Land-use planning and volcanic hazards: Opportunities for New Zealand

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Presentation Outline

• Volcanic hazards in NZ
• Understanding volcanic hazards and risk
• Mitigating volcanic risk
• Land-use planning for volcanic hazards
  - case studies
  - opportunities for the future
Natural hazards in New Zealand

70% of NZers live within 200km of an active volcano.
Volcanic hazards

A variety of hazards are posed, including:
- Ash Falls
- Pyroclastic Flows / Surges
- Debris Avalanches
Volcanic hazards, ctd

- Lava flows
- Geothermal eruptions
- Lahars
- Tsunamis and seiches
- Flooding
Understanding volcanic hazards

Depending on wind direction, about 1 metre of ash could cover any area shown on this map.

Areas affected by future eruptions:
1. Likely to be affected most severely and most frequently by pyroclastic density currents
2. Likely to be affected most severely by debris avalanches, lahars and floods
3. Could be affected by debris avalanches and lahars and floods
4. Unlikely to be affected by volcanoes, lahars or floods

Possible Depth of Ash Deposits:
- Zone A: 0-0.3 m
- Zone B: 0.3-0.6 m
- Zone C: 0.6-1.0 m
- Zone D: >1.0 m
Volcano monitoring: The New Zealand GeoNet Project

An integrated geological hazards monitoring and data collection system, funded over 10 years by the New Zealand Earthquake Commission (EQC) and designed, built and operated by GNS Science

- Collect data for research with the long term aim of improving NZ’s resilience to hazard events
- Immediate response to geological hazards events
What does GeoNet do?

GeoNet includes real-time monitoring of:

- **Earthquakes**
- **Volcanic unrest**
- **Tsunami**
- **Land stability**
- **Land deformation**
Volcano Surveillance

GeoNet monitors all of New Zealand’s active volcanoes using:

- Water and gas chemistry
- Volcanic earthquakes and tremor
- Ground deformation
- Satellite based techniques
- Visual observations
- Photographs
- Lake, stream and spring temperatures

Continual monitoring of volcanoes can provide early warnings of unrest or an impending eruption.
Mitigating Volcanic Risk – Warning Systems

- Warning system hardware (e.g. ERLAWS, EDS)
- **Effective** warning systems
Using land-use planning to mitigate volcanic risk

- Avoid new development in hazardous areas
- Additional assessment criteria for consents
- Employing low density development
- Restrict or minimise further subdivision developed areas
- Site key facilities out of hazardous areas
- Incorporate good urban design to minimise ash fall effects
- Plan for the disposal of volcanic debris after an eruption
- Plan for other land-use recovery aspects
- Link the above land-use planning tools in with emergency management provisions!
Keeping areas free of development…

- Tongariro and Egmont (Taranaki) National Parks
Mount St. Helens National Volcanic Monument
(Public Law 97-243 – August 26, 1982)

• Acquire all lands within monument boundary by donation, land exchange, or purchase.
• Protect natural features and processes.
• Provide for recreation, public safety, and scientific research.

Frenzen, 2009
# Mount St. Helens National Volcanic Monument

## Land Exchange and Acquisition

<table>
<thead>
<tr>
<th>Land Owner</th>
<th>Area (Hectares)</th>
<th>Traded for other land (Hectares)</th>
<th>Purchased (Hectares)</th>
<th>Donated (Hectares)</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Cabins and Lots (114)</td>
<td>65</td>
<td>53</td>
<td>11</td>
<td></td>
<td>Completed, except one</td>
</tr>
<tr>
<td>Lodges and Organization Camps</td>
<td>32</td>
<td>--</td>
<td>--</td>
<td></td>
<td>Not satisfied with exchange</td>
</tr>
<tr>
<td>Private Timberlands</td>
<td>16,011</td>
<td>15,258</td>
<td>1,750</td>
<td>45</td>
<td>Completed</td>
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<tr>
<td>State Timberlands</td>
<td>1,731</td>
<td>1,641</td>
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<td></td>
<td>Most completed</td>
</tr>
<tr>
<td>Mining Claims &amp; Mineral Rts</td>
<td>4,088</td>
<td>4,088</td>
<td></td>
<td></td>
<td>Completed</td>
</tr>
</tbody>
</table>

Frenzen, 2009
## Low density development around Mt Rainier, WA

<table>
<thead>
<tr>
<th>Facility/Occupancy List</th>
<th>Case I: Lahar Inundation Zone</th>
<th>Case II: Lahar Inundation Zone</th>
<th>Case III: Lahar Inundation Zone</th>
<th>Pyroclastic Flow Hazard Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonus Densities</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
</tr>
<tr>
<td>Essential Facilities</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
</tr>
<tr>
<td>Hazardous Facilities</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
<td>Not allowed</td>
</tr>
</tbody>
</table>
| Special Occupancies     | - In Travel Time Zone A Limited to 100 person  
- In Travel Time Zone B Limited to 500 person. 
In Travel Time Zone C Limited to 1,000  
- In Travel Time Zone D Limited to 5,000 | - In Travel Time Zone A Limited to 100 person  
- In Travel Time Zone B Limited to 500 person. 
- In Travel Time Zone C Limited to 1,000  
- In Travel Time Zone D Limited to 5,000 | Not allowed                     | Not allowed                |
| Covered                 | - In Travel Time Zone A       | - In Travel Time Zone A       | Not allowed                     | Not allowed                |
Using other mechanisms to keep development to a minimum – Rotorua District Plan

- Alerts the public to risk, but uses another mechanism (lakes protection) to keep development low
- Development around the lake is required to be of low impact, low density and confined in its spread for visual amenity
- Relies on warning systems to evacuate the population
Mt Usu, Hokkaido, Japan

Following a pyroclastic eruption in 2000:
- Zoning to keep new development and key sites out of destructive areas
- Relocated buildings
- Engineering solutions
- Emergency management
- Park created for education
Using urban design to mitigate ash effects, Kagoshima, Japan

- Gutter-free roofs
  - Prevents collection of ash in gutters & associated blockages and corrosion

- Ash resistant roofing tiles

- Heavy duty rubber window and door seals to prevent ash entering houses

- Large overhanging roofs over balconies
Conclusions

• Opportunities exist to make better use of land-use planning to mitigate volcanic risk

• We should begin discussions on how to better make use of this tool:
  - What’s viable and what’s not?
  - What level of risk are we willing to accept?