Modelling Group
WATER NEW ZEALAND

Modelling Symposium

Assessing flood impacts – Flood hazard and how to use it

Presented by
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The New Zealand Water & Wastes Association Waiora Aotearoa

Overview

- Background
- Measuring flood impact
- Flood hazard – what is it?
- Flood hazard – how to use it
- Flood Impact Assessment Framework
- Next steps

Acknowledgements

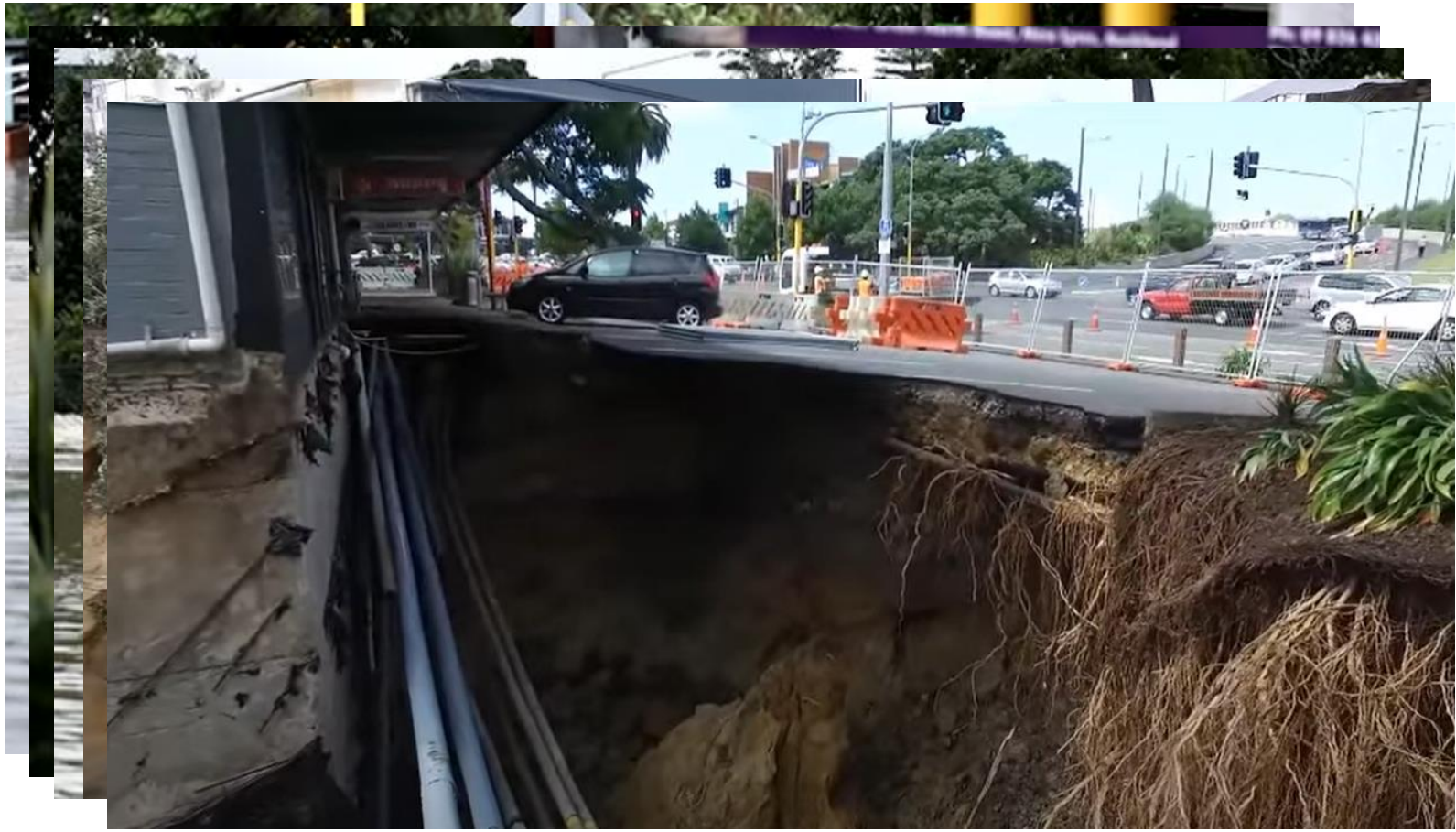
- **Fiona Macdonald** – Principal – Flood Risk
- **Nancy Baines** – Healthy Waters Specialist
- **Nick Brown** – Regional Planning Manager

Auckland Council
Te Kaunihera o Tāmaki Makaurau

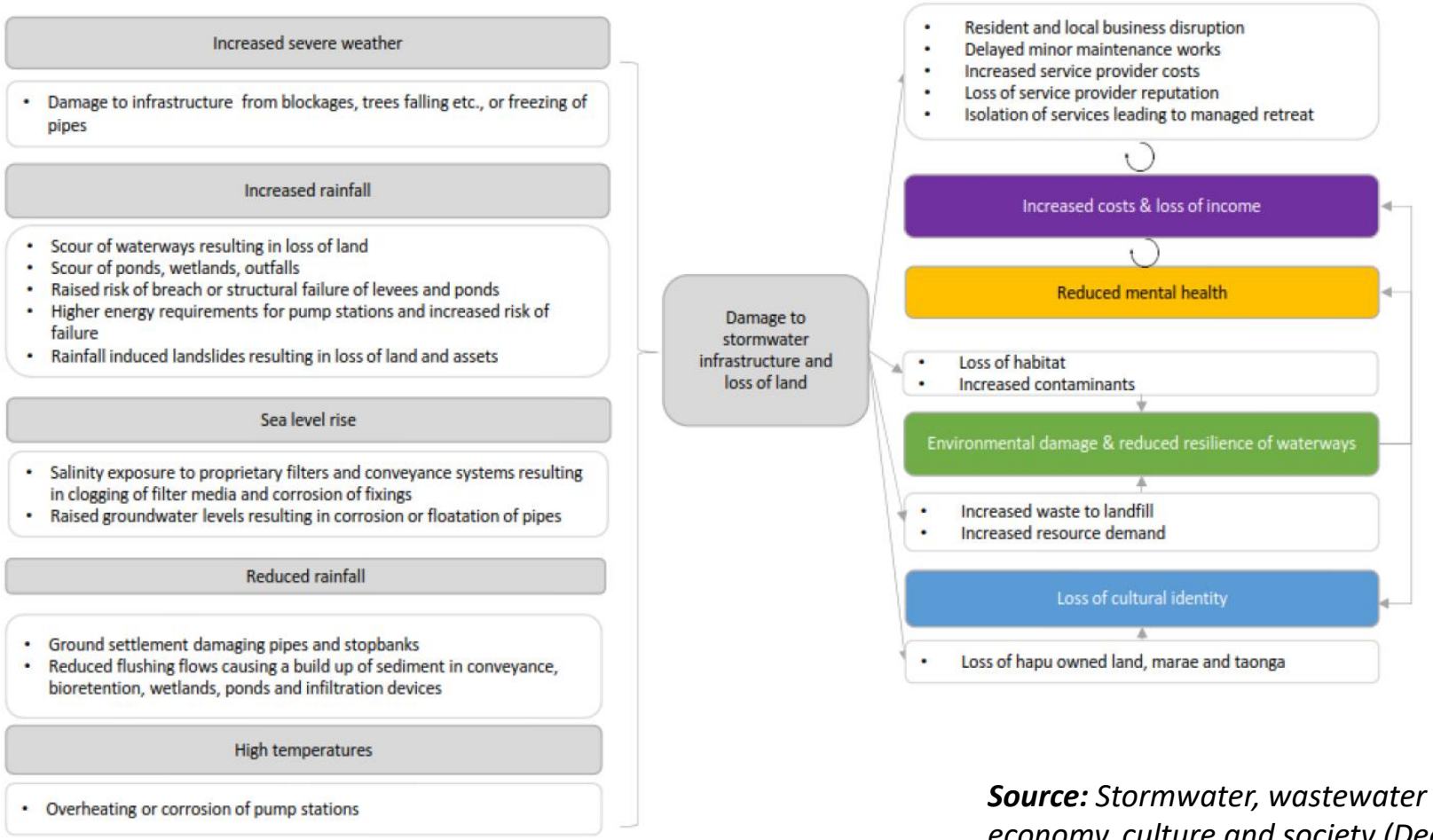
Background – Tasman Tempest

- 6x days - March 2017
- Wettest Auckland day in 58yrs

- Significant scouring
- Culvert overtopping
- Damage to:
  - Infrastructure
  - Businesses
  - Residential Property



Background – Wider flooding impacts



Source: *Stormwater, wastewater and climate change: Impacts on our economy, culture and society (Deep South National Science Challenge)*

Background – Project

Flood Impact Assessment Framework

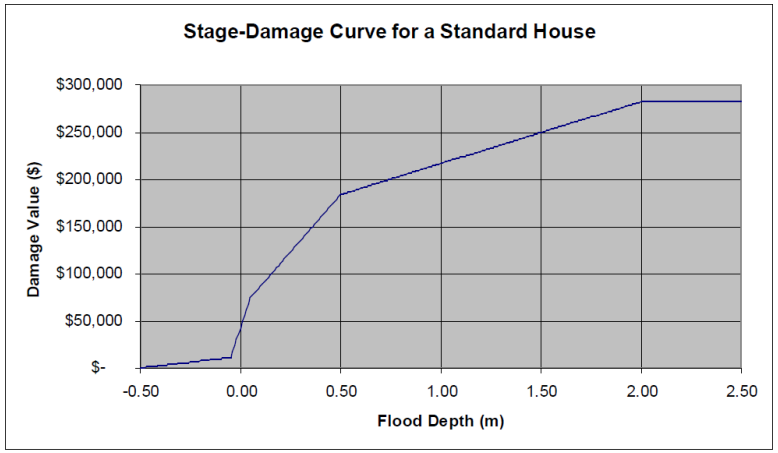
- Objective: to develop a framework that clearly defines the wider impacts of flooding on the community and infrastructure assets

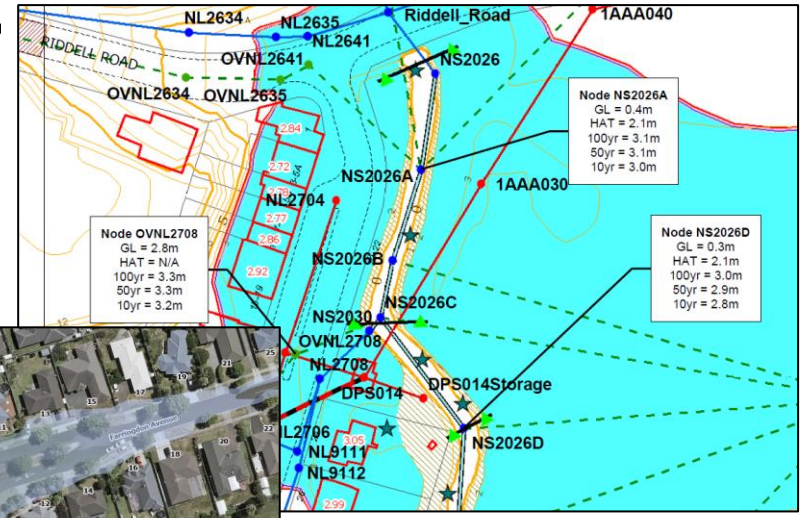
- Methodology:
    1. Review current local & international approaches
    2. Develop and test method for assessing wider flood impacts on the community and infrastructure assets
    3. Revise modelling specification to support the final method

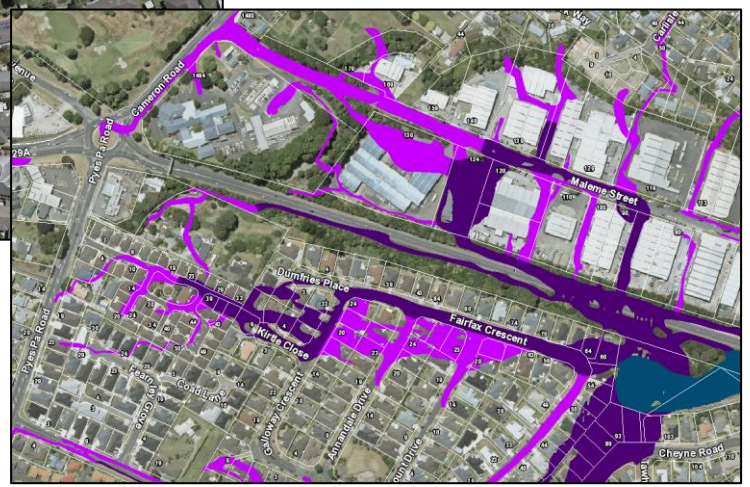
- Outcome: Improved planning and prioritisation of work

Measuring flood impact - NZ

- Count habitable floors
- Count non-habitable floors (sometimes by landuse type)
- Flood damage assessment (local data only)
- Hazard – often mapped, seldom assessed, generally inconsistent!







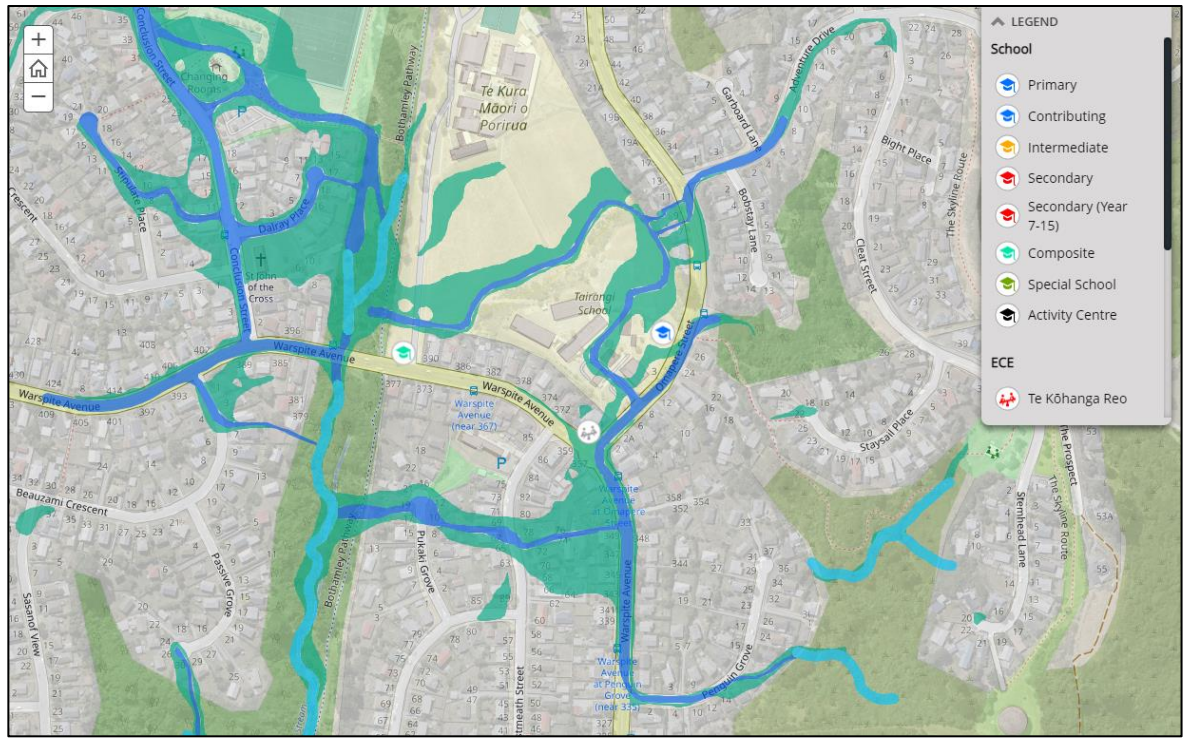
Measuring flood impact - NZ

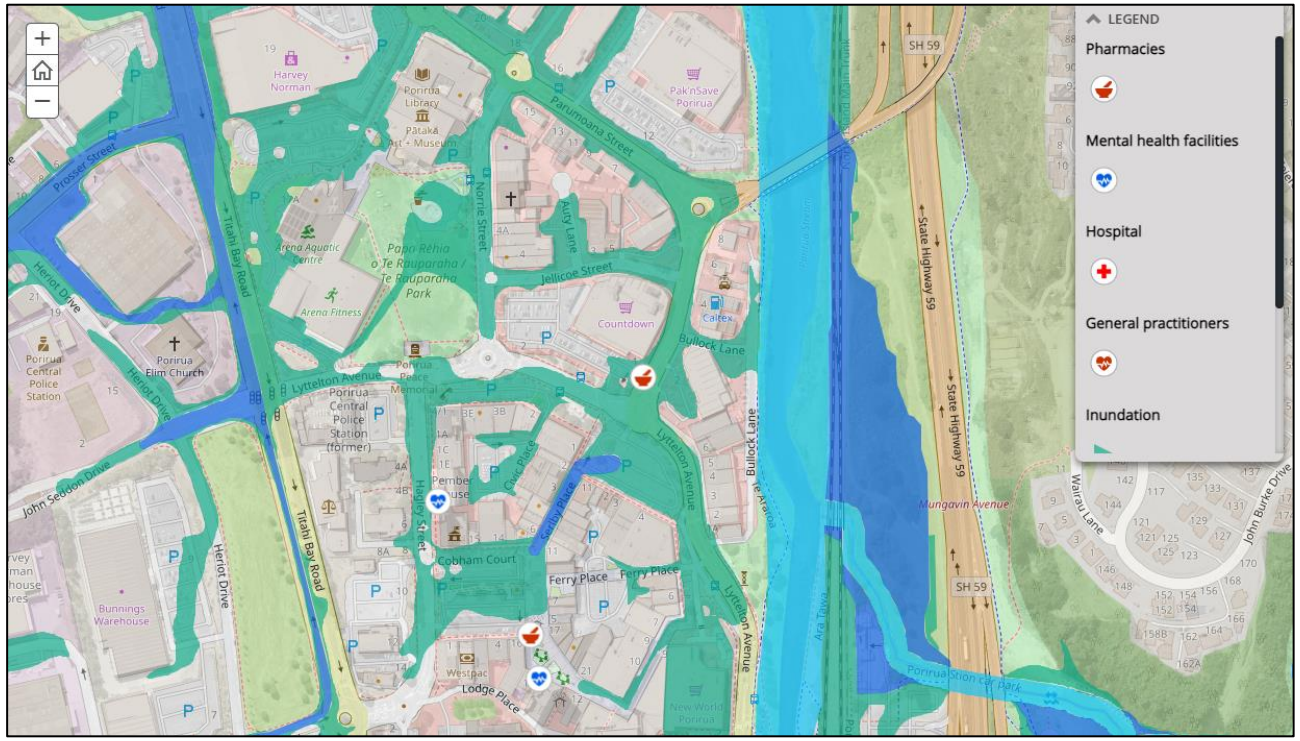
Organisation	Hazard Assessment
Auckland Council (Healthy Waters)	V > 2m/s, D > 0.3m or D x V > -20x+6
Auckland Transport	D x V > 0.4 to 0.6m^2/s for pedestrian safety D x V > 0.3 m^2/s for vehicle safety (traverse flow only)
Hamilton City Council	D > 1m, V >2m/s or D x V >1m^2/s
Tauranga City Council	D x V – all values mapped. Action taken where >0.4m^2/s for residential and >0.3m^2/s for non-residential
Wellington Water	Not used
Greater Wellington Regional Council	Not used historically – but recently published Modelling Standard uses the ARR General Flood Hazard Curve
Christchurch City Council	Not used
Dunedin City Council	UK (Defra) formulation of hazard

Measuring flood impact - NZ

Social vulnerability indicators for flooding in New Zealand

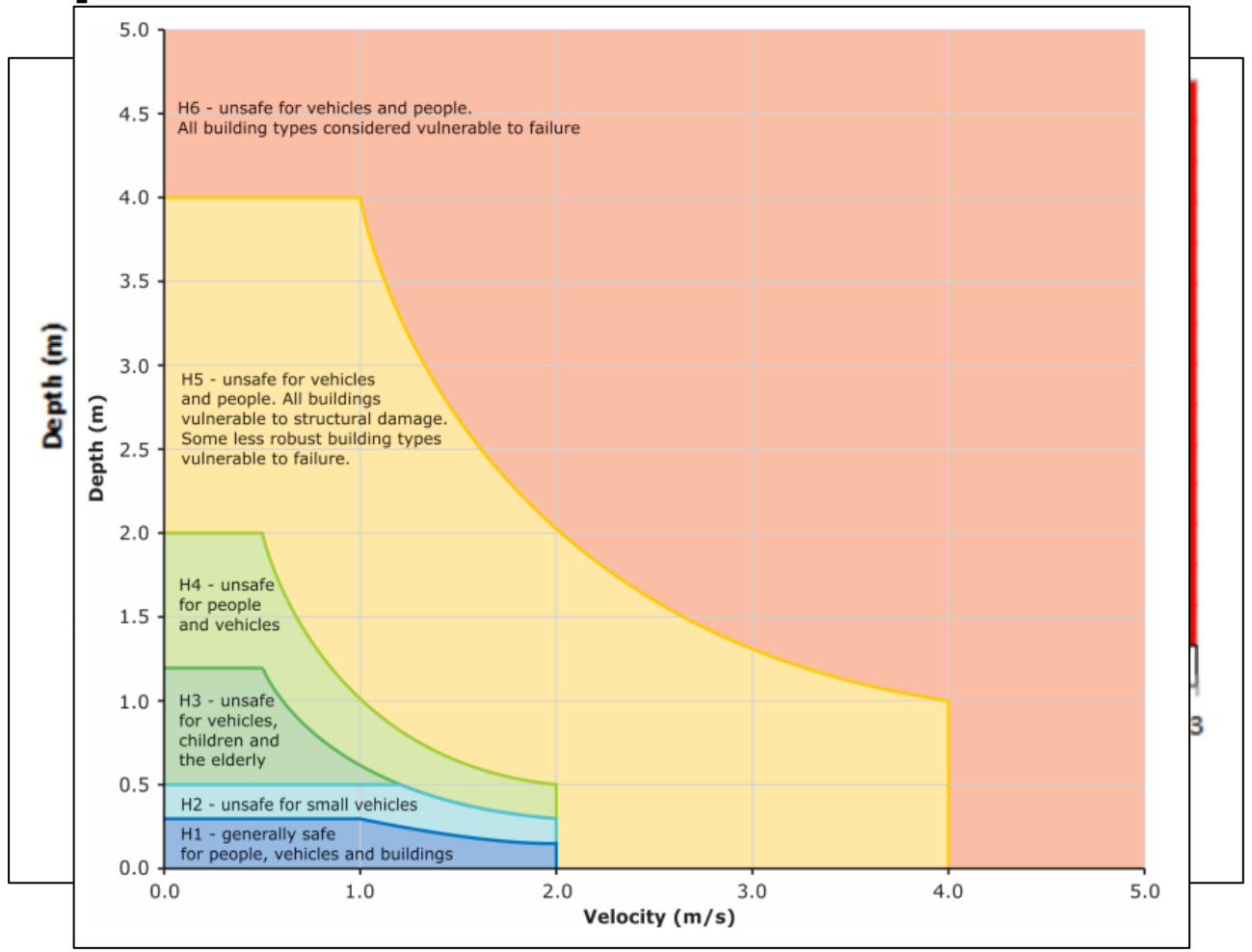
(www.ehinz.ac.nz/projects/social-vulnerability-indicators/)



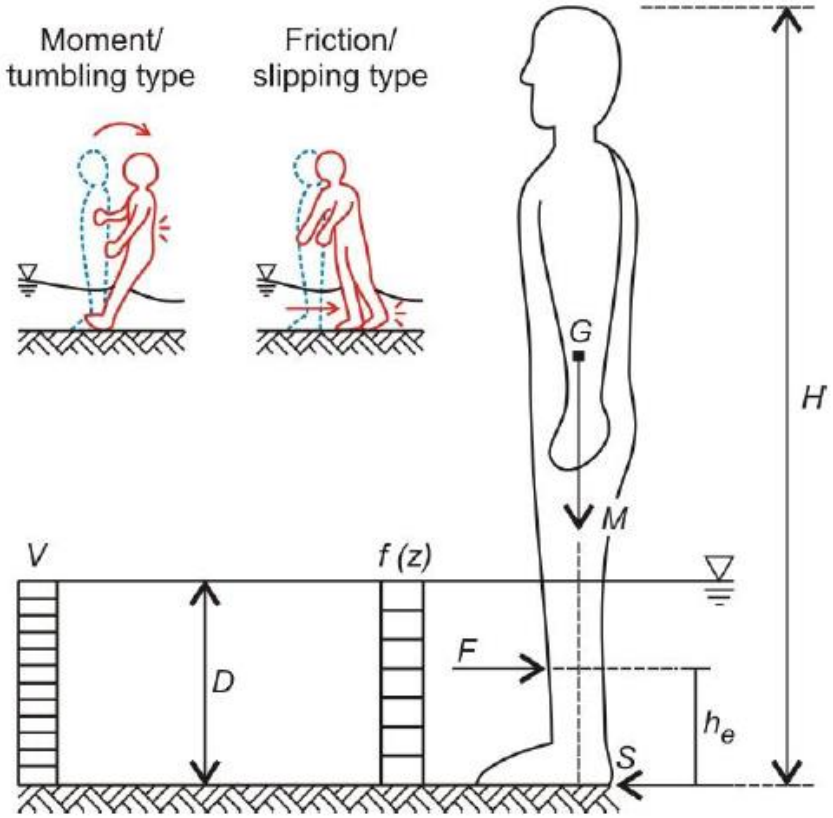


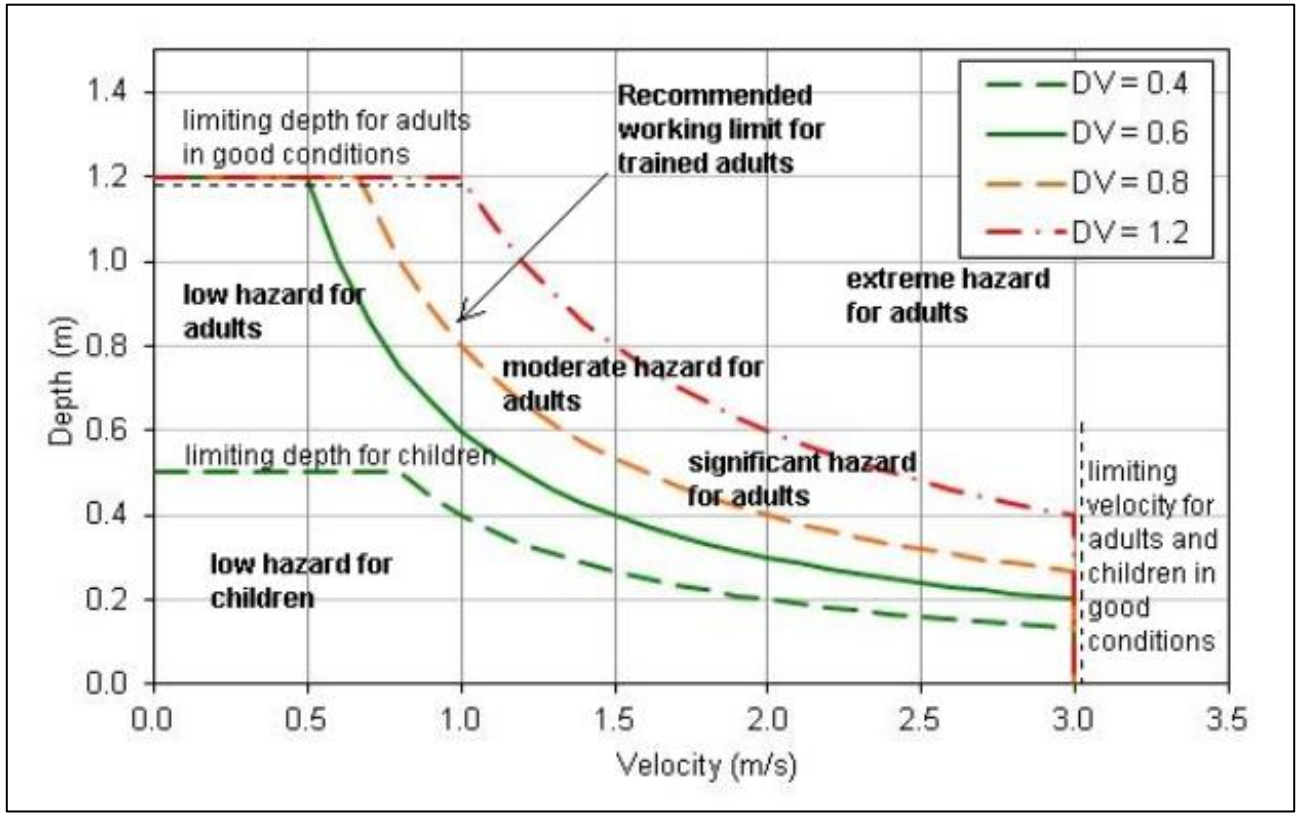
Measuring flood impact - Australia

- Guidance encourages consideration of:
  - People
  - Property
  - Infrastructure
- Flood Damage Assessment (generalised and local)
- (Older) Methods often applied in NZ
- General Flood Hazard Curve

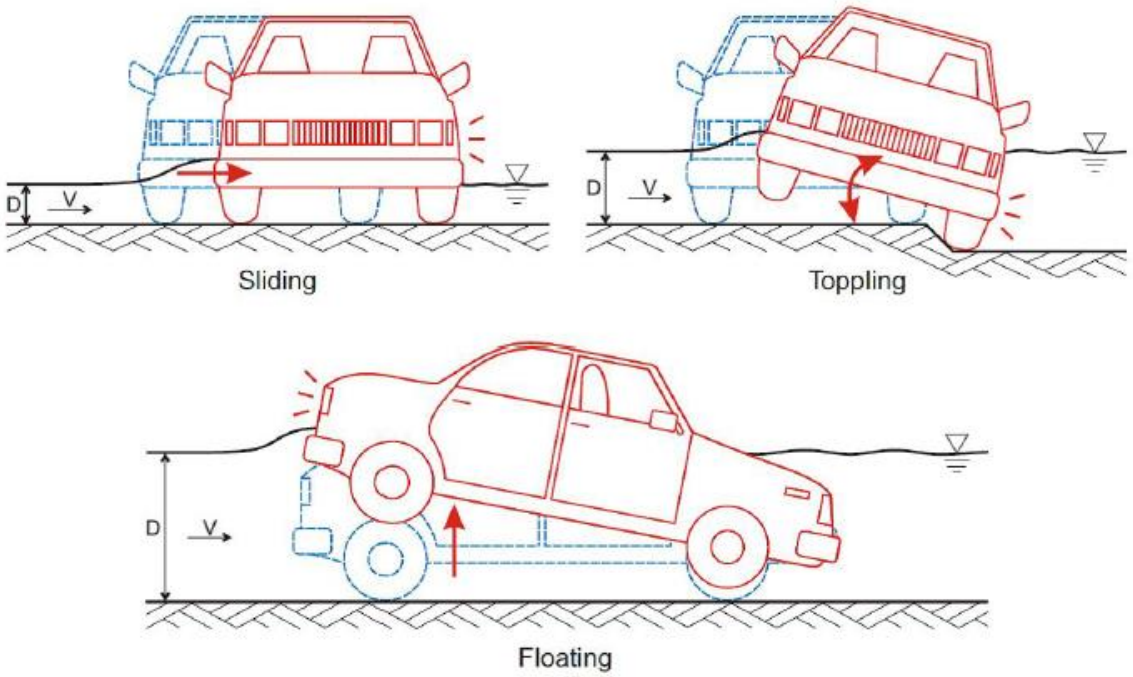


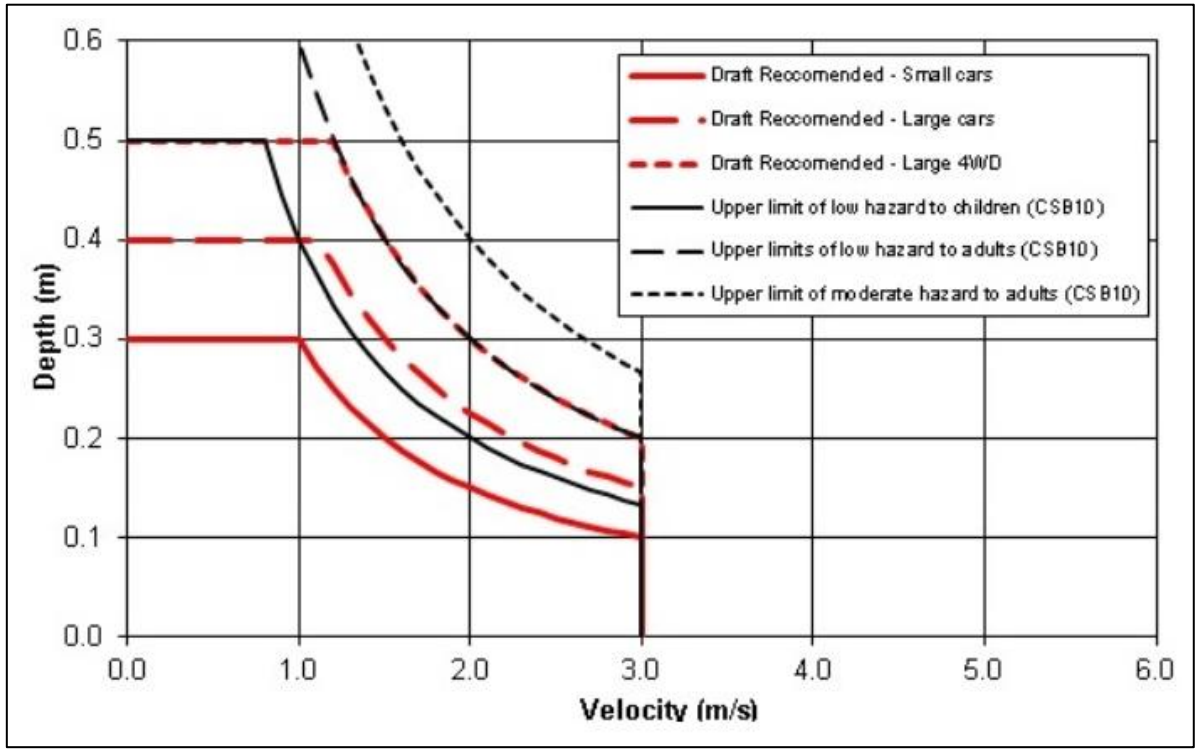
Measuring flood impact - Australia





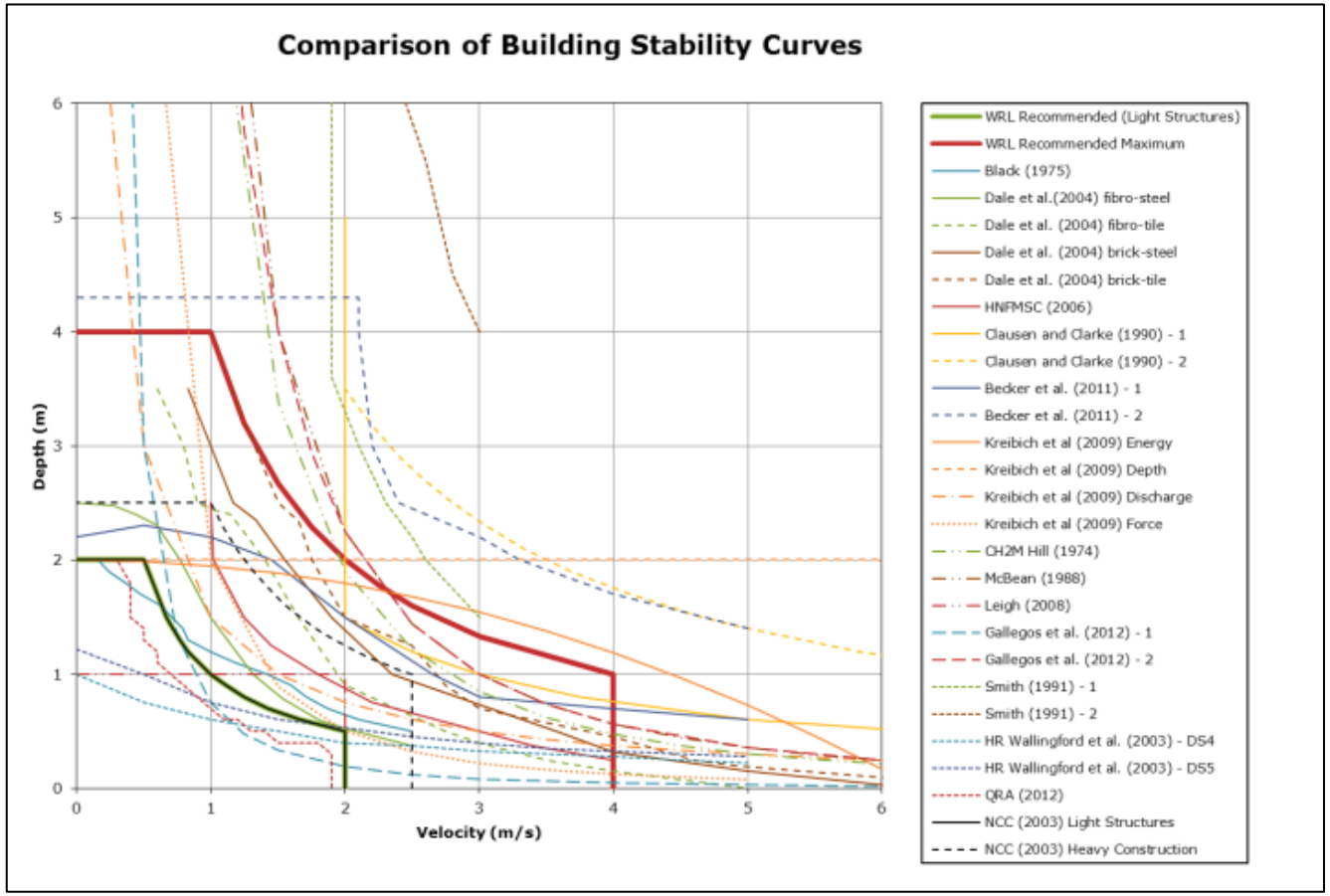
Measuring flood impact - Australia





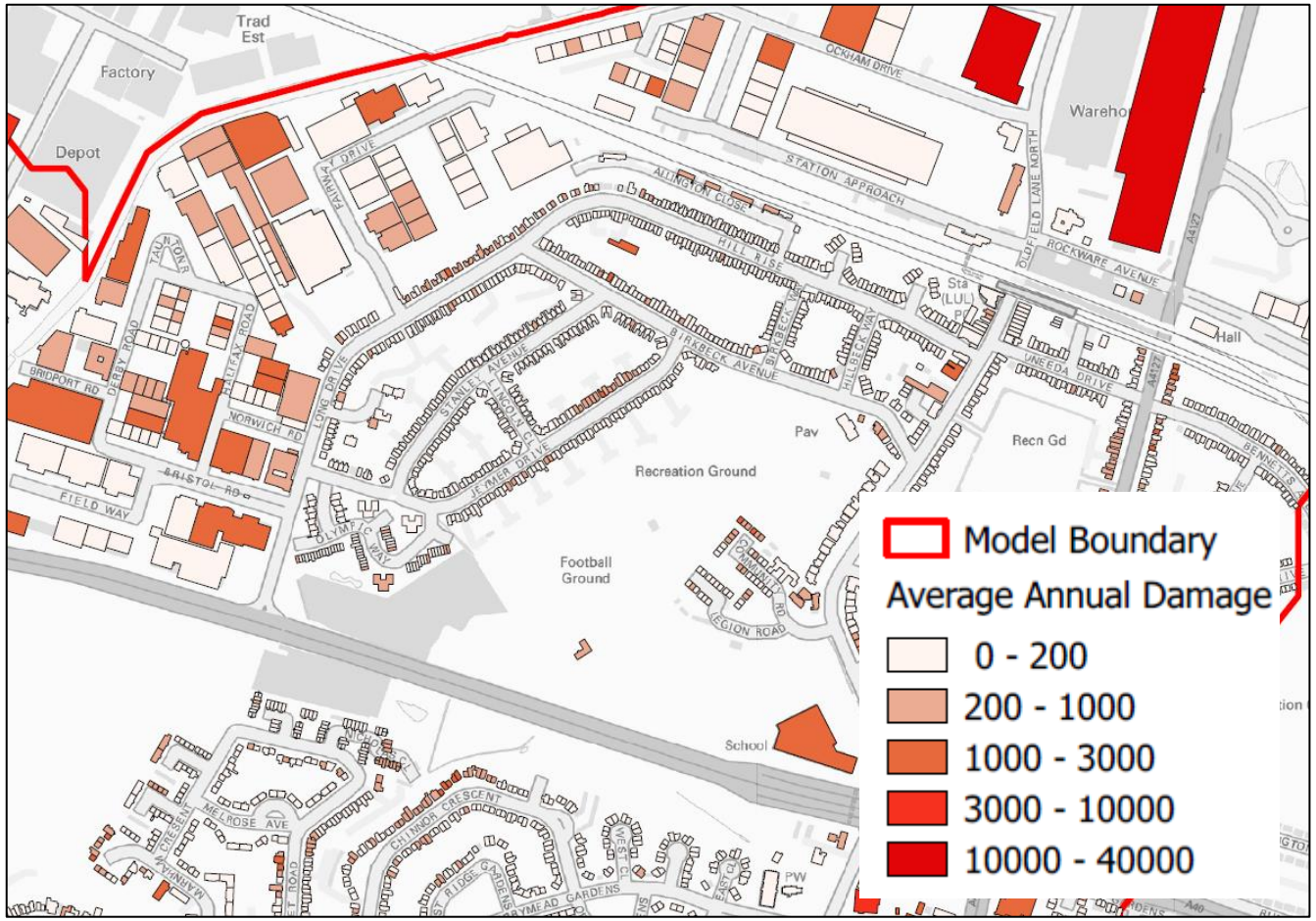
Measuring flood impact - Australia

- Variation in analysis methods
  - Some lab based
  - Some derived from field testing
  - Some derived from modelling
  - Some consider momentum & energy
- Significant uncertainty



Measuring flood impact - UK

- Financially focussed – categories:
  - Economic (~90% of effort)
  - Environmental (~8% of effort)
  - Social (~2% of effort)
- Long term policy – better protect households
- Advanced methods for damage assessment
- Hazard Rating – allows for debris



Measuring flood impact - UK

Flood Hazard

The Flood Hazard rating is calculated using the following equation:

$$HR = d \times (v + 0.5) + DF$$

where,

HR = (flood) hazard rating;

d = depth of flooding (m);

v = velocity of floodwaters (m/sec); and

DF = debris factor calculated using Table 3.1

Table 3.1 Guidance on debris factors for different flood depths, velocities and dominant land uses

Depths	Pasture/Arable	Woodland	Urban
0 to 0.25 m	0	0	0
0.25 to 0.75 m	0	0.5	1
d>0.75 m and/or v>2	0.5	1	1

Measuring flood impact

- The overall focus on 'people' impacts is clear
- Habitable floors are a good proxy for 'people' – but need to consider wider issues
- Impacts of flooding
  - People and communities – good understanding
  - Infrastructure – poor understanding
- Measuring impacts:
  - Primarily financial - flood damage assessment
  - Indirect & intangible – recognised, but not measured
  - Flood hazard – common modelled baseline dataset

Flood hazard – what is it?

Velocity?

Extent?

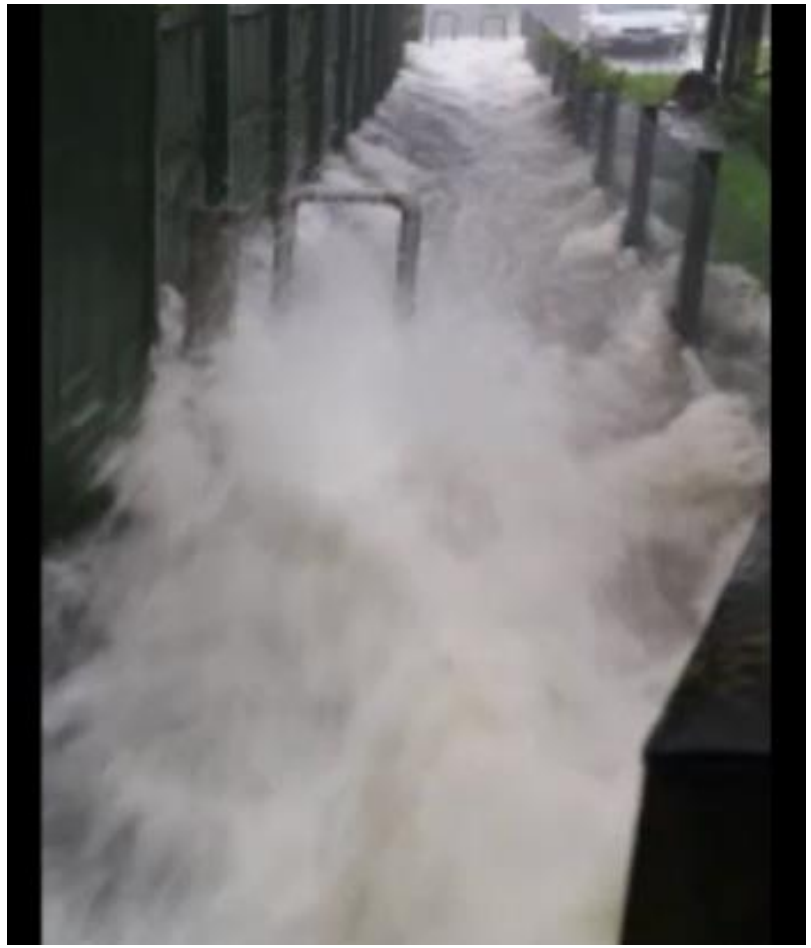
Depth?

Depth x Velocity?

How does the 'flood' impact people? vehicles? buildings?

What is the threshold for triggering action?

What about debris?!



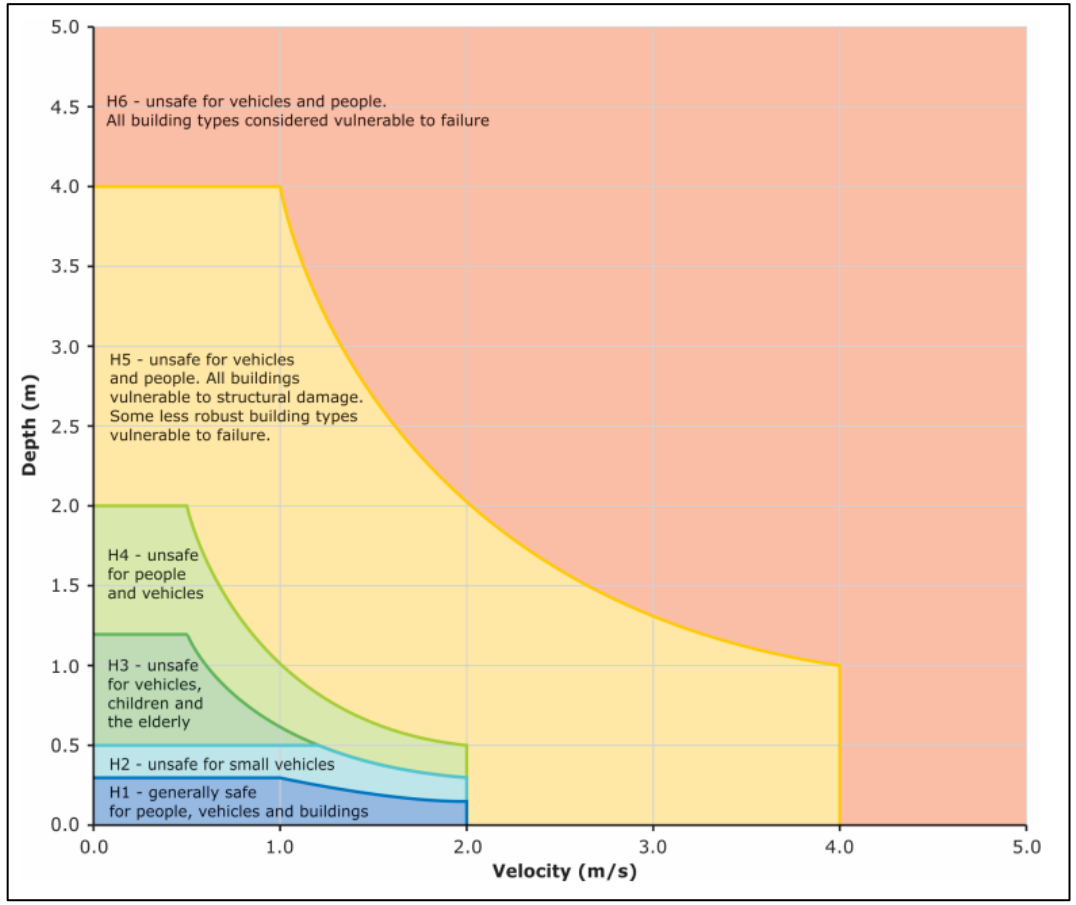
Flood hazard – what is it?

It's flooded…..

So what? How badly?

Well…that depends…..

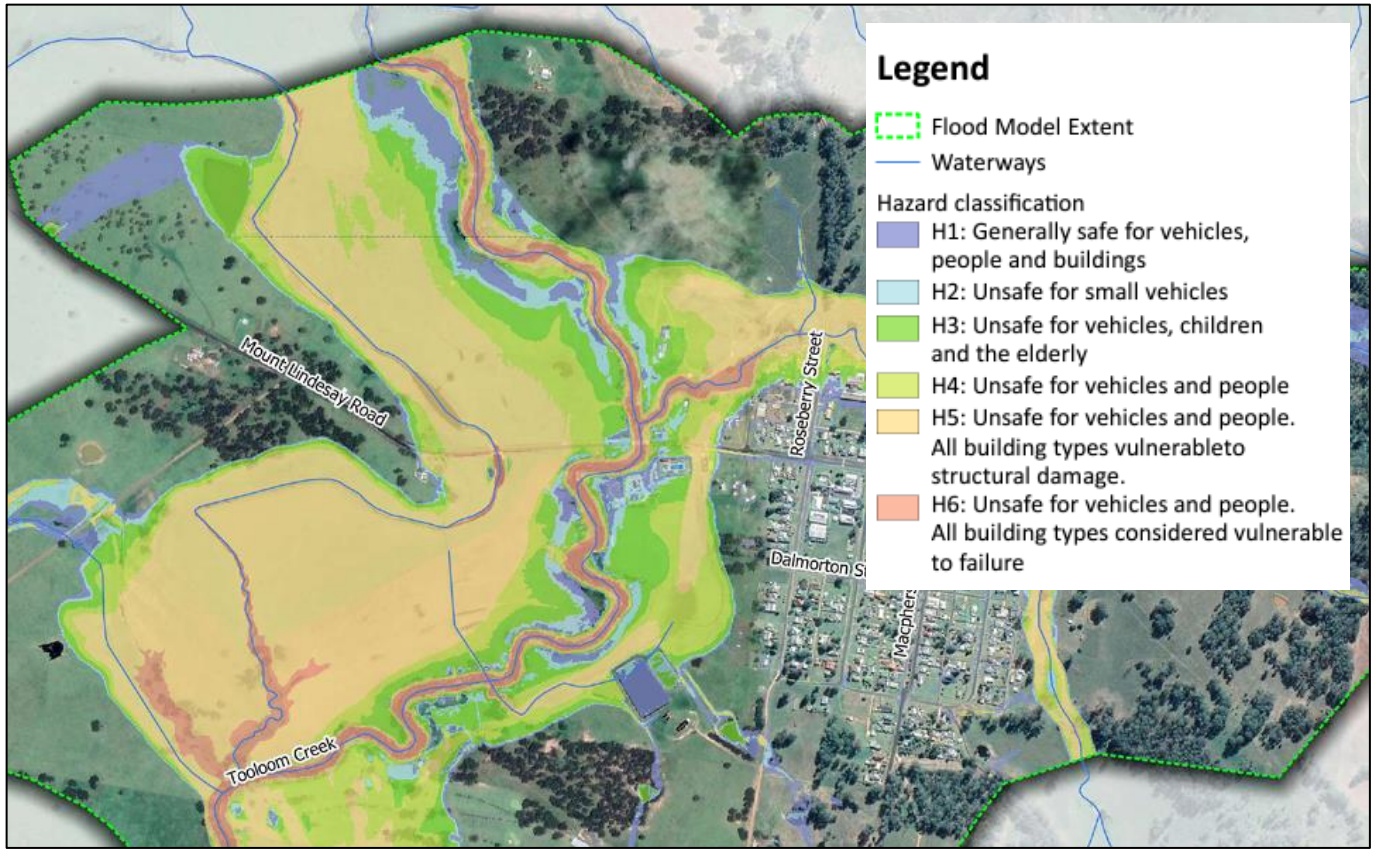
- Who might be there when it floods?
- When does it become unsafe?
- What is the threshold for damage? (functionally compromised?)
- What are the impacts of the damage? (cascading failures?)



Flood hazard – how to use it

- Inform the next step in decision making
  - What are the impacts?
  - Ability to recover?
  - Potential loss of life?
  - Loss of essential services?

- Inform emergency management
  - What is at risk?
  - Evacuation route planning?
  - Asset owner engagement (lifeline services)

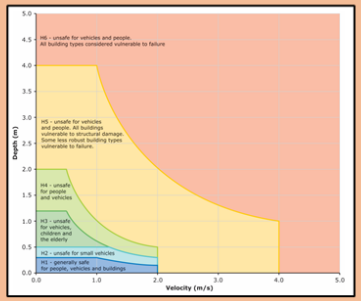


Flood Impact Assessment Framework

Output
Map of buildings / infrastructure / properties with impact ratings

Hazard

Flooding – Hazard rating used to measure potential impact on people, buildings, infrastructure and property



Vulnerability

Social – Factors that impact the ability of people and the land / infrastructure they rely on to recover from being flooded

Cultural – Factors that impact mana whenua and the wider communities ability to maintain their way of life after being flooded

Economic – The relative cost of recovering from flooding based on the physical attributes of property, building and infrastructure assets

Environmental – The potential for physical damage to or contamination of the environment

Impact Assessment

Impact Rating assigned based on combination of hazard / exposure / vulnerability for each potential measure within the vulnerability categories (refer Appendix C)

Exposure

Probability of hazard occurring (possible / likely / almost certain) + Location of people, buildings, infrastructure and property

Flood Impact Assessment Framework

Social – People, land use and infrastructure services

Cultural - Community and mana whenua's ability to maintain their way of life including community places and cultural practices

Flood Impact Assessment Framework

Economic - The direct and indirect costs that arise because of flooding

Date	Event	Categories	Cost ($m)
2022 Jan 15 - 15	Tonga Volcanic eruption and tsunami		5.87*
2021 Nov 3 - 5	Gisborne Floods	Flood	3.37
2021 Sep 9 - 13	South Island Windstorm	Wind, Storm	36.53
2021 Aug 30 - 31	West Auckland Flooding	Flood	62.29
2021 Jul 16 - 19	West Coast Flooding	Flood	97.2
2021 Jul 16 - 19	Wellington Floods	Flood	17.88
2021 Jul 16 - 19	Upper South Island Floods	Flood	17.35

Environmental - Potential for contamination and physical damage

Flood Impact Assessment Framework

- Applications
  - Common method for assessing impact (current and future scenarios)
  - Update modelling standard

- Trigger for action? Maybe…risk to life? risk to lifeline service?
  - Engage with asset owners
  - Emergency management – lifeline services & assets

Next steps

- Test using case studies – does the assessment represent reality?
- Map of high / medium / low impacts by property / land parcel / asset
- KISS – Keep it simple, stupid
- Identify what information from the modelling programme is needed

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Thank you!
Questions? Patai?

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