# Assessing and enhancing resilience in New Zealand's wine industry


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Manaaki Whenua Landcare Research
NEW ZEALAND WINE PURE DISCOVERY
Ministry for Primary Industries Manatū Ahu Matua
THE UNIVERSITY OF AUCKLAND NEW ZEALAND
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## Outline of presentation

1 Research context, aims and objectives

2 Applied resilience science

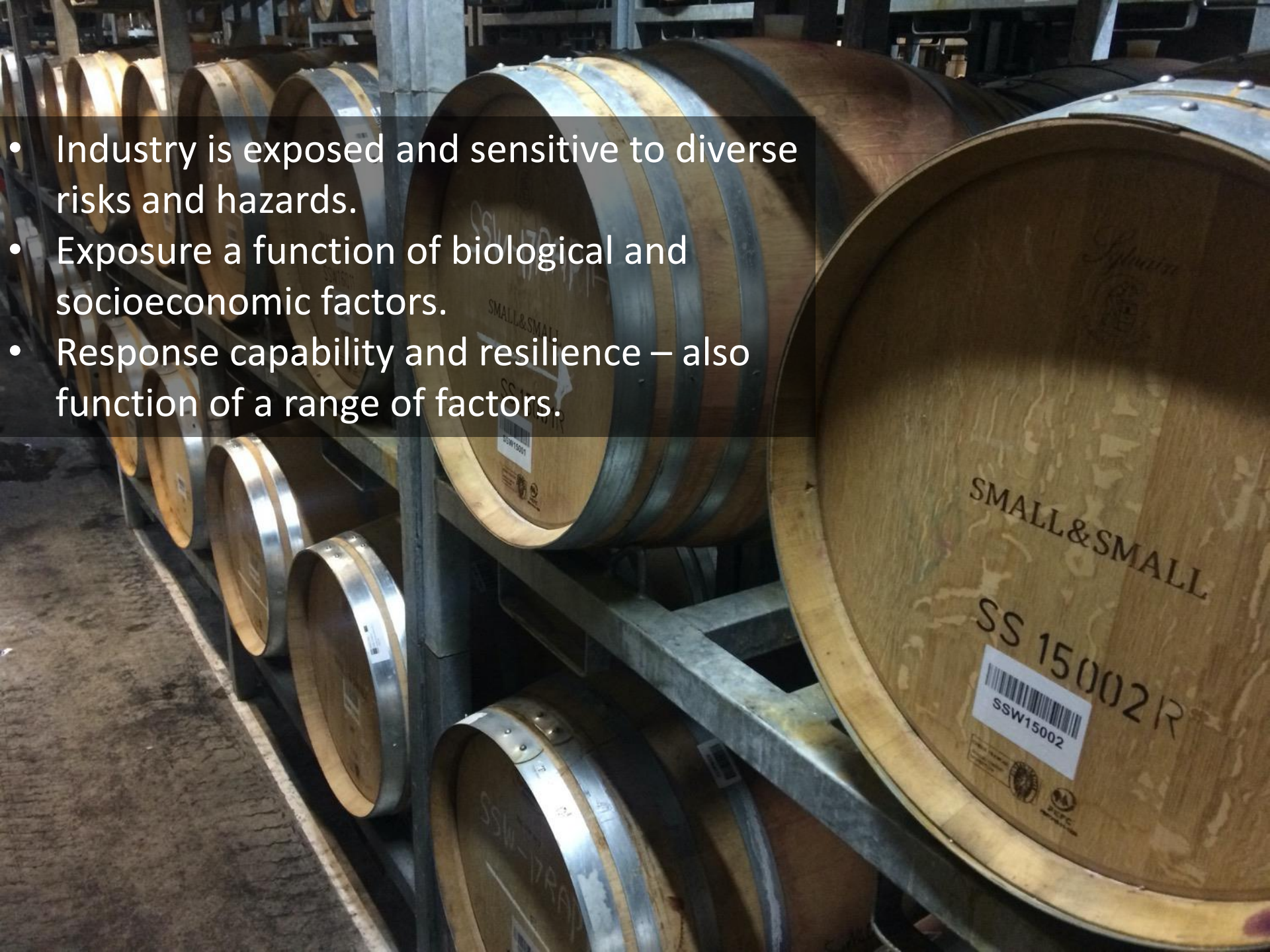
3 Engineering impacts and implications

4 Socio-economic impacts and implications

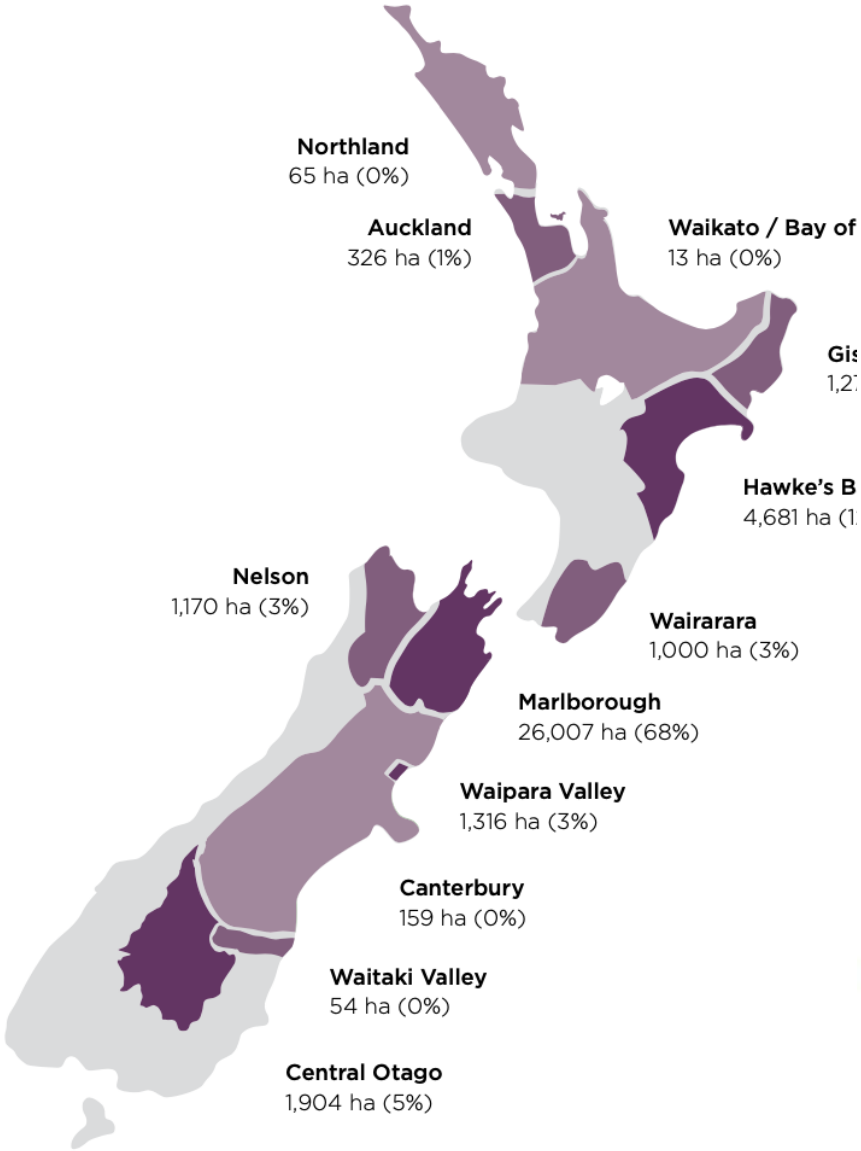
5 Conclusions

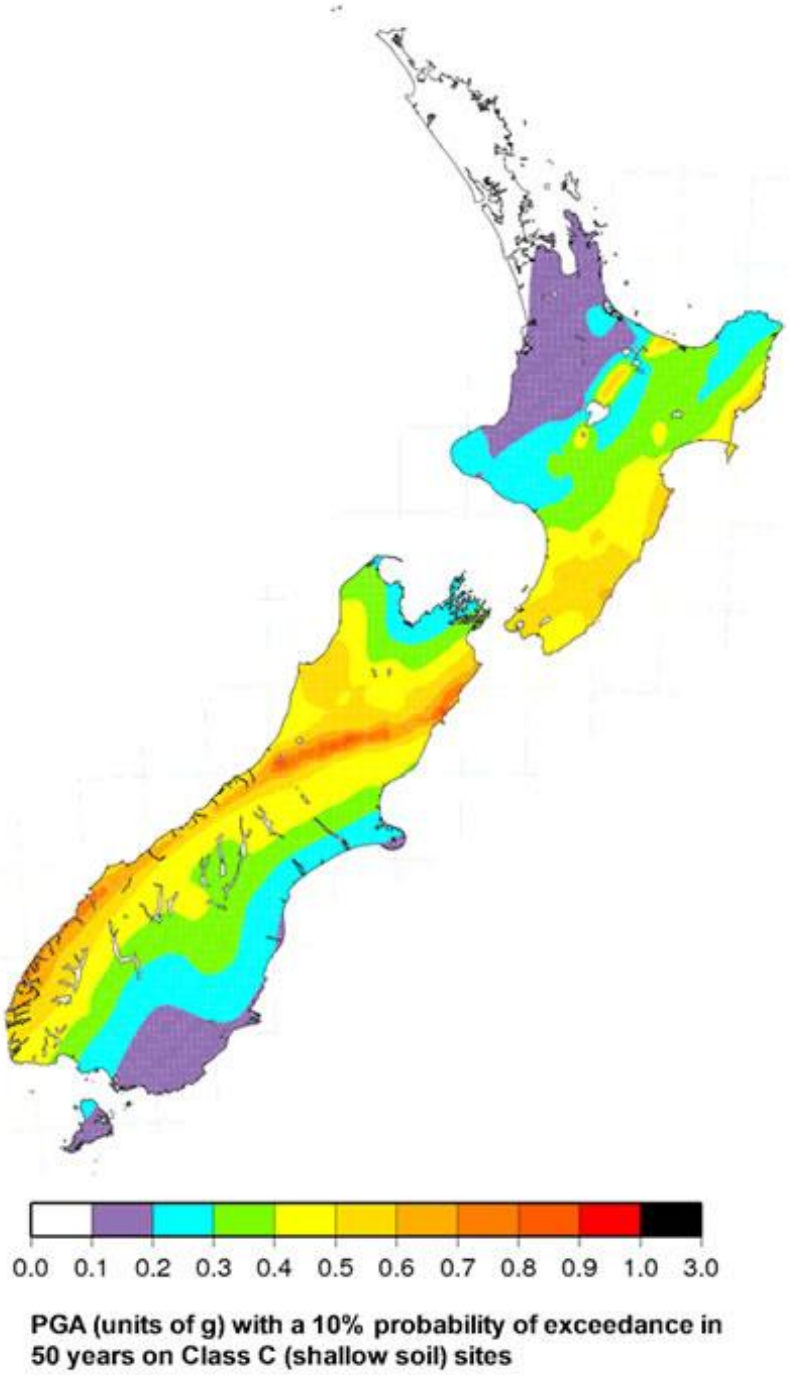
- Wine and high value horticulture fastest growing primary industry
- Wine is 5th largest export
- NZ$1.7B (2017, + 6%; 2018, 2.5%)

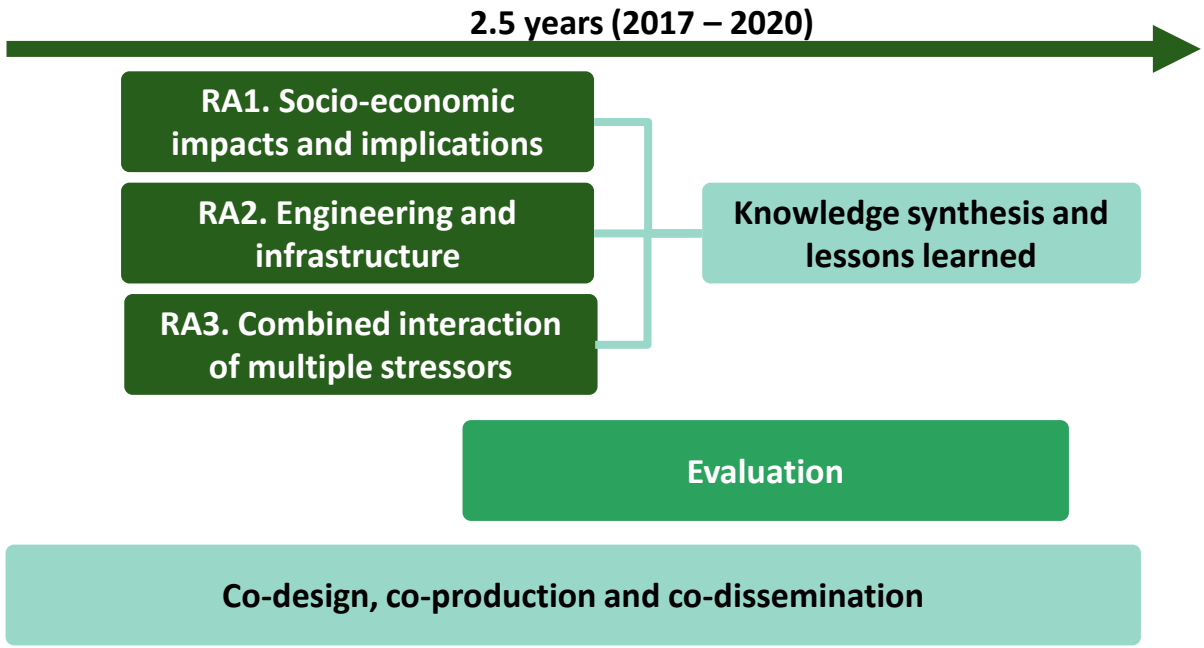
- 26,000+ ha in Marlborough (68%)




- Industry is exposed and sensitive to diverse risks and hazards.
- Exposure a function of biological and socioeconomic factors.
- Response capability and resilience – also function of a range of factors.


Northland
65 ha (0%)
Auckland
326 ha (1%)
Waikato / Bay of
13 ha (0%)
Gis
1,2
Hawke's B
4,681 ha (1
Nelson
1,170 ha (3%)
Wairarara
1,000 ha (3%)
Marlborough
26,007 ha (68%)
Waipara Valley
1,316 ha (3%)
Canterbury
159 ha (0%)
Waitaki Valley
54 ha (0%)
Central Otago
1,904 ha (5%)


0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 3.0
PGA (units of g) with a 10% probability of exceedance in 50 years on Class C (shallow soil) sites




NEW ZEALAND WINE
PURE DISCOVERY

Ministry for Primary Industries
Manatū Ahu Matua

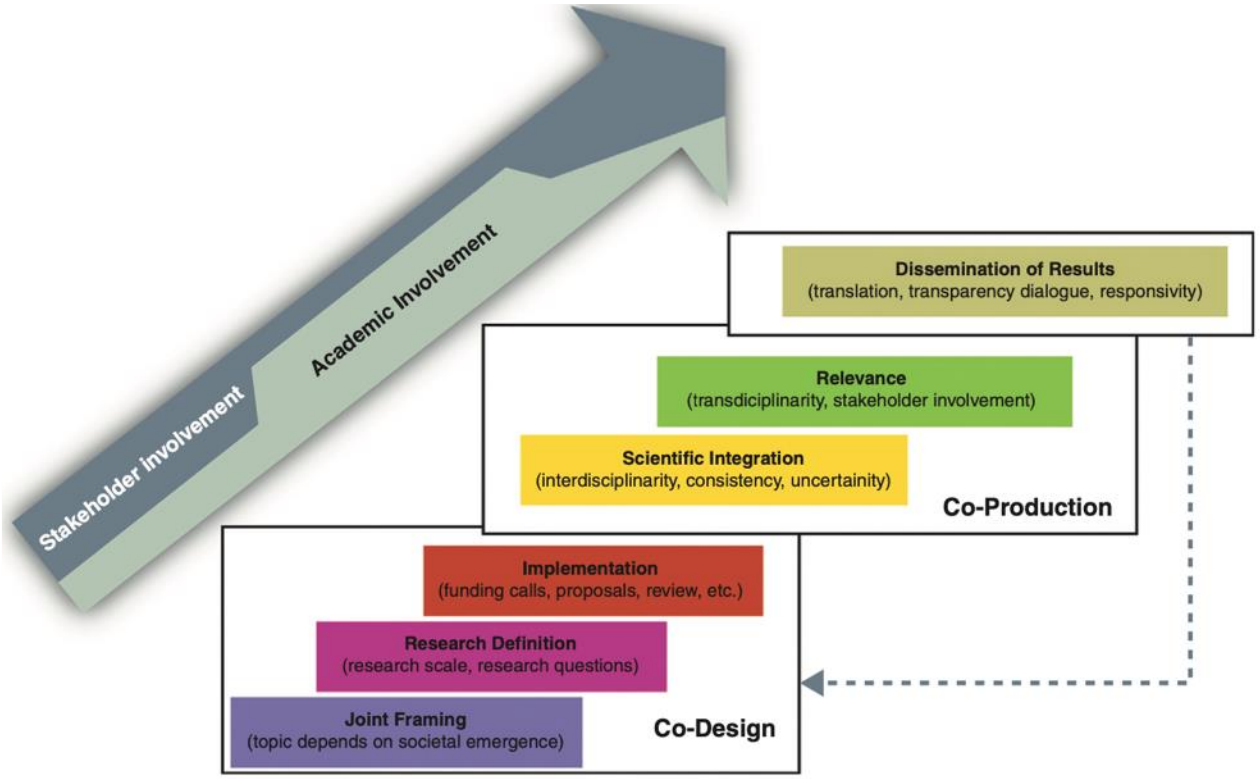
# Co-Design, Co-Production, Co-Dissemination

## Overall Aim (2017-2020)

- Document key vulnerabilities and identify resilience interventions throughout the wine value chain:
  - from vineyard and winery operations to market with whole of industry implications;
- Tools and insights will be developed, applied and shared through new and existing networks;
- Practice-oriented outputs and novel communications to enhance resilience will be distributed and provide the basis for pathways planning for resilient futures.

## Research Questions

1. What are the structural, economic and social impacts of earthquakes on wineries?
2. What are the best ways to enhance structural and social-ecological resilience in the wine industry, and how can barriers to increasing resilience be overcome?
3. How can resilience in the wine industry be developed through extended learning networks to share insights from others' experience?
4. What is the role of social networks, peer-to-peer relationships, and social capital in supporting recovery to a range of hazard events in the industry, and for preparing for the future?




NEW ZEALAND WINE
PURE DISCOVERY
structex

Marlborough Emergency Management GROUP
CIVIL DEFENCE

enterprise north canterbury

PORT NELSON

WINE MARLBOROUGH NEW ZEALAND

Thornton Tomasetti

Mauser et al. (2013)

# Co-Design, Co-Production, Co-Dissemination

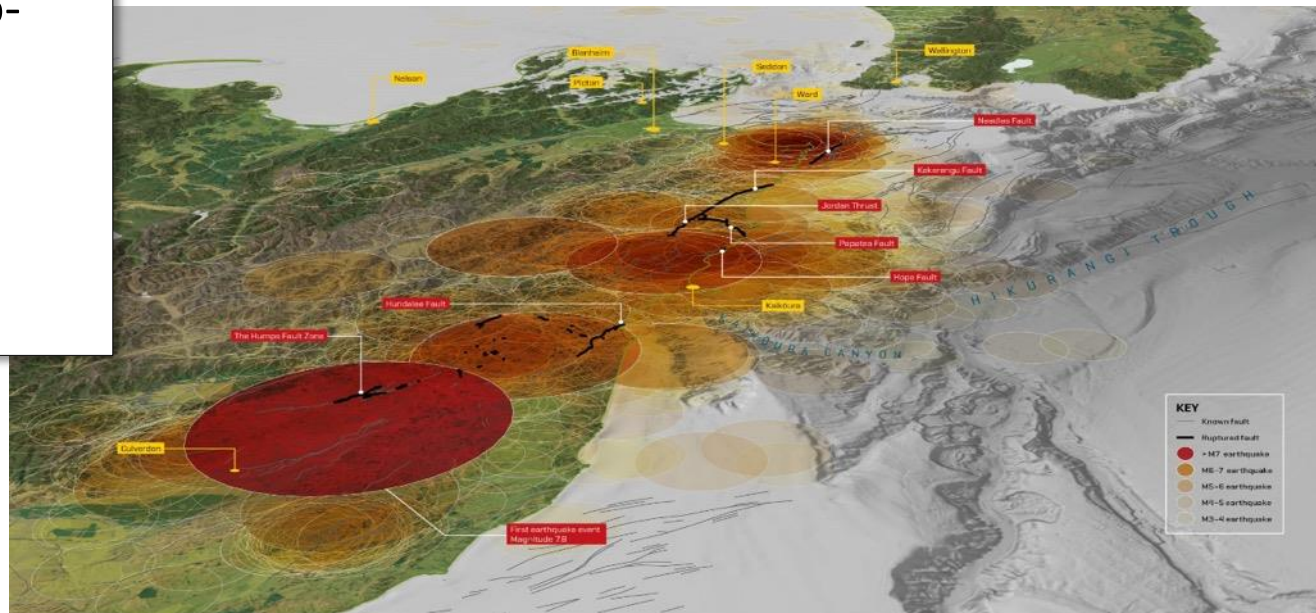
## Technical Advisory Groups (Marlborough & North Canterbury)

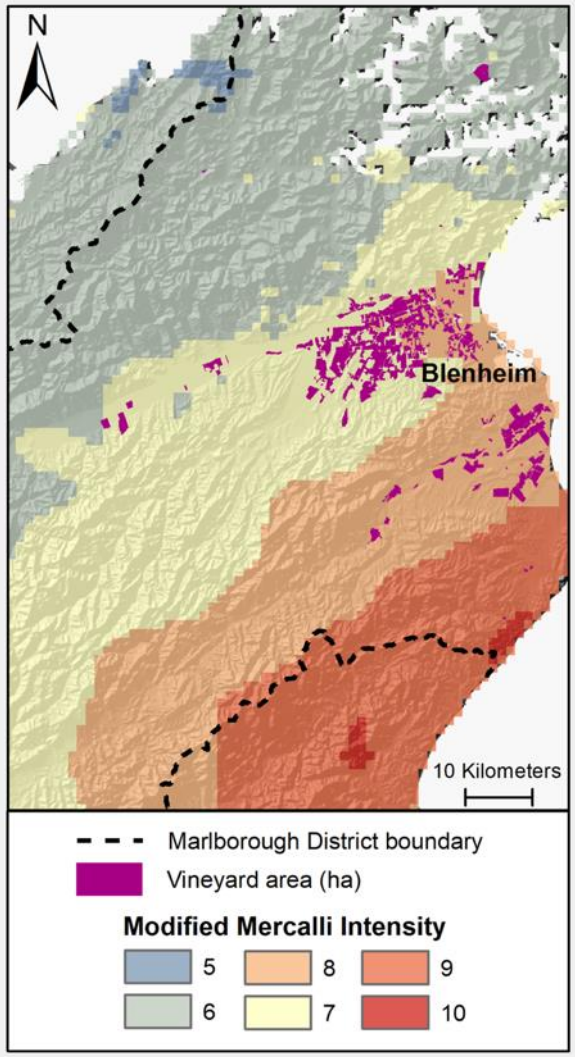
- Organized, permanent group representing a broad set of interests and perspectives.
- Meets regularly to advise the project team, share project's messages forward, and sounding board for key project concepts.
- Facilitate networking and wider engagement with stakeholders in Marlborough region.

# 14 November 2016

- Felt effects in Marlborough
- Second large event in less than 5 years
  - 2013 Seddon Earthquake
    - 6.6 $M_w$
    - $100M damages
- Six years after the 2010/11 Canterbury earthquake sequence
- Fruit harvested (February-March)
  - 2016 Vintage in tanks
  - Awaiting distribution

- 0002hrs - 7.8 $M_w$
- > 80,000-100,000 co-seismic landslides
- 21 faults ruptured
- Surface faulting
- Road, rail, port disruption






| MMI | Vineyard area (ha) | MMI Description |
|---|---|---|
| VI | 4,077 | **Strong:** Felt by all, many frightened. Heavy furniture moved; damage slight. |
| VII | 13,407 | **Very strong:** Negligible damage well-designed/built; slight to moderate ordinary structures; considerable damage in poorly built or badly designed structures.. |
| VIII | 4,767 | **Severe:** Slight damage specially designed structures; considerable in ordinary substantial buildings, partial collapse. Damage great in poorly built structures. |
| IX | 59 | **Violent:** Damage considerable specially designed structures; well-designed frame structures thrown out. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. |

# Immediate impacts

**Direct and indirect impacts**

- Wine loss
  - 5M litres (2% of total of production)
- Tank capacity
  - 60M litres of tank capacity lost at critical time
  - Corporate  vs. small producers
- Transportation and logistics
  - Port and road closures, incl. main state highway

*Barrel hall, Riverlands, Blenheim*

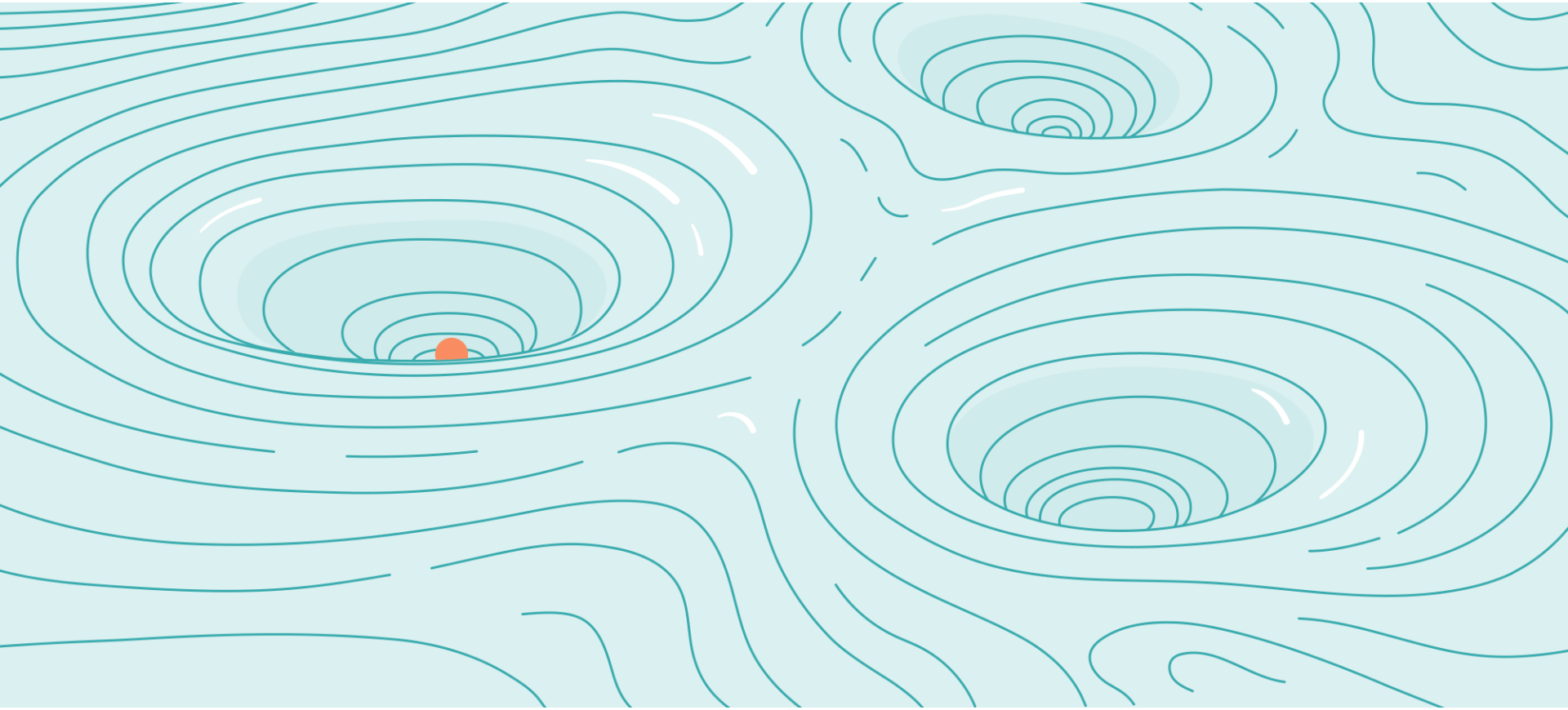
*SH1, near Ward*

# Immediate impacts

*Surface movement, Blenheim*

- Human resource capacity
  - Workforce displaced through damage to homes
  - Access issues, mental health
- Surface faulting and vineyard infrastructure
  - Trellises, irrigation and frost control, fencing

A **resilient system** is able to adapt, self-organise, learn and increase its capacity to buffer against shocks and stresses.



Increasing capability and capacity to **buffer against stressors and shocks**, avoiding **tipping points** or thresholds that move you into an undesirable state.

| Stability landscape property | Definition | Characteristics |
|---|---|---|
| Resistance | The particular set of stresses associated with direct and indirect impacts. | • Impacts on infrastructure<br>• Impacts on transportation and logistics<br>• Socio-economic impacts |
| Latitude | Opportunities for diversification and flexibility, which enable different configurations to be adopted, while preserving essential functions. | • Response and decision-making<br>• Capability and capacity<br>• Networked logistics solutions<br>• Financial services and markets |
| Precariousness | Crossing thresholds or tipping points from one stable state to another, less desirable state. | • Frequency and magnitude |

Cradock-Henry NA, Fountain J. Characterising resilience in the wine industry: insights from Marlborough, New Zealand. *Env Sci Pol*, 2019. https://doi.org/10.1016%2Fj.envsci.2019.01.015

# Engineering impacts and implications

**Mohsen Yazdanian** University of Auckland

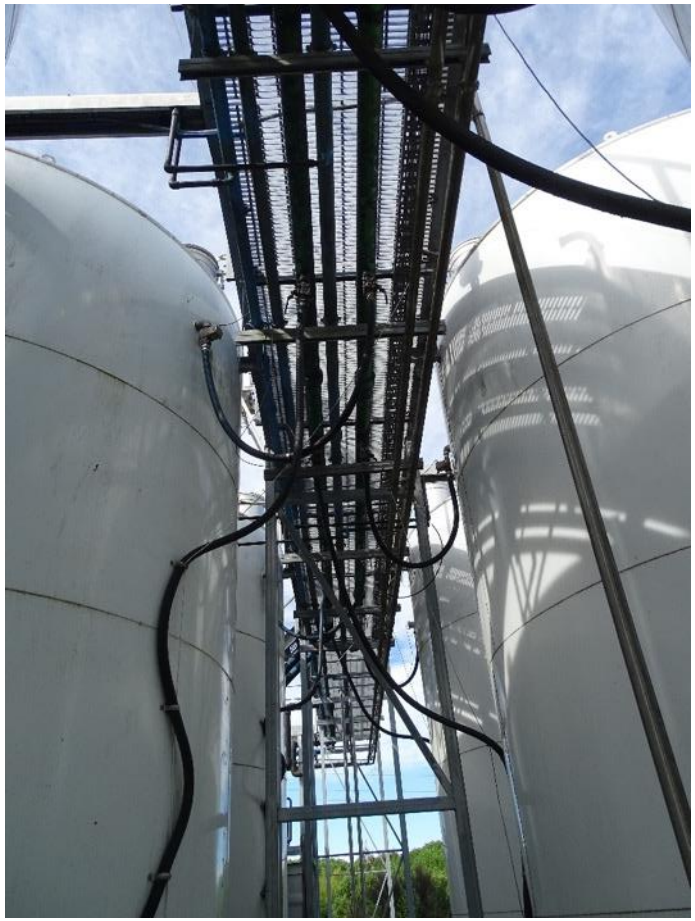
# Elements at wineries

## Buildings

## Racking system

# Elements at wineries

## Catwalks



## Wine tanks

# What are wine storage tanks?

Legged


Flat based

# Damage data collection and analysis

Damage data

- Flat-based tanks
  - 2013 EQs: 546 tanks — 73% damaged
  - 2016 EQ: 802 tanks — 69% damaged
- Legged tanks
  - 2013 EQs: 1512 tanks — 50% damaged
  - 2016 EQ: 599 tanks — 57% damaged

# How fragility curves developed?

Fragility curves

PGA

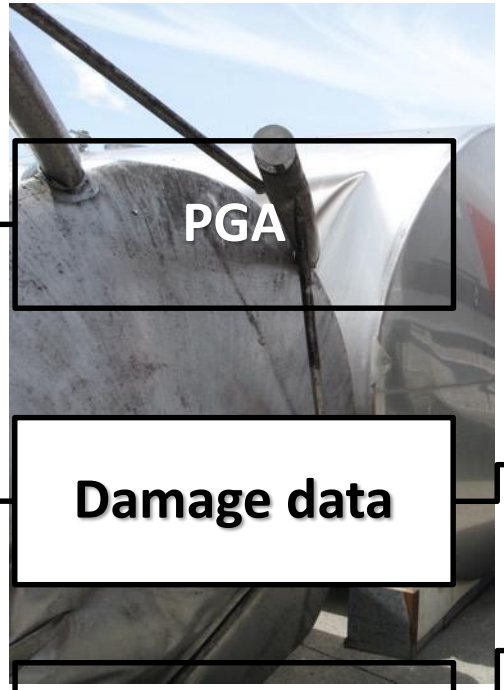
Damage data

Damage states

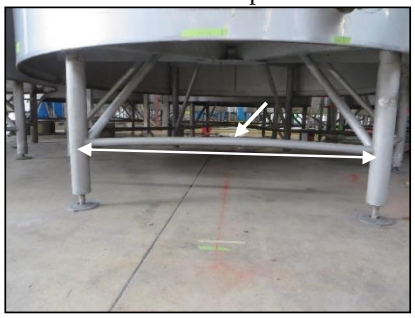
Tank types

Flat-based tanks

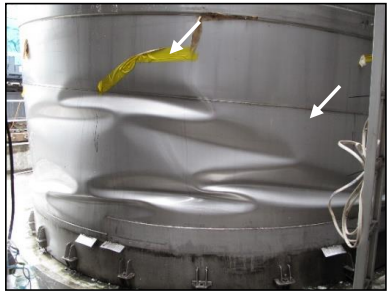
Legged tanks



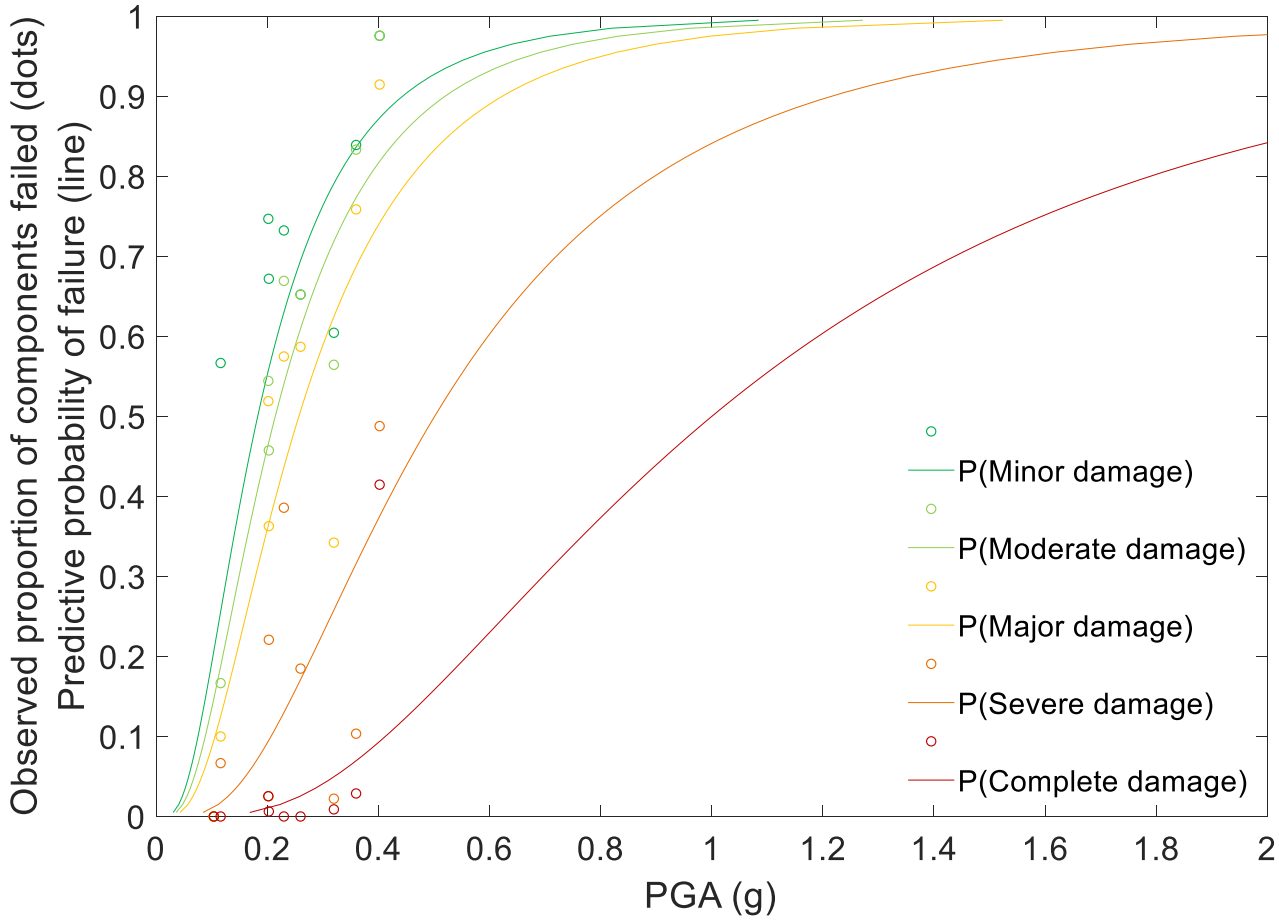
# Damage states

| Damage states | Description and picture reflecting damage state | |
|---|---|---|
| | Flat-based tanks | Legged tanks |
| No damage (DS0) | No damage  | No damage   |
| Minor damage (DS1) | Repair is not required (tank fully operational), or repair is limited to foundation/anchor without affecting tank operation  | Repair is not required, or tank did not requi repair as the damage is minor and does not affect the tank operation  |
| Moderate damage (DS2) | Localised repair is required (e.g. roof damage/shell damage)  | Localised repair is required (e.g. minor damage to the tank shell or legs/frame that could be repaired)  |

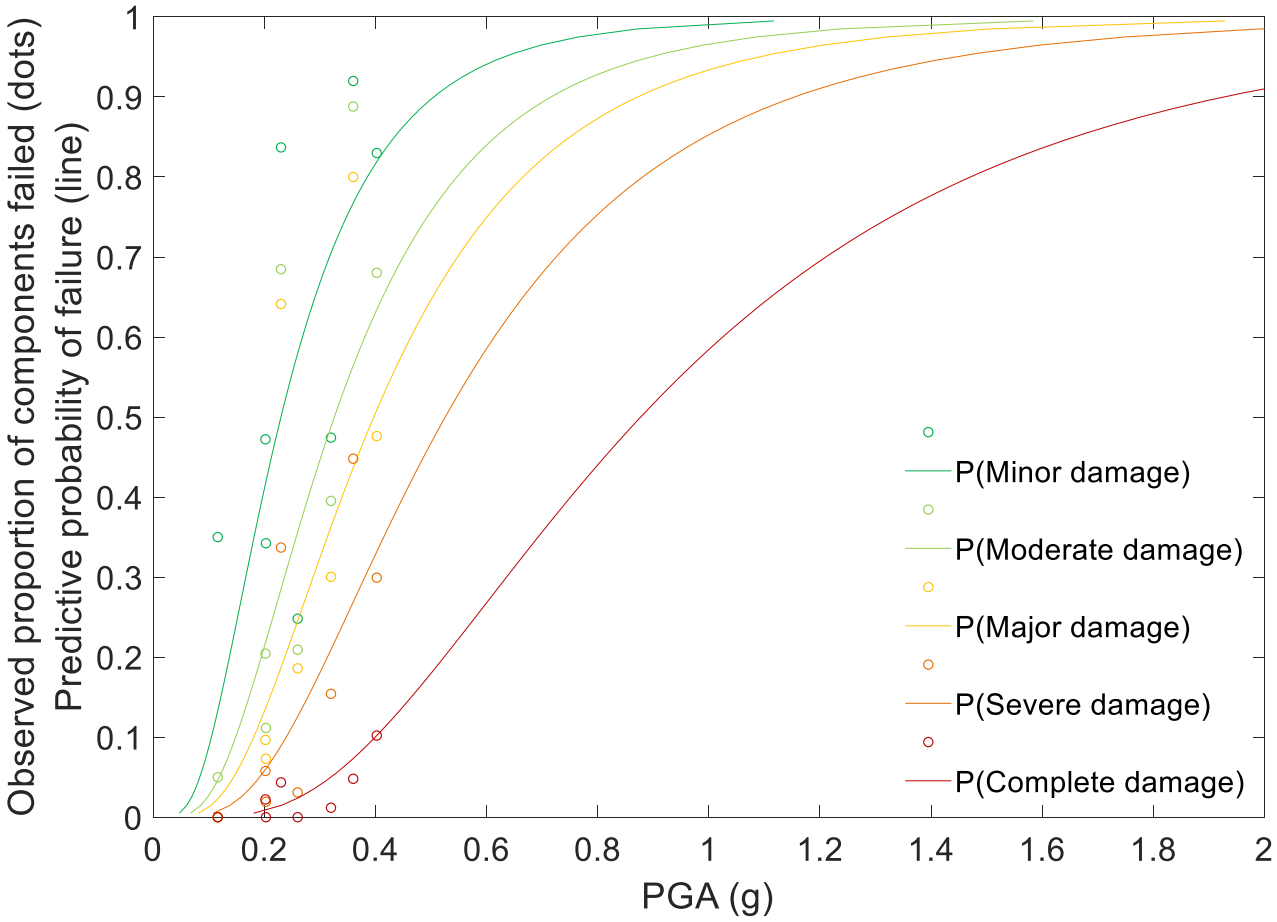
# Damage states

| | | |
|---|---|---|
| Major damage (DS3) | Localised replacement is required (e.g. EFB*, DSB**)<br>  | Localised replacement is required (e.g. some part of legs-frame or one layer of the tank barrel require replacement)<br>  |
| Severe damage (DS4) | Section replacement is required (e.g. major damage to barrel due to EFB*, DSB**)<br>  | Section replacement is required (e.g. legs/frame or entire tank shell element such as base shell, barrel, or cone require replacement)<br>  |
| Complete damage (DS5) | Tank replaced/collapsed<br>  | Tank replaced/collapsed<br>  |

# Set of developed empirical fragility curves for the flat-based wine tanks

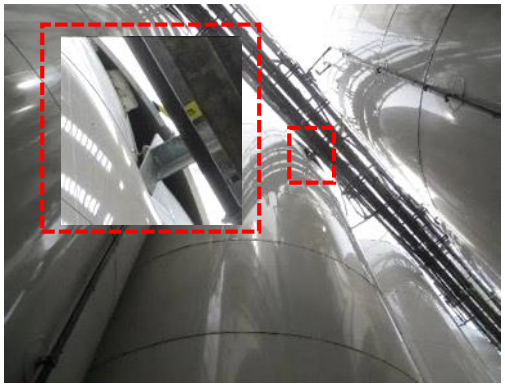


# Set of developed empirical fragility curves for the legged wine tanks



# What are the implications of damage data and fragility curves?

- Parameters influencing damage – % full, tank size, anchorage system, seismic resilience
- Elements still vulnerable – Barrels – due to catwalks
- Use the fragility curves to estimate the potential damage to the other area



## Time for a Wine Tank Design Standard?

# Socio-economic impacts and implications

**Joanna Fountain** Lincoln University

# Industry Engagement

**Interviews and discussions - wineries**

- Predominantly large and medium wineries (Marlborough); small wineries (N Canterbury)
- Additional conversations with cellar door staff
- Survey of members re: risk and resilience (N Canterbury)

**Supporting industries**

- Approx. 20 RSE workers; Two managers
- Wine/hospitality/tourism operators
- Other researchers; BRI
- Steel manufacturers, Port Nelson, CDEM

# Industry Engagement

→ ***Shift in focus and emphasis over time***

- → From ‘hot’ to ‘cool’ issue
- → Greater understanding of costs of damages, and implications
- → Greater consideration with benefits of hindsight

# Short term responses


*On the move, Riverlands, Blenheim*

## Short term responses

- Tank capacity was the biggest impact, and highlights differences in latitude
  - Wineries moved product elsewhere for bottling/bulk wine
  - Primarily corporates/large wineries
- Coordinated messaging
  - NZW, Wine Marlborough
- Focus on Internal communication and pastoral care

# Impacts longer term

**Insurance companies**

- Requirements for upgrades
- Schedules of repairs
- Premium changes
- Better understanding of costs of repairs


- **New science/engineering**
  - Tank design, bolting systems
  - Piping, catwalks

# Longer term implications


*On the move, Riverlands, Blenheim*

- Changing OSH practices
- Altered logistics/routing due to strengthened relationships
- Shared knowledge of earthquake repairs and seismic strengthening
  - Shared between companies locally
  - Shared within companies nationally/internationally

*"A NEW NORMAL"*

## What makes the difference for resilience?

- How much can the system can be modified?
- What are the opportunities for diversification and flexibility?
- Wide range of response options means latitude is larger; very few options, it has small latitude.

*Consider…*

- Socio-economic characteristics of owner/operators and/or operation
- Information, communication, access
- Markets
- Networks
- Health and well-being (HSE)

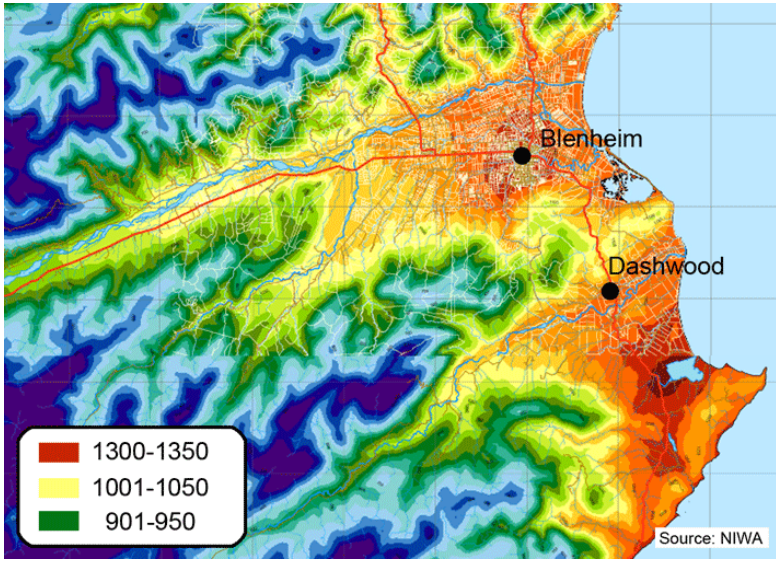
**What makes the difference for resilience?**

**Proximity to thresholds between states**

- Corporate vs. small, owner operator
  - Access to resources: tanks size/capacity; bridging capital; HSE resources for staff
  - insurance (levels and thresholds)
  - Scale and scope of damages
    - Vineyard → storage
  - Damages localised due to ground acceleration (proximity to epicentre), soil types, and geology
  - Impact of tank design/engineering
  - Learning from previous events
    - Canterbury 2010/2011; Seddon 2013

- Marlborough's (NZ's?) wine industry is relatively robust
  - Despite some damage to infrastructure, wineries able to deliver product
  - No winery bankrupted by events
- And becoming more resilient
  - Learning is an essential part of resilience, and wineries' experience with previous (2013) quake positive lessons
  - *"What we learnt in '13 was you've got to act like you've got no insurance; which is what we did. We acted like we had no insurance and we just forged ahead and started ordering tanks and doing stuff without even putting claims in."*
- Greater focus on people

- Building standards for tanks?
  - Capital cost and insurance implications
- Compounding risks?
  - Changing markets, climate risks (late frosts, high winds, extreme rainfall)
- Managing risks and recovery?
  - Institutional and governance arrangements, agency and collaboration




## Research outcomes

- Stakholders' have increased capacity for thinking logically and creatively about the future and changes needed / that may be required to enhance resilience.
- Partnerships to reach goals have been established – space for facilitating conversations (sharing knowledge)
- Greater understanding and awareness of the cause and effects of disasters / hazard events, and how impacts unfold across sectors and scales
- Increased clarity about where to intervene in the system: what to maintain, what to modify and what to transform
- Enduring, long-term relationships – and sharing lessons (RNC2, DSC 'Wine and climate', MPI SLMACC)

# Thank you.

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Cradock-Henry, N.A., Fountain, J., 2019. Characterising resilience in the wine industry: Insights and evidence from Marlborough, New Zealand. Environmental Science & Policy 94, 182–190. https://doi.org/10.1016/j.envsci.2019.01.015

Yazdanian, M., Ingham, J.M., Lomax, W., Wood, R., Dizhur, D., 2020. Damage observations and remedial options for approximately 1500 legged and flat-based liquid storage tanks following the 2016 Kaikōura earthquake. Structures 24, 357–376. https://doi.org/10.1016/j.istruc.2020.01.024

Yazdanian, M., Ingham, J.M., Kahanek, C., Dizhur, D., 2020. Damage to flat-based wine storage tanks in the 2013 and 2016 New Zealand earthquakes. Journal of Construction Steel Research, accepted in press.