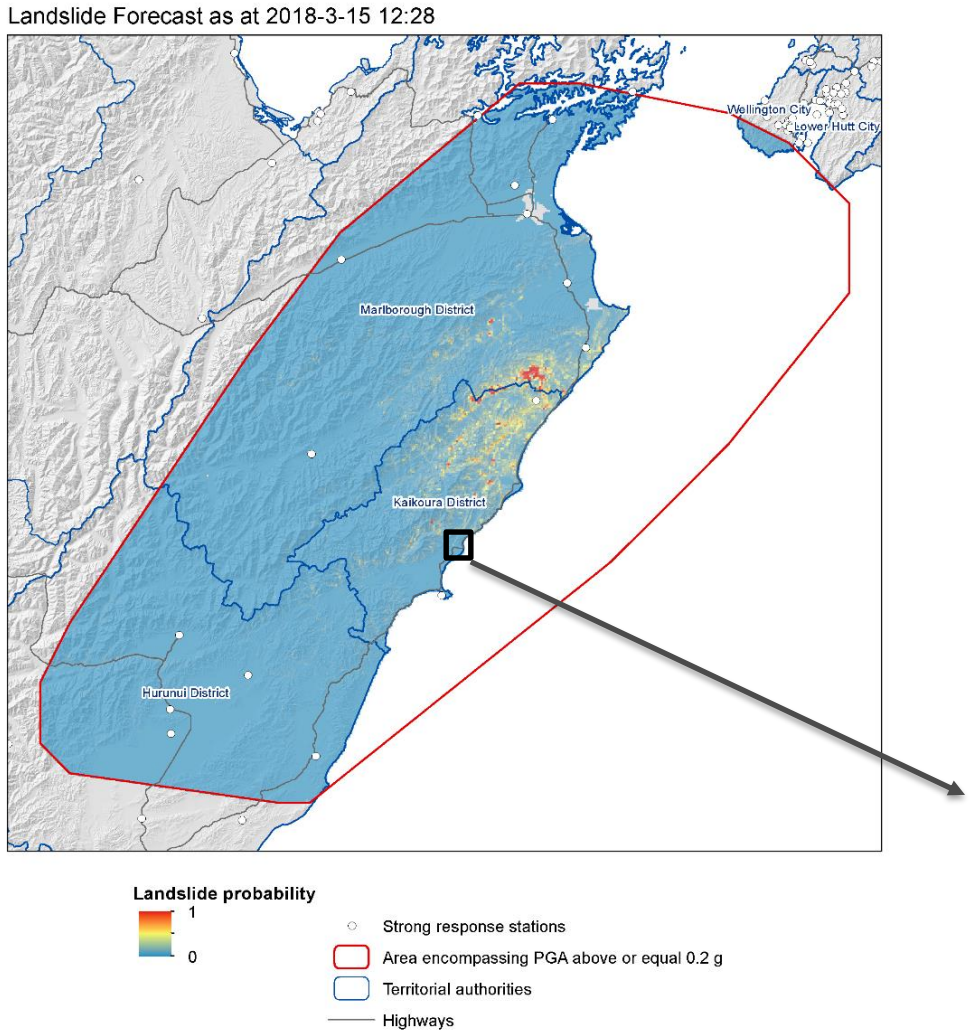


d) Local slope relief (height), used as an amplification factor, 32 m grid

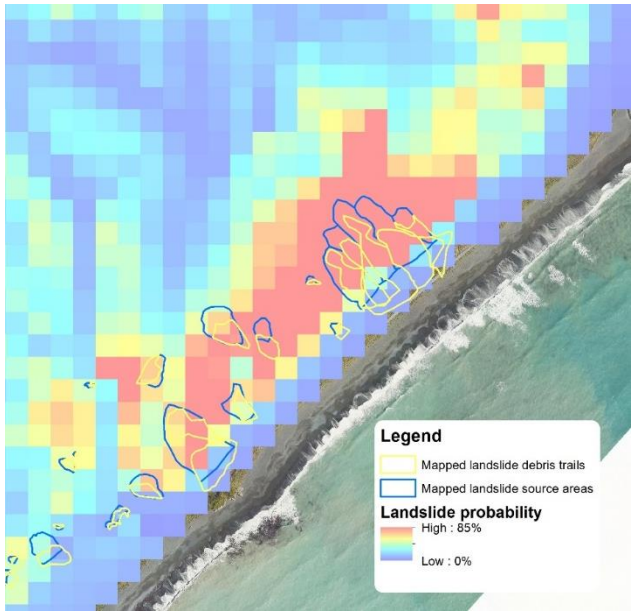
e) Proximity to active fault, 32 m grid

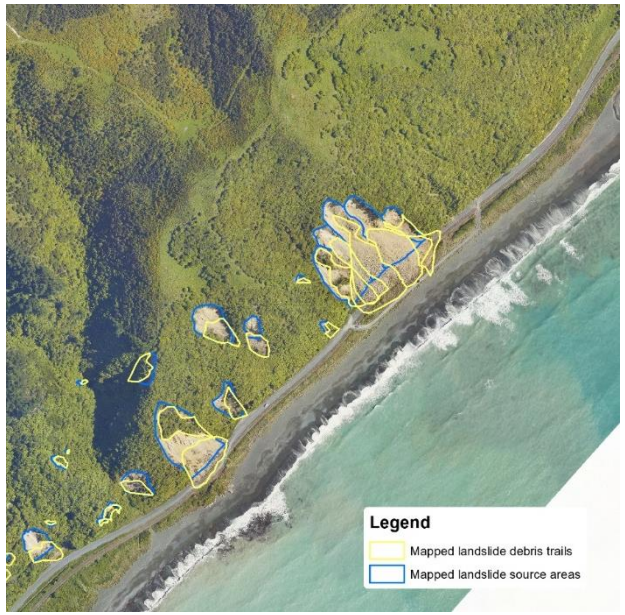
f) Geology types, 32 m grid

Advisory: Text and Maps 5-7 mins after tool triggered



TA that might be affected by landslides	Area where PGA exceeds 0.2 g (km^2)	Percent of TA's area where PGA exceeds 0.2 g	Maximum PGA within TA (g)
Hurunui District	4205.08	48.6	0.68
Kaikoura District	2046.78	100	1.27
Lower Hutt City	1.2	0.3	0.22
Marlborough District	6362.82	60.8	1.27
Wellington City	22.72	7.8	0.26





Landslide probability model used is an updated version of the model presented in Massey et al., 2018 (BSSA)

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- **GNS Science:** Chris Massey, Sally Dellow, Simon Cox, Garth Archibald, Natalie Balfour, John Begg, Zane Bruce, Jon Carey, Geoff Clitheroe, Fernando Della Pasqua, Phil Glassey, Matt Hill, Katie Jones, Biljana Lukovic, Barbara Lyndsell, Mark Rattenbury, Stuart Read, Brenda Rosser, Corinne Singeisen, Dougal Townsend, Pilar Villamor, Yoshi Koneko; Caroline Holden; Anna Kaiser; David Rhoades
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