Woods

Create More Resilient Communities Anticipating Impacts of Climate Change

Simran Bassan, Ajay Desai, Pranil Wadan, Juan Alvarez De Lugo

water NEW ZEALAND
The New Zealand Water & Wastes Association Waiora Aotearoa

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Understanding and Defining Flood Risk

- Flooding is one of the most significant natural hazards faced by communities around the world
- Understanding flood risk becomes evermore important when considering Auckland anniversary weekend flood and Cyclone Gabrielle

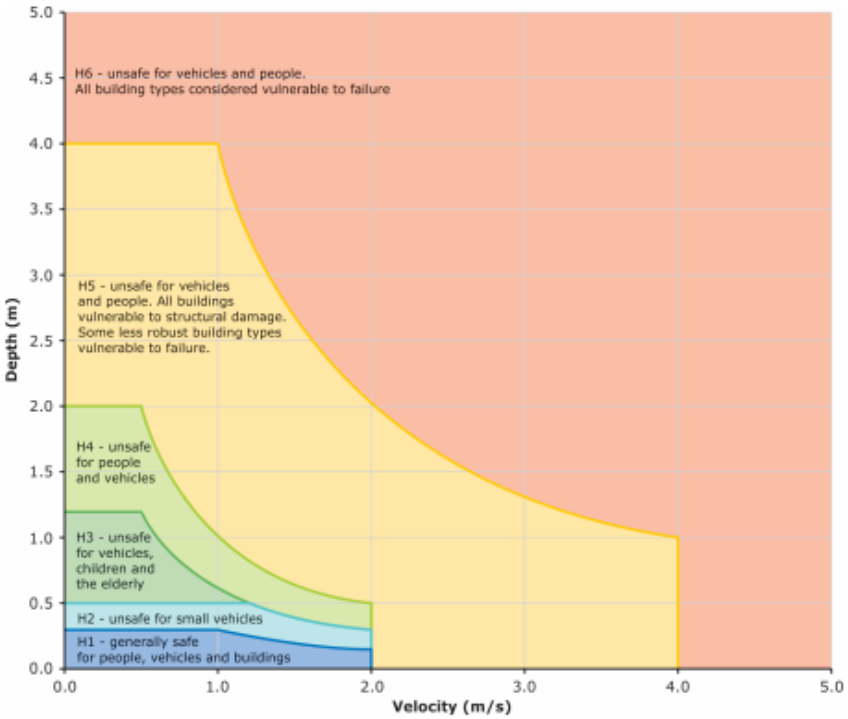
- Assess potential impact of flood hazards on the built environment - people and property

Tools for Assessing Flood Risk

- Assessment tools are critical in assessing flood hazards and associated damages

- Available tools:
  - Hazard vulnerability curves
    - Australia Rainfall Runoff Guidelines 2019 (ARR2019)
  - Flood fragility curves
    - RiskScape methodology - 'RiskScape: Flood fragility methodology', (NIWA, 2010)

Hazard Vulnerability Curves - ARR

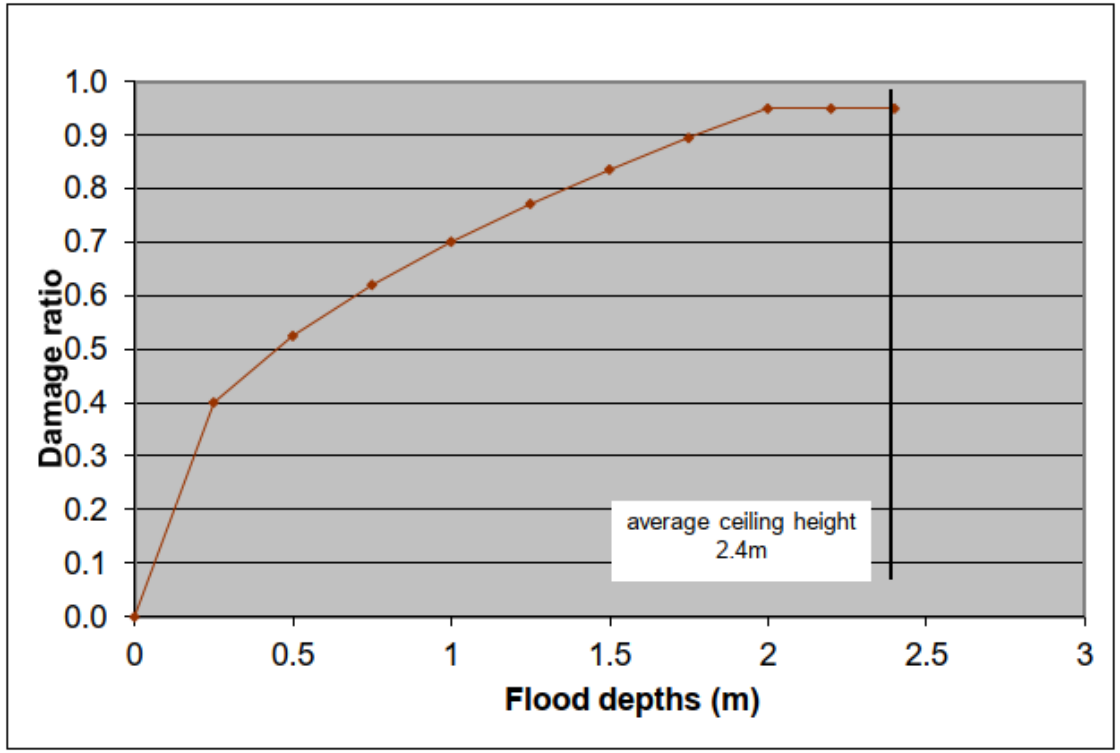


Hazard Vulnerability Classification		Classification Limit (D*V)	Limiting Still Water Depth (m)	Limiting Velocity (m/s)
H6	Structural failure	D*V > 4.0	-	-
H5	Structural damage	D*V <= 4.0	4.0	4.0
H4	All people and vehicles	D*V <= 1.0	2.0	2.0
H3	Children/elderly	D*V <= 0.6	1.2	2.0
H2	Small vehicles	D*V <= 0.6	0.5	2.0
H1	Generally safe	D*V <= 0.3	0.3	2.0

- Hazards are classified as H1 – H6 depicting increasing levels of flood risk
- Thresholds identify which different parties which will be at risk in different flood conditions

Flood Fragility Curves – Risk Scape Model

Fragility curves relate depth to damage ratio and damage state



Damage state	Description	Damage ratio
DS0	Insignificant	0–0.02
DS1	Light—Non-structural damage, or minor non-structural damage	0.02–0.1
DS2	Moderate—Reparable structural damage	0.1–0.5
DS3	Severe—Irreparable structural damage	0.5–0.95
DS4	Collapse—Structural integrity fails	> 0.95

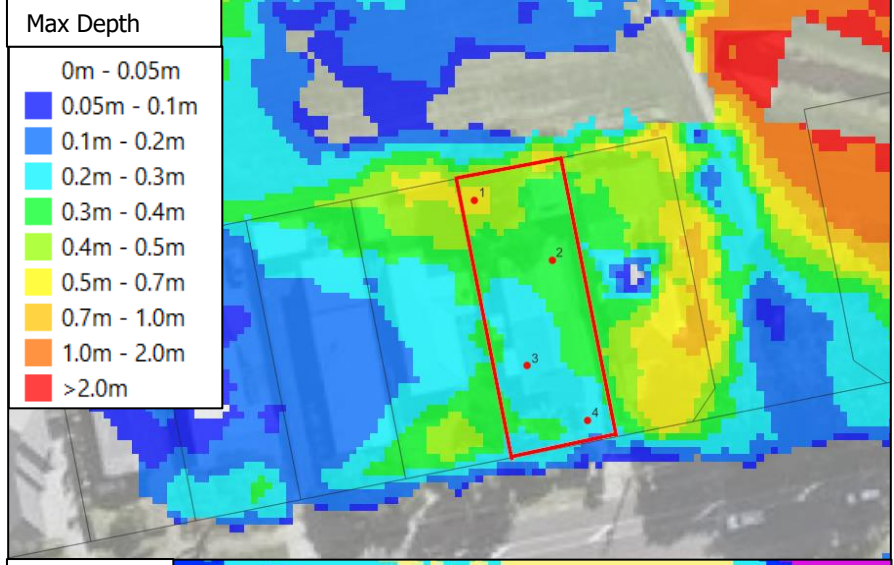
Damage states identify –

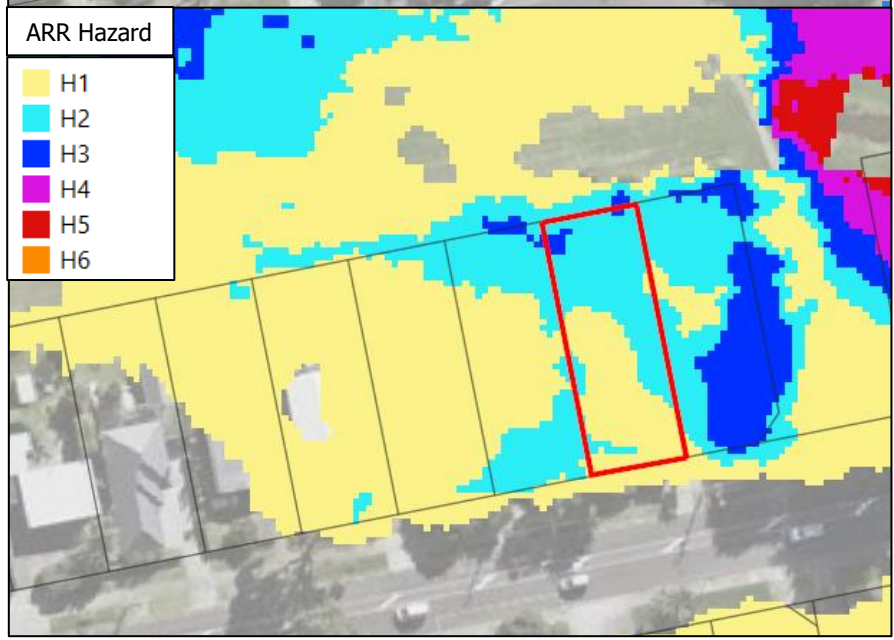
- Extent of damages to a building and its content
- Repair actions required to restore the structure to its pre-flood condition

Case Study 1 - Property flooding

- Model predicts 260mm-530mm of flooding for a 100yr event inclusive of climate change
- Analyse flood extents, flood depths, velocities as well as the depth * velocity
- Under the ARR guidelines, this property is to expect a flood risk level of H1, H2 and H3.

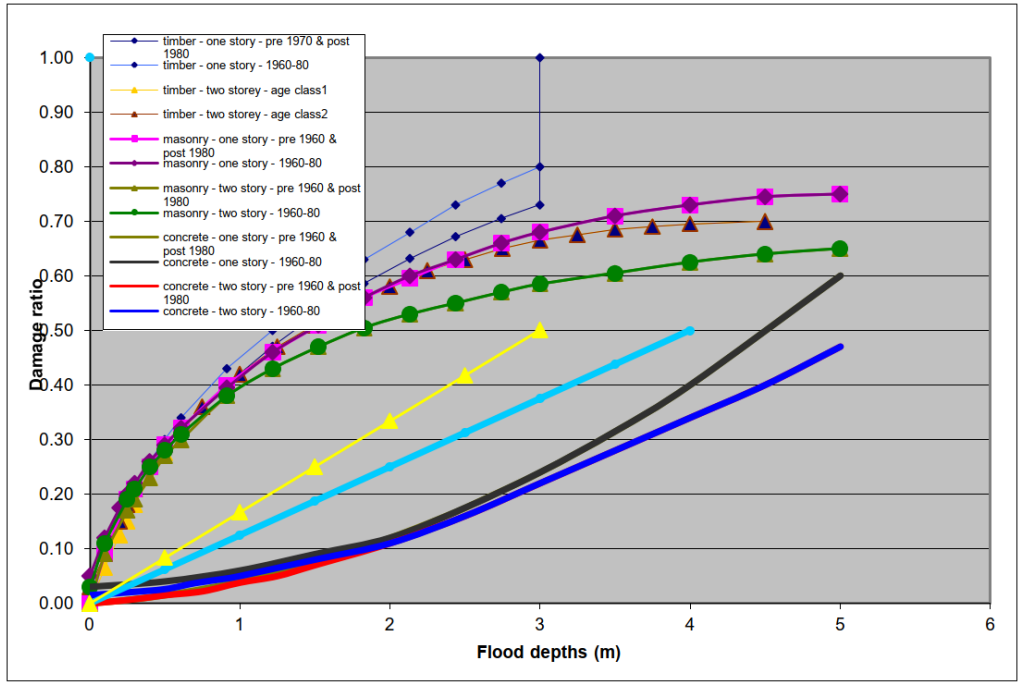
Location	Max Depth	Max Velocity	D*V	Hazard Vulnerability
Point 1	0.53 m	0.15 m/s	0.07	H3
Point 2	0.34 m	0.11 m/s	0.03	H2
Point 3	0.26 m	0.06 m/s	0.02	H1
Point 4	0.26 m	0.11 m/s	0.03	H1





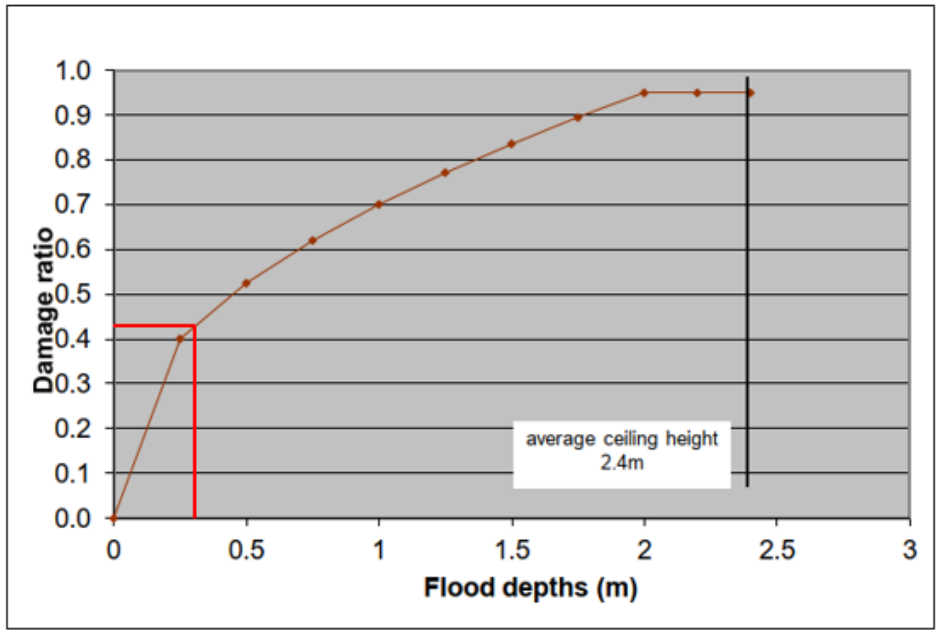
Case Study 1 - Discussion

- Under the ARR 2019 guidelines, this property is to expect a flood risk level of H1, H2 and H3.
- Floor levels were above peak water level and have freeboard
- Fragility curves can be used to assess the expected damage to the building



Case Study 2 – Internal Damage using fragility curves

- Approximately 300mm of flooding
- Damage ratio of 0.43
- Damage categorised in damage state 2

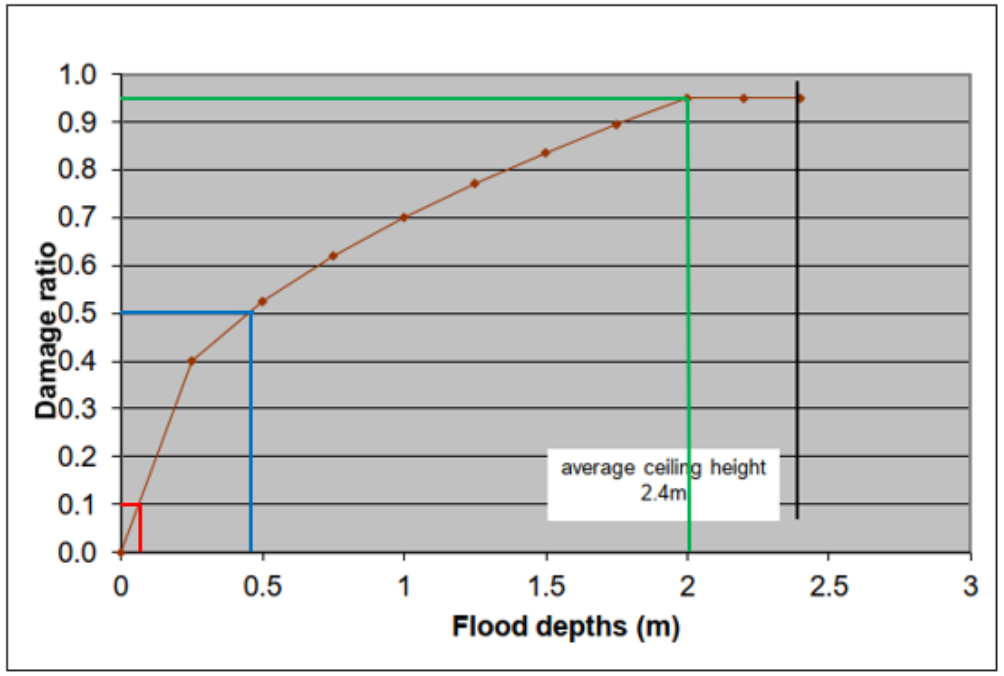


Legend

— Case Study

Case Study 2 – Discussion

- Damage State 1: Flood Depth < 100mm
- Damage State 2: 100mm < Flood Depth < 500mm
- Damage State 3: 500mm < Flood Depth < 2000mm



Legend

- Damage State 1
- Damage State 2
- Damage State 3

Assessing Effects

How does a change in water level effect the expected extent to damages?

- A higher flood level would typically result in more extensive damage to the house, which would require more costly repairs.
- **Within each damage state, it is unlikely that any increase in the water level, will cause significant change to the expected repair actions.**
- It is important to consider this concept when assessing the effects of development on a property
- Consider the real-life implications of the damage using damage data sets from previous flood events

Implementation

How do we create a more resilient communities?

- A common objective for councils is to create communities that are more resilient to natural hazards and the effects of climate change
- Ensuring the development of resilient infrastructure is best done at policy level that is enforceable
- Some current policies are subjective and may not provide clear directions.
- By setting more objective policies we limiting the influence of personal bias

Proposed Plan Change 78

Section B10.2.2 of this plan change discusses the management of natural hazards and climate change. Some relevant policies that may benefit from the adoption of this methodology are as follows:

(1) Identify areas potentially affected by natural hazards, giving priority to those at high risk of being affected, particularly in the coastal environment.

(3) Ensure the potential effects of climate change are taken into account when undertaking natural hazard risk assessments.

(8) Manage the location and scale of activities that are vulnerable to the adverse effects of natural hazards so that the risks of natural hazards to people and property are **not increased.**

Key Findings

- Vulnerability curves provide more of a holistic flood risk analysis at a catchment level
  - Analysis of hazards in conjunction with flood extents can be used to identify critical infrastructure and more at-risk properties

- Fragility curves can be used to analysis internal damage to specific sites more in depth
  - Assess the extent of damage and the expected repair actions with relation to flood depth

- This methodology can be included in policy to set more objective rules around the management of flood hazards and climate change.