

# Built environment seismic resilience research

Liam Wotherspoon (UoA) on behalf of a wider research team

**Wellington Earthquake Resilience Collaboratory**

**30 November 2023**

# Acknowledgements

- Contribution from a wide range of institutions
- We acknowledge the range of stakeholders partners involved across these projects

RESILIENCE  
TO NATURE'S  
CHALLENGES

Kia manawaroa  
– Ngā Ākina o  
Te Ao Tūroa

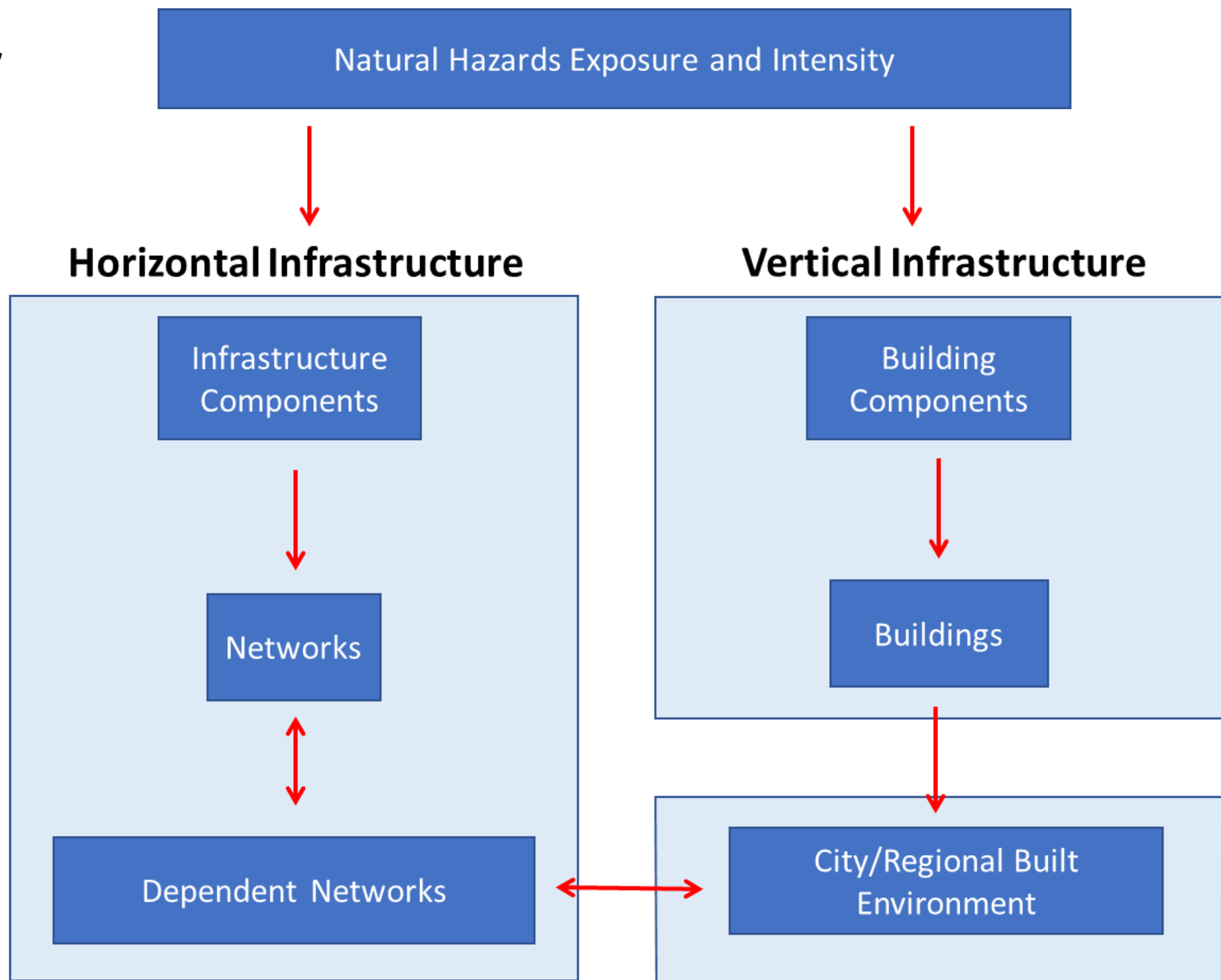
National  
**SCIENCE**  
Challenges



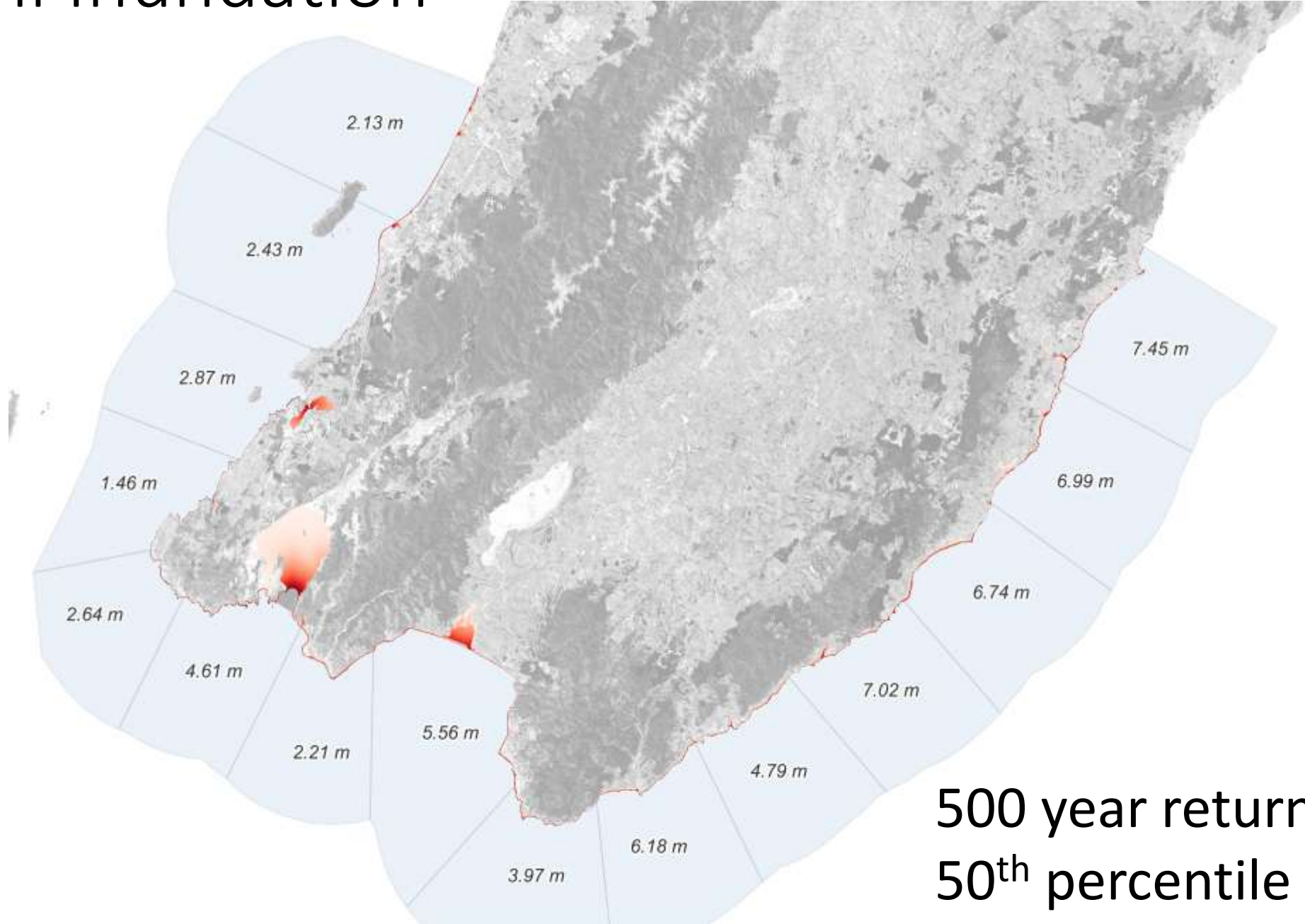
Quake**CoRE**  
NZ Centre for Earthquake Resilience  
*Te Hiranga Rū*

Toka  
Tū Ake **EQC**

# Overview



# Tsunami Inundation



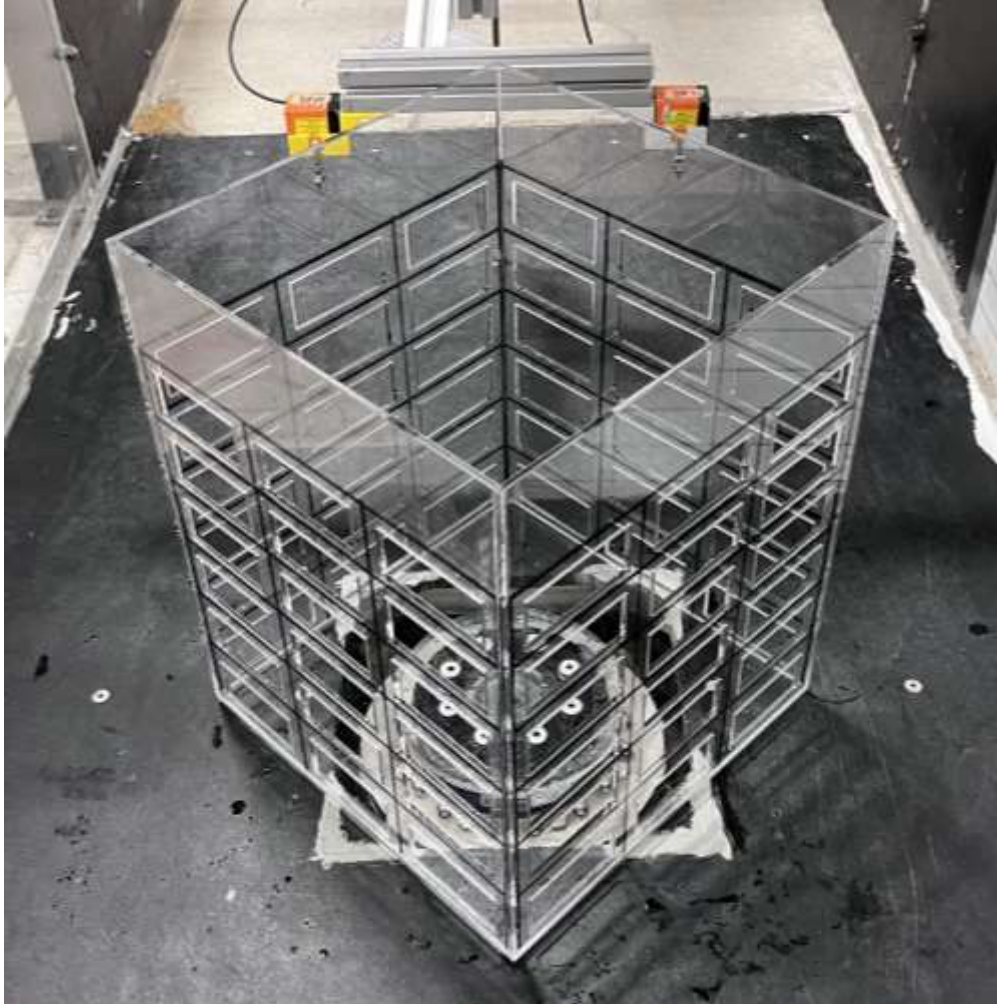
500 year return period  
50<sup>th</sup> percentile

# Vertical Infrastructure - Buildings

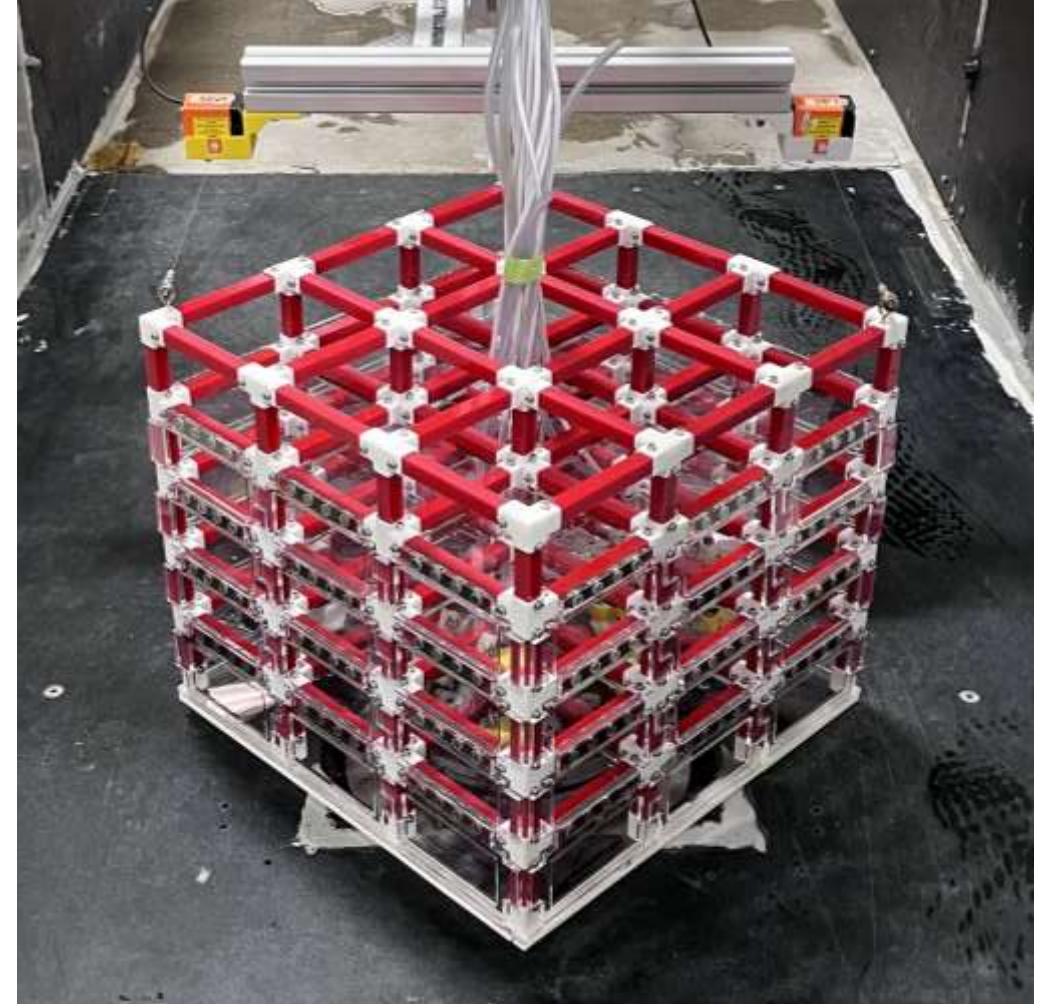


# Tsunami Loading

**RIGID**



**FLEXIBLE**



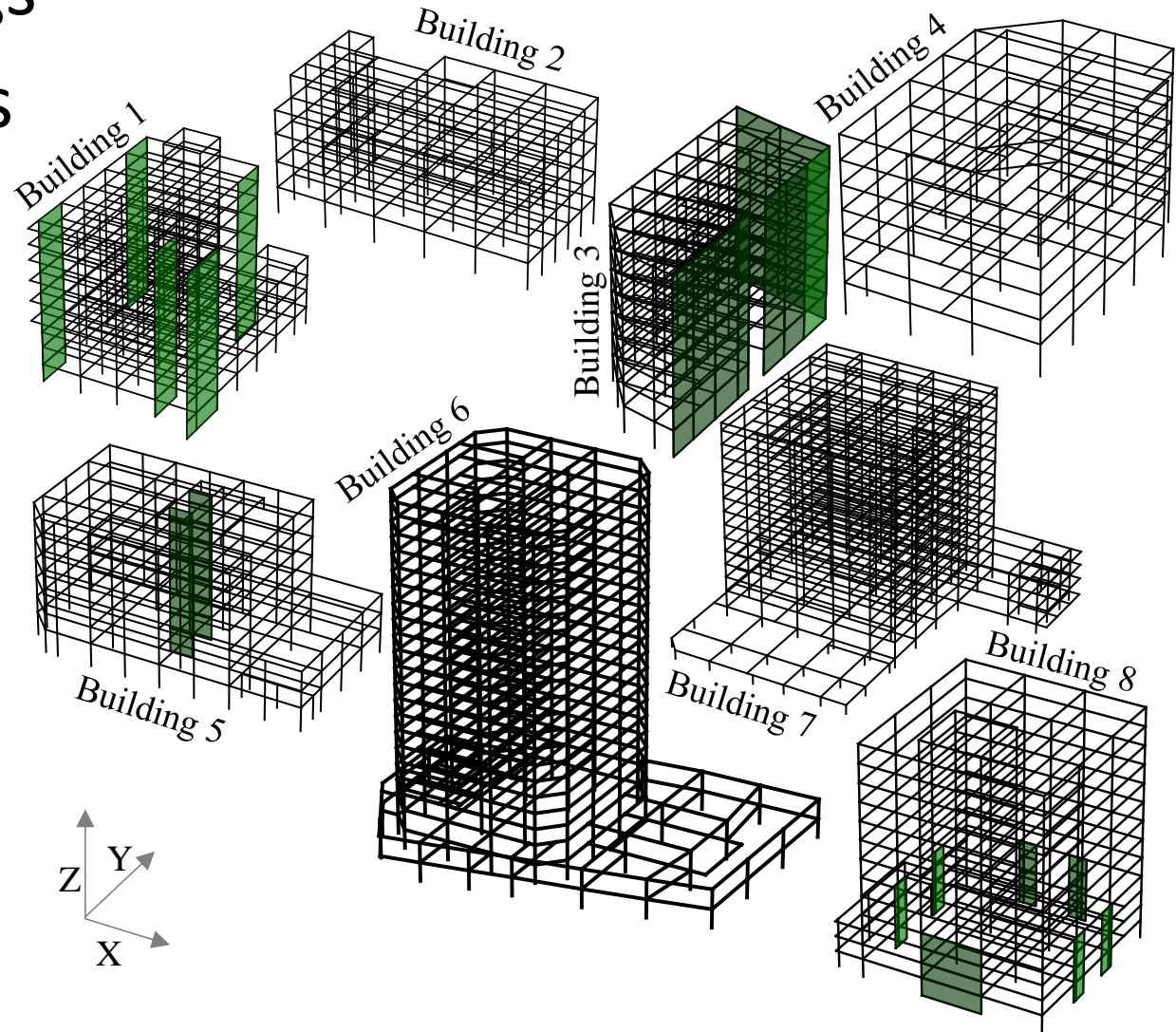
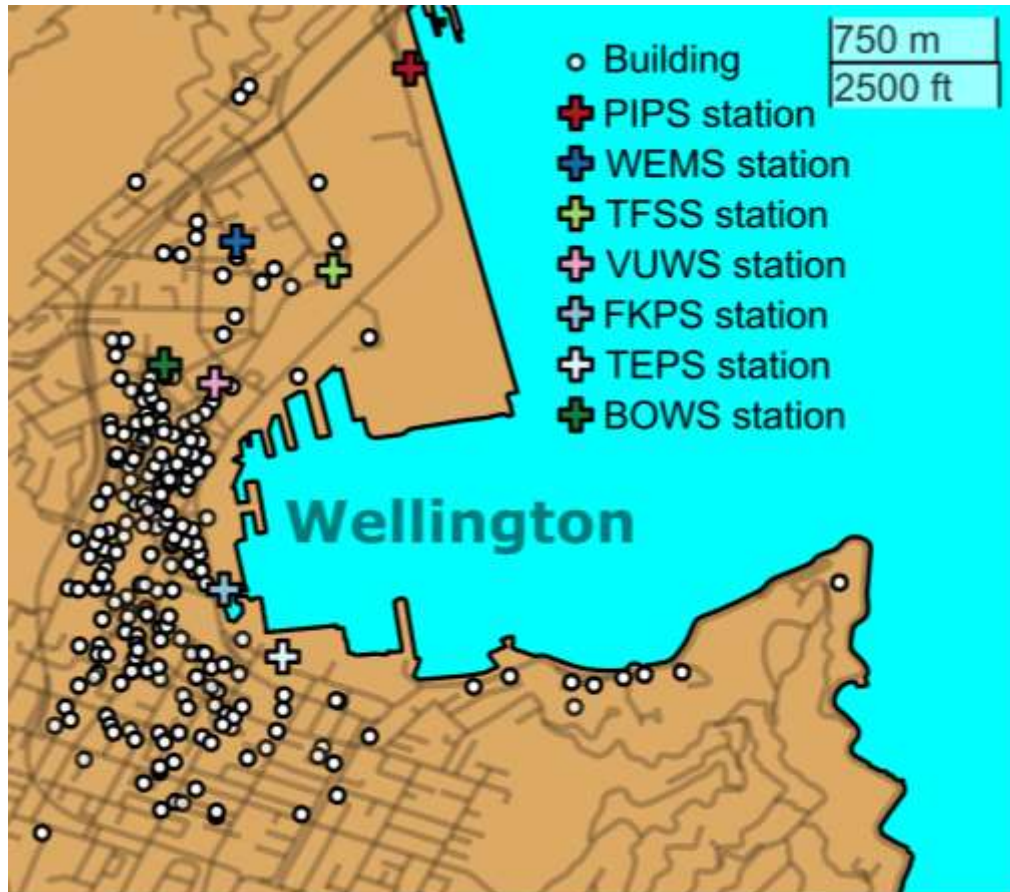
# Tsunami Loading





# Wellington Building Seismic Performance

- Inventory: ~800 5+ storey buildings
- Models developed for all buildings

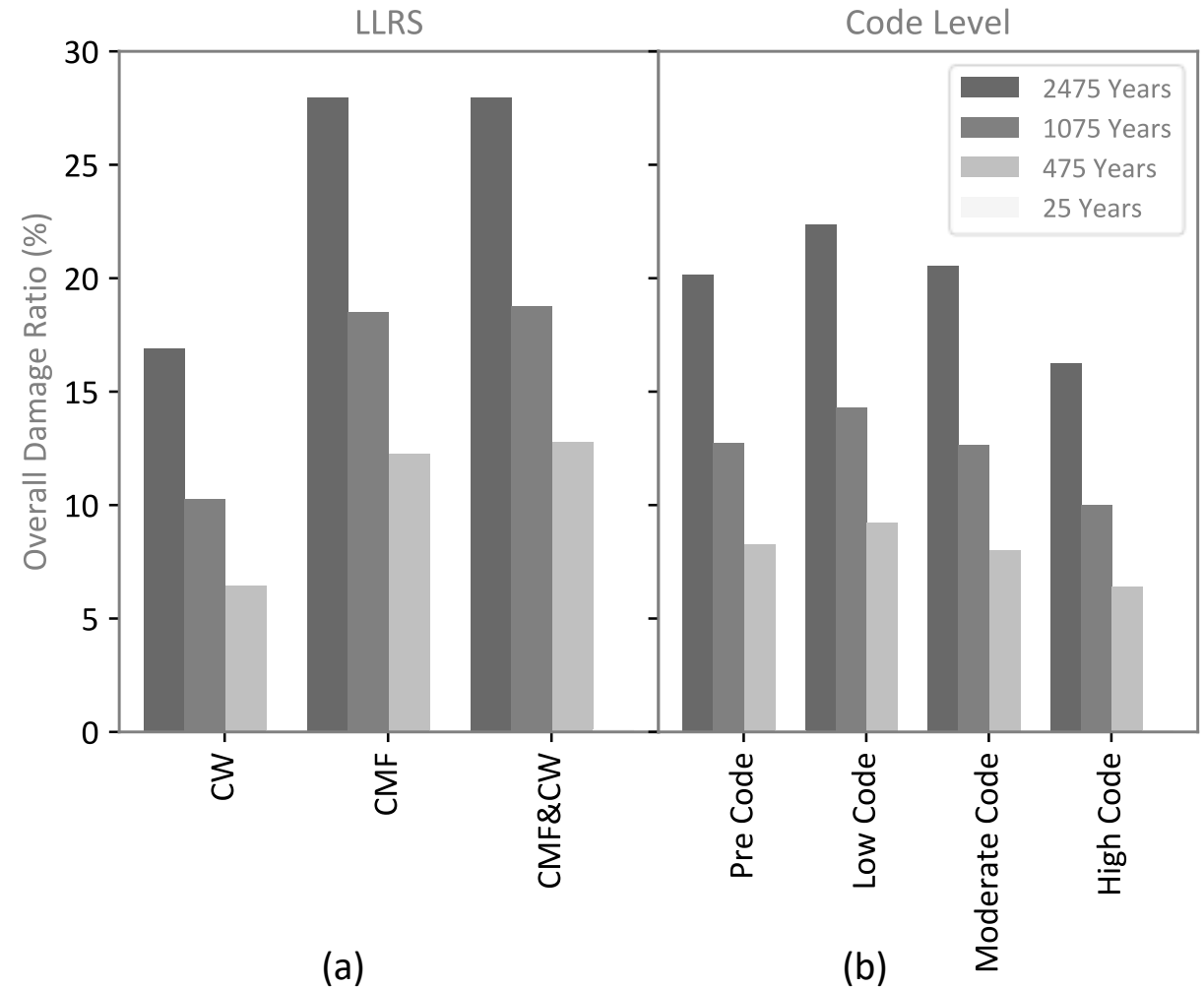




# Damage Ratio

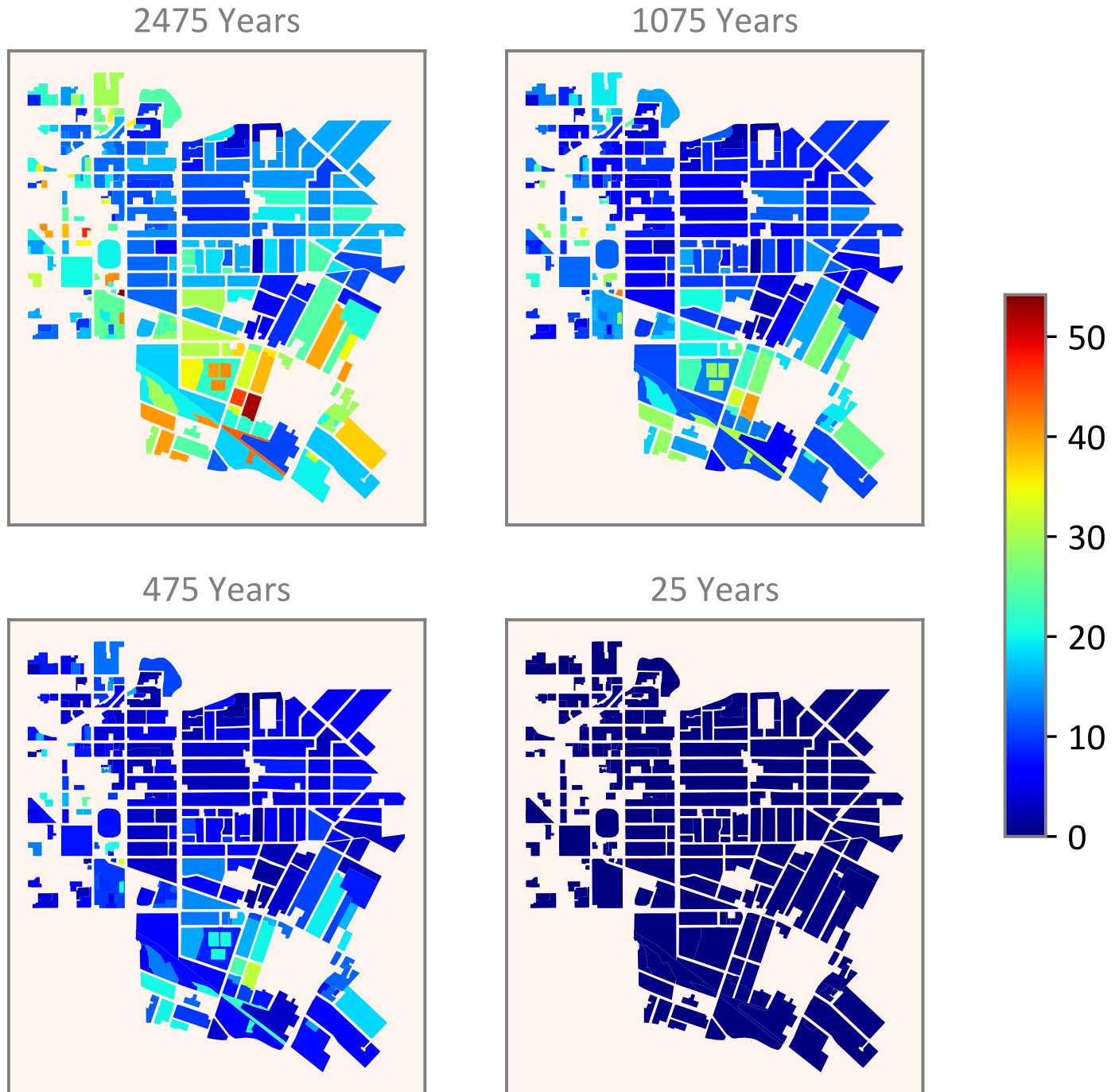
- Damage ratio indicates extent of expected damage
- Wall buildings tend to perform the best
- New buildings performed better than old buildings (probably obvious)

*Mean damage ratios based on lateral system and code of design*



# Damage Ratio

Ghasemi et al.

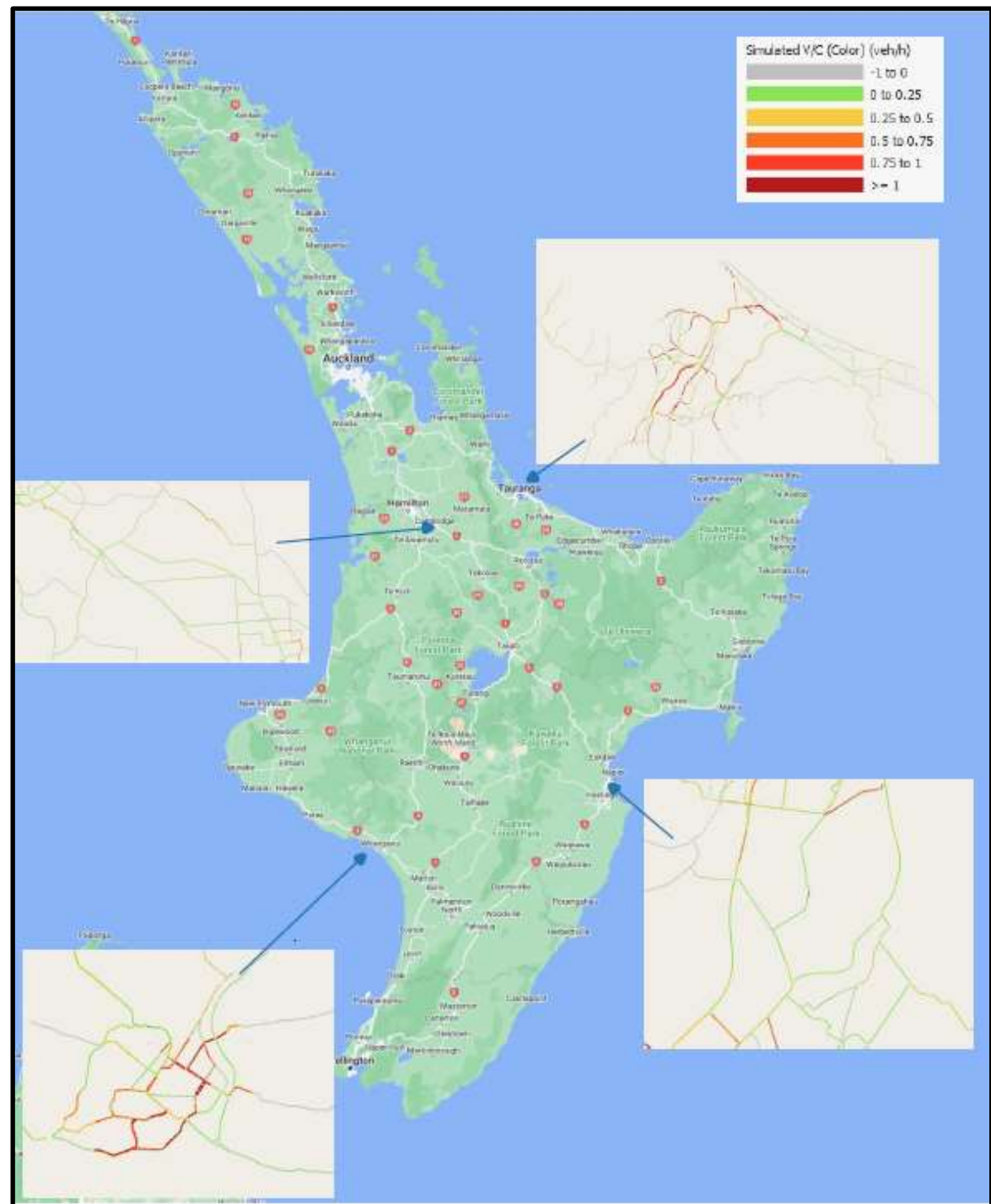


**Note:** Shake city is Wellington buildings on scrambled footprints

# Horizontal Infrastructure

# NI Transport Model

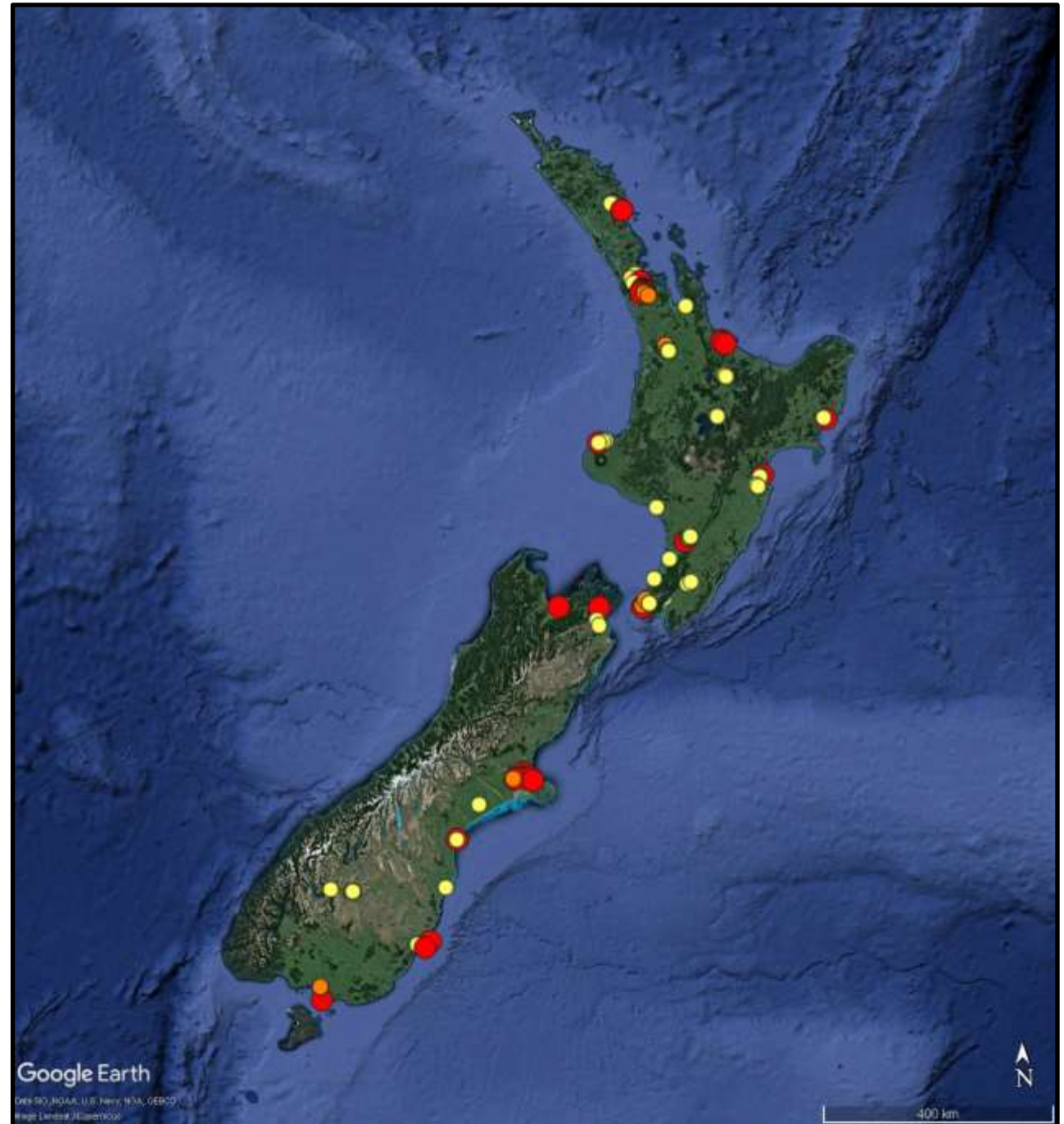
- Commuter
- Freight
- Tourists
- Disrupt with various events
- Explore network changes and interventions





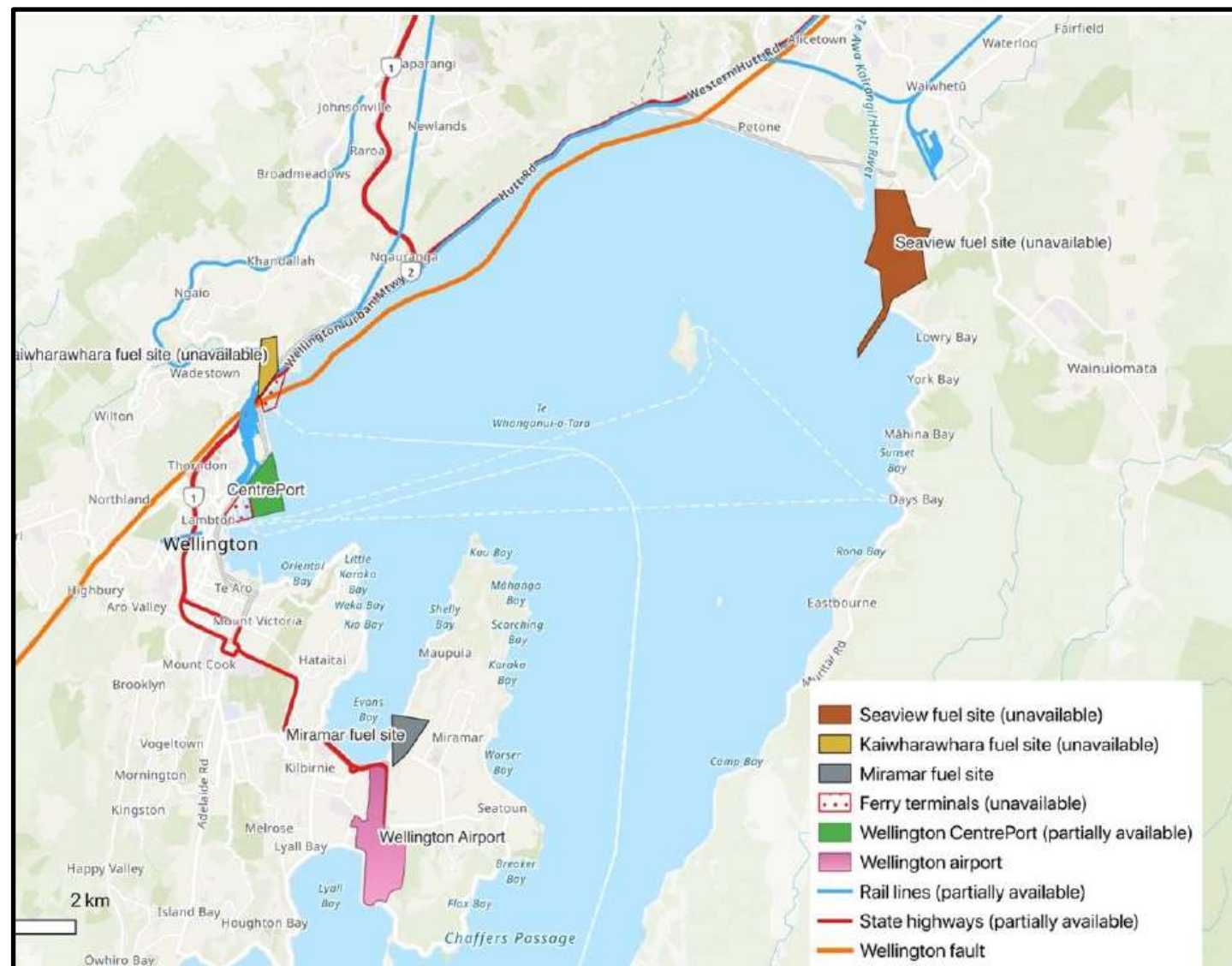
# Post-Event Logistics

- Freight transport model
  - BAU
  - Post-event disruption
- Physical system and decision making



# Cook Strait Logistics

- Mitigating bottlenecks following Cook Strait outage
  - Constraints
  - Cause and effect relationships
  - Solutions
- Interviews with 25-30 stakeholders



# Upper Hutt FMCG

Wight et al.



**Distribution Locations**

**Supermarket Locations**

**Transport Network**

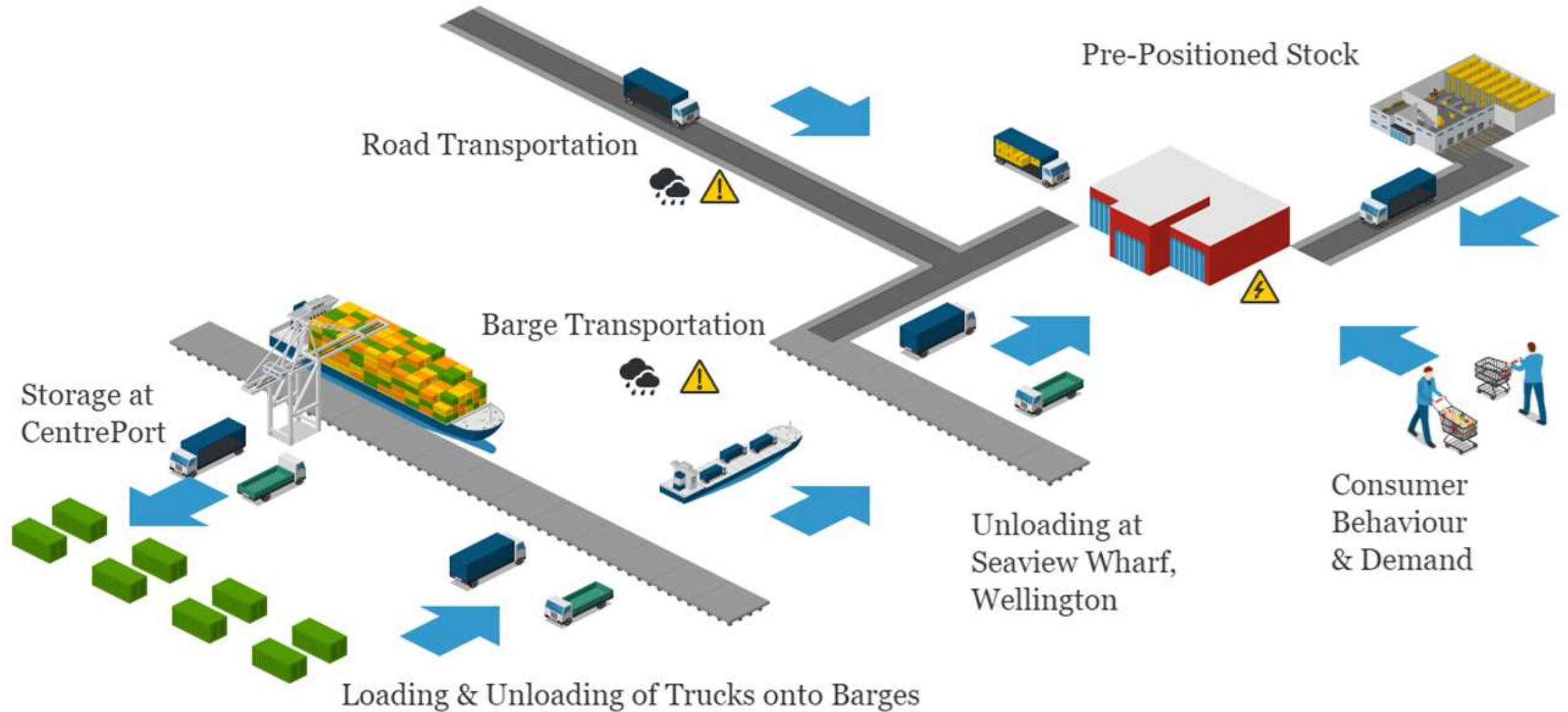
**Population Areas**

**Hazard & Weather Data**

**Recovery Estimates**



# Upper Hutt FMCG



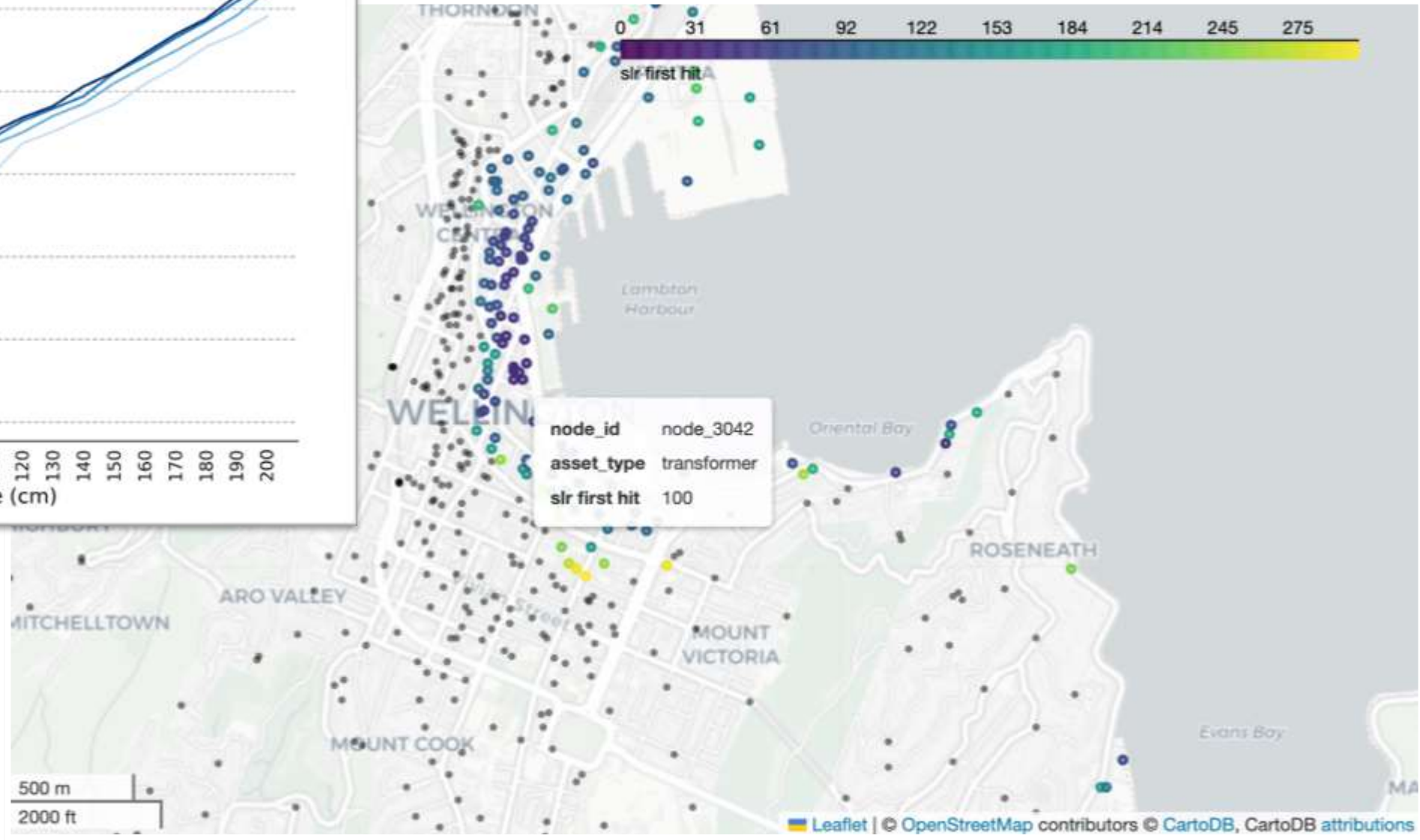
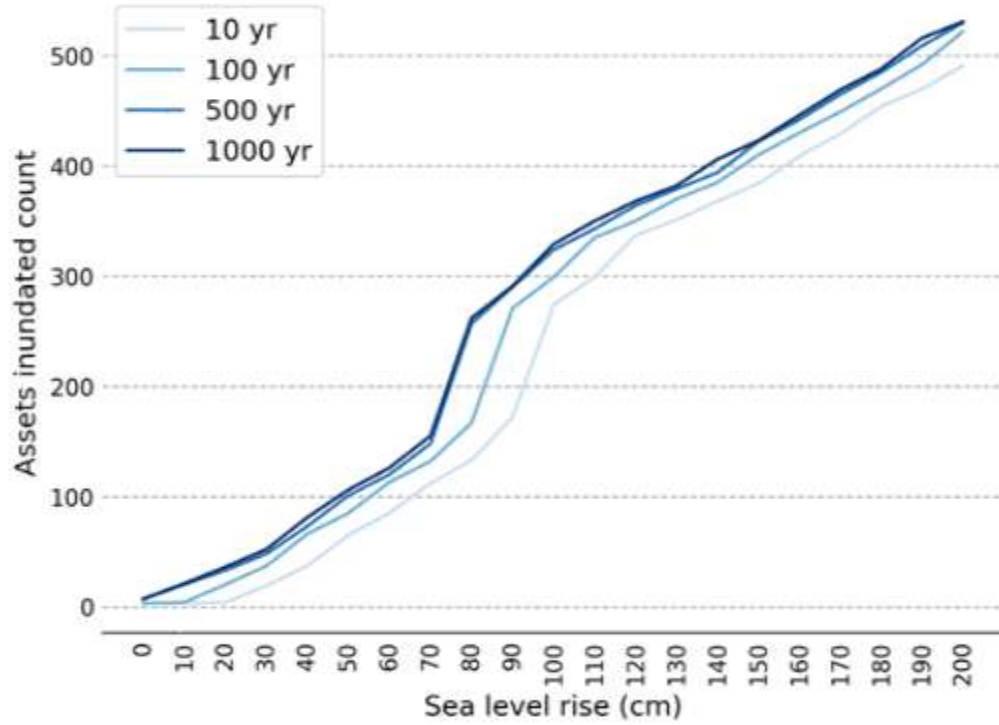


# Critical Infrastructure Dependencies



# Exposure analysis

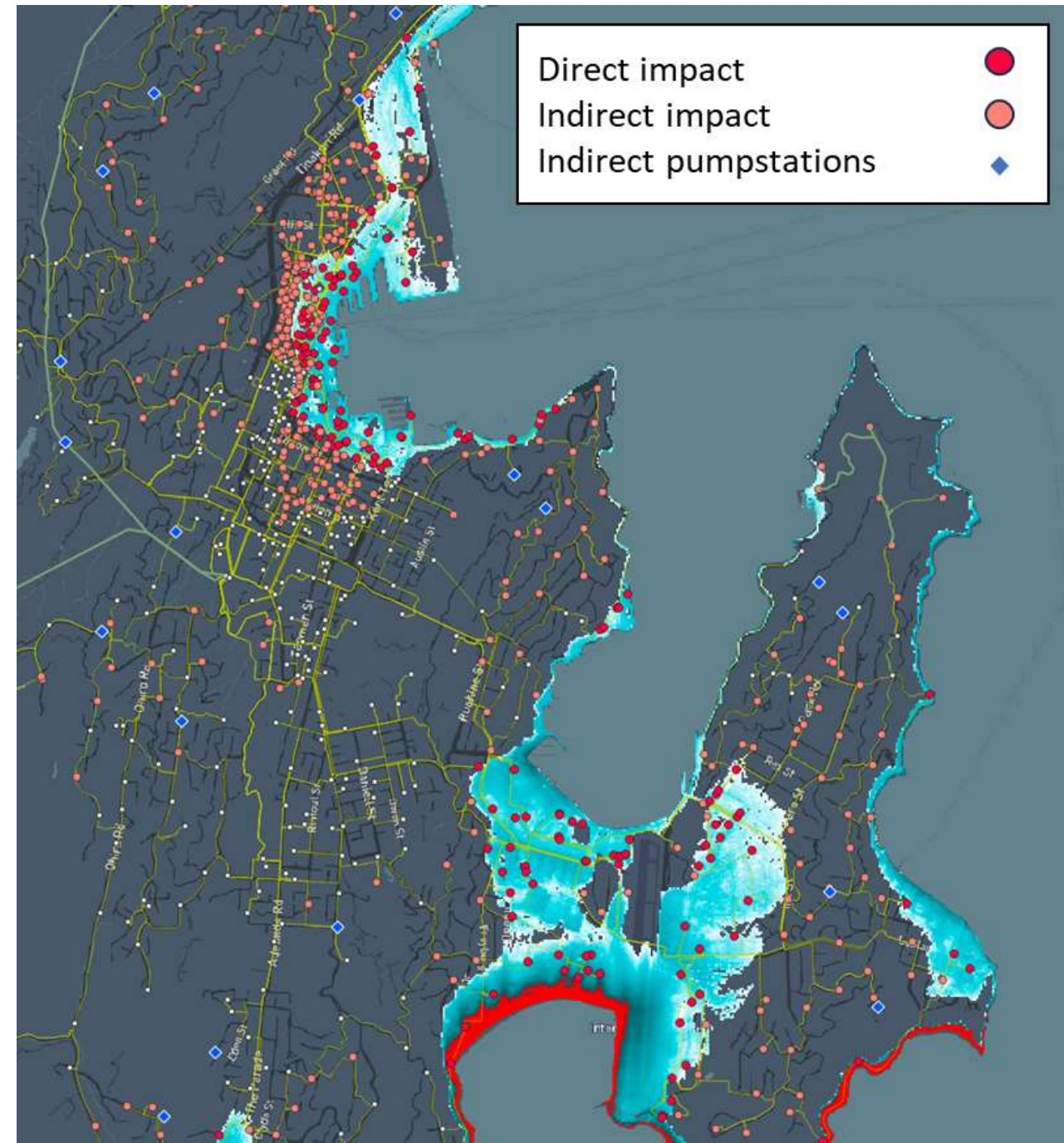
Wellington water supply and power assets - coastal inundation exposure





# Network Analysis

- Hikurangi tsunami event



# Questions?

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