Australian Government
Geoscience Australia

Advancing Methodologies for Multi-hazard Systemic Risk Assessment for Use in Disaster Risk Reduction

A Geoscience Australia Perspective

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Place & Communities Division, Geoscience Australia

Disaster Risk Reduction Forum : 13th Feb 2023

Geoscience Australia's Purpose

- Delivering earth sciences for Australia's future in the Australian public sector, within the Industry, Innovation and Science portfolio.
- Purpose is to be the trusted source of information on Australia’s geology and geography for government, industry and community decision making.
- Support evidence-based decisions through information, advice and services for a strong economy, resilient society and sustainable environment.
- Resilience includes that of communities and their supporting infrastructure in the context of natural hazards and developing options for risk mitigation.

Strategic Impact Areas

Building Australia's resources wealth

Supporting Australia's community safety

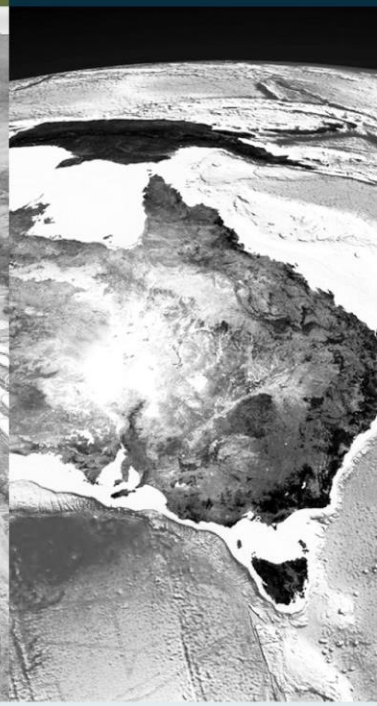
Securing Australia's water resources

Managing Australia's marine jurisdictions

Creating a location-enabled Australia

Enabling an informed Australia

Trusted, sustainable and high performance



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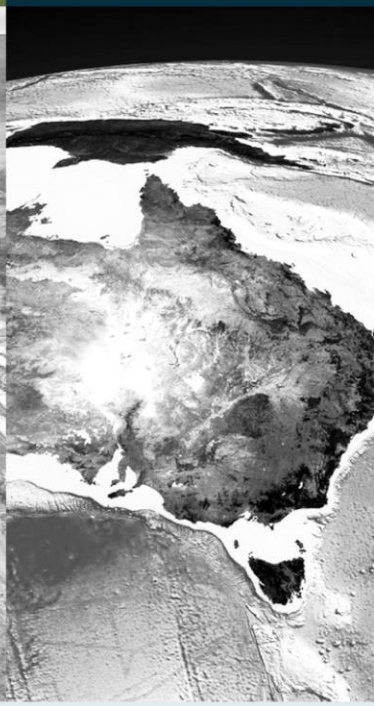
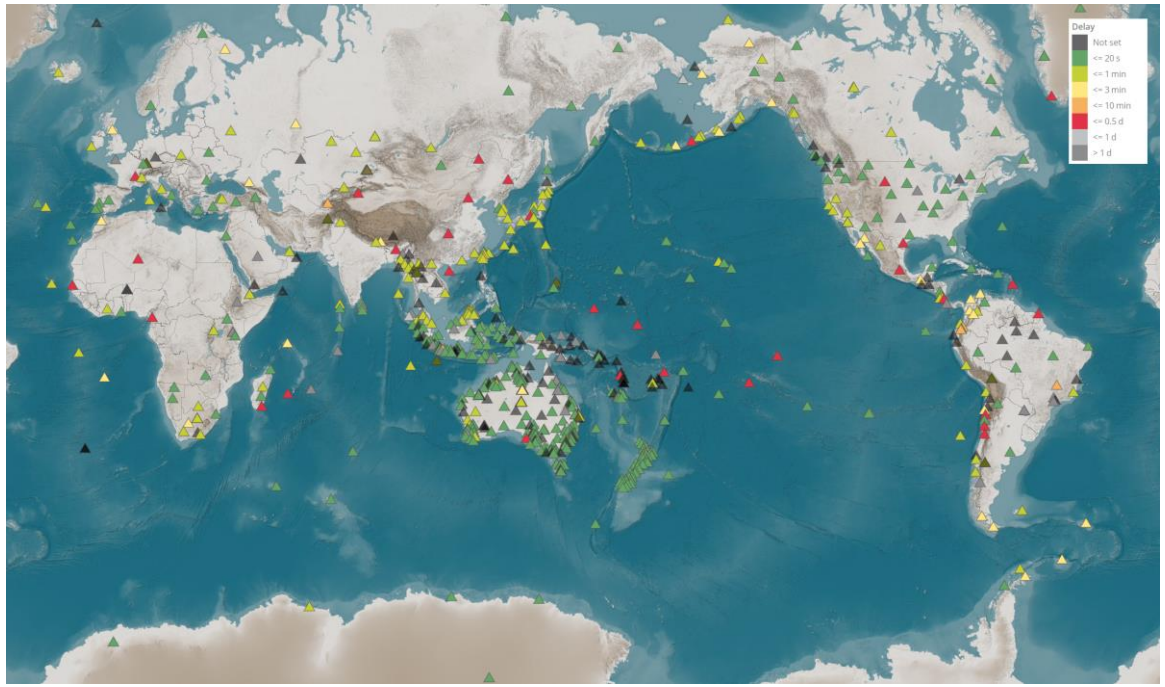
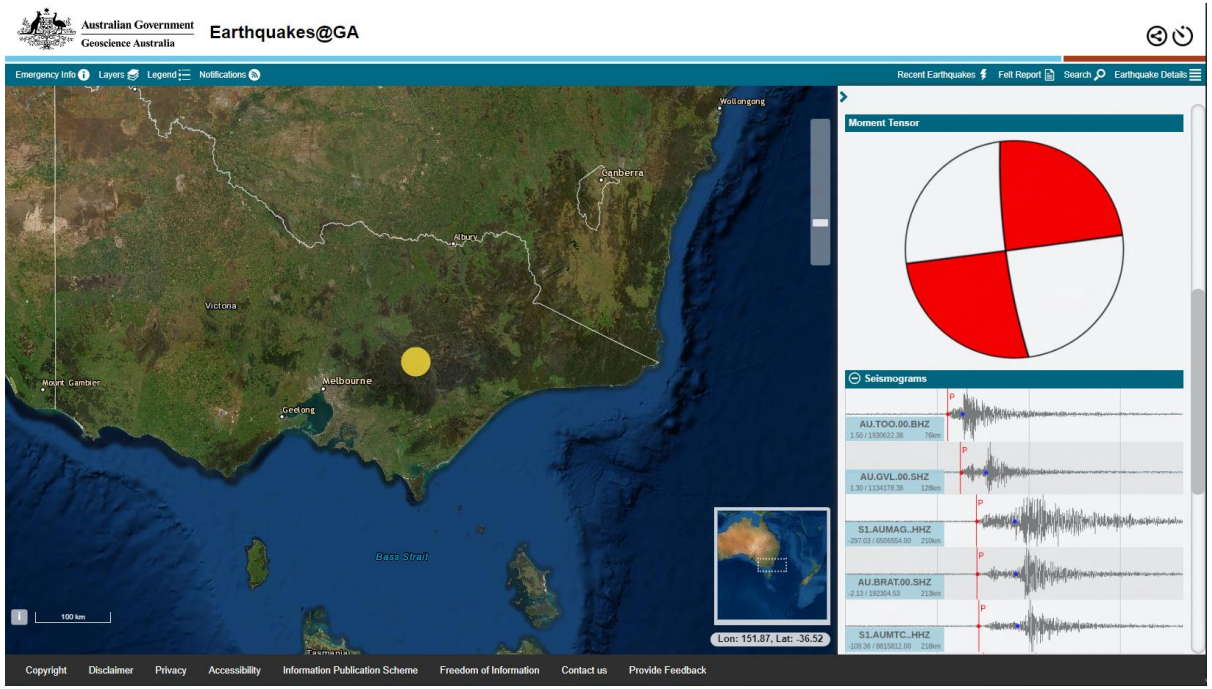


National Earthquake Alerts Centre (NEAC)

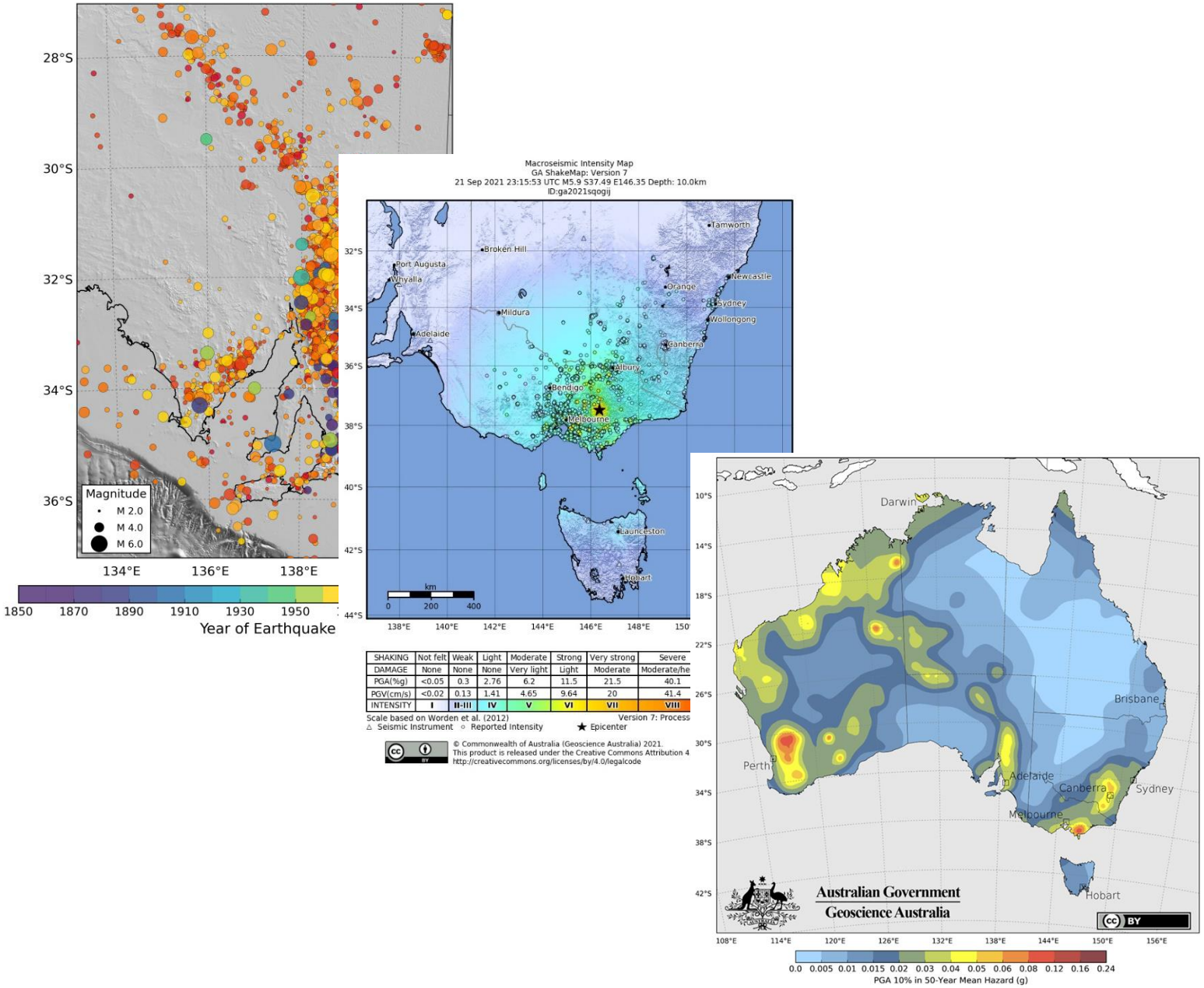
- 24/7 near-real-time earthquake monitoring, detection, analysis, and alerting service
- Partners with the Bureau of Meteorology (BoM) in the Joint Australian Tsunami Warning Centre (JATWC)
- Rapid earthquake information available at: https://earthquakes.ga.gov.au/





NEAC Products and Services

- Provides time-critical earthquake information which includes ShakeMap
- Australian earthquake catalogue curation, production and publication
- Catalogue fundamental input to Australian earthquake bedrock hazard assessment, NSHA18.



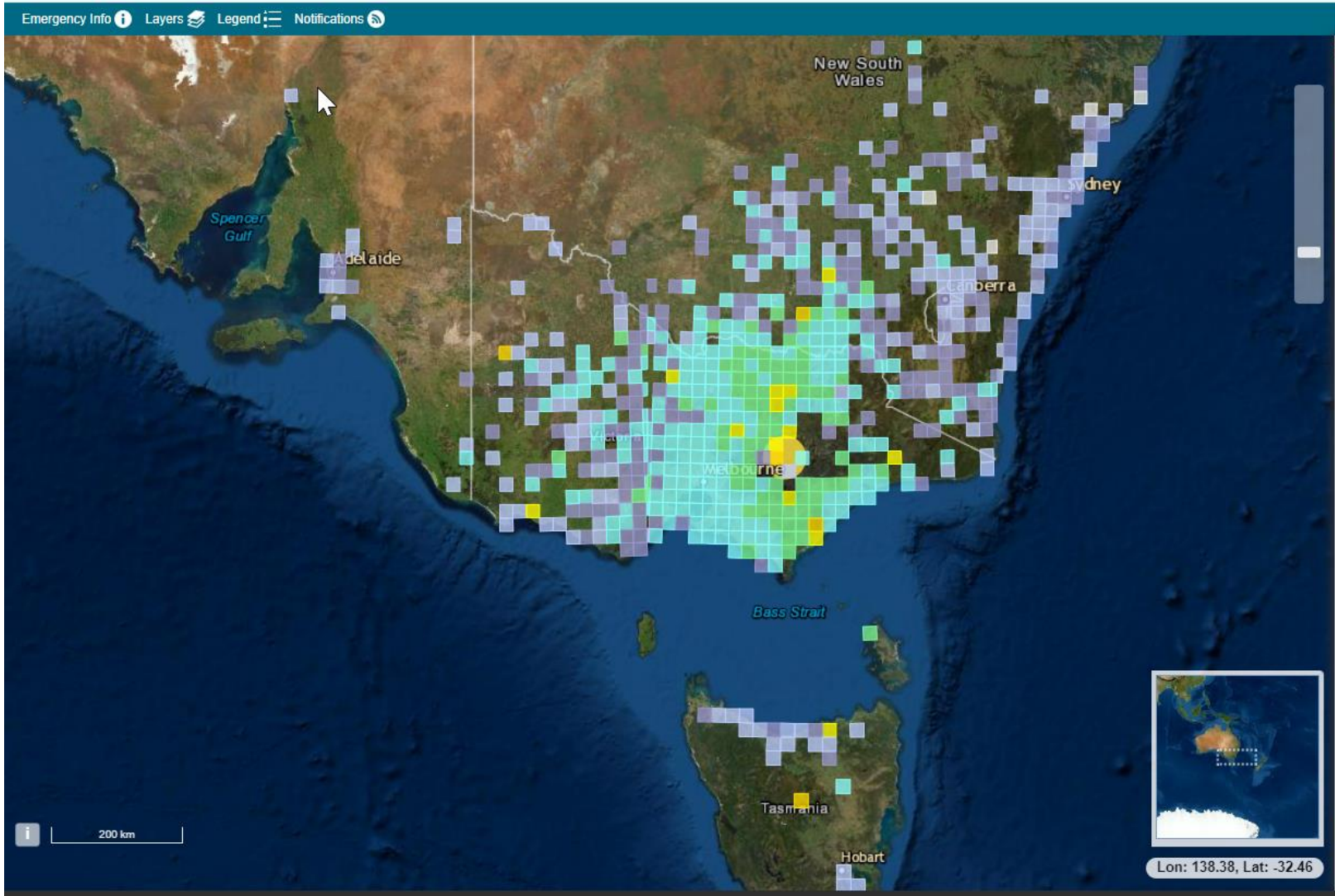
Felt Reports

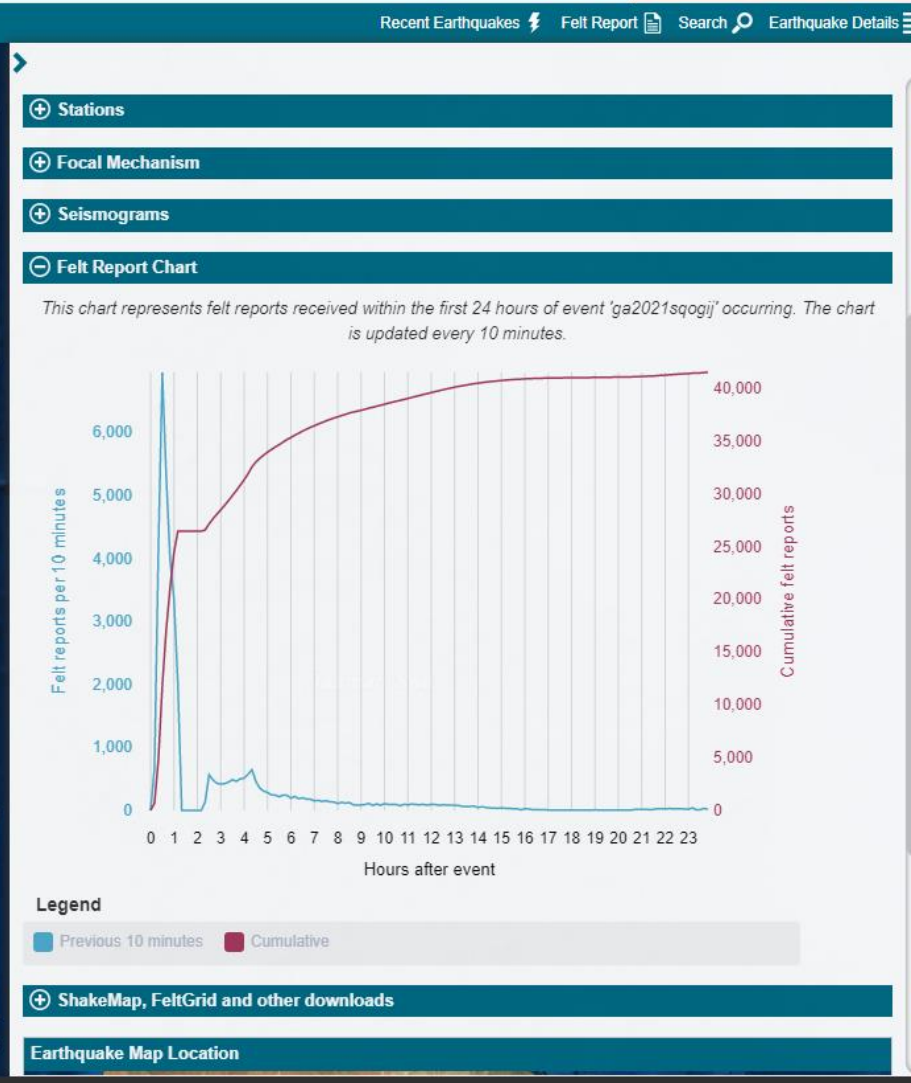
https://earthquakes.ga.gov.au/event/ga2021sqogij

Australian Government Geoscience Australia

Earthquakes@GA

Woods Point Earthquake, VIC, 21 Sept 2021, M_w 5.9, 41,000+ Felt Reports





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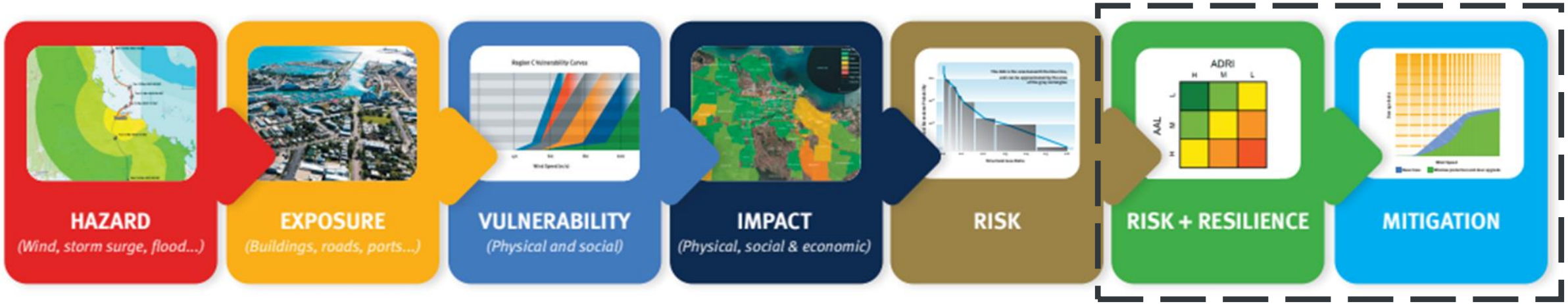
Impact, Risk and Mitigation Scope

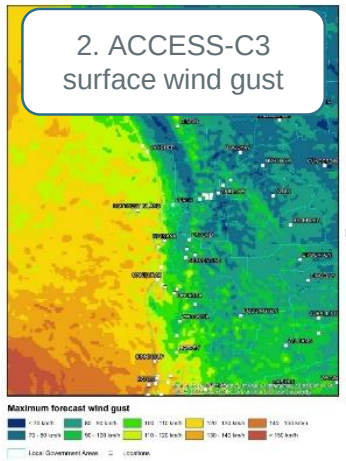


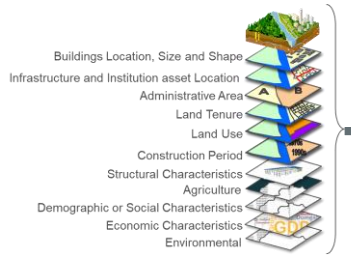
Natural Hazard Scope:-

- Earthquake
- Tsunami
- Severe Wind
- Riverine Flooding
- Storm Surge

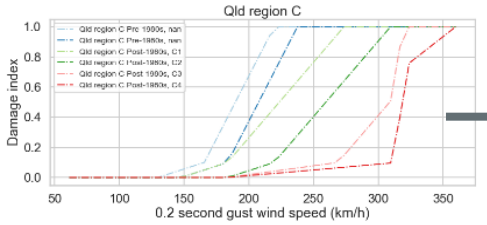
*HazImp – (**Hazard Impact** modelling application)*

2. ACCESS-C3 surface wind gust





1. NEXIS building point data



3. Vulnerability models

4. Sample maximum wind speed at each building point

5. Select vulnerability based on building attributes

6. Evaluate damage index at each building point based on vulnerability

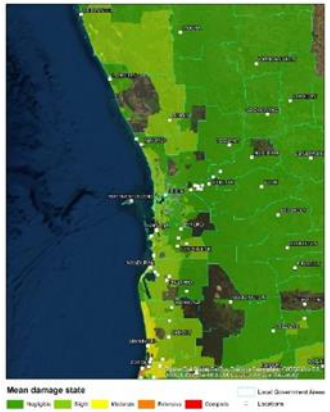
7. Aggregate point data to regions (mean damage index)

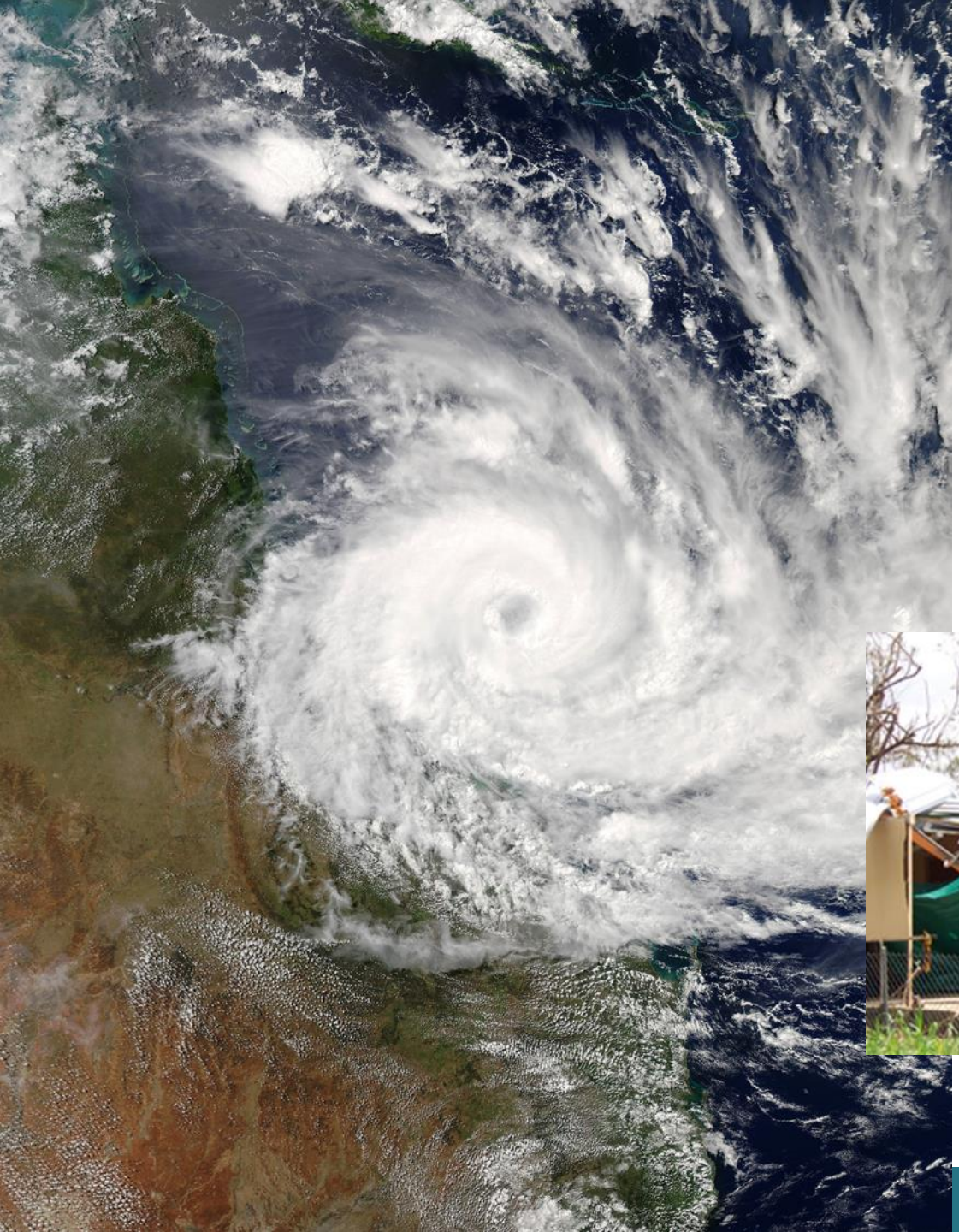
8. Categorise building points

9. Categorise regions

10. Count buildings in each category in regions

11. Output dataset





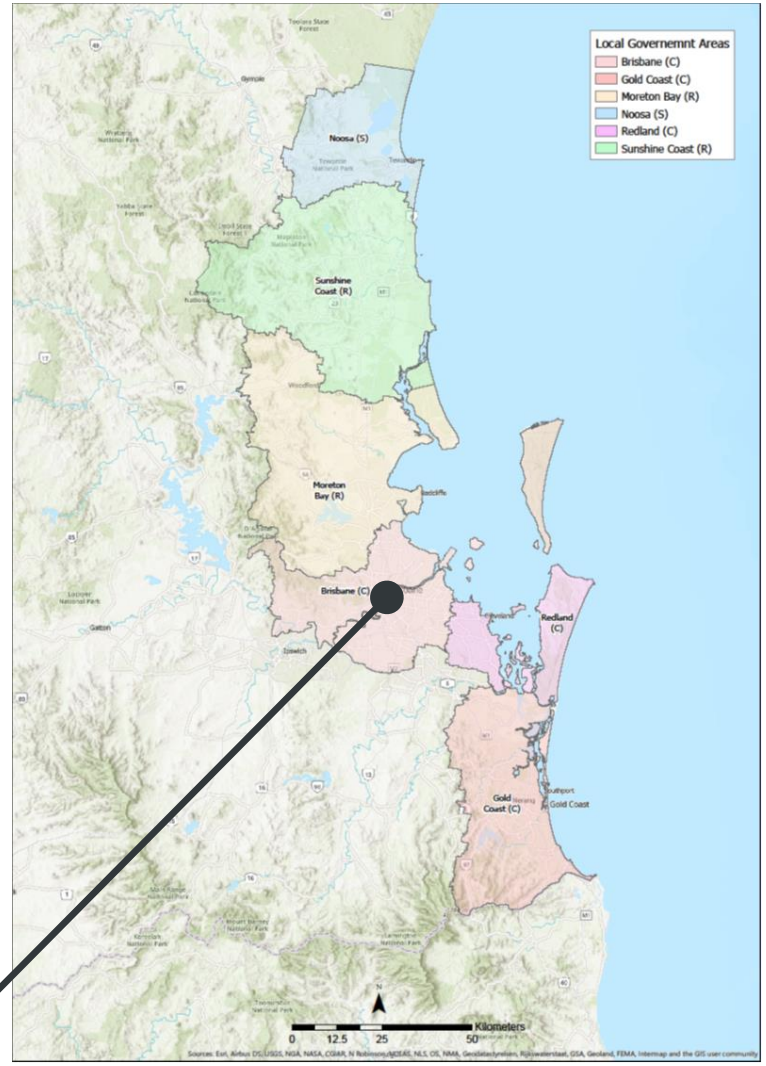
Severe Wind Hazard Assessment for South East Queensland

15 Partners and 4 Stakeholders

Project Drivers

Significant community exposure:

- 6 Coastal Councils in SEQ
- 900,000+ homes
- 2.9m residents
- 56% of Queensland's population
- Climate change, changes in demographics and urban growth may increase consequences of storms.
- Need to effectively communicate risk to the public and opportunities to mitigate.



Brisbane City

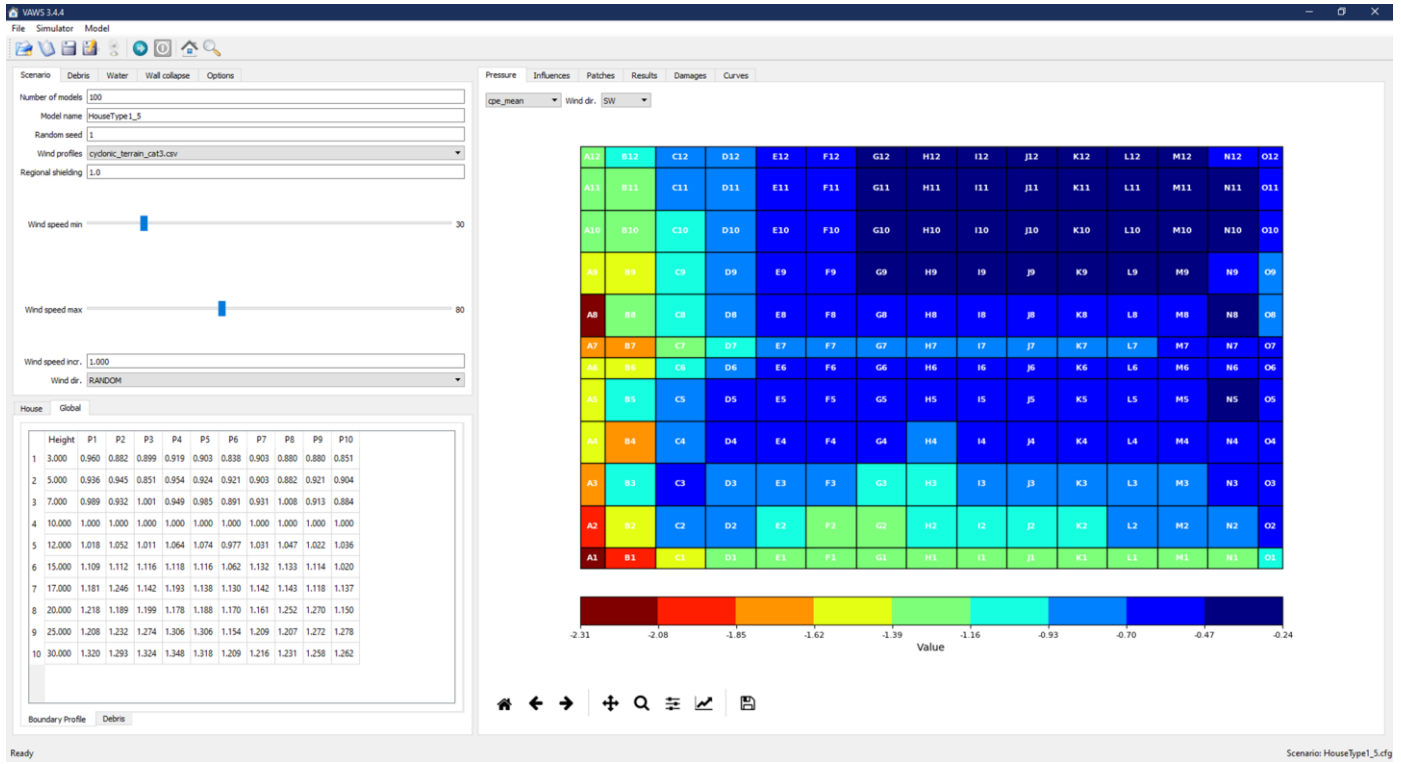
Vulnerability and Adaptation to Wind Simulation (VAWS)

Engineering based vulnerability model

Monte Carlo based vulnerability simulation.

Accounts for:

- Wind directions/ pressure distributions
- Debris impacts
- Variability in connection strengths
- Progressive failures
- Water ingress



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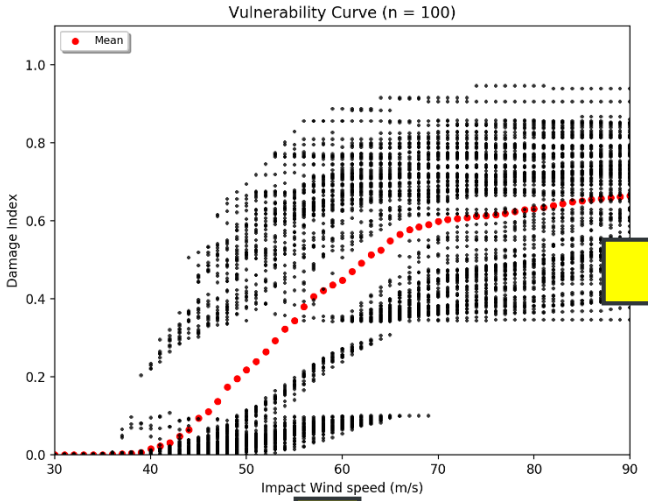
CYCLONE TESTING STATION

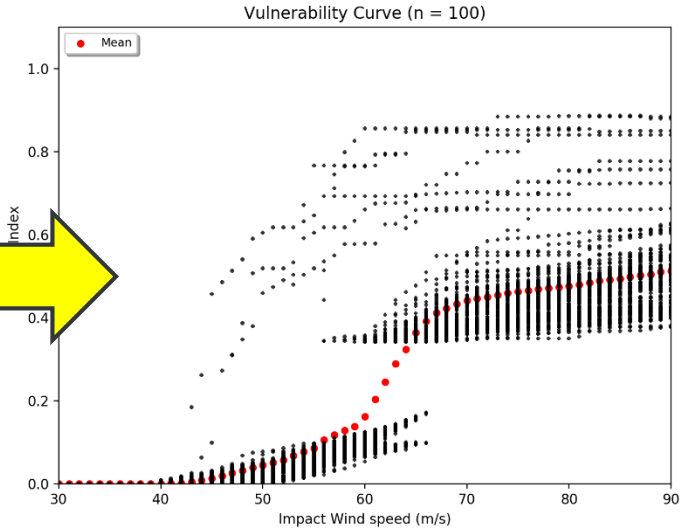
House Type 1

- Pre 80's
- Metal Roof Cladding
- Timber Frame

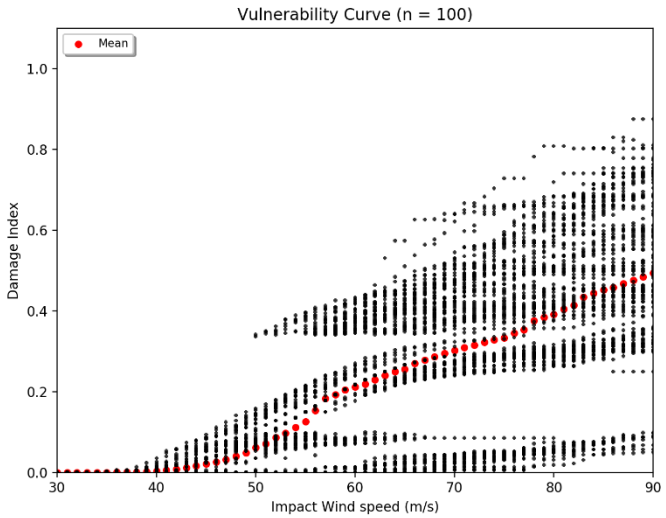
Base Case



Window and Door Protection



Roof Structure Upgrade



Window and Door Protection

+

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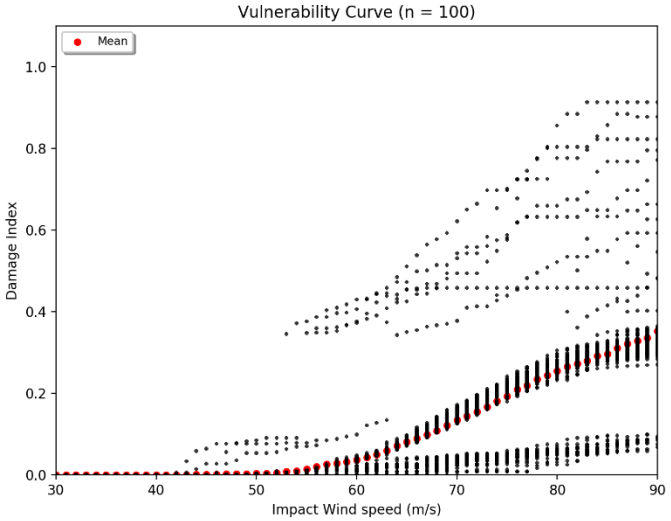

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CYCLONE TESTING STATION

Critical Infrastructure





Earthquake Impact and Risk Assessment for Perth and Supporting Infrastructure (EIRAPSI)

Partners:-

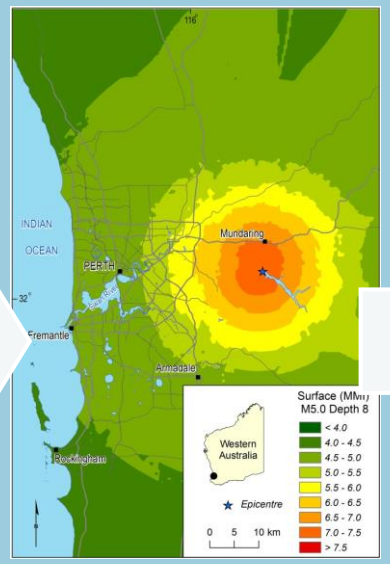
- Global Earthquake Model Foundation
- Geoscience Australia
- Watercorp
- Western Power
- WA Main Roads
- WA Department of Fire and Emergency Services

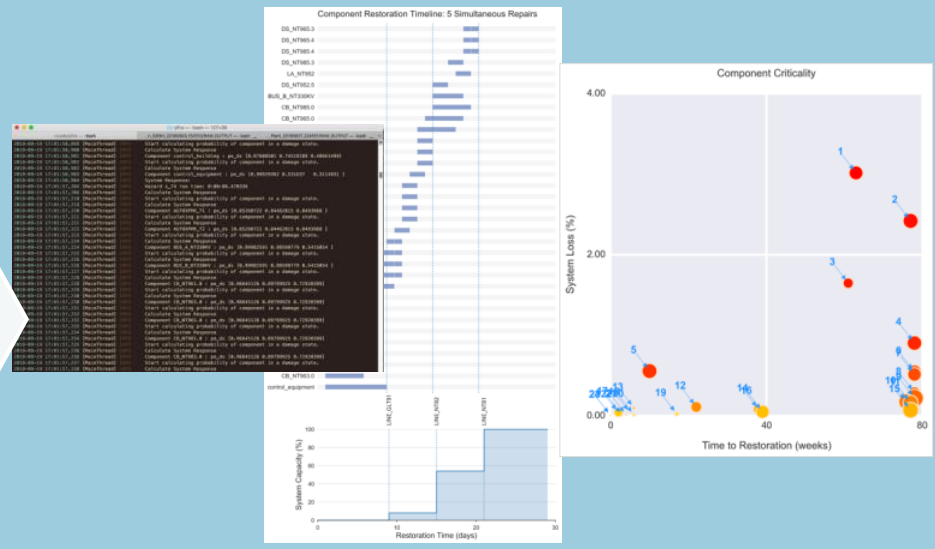




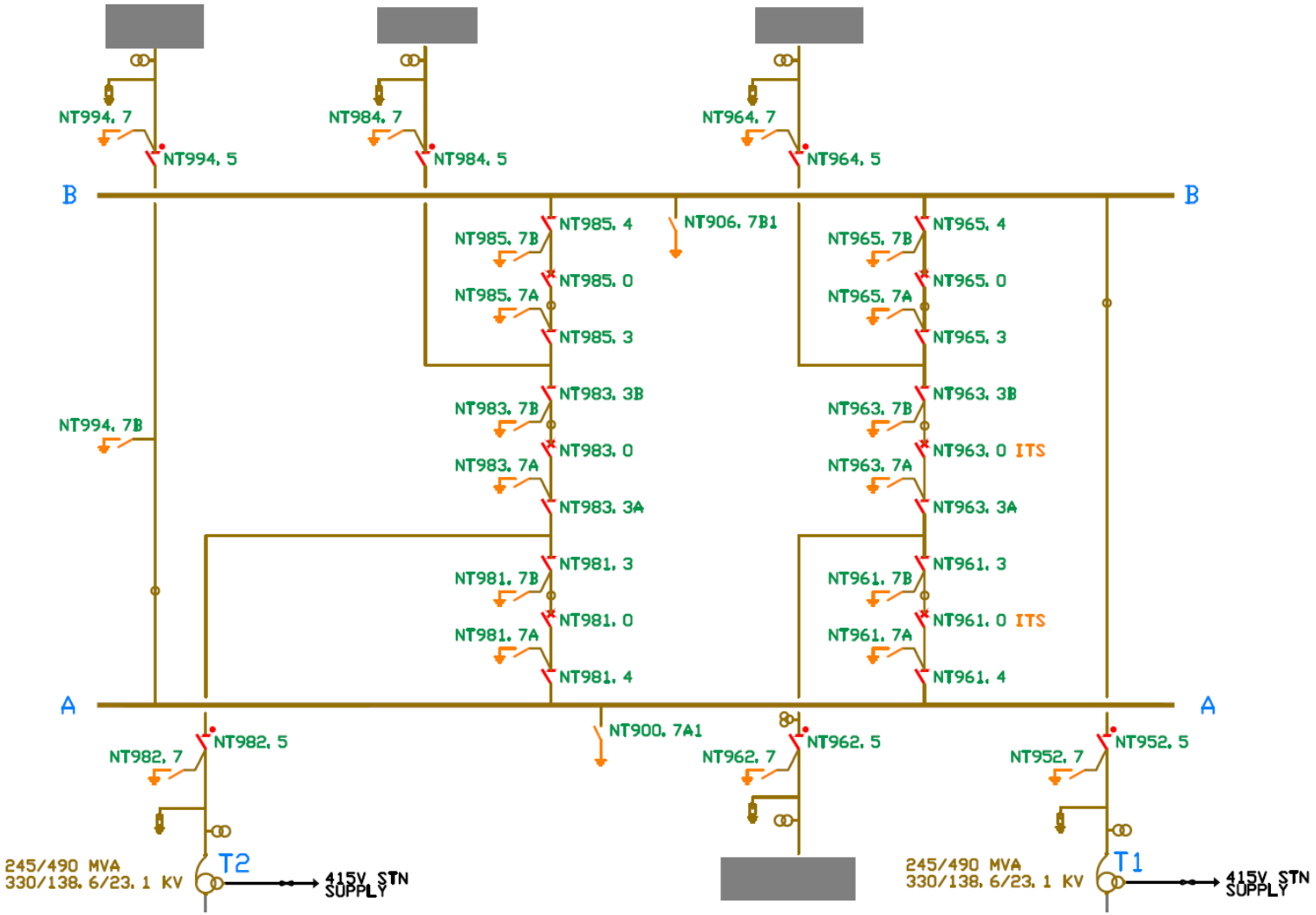
System for Infrastructure Resilience Analysis (SIRA)

System Diagram Redacted



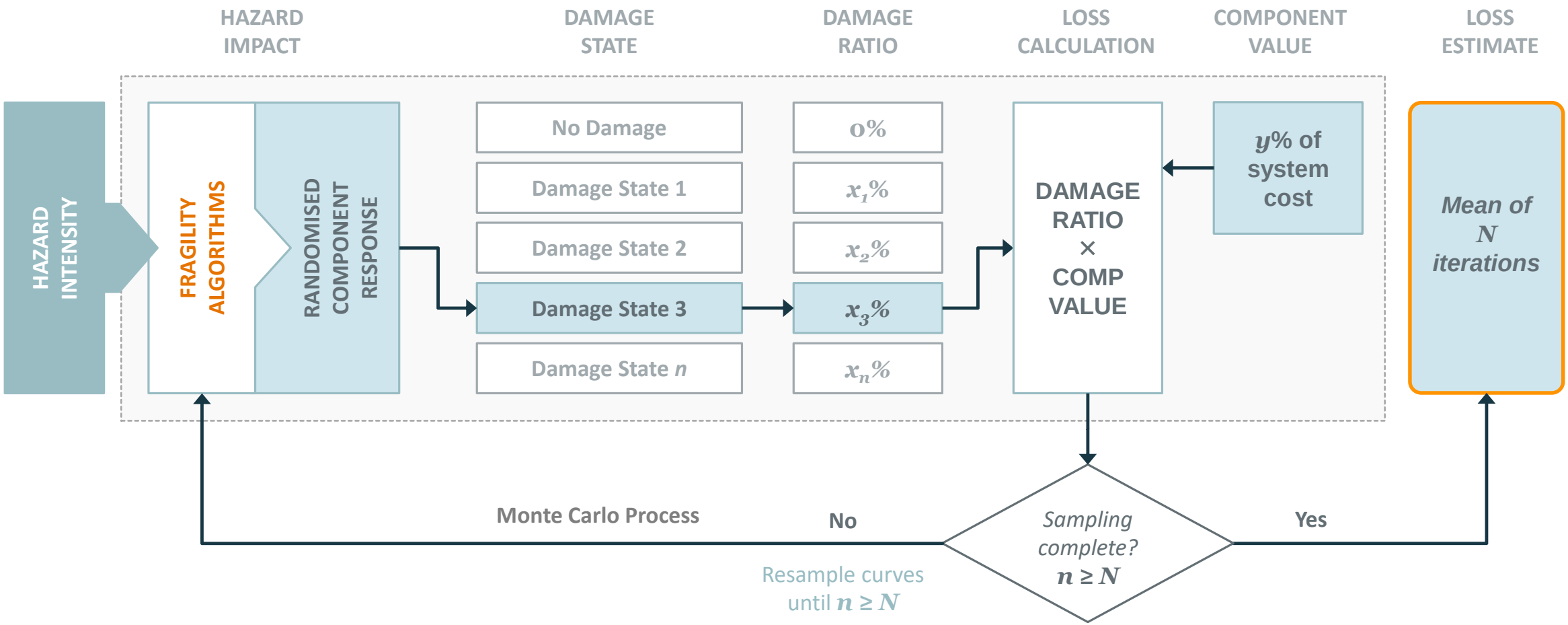


System Model – Transmission Substation - Schematic



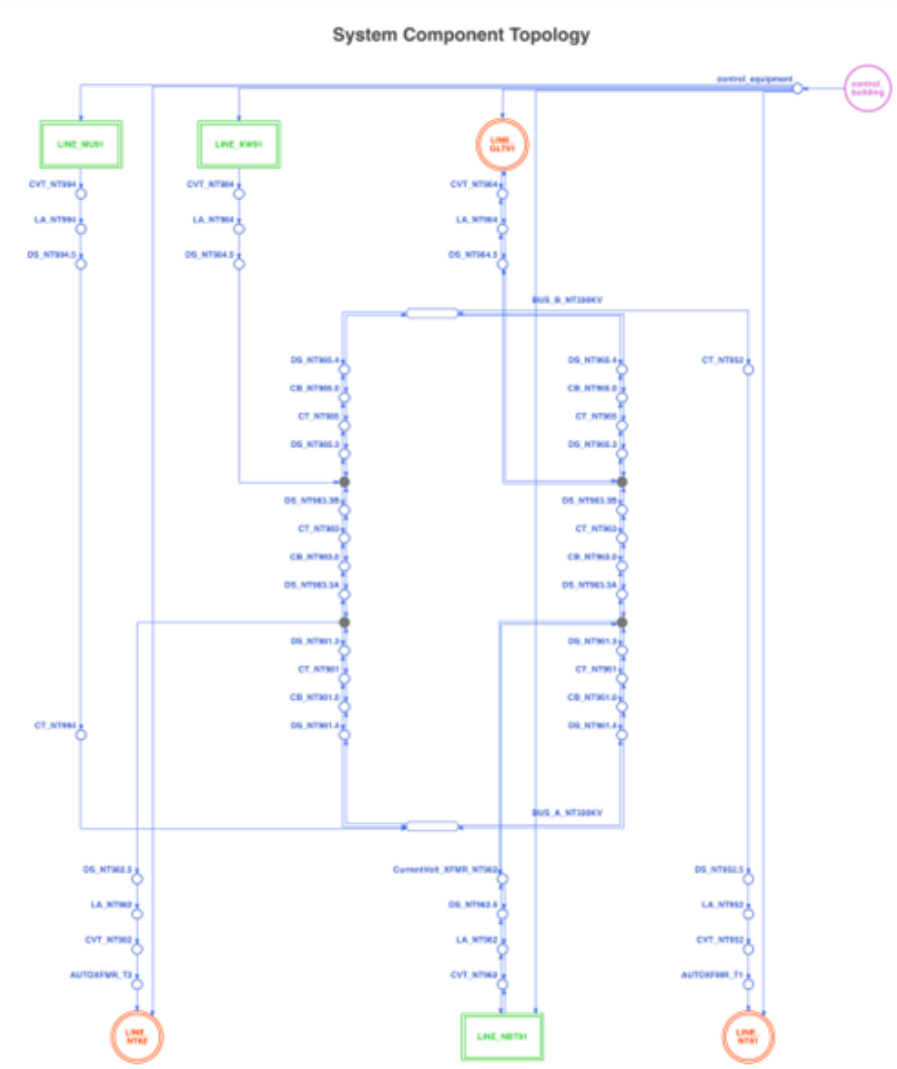
LOSS MODEL – Link Hazard to Damage and Loss

Currently only considers direct economic loss

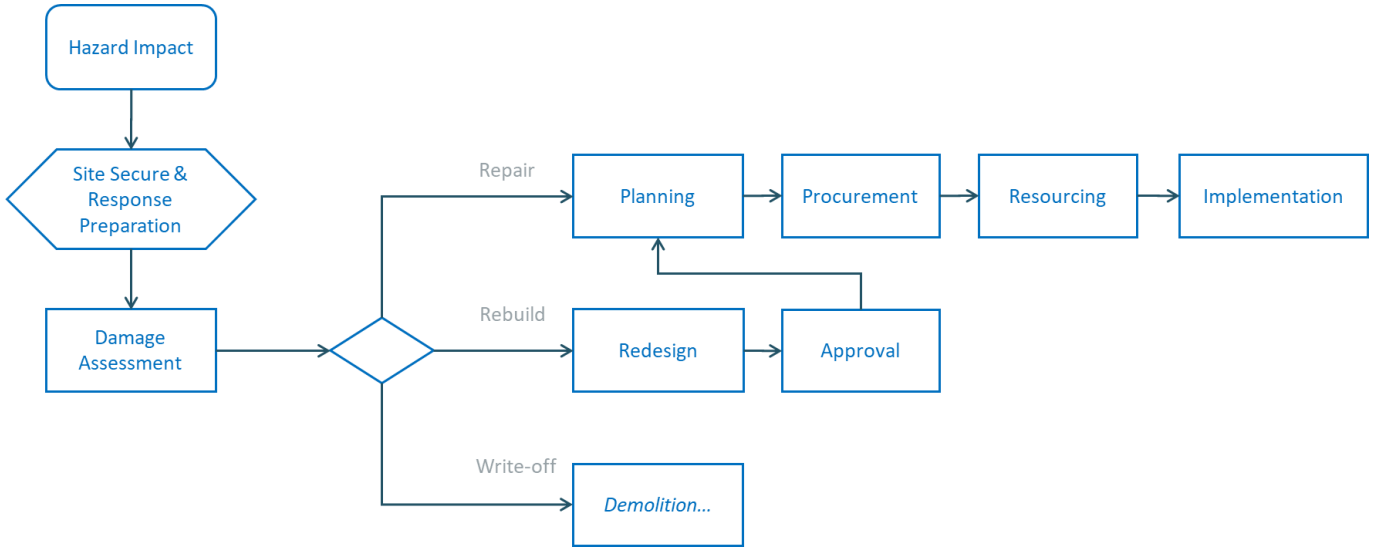


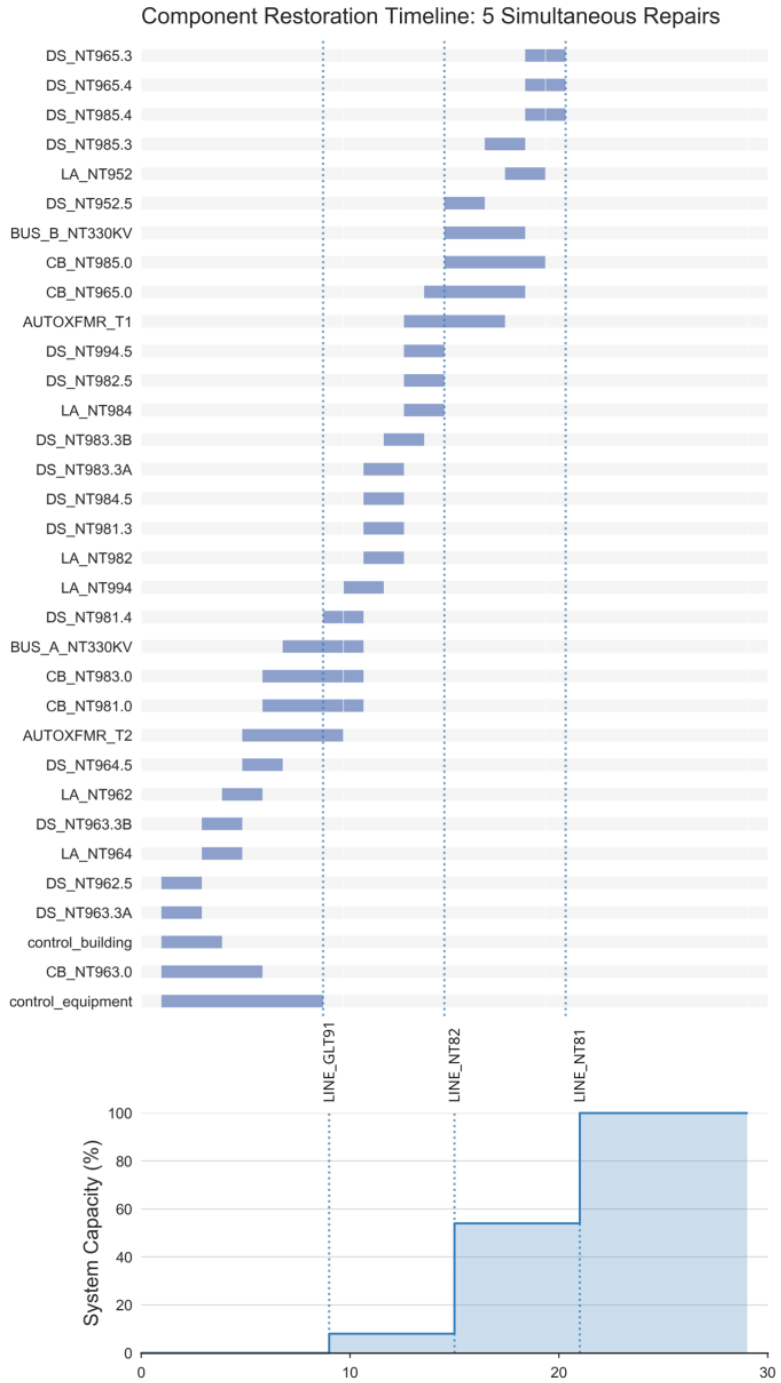
The System Model: Functionality

- System's residual functionality modelled as flow though network:
  - Calculated as 'maximum flow' through the system, given:
    - A specific hazard intensity
    - The likely response each component at that hazard level

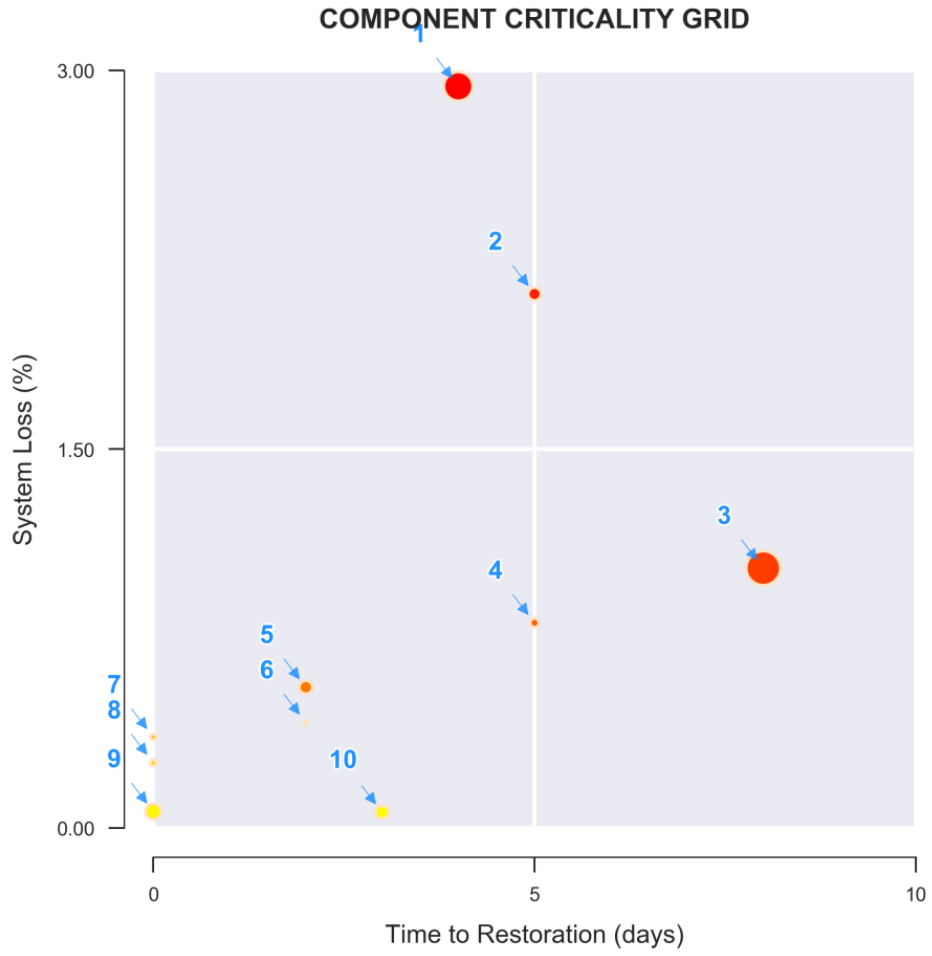


RESTORATION Time Approximation – Process



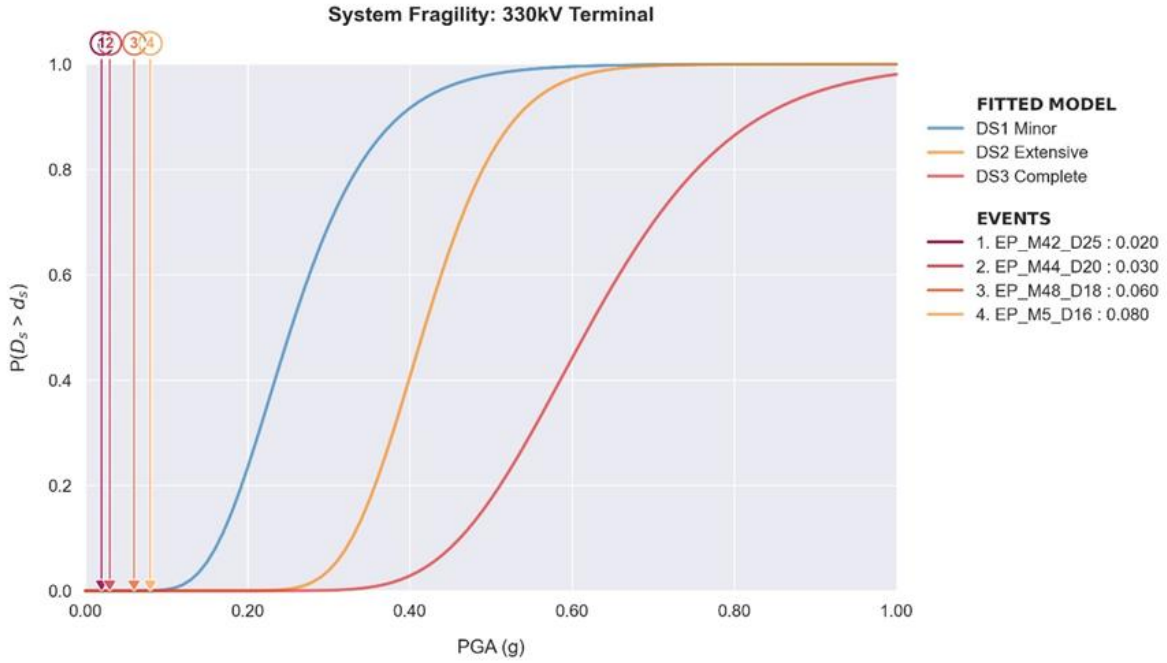


Component Criticality and Vulnerability: High Voltage Terminal Station



Infrastructure: Substation
Hazard: Earthquake 0.170 g PGA

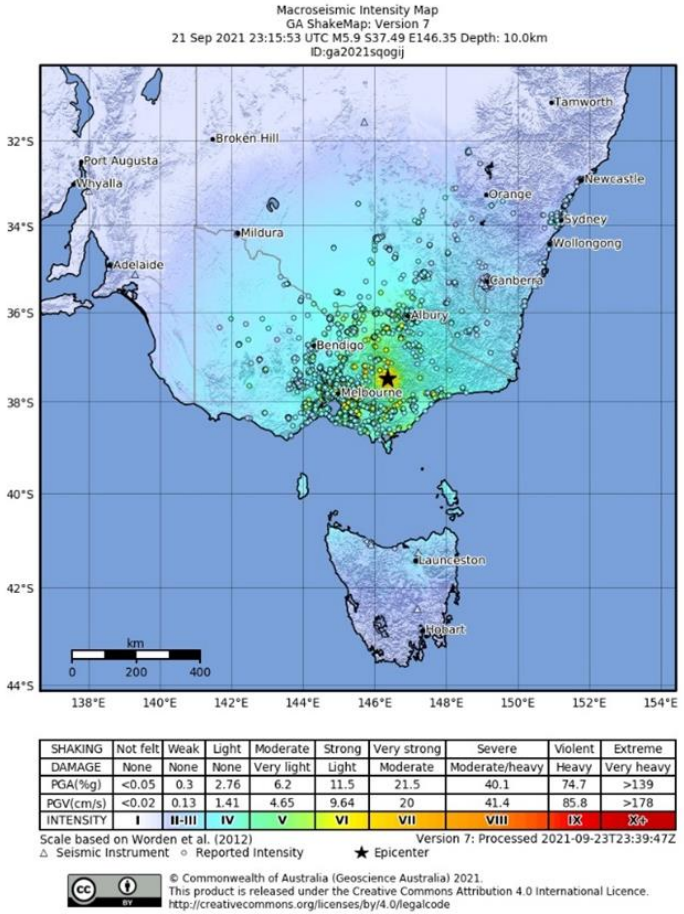
1 Bus
2 Circuit Breaker 230kV
3 Electrical Equipment
4 Autotransformer 245-490MVA
5 Lightning Arrester
6 Disconnect Switch 330kV
7 Current Transformer 330kV
8 Capacitor Voltage Transformer 330kV
9 Combined Current Voltage Transformer 330kV
10 Building URM



Looking Ahead

- Impact forecasting service using prototype *Natural Hazard Impact and Risk Service (NHIRS)*

NEAC Shakemap

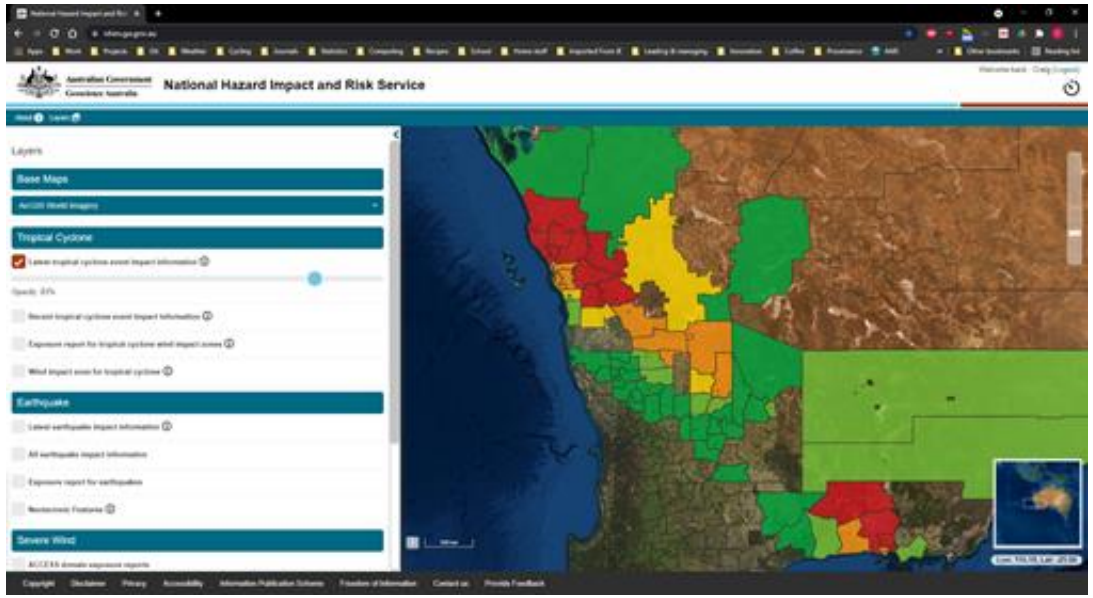


SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.05	0.3	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.02	0.13	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based on Worden et al. (2012) Version 7: Processed 2021-09-23T23:39:47Z

△ Seismic Instrument ○ Reported Intensity ★ Epicenter

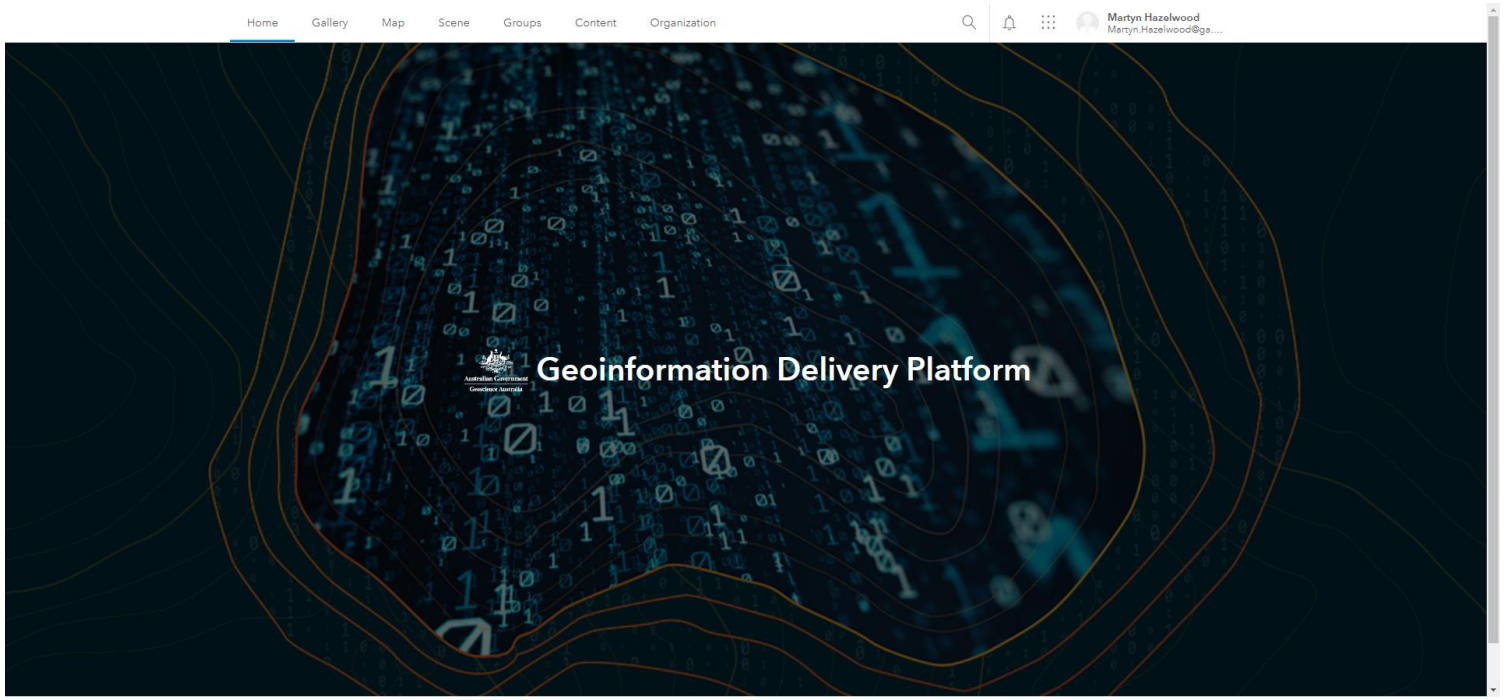
NHIRS Interface for TC Seroja 11 April 2021



Looking Ahead

- Impact forecasting service using prototype *Natural Hazard Impact and Risk Service (NHIRS)*

- Launch of *Geospatial Delivery Platform (GDP)* to enable external users to interact with data and information – Example of Murwillumbah, NSW flood risk study outcomes made accessible.



Martyn

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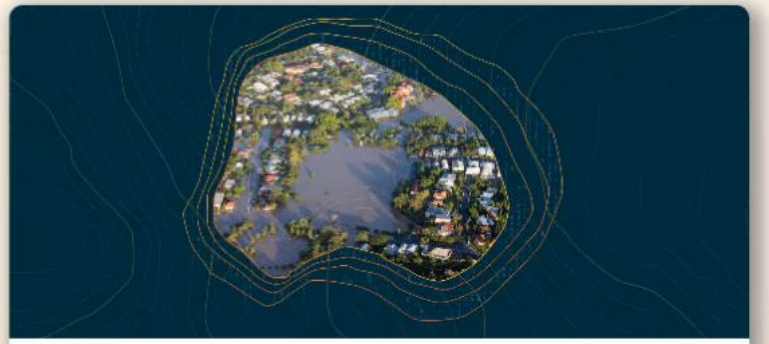
Natural Hazard Spatial Resource Hub (Prototype)

Use our data | Understand impacts | Hazards | Community | EM-LINK

Geoscience Australia provides authoritative information and insights to support Australia's resilience to natural hazards. Our ability to better prepare and plan for natural hazards, as well as respond and recover from disasters, keeps our communities safe.



Understand impacts of hazards

Plan and prepare for future hazards and assess impact and effect to better target investment or mitigate risks to the community.

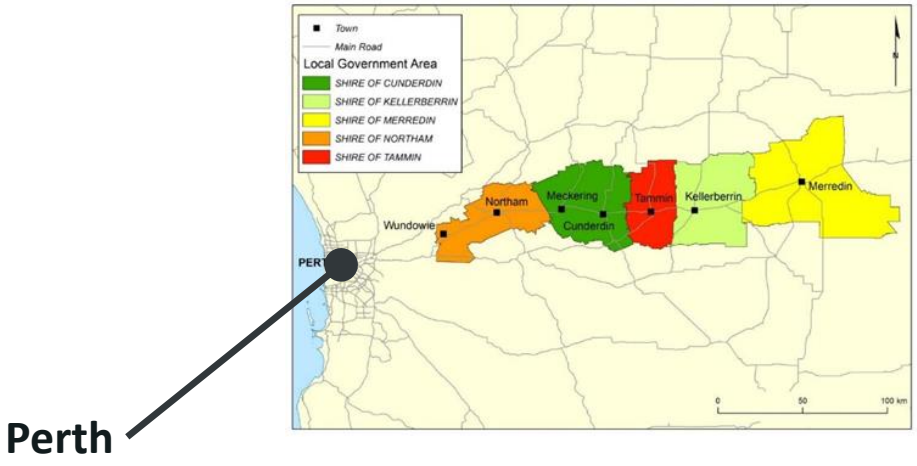
Explore our case studies

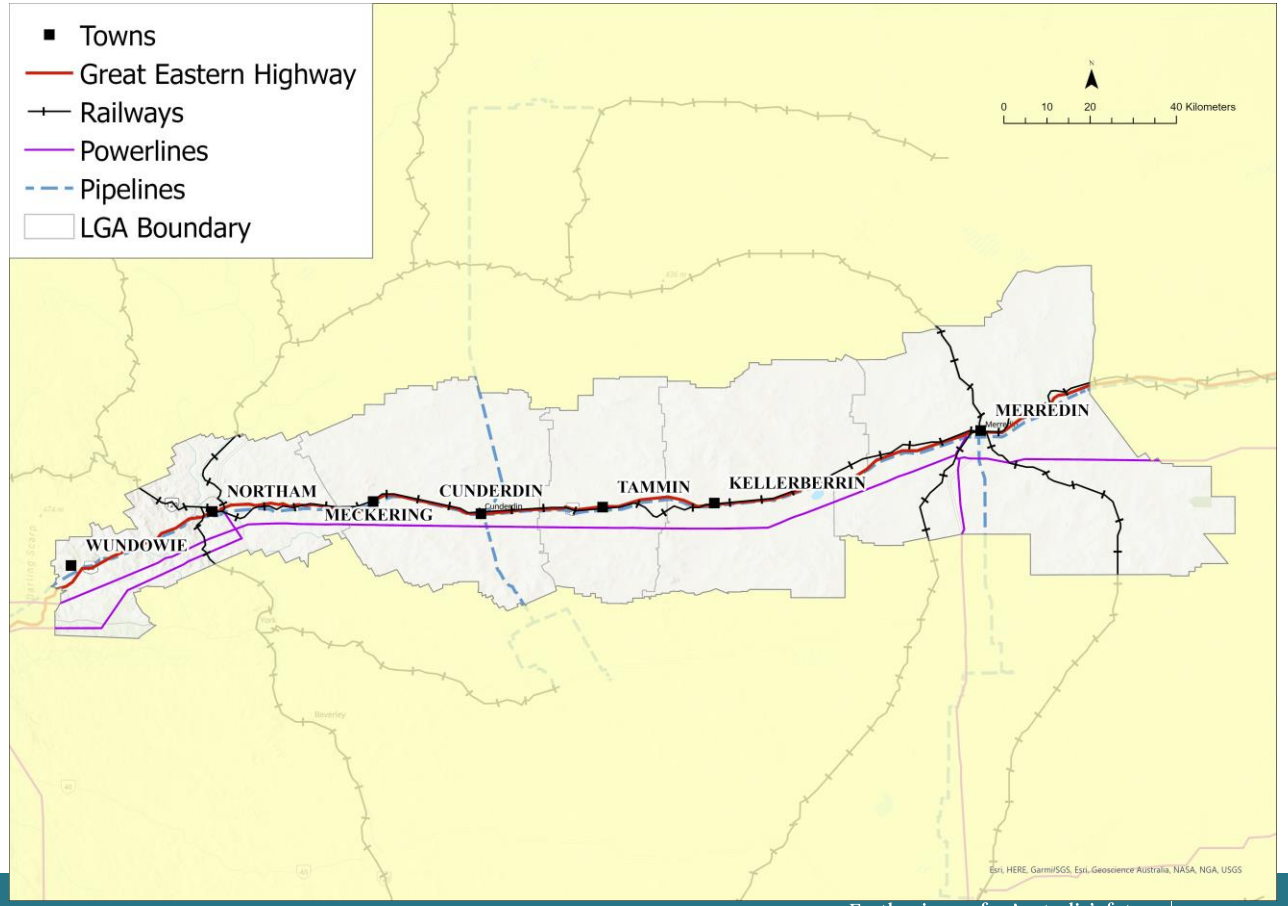
Explore information which helps explain natural hazards including Bushfires, Tropical Cyclones, Earthquakes and Floods.




Looking Ahead

- Impact forecasting using prototype *Natural Hazard Impact and Risk Service (NHIRS)*
- Launch of *Geospatial Delivery Platform (GDP)* to enable external users to interact with data and information – Example of Murwillumbah, NSW flood risk study outcomes made accessible.
- Application of SIRA to geographically dispersed and interconnected critical infrastructure in the Yilgarn region of Western Australia as a CI risk assessment – GEM co-funded RAMSEY Project





Summary

- Geoscience Australia as a government science agency has built on existing capability to meet the DRR information needs of the Australian Government and other stakeholders.
- The information needs are multi-hazard and are migrating beyond impact and risk to cost-effective mitigation with consideration of community resilience.
- These needs are being met collaboratively utilising a broad range of skills and collaborations to develop the tools and information products needed.
- In working with critical infrastructure operators as a government agency, GA has cultivated a level of trust through it's handling of sometimes sensitive industry input data and information along with the learnings derived from the research.
- Geoscience Australia's objectives are to share DRR information as widely and easily as possible. Modelling capability is being shared as open source.