

# Let's Talk about Earthquakes: Wellington Edition



Dr. Rob Langridge

Dr. Graham Leonard

Russ Van Dissen

Kim Wright



# What is this presentation about?

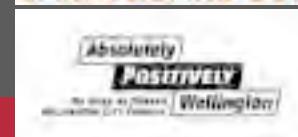
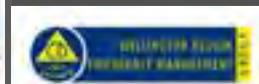
- Who we are
- Why we study earthquakes
- Wellington's "It's Our Fault" project
- Lessons from Christchurch
- but first a survey....and a short movie

# What is the "It's Our Fault" project?

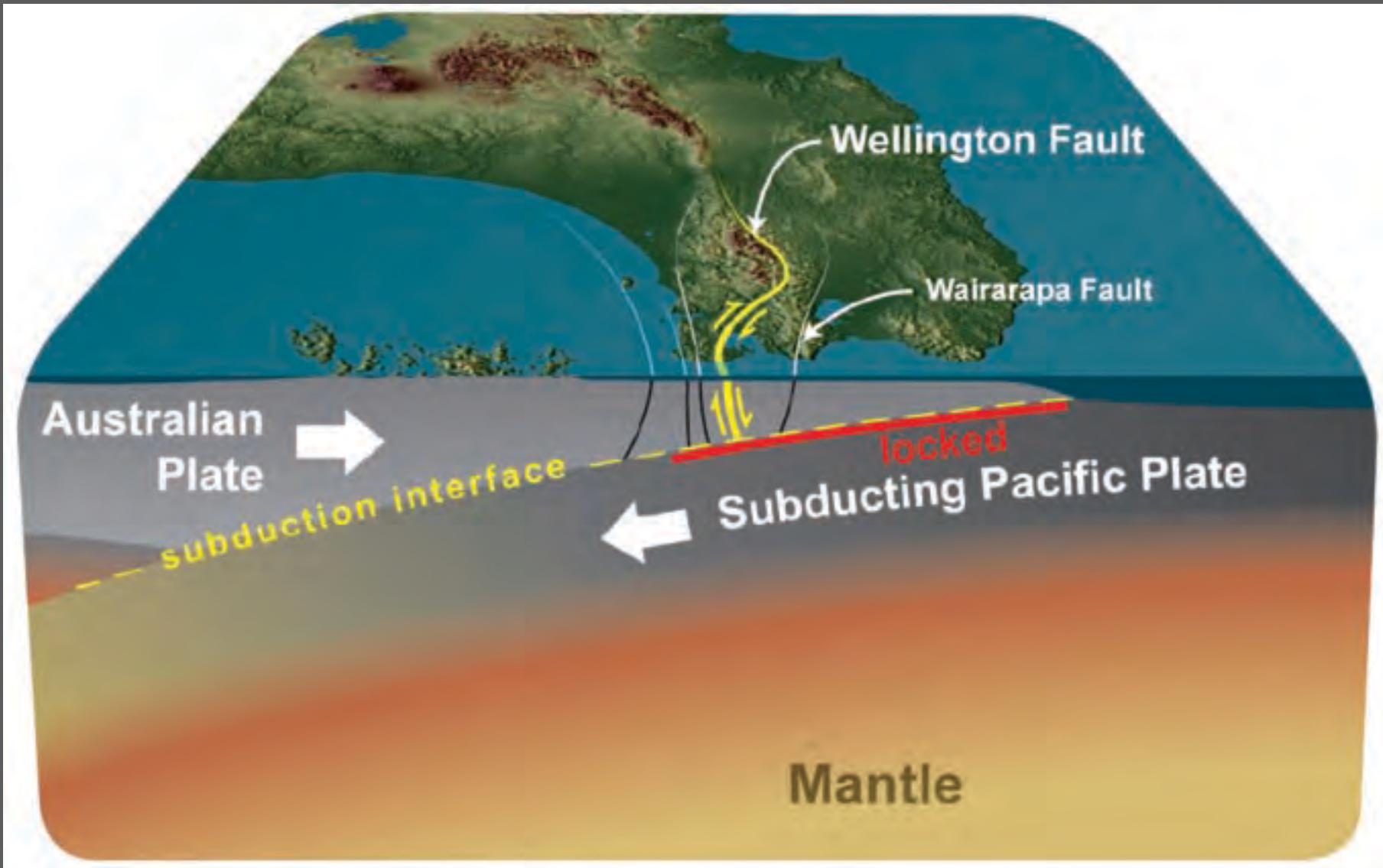
- To see Wellington positioned to become a more resilient city through a comprehensive study of the likelihood of large Wellington earthquakes, the effects of these earthquakes, and their impacts on humans and the built environment
- ***Translation:*** to understand the potential for earthquakes so we can strengthen Wellington



NHRP



# Wellington's Earthquake Setting



# Wellington's Earthquake Setting



# Simplified Active Fault Map of Region

Active faults are the sources of past, and future, large earthquakes

**Is the “Big One” overdue?**



# Wellington Fault: Digging up past big earthquakes



Long Gully Station on South Coast  
- Te Kopahou trench site for It's Our Fault

# Wellington Fault: Conditional Probability of Rupture

Likelihood of a really big earthquake on the Wellington Fault  
(accounting for)

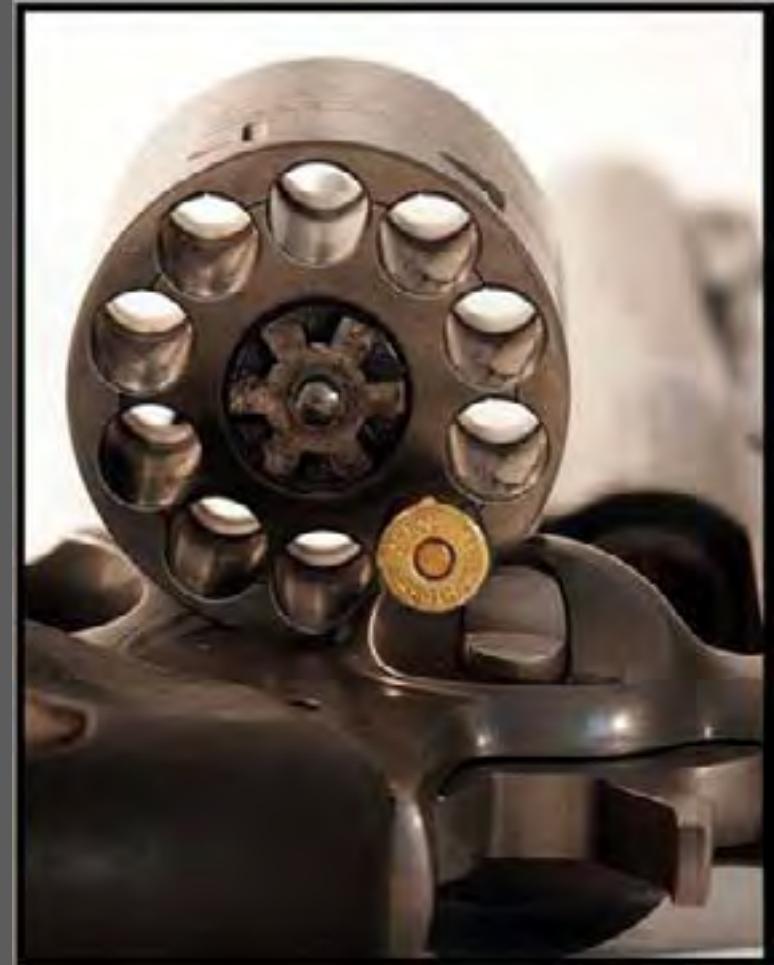
- Elapsed time since most recent rupture
  - Slightly younger than previously thought ( $\sim 300$  years ago)
- Timing of older ruptures
  - Slightly less frequent than previously thought ( $\sim$  every 800-1000 years)
- Single event displacement size
  - Slightly larger than previously thought ( $\sim 5$  m per rupture)
- Slip rate
  - Slightly slower than previously thought ( $\sim 6$  mm/year)
- Rupture statistics of the Wellington-Wairarapa fault pair in a synthetic earthquake catalogue derived from a physics-based numerical model
  - Rupture of nearby Wairarapa Fault “unloads” Wellington Fault
- Various recurrence-time models
  - Exponential, Lognormal, Weibull, inverse Gaussian

# Results: Likelihood of rupture of *Wellington Fault* within next 100 years

Pre-It's Our Fault: ~ 30%



New: ~ 10%



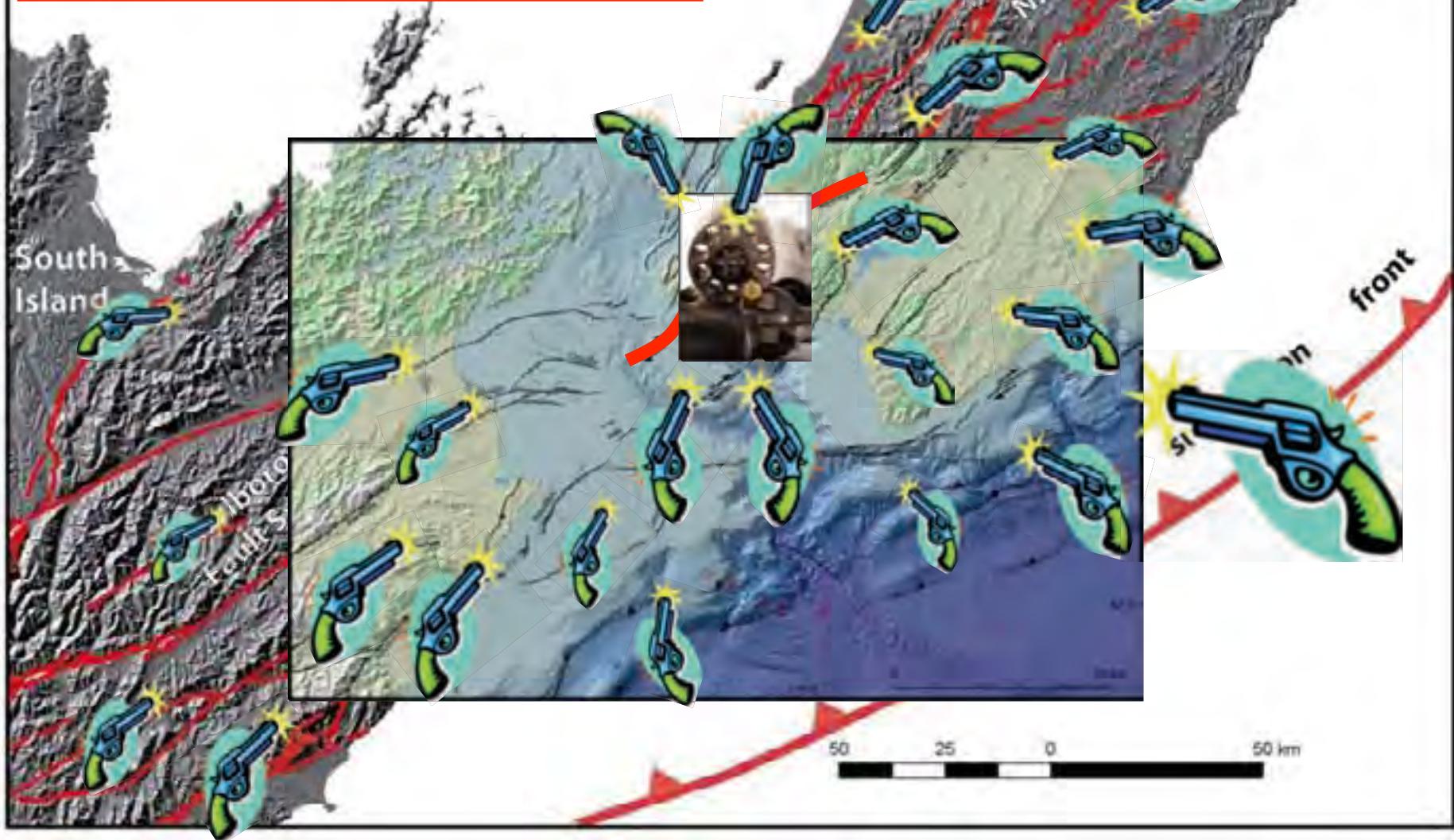
# *It's Our Fault* – key Likelihood conclusion

- Significant reduction in the likelihood of a really big earthquake on the Wellington Fault over the next hundred years.

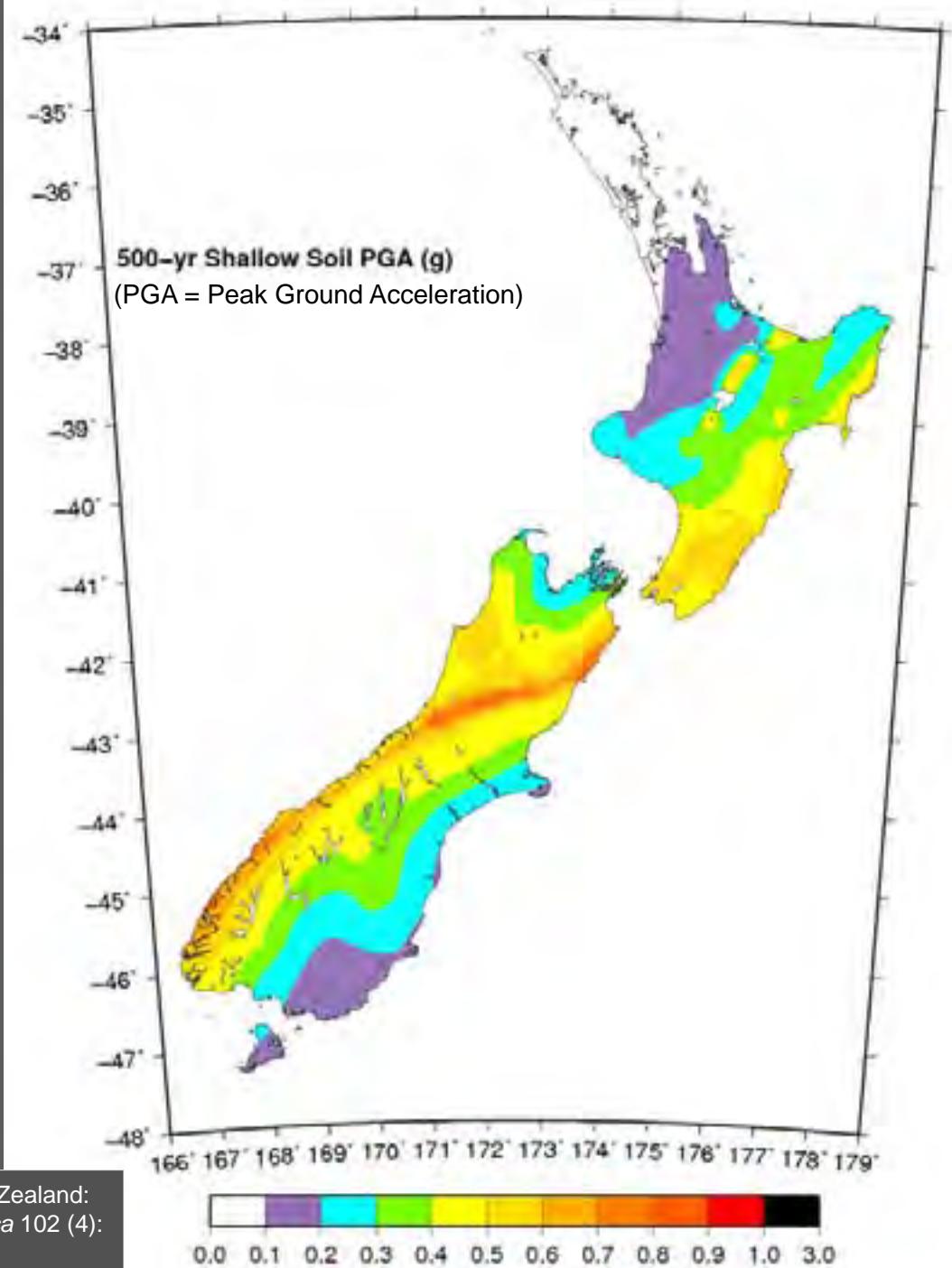
**This is Good News!!!**

- **However, no room for complacency.**  
There are other earthquake sources in, and around, the region that can produce significant damage and loss.

More than a few large earthquake sources in and around Wellington



# Time averaged ground shaking hazard



From: Stirling et al., 2012, National seismic hazard model for New Zealand:  
2010 update. *Bulletin of the Seismological Society of America* 102 (4):  
1514-1542.

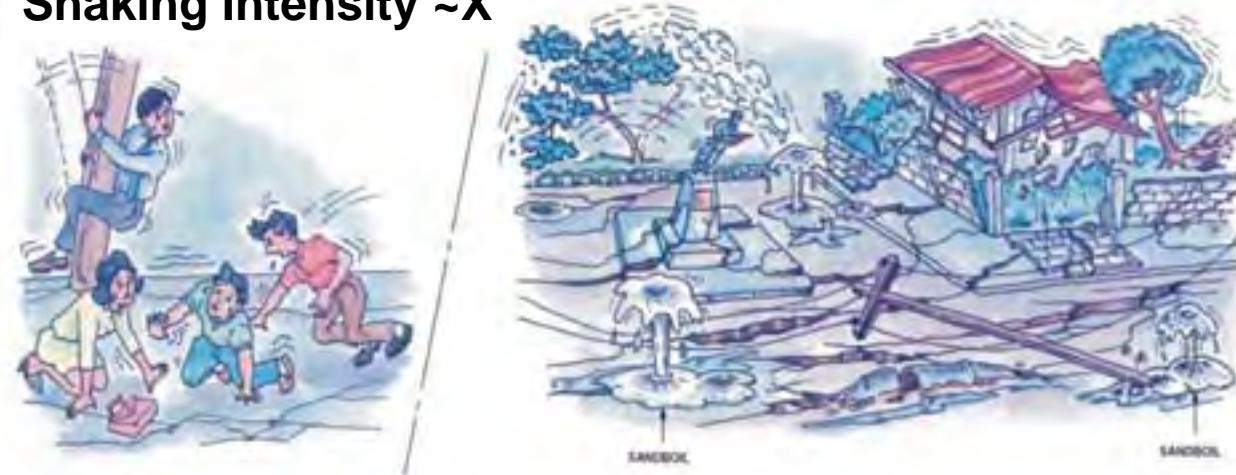
# Return time of *shaking* in Wellington (Modified Mercalli Intensity shaking)

Shaking Intensity	Return Period (years)
VII	30
VIII	120
IX	400
X	1350

Shaking Intensity ~VII



Shaking Intensity ~X



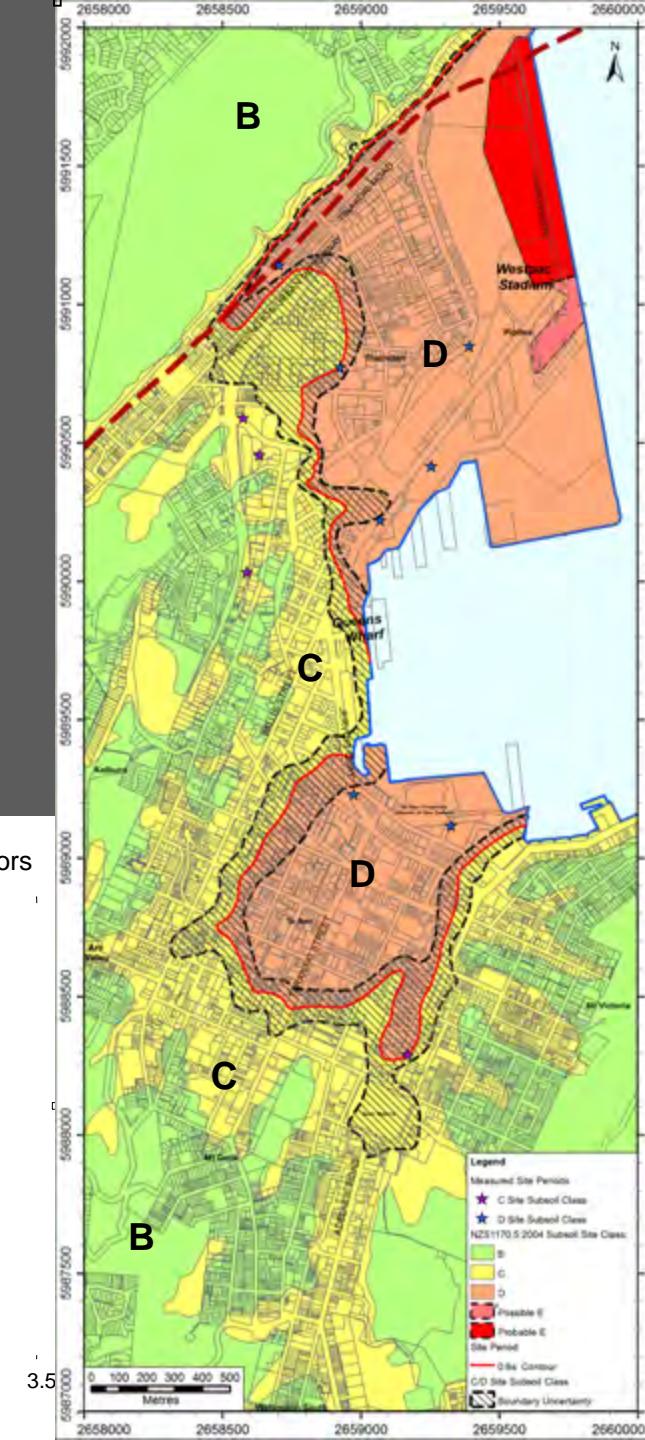
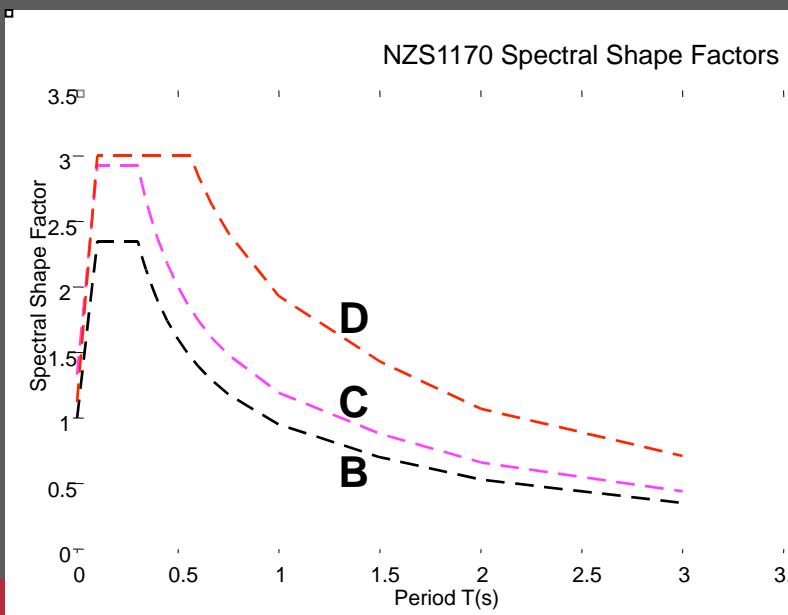
# What would happen in a big earthquake in Wellington? Let's look at Christchurch:

- Ground Shaking
- Liquefaction (including lateral spreading)
- Slope Failure
- Surface Fault Rupture (including tectonic tilting)
- Tsunami

Areas affected by permanent ground deformation, as well as strong ground shaking, suffer greater levels of **damage** and **loss**

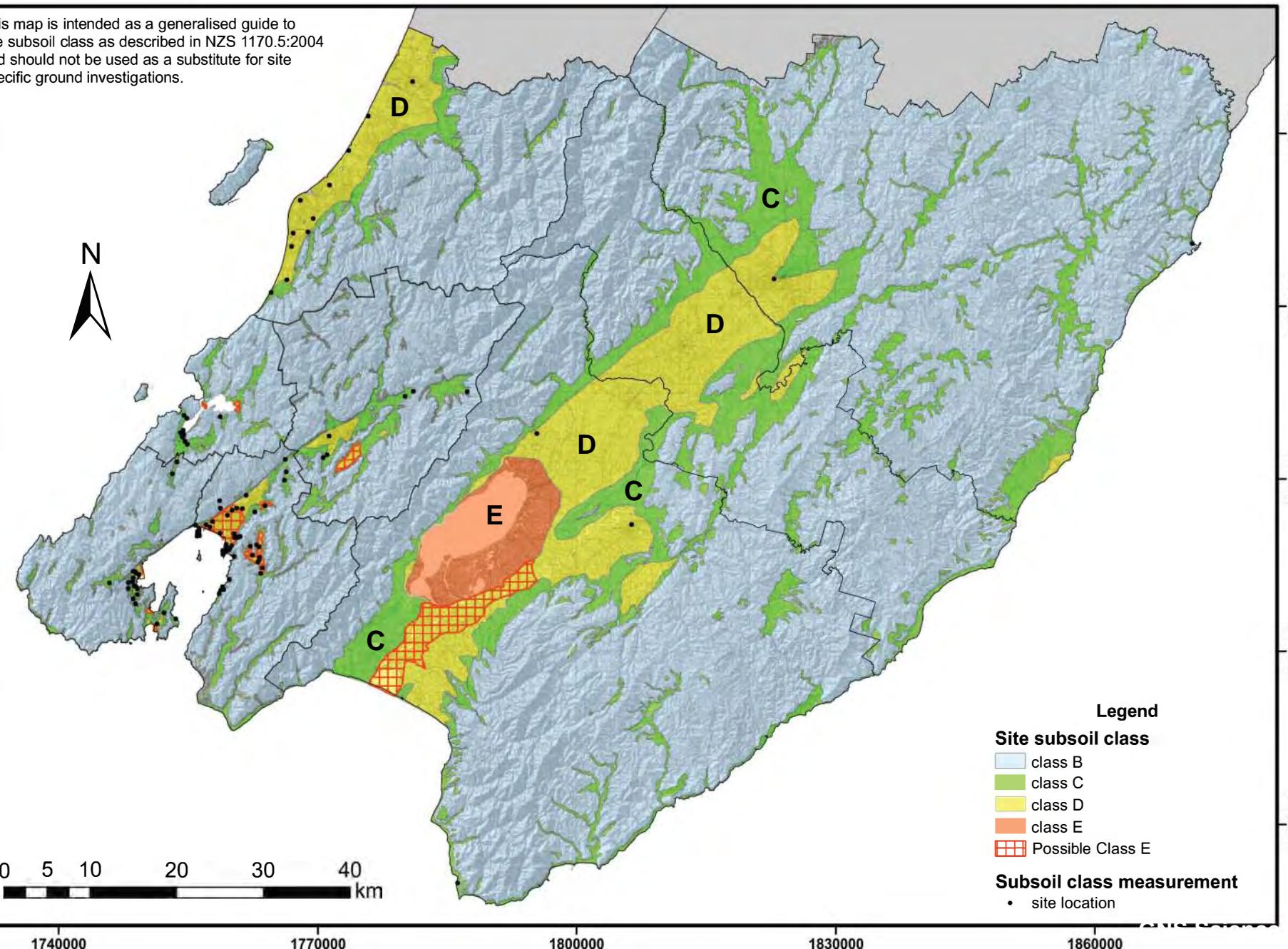
# Ground Shaking

Not all ground is created equal & how we deal with it



# Wellington Region site subsoil classes

This map is intended as a generalised guide to site subsoil class as described in NZS 1170.5:2004 and should not be used as a substitute for site specific ground investigations.



# Liquefaction (in CHCH)

## Actual vs. Previously Mapped Hazard

Extent of liquefaction from 22 Feb 2011.

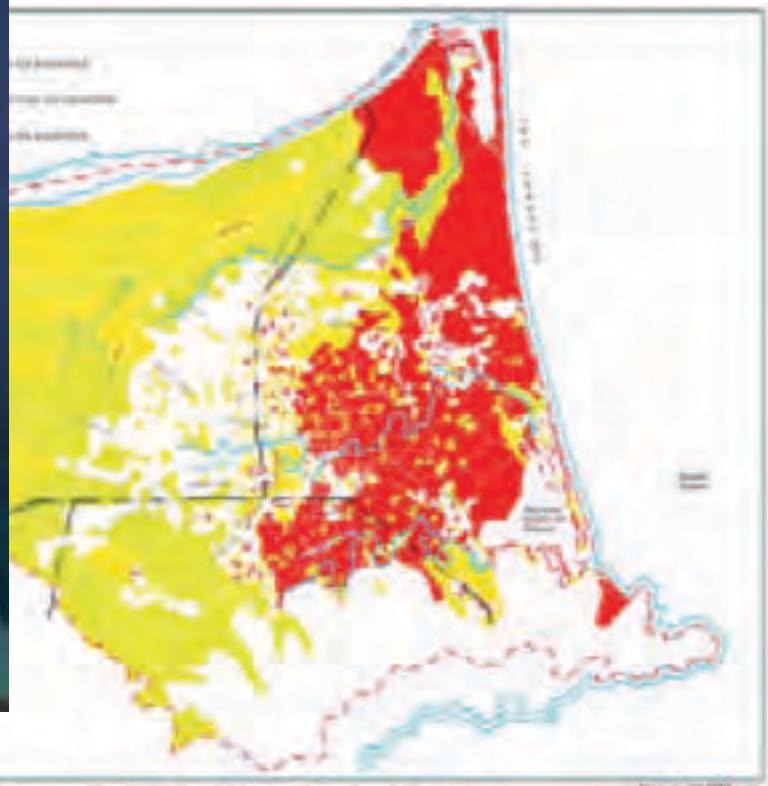
Preliminary indicative land damage map.

Orange = major liquefaction.

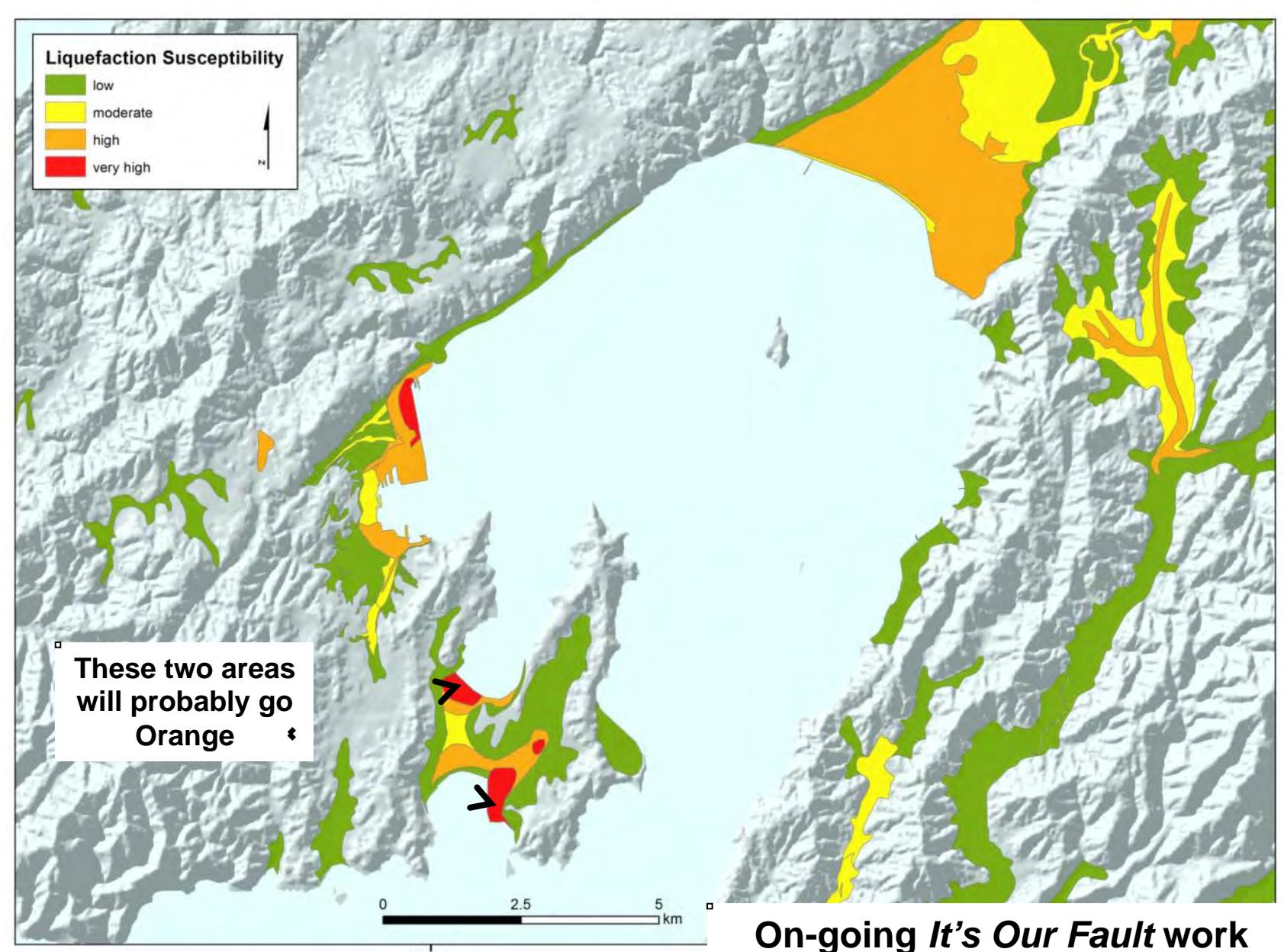
Yellow = minor / trace / isolated small liquefaction areas



2004 Liquefaction Hazard Map

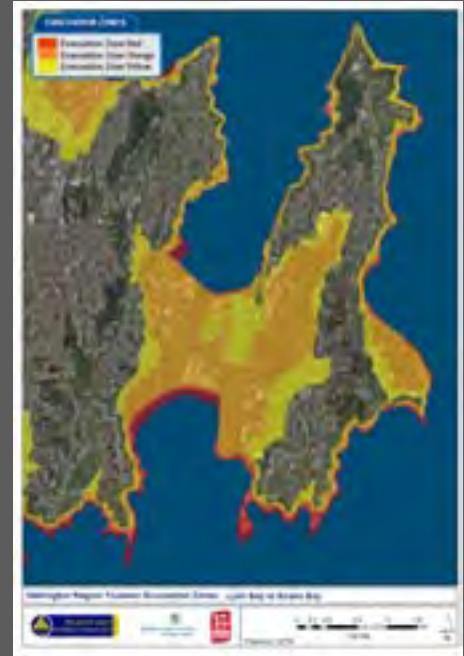


# Wellington - Liquefaction Susceptibility



# Earthquakes & tsunami

- In a long OR strong earthquake evacuate all zones (to above the blue line where present)
- Longer than a minute, OR hard to stand up
- Don't wait for official warnings, there is no time for official warnings after a local earthquake generated tsunami
- A tsunami may arrive in as little as 5 minutes



# What will Wellington look like after a big quake?



Source: TV3 Aftershock

# Actually...that will depend on a number of things:

- Location of the quake
- Timing (today, tomorrow, twenty years from now)
- The level of priority placed on increasing resilience (buildings, infrastructure, community)
- And...importantly...YOU!
  - Emergency Preparedness
  - Drop, Cover, Hold
  - After a long or strong earthquake, evacuate all tsunami zones

# Conclusions

- Not all ground is created equal
- Not all buildings (*and lifelines infrastructure*) are created equal
- Risk (*damage & loss*) = Hazard × Vulnerability
- To reduce Risk, need to start focusing on:
  - Post-event functionality (not just life safety)
  - Damage control
  - Reparability
  - Preparing ourselves today
- **[www.gns.cri.nz/ItsOurFault](http://www.gns.cri.nz/ItsOurFault)**

# Wellington rocks

“Let’s talk about Earthquakes”

Neville Brown,  
Manager  
Earthquake Resilience



People are evacuated from a damaged building after an earthquake in Christchurch, New Zealand, in this February 22, 2011, image taken from video footage.



**BREAKING NEWS**

Mass fatalities, devastation in NZ city of Christchurch after 6.3 magnitude quake

7  
NEWS



Absolutely

**POSITIVELY**

We Are Wellington  
Wellington City Council

# Terrible

Absolutely  
**POSITIVELY**  
We Are All Positively  
Wellington City Council Wellington

Terrible      Remarkable



2 92%

Absolutely  
**POSITIVELY**  
We Are All Power  
Wellington City Council  
**Wellington**

480      37,000

Any cause: 1 in 1

Heart disease: 1 in 6

Cancer: 1 in 7

Stroke: 1 in 29

Motor vehicle: 1 in 96

Intentional self harm: 1 in 109

Air or space transport: 1 in 7,176

Earthquake: 1 in 97,807



# Wellington's history

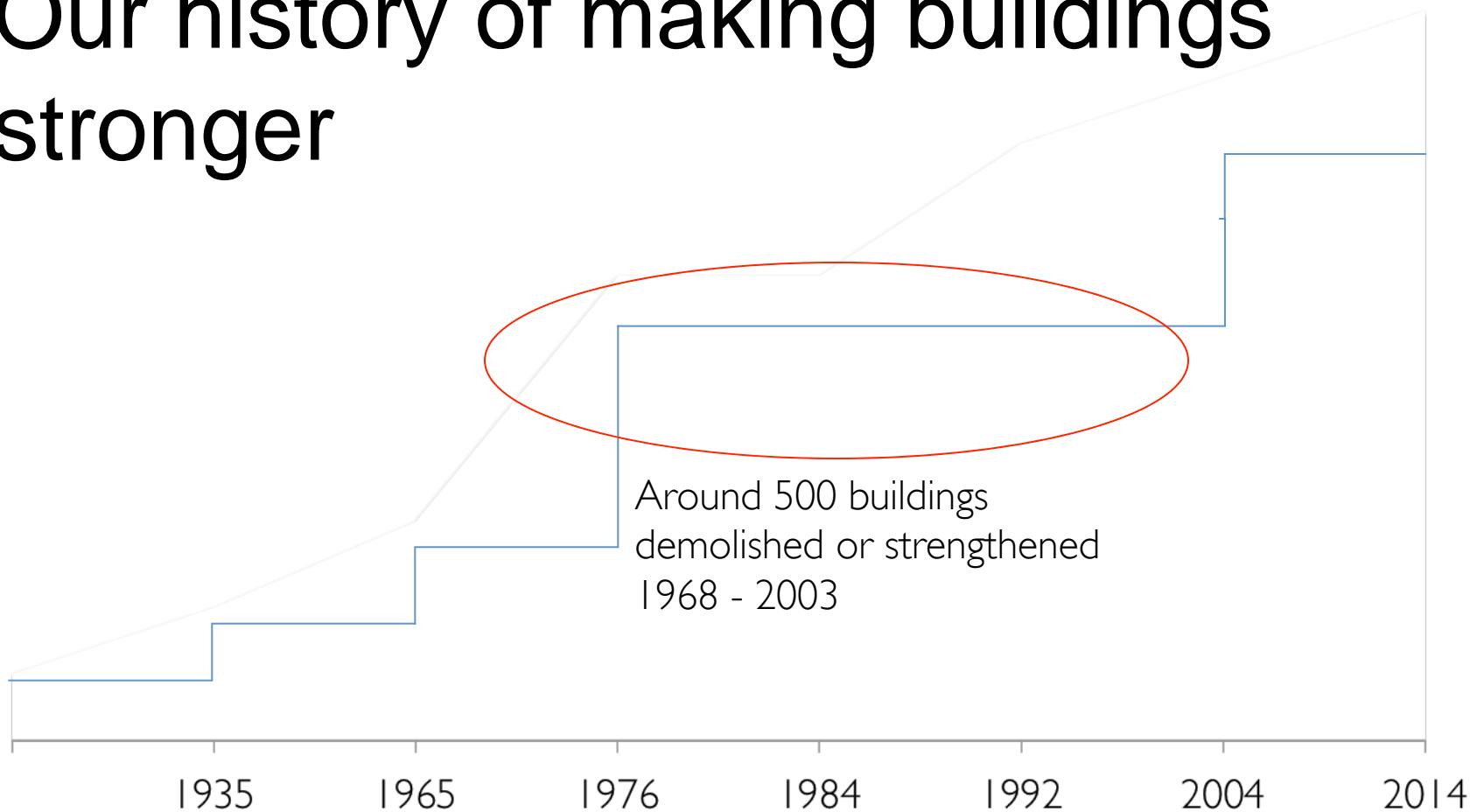


# Resilience is not a new concept here

- We've had 4 significant earthquakes since 1840, including an 8.2 magnitude centred at Palliser Bay
- As a city we learnt from the experience and rebuilt with more resilient material. Because of this fatalities have been low – 3 in the first 1848 earthquake, and 2 deaths in 3 later earthquakes



# Our history of making buildings stronger



# Demolition and strengthening of buildings



Absolutely  
**POSITIVELY**  
My Home is Positive  
WELLINGTON CITY COUNCIL Wellington

# Wellington Seismic Standards

- Buildings must be built to different standards according to their seismic zone. In Wellington, since 1965 buildings have to be more resilient than buildings in other New Zealand cities.
- Today, seismic loadings for new buildings in Wellington must be **one third higher** than the standard for buildings in Christchurch and **three times** the standard for buildings in Auckland.
- That doesn't necessarily mean Wellington buildings cost a lot more, but it does mean they have to be designed differently, to perform better.





An Auckland shoe



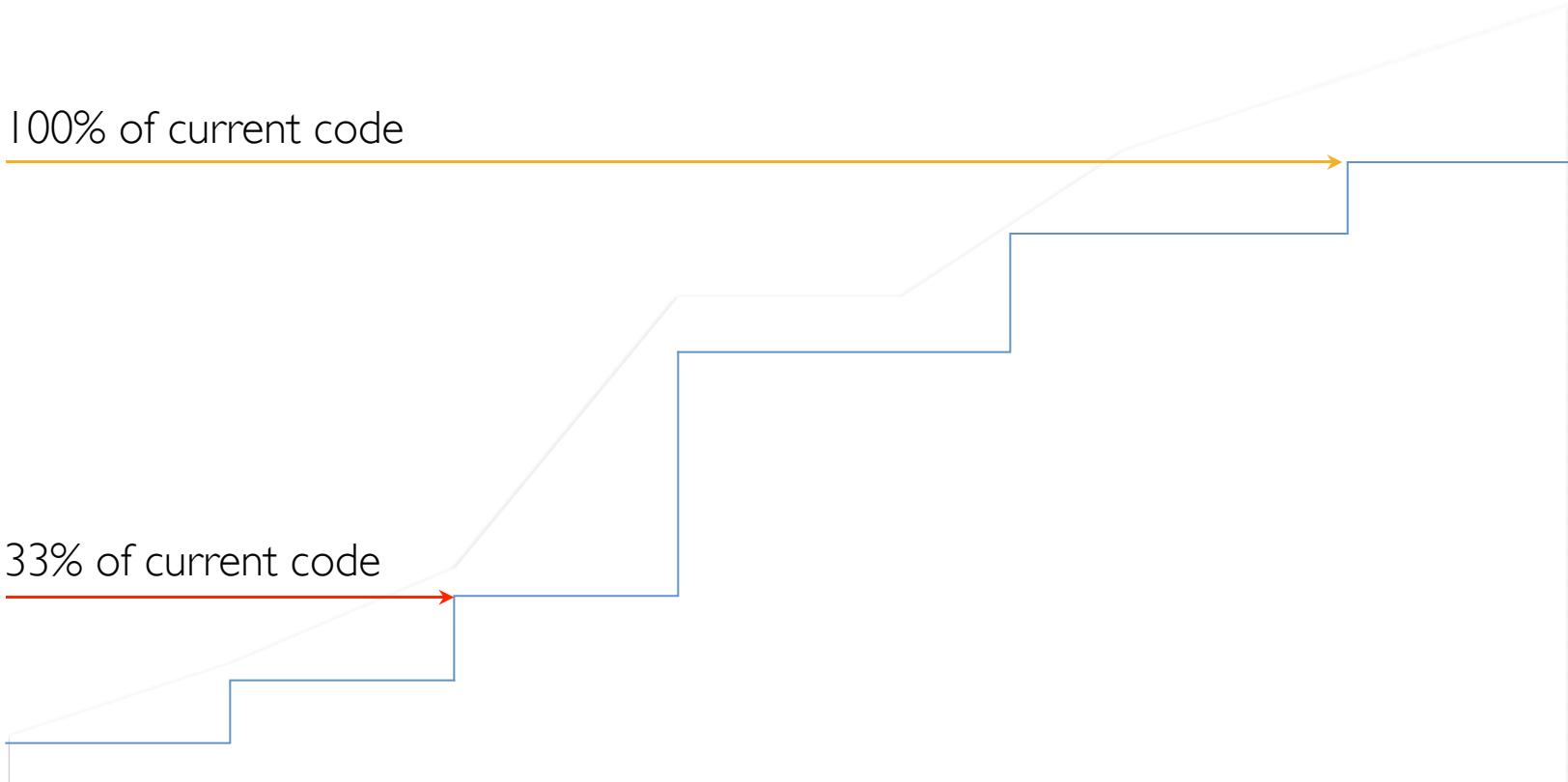
A Wellington shoe

Absolutely  
**POSITIVELY**  
My Best Ki Pōtatau  
WELLINGTON CITY COUNCIL  
**Wellington**



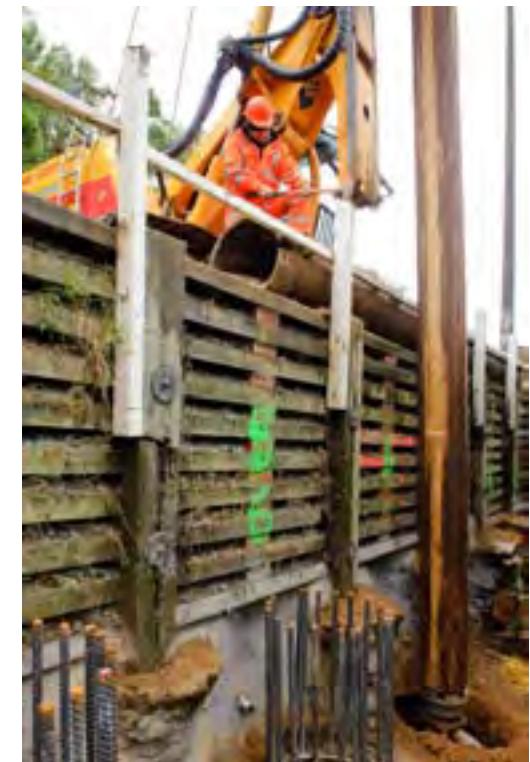
Absolutely  
**POSITIVELY**  
We work as partners  
Wellington City Council  
**Wellington**

# Our Earthquake Prone Buildings Policy



# Our history of making our city safer

- **1990s** strengthening of our water network begins
- **2000s** strengthening of the water networks continues along with roads.
- **2005** Wellington Region Civil Defence Emergency Management Group Plan adopted
- **2010** Wellington Earthquake National Initial Response Plan adopted



# Our future priorities

# Resilient city

- City resilience a top priority for the next decade - \$49 million committed to strengthening buildings and \$31m to infrastructure over next decade
- Earthquake resilience team within Council
- Working in partnership with a range of other organisations on projects - example Cuba Street project with Victoria University
- Advice to government and involvement in government policy formulation



# Resilient buildings

## Council buildings

- Strengthening building programme in place

## Citywide building assessments

### (Commercial and Apartment complexes)

- All buildings assessed by mid 2014
- High priority buildings strengthened by 2025, other buildings by 2035
- District Plan review of high risk building features and heritage items



# Resilient buildings

## Assist building owners

- Financing opportunities for building owners with banks
- Tax treatment of earthquake strengthening
- Heritage grants
- Education and information for all ratepayers, and building owners
- New Insurance product.



# Resilient residences



Earthquake strengthen  
**YOUR HOUSE**

Ways to make your house better  
cope with earthquakes

Absolutely  
**POSITIVELY**  
No Body or Place  
Wellington City Council

- Have developed with BRANZ a residential guide for homeowners
- Master Builders Federation & Certified Builders Association home assessment service

Absolutely  
**POSITIVELY**  
No Body or Place  
Wellington City Council

# Resilient infrastructure

- Tunnel strengthening (Karori, Seatoun, Northland and Hataitai bus tunnel)
- Roads, retaining walls and bridge strengthening
- Regional assessment of roading network availability and alternative routes to be completed in 2012

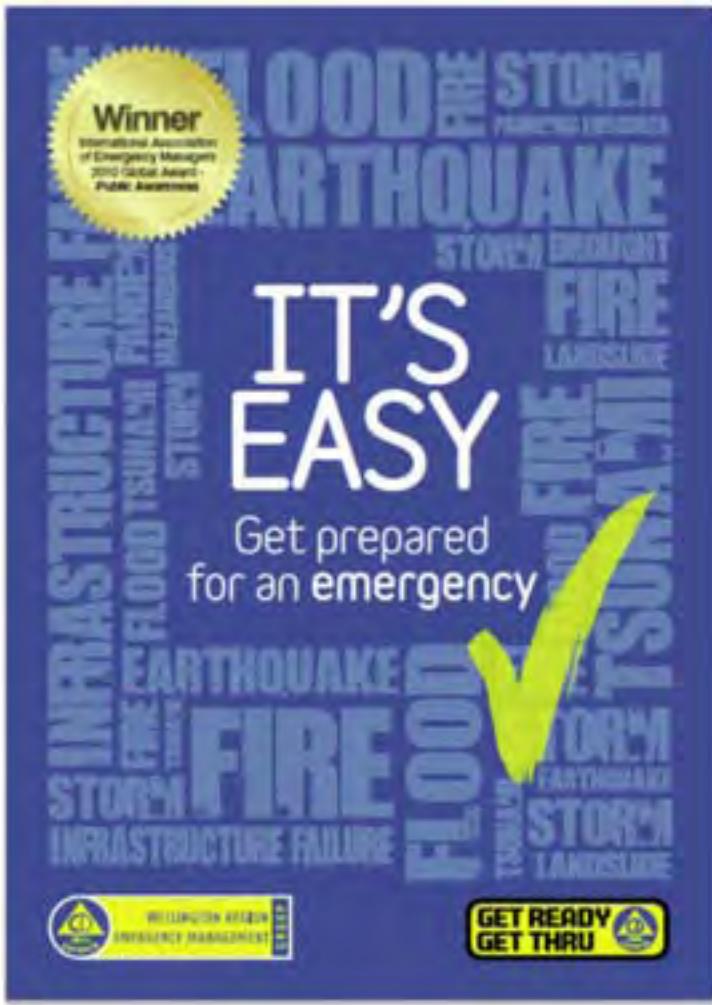


# Resilient infrastructure

- Water – strengthening reservoirs and installing shut off valves
- New central city reservoir to also provide water for hospital in case of an emergency
- Mapped route for temporary power supply and will begin installing concrete plinths so temporary power poles can be installed quickly.



# Resilient people 12 easy steps to preparedness



This is a  
Conversation document  
Household emergency plan  
Survival items  
Know your neighbours



# Resilient People

On the day – be prepared with a

Work through the booklet to complete the steps below.

## HOUSEHOLD EMERGENCY PLAN

- 1 Know your risks**  
 I am aware of the hazards in my area that can affect me and my family.
- 2 Meeting places**  
If we can't get home or contact each other we will meet at:  
  
at:  
  
Our primary contact is:  
Name:  
Address:  
Phone:
- 3 Collecting children**  
The person responsible for picking up the children is:  
Name:  
Contact details:  
Name (back-up):  
Contact details:
- 4 Location of utilities**  
 I know the location and how to turn off our utilities.  
Water:  
Power:  
Gas:
- 5 Evacuation routes**  
 I am familiar with the local evacuation routes.
- 6 Information sources**  
Council Phone Number:  
Council Web Address:  
Radio Station Frequency:
- 7 Warning systems**  
 I am familiar with the local warning systems.
- 8 Civil defence centres**  
I know where my local Civil Defence Centres are:  
Reserve to home:  
Reserve to work:
- 9 My neighbours**  
Neighbours that may need my help or can help us are:  
Name:  
Address:  
Phone:  
Name:  
Address:  
Phone:
- 10 Storing water**  
 I have stored at least 3 litres per person per day for at least 3 days.  
 I have also stored additional water for cooking and hygiene.
- 11 Survival items**  
 I have located all my essential survival items.
- 12 Getaway kits**  
 I have considered having Getaway Kits at work, in the car and in a bag at home in case we need to evacuate.

**RESCUE ME! EMERGENCY PREPAREDNESS**

## Household Emergency Plan

- Identified meeting place
- Alternate plans to collect children
- Know how to turn off utilities
- Know evacuation routes
- Know information sources
- Know where your local CDC is
- Emergency items, list in brochure.

# Resilient people

Wellington City Council has a plan that will support the wellbeing of the people in an emergency - the city's welfare plan

However ensuring the wellbeing of people in an emergency is more than a response on the day-

It is about being prepared through

- individual preparedness
- connected local neighbourhoods



# Resilient neighbourhoods

## Know your neighbours

- Relationships matter and are an important resource in an emergency
- Neighbours have valuable skills sets and materials
- Meet the people who might need extra assistance
- Find ways to strengthen networks in on your street
- Consider developing a Neighbourhood Support Group



Emergency Txt Alerts  
For Vodafone & Telecom mobiles\*  
txt

“follow WREMOalert”

to

8987

If you receive an alert, forward it  
to everyone you know!

\*Not available on other networks.



# Resilient neighbourhoods

## Ways to get started

- See what's in the bag along with 'It's Easy'
  - 10 steps to plan a get together and stay in touch
  - Neighbourhood Support – or your own kind of group
  - Neighbourhood register – get prepared together
- Also think about...
  - Apply for a grant for a neighbourhood project\*
  - See what's on at your local Community Centre

\*Need a legal entity to support application



# Resilient thinking



Wellington pre-schoolers get ready for Shakeout

And in all likelihood, remember,  
this would come without warning,  
out of a clear sky.

Bill Bryson



Thank you

[www.wellington.govt.nz/earthquake](http://www.wellington.govt.nz/earthquake)

neville.brown@wcc.govt.nz

