



Springs related to the Christchurch Earthquakes

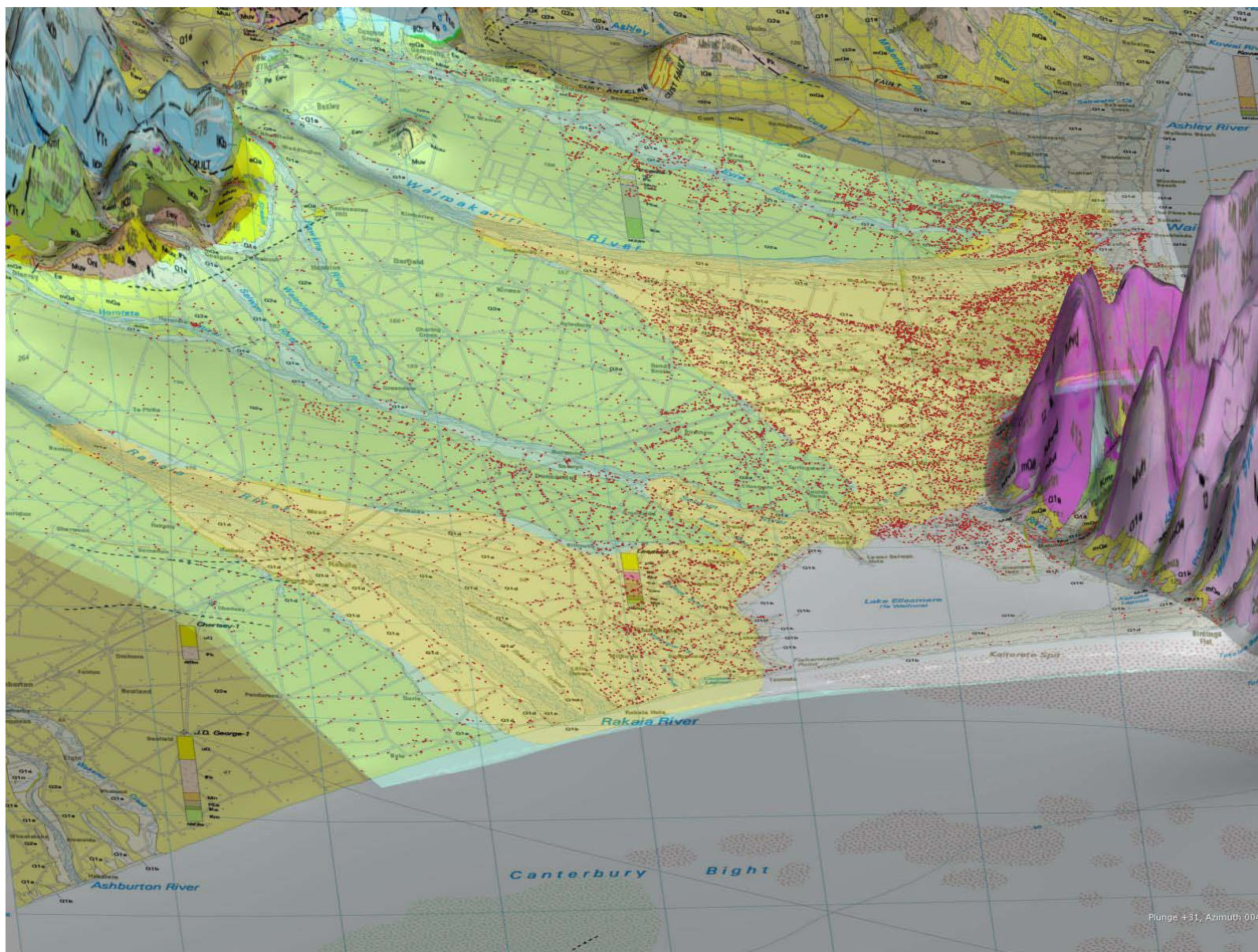
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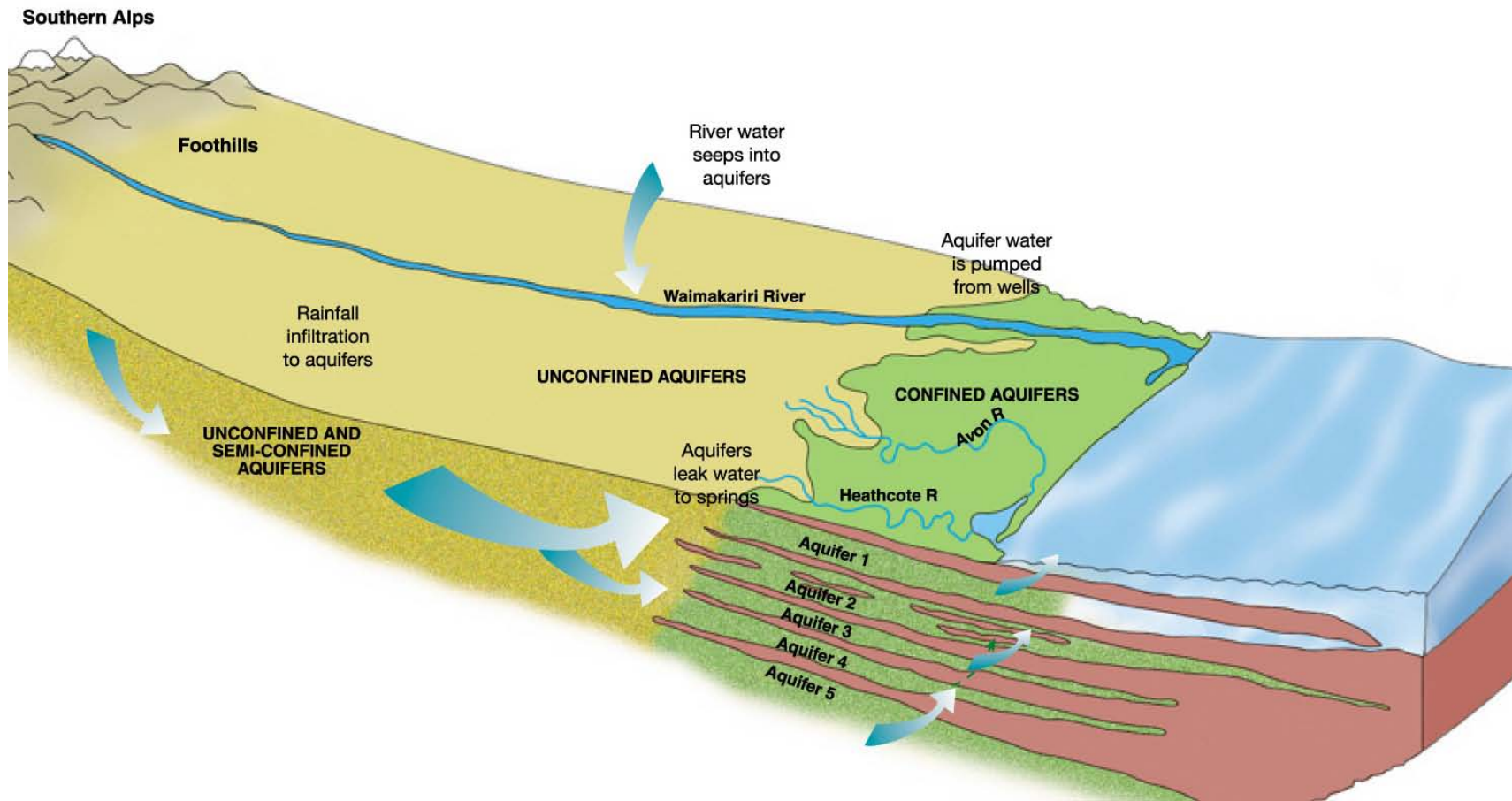
Presentation Outline

- Introduction
 - Conceptual model of the aquifer system
 - The earthquakes
- Impacts of the earthquake
 - Well damage, well performance, occurrence of springs
- Sources of springs
- How long will they last?
- What can we do about them?





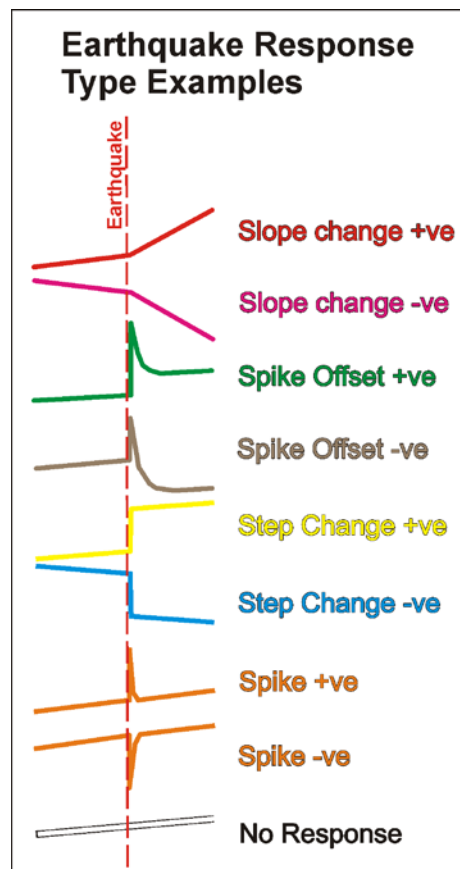
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The earthquakes and their impact on groundwater

- 7.1 in September, 6.3 in February, 6.3 in June – and the rest.....
- Water levels
- Possible effects on the aquifers
 - Lower yields?
 - Consolidation of the aquifers?
- Liquefaction
- Damage to infrastructure – drains, water supply pipes

Characteristic groundwater pressure responses



Potentially permanent effect

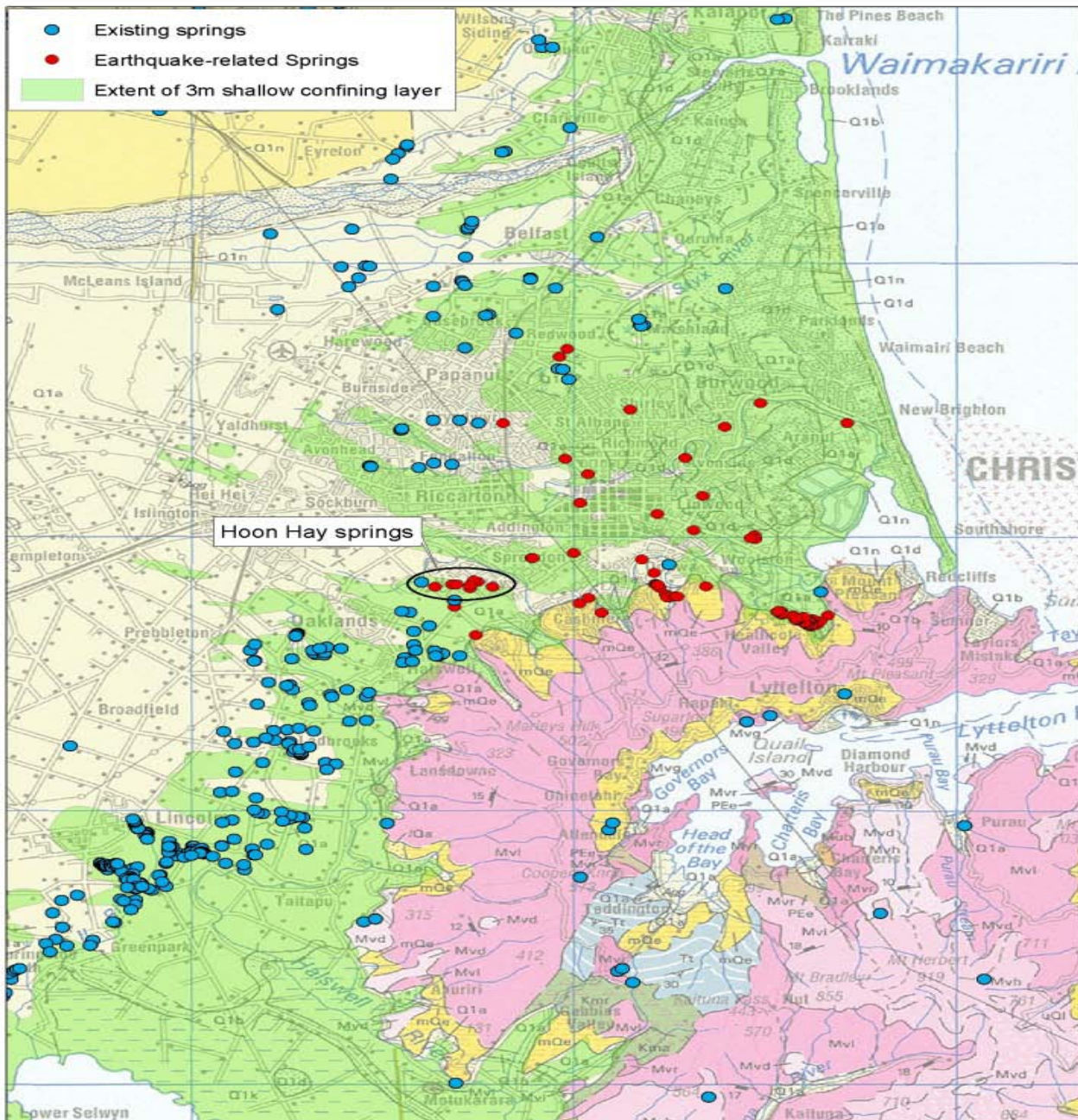
Likely temporary effect

No effect

Occurrence of springs

- Springs have emerged in numerous locations across the city
- Various potential reasons
 - Reactivation of old, sealed bores
 - Reactivation of old springs due to higher water levels
 - Discontinuities developed in confining layers
 - Permeability developed in consolidated rocks



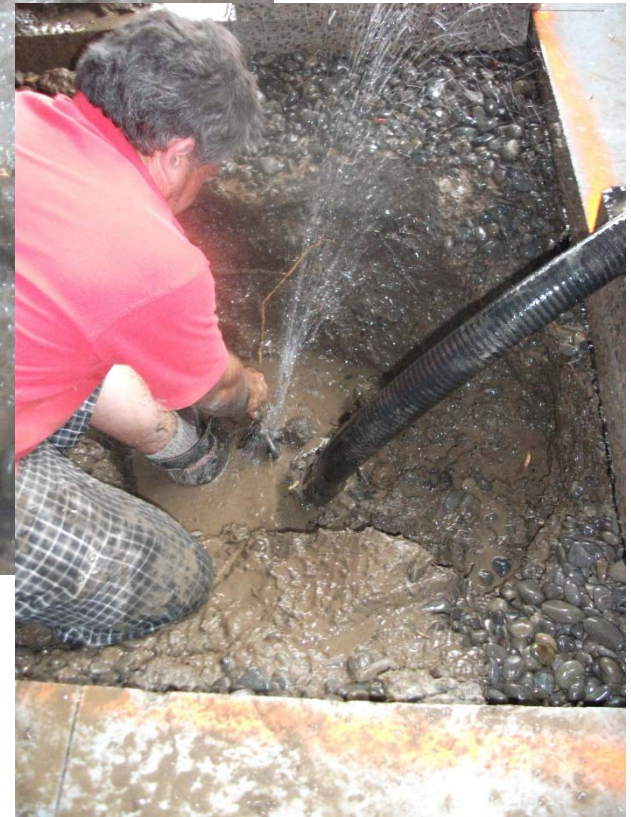


Old bores

- Widely reported
- Prior to a reticulated water supply, all houses had private bores.
- Many bores sealed or capped after water supply became available, and frequently were built over.
- Most not on any database
- Presence is inferred through identifying the history of the area, assessing the depth to the first aquifer whether there is evidence of artesian groundwater, and GPR.
- Remediation



Old bores



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Discontinuities in confining layers

- Tend to be clustered in certain areas
- Reflect the westwards thinning of the uppermost confining layer: the confining layer needs to be a maximum of 6 or 7 metres thick.
- In some cases, these are at the sites of sand volcanoes.
- Remediation





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Development of permeability in volcanic rocks

- Changes in permeability of the volcanic rocks in the Port Hills.
- Numerous new springs along the loess/alluvium contact at the base of the Port Hills that are likely to be due to this.
- Identified through location and water chemistry
- Confused by history of land drainage in these areas
- Remediation

Development of permeability in volcanic rocks



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What can we do about them?

- Solution depends on the cause of the problem
- Identify most likely cause
 - History of the springs
 - Location and local geology
 - Groundwater levels
 - Chemistry
 - Surface geophysics



Conclusions

- Numerous springs have developed
- No central collection of data on where the springs are or how to deal with them
- Developing understanding of the best methods to remediate

