Understanding the impacts *of an* Auckland Volcanic Field eruption *on* Auckland's infrastructure

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Roadmap

- **DEVORA**
  - Research programme investigating all matters Auckland Volcanic Field (geology through consequences)
- **Volcanic Impact Study Group (VISG)**
  - ALG-sponsored, promotes and facilitates lifelines volcanic impacts research
- **RiskScape volcano**
  - Multi-hazard software programme to evaluate impact and risk
- **Economics of Resilient Infrastructure Auckland eruption scenario**
  - Consequences of “Mt Ruaumoko” eruption

DEVORA:
DEtermining **VO**lcanic **R**isk in **A**uckland

- DEVORA is a multi-agency, multi-disciplinary collaborative research programme, started in 2008
- DEVORA researchers collect and integrate **geoscience**, **volcanic hazard**, and **risk and social data**
  - Primary focus is Auckland Volcanic Field, some consideration of disruption from distant volcanoes
- Aims: improving risk management and business decision-making, make Auckland a safer place

EQC
EARTHQUAKE COMMISSION
Kōmihana Rūwhenua

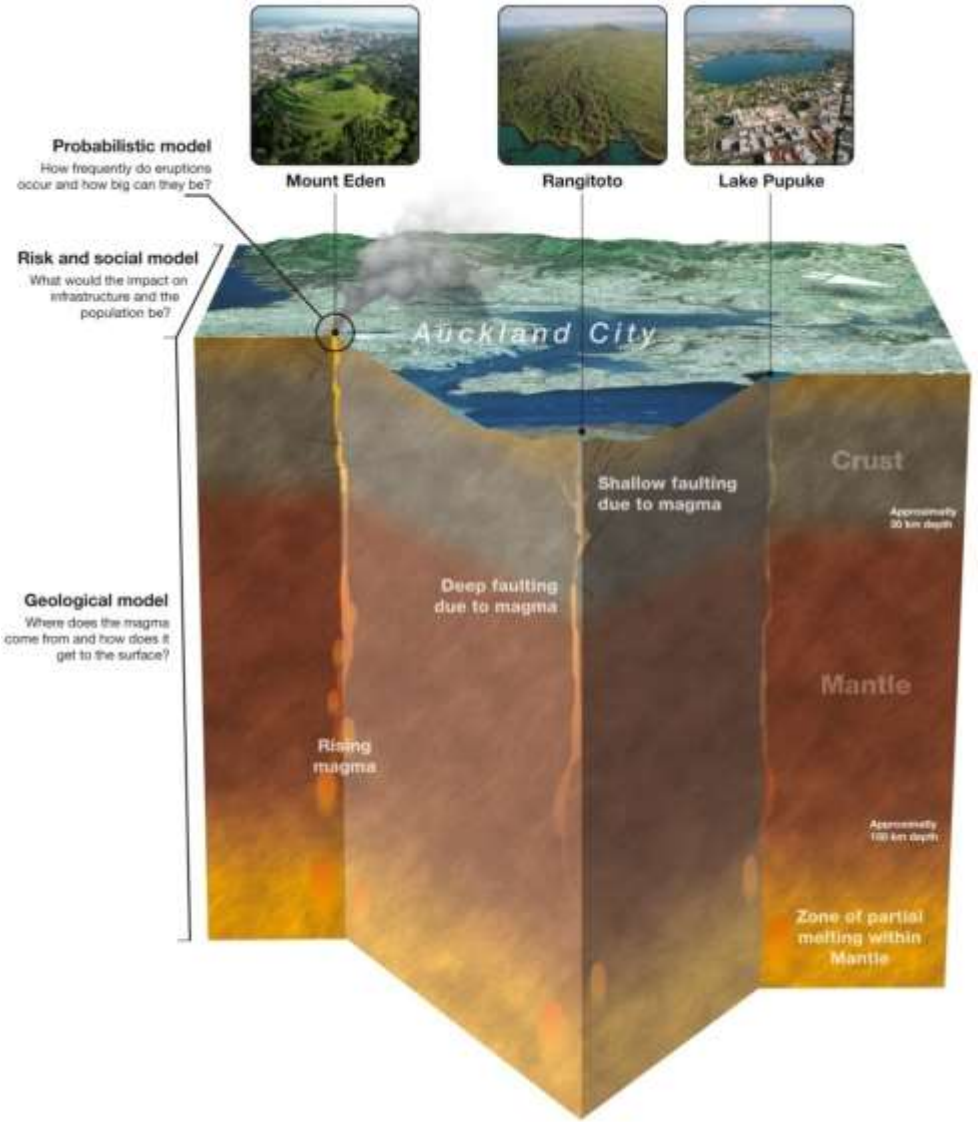
Auckland Council
Te Kaunihera o Tāmaki Makaurau

DEVORA 2020 Aspirational Objectives

1. We are confident in knowing the **Auckland Volcanic Field**
2. **Our diverse society knows, understands and trusts our science**
3. **People will behave appropriately in a volcanic crisis**
4. **People understand and appropriately mitigate risk and consequence** in language/formats that suit their needs
5. Auckland Council, businesses and individuals have **anticipated, prepared for and are able to respond and recover**
6. **DEVORA supports 'Resilient Auckland'**
7. **Auckland continues to thrive** following any NZ eruption
8. **Our science has wider benefits**
9. Auckland is **linked in to other major hazard programmes**, aligned to DEVORA
10. We are confident in knowing **other volcanic threats to Auckland**

Insight areas from new research

- Geology & magma system
- History and likely future
- Eruption styles
- Hazards
- Monitoring reach
- Impacts and preparedness
- Calculating risk
- Evacuation planning



Sample of recent DEVORA achievements

- **Working with RiskScape to implement proximal volcanic hazards & vulnerability functions relevant for Auckland**
  - Provides ability to directly compare risk from volcanic hazards to weather, tsunami, and other natural hazards – world first
- **Detailed study of several past Auckland eruptions to understand the tempo, style, size and timing of past eruptions**
  - Much improved understanding of likely eruption sequence across most AVF eruptions
  - High profile example: results from coring Rangitoto
- **Improved knowledge of number and timing of past eruptions**
  - High profile example: recent coring of Orakei Basin
- **Collaboration on Auckland Council's revision of volcanic contingency plan**
- **Laboratory experiments on impacts of volcanic ash and ballistics on buildings, roads, and other lifeline sectors**

Sample of ongoing work programme

- **Improving hazard models across Auckland**
  - Moving from detailed studies of specific past eruptions to broader Auckland-wide hazard models
- **Building eight scenarios for Riskscape to be available for all suitable locations across Auckland**
- **Better understanding the ascent and detection timeframe, exploring potential for "failed eruptions"**
  - How can we improve monitoring network? Work with GeoNet
- **Understanding impacts of more volcanic hazards**
  - Moving beyond 'just' ash
- **Beyond impact: exploring recovery and return of functionality**
- **Evaluating risk (probabilistic treatment of impacts)**
- **Improving evacuation models and decision tools**

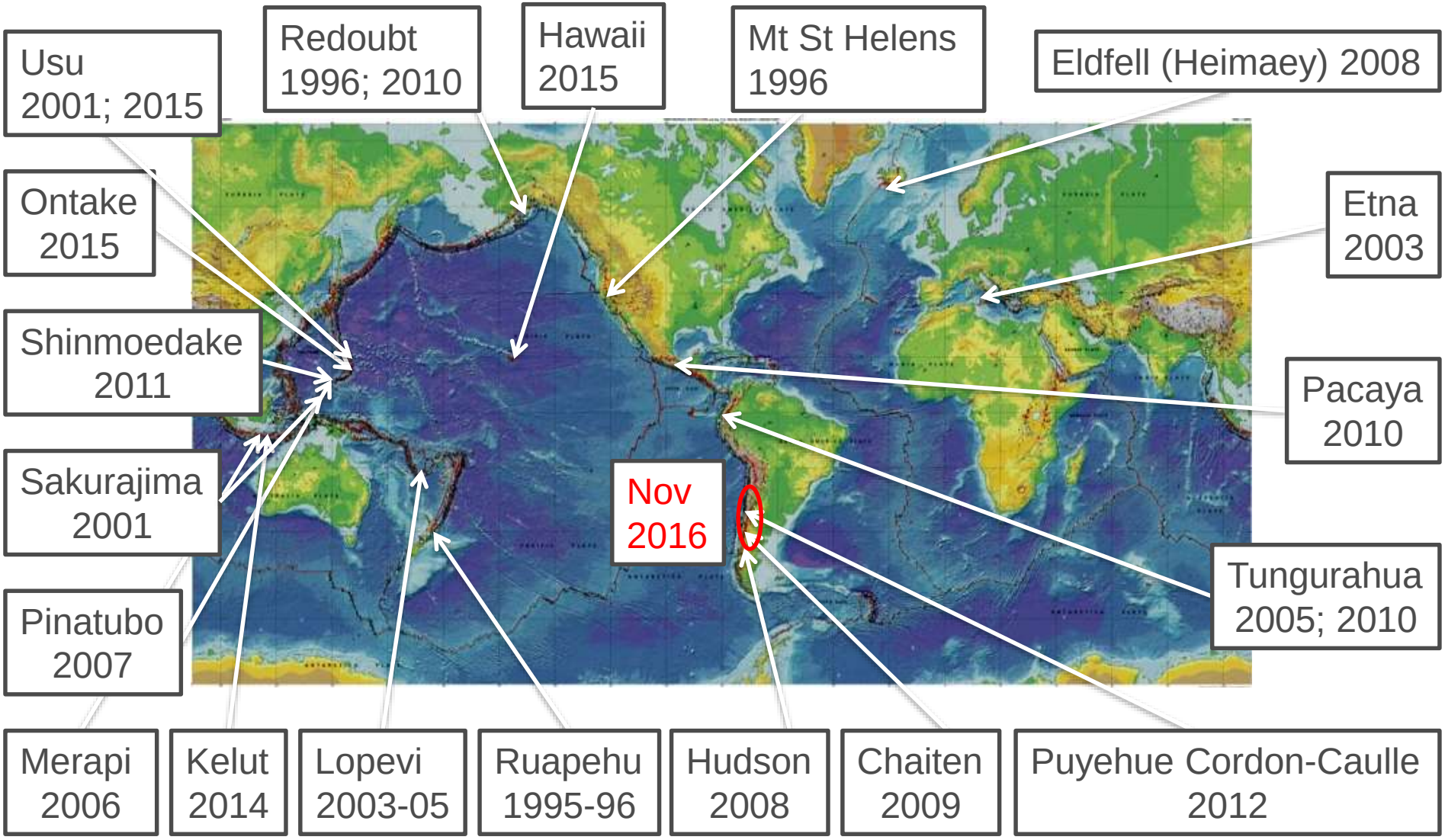
Volcanic Impacts Study Group
ALG Subcommittee

Objectives:

- To **collate and advocate existing knowledge** about the impacts of volcanic hazards (e.g., volcanic ash) on, and mitigation measures for, lifeline infrastructure.
- To **facilitate and support research**
- To provide a **vehicle for two-way exchange** of research with lifeline infrastructure community.
- To **facilitate reconnaissance investigations**, and advocate lifeline representation, to active volcanic areas to understand impacts on infrastructure.
- To provide a **national focal point** for volcanic impacts work on lifeline infrastructure.

Impact data NZ team reconnaissance trips

Learning from impacts of volcanic eruptions



VISG projects
funded by ALG

Current (2014 – 2016)

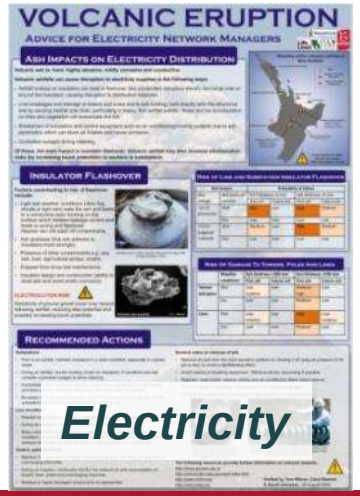
- **VISG Volcanic ash posters to web-friendly format**
- **Experimental work on ash impacts to generators**
- **Annual seminar**

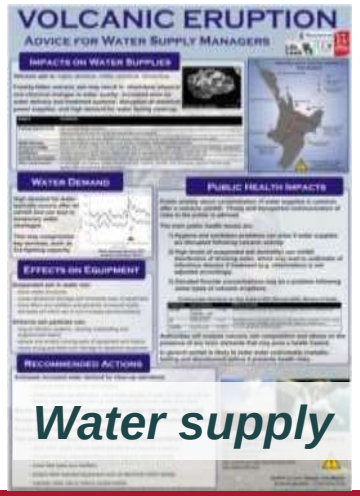
Past (2001 – 2013)

- **VISG Volcanic ash poster series**
  - 10 sector specific impact and mitigation posters
- **Report: Health and Safety Impacts of Volcanic Ash**
- **Report: Volcanic Ash Impacts on Auckland's Water Supply**
- **Report: Volcanic Ash Impact of Ash on Electricity, Telecommunications, Broadcasting Networks**
- **Report: Volcanic Ash Impacts of Lifelines and Collection/ Disposal Issues**

VISG Volcanic Ash Poster Series 1: 2006 – 2010

- **Many detailed reports following NZ 1995/6 Ruapehu eruptions**
  - Valuable information for scientists
  - Not very practical for everyone else (boring, long, too detailed…)
- ➢ **VISG produced short, well summarised, authoritative reference posters for 5 sectors**
  - Collaboration with ALG

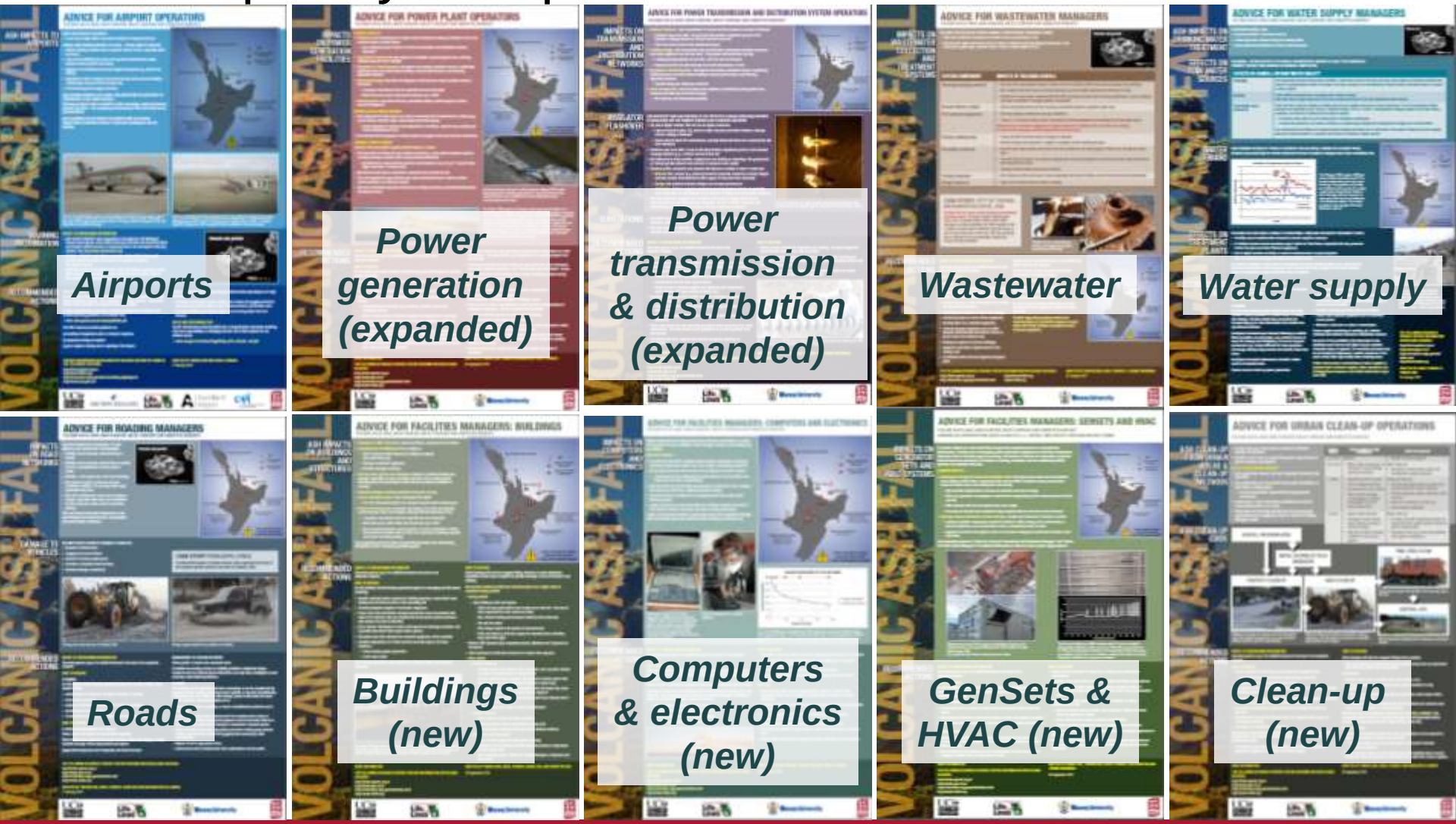




VISG Volcanic Ash Poster Series 2

Existing posters revised and expanded (6 total)

4 completely new posters. VISG and DEVORA team



Review process

- Iterative process (!)
- Promoted considerable enduser engagement
- Revisions educational for endusers & scientists (content, presentation)

KEY
Individual endusers
Lifelife groups
Scientists
Government
Poster developers

Civil Aviation Authority

Enviro Scie Res

Ministry of Health

Volcanic Impact Design Team

Graphic designer

[3]Water supply & wastewater

Watercare[3]

Auckland Council[4]

[4]Local gov.

Mighty River Power[5]

Bay Plenty Engineering Lifeline Group

[5]Power gen.

Contact Energy[5]

Alaska Volcano Observatory (AVO)

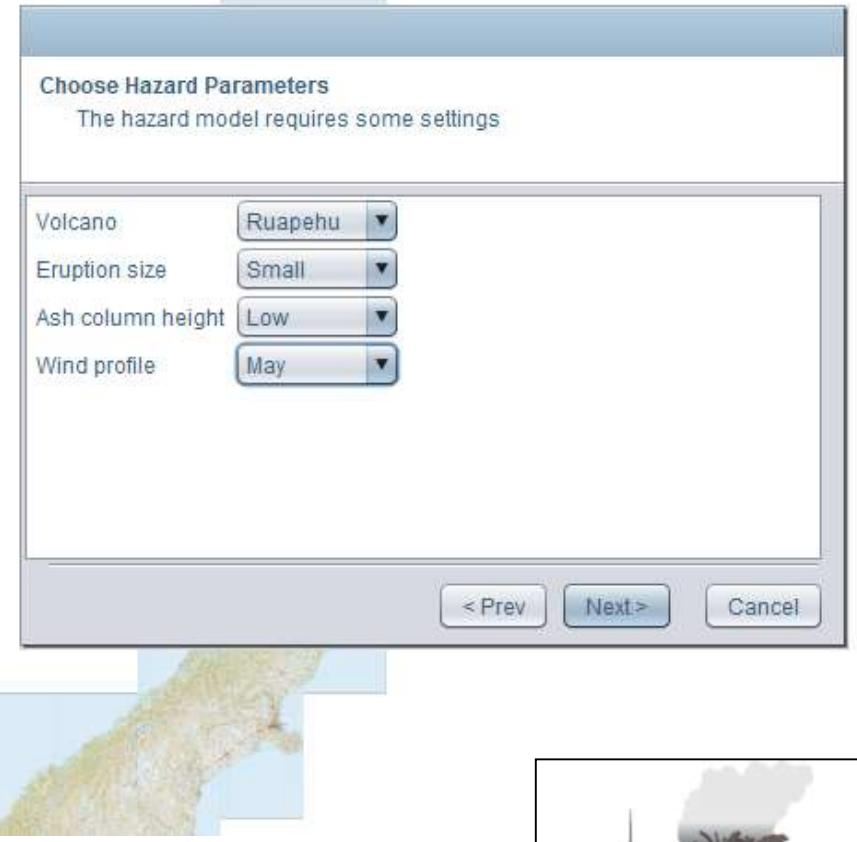
GNS + UC volcanic impact researchers

Wilson et al (2014)

RiskScape volcano Hazard: Volcanic ash for people, buildings and infrastructure

RiskScape

- **On the fly modelling**
- **Input parameters:**
  - Volcano
  - Eruption size (S/M/L)
  - Ash column height (S/M/L)
  - Wind profile (month or southerly)
    - Can load own wind file
- **Can also load own isopach map (thickness in mm)**

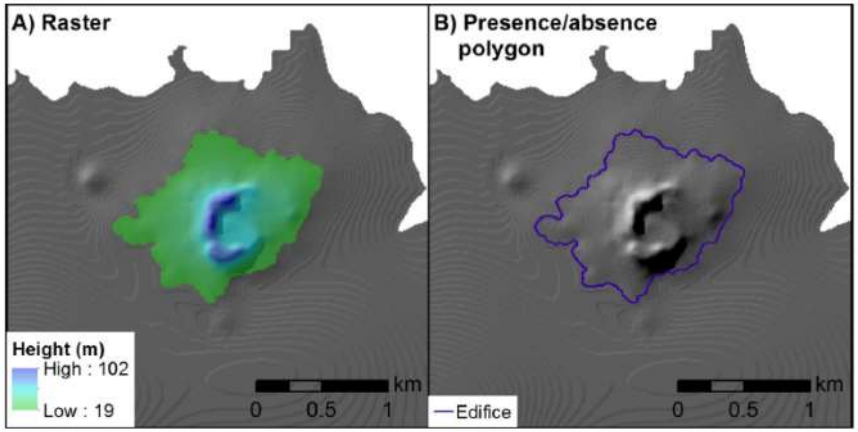


DEVORA

RiskScape volcano
New volcanic hazards for people, buildings and infrastructure

RiskScape

- **New: PDC, lava, lahar, edifice**
- **NO on the fly modelling – user at this stage must provide own hazard layers as raster (preferred) or shapefile - 8 scenarios will be made available.**
  - User can also upload presence/absence extent (default severity values will be assumed)



Mt Mangere example

DEVORA

Economics of Resilient Infrastructure (ERI)

- ERI & DEVORA researchers developed **detailed scenario** of an eruptive event in South Auckland
  - "**Mt Ruaumoko**" – continuing Exercise Ruaumoko
- Scenario examined following **infrastructure sectors:** power, fuel, roads, rail, aviation, port, water supply, wastewater, stormwater and telecommunications
- Scenario examined **impact on services, effect on Auckland's population, expected timelines of infrastructure service recovery**
- *DEVORA planning to develop 8 scenarios, this is the first*

What DEVORA and ERI did

- Develop hazard scenario
- Prepare hazard maps for evolving situation
- **Describe how the relevant infrastructure is impacted** by the hazard(s) as a single impact map for each sector or a series of maps for an evolving situation
- **Consult with ALG members to determine and apply metric describing "enduser experience"**
  - Engaged with 24 individuals from 13 ALG organisations
- **Prepare time-series outage maps / tables**

“Mt. Ruaumoko” report highlight

credit: Daniel Blake

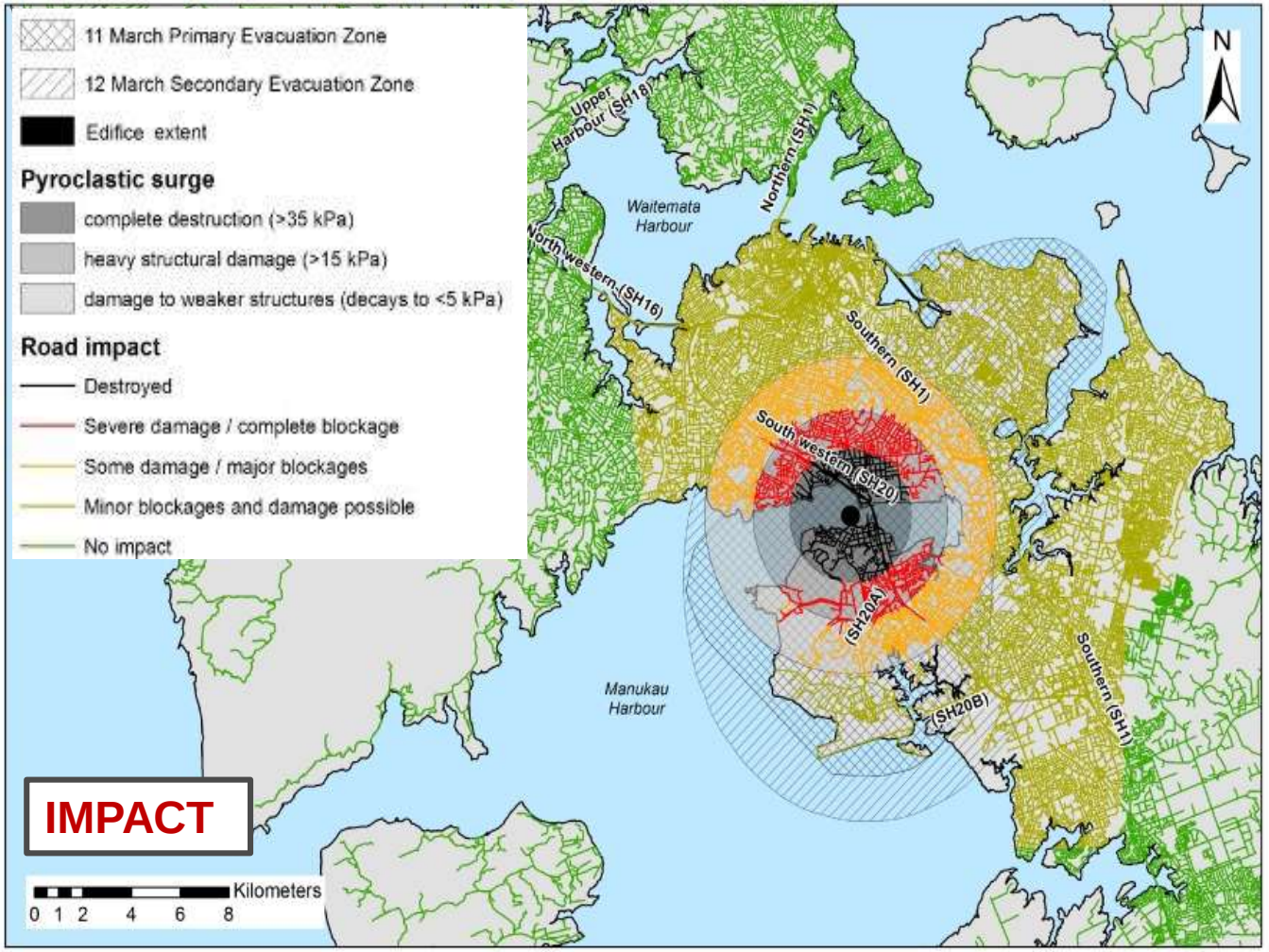
14 March AM Impact to road network

Summary:

- Main impact from pyroclastic surge once eruption begins

Comment:

- No pre-emptive shutting of network due to physical impacts



“Mt. Ruaumoko” report highlight

credit: Daniel Blake

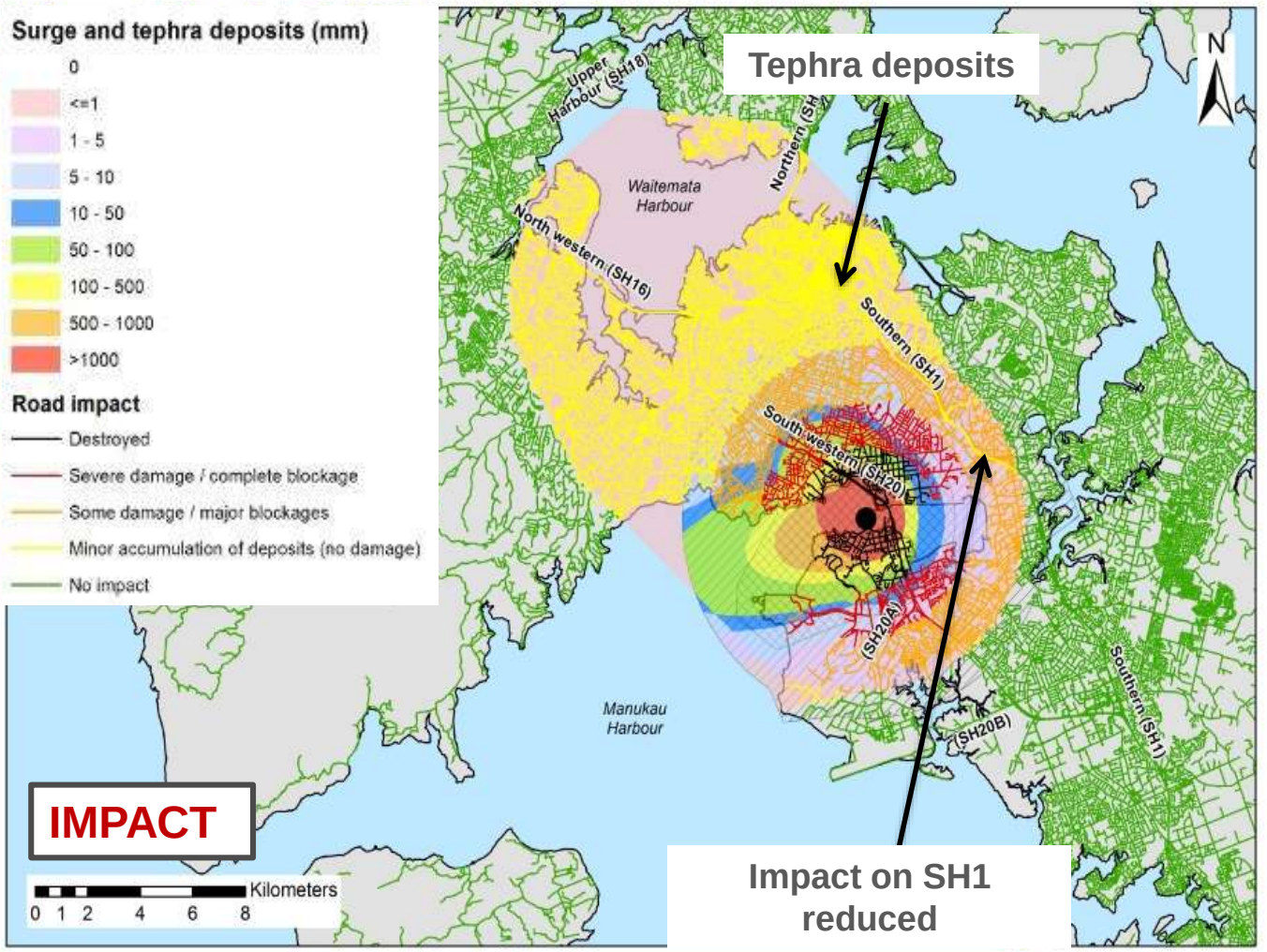
21 March
Impact to road network

Hazard:

- Widespread tephra accumulation

Comment:

- Some earlier impact on critical routes reduced



“Mt. Ruaumoko” report highlight

credit: Daniel Blake

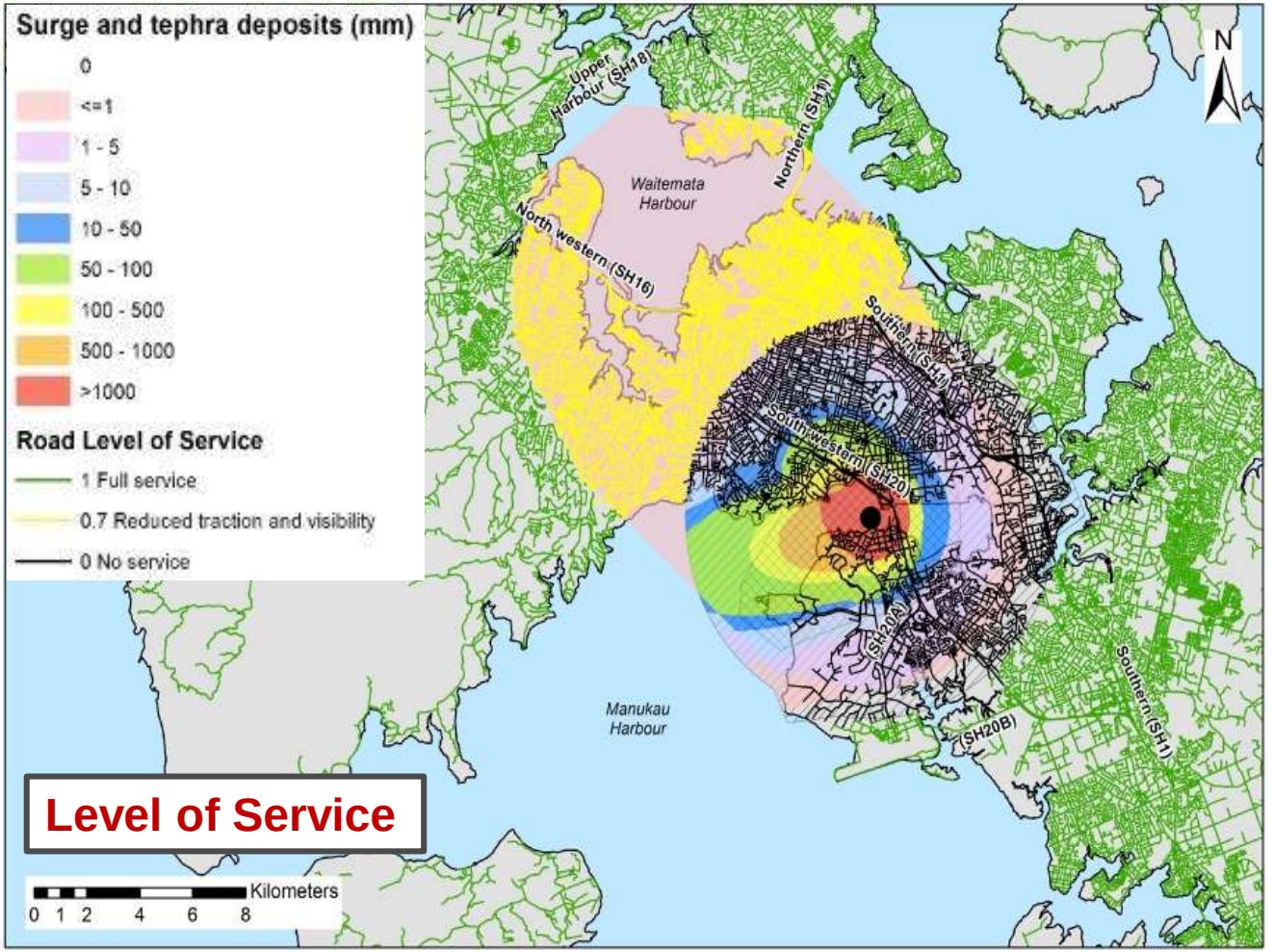
21 March
Level of Service of road network

Summary:

- Tephra causes widespread Level of Service reduction

Comment:

- Complete closure within evacuation zones



“Mt. Ruaumoko” report highlight

credit: Daniel Blake

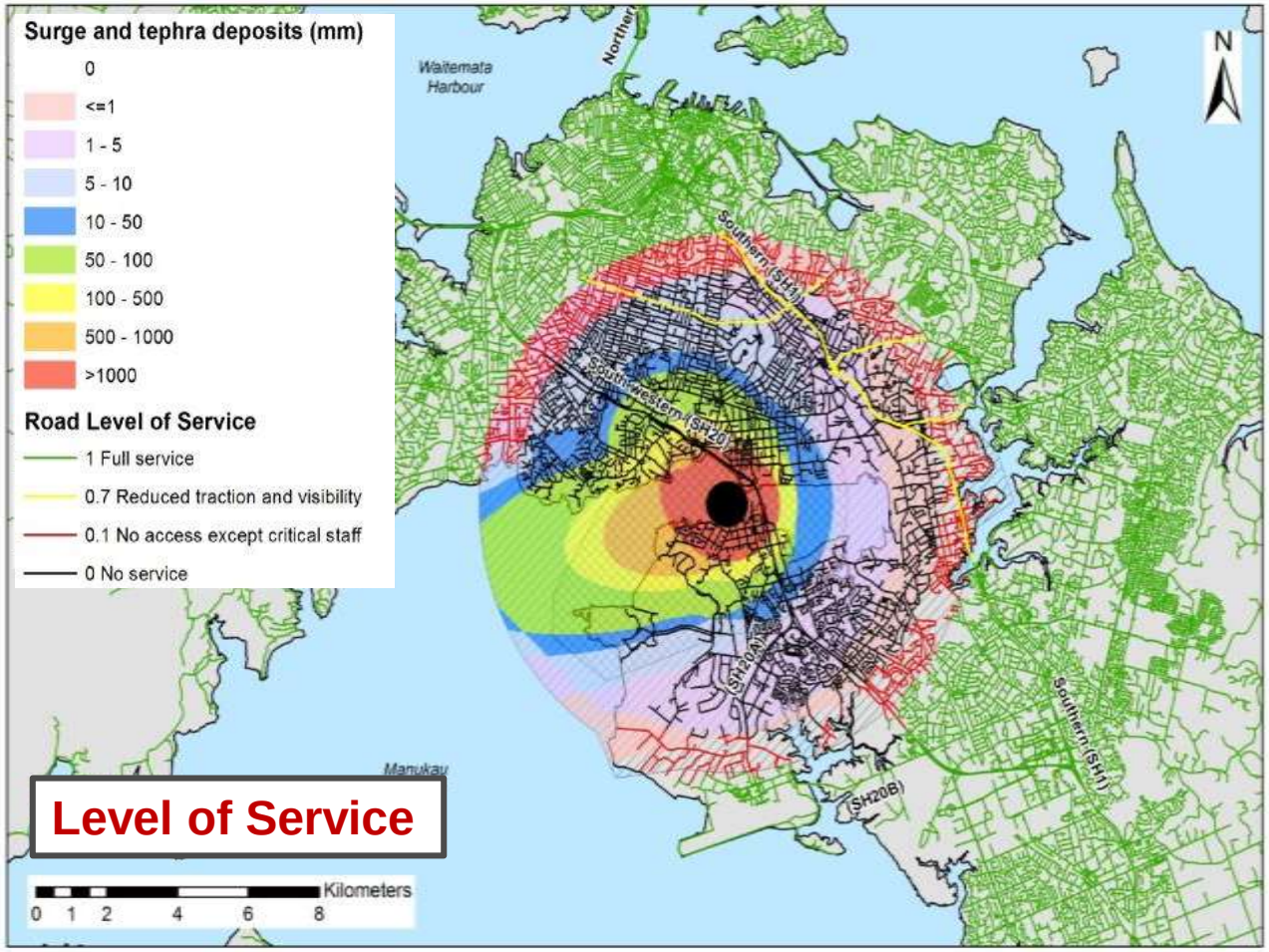
30 March
Level of Service of road network

Hazard status:

- Tephra clean-up underway

Actions:

- Critical routes prioritised
- Lifeline staff access into Secondary Evacuation Zone
- Once evacuation zones lifted, restoring service will take time



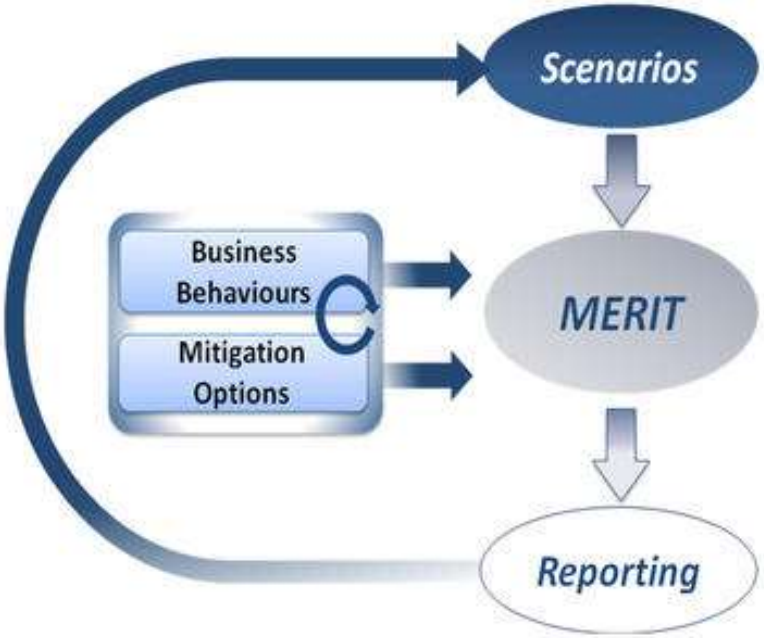
MERIT tool

ERI scenario next step

- **Final product of ERI Research Programme is MERIT:**

Measuring the Economics of Resilient Infrastructure Tool

- **Given series of outage maps, evaluates the economic impacts of event**
  - Incorporates business behavioural research led by ResOrgs



Summary

- **VISG and DEVORA team are world leaders in volcanic impacts research** – supported by and collaborating with ALG for 15 years
- We now have a wide range of quantitative infrastructure impact and mitigation knowledge
- It is important that this work is **guided by ALG member needs**
- **5 volcanic hazards can now generate losses and be compared to weather/tsunami in Riskscape**
- Detailed user experience (impacts and level of service) analysis in ERI