

## How Much Risk Should We Take?

### Developing a Framework for Holistic Risk Based Floodplain Planning

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## Preface

- MBRC Regional Floodplain Database
- Steven Roso & Giorgis Hadzilacos
- One part of a 250 page guideline
- Please read the written paper
- Starting point for discussion
- Provide feedback

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## Overview

- Background
- Flood Risk Assessment Approach
- Flood Hazard Categories
- Risk Tables
- Risk Management Measures
- Conclusions

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## Background

- Risk = probability x consequence
- Traditional Flood Risk mainly focused on above floor flooding
- Other risks not well considered (e.g. building failure and isolation)
- Paper inviting industry feedback rather being definitive

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## Risk Assessment Approach

- Categories of consequence and categories of likelihood. (NERAG, 2010)
  - Acceptable Risk: not necessary to reduce the risk (green)
  - Tolerable Risk: reasonably practical measures to reduce risk (yellow)
  - Unacceptable Risk: society will not accept this risk and must be reduced to tolerable (red)

	Insignificant Consequence	Significant Consequence	Severe Consequence
Low probability	Green	Yellow	Red
Medium probability	Green	Yellow	Red
High probability	Yellow	Red	Red

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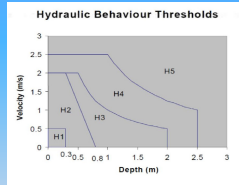
## Risk Types Considered

- Risk of isolation
- Risk to road access
- Risk to life in residential buildings
- Risk to life in non-residential buildings
- Risk to residential property
- Risk to non-residential property
- Risk to critical infrastructure

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## Hydraulic Hazard as a Metric

- Depth velocity product standard measurement of the flood 'hazard'.
- Multiple classifications, thresholds used in industry.
- Adopted Newcastle LGA (BMT WBM, 2008).



Low Risk to Life and property		High Risk to Life and property		
H1	H2	H3	H4	H5
No significant life risk Property risk only to items which come in direct contact with floodwaters such as building contents	Low life risk. Able bodied adults can walk safely. Cars can float and precautions must be followed to keep them out of floodwaters	Able bodied adults cannot safely walk Only large vehicles (trucks) can safely travel.	Major life risk Light frame buildings (e.g. houses) can fail structurally	Extreme life risk Majority of buildings could fail

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## Other Consequence Considerations

- Rate of rise
- Warning time
- Duration
- Vulnerability
- Criticality
- Affordability
- Cumulative Impacts

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## Probability and Risk Management Measures

- Apart from 1 in 100 event for above floor flooding, little guidance available for probabilities for other flood consequences
- Survey finds 1 in 500 or 1 in 1,000 too frequent for severe property damage consequences (Molino, 2012)
- Objective rather than prescriptive based risk management measures presented
- For extreme risks more than one measure may be required

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## Residential Property Risk

Event Range	H1 - H3 - no building structural damage			H4 - light frame structural damage	H5 - all frame structural damage	
	Above floor flooding All buildings	First floor flooding 2 storey or non ground floor unit	Ceiling depth Single storey or ground floor unit	Multistorey flood resistant unit block	All other dwellings	All buildings
1,000-PMF				4	2 and 4	3
100-1,000			1, 3 or 4	4	2 and 4 or 3	3
50 to <100	1 or 4	4	1 and 4, or 3	3	3	3
>10 to <50	1 or 3	3	1 and 4, or 3	3	3	3
10	1 or 3	3	3	3	3	3

### Potential Risk Mitigation Options:

- Lift minimum floor level
- Strengthen building
- Remove buildings
- Flood compatible building materials

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## Risk of Isolation

Event range	Maximum hazard category of surrounding floodwater					
	H1	H2		H3-H5		
		<24 hrs	>24 hrs	<24 hrs	<1,000people	>1,000people
1,000 - PMF				Non vulnerable population	Vulnerable population	
1,000 - PMF				1,2,3 or 4	1,2,3 or 4	1,2,3 or 4
100-1,000				1,2,3 or 4	1,2,3 or 4	1,2,3 or 4
50 to <100		1,2 or 3	1,2 or 3	1,2 or 3	1,2 or 3	1 or 2
>10 to <50		1,2 or 3	1 or 2	1,2 or 3	1 or 2	1 or 2
10		1,2 or 3	1 or 2	1,2 or 3	1	1

### Potential Risk Mitigation Options:

- Ability for entire population to be accommodated, until road access is restored, in buildings which are not flooded. Emergency power supply, food fresh drinking water supplies and road access to hospital grade medical facilities be available for full duration of the flood
- Warning system, community education program and evacuation plan which can be demonstrated to evacuate all people to a location outside of the flood affected area before evacuation routes are cut by H2 flooding.
- Ability to use large vehicles to access through H3 floodwaters for essential supplies and medical evacuations
- Ability to use fixed wing or rotary aircraft for essential supplies and medical evacuations

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## Risk to Road Access

Event Range	Road Type						Critical Evacuation Route
	Collector Road	Distributor Road	Sub-Arterial	Arterial	Highway	Motorway	
1,000 - PMF						4 or 5	2 or 3
100-1,000					4 or 5	4 or 5	2 or 3
50 to <100				4 or 5	4 or 5	4 and 5	1 or 2
>10 to <50			4 or 5	4 or 5	4 and 5	1, 4 and 5	1 or 2
10		4 or 5	4 or 5	4 and 5		1, 4 and 5	1 and 2

### Potential Risk Mitigation Options:

- Route raising to ensure its probability of flooding is at least tolerable
- Route capacity and warning time are sufficient for all to evacuate before road is cut
- Route raising to ensure its probability of flooding is acceptable
- Alternative route is available which is not flooded at this probability and is no more than two categories lower on the road hierarchy
- Route is cut for no more than 24 hours

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## Risk to Residential Lives

Event range	Maximum hazard category of floodwater surrounding residential building							
	H1	H2		H3		H4		H5
		<24hrs	>24hrs	<2hrs	>2hrs but <24hrs	<24hrs	>24hrs	
1,000 - PMP				1,2,3,5 or 6	1,2,3 or 4	1,2,3,5 or 6	1,2,3 or 4	1,2,3 or 4
100 - 1,000				1 and (2,3,5 or 6)	1 and 3, 2 or 4	1 and (2,3,5 or 6)	1 and 3, 2 or 4	1 and 2, 2 or 4
50 to <100		1,2,3 or 5		1 and 5, (2 and 5), or 4	1 and 2, or 3	4	4	4
>10 to <50	1,2,3 or 5	1,2,3 or 5	1,2 or 3	1,2,3 or 5	1 and 5, (2 and 5), or 4	1 and 2, or 3	4	4
10	1,2,3 or 5	1,2,3 or 5	1,2 or 3	1,2,3 or 5	1 and 5, (2 and 5) or 4	4	4	4

**Potential Risk Mitigation Options:**

- Warning system, community education program and evacuation plan which can be demonstrated to evacuate all people to a location outside of the flood affected area before evacuation routes are cut by H2 flooding.
- Able bodied occupants are able to walk to a flood free location ahead of rising floodwaters should they not evacuate until floodwaters enter the premises
- The building is flood resistant, there is a flood free refuge within the building and there is sufficient clean water, food and emergency power supply for the duration of the flood and there is a practical means of medical evacuation
- Voluntary purchase of building
- The building is flood resistant and ground floor level is above peak flood level
- The building is flood resistant and there is a flood free refuge within the building

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## Risk to Critical Infrastructure

Infrastructure Type	Within infrastructure categorization								
	Local water supply network	Trunk mains	Reservoirs/Towers	Water Treatment Plant/processing infrastructure	Water Treatment Plant/Storage tanks and pipes and mains leading out of WTP	Source (e.g. Dam) and main trunk			
Electricity	11 kV distribution system	33 kV power cables	33/11 kV substation	110 kV power cables	110/33 kV substation	275/110 kV substation & 275kV and higher voltage power cables			
Telecommunications	Cables connecting mst exchanges	Mini exchanges	Other mobile phone towers cables connecting terminal exchanges and mobile phone towers to switching centres and each other	Terminal Exchanges And critical mobile phone cables	intercity cables and cables between switching centres	Public transmission infrastructure used by emergency services	Telephone switching centres		
Emergency Services				Major Evacuation Centres	Station/Police/Fire or ambulance/SES	Major Evacuation Centre or Control Centre/Police/Fire/Ambulance/SES			
Storage and waste			Gravity Pipes	Storage dumps and waste tips or landfills	Storage Water Treatment Plant				
Health services			Medical Centres	Private Hospitals and aged care facilities	Local Public Hospitals	Regional Public Hospitals			
Duration						<24hrs	>24hrs		
Event Range						2 or 3	2 or 3	2 and 3	
1,000 - PMP						2 or 3	2 or 3	2 and 3	
100-1,000						3	3	2 and 3	
50 to <100		1, 2 or 3	2 or 3			3	3	2 and 3	
>10 to <50	1 or 3	2 or 3	3			3	3	2 and 3	
10	1 or 3	2	3			3	3	2 and 3	

**Potential Risk Mitigation Options**

- Means of restoring basic service within 48 hours.
- Provide backup/alternative system/service to provide adequate service for more than 48hrs. This includes power, telecommunications, access and consumables required to provide critical services
- Relocation of infrastructure.

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## Conclusions

- Additional tables for other risks in paper
- Need for holistic consideration of flood risks and consequences
- Limited data on acceptable probabilities
- Presented in order to receive industry feedback on methodology as well as opinions on thresholds of risk tolerance and appropriate mitigation measures
- Forum – [www.molinostewart.com.au](http://www.molinostewart.com.au)

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