

# Is Intensification Wise?

By

Robina Dobbie

Tuesday 14<sup>th</sup> November 2023

KIA ORA TATOU  
Greetings All

KO MAUKATUA TE MAUNGA  
Sefton is the Mountain

KO RUATANIWHA TE AWA  
Ruataniwha is the Lake

NO OTAUTAHI AHAU  
I am from Christchurch

KO DOBBIE TOKU WHANAU  
Dobbie is my Family

KO ROBBIE TOKU INGOA  
My name is Robbie

# You will see...

- 1) Who I am
- 2) Why a Qualifying Matter
- 3) History of ruptures
- 4) What we know about the AF
- 5) More about the AF
- 6) And yet more
- 7) Space and Time Diagram
- 8) How will next earthquake occur
- 9) NZs biggest earthquakes
- 10) Likelihood of AF rupture
- 11) What they said in 2007
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- 13) Magnitude Scale is Logarithmic
- 14) Shaking compared to energy release
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- 20) Impact on Electricity
- 21) Emergency Preparedness
- 22) Health & Wellbeing
- 23) Are we building wisely?
- 24) Summary
- 25) Please Consider our Geological Situation
- 26) Add Earthquakes as a Qualifying Matter
- 27) References

# Who am I?

- ✓ Meteorological observer
- ✓ Geology technician
- ✓ Air Traffic Control – retrained in meteorology
- ✓ Early adopter in technology
- ✓ Data analyst & Project Manager
- ✓ Business Mentor/Coach & Strategy Consultant

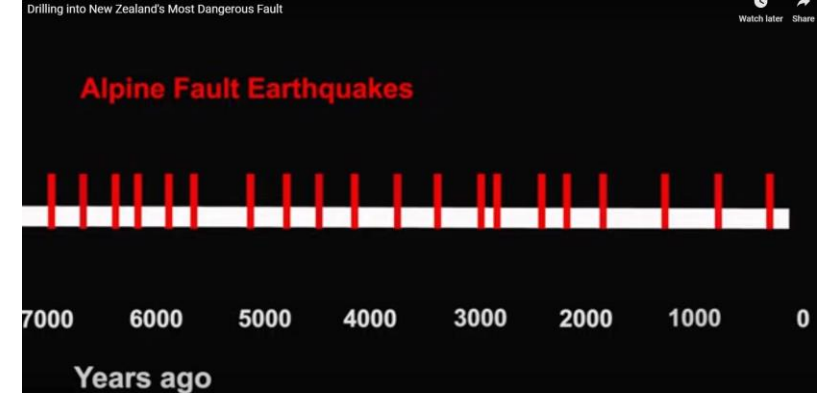


# Why isn't "Earthquakes" a Qualifying Matter for the Christchurch City Council?

- ❑ Alpine Faultline is one of the most active major faults in the world
- ❑ AF Earthquake is likely to be the biggest in NZ since 1855, high chance ever recorded here
- ❑ Where is there another CBD the size of Christchurch that closed for >12 months due to an earthquake?
- ❑ Our City is Still Recovering
- ❑ Likely 8+ Magnitude earthquake – possibly 9
- ❑ Risk Assessment?



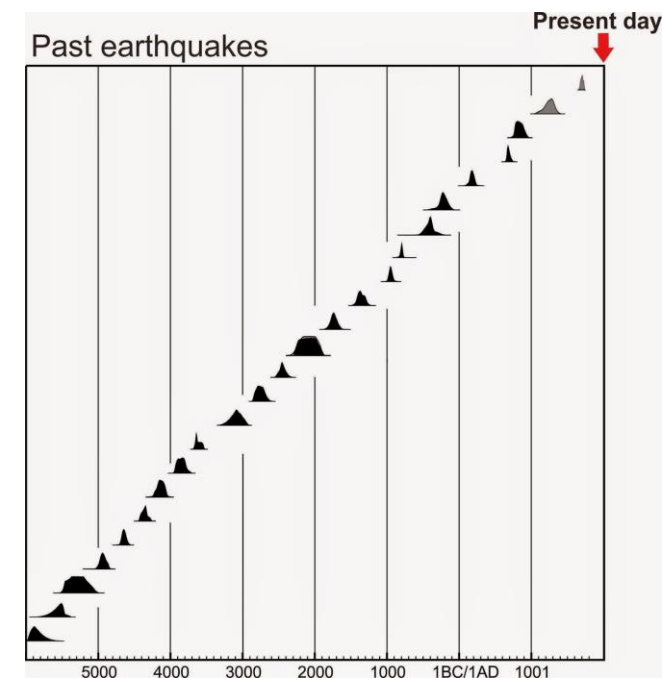
# History of ruptures



- Alpine fault runs 850km Harold Wellman (1941-42)
- 27 earthquakes back through the past 8000 years
- Research shows **regular** ruptures
- The fault has ruptured four times in the past 900 years:

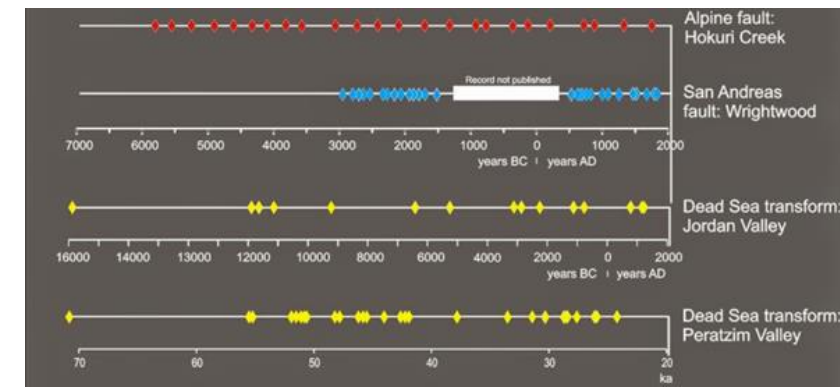
## Approximate rupture dates

- 1717 AD 8.1MM
- 1620 AD (97 years – doubt expressed recently)
- 1450 AD (170 years)
- 1100 AD (350 years)
- We are overdue for the next AF earthquake

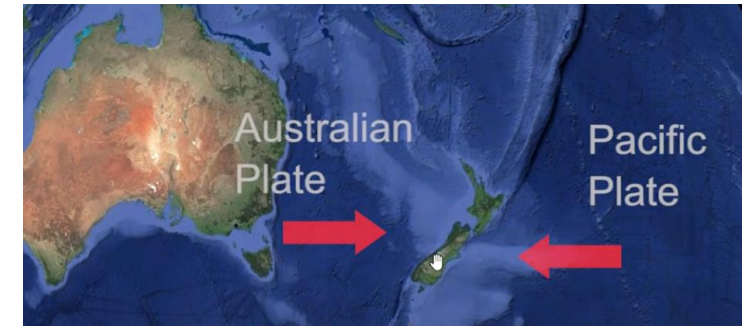


# What we know about the Alpine Fault...

- ✓ Best example world-wide of an earthquake that could rupture in a magnitude 8+ earthquake and hasn't in the last 300 years
- ✓ AF is one of the world's major geological features
- ✓ In between earthquakes, the Alpine Fault is locked
- ✓ The rupture will produce one of the biggest earthquakes since European settlement of New Zealand
- ✓ It will have a major impact on the lives of many people
- ✓ We are a part of the "Pacific Ring of Fire"
- ✓ AF End of its seismic cycle



# More of what we know...



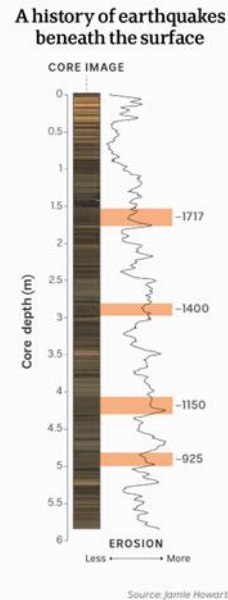
- ✓ Alpine Fault is the visible "on-land" boundary of colliding plates
- ✓ The Pacific & the Australian Plates – transform plate boundary
- ✓ Twisted plate boundary – important!
- ✓ Southern end – Australian plate diving down under the Pacific
- ✓ Northern end – Pacific plate going under the Australian plate
- ✓ Horizontal movement is about 3 to 4.45cm per yr (Approx 9 – 14m)
  - considered very fast by global standards
- ✓ Each time it has ruptured, it has also moved vertically, lifting the Southern Alps in the process 1+cm per year (Approx 3 – 4 m)



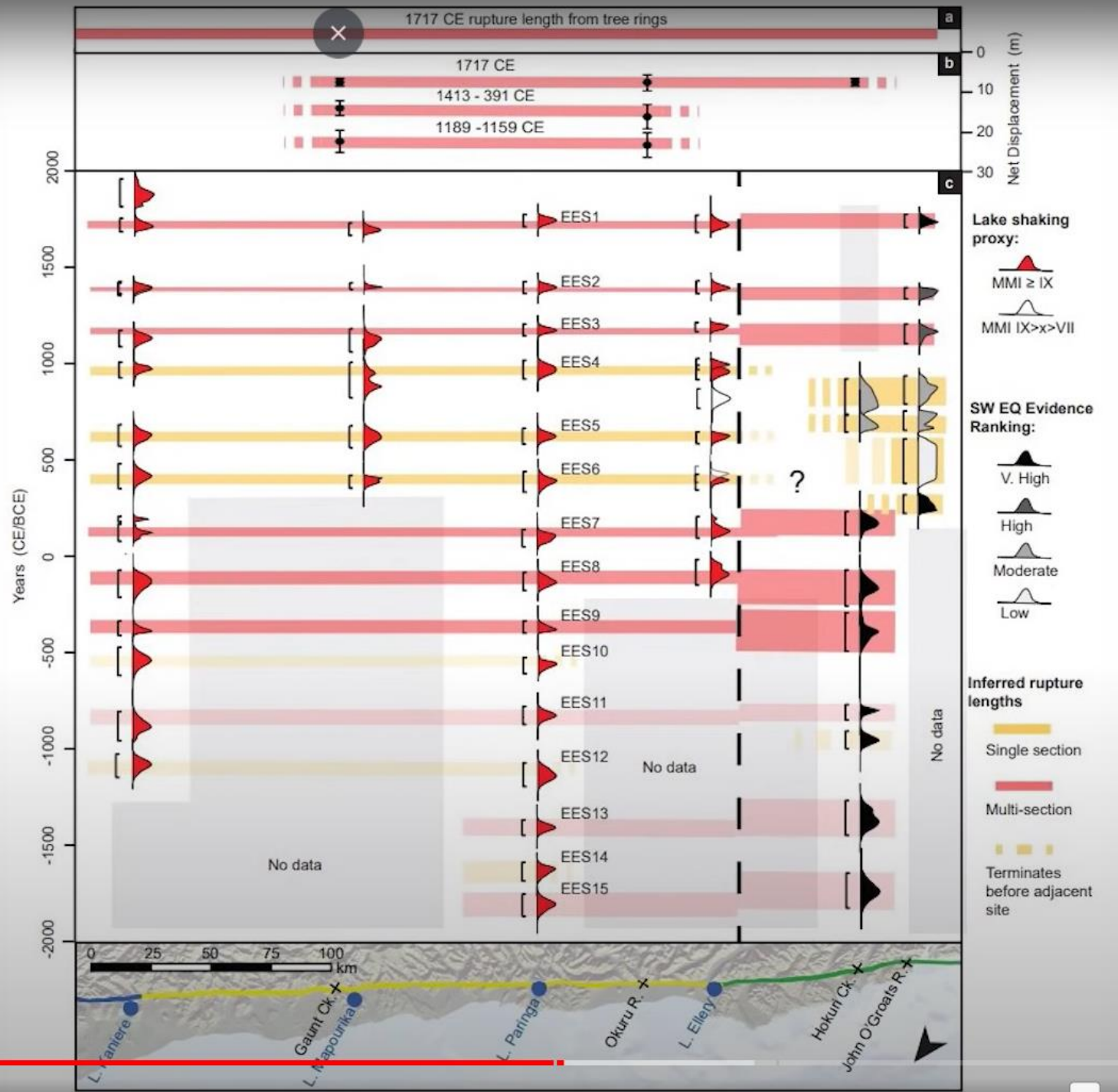
# And More of what we know...

*New Zealand's Alpine Fault reveals extreme underground heat and fluid pressure* Published: May 18, 2017 8.16am NZST

- Pressure is building for the AF earthquake
- “The fault is very close to rupturing” June 2023 Caroline Holden
- “It’s very active & it’s producing a lot of clues about what the next quake will be like”.
- “Very long, very complex & there will be very strong aftershocks”
- Recurrence interval (R.I.)  $259 \pm 43$  Max R.I. 337 years, Min R.I. 220 years (may be only 97 years)
- **The AF is one of the most active faults in the world**



# Space and Time Diagram



# How will the next great Alpine Fault earthquake occur?

- Earthquake will occur with no recognisable warning
- It will most likely start in South Westland
- It will alter tectonic stress distribution – other fault lines may rupture in the days or years following it
- Rupture of another fault line nearby may trigger it – we will only know afterwards
- May rupture along part of its length with lower magnitude and be followed shortly by rupture of the rest
- May be two very large quakes or a series of large quakes are also realistic scenarios

# NZs Biggest EQs

- Some predict that when it goes it will be the **biggest quake in recorded history...certainly in NZ**
- Globally it is likely to be **one of the largest on land earthquakes ever recorded**
- We are talking about an extremely large earthquake!!!

Date	Location	Magnitude	Fatalities	Further information
08 Jul 1843	Wanganui	7	2	1843 Wanganui earthquake
16 Oct 1848	Marlborough	7.5	3	1848 Marlborough earthquake
* 23 Jan 1855	Wairarapa	8.2	9	1855 Wairarapa earthquake
23 Feb 1863	Hawke's Bay	7.5	Unknown	
19 Oct 1868	Cape Farewell	7.5	Unknown	
01 Sep 1888	North Canterbury	7.1	0	1888 North Canterbury earthquake
12 Feb 1893	Nelson	6.9	Unknown	
16 Nov 1901	Cheviot	6.9	1	1901 Cheviot earthquake
09 Mar 1929	Arthur's Pass	7.1	Unknown	1929 Arthur's Pass earthquake
17 Jun 1929	Murchison	7.8	17	1929 Murchison earthquake
03 Feb 1931	Hawke's Bay	7.9	256	1931 Hawke's Bay earthquake
13 Feb 1931	Hawke's Bay	7.3	-	Aftershock to 3 Feb 1931
05 Mar 1934	Pahiatua	7.6	2	
24 Jun 1942	Wairarapa	7.2	0	
02 Aug 1942	Wairarapa	7.0	1	
26 Jun 1946	Lake Coleridge	6.2	0	
24 May 1968	Inangahua Junction	7.1	3	[2] @
02 Mar 1987	Edgecumbe	8.3	0	1987 Edgecumbe earthquake
13 May 1990	Weber	6.4 <sup>[9]</sup>	0	
18 Jun 1994	Arthur's Pass	6.7 <sup>[10]</sup>	0	
06 Feb 1995	East Cape	7.0	0	
22 Aug 2003	Fiordland	7.1	0	
22 Nov 2004	Puysegur Trench	7.2	0	
20 Dec 2007	Gisborne	6.8	0	2007 Gisborne earthquake
15 Jul 2009	Fiordland	7.8	0	2009 Fiordland earthquake
04 Sep 2010	Darfield, Canterbury	7.1 <sup>[11]</sup>	0	2010 Canterbury earthquake
29 Sep 2010	White Island	6.4	0	
22 Feb 2011	Christchurch	6.3	<del>485 confirmed, 182 expected</del> <sup>[12]</sup>	2011 Christchurch earthquake

185

# Likelihood of Alpine Fault Rupture

- ✓ Ruptures on a Regular Basis
- ✓ We sit right across the plate boundaries
- ✓ Meeting of the:
  - Pacific Plate – moving SW
  - Australian Plate – moving NE
- ✓ Stuck and will release in **a large earthquake**
- ✓ Southern Alps show fast movement by global standards
- ✓ 2021 likelihood **revised to be a 75% chance**

The screenshot shows a video player interface. At the top, a light blue header contains the title "Likelihood of rupture of Alpine Fault within next 50 years". Below the header, the text "Biasi et al (2015): - 30%" is displayed. To the left is a photograph of a mechanical component, possibly a valve or part of a wellhead, with several yellow circular markers. To the right of the photo, green text reads: "...the next Alpine Fault rupture is an inevitable event" and "– would you gamble on being unprepared for this?". At the bottom right of the slide area, "GNS Science" is written. Below the slide area is a video player control bar with a play button, a progress bar showing "35:20 / 54:31", and a volume icon.

The Next Alpine Fault Earthquake in New Zealand

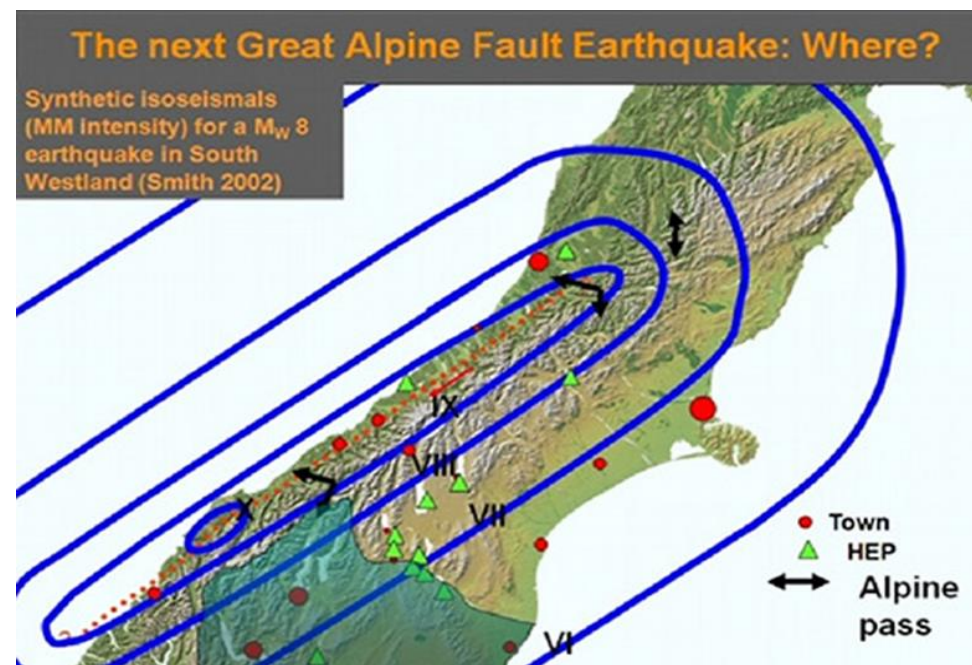
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# In 2007 They Were Saying...

- Likely to rupture very soon
- *Current pressures on plates make it probable that the next earthquake on the Alpine Fault will occur in the next 1 – 20 years (3+ years left!!!)*
- *The further we look into the future, the less likely it becomes because it is most likely to occur now!*
- *The probability is increasing every year*
- **The longer it goes without rupture, the *bigger it will be*, and the worse are its consequences**



# So a 75% Chance by 2027 to 2069

- The last rupture was in 1717 AD
- Where will the next great alpine fault earthquake begin?
- Most likely South Westland
- We have been told the Alpine Fault has a typical cycle of about 259 years, now **306 years**
- AF is at the **end of it's seismic cycle**
- Likelihood it will be a magnitude 8+ (**82%**) for **4+ mins**
- Will be felt throughout the South Island and as far away as Sydney

# The Magnitude Scale is Logarithmic

This means that if you add 1 to an earthquake's magnitude, you multiply the shaking by 10. An earthquake of magnitude 5 shakes 10 times as violently as an earthquake of magnitude 4...

7.0 intensity of -1

7.5 intensity of – 11

8.0 intensity of – 63

8.5 intensity of – 354

9.0 intensity of – 1995

I have followed the research relating to our Alpine Fault and remember them expecting it to be an **8.5 - 9 magnitude** quake



# Shaking compared to energy released

Comparing the magnitude 9.0 earthquake in Japan with the magnitude 6.3 quake that struck New Zealand in February.

- The difference in magnitudes is 2.7, so the difference in shaking is  $10^{2.7}$ , or just over **500 times as big**
- The difference in energy, however, is  $10^{(2.7*1.5)} = 10^{4.05}$ , or about **11,220 times as big**

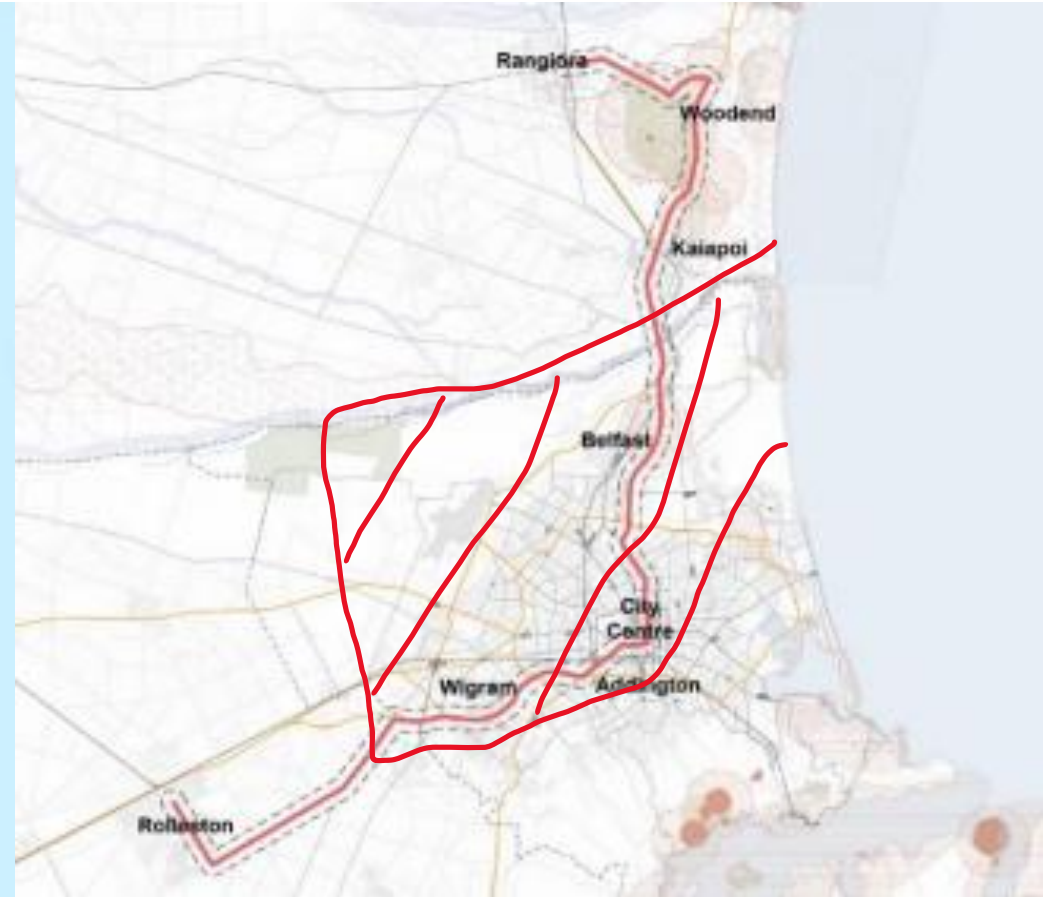
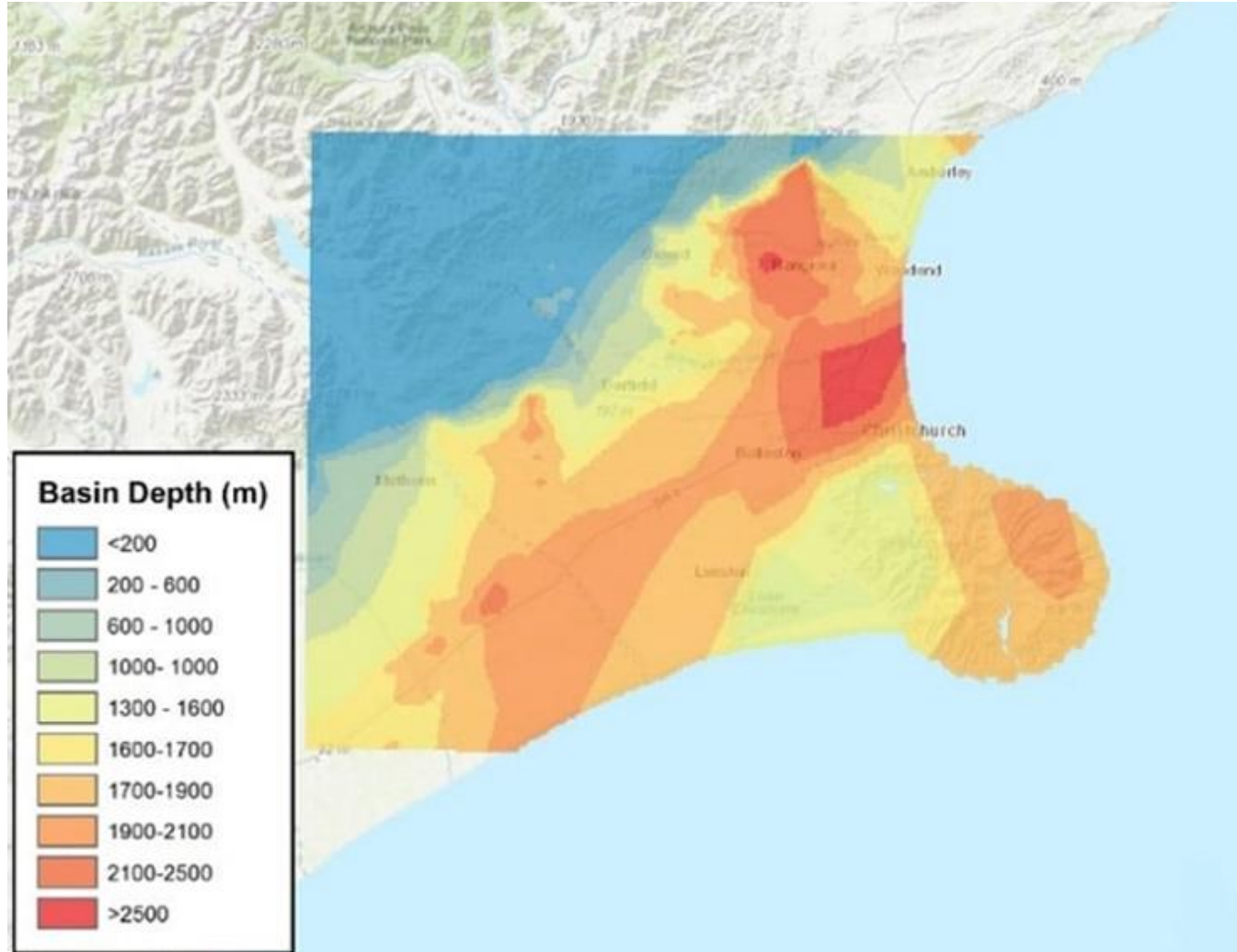
# Alpine Fault Quake ‘More Damaging’ for Plains

- “The Canterbury Plains could suffer more damage in an AF quake than some areas closer to the fault”
- AF is going to be such a widespread event – less support as people “all going to be dealing with their own issues”
- Professor Brendon Bradley – computer simulation
  - “Our simulations indicate that this large energy that enters the sedimentary basin, the soft soils that the Canterbury Plains reside on, leads to a lot of trapping of what we call surface waves”.
- Result – Canterbury ground shaking a lot stronger – will last longer than regions around SI without those features

# Some quotes from 2011

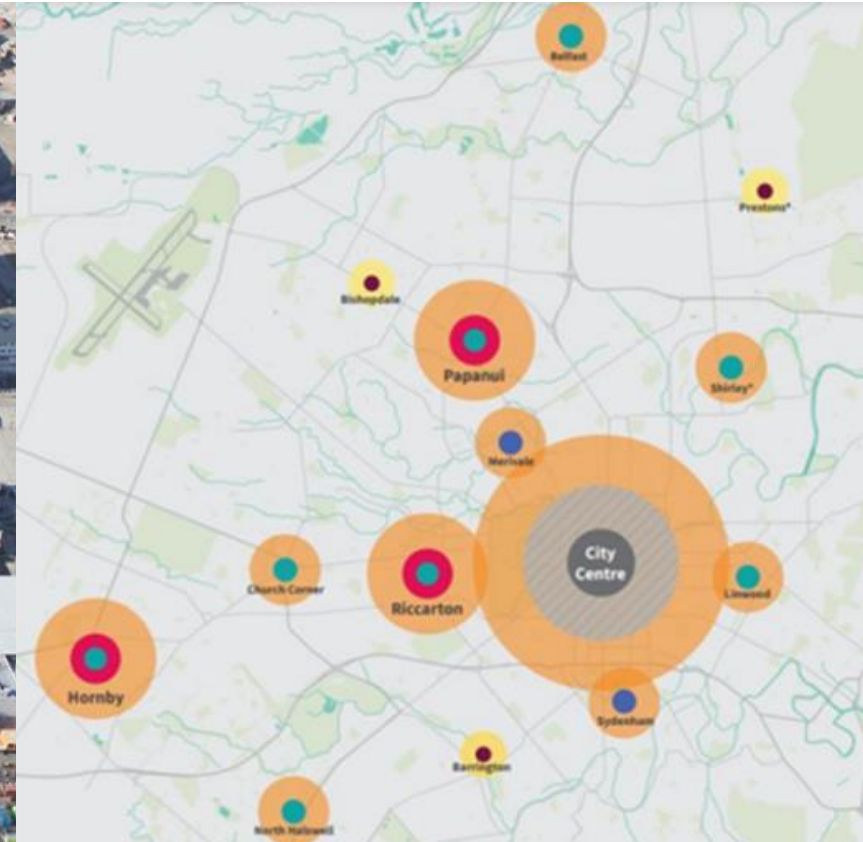
- ❖ *"It is just a scene of utter devastation. We have to work as fast as we can to get people out of environments where they are trapped."*
- ❖ *"This is a terrible, terrible toll on our city."*
- ❖ *"There is no power in most of the city; there is no water in most of the city,"*
- ❖ *"The roads here are a mess; this earthquake is a lot worse than the one that hit us back in September last year."*
- ❖ *"The phone lines and water are not working and the roads are grid-locked as the city is being evacuated."*

# Infrastructure – Susceptible Land





# City Centre High Density Zone: 32 metres enabled (10 storeys) – *Where did this idea come from?*



## Key

- City Centre Zone: unlimited height
- High Density Zone: 32 metres enabled (10 storeys, depending on building design)
- High Density Zone Precinct: 20 metres enabled (six storeys, depending on building design)

# Impact on Infrastructure

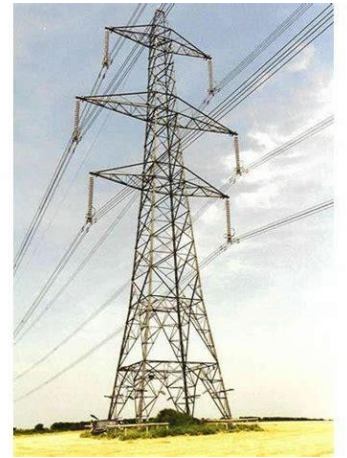
- Soft soil deposits amplify shaking for longer period ground motions this results in **disproportionately high damage for mid-rise and high-rise buildings**
- Roading will be out for a period – some roads could take more than six months – many bridges will be out
- Water, sewerage, energy, transport, health and social services are likely to be disrupted for weeks
- Telecommunications – **no copper lines** so reliant on electricity
- Satellite based telephone systems initial means of communication
- Major problem constraining repair & rebuilding – shortage of materials and of trades people
- No Support – everyone will have their own things to deal with





# Impact on Electricity

- There will be damage to hydro electrical generation & transmission lines
- Immediate shut down of South Island **power generation**
  - need electricity to restart
- Each pylon takes two days to repair/replace
- Electric vehicles will be mostly unable to operate
- Electricity supply is likely to be unavailable for many weeks or even months in some remote areas
- Will need solid fuels back-up preparedness



# Emergency Preparedness



- Medical services will be overwhelmed
- Emergency services will be inhibited in rescue efforts by scale of damage to roads & buildings
- Water supplies are likely to be a major issue
- Electricity cannot be relied on
- Will need vehicles running on petroleum products
- Food storage will be needed
- Tourists will be stranded & completely reliant on locals
- If winter – solid fuels will be needed as back up or main supply
- Where is the preparedness for this?



# Health & Wellbeing

- ✓ Medical support – we need some self-reliance
- ✓ Way to get exercise – for physical and mental health
- ✓ Communications – issue for many due to reliance on technology
- ✓ People support and management
- ✓ Pets – how to cater for them
- ✓ Many will be shocked
- ✓ Preparedness is needed now – connection trees



# Are We Building Resilience into our CCC Plan?

- Remember CBD was closed for 12 months
  - That was only 2010/2011 – Do we have Alzheimer's?
- We know the AF will rupture – **it is overdue!**
- Why would we build **unlimited heights** in CBD?
- AF likely to be **more damaging for our city** than 2010/2011
- **Where does the accountability lie?**
- **Who is taking the responsibility for this?**

# Summary

- ✓ The Alpine Fault is at the **end of its seismic cycle**
- ✓ AF rupture is more likely to **happen today than tomorrow**
- ✓ There is a **75% chance** of the fault rupturing **by 2027 to 2069**
- ✓ The probability that the next earthquake on the Alpine Fault will be a **magnitude 8+ is 82%**
- ✓ It will last for **4+ minutes**
- ✓ Soft ground causes amplified ground motions and results in **disproportionately high damage for mid-rise and high-rise buildings**

# Please Consider our Geological Situation

- This is not a one-off Geological mistake
- Parakiore – Metro Sports Facility – land sinking...predictably
- \$32.5 Million approved for replacement of South Library
  - The building failed after 7 years
- Sit in council meetings and hear councillors comments like...
  - ‘It’s good to spend other people’s money. Don’t stop spending’
- Time for councillors to stop this reckless attitude – not all of them
- We have idealistic dreams of the GCSP – do these people know about the Alpine Fault?

# Add “Earthquakes” as a Qualifying Matter

- ✓ *Why are we intensifying?*
- ✓ *Who is responsible for this **dangerous** planning?*
- ✓ *Time for CCC to consider the safety of their residents*
- ✓ ***Make Earthquakes a Qualifying Matter and go back to the government and say NO to intensifying***
- ✓ *The UN are encouraging initiatives with SDGs from a global viewpoint – **our local factors** must be considered!*
- ✓ *After the Alpine Fault and aftershocks we can reconsider*
- ✓ ***We need to be preparing NOT intensifying!***

Thank you

# References

New Zealand's largest fault line, the Alpine Fault, is even longer than previously thought – Jun 2023

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What countries are on the Ring of Fire?

The Pacific Ring of Fire stretches across 15 more countries including Indonesia, New Zealand, Papua New Guinea, Philippines, Japan, United States, Chile, Canada, Guatemala, Russia and Peru etc.

Where is the longest fault line in the world?

The Ring of Fire is the largest and most active fault line in the world, stretching from New Zealand, all around the east coast of Asia, over to Canada and the USA and all the way down to the southern tip of South America and causes more than 90 percent of the world's earthquakes.

What is the biggest earthquake possible?

No, earthquakes of magnitude 10 or larger cannot happen. The magnitude of an earthquake is related to the length of the fault on which it occurs. That is, the longer the fault, the larger the earthquake.