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Cover Image: Surf Life Saving personnel receive education that promotes leadership and personal growth that can enhance their delivery of services to beachgoers.

Image: Surf Life Saving Australia.

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Contributions in the Research section of the *Australian Journal of Emergency Management* are peer reviewed to appropriate academic standards by independent, qualified reviewers.

Foreword



Blythe McLennan

Manager, Knowledge Development, AIDR.



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It's my pleasure to welcome you to the October 2025 edition of the Australian Journal of Emergency Management (AJEM) as the new Manager, Knowledge Development at the Australian Institute for Disaster Resilience (AIDR).

I've come to AIDR from Natural Hazards Research Australia where I was the Node Research Manager for Victoria and Tasmania, following a 12-year research career spanning disaster risk reduction, response and recovery. Moving into knowledge development at AIDR is an amazing opportunity to work with collaborators across the disaster resilience sector to develop and curate good practice, knowledge and resources that inform decision making and action. As well as contributing to this journal, I'll also be managing the Australian Disaster Resilience Handbook Collection and Glossary, as well as taking care of the What's New in Knowledge blog series, created by AIDR Executive Director, John Richardson.

It was an honour to begin my new journey at AIDR at the Australian Disaster Resilience Conference 2025 held in late August – a feat of research-based insights and diverse perspectives on policy and practice.

As well as meeting my new AIDR colleagues, I was thrilled to also meet the speakers, Resilience Lane exhibitors, and delegates who joined us in Perth as we explored the theme **'Embracing radical transformation: The future is now'**. A personal highlight for me was learning about the proactive, engaged and thoughtful on-the-ground resilience building work facilitated and led by local governments. I was also privileged to hear firsthand from people about the important role that AIDR fills as a supporter to so much good work being undertaken across the country. Proceedings from the conference 2025 are now available via the Knowledge Hub. Congratulations to everyone that contributed to making this year's conference such a success.

In this October 2025 edition of the AJEM, the research papers share a focus on learning from the diverse perspectives, experiences and capabilities of those who are, in various diverse ways, on the frontline of disaster risk reduction and recovery. This includes surf life savers, teachers and primary school students, community sector organisations, community-based environmentally focused groups, and public sector and international non-government organisation workers. Alongside these papers, you can read reports on cutting edge practices in the diverse areas of AI-enhanced lessons management, rapid assessment of critical road assets, and scenario-based training and curriculum design. In news and views, we celebrate 10 years of continuous improvement in lessons management in Victoria, and the growth of the DisasterWISE community-led learning network.

I have joined the AJEM team at an auspicious moment. Next year will mark 40 years since this journal was founded. It's a legacy to be proud of, and we will be celebrating this in a series of anniversary issues kicking off in January 2026. I'm looking forward to reflecting on past editions and working towards new ones with you.

Surf lifesaver perspectives on operational challenges and emerging issues, risks and hazards

Peer reviewed

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Introduction

Drowning is a significant cause of preventable injury-related mortality and morbidity globally, regionally and in Australia (Lawes et al. 2023; Peden et al. 2021; World Health Organization 2014). Estimates suggest 300,000 people died from accidental drowning in 2021 (World Health Organization 2024). This number is likely a significant underestimate due to the exclusion of drowning caused by boating incidents and disaster events like flooding (Peden et al. 2017). In 2023–24 in Australia, 323 people died due to drowning (Royal Life Saving Society - Australia 2024) and many more were hospitalised, treated at the scene or rescued by emergency services personnel including lifesaving personnel. In Australia, lifesaving personnel include paid and volunteer surf lifesavers and lifeguards (Surf Life Saving Australia 2024a).

Almost half of the national 2023–24 drowning burden (46%) occurred in coastal waters (Royal Life Saving Society - Australia 2024) with coastal environments having the highest number of drowning deaths since records began in July 2004 (n=150) (Surf Life Saving Australia 2024a). Given the significant contribution of coastal environments to the global and national burden of drowning (Koon et al. 2021; Surf Life Saving Australia 2024a), the provision of supervised swimming or bathing locations by lifesaving personnel is an important preventative and emergency response component of efforts to prevent drowning (Koon et al. 2023).

Surf Life Saving Australia (SLSA) is Australia's peak coastal water safety, drowning prevention and rescue authority (Surf Life Saving Australia 2023b, 2024a, 2024b). SLSA is an iconic organisation that delivers a range of services including coastal water safety, education and development programs, drowning prevention and emergency rescue services (Surf

Abstract

Surf lifesavers are an important component of Australia's emergency workforce. Despite significant coastal safety and emergency response knowledge, surf lifesavers are rarely consulted on coastal issues. This paper reports the findings of a survey of Surf Life Saving Australia members to determine perspectives on current and future coastal issues to better inform future support for members. In the 898 completed surveys, respondents identified 'swimming outside the patrol flags', a 'lack of swimming ability', 'rip currents' and 'increased coastal visitation' and 'extreme weather' as important coastal issues in their area. A total of 61 per cent of respondents felt these issues were changing and there was a need to respond to emerging challenges presented by increased beach visitation, language needs for culturally and linguistically diverse communities, low or poor understanding of beach conditions and surf knowledge, a lack of understanding of the flags and poor knowledge of coastal erosion. Addressing these issues via public education, changes to signage, safety campaigns and training should be considered. The survey findings influence Surf Life Saving Australia practice through development of behaviour change focused public education materials and improved member training. These findings serve as a baseline for repeat surveys in the future to assess change that supports this essential workforce into the future.



SLSA provides programs and workshops that promote leadership and personal growth helping members provide the best-possible service to beachgoers.

Image: Surf Life Saving Australia

Life Saving Australia 2024a). SLSA also facilitates many competitions (at recreational and elite levels) as well as provides a range of leadership, diversity and inclusivity programs for people aged 5 years and above (Surf Life Saving Australia 2023b). The net benefit of SLSA to the Australian community has been estimated at \$97 billion dollars (Deloitte Access Economics 2020). SLSA provides an integrated national surf lifesaving service comprising volunteer surf lifesavers and paid lifeguards, known as the Australian Lifeguard Service. Surf lifesavers and lifeguards are community members who, for over 100 years, have patrolled coastal beaches and kept people safe (Booth 2001; Fien et al. 2021). Surf Life Saving and the iconic red and yellow beach safety flags are embedded into the Australian culture as, historically, personnel have risked their own lives to assist people who are hurt, injured or may be at risk of drowning or other serious injury (Fien et al. 2021; Fien et al. 2023; Surf Life Saving Australia 2024a).

Lifesaving personnel are trained to established standards under the Australian Vocational Education and Training system (Australian Government 2024; Surf Life Saving Australia 2024b). Many state entities also have registered training organisations available through the National Register of Vocational Education and Training. The overarching goal of lifesaving personnel is to prevent drowning and injury of people at the coast and the tasks undertaken by patrolling and non-patrolling personnel expose them to a range of challenges on and off the beach (Fien et al. 2021; Lawes et al. 2021a). Such experiences

highlight that SLSA's lifesaving personnel are a skilled and knowledgeable workforce whose understanding of broader coastal, societal and cultural issues have largely been unexplored. Depending on their experience, surf lifesavers and lifeguards are likely to be extremely knowledgeable about various coastal risks, hazards and issues (e.g. the rip current hazard) (Brighton et al. 2013; Kelly et al. 2025), which they regularly encounter. Unfortunately, this knowledge of, and direct experiences with, coastal risks and hazards is anecdotal and has not been formally captured nor investigated.

SLSA conducts research to provide evidence-informed insights and understanding to improve water safety and practice and to guide education (Cooney 2020; Lawes et al. 2021b, 2021c; Lawes et al. 2020; Lawes et al. 2021d; Reid et al. 2025; Surf Life Saving Australia 2023b, 2024a). Surf lifesavers and lifeguards are frontline responders to all incidents that occur along the Australian coastline (Kelly et al. 2024; Koon et al. 2023; Lawes et al. 2021e; Lawes et al. 2020; Reid et al. 2023; Reid et al. 2025) and they have a wealth of practical experience and knowledge in coastal safety and emergency response. Despite this, their contribution has rarely been considered when reviewing coastal safety risks and issues as well as when determining priorities for investigation and blackspot areas. The exclusion of their input is a missed opportunity, particularly in developing future risk mitigation strategies, appropriate and relevant educational material and identifying high-risk demographic groups.

This study investigated the perceived challenges and emerging coastal issues that surf lifesavers and lifeguards face while on patrol across Australia's 11,000 mainland beaches (Short 2006). Specifically, the objective of this study was to document surf lifesaver and lifeguard knowledge and experiences including:

- understanding perceived current coastal issues
- perceived emergent coastal issues
- perceptions whether issues are changing
- knowledge and understanding of available information
- what may need to change to address future coastal safety concerns and meet the needs of the community.

The findings of this study provide valuable information to assist the development and delivery of relevant future beach safety interventions that protect beachgoing communities in Australia.

Methods

This study was a cross-sectional analysis of anonymous survey data collected from SLISA members between 15 February and 30 April 2018. Repeated surveying of the cohort was interrupted due to the COVID-19 pandemic, so this study provides a baseline against which future surveys can be assessed.

Survey design

An online survey included questions designed to identify national and regional coastal safety issues and concerns as perceived by surf lifesavers and lifeguards. The aim was to inform future strategic actions within SLISA and the surf lifesaving movement. The survey was developed in collaboration with its other departments and was tested by staff prior to being promoted. The survey consisted of 10 closed- or open-ended questions and sought information on topics including:

- member demographics (i.e. position within surf lifesaving, gender, local government area or council area where services were delivered)
- perceptions of current issues on the coast in their area (i.e. coastal hazards, beachgoer activities and other issues such as mental health, violence and language barriers) ranked on a 5-point scale from not an issue (scored as 1) to a severe issue (scored as 5)
- respondents' perceptions regarding whether these issues were changing or if new issues were emerging in their area of service delivery.

For survey questions with multiple-choice response options, an additional text field was provided to allow further details to be added if respondents wanted to. The survey also asked respondents for their views on public visitation to the coast in their area, how often they receive questions from the public about coastal safety, if they feel

they have the right information to be able to respond to such questions and their level of awareness and knowledge of latest trends and information on coastal drowning incidents. Respondents were asked if they felt changes were needed to address future coastal safety concerns and the needs of the community.

Recruitment and sample collection

The online survey platform, Survey Monkey, was used to collect responses. The survey ran from 15 February to 30 April 2018. The survey was emailed to all SLISA members who had previously elected to receive email communications. It was also included in SLISA's monthly newsletter, which is sent via SLISA's direct mail database. The newsletter included the survey link and described the purpose of the survey, what was being asked of respondents and that responses would be anonymous.

The SLISA patrolling membership included members from all states and the Northern Territory. When the survey was conducted, membership comprised 61% male and 39% female members (Surf Life Saving Australia 2018a). Any person who received the invitation to participate could respond and no inclusion or exclusion criteria were applied. Respondents were not reimbursed for their participation in the survey.

Data cleaning, coding and analysis

The survey averaged 5 minutes to complete. All survey results were exported into Microsoft Excel for analysis. Descriptive analyses were used for most questions and responses were post-weighted for questions where responses were scalable. For issues where level or concern or severity were rated on a 5-point scale, these ratings were converted to numeric values (1 to 5) and given an average score out of 5.

Data from the open text questions were analysed using a qualitative thematic analysis approach (Castleberry and Nolen 2018). The survey responses were thematically coded into overarching categories via dual independent coding following the process outlined by Braun and Clarke (2021). This process included responses being read and reread with initial codes and themes generated separately by each coder. Themes and codes were reviewed and condensed through an iterative coding process and resulted in the development of the overarching themes (Braun and Clarke 2021).

Ethics

Human research ethics approval for the analysis of the survey data was granted by the University of New South Wales Human Research Ethics Committee (approval number: HC230179). The University Ethics Committee granted a waiver of consent to use anonymous data for the purposes of a secondary analysis.

Results

The survey was sent to 125,869 SLSA members. A total of 1,007 responses were received with 898 being fully completed. These were included in the final analyses (0.7% response rate, 89% completion rate).

Sample demographics

Nationally, 81% of respondents were surf lifesavers, 5% were lifeguards and 14% held both roles (i.e. were both surf lifesavers and lifeguards). Most respondents were male (n= 691, 77%) and the majority of respondents were from New South Wales (n=393, 44%) followed by Queensland (n=194, 22%) and Victoria (n=121, 13%). These demographic distributions were broadly in-line with service distribution nationally as shown in Table 1.

Perceptions and attitudes about coastal issues

When asked 'What do you perceive as current issues on the coast in your area?', the multiple-choice option of 'swimming outside the patrol flags' ranked as the number one selection by respondents with a weighted average of 3.32 out of 5. This was followed by 'a lack of swimming ability' (weighted average of 3.17), 'rip currents' (a weighted average of 3.14) and 'increased coastal visitation' and 'extreme weather' (a weighted average of 2.56, respectively). Other issues were assessed as being of moderate to minor concern (see Figure 1).

These responses differed by state and territory. Swimming outside the red and yellow on-beach flags was the top-

rated issue of concern in Queensland, South Australia, Tasmania, Victoria and Western Australia. The top concerns of New South Wales were rip currents that outranked swimming outside the flags. In the Northern Territory, marine creatures, alcohol/drugs and extreme weather made up the top 3 selections. Surprisingly, swimming outside the flags did not appear in the top 5 issues of concern in the Northern Territory. The lack of swimming ability and mental health issues were fourth and fifth place, respectively (see Figure 2).

When asked 'Are the coastal issues in your area changing or are there new issues emerging? If yes, please detail', more than half of respondents reported that the coastal issues in their area were changing (n=550, 61%) and a third of respondents thought that they were not (n=336, 37%). Of those respondents who considered the coastal issues in their area were changing, increased visitation was identified by almost half (n=243, 44%) as the number one emergent issue for coastal areas, followed by thematic codes of increasing visitation by multicultural or culturally and linguistically diverse (CaLD) communities (n=95, 17%), low/poor understanding of beach conditions/surf knowledge (n=90, 16%), lack of flag awareness (n=66, 12%) and coastal erosion (10%). Figure 3 is a word cloud that represents the weighting of the concerns resulting from the survey.

Knowledge, information and community engagement

When asked 'How do you perceive public visitation to the coast in your area?', most respondents (n=701, 78%) reported a perceived increase in public visitation to their

Table 1: Demographic profile of survey sample and broader Surf Life Saving Australia patrolling members as at 2018.

	Survey sample		SLSA patrolling members (as at 2018)	
	N	%	N	%
Total	898	100.0	42,740	100.0
Female	204	22.7	16,274	38.1
Male	691	76.9	26,459	61.9
Other/unknown	3	0.4	7	0.02
Position within SLS				
Surf lifesaver	724	80.6	-	-
Lifeguard	49	5.5	-	-
Both	125	13.9	-	-
State or territory of residence				
New South Wales	393	43.8	18,903	44.2
Queensland	194	21.6	8,792	20.6
Victoria	121	13.5	6,635	15.5
Western Australia	90	10.0	4,813	11.3
South Australia	56	6.2	2,693	6.3
Tasmania	26	2.9	746	1.7
Northern Territory	14	1.6	158	0.4
Unknown	4	0.4	-	-

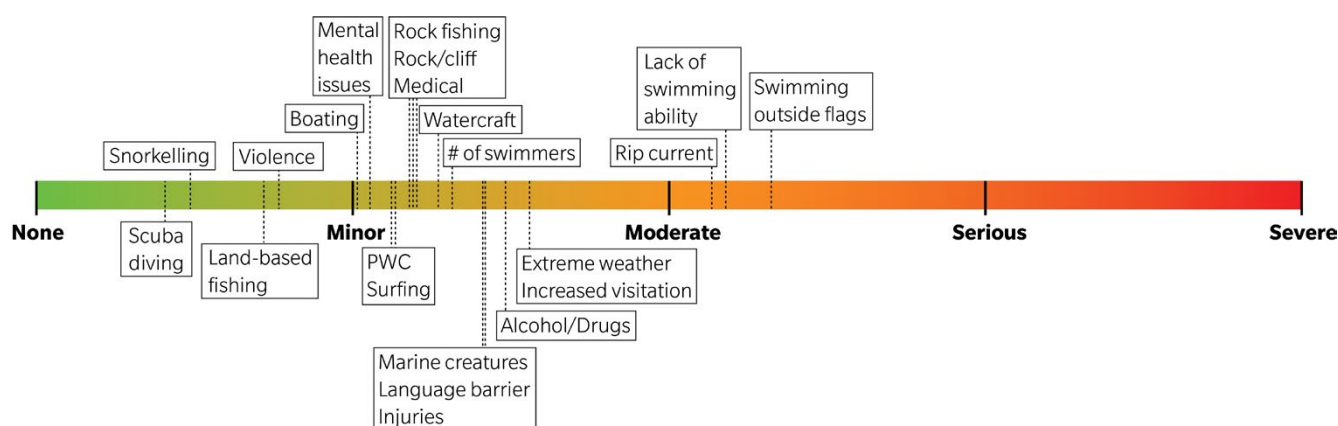


Figure 1: Current coastal issues identified by SLSA members weighted by importance.

local coastal area while 15% reported no change (n=136) and 1% reported a perceived decrease (n=11). Five per cent of respondents reported other changes (n=48) and the dominant change included increased visitation by tourists and people of CaLD background.

To explore surf lifesaver and lifeguard interactions with communities, respondents were asked 'On average, how often do you receive questions regarding coastal safety from the general public?'. A third of respondents answered at least once per day (n=324, 36%) and 56% answered at least weekly (n=500). Interestingly, 1 in 10 (n=74, 8%) reported that they never receive questions from the public. When asked 'Do you feel like you have the right information or knowledge to address safety questions of the public?' most respondents felt that they did (n=826, 92%) while 6% were unsure (n=50) and 2% felt that they did not have the right knowledge or information (n=22).

Future perceptions for change

To understand what surf lifesavers and lifeguards felt was needed in the future they were asked 'Do you feel that changes are necessary to address future coastal safety concerns and meet the needs of the community?'. Thematic coding showed public education was identified by 84% (n=753) respondents as the most important area that would address future coastal safety concerns. This was followed by changes to signage (n=528, 59%), safety campaigns (n=478, 53%) and training (n=351, 53%). Figure 4 shows the areas of activity that would improve public safety at beaches and waterways.

Discussion

Australia benefits from the provision of an integrated national surf lifesaving service that includes volunteer

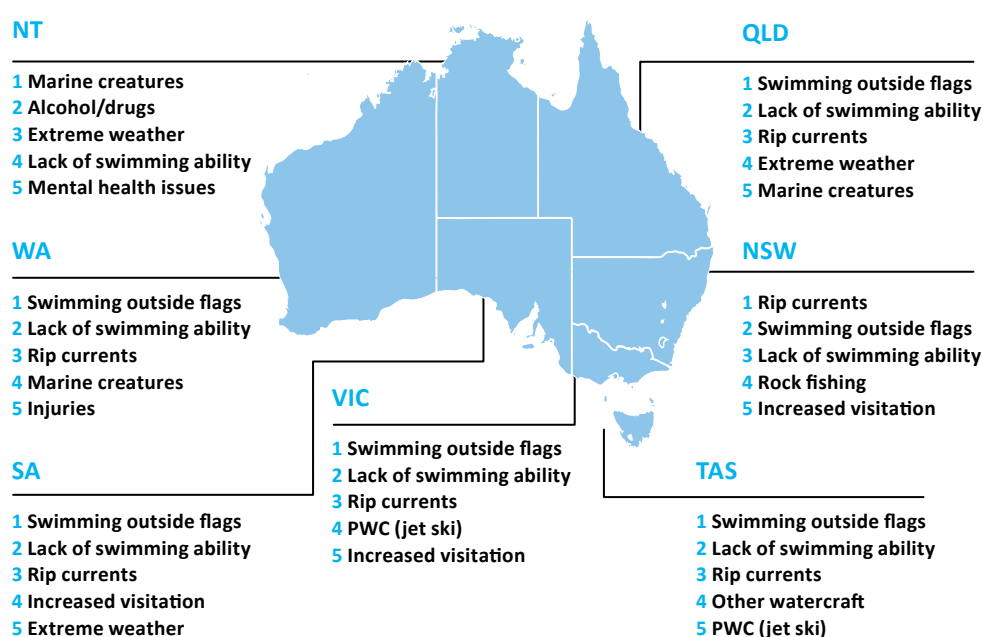


Figure 2: Overview of the top 5 coastal issues by state and territory.



Figure 3: Issues that are perceived to be changing at beaches around Australia.

surf lifesavers and paid lifeguards, who interact directly with the public and other emergency response services (Kamstra et al. 2023). This study addresses this knowledge gap and acknowledges the importance of workforce consultation that occurs more broadly across Australia's emergency response sector (Chong et al. 2022).

The concepts identified by respondents were not surprising and generally were well aligned with the strategic direction of the surf lifesaving movement (Surf Life Saving Australia 2018b, n.d.). Specifically, the identified need to support new (or update existing) public education programs to address future coastal safety issues aligns with the strategic priority to develop and support people by delivering educational programs that meet the needs of the community (Surf Life Saving Australia 2024a). Since this survey, progress has been made with the development, review and delivery of school- and CaLD-specific programs, which are available across some states (Surf Life Saving

New South Wales, n.d.; Surf Life Saving South Australia n.d.). Next, formally evaluating these resources will improve understanding of their acceptability and efficacy among specific cohorts.

Safety campaigns were also prioritised and SLSA has completed a 5-year national awareness campaign, which targeted rip current awareness and behaviour change (Cooper et al. 2021; Surf Life Saving Australia 2021). A focus on rip currents is important as the number one coastal hazard in New South Wales (Brander et al. 2013; Brighton et al. 2013; Cooper et al. 2021; Kelly et al. 2025). Similarly, public education on the importance of swimming between the red and yellow flags at patrolled beaches is warranted given respondent views of the importance of the issue and the high drowning rates of people swimming in waters outside of the flagged areas (Koon et al. 2023; Surf Life Saving Australia 2023a; Uebelhoefer et al. 2022). Given the small number of patrolled locations relative to

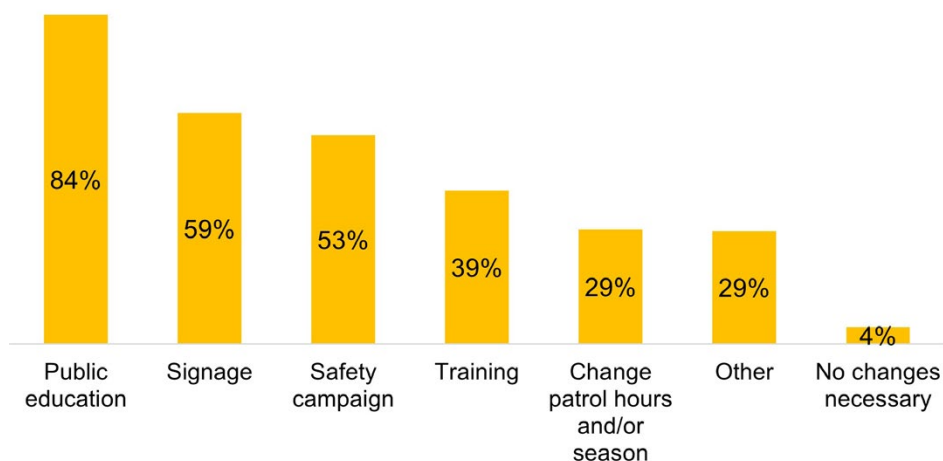


Figure 4: Changes that respondents identified as necessary to address coastal safety concerns and meet the needs of the community.

Note: Respondents could select multiple options.



Surf life savers monitor surf conditions at many of Australia's beaches to keep beachgoers safe.

Image: Surf Life Saving Australia

the size of Australia's coastline (Surf Life Saving Australia 2024a) and potential risks of overcrowding at patrolled locations during high-usage periods, consideration of alternative approaches to provision of trained supervision or community education may be warranted. Future surveys could seek feedback from the SLSA membership on alternative ways to promote water safety such as alternative patrolling methods, alternative messaging and on-site education (Kamstra et al. 2023).

Education

Public education in the form of safety videos shown on domestic and inbound flights to Australia have been introduced as have coastal safety awareness materials promoted at airports designed to raise the awareness of incoming visitors (Cooper 2019a, 2019b; Hogg 2017). Public education remains an important component of preventing drowning and improving coastal safety (Koon et al. 2021) particularly given the plateauing drowning rates on Australia's coast (Koon et al. 2023). Most public education material relating to water safety is passive and broad. However, research by Cook et al. (2024) highlighted the importance of normative learning approaches for educational outcomes that result in behaviour change within the community.

Training resources available to surf lifesavers and lifeguards are reviewed regularly (Surf Life Saving Australia 2020,

2024b) and are streamlined to be effective. These resources equip SLSA personnel with the tools they need to provide the best-possible service to beachgoers. SLSA members are encouraged to participate in programs and workshops that are developed to promote leadership and personal growth (e.g. Surf Life Saving Australia 2024c). This can enhance service delivery and community cohesion between members and lifesaving clubs.

Extreme weather

Respondents rated 'extreme weather' as the fourth leading coastal issue. Repeated delivery of the survey may help to assess any changes in the perceived importance of extreme weather as a coastal issue in recent years, particularly with increasing awareness of changing climates in Australia (Hase et al. 2021) and consequences seen among other first responders (Kyron et al. 2022). Specific to the coastal environment, surf lifesaver and lifeguard views would be important to reassess given recent flood, heatwaves and bushfire events that influence membership (Lawes et al. 2021e; Peden et al. 2022).

Extremes in climate conditions, in particular heatwaves, are likely to result in increased coastal visitation as people seek to cool off in the water or close to the coast where temperatures can be cooler (Peden et al. 2024). Integrating existing tools, such as survey data and using new technology, such as mobile phone data, to understand visitation patterns

indicates that visitation is increasing. This is leading to higher drowning risk (Lawes et al. 2021b) as more people are exposed to coastal hazards more often. Surf lifesavers and lifeguards are seeing these changes and survey respondents indicated that increased visitation is the equal fourth most important coastal issue with significant management implications. More people in the water increases the risk of rescue and amplifies the demands placed on lifesaving personnel, which, if not managed appropriately, may lead to workforce fatigue, including burnout. It remains to be seen what can be done to support personnel amid this challenge, though improving public education will hopefully lead to improved safety behaviours on the beach.

Surf Life Saving Club resilience and preparedness

SLSA seeks to understand the ongoing risks and resilience of the Surf Life Saving movement. SLSA supported by consultants, ResilientCo and Meridian Urban, completed a national disaster preparedness project along Australia's coastline. A project was funded from 2022 to 2025 (National Emergency Management Agency n.d.) to assess the consequences of natural hazard events on the operational capacity and capability of Surf Life Saving clubs. The project included a national exposure assessment that determined baseline natural hazard exposures for all 315 clubs in Australia. This project also conducted 50 site-specific assessments with members of clubs across different natural hazard risk profiles to determine a suite of recommendations that improve resilience of the SLS movement. This culminated in an interactive SLSC Disaster Resilience Workbook (SLSA 2025) that guides clubs through a self-assessment process, covering exposure to 4 major natural hazards of bushfire, cyclone, flood and coastal erosion. This workbook enables clubs to build a tailored profile of their risks, explore recommended actions and plan improvements to their facilities and services. The project highlighted opportunities for clubs to strengthen their emergency response capabilities to provide additional support to emergency services organisations and the community.

Mental health

Although rated lower down the list, aside from in the Northern Territory, mental health was an important issue identified in the survey. SLSA members had responded to incidents of self-harm and suicide at coastal locations (Lawes et al. 2021a) and there is a need to support the mental health of members (Fien et al. 2021; Stewart et al. 2024). This has been acknowledged in other emergency services cohorts (Kyron et al. 2021). Future surveys of members could monitor any changes in views related to mental health and identify and address supports for members.

This research addresses this gap in understanding and it confirms the need to consult with surf lifesavers and lifeguards to identify and analyse emerging issues. It reinforces what was previously only anecdotally understood; that frontline perspectives and experiences are invaluable and can provide an holistic view of coastal safety issues. Although issues ranged from minor to moderate (no issues ranked as severe), regularly repeating these surveys will identify any movement in issues or new issues. This allows SLSA to support its members over time. Further qualitative data collection with members may provide additional insight into member perspectives that support the survey findings.

Strengths and limitations

This study sought and reports on the views of a highly skilled and knowledgeable section of the emergency services workforce who have traditionally not been consulted on issues of coastal safety. The views of surf lifesavers and lifeguards are vital to inform decisions about resources that support members to perform their roles better.

There are limitations in that this survey represents a cross-section of the SLSA membership in 2018. The survey provided a convenience sample and, thus, the views of respondents may not be representative of the entire SLSA membership. This survey was conducted in 2018 and has not yet been conducted again. It is recommended that the survey be repeated in coming years to provide up-to-date information on the views of surf lifesavers and lifeguards, using this initial survey as a baseline against which to assess change.

Data relating to age and years of service of respondents were not collected. As all respondents were qualified surf lifesavers or lifeguards, their expertise and insights were valuable. However, future studies may ask questions relating to years of service and additional qualifications. This would allow for the stratification of responses by these variables to investigate if there are variations in responses by experience level.

Conclusion

The lifesaving role of surf lifesavers and lifeguards in Australia is an important one, yet this cohort is rarely engaged with nor consulted on beachgoer issues. This study reported the findings of the first survey of SLSA members in 2018 that determined their views on current and future coastal issues. Findings informed coastal safety interventions and tools to support the workforce. It is recommended the survey be repeated, using the current study as a baseline to assess change. Ongoing research will provide the data and information that will better meet the changing needs of this specialist section of the emergency services workforce in Australia.

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Abstract

The increasing number, duration and intensity of extreme heat events associated with a changing climate demand investment in preparedness in settings where people learn, work, play and live. The success of interventions and resilience initiatives relating to community level emergency and disaster management as well as future thinking on climate change adaptation is enhanced when communities are closely involved in the development and implementation. The Citizen Science for Cooler School's project (CS²) was a 12-month pilot that explored heat risk in Queensland schools and involved students as scientists to learn about and consider ways to manage identified 'hotspots' on school grounds. Two schools in South East Queensland were selected after meeting eligibility requirements. In partnership with researchers, students in Science Technology Engineering and Maths (STEM) clubs used inquiry-based methods to understand the heat problem and its effects. They used scientific equipment to identify school hotspots and, during guided classroom activities, students planned projects to mitigate heat-health concerns. Alongside this student involvement was the development of the Heat Risk and Preparedness Toolkit that was co-designed by researchers and school staff. This paper presents the project's findings, recommendations for future testing and options for development and application of the project deliverables in more Queensland schools.

Citizen science for cooler schools: improving heat resilience in educational settings

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License Australian Institute for Disaster Resilience, Melbourne, Australia. This is an open source article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) licence (<https://creativecommons.org/licenses/by/4.0>). Information and links to references in this paper are current at the time of publication.

Introduction

Trends in climate variance indicate hotter summer seasons with record-breaking heat, along with more frequent and prolonged heatwaves (Domeisen et al. 2023; Franklin et al. 2023; McNeilly Smith et al. 2023). For Queensland, a state that already has significant summer heat complexities compounded by high humidity levels, managing health risk from heat is critical (Government of Australia 2024; Mason et al. 2023). Heat risk reduction and readiness is not simply climate adaptation; it is a fundamental form of emergency management in Queensland, now and into the future (QFES 2019).

In this context, components of this project align with Queensland's Continuity, Disaster and Emergency Management Policy (Queensland Government 2022) in particular the prevention, preparedness and response elements (see Figure 1) and align with the state's Disaster Management Framework (Queensland Government 2024a).

Extreme heat events across Queensland and Australia pose significant health and safety risks to many specific cohorts. Young children (in the case for this project, primary school students) are particularly susceptible to heat stress because of their specific high activity levels and immature self-regulation via behaviour (Vanos 2015). The concurrent presence of elevated temperatures and humidity can increase heat-related risks for school children to hazardous levels during the school day (Vanos et al. 2016).

In the 2024 summer in Queensland, the 'state-averaged summer maximum temperature was 1.18°C above the 1961-1990 average, which is the highest since 2019-20' (BOM 2024, para. 2). These warming trends

What success looks like:



Figure 1: Department of Education Disaster and Emergency Management Framework.

Source: Queensland Government (2024a) <https://ppr.qed.qld.gov.au/attachment/continuity-disaster-and-emergency-management-framework.pdf>

align with national and international longitudinal data of global climate change. Additionally in Queensland, the complexity of a large state with a diversity of climate zones requires management of heat in schools at a grassroots level. School managers and staff need to be aware of local conditions and site risks. Managing exposure risk within school settings and targeting where children are often located during hotter parts of the day is one important tactic. A study by Rusli et al. (2018) outlined the role of children in the design of ways to mitigate the effects of urban heat and this study engaged primary school students towards similar goals.

This paper reports the findings and lessons from the pilot citizen-science research project Citizen Science for Cooler Schools (CS²). Using 2 public primary schools in South East Queensland as case studies, the project's goal was to examine the heat-related risks on school campuses via the development of a STEM extracurricular activity. In parallel, a heat-health mitigation toolkit was developed that could serve as a starting point for an emergency system for extreme heat events in numerous schools. The toolkit could be used to generate insights and learnings for future direction. The research had 3 foci:

1. the citizen-science element of engagement as method and approach
2. the Heat Reduction Toolkit produced by the project
3. the project insights and learnings.

Literature review

Extreme heat and school settings

Extreme heat and heatwaves are increasingly being included as extreme weather events and are captured in

emergency management planning in Australia (Bolitho and Miller 2017). Extreme hazards like severe storms, fires and floods are present in many school crisis plans, however, while heat is considered in education policy (Queensland Government 2024b) and resources exist that link youth education to disaster resilience (AIDR 2021), the extent to which extreme heat is considered in the emergency management context in Queensland schools is under-explored. In Australia, the long school summer break coincides with a large part of summer but the shoulder seasons and the beginning and end of summer fall within school terms. It is anticipated that changes in climate will see an extension of summer conditions in the coming decades (BOM 2023, 2024).

According to Shortridge et al. (2022), heat safety culture in schools has received relatively little attention. Contemporary literature focuses on 2 domains for understanding and reducing heat risk in school settings. First is the thermal comfort of students inside classrooms and school buildings (de Dear et al. 2015; Jindal 2018; Katafygiotou and Serghides 2014; Kwok and Chun 2003). Second is managing exertional heat stress during school sport and outdoor recreational activities (Bergeron 2013; Bergeron et al. 2011; Kerr et al. 2014). Quantifying and reducing incidental heat exposure during outdoor classes, recess and lunch periods, travelling to and from school and school entry and exit points where students and parents may congregate, has not been explored in the literature.

Shortridge et al. (2022) investigated school heat readiness and child heat vulnerability in Phoenix, USA. They found that students were physically and academically negatively affected by extreme heat inside and outside the classroom. Experts they consulted understood this and widely supported extreme heat readiness plans accounting for

site-specific needs within education precincts. Most notable was the finding that heat safety resources were often available but rarely fully used within Phoenix schools.

Antoniadis et al. (2020) specifically explored schoolyard thermal comfort. They discovered that landscaping materials and design styles commonly employed in the schools they studied often lead to high surface temperatures. Poor materials choice meant increased heat absorption from direct and indirect radiation that increased heat risk and associated health consequences for children. Evaluations of heat stress have also been conducted in playgrounds (Bäcklin et al. 2021; Pfautsch et al. 2022; Vanos et al. 2016) and outdoor sporting fields (Liu and Jim 2021). Typically, these studies were purely scientific in nature with little to no end user engagement through either co-design or citizen science. As a result, data collection was costly with sophisticated methodologies and equipment employed.

Outside the scientific literature, toolkits and practical guidance on heat risk and management in schools and school activities are becoming available in a few countries, including Australia. The Climate Council's 'Keeping School Kids Safe During a Heatwave' explores risk reduction measures in classrooms, during recess, lunch breaks and school sports days and offers advice on hydration (Hannah n/d). The Queensland Department of Education provides some policy guidance for heat risk management in schools and information about managing heat (Queensland Government 2024b). However, no individual school or site-specific guidelines are publicly available. Relating to whether schools remain open during extreme heat, Queensland Government online information indicates that:

Unless the principal or regional director determines that the school must temporarily close due to a disaster or emergency situation, Queensland state schools remain open and students are not sent home during periods of excessive heat or heatwave conditions. Staff manage risks associated with excessive heat at schools through a variety of strategies.

(Queensland Government 2024b, para. 2)

The Extreme Heat Policy (Sports Medicine Australia 2012) provides a biophysical model for predicting heat stress risk and recommends cooling strategies to mitigate heat stress risk in adults but is not specifically tailored for children. Research undertaken by Western Sydney University offers a comprehensive review of thermal comfort in school settings and environmental cooling opportunities (Madden et al. 2018). Key recommendations from this report are identification, testing and implementation of best practices for cooling to offset effects of rising temperatures on children's activity, health and learning. This highlights that more work needs to be done.

Citizen science

The most common conceptions of citizen science are where the public is enlisted in the process of data collection (Bonney et al. 2009), data analysis and data verification (Kelling et al. 2009) and evaluating program success and effects (Cooper et al. 2010). This forms an important connection between science and education. Most current citizen-science projects are large scale with an emphasis on involving adults in relevant issues internationally (Clery 2011), nationally (Trumbull et al. 2000) or locally (Kermish-Allen et al. 2019). The CS² project offers understandings about the application of citizen-science principles to the school setting and involving school-aged children, in this case, heat risks in schools. This real-world setting for the teaching component of the project aligned with current Queensland Department of Education principles of immersive learning in classroom settings as prescribed curricula (Department of Education Policy Officer pers comm 2023, see also the Queensland Department of Education 2024).

The application of citizen-science principles in schools is an emerging element within citizen-science projects with benefits such as increased understanding of science (Saunders et al. 2018) and a better understanding of the methods of science (Shah and Martinez 2016). Literature available on citizen science in school settings focuses on high school students, which is understandable as many of the concepts are quite advanced or are only addressed in high school settings. Additionally, as concluded in a review of 20 citizen-science projects with a student focus, a major barrier to embedding such projects within the curriculum is the need to balance research and educational outcomes (Nistor et al. 2019).

Generally, most schools have a set curriculum with learning objectives in relation to content, skills and attitudes, time bound by terms or semesters and assessment requirements that are state or nationally mandated. A set school curriculum contrasts with many citizen-science projects where specific learning may not be a priority. Instead, the aim is on knowledge or skills that are not in a curriculum and are not formally assessed and not temporally bound by the school year (Ballard et al. 2017). Nistor et al. (2019) argue that curriculum tension must be resolved and suggest that increased dialogue between researchers and schools will allow respective agendas and goals to be met when designing school-specific citizen-science projects.

Methodology

A case-study approach facilitated design and testing of age-appropriate science-based activities (curriculum or extra-curriculum) and design and testing of a heat

1. Index of Community Socio-educational Advantage, see https://saasso.asn.au/wp-content/uploads/2012/08/Guide_to_understanding_ICSEA.pdf.

risk reduction toolkit. The success of interventions and resilience initiatives is enhanced when communities are closely involved in their development and implementation (Robertson et al. 2021; Slingerland et al. 2023). The CS² project took a citizen-science and cross-curricula sustainability approach to raise awareness of heat exposure in schools. The aim was to build on the Queensland Government's Heat, Health, and Human Environment Sector Adaptation Plan Plus (SAP+) initiatives (Armstrong et al. 2018) and the Cooler Cleaner Schools Program (Queensland Government 2022).

The project was structured into 4 research phases (see Table 1) and was designed and implemented by a multi-disciplinary team including specialists from environmental health, urban planning, education, thermal physiology, architectural science and environmental science.

Two public primary schools in South East Queensland, one each from a metropolitan and non-metropolitan area, were selected as study sites. The schools were chosen based on their geographical location, potential for heat stress and socio-economic status (high vs low ICSEA¹) with the aim to better understand the complexities

and challenges of implementing such a project in those contexts. Hereafter these schools will be referred to as the Metropolitan State School (MSS) and Non-Metropolitan State School (NMSS).

Using concepts in disaster resilience as outlined in the *Second National Action Plan for Disaster Risk Reduction* (AIDR 2024) and the Continuity, disaster and emergency management policy (Queensland Government 2022), including prevention, preparedness, response, recovery, the CS² project focused on prevention and preparedness with some response elements. Over the course of the 12 months, researchers worked with teachers, students and administrative staff to identify 'hotspots' within the school grounds and provide advice on addressing the risks. They also developed an inquiry unit implemented through the extra-curricular 'STEM club' that targeted heat-health risk.

Citizen-science principles of active involvement and a genuine science outcome (for hotspot analysis) and contemporary educational practice provide benefits to both science and society and involve citizens in all stages of the scientific process (ACSA n/d). These principles, in combination with an inquiry-based learning approach, facilitated the student engagement and education and enabled students to co-design mitigation and adaptation measures to address identified hotspots in each school.

For site-specific measurements, researchers provided the schools with handheld scientific instruments of one thermal imaging camera and one wet bulb globe temperature probe as well as supplying 5 temperature and relative humidity logging sensors with a data gateway for automatic upload to an online data portal. At the completion of the project, some of the equipment was donated to the schools for their ongoing use in STEM activities.

During the final stages of the pilot, researchers facilitated reflection on the project and discussed future directions with the members of the advisory board. Feedback was positive from all members relating to the success of the project. The project aims and findings were discussed and it was agreed that citizen-science projects like this could feed into longer-term governance for climate change and disaster preparedness (Sexton 2023, pers comm).

Developing toolkit components: the co-design process

A heat risk reduction toolkit was designed as part of the pilot project. The heat risk mapping process began as discussions between researchers and school staff. This allowed the research team to better understand school administrative processes and guidelines around heat, risk and mitigation. Staff strongly advised that guidelines for heat mapping and risk reduction should be accessible, concise and simple to use. They also indicated the project would need to sit outside the curriculum due to

Table 1: The 4 research phases of this project.

Distance	Operationalisation example
Phase 1	• School selection and engagement. • Identify existing heat policy and practice. • Analyse project constraints at each school. • Establish project advisory group. • Initial project interviews with teachers and administrators.
Phase 2	• Student unit of inquiry – 'how can we make the school more heat resilient?'. • Student fieldwork, identifying school hotspots. • Student data collection using handheld scientific instruments. • Locating static logging devices to measure temperature and humidity. • Ongoing school staff interviews.
Phase 3	• Collaboration between students, teachers and researchers. • Student design and application of heat risk reduction projects. • Design, refinement and application of bespoke heat risk reduction toolkit. • Ongoing school staff interviews.
Phase 4	• Final interviews with staff. • Researcher reflections documented. • Feedback provided by the advisory group. • Produce the overarching project report and outputs.

departmental assessment requirements, available time and resources. Despite sitting outside the curriculum, clear and evident links to the Australian Curriculum, Version 9 were made to the Geography, Science and Mathematics curricula (ACARA 2024a) (see Table 2).

After several months of data collection and prototyping, a preliminary toolkit was produced that considered elements of heatwave prevention, preparedness and response as well as heat risk resilience. This draft version was shared with staff to engage, apply and test. Feedback on the first draft was used to refine the toolkit with a final version produced for the one-year pilot. Taking on feedback and recommendations as each element of the project developed, the research team worked with staff to identify deliverables that were aligned with their practical recommendations and that they would use.

Ethics statement

The project received full ethics review by the Griffith University Human Research Ethics Committee as well as ethics clearance from the Queensland Department of Education. Ethics approval was provided on 7 September 2022, reference number 2022/641. Supplementary ethics clearance from the Department of Education was granted on 19 September 2022. All researchers had valid Working With Children Blue cards prior to any field visit to school grounds.

Table 2: Links to the Australian Curriculum.

Learning area	Content description (adapted from ACARA 2024a)
Geography	The management of Australian environments, including managing severe weather events such as bushfires, floods, droughts or cyclones, and their consequences (AC9HS5K05). Locate, collect and organise information and data from primary and secondary sources in a range of formats (ACH9HS5S02). Develop evidence-based conclusions (AC9HS5S05). Propose actions or responses to issues or challenges and use criteria to assess the possible effects (AC9HS5S06).
Science	Consider how people use scientific explanations to meet a need or solve a problem (AC9S3H02). Construct and use appropriate representations, including tables, graphs and visual or physical models, to organise and process data and information and describe patterns, trends and relationships (AC9S5I04).
Mathematics	Use mathematical modelling to solve practical problems involving additive and multiplicative situations including financial contexts; formulate the problems, choosing operations and efficient calculation strategies, using digital tools where appropriate; interpret and communicate solutions in terms of the situation (AC9M5N09).

Findings

School study sites

The MSS is a large school located in the greater Gold Coast Council area. At the time of inquiry, the MSS (ICSEA = 999)² had a student population of 649 covering prep to Grade 6. The MSS has a long running extra-curricular STEM club that successfully hosted the research pilot for the entirety of the project timeline. The project also included close involvement with the school principal and administration staff.

The NMSS (ICSEA = 920) is a small school located in the Scenic Rim region near Beaudesert. The school had a student population of 118 covering prep to Grade 6. The initial phases of school selection identified that this school did not have an extra-curricular STEM club. However, on further discussion with the school, one of the science teachers offered to start one and students soon became involved. The school was subsequently selected and the STEM club successfully ran the pilot study for the entirety of the project. The principal and administration staff were also involved in the pilot study.

School data for this section was sourced from the Australian Curriculum and Reporting Authority (ACARA 2024c).³

Hotspots in the schools

MSS

Nineteen ‘hotspots’ were initially subjectively identified by students, staff and researchers at the MSS. Initially, students conducted a walk around and ‘feels like’ exercise with the STEM teacher and 2 researchers. Students first were asked to describe how they felt in different locations, making a note of the locations where they felt warm or hot. Students then revisited those locations with scientific equipment to measure heat on several occasions to map a baseline. Once these initial sites were mapped, students discussed them with the research team and STEM teachers to select 5 locations that were then monitored by students for the remainder of the pilot study.

Figures 1 and 2 represent a selection of the spreadsheets created by and with students in the classroom and, hence, they have slight differences in data presentation. The in-class discussions on heat mapping and tabulating of data that lead to the selection of study sites demonstrates the interaction between the researchers and the students as learning activities.

2. Index of Community Socio-educational Advantage is ‘a scale of socio-educational advantage that is computed for each school ... estimated by the National Assessment Program- Literacy and Numeracy (NAPLAN)’ (ACARA 2024b). *Guide to understanding the Index of Community Socio-educational Advantage (ICSEA)*. Australian Curriculum, Assessment and Reporting Authority. www.myschool.edu.au/media/1820/guide-to-understanding-icsea-values.pdf

3. Data informing the school metrics was sourced from ACARA My School website. Specific webpage information and URL details related to each school is redacted.

NMSS

Using the same hotspot identification and monitoring process as the MSS, 13 'hotspots' were initially identified by students and researchers at the NMSS. Five of these were selected and monitored for the remainder of the pilot. Figure 2 shows the list of hotspots at the NMS and those selected for the pilot study have been highlighted.

Participating school engagement

An education package was designed on the topic of heat risks in schools using an inquiry-based approach. Following the stage of hotspot identification and selection of sites, students identified and short-listed potential heat risk mitigation projects using a decision making matrix. Students developed criteria and then used those criteria to judge the feasibility of the project ideas. Once projects had been selected, students were grouped into their projects with a project journal template so they could keep accurate records of their projects for the purposes of submission into the Gold Coast Schools Science Competition and the Queensland Science Contest.

Due to the depth of inquiry underpinning the education package and the audience that would need additional detail of the findings, a separate paper detailing the education package/unit of inquiry is in development. In this paper, we focus on the value of the education component to student learning, community engagement and school outcomes.

Student learning

The goals of the unit were to raise heat risk awareness among students (and vicariously their parents and the

community) while addressing key educational priorities. These are to show explicit links to the existing curriculum, development of higher-order thinking and having students address real-world issues, accessing and understanding authentic texts, using technology as a communication and research tool and to analyse and process data. Essentially, to communicate with real-world audiences for the purpose of making a difference in their lives or the lives of others.

While the students were encouraged towards self-directed actions on heat mitigation, most of the student groups chose to not mediate hotspots directly (e.g. via infrastructure changes or environment modification) and instead focused on cooling the human body. Only one student group at the MSS elected to design shade infrastructure for their STEM room. Table 3 shows that the students presented their projects across 4 categories at the Queensland Sustainability and Science Showcase in 2023.⁴

Broader student engagement

The student STEM club activity sparked interest from other students who were not directly involved in the pilot project. This was evidenced in discussions with teachers:

Students are looking and going 'ohh, what are you doing?' And when Harry takes them around the school to take photos, readings and things like that. ... So, there's that curiosity about what they're doing.

(MSS STEM Teacher, February 2023)

4. Sustainability and Science Schools Showcase 2023, see www.chiefscientist.qld.gov.au/science-comms/programs-events/sustainability-and-science-schools-showcase.

Locations	Amnt of activities	Atmospheric readings			
		WGBT	Air temp (TA)	Globe temp (TG)	Relative humidity (RH)
Outside Admin	Low	24.8	26.7	43.7	35.1
Year 4 eating area	Low	23.8	36	37.7	39.4
Native forest		22.2	26.3	41.1	32.8
B'ball court (undercover)	Low	21.8	26.2	37.8	35.9
B'ball court (open)	High	21.7	27.7	39.2	33.1
Native forest		21.1	26.7	32.1	38.5
Oval	High	20.3	25.5	37.7	37.8
Library		20.1	26.4	26.7	38.9
STEM room	Low	19.8	25.2	24.8	45.3
5A		19.3	23.9	31.3	38.1
Prep playground		18.2	24.8	33.8	38.4
Prep C					
Oval					
4C					
Prep A					
Kiss and go					
Administration					
B'ball court					
Senior playground					
Music room					
STEM room deck					

Figure 1: The initial hotspots identified at the MSS - yellow highlight shows locations were selected for monitoring, salmon highlight indicates a missing sensor after installation.

Location	Averages				WGBT (Heat stress)		TA (Air temp)		TG (Radiation)		RH (Humidity)	
	WGBT	TA	TG	RH	1	2	1	2	1	2	1	2
Prep eating area	19.8	24.85	28.35	46%	19.8	19.8	24.8	24.9	28.5	28.2	44%	48%
Hall	19.65	25.35	25.5	44%	19.3	20	25.3	25.4	25.1	25.9	42%	45%
Green shed	19.6	24.7	27.65	42%	19.6	19.6	24.6	24.8	27.5	27.8	43%	42%
UCA	19.6	24.4	27.7	39%	19.4	19.8	24.2	24.6	28	27.4	45%	34%
Sand pit	19.55	24.5	27.75	43%	19.5	19.6	24.1	24.9	28.1	27.4	44%	43%
Table at W end	19.5	25.35	26.7	41%	19.4	19.6	25.1	25.6	26.5	26.9	41%	41%
Outside admin	19.35	24.85	26.95	45%	19.1	19.6	24.6	25.1	26.7	27.2	48%	42%
Senior playground	19.35	24.45	26.75	41%	19.4	19.3	24.5	24.4	26.6	26.9	40%	41%
Court	19.3	24.85	29.15	39%	19.2	19.4	24.7	25	28.7	29.6	38%	39%
Year 6 breakout room	19.2	25.3	25.95	44%	19	19.4	25.2	25.4	25.8	26.1	42%	45%
Junior playground	19.1	24.65	26.75	43%	18.9	19.3	24.5	24.8	26.7	26.8	42%	44%
Year 4/5 classroom	18.9	25.3	25.1	47%	18.8	19	25.1	25.5	25.1	25.1	53%	40%
Table at E end	18.35	24.7	25.5	37%	18.1	18.6	24.4	25	25.7	25.3	37%	38%

Figure 2: The initial hotspots identified at the NMSS - yellow highlight shows locations selected for monitoring.

School outcomes - policy, risk reduction and school mapping

Suggestions from the pilot in the school setting included rescheduling school events to cooler periods and times of day, reducing physical activity at certain times, providing additional hydration and using cool refuges such as greenspace, shade and airconditioned indoor areas. Incorporating these suggestions into school and departmental policy and guidelines as informed by discussions with Queensland Education Department officers during the pilot could be tested for in future research developments. For example, heat risk identification and management could be linked with preexisting school auditing cycles to ensure school heat mapping is known to managers including cooler refuge spaces that can be used as retreat on hotter days, as outlined in the pilots Heat Risk reduction Toolkit. During the pilot, teachers acknowledged that there was a change in the way school managers responded to hotter days, with one teacher saying:

I've been teaching for 10 years—15 years actually, and never have we had a withdrawal of play. So those days where it was really, really hot, they had a 15-minute play and then they were withdrawn to undercover areas.
(MSS STEM Teacher, February 2023)

Table 3: Project titles and categories displayed by students at the Sustainability and Science Schools Showcase in 2023.

School	Category	Project
MSS	Environmental action	Creating a school garden: a place to cool down
MSS	Communicating science	Inferno: the boardgame
MSS	Technology and engineering	Automatic sunscreen dispenser and personal air-conditioning unit
MSS	Technology and engineering	What's the best way to keep our classroom cool?
NMSS	Science investigations	What's the best way to cool yourself down?
NMSS	Technology and engineering	Cool shoes: keeping your feet cool
NMSS	Technology and engineering	Cool hat: keeping your head cool

The Heat Risk Reduction Toolkit

A co-designed Heat Risk Reduction Toolkit was developed with resources designed to support prevention and preparedness elements of risk reduction. Preparedness items and event checklists were drawn from academic resources, government policies and guidelines and grey literature.

The toolkit has 5 components or steps:

- Step 1: An instruction page that defines 'heat risk' and explains how the 3 functional toolkit sheets work together.
- Step 2: Heat risk analysis and mapping process that describes the equipment required and how to conduct a heat risk mapping process.
- Step 3: A heat preparedness checklist that guides the user to assess and prepare for heat events before they happen.
- Step 4: An extreme heat event checklist that guides the user to manage student activities and access to safe places during a heat event.
- Step 5: A spreadsheet of mid- to long-term mitigation activities that could be adopted at a school to reduce heat risk.

The toolkit can be used by schools at any time of the year. Elements of the toolkit link together and form an auditing cycle that shows the relationships between the different parts of the kit and how they connect to existing school risk reduction processes. Given the co-design element of the creation of the toolkit and auditing cycles, researchers were guided by teachers and principals to align the kit components with current school health and safety review cycles. Feedback from educators and school administrators was that any resources created needed to be easy to use and accessible:

... sometimes there'll be these toolkits that are quite in-depth [and] involved and they stay on the shelf in the library because no-one has time to use them.
(MSS STEM Teacher, February 2023)

Since the study's conclusion, incorporating feedback, and further discussions with advisory group members and practitioners in emergency management, the researchers consider the auditing cycles for the heat mapping and preparedness could be included in guidance from the Department of Education related to disaster and risk management. Additional research, application and testing of the toolkit would be needed to confirm this potential.

The heat risk analysis and mapping process (step 2) was co-designed to be a simple and practical exercise. Minimal equipment is required for hotspot identification and suggestions of methods and approaches are explained in the toolkit instructions.

Emphasis is placed on administrative control, hydration and education in the heat preparedness checklist (step 3) and the extreme heat event checklist (step 4) to reduce identified heat risk, including during an active or emergency heat event. Administrative controls can be very effective to protect the health and wellbeing of students and staff on hot days. For example, cancelling outdoor activities on days exceeding specific temperature and humidity limits, restricting activities to cooler parts of the day and keeping students inside in airconditioned spaces are all effective in reducing heat risk in school.

Discussion

Heat as a 'disaster' event

School settings present several challenges to observe, measure and mitigate heat risk (Antoniadis et al. 2020; Shortridge et al. 2022). Children can be susceptible to heat (Vanos 2015) and the heat risks may vary depending on the ambient temperature, humidity, wind speed, solar radiation, children's clothing insulation, activity levels and individual health conditions (Vanos et al. 2016). This combination of variables adds complexity to how staff can manage or mitigate heat risk. Additionally, school settings vary greatly in design, layout, architecture, age and local climate.

Administrative controls that might work in a large modern school in a sub-tropical coastal hinterland could differ greatly to a small school in a regional drier climate. This is pertinent in Australia where sport and physical activity throughout the entire year are key elements of the school experience. In recent years, Queensland teaching spaces have been airconditioned to provide a level of thermal comfort throughout the year (Queensland Government 2022). Even so, there remains many parts of a school campus that can be heat risks coinciding with lack of shade, peak times of temperature, increased physical activity and built environments such as sports and assembly halls that are not easily airconditioned or well ventilated.

Basic risk reduction principles of mitigation, preparedness, response and recovery (AIDR 2024) also cover extreme

heat risk and call for audits of high-risk areas, preparation for heat events and responding appropriately during hot weather. Preparation mechanisms discussed with participating schools included adaptation of the physical environment, scheduling activities and cooling the body. Responses to heat stress also consider climate adaptive measures to reduce the 'general' heat of school grounds (outside of specific heatwave events) that bridges risk reduction and climate adaptation domains. Examples of heat mitigation included:

- activity scheduling:
 - planning school athletics carnivals in cooler months
 - changing high intensity activities to cooler times
 - allowing time after play to rest in a cool place
- cooling the body:
 - increasing access to water and including information on good hydration practice
 - adapting school uniform materials, fit and style
- modification of the school environment:
 - building shade structures (e.g. hard cover and shade sails)
 - altering gardens and school grounds to increase vegetation, trees and gardens.

The approaches to heat mitigation in each of the school grounds were based on the research team expertise, underpinned by empirical evidence and literature. While school-based approaches were discussed with staff, it was not within the pilot project's scope to design or implement such approaches. This is due to the time, cost, necessary changes to school policy and guidelines as well as departmental approvals required. Schools are a vital element of communities and school heatwave management should be included within local emergency management processes and guided by state policies.

Application of heat preparation and adaptation tools in practice

This study confirmed the considerable time constraints experienced by staff to embed new processes and guidelines into school administration. Thus, the toolkit was designed to be easily incorporated into existing practices. School staff identified the components of the toolkit that could be carried out by student leaders in support roles, which is a practical measure to alleviate time pressures on staff.

The preparedness and heat event checklist items vary from low cost (e.g. scheduling changes, rescheduling sports carnivals to cooler months) to high cost (installing hydration stations and changes to uniform materials and style). Preparedness approaches require adoption by whole-of-school communities as they require support from

the school administration, of the parent and caregiver communities as well as teaching and other staff.

Pre-emptively reviewing the school year calendar allows for administrative changes to be made to reduce heat risk. For example, swapping track and field events to cooler months appears to be a simple example. However, representative sport (e.g. athletics) may require national level coordination so that school athletics calendars could be aligned with regional, state and national titles events. What emerged during the pilot was a need to prepare for heat events:

... being able to plan for something in advance ... if it's Sunday night, I open up the news and it says forecast for the week is going to be 31, 32 ... and humidity is going to be above 70% every one of those days. Well, I want to know what that's going to feel like on the students ... the direct effects. Like, you know whether that be student attention spans will be impacted, whether they're going to be more stressed, whether they're going to be more agitated because of the heat.

(NMSS STEM Teacher, February 2023)

A recurring discussion item during the study was the financial barriers of modification of school grounds. Infrastructure changes such as shade sails, gardens and hydration stations can be costly. Most of the costs for infrastructure changes are borne by the school and not necessarily by state governments. Fundraising was mentioned at both schools as a usual activity but rarely did this relate to grounds and heat reduction infrastructure. One of the teachers spoke of the trade-offs that could arise when funding infrastructure changes versus in-class teaching materials:

... and in terms of cost ... if you came to the school and said this is what [infrastructure changes] you could do, it's going to have these benefits and it's going to cost this much money, I think that's going to be weighed up against what else that money could be spent on. I know that at the moment there's only one class that has ... laptops, and ... the laptops are starting to get a little long in the tooth. So, from a cost perspective, if it was me that was given the budget, I'd be weighing up what's going to have more long-term impact. A whole class set of laptops ... that I can use every single year, or heat mitigation strategy for 12 weeks of the year. That's the analytical side of it.

(NMSS STEM Teacher, February 2024)

This suggests that future school grants will be required to provide the resources needed for heat preparedness and longer-term adaptation. Retrofitting schools is a costly measure and heat risk modifications may also create risk in other ways. For example, the installation of a shade sail could mitigate heat risk but the sail could be considered as a personal injury risk if damaged during a severe storm and add to maintenance costs.

Schools as a community education and heat preparedness hub

Engaging students and school staff as citizen scientists is a meaningful way of incorporating non-academic insights into real-world problems (Saunders et al. 2018). Involving young people in emergency education also allows them to contribute positively to understand and plan for natural hazards (AIDR 2021). The CS² project stimulated student learning about heat risk, climate change and school settings. Students applied new knowledge gained about temperature and heat monitoring to their school environment, measured and monitored heat in the school, identified hotspots and developed teamwork projects to mitigate heat or create ways to be cool:

So, there hasn't actually been any challenges from the delivery of the project and the students are really engaged. ... we've actually got the opposite problem; how do we rein them in? Because now that they've got a taste of all these tools and different things that they're learning and different ways of learning ... they're in from 7:15 in the morning to work on their projects.

(MSS STEM Teacher, February 2023)

Schools are common hubs of community engagement and gathering, which fosters school, family, and community partnerships (Cleveland 2023). These kinds of communities can build resilient community networks. One of the positive effects of the program created during this pilot was receiving feedback from staff that the engagement of students also engaged parents and guardians at home. The activities and education program filtered onto student homes and interest in the mitigation projects from parents and guardians grew as the project progressed. This 'at home' connection was evidenced by one school including the project in their social media posts and parents assisting with sourcing materials and equipment (MSS STEM Teacher, pers comm, 2023). Parental support was also demonstrated by their attendance at the student presentations at the Sustainability and Science Showcase in 2023. Additionally, one of the teachers said that the project had expanded reach throughout the student population:

But what is positive, is students have been talking to other students also with the news coverage of the story as well of the project students are coming in saying 'ohh, so what is it you're doing'? So, it's generating a lot of interest from students that weren't initially involved.

(MSS STEM Teacher, February 2024)

Key to implementing some of the heat preparedness and heat event suggestions and the longer-term heat adaptation investments will be the support of the school community. This may include the raising of necessary funds. When asked about fundraising for school

infrastructure changes such as a shade sail, one NMSS STEM teacher said:

I could definitely see that there would be parents that would want to get involved with that, absolutely. If it was put forward to the school, then I think then the Student Council and the Leadership Team that work with them to do fundraising. The fundraising could be channelled over a year or 2 or 3 ... but I could definitely see that fundraising could be done.

(NMSS STEM Teacher, 2023)

School administration support and time to make changes in physical activities and sporting endeavours and restrictions on activity should be provided. For example, students, parents and teachers will require time to adjust to new school management relating to heat events and changes to calendar events and uniforms. Support will be required for staff to learn the optimal use of cooling locations and time will be needed to incorporate any increased costs and policy changes associated with hydration.

Due to the 12-month timeline of the CS² project and the citizen-science approach taken, the project emphasis on heat mitigation in each school focused on student-led projects. Attention to other mitigation was limited due to constraints in time, resources or data to make recommendations on infrastructure changes. For example, shade structures can reduce heat risk in playground areas, however, staff indicated that there was no budget available for this work. While the final sheet (step 5) in the toolkit is a spreadsheet that lists potential infrastructure changes, these were general recommendations and suggestions. Suggestions were also not specifically aimed at either of the project schools. An in-depth heat study would need to be conducted at a school for recommended architectural and infrastructure changes.

Consideration of heat monitoring requires a balance of methods that consider cost, technical knowledge, information and communications technology (ICT) infrastructure as well as departmental security policy, precision, accuracy and need. Should this monitoring also involve students, then simplicity of use and data visualisation are key factors. For these reasons, simple handheld scientific equipment is recommended, like that employed in this pilot study.

ICT policy and infrastructure became apparent as limiting factors for this case study research. For example, after deploying the automatic temperature and relative humidity sensors and data gateway at the NMSS (the regional school location), weak cellular data coverage meant the gateway was unable to connect to the 4G network. After some trouble shooting, the gateway and sensors were abandoned and manual download temperature and humidity sensors were deployed.

Feedback from teachers at both schools indicated that students did not regularly interact with nor use data gathered from site location devices. Additional research is required to explore why this was so, or whether local deployment of site devices is necessary in lieu of other readily available meteorological data available in most Australian locations.

Recommendations and conclusion

Further development and testing of the toolkit is needed to refine its application, efficacy, effect and usability in school settings. This could include a broader range of climate zones, school types (larger schools, vertical schools, diversity in school age) and school populations (high cultural and linguistic diversity, student or staff disability).

In relation to data gathering, while the handheld scientific instruments (particularly the thermal imaging camera) were well used in the pilot, there was minimal student use of the real-time and scientifically rigorous sensor data generated. Given that general weather data is widely available, further testing of student interaction with such data is needed. Other considerations for the development of the toolkit could include engagement with the Outdoor and Environment Education Centre Network, equipment sharing between schools, and expansion into an online resource such as a dashboard.

Revision and application of the education component of this pilot is also warranted to understand how the involvement of students is maintained in other school settings. While this education package was designed as an extra-curricular activity with STEM club students, feedback from the Queensland Department of Education indicated that the package could be included in classroom activities as citizen-science approaches are already employed in Queensland school settings. This will strengthen the alignment of the education package with current curriculum pedagogies. In parallel with the refinement of these resources, embedding heat as part of school-based disaster planning will be key to successful implementation of school-based heat preparedness and mitigation. This can be assisted by drawing on resources already available such as the Disaster Resilience Education for Young People (AIDR 2021).

The pilot was successful in meeting its aims by producing and testing a preliminary Heat Risk Reduction Toolkit alongside an extra-curricular STEM heat-related activity. Future research to upscale the study to address this study's recommendations, revisit and refine the education component and further develop and test the toolkit is warranted, important and timely particularly given the changing and warming climate.

Extreme heat should be recognised as an important hazard, alongside other climate-related extreme events. As the world warms, we need to be prepared and have the

tools to protect the health and wellbeing of communities from this growing issue. Schools are learning places for children, working places for teachers and other school staff and community hearts for parents and carers. The day-to-day operations of schools can present a heat-health risk due to the kinds of activities, duration and potential exposures to those who gather there.

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How shared responsibility is perceived by community sector organisations: insights from a qualitative study following the 2022 Queensland floods

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Introduction

While the principle of ‘shared responsibility’ is found within many disaster risk reduction (DRR) frameworks, it is rarely clearly defined. The principle has attracted sustained scholarly critique concerning lack of clarity around lines of accountability, neoliberal influences, organisational cultural norms, role confusion and resource constraints. All these factors undermine shared responsibility as a normative, guiding principle applicable to all DRR actors ranging from the Australian Government through local community centres. The lack of explicit definition results in ambiguity as to where responsibility sits to assist those at risk of harm from emergencies and disasters (Maguire et al. 2022).

Previous studies of CSOs involved in DRR reveal a divide between the aspiration of shared responsibility and its operational reality at the grassroots level (Baldwin 2020; Cooper et al. 2020; Drennan and Morrissey 2019; Ingham et al. 2020; Ingham and Redshaw 2017; McLennan 2020; Satizábal et al. 2022; Singh-Peterson et al. 2015). This paper reports on a small empirical project conducted in South East Queensland¹ that investigated how frontline workers in CSOs who deliver place-based risk reduction and resilience-building activities interpret the notion of ‘shared responsibility’. The rationale for this research was to clarify the role CSOs play in DRR and to identify gaps in distributed roles and responsibilities among other actors.

1. South East Queensland is the most densely populated area of the state and includes Brisbane, Ipswich, the Sunshine Coast and the Gold Coast.

Abstract

Studies of how Community Sector Organisations (CSOs) negotiate their role in place-based disaster risk reduction and resilience reveal a fundamental disconnect between the policy aspiration of ‘shared responsibility’ and its operational reality at a grassroots level. This paper presents findings from an empirical study in South East Queensland about how workers in frontline community sector organisations interpret the concept of shared responsibility. Seven representatives from 6 different community sector organisations were interviewed about what shared responsibility meant to them. The study found that these workers understand this term to involve horizontal service coordination and teamwork between service organisations rather than vertical lines of accountability between government and the community. Study participants described shared responsibility in very context-specific ways and perceived that their role in shared responsibility was often minimised and misunderstood by government agencies. This study also found that the responsibility of property developers and strata scheme operators in risk reduction is confusing and poorly understood. This remains an underexamined area of research. This paper recommends actions that move accountability towards these influential private sector actors. This study demonstrates that despite shared responsibility being a key principle of risk reduction policy, community sector workers are unfamiliar with the term. Reform of policy needs to meaningfully detail how responsibility is shared.



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This study makes 2 specific findings. First, the participants in this study perceived shared responsibility as operating at a hyper-localised level that predominantly involves horizontal rather than vertical lines of accountability. Second, that shared responsibility of private sector actors in DRR, especially property developers and strata scheme operators is underacknowledged and underexplored. The first of the findings correlates with existing literature in which CSOs consider their activities to be routinely misunderstood within the emergency management sector and, in this case, local government councils. The second finding prompts a call for accountability to be directed towards private sector actors to reduce risk for apartment dwellers in risk-prone areas.

This paper describes the literature on shared responsibility with a focus on CSOs. A brief overview of the international, Australian and Queensland Government policy settings for shared responsibility is provided. This gives important context to better understand shared responsibility from the perspective of place-based CSOs. The second part of this paper describes our research methods, findings and discussion. Observations from 7 individuals whose roles involve supporting communities in emergency response, recovery and resilience-building activities are presented, followed by commentary on the implications of study findings.

Literature review: shared responsibility

Increasingly frequent and severe climate change-induced disasters means that governments alone cannot reduce disaster risk. The idea that responsibility for DRR is shared by all actors in society is a driving principle of the *Sendai Framework for Disaster Risk Reduction 2015-2030* (Sendai Framework) (UNDRR 2015). The framework is considered to be ‘urgent and critical’ (UNDRR 2015, p.10) in light of the accelerating and increasingly severe effects of climate change. The Sendai Framework represents a global consensus on ‘not only reducing the risks posed by disasters, but also the manner in how they are to be addressed’ (Atkinson and Curnin 2020, p.4).

Although the framework holds nation states primarily responsible for DRR, stakeholders across society have important supplementary roles as ‘enablers’ in providing states with support in line with national policies, laws and regulations (UNDRR 2015, Article 35). The framework provides explicit guidance on encouraging public and private stakeholders to participate in DRR activities. In the context of CSOs, the Sendai Framework calls for the active inclusion of women, children and young people, people with disability, older people, Indigenous peoples and migrant communities to contribute to DRR efforts (UNDRR, Article (36)(a) (i–vi)). Private sector businesses, professional associations and financial institutions also

have roles to integrate disaster risk management into their business models and practices and to develop normative frameworks and technical standards (UNDRR, Article 36(c)).

In Australia, shared responsibility has been a central feature of disaster resilience policy since the creation of the Australian *National Strategy for Disaster Resilience* (National Strategy) in 2011.² Despite multiple references to the principle of shared responsibility within the strategy, it does not provide specific guidance on how responsibility is to be shared and who is accountable for specific tasks or failures. The policy broadly outlines collective, society-wide responsibility for resilience to be delivered by designated stakeholder groups, including government, business, individuals, non-government organisations and volunteers (Commonwealth of Australia 2011). The role for business is highlighted to include the provision of ‘resources, expertise and many essential services on which the community depends’ (Commonwealth of Australia 2011, p.v). Notably, the strategy does not impose any obligations on the private sector to take actions to reduce risks associated with their operations. In affirming the frontline role played by non-government and community organisations, the National Strategy states:

It is to them that Australians often turn for support or advice and the dedicated work of these agencies and organisations is critical to helping communities to cope with, and recover from, a disaster.
(Commonwealth of Australia 2011, p.v)

Shared responsibility in Queensland disaster management arrangements

In Queensland, local governments are responsible for managing emergencies and disasters rather than state governments (Queensland Government 2003). However, the term ‘shared responsibility’ is not afforded legislative definition. The *Queensland Strategy for Disaster Resilience 2022–2027*, or QSDR (Queensland Government 2022a), is the state’s overarching policy instrument for disaster resilience. It describes shared responsibility in the context of stakeholder participation as:

Resilience is a shared responsibility and the success of the QSDR will depend on the collective effort of individuals, communities, businesses and state agencies. Strong well-connected networks, together with a coordinated collaborative approach to increase alignment of effort across the disaster management cycle, will provide a primed environment for disaster resilience initiatives to take effect.
(Queensland Government 2022a, p.12).

2. It is noted that the principle of shared responsibility first emerged during a national inquiry into 2002–03 Australian bushfire season, as cited in McLennan *et al.* (2020, p.40).

Further:

Everyone has a role to play, and all Queenslanders are encouraged to consider what the objectives, strategic commitments and actions mean for them and how they can contribute to improving overall community resilience. (Queensland Government 2022a, p.12).

Similarly broad, aspirational language often appears in local council disaster management plans. For example, the Brisbane City Council Local Disaster Management Plan states that ‘the idea of shared responsibility [means] no one person or agency can do everything, but we can work together for a stronger, more resilient Brisbane’ (Brisbane City Council 2023, p.35).

DRR and resilience policy frameworks from the international level to national, state and local policy all broadly endorse the principle of shared responsibility but none clearly articulate how responsibility is to be shared and, more importantly, who is accountable (Box et al. 2013; Lukasiewicz et al. 2017; McDonald and McCormack 2022). The Royal Commission into National Natural Disaster Arrangements affirmed widespread acceptance of the concept of shared responsibility but it also recognised the need for a clear, robust and accountable system with ‘unbroken linkages’ from the highest levels of government through to individuals in the community (Biskin 2020, p.7). The findings of this study suggest that breaks in the linked chain of shared responsibility remain.

Shared responsibility and CSOs

There is considerable literature on the role that CSOs play across the full cycle of emergency and disaster management and in the building of community resilience. However, there is limited consideration of perceptions of shared responsibility by CSOs. A 2013 study on perceptions of shared responsibility in flood risk management examined this concept from various stakeholder perspectives but did not include the perspective of CSOs (Box et al. 2013). A briefing paper prepared by the Australian Red Cross contains an integrated literature review of the role of non-profit organisations in this context and includes enablers and barriers to leverage adaptive capacity (Australian Red Cross 2014). Recent studies have shown how dominant accounts of shared responsibility in DRR undermine the community development methodology and approach that CSOs typically deploy. Ingham and Redshaw (2017) studied community connections following the 2013 Blue Mountains bushfire and identified the need to ‘reconceptualise disaster preparedness, response and recovery from something ‘done’ to the community, to something the community expects to be involved in and be a part of’ (Ingham and Redshaw 2017, p.62; Ingham et al. 2020). This highlights the power dynamics that are exercised in formal emergency and disaster management

arrangements and the clash of cultures between top-down disaster coordination and bottom-up community-based approaches (Baldwin 2020; Crosweller and Tschakert 2021b). Satizábal et al. (2022) examined the complexities and experiences of CSOs undertaking risk reduction and resilience activities in the context of neoliberalism. They concluded that the political economy of state-led emergency management inhibits genuine opportunities to listen, learn and work with CSOs.

As place-based organisations, CSOs experience the disaster alongside the local community. The deep local knowledge and high social capital makes CSOs a crucial entry point to engage with communities (Muir 2021). CSOs are also well-placed to support self-organisation activities which have been recognised as a feature of community-led emergency and disaster management (Crosweller and Tschakert 2021a). Despite the significant contributions of CSOs, existing policy does not adequately recognise this expertise nor adequately fund the activities of these groups. This study builds on this literature by identifying how CSOs perceive and understand the principle of shared responsibility in the activities that they undertake.

The 2022 South East Queensland rainfall and flood event

Between 22 February and 7 March 2022, South East Queensland and northern New South Wales experienced an unprecedented rainfall and flood event. Flooding affected 23 of Queensland’s 77 local government areas with the Bureau of Meteorology issuing more than 500 warnings over the period (Taylor et al. 2023, p.15). In Brisbane, flooding was experienced from 25 February through to 27 February 2022. The Brisbane River peaked on 28 February after Brisbane and surrounding regions had received around 80 per cent of their average annual rainfall in less than one week (de Jersey 2022). It is estimated that more than 500,000 people, or one-tenth of the state’s total population, were affected in some way, either through lives lost, homes inundated, loss of power and essential services, or major road closures (IGEM 2022). This event is described by the Insurance Council of Australia as the ‘costliest insurance event in Australian history’ as it resulted in more than \$6 billion in insured losses (Insurance Council of Australia 2023).

Various reports and inquiries into the rainfall and flood event were subsequently undertaken. On 1 March, just one day after the Brisbane River peaked, the Brisbane City Council announced an independent review to be led by the former Queensland Chief Justice the Honourable Paul de Jersey. Its geographic remit only extended to the Brisbane local government area and the Terms of Reference had a narrow focus on compliance and assessment of the council’s disaster management framework. There was little

community engagement in the review and no submissions sought from councillors or agencies outside the Brisbane City Council (de Jersey 2022).

On 15 March 2022, the Queensland Government requested the Office of the Inspector-General of Emergency Management (IGEM) to undertake a report into the effectiveness of preparedness activities and the response to the rainfall and flood event. In its report, IGEM acknowledged the important contribution of non-governmental organisations and noted that these organisations provided valuable assistance by operating recovery hubs or delivering outreach services, clean-up help and sourcing goods and donations for flood-affected communities. IGEM also noted various local community suggestions to improve response, including adopting a warden system and establishing local flood committees in flood-prone areas. However, the report made no recommendations to implement these suggestions (IGEM 2022, p.36).

A large, mixed methods study on community experiences of the 2022 floods was conducted by Taylor et al. (2023). The study analysed data collected from a quantitative survey and qualitative interviews with flood-affected individuals in both Queensland and New South Wales but did not apply an analytical lens to shared responsibility. Although many of the policy recommendations identified in that study relate to issues of accountability, risk-sharing and task allocation for various actors involved in emergency management, the role of CSOs in the context of shared responsibility was not a specific focus.

Methods

A project team within the Queensland University of Technology established a study to interview workers from

place-based neighbourhood centres, community collectives and hubs who were involved in supporting disaster-affected individuals and families following the 2022 floods. Drennan and Morrissey (2019, p.331) note that CSOs take many forms such as industry associations, community housing organisations, faith-based organisations or sporting groups. This study regarded CSOs and their clients as falling within the definition of a place-based ‘community’; however, we note that this term is contested in the literature (Fairbrother et al. 2013; Titz et al. 2018).

Participants

Semi-structured interviews were conducted with 7 individuals (6 staff and one volunteer) representing 6 CSOs operating in Brisbane suburbs affected by the 2022 floods. The suburbs were Logan, Yeronga, Graceville, West End, Mitchelton and Pine Rivers. These locations cover a range of local government areas and include both inner-city and outer-suburban areas with diverse demographic, social and economic indicators. Interview participants were identified using a purposive sampling method (Lewis-Beck et al. 2004). A member of the project team had previously worked for the peak body for Neighbourhood Centres in Queensland and brought industry connections to the project, which assisted with participant recruitment.

Individuals were invited to take part in the study if they satisfied the criteria of being directly involved in providing disaster response, recovery and resilience-building activities associated with the floods. All individuals who were approached agreed to be interviewed. All participants were female and most were employed on a part-time basis in recovery service navigator roles. Table 1 shows their role, work type, age bracket and type of CSO the participant worked in.

Table 1: Breakdown of interview participants.

Code	Gender	Role title	Work type	Age bracket	Type of CSO	CSO size
Interview 1	Female	Community Resilience Coordinator	Full-time	50–60 yrs	Community Hub (incorporated)	Medium (approximately 10 FTE*)
Interview 2	Female	Community Development Worker	Part-time	20–30 yrs	Neighbourhood Centre/House (incorporated)	Small (approximately 3 FTE)
Interview 3	Female	Community Engagement Officer	Part-time	30–40 yrs	Neighbourhood Centre/House (incorporated)	Small (approximately 5 FTE)
Interview 4	Female	Member	Volunteer	50–60 yrs	Community Collective (informal network)	Large (approximately 100 volunteers and supporters)
Interview 5	Female	Service Navigator	Part-time	40–50 yrs	Neighbourhood Group (incorporated)	Large (approximately 20 FTE)
Interview 6**	Female	Service Navigator	Full-time	40–50 yrs	Neighbourhood Centre/House (incorporated)	Large (approximately 50 FTE)
Interview 7**	Female	Service Navigator (support)	Part-time	30–40 yrs	Neighbourhood Centre/House (incorporated)	Large (approximately 50 FTE)

*FTE = full-time equivalent staff. Details of FTE obtained from annual reports or in conversation with participants.

**I6 and I7 represented the same organisation.

Interview guide

A semi-structured interview guide was prepared with the following indicative questions:

1. Can you give me a sense of what you do in the community-led disaster response space and how you go about it?
2. The term 'shared responsibility' is commonly used in disaster management. Can you tell me about your understanding of the term, and what it looks like in your context?
3. How aware is the community you work with of the concept of shared responsibility?
4. What do you think the community interprets its shared responsibility role to be?
5. Can you tell me about how your work and organisation supports the community to perform that shared responsibility? What actions are you performing? What gaps are you filling?

Participants were invited to share their perspectives on these questions as well as any ideas or observations they had about shared responsibility.

Procedure

Prior to the interview, each participant received a consent form and a participant information sheet that contained a brief description of what shared responsibility means in DRR circles, and a list of likely questions for discussion. All interviews took place online and each conversation ran for approximately 45 minutes. Data analysis involved manually coding and thematically analysing the transcripts in line with the Braun and Clarke 6 step approach (Braun and Clarke 2006; Braun et al. 2019).

Ethics statement

This study was approved by the Queensland University of Technology Human Research Ethics Committee (7056).³

Results

The interviews showed that shared responsibility, as interpreted by participants, involved self-organisation, horizontal service coordination and power-sharing as well as a perceived minimisation of CSO roles by local government. There was also confusion about the responsibility of property developers and strata scheme operators in risk reduction.

Shared responsibility as horizontal service coordination across the community service sector

When participants were asked to describe how they understand shared responsibility in the context of their

work, some admitted they had never heard the term before. After consideration, several participants described shared responsibility as something that applies to people and actions taken within and between individuals and CSOs in their own community, rather than as between different actors or levels of government. One participant emphasised the importance of role clarity between place-based CSOs to provide a 'united front'. They thought it was particularly important to provide people with good disaster-related support and to do everything possible to minimise confusion and rivalry between service providers. Another described service coordination this way:

I hadn't heard it framed as shared responsibility ... I guess we're trying to identify the responsibilities within the community that we're working within and trying to be clear about what our responsibility is, and what the other community support services that we work closely with, who we do a lot of referrals through, what their responsibilities are, because we are in a unique position where the bulk of our work has been through door knocking so it's very face-to-face with the community members.

(Interview 2)

Within this hyper-localised context, participants also described shared responsibility as a process of encouraging individuals to develop their own sense of personal responsibility:

You know, sometimes ... throwing it back at people, it also gives them a feeling of ownership, gives them the opportunity to feel like whatever they're saying is valued as well. That all eventually ties into that shared responsibility.

(Interview 3)

Translation of shared responsibility in very context-specific ways

The concept of shared responsibility was described in very relatable terms by the participants. They explained it as akin to 'cutting a cake', 'living in a share house' or 'having children'. One participant who assists culturally diverse communities described it by using a Malaysian cultural term, which they said was analogous to a 'working bee' in the Australian context. This reinforces the importance of ascribing real and tangible meaning to the term depending on the cultural context in which it is used. It also aligns with previous research findings that, while the concept is well established in academic and policy circles, it has not yet gained a similar level of awareness at the grassroots level (Singh-Peterson et al. 2015).

3. An earlier version of this paper sharing preliminary findings was presented at the IGEM Queensland Disaster Management Research Forum on 7 November 2023. Where this paper reports on participants' perceptions of shared responsibility, a previously published briefing paper includes broader themes about community resilience that also emerged from interviews (Taylor et al. 2024)

Because shared responsibility is that you agree that we have some responsibility in this plan. And if we don't have some responsibility in the sharing of that, you can't say you're going to share a cake and then you take the cake and leave the crumbs—that's not sharing. And so we've got to think that if it's a true share, I get to cut the cake and you can pick the piece. You know, like you do with your kids. (Interview 5)

And a housemate analogy:

My understanding of shared responsibilities: every day in whatever the situation is, the more people the better, the more brains that we pull together, the better. It also gives people the opportunity to participate, in terms of trying to do something for our community, you know, having that shared responsibility, it just divides the jobs up and just makes everyone feel important and involved. For me, it's like sharing a house with 3 different people that you don't know, [you] have that shared responsibility of cleaning the house and it just makes everyone feel more welcome and involved. (Interview 3)

Participants reflected on the distinctive role of CSOs as compared to other agencies involved in DRR and resilience-building. Themes of safety and collective purpose emerged:

I think everybody has a part to play ... Council has a part to play, Red Cross has a part to play. The part that the neighbourhood centres play is to be there to support the community in times of natural disasters when it's needed—and they're a good place. People are going to go there because they feel safe, but it's a good place for all those services to come together and share that responsibility of providing for those individuals. (Interview 6)

Most of the time, we get a lot of: 'You're the community centre, why aren't you doing it?' But we are a community centre—the community is that middle word, and it involves everyone in this region. (Interview 3)

CSOs perceive that their role is minimised and misunderstood by local government

Participants held mixed views about the extent to which local government understood their work in disaster support. While the majority generally agreed that local council plays an important role in coordination, none of the participants thought that the contribution of their CSO to response and recovery was properly understood by council. One participant levelled strident criticism at council representatives for their approach to working with CSOs:

I don't really think [they believe] there's a shared responsibility. We keep hearing about community-led. What they really mean is 'engaged with community' but they've just made their own mind up. Some of them are just like, 'Oh, we engaged with community, therefore, it's community-led'. That's just useless. It's just rhetoric. They're just using the words. We had a guy from community recovery last week start using community-led, and I don't even think he knew what the word was 2 days before. (Interview 1)

[X] is a perfect example. They say, 'Oh, we're going to share responsibility around the recovery hubs. Here are some signs, this is how you do it'. Council thinks they know best. And so they're just saying: 'This is a shared responsibility as we'll have recovery hubs. We'll give you some corflute signs to put up. You can just do tea and coffee and a charging station'. If that's what they think neighbourhood centres do, well, there's the door ... We're more than tinnies and the Mud Army, we're a lot more than that. And every neighbourhood centre who's ever worked in a disaster-affected community has always risen above a cup of tea and a charging station. It's just embarrassing. It's actually embarrassing to think that's what we do. (Interview 1)

Self-organising in strata properties

One participant resides in an apartment building in a flood-prone area and serves as the chair of the building's body corporate committee. They are actively involved in a place-based, grassroots collective that works to achieve flood resilience. This participant felt that local government agencies did not understand apartment living, even though vertical communities can be significantly affected by flooding:

We're not New York or London ... there's a lot of high-density living, a lot of vertical living like in Spain, but that's how they've done it forever. They just know how to live like that and the rules and who's responsible for what, whereas I don't think Australia or maybe Brisbane is quite as mature with that understanding as a community. (Interview 4)

This lack of understanding led to several body corporates experimenting with flood communication systems and processes so that residents who required specific assistance did not miss out on timely, accessible information and alerts. It also prompted a mindset shift in that all residents (tenants and owner-occupiers) were regarded as equal members of the apartment community. These initiatives helped reduce residents' trauma during the flood and people were out of their homes for a shorter period than they would otherwise have been:

They [government] fail to acknowledge that you can't access your home; your home may not be flooded, but ... lift services or basements are totally inaccessible for however long. Power, all of those sorts of things affect it. And that costs money to fix. Your apartment may or may not be affected if you're not on the ground floor, but then apart from that if you've got no power or basic functioning utilities (sewer/water) in a 20-storey building—let alone our local planning are trying to approve up to 90 storeys—where are you going to put all these people? They just sort of think, 'Oh well, you don't need to leave, that's voluntary'. Well, you do need to leave because how are you going to flush your toilets? (Interview 4)

Sharing responsibility with the private sector

In the context of flood risk, participants questioned the shared responsibility of property developers, asking why developers continue to build apartment complexes in known flood zones, yet bear little accountability for what happens to those buildings when they flood. In Queensland, local governments oversee planning regulations for development assessments. The creation of disaster risk by seeking and granting approvals to construct apartment complexes in flood-prone areas remains lawful. Land use planning is a highly complex area with overlaid laws and by-laws. It is beyond the scope of this paper to examine the many associated issues of liability and responsibility that are areas of further research. But questions arising from confusion about the accountability of property developers were raised by participants. One participant drew a comparison between flood and fire management plans:

Where does the responsibility come? Is it just for [residents] to know? Should this be part of the developers putting together... like a fire management plan, you know, how many fire drills—fire has all this structure around it. I haven't lived through a fire anywhere, but I've lived through 2 floods. And you know, there's so much preparation and guidance and restrictions and rules around fire preparation, but nothing around floods. So people had no idea what to do, and neither did managers, body corporates, residents. Nobody. (Interview 4)

Nobody asks, if there's a fire, are you prepared? Because it's a given. And that's very structured around the rules and how many times you must practise, and people have to know where their escape routes are. Flood, you know, it's too hard or it might devalue our building. That's just rubbish ... it's a selling point to say 'This building, yes, it will flood, but we have got plans and preparations, and we have done all this flood mitigation work. We know what to do to protect [ourselves]'. (Interview 4)

Discussion

The results of this study show that shared responsibility is a foundational principle of emergency and disaster management but was poorly understood by participants. However, given the opportunity to describe the principle, a picture of horizontal power-sharing, intra-sector collaboration, teamwork and self-organisation emerged. According to the participants of this study, a disjuncture exists between what CSOs say they deliver to support people in disasters, and what they think local government agencies perceive as the CSO role. Similar examples in the literature also suggest that local councils often do not 'get it' in relation to working with CSOs in DRR and resilience-building work (Baldwin 2020; Ingham et al. 2020; Satizábal et al. 2022). This underscores the fact that the concept of shared responsibility is understood differentially and has no uniformity of perspective. Explicit definitions of shared responsibility as it relates to different sectors would improve lines of responsibility and accountability if the aspiration of working together in a coordinated, collaborative way is to be achieved.

While community self-activation in response to the 2022 flood is acknowledged (Taylor et al. 2023, p.10), self-organising approaches in strata properties is not well documented. The few available studies suggest that disaster preparedness is generally a low priority for property managers (Guilding et al. 2015) and owners who do not fully understand their obligations and lack funds to repair properties beyond the bare minimum (Finn and Toomey 2017). As rates of urban apartment dwelling in South East Queensland increase, further research to better understand how strata scheme operators ought to prepare their communities for flooding will be needed.

A further issue was the overlooked role of private sector actors in shared responsibility, in particular property developers and strata scheme operators, to reduce risk for apartment dwellers. Private sector actors have a 'fundamental role' in sharing responsibility for DRR (Commonwealth of Australia 2011, p.4; IGEM 2022, pp.98–99; UNDRR 2015), yet this study noted that shared responsibility of the private sector remains underexamined (Lukasiewicz et al. 2017, p.304). The lack of clarity about what shared responsibility means for the broad array of private sector actors and where their accountability lies results in many of them performing ad hoc, informal roles (Hunt and Eburn 2018, p.484). Pursuing the goal of shared responsibility in an era of escalating emergencies and disasters necessitates greater accountability to be directed towards these influential actors. The issue of developers' responsibility for risk reduction could equally be applied to the construction and management of other residential facilities that are built in flood zones. This could include aged care facilities and retirement or private

hospitals where elderly people with complex care needs may require significant emergency service support during evacuation (Callinan 2022). Climate change effects means that governments need to reconsider the division of risk and responsibility for all actors and, at a minimum, ensure that the private sector does not increase risk by developing areas with historical or predicted high inundation. The Queensland Government has hinted at the need for bold, timely and enforceable policy to manage what can and cannot be built on flood plains (Queensland Government 2022b, p.95). However, implementation of such a policy agenda is yet to be realised. Directing accountability onto developers and strata scheme operators for their roles in disaster risk for apartment dwellers in hazard-prone areas is urgently required given the lack of reported recognition of their responsibilities during the 2022 floods in inquiries and studies.

Study limitations

This small empirical study captured qualitatively rich data that explored various aspects of CSO work in the aftermath of a local flood event. This study presents place-based insights from a very small dataset and, given the limited number of participants, their responses cannot be seen to reflect the wider views of all CSO workers. In particular, the theme of private sector shared responsibility derived mainly from the views of one participant who spoke about this issue based on their experience. Relying on the view of one participant to generate a thematic finding is not optimal. However, we consider it a noteworthy theme in view of the lack of attention on private sector actors in the literature.

Another limitation is that this research did not investigate the views of emergency management authorities nor private sector actors. Research that includes these perspectives on how CSOs contribute to shared responsibility would enable deeper exploration of this issue. Future research that examines the experiences of CSOs providing assistance in other locations and in the context of different hazards would offer an opportunity to validate the findings of this study.

Conclusion

The research presented insights into perceptions of shared responsibility from the perspective of 7 CSO workers following the 2022 flood and rainfall event. The viewpoints uncovered reflect ongoing concerns about the roles of CSOs being minimised and misunderstood. Findings indicate that participants understand the principle of shared responsibility in context-specific ways. This raises an issue for implementation of the principle as without a common understanding of what shared responsibility

means or requires, there is little chance of coordinated action across governments, communities and the private sector. There is a need for a nuanced definition of shared responsibility within policy instruments that recognises the roles, functions and knowledges of organisations and how responsibilities should be shared in a coordinated way. The findings also move beyond vertical ideas of sharing responsibility by showing how CSOs conceptualise this term horizontally. Clear definitions of shared responsibility as they relate to different actors could be included in laws and policy frameworks. The shared responsibility of property developers and strata scheme operators is also highlighted and greater accountability on private sector actors is needed to reduce disaster risk for apartment dwellers in flood-prone areas.

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Experiences of members of community-based, environmentally focused groups following the 2019–20 bushfires

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Introduction

Disasters have wide ranging impacts and cause considerable disruption to individuals, communities and environments. The large-scale 2019–20 bushfires resulted in significant loss and damage across multiple states in Australia. Within Victoria, 5 people were killed directly in the fires, with estimations of an additional 120 deaths from bushfire smoke exposure (Australian Institute of Disaster Resilience 2020), more than 450 residences were damaged or destroyed (Inspector-General for Emergency Management 2020) and 1.5 million hectares of land burned (Australian Institute of Disaster Resilience 2020). Nationally, over 3 billion animals were estimated to be displaced or killed as a result of the fires (Australian Institute of Disaster Resilience 2020), with ongoing changes to their habitats, food and shelter sources (Abbas Khan et al. 2019; Filkov et al. 2020; Ward et al. 2020; Dickman 2021). Many of the Victorian communities affected by the 2019–20 bushfires had experienced multiple disasters in the decade prior (O'Rourke et al. 2024).

This article focuses on the experiences of members of Victorian community-based environmentally focused groups after the 2019–20 bushfires. We offer a brief summary of literature relevant to connection to the environment, the role of social connection after disasters, community-led approaches to recovery and psychosocial intervention principles before outlining the findings of this study.

Abstract

The 2019–20 summer bushfires in Australia resulted in significant loss and damage across Australia. This article focuses on the experiences of community-based, environmentally focused groups in the East Gippsland and northeast regions of Victoria after the fires. Qualitative interviews with 21 group members and a focus group with 12 industry stakeholders were undertaken. We identified that despite disaster recovery not being a core function of these groups, they had recovery related benefits in post-disaster settings. This included supporting connection to the natural environment, benefits of group membership that aligned with the mass trauma intervention principles, and the ability to help amplify the work of government and other organisations. The findings from this study indicate that community-based, environmentally focused groups can positively contribute to both social and environmental recovery after disasters such as bushfires.



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Connection to the natural environment

There is a growing body of research indicating that the way people are connected to the natural environment may influence their experience of disaster events. Existing research has recognised the concept of ‘urgent biophilia’ in post-disaster contexts, whereby both individuals and communities actively pursue connection with nature and restorative practices to support their own resilience (Tidball 2012). In Australia, research following the 2009 Victorian bushfires indicated that people with a strong connection to the natural environment experienced profound grief at disaster-related destruction, but also drew solace from environmental regeneration. These strong connections were also positively associated with mental health and wellbeing for these individuals (Block et al. 2019). Aboriginal and Torres Strait Islander peoples may experience disaster events differently to non-Aboriginal people, attributed to deep intersections between connection to Country and experiences of systemic marginalisation (Williamson et al. 2020; Williamson et al. 2021).

Social connections

The importance of social capital in disaster recovery is well established (Aldrich 2012). It has been argued that levels of social capital affects communities’ ability to mobilise, access resources and respond both during and following a disaster event (Aldrich 2011, 2012; Aldrich and Meyer 2015; Akbar and Aldrich 2017). Pre-existing community groups are recognised as an important aspect of social infrastructure in disasters (Aldrich 2012; Gallagher et al. 2019). Group identity and moderate levels of group membership may be protective for the psychological wellbeing of participating individuals (Gallagher et al. 2019; Cruwys et al. 2023) and those within their wider communities in the years following large-scale bushfire events (Gallagher et al. 2019).

Engaging with and for nature provides opportunities for individuals to build social connections through shared interests. Social connection and sense of community have been identified as important themes within research into nature-based activities and the role of green spaces both generally (Abraham et al. 2010; Husk et al. 2016; Keniger et al. 2013) and within the post-disaster context specifically (Chan et al. 2015; Li et al. 2021; Mabon 2019; Miller and Management 2020; Shimp et al. 2019).

Community-led approaches

There is an established body of research that identifies the importance of community-led approaches to disaster recovery (Olshansky 2005; Alesch et al. 2009; Cretney 2016; Easthope 2018; Dibley et al. 2019), and *using community-led approaches* is one of the national principles for disaster recovery in Australia (Australian Institute of Disaster Resilience 2018). The wide range of approaches of

citizen participation in decision-making is well documented in both sociological and political economy research, and acknowledges that there is a broad spectrum of types of community engagement (Arnstein 1969; Bishop and Davis 2002; IAP2 2014).

Although much existing literature emphasises the importance of community-led recovery, there are also recognised challenges to this approach. A review of the 2019–20 bushfire recovery undertaken by the Inspector-General of Emergency Management in Victoria noted that there is little agreement regarding the term ‘community-led recovery’ and that community members actively involved in recovery processes may be faced with very high workloads at the same time that they may be facing personal recovery challenges or supporting others to recover (Inspector-General Emergency Management 2021). Despite community-led approaches being recognised as a core principle by governments in Australia, the ways governments approach community-led recovery is widely varied, even within jurisdictions (Young et al. 2021; Brady et al. 2023). Preliminary findings in recent research identifies an inconsistent and varied understanding of community-led approaches by community members and recovery workers, indicating the importance of understanding community context in post disaster settings (Brady et al. 2023).

Intervention principles

The mental health and psychosocial effects of disasters are well established (Beaglehole et al. 2018; Bryant et al. 2020; Newnham et al. 2022) and there is a growing body of evidence that indicates that people affected by multiple and cascading disaster events may experience poorer mental and physical health outcomes than people exposed to single events (Leppold et al. 2022). In 2007, Hobfoll and colleagues published the influential *Five Essential Elements of Immediate and Mid-Term Mass Trauma Intervention: Empirical Evidence* (2007). These principles were developed to guide short to mid-term interventions and support wellbeing following disasters and underpin widely used interventions, including Psychological First Aid (Bisson and Lewis 2009, 2009; Shultz and Forbes 2014). The principles are grounded in existing evidence and expert consensus and emphasise the promotion of (1) a sense of safety, (2) calming, (3) a sense of self and collective efficacy, (4) connectedness, and (5) hope following a disaster event (Hobfoll et al. 2007).

This paper presents findings from a study undertaken during 2021–22 in partnership with Landcare Australia looking at the role of community-based, environmentally focused groups in Victoria, Australia following the 2019–20 bushfires. We draw on the existing evidence related to both nature-based recovery, the roles of groups in recovery and recognised psychosocial intervention principles.

Method

During 2021–22, a team from the University of Melbourne and Federation University undertook a qualitative study funded by the Australian Government *Bushfire recovery program for wildlife and their habitat*, administered through Landcare Australia. The aims of the study were to explore:

- the contribution of local groups to environmental and biodiversity recovery after bushfires
- how involvement in natural environmental recovery activities affects group members' wellbeing and social resilience
- factors likely to enhance and/or inhibit the capacity of community-based environmental groups to contribute to environmental and social resilience after a bushfire.

The team used a purposive sampling approach to recruit 21 participants located in East Gippsland and the northeast regions of Victoria who were members of a community-based, environmentally focused group and also affected by the 2019–20 bushfires. The study was promoted through the existing networks of community-based, environmentally focused groups. Landcare facilitators in East Gippsland and northeast Victoria played a key role in recruitment by notifying existing network members about the study and participation options. Personal disaster experiences identified by participants included evacuation, separation from loved ones, total property loss, injury, smoke-related affects and changes to livelihoods.

Semi-structured, qualitative interviews were undertaken by 3 of the researchers between January and March 2022 via telephone or video (due to COVID-19 pandemic restrictions), which were recorded and transcribed for analysis. Interview data were coded qualitatively using an inductive, thematic analysis approach to identify emergent themes (Clarke and Braun 2017) that were then aligned with existing evidence, theory and principles. Data analysis occurred simultaneously with data collection. The data were coded iteratively, building on themes identified in earlier interviews and discussions between the interviewing researchers and then re-analysed as new themes emerged in later interviews. This iterative approach allowed interviewers to interrogate some of the emerging themes raised in early interviews with some of the later participants.

An additional online workshop was undertaken in March 2022 with researchers and 12 stakeholders who were all involved in environmentally focused recovery work following the bushfires in paid professional roles. Workshop participants were asked to reflect on a presentation of the initial themes identified in the interviews and given the option to discuss their professional observations of recovery. These observations were integrated into the thematic analysis of the interview data.

Ethics approval was granted by the University of Melbourne Human Research Ethics Committee number 22709.

Results

The findings from 21 individual semi-structured interviews and one workshop with 12 participants were analysed together and are presented in Table 1.

Table 1: Participant characteristics - interviews.

Gender	Number
Female	13
Male	8
Landholder type	
Productive	8
Lifestyle	13
Land size	
<10 acre	9
10–40 acres	6
40+ acres	6

Participant characteristics – professional workshop

Organisations represented at the workshop included Agriculture Victoria, Victorian Department of Environment, Land, Water and Planning, East Gippsland Catchment Management Authority, East Gippsland Conservation Management Network, Far East Gippsland Landcare Network, North East Catchment Management Authority, Parks Victoria and the Rendere Trust.

Nature of group activities

Participants identified a wide range of motivations for their membership in community-based, environmentally focused groups and a breadth of activities they had undertaken to support environmental recovery on their own properties and communities. This included monitoring and reporting wildlife through visual identification and the use of motion sensor cameras on their properties, installing interim habitat shelters (some fitted with heat sensing technology to support monitoring), participating in citizen science activities including collecting water samples and recording sightings of fauna and regrowth of flora, weed control activities and undertaking considerable revegetation efforts. Many of these activities were undertaken in partnership with government, not-for-profit organisations and research institutions and were able to expand on work being undertaken on public land to private land in the fire affected regions. This was especially notable during COVID-19 restrictions where some research and agency staff could not physically travel to monitor activities.

Almost all of the participants had been members of these groups prior to the 2019–20 bushfires. All participants said that they would recommend joining a community-based, environmentally focused group to people in a similar position to themselves.

Multi-disaster exposure

One of the clearest and most consistent points raised by participants in the interviews was that the 2019–20 bushfires was only one of many disasters and disruptions they were grappling with. The East Gippsland and northeast Victorian regions had experienced a number of disaster events over the decade prior, including fires, floods, storms and drought (Young et al. 2021; O'Rourke et al. 2024) and industry changes, resulting in considerable economic, agricultural and environmental stress. The 2019–20 bushfires, and shortly after, an avian flu outbreak and COVID-19 presented new challenges and amplified existing ones.

Relevance of mass trauma intervention principles

When asked to describe the benefits of their group membership, participants identified a range of elements including feeling as though there was a sense of collective achievement:

So at the end of the year, you look back and say 'yep, we achieved that. We had fun doing it, we had a few really good social days, but we actually achieved this,' and that could be proving that there's platypus in the river or doing the fox program or seeing more live numbers next year on our cameras or even seeing the hill all planted up with trees.

Participants described how group membership fostered a sense of connection both to other people in their community and to the surrounding environment:

I think it's connection and place perhaps, purpose... I guess it's a sense of connection and community in a way, with a huge value underpinning it.

They reflected on the breadth of changes and challenges they had faced in the aftermath of the fires and spoke of a sense of hope that participation in activities through the groups was able to instill:

...that little bit of hope, and I think giving people that little bit of control over how things come.

Some participants noted that, even in times of stress, the trust and connection among the group members meant they were generally able to maintain harmony:

...it's been so easy to keep it harmonious, I think it's been really good for a group... We had a few laughs, we had a wine, or some of us had a wine afterwards, and a bit of

a laugh, and we planned to do the next 2 or 3 months of what we're going to do.

Participants were able to identify a variety of ways the groups had been beneficial, with elements identified resonant to existing literature.

Challenges and benefits of community-led recovery

Participants in the interviews and focus group discussed the benefits and challenges to contributing to community-led recovery approaches in nuanced ways. Strong, trusted relationships that pre-dated the bushfires were identified as helpful for offering and accessing support:

I think probably one of the advantages of being in a community at that time was that the network existed and the contact between people existed already. So, you were in a position to respond probably more quickly than other agencies were, and in a personal kind of way, personal contact kind of way.

These pre-existing relationships extended beyond group membership. As an example, despite not being included in formal pre-event recovery planning, the Landcare facilitator in East Gippsland was invited to participate in government-led recovery committees after the fires and was able to use this platform to act as a conduit between 'outsiders' and their communities and advocate for needs that group members had identified:

Being invited even to be on that [recovery committee] as a not-for-profit was so valuable. And being able to shout out, if you like, for private landholders, I found really beneficial. And really empowering for Landcare I think. Being recognised that way.

The benefits identified from the inclusion into the formal recovery processes highlight an opportunity for inclusion of community-based environmentally focused groups in local and state government recovery plans.

The community-based, environmentally focused groups that had been able to undertake substantial, long-term strategic planning prior to the bushfires identified that they were able to take advantage of recovery grants to progress existing plans. As much of the planning had already been undertaken, these groups seized the opportunity of unanticipated funding to 'leapfrog' activities and programs that otherwise would have taken longer or been more difficult to fund without available disaster funding.

Despite being able to point to the benefits of community-led recovery approaches, participants articulated significant challenges. A number of participants identified that disaster-related stress compromised group members' ability to lead recovery efforts. They also discussed that there was a tension in how community-led approaches were understood and enacted by different government

organisations in a range of ways. Some participants emphasised that while the overwhelming nature of disasters meant they did not always have capacity to lead activities, this did not mean that they wanted to be cut out of the planning altogether:

We need government to take more of a lead. Community-led is a nice idea but when community is just busy holding itself together, it's difficult... local people know what needs to be done, but don't have the energy and time to do it. We need to be able to direct others to do what needs to be done, not have to do it all ourselves.

There were frustrated reports from participants that, in instances where community members were not in a position to take the lead, source funding or drive activities, that their ideas, needs and priorities were often ignored or overlooked by government. Participants expressed disappointment and irritation with the structure of grants processes that forced disaster-affected communities to compete with each other:

It's full on, and then the government came along and made these communities compete with each other for funding. And that sense that the answer was this market mechanism overlaid over a disaster has had a cost...

The bureaucratic nature of available funding was also a point of significant frustration. Some participants expressed dismay at the complexity of the application and acquittal processes for funding:

Funding applications! They are deliberately made complicated... You couldn't believe how difficult it can be made to apply for some of the grants... I do feel that they're made so that they [government] can appear to be giving funding grants when they make an announcement, but they make it so complicated that the money's not taken up... it's almost cruel.

Interview participants noted that organisations from outside the affected communities had more capacity to manage these requirements than local groups in fire-affected areas that were managing significant disruption and demands and had less time and energy to navigate the complexity of the funding processes.

Alarmingly, concerns were raised by some participants that the rigid parameters set by grant funders created perverse incentives to implement actions that would potentially create more problems in the future for communities. One participant gave the example of a grant timeframe that resulted in reduced biodiversity for their region:

There was money for replanting, but the timing was all out [of synch]. [The funder's] deadlines drove things, not when the seeds and seedlings were ready. It's affecting the biodiversity of the area too because we didn't have the seeds for a broader range [of species that were

native to the area] but we needed to spend the money in a short period of time so we had to plant other species that were ready.

Several participants also noted that the post-disaster activities and funding drew new organisations to the affected regions on a temporary basis. These groups were better resourced than local groups, but didn't necessarily have established relationships or ongoing presence in the community:

I guess it was making us feel a bit invisible and that the work we've done previously hasn't been acknowledged. And with the new groups coming in, there was this overall sense... that, 'Oh gosh, it's a honeypot. Here come the bees'.

The issues raised by participants speaks to the benefits, complexity and challenges of community-led approaches to recovery.

Discussion

This qualitative study explored the experiences of people involved in community-based, environmentally focused groups who were also personally affected by disasters, with additional insights from professionals involved in natural environment disaster recovery.

Benefits of membership

Participants were able to identify a range of benefits to group membership. Despite the interview participants not considering disaster recovery as a core business for their groups, the benefits described were very closely aligned with existing evidence of the benefit of connections to nature (Abraham et al. 2010; Husk et al. 2016; Block et al. 2019; Corazon et al. 2019) and the five essential elements of mass trauma interventions, that is, promoting a sense of safety, calm, connectedness, self and collective efficacy and hope (Hobfoll et al. 2007).

This finding indicates that while these groups may not see post-disaster support for members as core business, these groups can nonetheless play an important support role for disaster-affected group members. Pre-existing levels of trust and reciprocity before a disaster, as well as the nature of the activities the groups undertake, positions them to provide support in line with the existing evidence base for psychosocial support after disasters.

Amplification of public programs

An important finding of this research is that community-based, environmentally focused groups were able to partner with and amplify the work of other organisations, including government, not-for-profit organisations and research institutions. This was achieved in a range of ways, including citizen science efforts, harnessing

volunteer groups to help operationalise activities planned by other organisations, monitoring activities at a time where agencies were constrained by COVID-19 pandemic restrictions and through spanning the boundaries between public and private lands to enable more wholistic regional approaches. This occurred despite limited pre-disaster planning for these partnerships to take place. This finding indicates important opportunities for future partnerships between community-based, environmentally focused groups and other organisations to plan for ways to cross public and private land divisions in order to scale conservation and environmental rehabilitation activities in future disasters.

Challenges and benefits of community-led recovery

These findings contribute to the growing body of work exploring the nuance of community-led approaches to recovery (Dibley et al. 2019; Inspector-General Emergency Management 2021; Brady et al. 2023). Participants identified a number of benefits to community-led approaches, including being able to draw on pre-existing networks, local knowledge and existing trust. Additional benefits included being able to rely on acts of reciprocity, being able to act as a conduit for community-based groups to the formal recovery system (even if this was done inconsistently) and to harness new funding to accelerate pre-disaster plans.

Participants were able to clearly identify the challenges of community-led recovery approaches already documented (Inspector-General Emergency Management 2021) (including intense demands on disaster-affected community members at a time of high workloads and fatigue) and to point to a number of ways the formal recovery system was often at odds with community-led approaches that are supposed to underpin recovery policy and practice in Australia. These included treating the bushfires as a discrete disaster event rather than considering it in a broader context of community disruption and multi-disaster exposures. This indicates that disaster recovery services and policies are not yet reflecting the increased exposure of Australian communities to multiple disaster events (Richardson et al. 2023). Other challenges included short-term funding that often needed to be applied for before communities and groups were ready, competitive and complex grant processes that favoured groups from outside the affected areas that were not struggling with disaster-related disruptions, governance processes that placed a high burden of administrative demands on disaster-affected people, development of new committees and groups rather than supporting existing groups and project timeframes based on funder requirements that created perverse incentives in communities in order to retain funding support.

Implications

The findings from this study indicate that community-based, environmentally focused groups can positively contribute to the social and environmental recovery after disasters such as bushfires. This study identified that there were barriers for these groups to participate in formal recovery efforts that are likely to be issues for similar groups in other parts of the country. Actions taken by community-based, environmentally focused groups related to planning and capacity before a disaster that are likely to help these groups to be better prepared to support their members and take advantage of available funding after disasters. This includes medium- and long-term strategic plans for groups and identifying organisations and committees to partner with. Recovery planners should consider including these groups in community recovery planning and should consider incorporating findings relating to short-term, restrictive, burdensome and competitive funding.

Further insights and recommendations can be found in the published project report.¹

Study limitations

This study relied on a participant sample recruited through existing established networks. Recruitment and data collection took place during a time of COVID-19 related travel and in-person meeting restrictions and high demands on participants relating to disaster recovery, making community engagement in the lead-up to the study especially challenging. Future studies may be able to capture views of people in smaller or less formalised community-based, environmentally focused groups and may be able to design for comparison groups (e.g. non-environmentally focused community-based groups) to be included.

Despite these limitations, the findings of this study align with established evidence and theory, which may speak to the generalisability beyond the context of the current study.

Conclusion

In this qualitative study of the experiences of members of community-based environmentally focused groups in East Gippsland and northeast Victoria following the 2019–20 bushfires, we identified that these groups offered significant benefits in post-disaster settings despite disaster recovery not being their core function. The benefits reported by participants included supporting connection to the natural environment, group membership experiences that aligned with the promotion of safety, calm, connectedness, self and collective efficacy and hope (i.e. the essential elements of mass trauma intervention)

1. *The overwhelm of black and the joy of green*, at https://mspgh.unimelb.edu.au/___data/assets/pdf_file/0020/4170242/Landcare-Project-Report-Final90.pdf.

and the ability for these groups to help amplify the work of other organisations including governments and not-for-profit organisations. These findings point to the importance of medium and long-term strategic plans prior to disasters for these groups and the need for recovery planners to integrate community-based, environmentally focused groups into recovery plans and to support them to participate and deliver. The findings also point to the complexity, challenges and benefits of community-led approaches in post disaster settings.

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Abstract

In view of the increasing magnitude and frequency of hazards, governments and international bodies are exploring innovative strategies for managing or reducing risks and responding to emergencies. As there is an urgent need for responsiveness, it is crucial to analyse response considering both the rapid and slow onset nature of these events. While public sector organisations grapple with the perpetual challenge of making decisions given the ambiguous, uncertain and complex characteristics of hazards, exploring the nature of institutional pressures emanating from stakeholder expectations and demands, the mechanisms that drive institutional responses and the typology of responses that can be deployed to reduce risks is crucial. This study involved extensive literature review and semi-structured interviews of public sector organisations and international non-governmental organisations funded projects. Both interviews and textual data based on observational findings from a multi-scenario tertiary-level disaster risk management education simulation-based learning activity were analysed thematically to aid the design and development of the framework presented. The findings offer opportunities for authorities and stakeholders to facilitate responsiveness while improving informed decision-making and political will for managing or reducing risks and emergency.

An institutional response framework to enhance disaster risk reduction: a public sector perspective

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Introduction

Disasters can have multiple negative impacts on nations (IPCC 2014; CRED 2023) that often undermine the capabilities, skills and competencies available to respond before, during and in the aftermath of hazards (Dias et al. 2018; Ward et al. 2018; Shaw et al. 2022). This is in view of the adverse effect of climate change and issues associated with adaptive environmental governance and the perplexities of disaster risks that still presents enormous challenges for disaster risk reduction (DRR) organisational fields (IPCC 2012; IPCC 2014; Johnson et al. 2019). There is also the issue of knowledge management and translation of DRR policies into action (Pigeon 2013; Cleaver and Whaley 2018; Wisner et al. 2014) amid fragmentation, resourcing and risk communication methodologies (Abunyewah et al. 2020; Perera et al. 2020; Toinpre et al. 2025). While there is an urgent need for 'responsiveness' to address these issues, it is crucial to deconstruct response as an active and passive concept. This is bearing in mind the interconnected origins of disaster risks and the rapid and slow onset nature of natural hazards.

As public sector organisations and international bodies continue to define and explore innovative strategies to address risks (UNDRR 2016), it is crucial to identify institutional constraints that hinder organisational field responses to disaster risks and natural hazards; the institutional pressures that propel responses and the typology of responses that can be deployed to conform or resist pressures (Wisner et al. 2004; DiMaggio and Powell 1983; Oliver 1991). DRR organisational fields in this context refers to 'the totality of actors and individual organisations with varying goals, values and interests whose statutory functions cut across

providing public good and reducing disaster risks' (Toinpre et al. 2018; Toinpre et al. 2024). Although, the institutional capacity for responding to emergencies and reducing disaster risks may be influenced by resourcing and an awareness of the nature of pressures (Norman 2014; Toinpre 2020), it is crucial to understand the processes through which they may be created, maintained and disrupted (Willmott 2011; Lounsbury and Boxenbaum 2013; Koskela-Huotari et al. 2020). This study therefore presents the Institutional Pressure and Response Mechanism (IPRM) framework to illustrate the complex interactions between pressures and institutional responsiveness while suggesting inter-operational network mechanisms that can assist in bridging response gaps. It analyses 41 semi-structured interviews sourced from public sector organisations and international non-governmental organisations funded projects in Imo State, Nigeria and secondary data sources such as journal articles, books, conference papers, government reports.

The study also builds on the observational findings from a co-authored published study on tertiary-level disaster risk management education simulation-based learning to textually analyse multi-stakeholder institutional response strategies based on case studies from Nigeria and Ghana (Tasantab et al. 2023). The simulation-based learning was designed using a formative assessment approach where information regarding existing flood risk conditions in both case studies were utilised. Finally, this study advocates for an adaptive environmental governance approach for the often-misconstrued notion of 'response' through a mutual learning alignment between the academia, public and private sectors. This approach offers opportunities for public sector organisations and stakeholders to enhance responsiveness to persistent risks and emergencies while facilitating informed decision-making, improving political will and significantly contributing to capacity building, competencies and commitment.

Literature review

Disaster risk governance and institutional pressure typologies

The concept of disaster risk governance and what it means to researchers in disaster risk management literature has evolved over the years (Klinke and Renn 2018; Djalante and Lassa, 2019; Renn 2020). This evolution has witnessed gradual shifts from a reactive form of response to a more proactive response guided by international and transboundary agreements such as the 2030 Agenda on Sustainable Development, New Urban Agenda, Agenda for Humanity, Paris Agreement on Climate Change and the *Sendai Framework for Disaster Risk Reduction 2015-2030*. These frameworks have provided an invaluable platform

for decision-makers across various levels of governance to develop and localise institutional mechanisms to effectively reduce disaster risks within their respective jurisdictions (Renn et al. 2018). In addition, an appreciable number of studies have distinctively explored and distinguished between 'collective decision-making' (Okada et al. 2013; Ton et al. 2021) and 'risk governance' (Renn and Klinke 2014; Klinke and Renn 2018; Renn 2020). These definitions simply put together infer elements of institutional structures and processes aimed at regulating, reducing and controlling disaster risks through collective actions by individuals, groups, regions or nations across the globe.

Vulnerability is socially constructed and mainly driven by limited accessibility to power, structures and resources (Wisner et al. 2014; Oliver-Smith et al. 2017). Just as politics is manifested in visible contests, the ability to set an agenda as well as the underlying ideology that frames perceptions of what is an appropriate course of action, while the power influences how it works, who has it, and how it is deployed (Lukes 2021; Torabi et al. 2022). It is also based on both precedents that emphasises the view of resilience and risk reduction in cities posing the fundamental question over who makes decisions, what sectors or networks are prioritised, which risk conditions are to be addressed and what locations are to be assisted (Djalante et al. 2013; Djalante 2012; Meerow and Newell 2021). This philosophy has been based on the interactions between socio-political and economic ideologies, which have rippling effects on human behaviour and concomitant risk conditions necessitating a more holistic and integrated approach for risk governance and response (Paton and Johnston 2017; Djalante et al. 2013). While the magnification of the effects of hazards is embedded in the level of exposure and susceptibility, the persistence of disaster risks exacerbate effects on communities (Wisner 2022; Wisner et al. 2014). Public sector organisations are likewise susceptible to these risks and have to deploy response strategies based on established symbolic systems (i.e. rules, codes of conduct, laws, values and policies), routines (i.e. protocols, standard operating procedures, roles and scripts) and artefacts (i.e. technology and non-technology-based products/services). Further, the response strategies deployed are subject to the typology of institutional expectations and demands.

Vulnerability to hazards is associated with a state of function or dysfunction and nature of control exercised through governance and existing capabilities for risk reduction (Wisner et al. 2014). Hence, DRR is characterised by complex governance arrangements as well as cross-border cooperation (Tierney 2012) among dominant entities. Such entities (e.g. public sector organisations, non-government organisations, multinational corporations) allocate resources to develop systems, routines and

artefacts adopted by subsidiary organisations or communities (Resell 2020). In addition, researchers argue that the existence of a common legal environment affects several aspects of an organisation's behaviour and structure (DiMaggio and Powell 1983; Fadare 2013). The persistence of institutional constraints triggered by these interactions therefore channels root causes into specific forms of unsafe conditions (Wisner et al. 2014; Twigg 2015), which are further revealed through fragility of the physical environment and the economy. This affects livelihoods, household incomes, social groups at risk and limited public action (Wisner et al. 2014; Wisner 2016). Institutional theory therefore offers unique insights into an organisation's environment in relation to institutional pressures (Oliver 1991). Three forms of institutional pressures propounded by DiMaggio and Powell (1983) that could be internally or externally exerted on public sector organisations and constituents include coercive, normative and mimetic pressures (Oliver 1991; Dhanda et al. 2022). The manner with which these pressures are responded to reflects on the field outcome and ultimately, the similarities exhibited by organisational norms, practices and standards of operation. This best describes 'institutional isomorphism'. The coercive pressure involves the adoption of practices based on the prescriptions of dominant organisations, which have a higher sphere of influence and could lead to structural reforms (DiMaggio and Powell 1983; Zucker 1987). The normative pressure is linked to professionalism and relates to individual and organisational attainments and legitimacy driven attributes such as set targets and benchmarks, professional standards, standards of practice and certifications (Toinpre et al. 2018). Lastly, the mimetic pressures are manifested through the need for entities to adopt policies or practices under ambiguity and uncertainties (Piccolino 2020). This form of pressure is usually observed when imitating practices from other entities that have proven to be successful.

Institutional response typologies and strategic choices for risk reduction

Public sector organisations respond to stakeholder expectations and demands based on several antecedents. However, most of the response strategies are influenced by the type of pressures (i.e. coercive, normative, mimetic) being exerted and antecedent factors (i.e. cause, context, constituents, control or content). Conversely, depending on the constraints, public sector organisations may not be aware of stakeholder expectations and demands and may be under-resourced to respond, thus necessitating the need to assess pressure typologies and assess responses that can be deployed to improve DRR outcomes. Furthermore, as strategic responses are choices organisations make through self-interest or active agency,

it reflects on the principles and standards of practice, organisational interests, resources and capabilities available (Wijethilake et al. 2017). These include:

- acquiescence
- compromise
- avoidance
- defiance
- manipulation (Oliver 1991), see Table 1.

Mintzberg and Waters (1985) argued that strategies may be deliberate (i.e. planned or intentional) or emergent (realised without intention). However, a deliberate strategy is realised exactly as prescribed or intended by an organisation and constituent actors, which result to operational responses.

By operational responses, we refer to deliberate actions aimed at reducing disaster risks. These sorts of responses are typically process-driven and can lead to the design and development of structural or non-structural risk mitigation measures using physical (e.g. critical infrastructure such as bridges, dams, culverts, dykes), social (e.g. community-based DRR initiatives) or economic (i.e. fiscal or monetary policies) instruments. In addition, the typology of responses deployed directly or indirectly mitigates risks by virtue of policy and planning initiatives, legal and regulatory systems, resourcing, capacity development, activation of institutional arrangements, stakeholder accountability, participation and engagement (see Figure 1). It is in view of these measures that the concept of risk governance continues to evolve shifting the discourse away from a government-dominated agenda to a shared responsibility where governance structures, markets and institutional networks are aligned to achieve collective goals (Hasselman 2017; Lange et al. 2013). Although the application of strategic responses and corresponding tactics to institutional processes have been recognised in various studies (Covaleski and Dirsmith 1988), its application to disaster risk management simulation and environmental sustainability studies have been noteworthy (Wijethilake et al. 2017; Toinpre 2020). Table 1 details the institutional response strategies and tactics.

Within DRR organisational fields, coordinating entities may often be inclined to instantaneously making strategic decisions in the best interest of the organisation and the jurisdiction where their statutory functions are undertaken. Hence, in deploying such response strategies it is ideally expected that stakeholder pressures to reduce risks should tend towards conformance. However, limited capacities, resources or awareness of pressures being exerted may result in resistance, which may translate to unsafe conditions that exacerbate vulnerability. Exploring actors and channels for response to pressures is therefore crucial.

Table 1: Typologies of strategic response to institutional processes.

Strategic responses	Description/tactics	
Acquiescence	Compliance with pressures to enhance legitimacy and social support.	
	Habitual	Response to taken for granted norms and adherence to rules and reproduction of practices and strategies which later become conventions.
	Imitation	Mimicking best practices from successful organisations and accepting recommendations under uncertain conditions.
	Compliance	Conscious obedience to or integration of values/norms institutional requirements.
Compromise	Response to conflicting or inconsistent pressures often described as the edge of the wedge signalling inconsistencies in expectations and demands.	
	Balance	An attempt to attain parity between and among multiple institutional actors.
	Pacify	Reflects on partial conformance based on interests.
	Bargain	Negotiations with various constituents to obtain concessions.
Avoidance	Involves the implementation of modification strategies.	
	Concealment	Disguising non-conformance under the pretence of acquiescence (also referred to as window dressing).
	Buffering	Partial decoupling of technical activities from institutional expectations.
	Escape	A way of exiting the context within which the pressure was exerted. Involves altering objectives, activities, domains to avoid conformity.
Defiance	Rejection of institutional norms or expectations.	
	Dismissal	Where organisational goals differ from expectations and demands of institutional constituents.
	Challenge	Refutation in instances where pressures seem irrational.
	Attack	The instance where organisations vehemently belittle denounced institutionalised values. It is also the disregard of values and external constituents that express them.
Manipulation	An extreme level of active resistance to pressures.	
	Co-opt	Neutralise pressures to enhance legitimacy persuasive in nature.
	Influence	Directed towards institutionalised values/beliefs. Involves influencing standards by which evaluations are made.
	Control	The establishment of power and control over external constituents that put pressure on the organisation.

Conformance

Resistance

Source: Oliver (1991)

Institutional actors and channels for DRR response

Governance is characterised by multiple and contextual actions, norms and behaviours of groups or individuals that simultaneously operate via formal or informal pathways (Renn et al. 2011; Renn 2014). Three categories of actors as identified by Lemos and Agrawal (2006) are:

- state actors (e.g. multilevel governance arrangements at national and sub-national levels)
- market actors (e.g. private sector)
- social actors (e.g. non-government organisations, community stakeholders).

Disaster risk governance entails bringing multiple actors together to solve complex issues and requires networks for seamless interoperability. Similarly, in instances where

responses via emergency services (e.g. paramedics, police, firefighting services, public health organisations, military personnel) and community-based organisations are beyond the capacity of a country, international entities intervene (Perera et al. 2020). Global platforms through which some of these interventions have been developed are the United Nations Office for Disaster Risk Reduction (UNDRR), the Intergovernmental Panel on Climate Change (IPCC) and International Risk Governance Council among others.

State actors are renowned for creating enabling collaborative mechanisms, which provide access to procedures and social services. These range from the establishment of technology, information, and communication channels to the design and development of critical infrastructure (Forino et al. 2015; Twigg 2015). DRR practitioners also aid the entire process of implementation

(Forino et al. 2015). Market actors develop alliances and finance non-government organisations' campaigns to promote environmental wellbeing and responsible behaviour (Forino et al. 2015; Chadda and Kundal 2023). Corporate social responsibility can be achieved through philanthropy (e.g. donations), contractual (i.e. sponsorships to carryout work for public benefit) and unilateral agreements as well as under adversarial circumstances (i.e. lobbying and public statements on the environmental impact of operations). To address some of response-based challenges, public sector organisations may be required to respond by changing policy and legal frameworks, adopting new strategies or reviewing coordination arrangements (Patterson and Huitema 2019). Although, von Meding et al. (2013) classified response based on the nature of hazards, a fundamental issue still lies in the disjointed approaches to risk reduction. An example is the time-bound nature of rapid and slow-onset events (Moe and Pathranarakul 2006). For example, responding to slow-onset disasters such as gully erosion, famine or drought would require a different approach when compared to earthquakes, flash floods or tsunamis. A limited consideration of the timely nature of hazards and lessons learnt may indicate ineffective or delayed responses (Mude et al. 2009; Wassenhove 2006). However, it is beneficial for public sector organisations to recognise these disparities while mobilising channelling resources efficiently to reduce disaster risks.

Some response-based challenges in DRR organisational fields

Despite several efforts made by public sector organisations to reduce disaster risks, there are still barriers that hinder positive DRR organisational field outcomes (Birkmann et al. 2010; Krüger et al. 2015; Forino et al. 2018). Challenges which still impact on institutional responses in DRR include contested logics among institutional actors; fragmentation and complexity of global environmental governance (Bertels and Lawrence 2016; van Asselt 2014); integration of Indigenous knowledge, worldviews and inclusivity (Agrawal et al. 2022; Goerlandt et al. 2020) and diversifying risk communication methodologies (Pigeon 2013; Abunyewah et al. 2020). Such barriers may prevent cross-disciplinary dialogue for inclusive and collaborative DRR-focused initiatives (Djalante and Thomalla 2012; IPCC 2012). Formal and informal responses have been identified in the wake of the 2004 Indian Ocean tsunami necessitating institutional reforms (Hettige and Haigh 2016; Birkmann et al. 2010). There is also the controversy between 'response' as a 'scientific/technical' issue and a 'social construct' that still lingers (Birkmann et al. 2010; Krüger et al. 2015). The technical responses are often broad-based and presents the public with minimal

engagement and participation opportunities (i.e. GIS and other geo-spatial analysis for risk assessment) while institutional approaches are widely criticised for being politically driven arguing the dominance of policy-actors (Forino et al. 2018; Jerez-Ramírez and Pinzón-de-Hijar 2022). However, regardless of the typologies used, public sector organisation responses should be adaptive and focused on risk reduction and resilience building (Ahmed et al. 2020), which may include social capital, competence, economic development and communication for response, which thrives on local level leadership.

Methodology

Research philosophy and data search

This study used a qualitative research method underpinned by constructivist worldview where individuals or groups ascribe meanings to social problems (Creswell and Poth 2016). This approach involves the gathering of data by reviewing documents, books, journal articles or reports (Patton 2014). According to Creswell and Poth (2016), qualitative research is conducted to explore a problem or issue, which requires a complex detailed understanding. Although there are various opinions about the extent to which literature reviews can be conducted, qualitative texts are reviewed to provide a rationale for a problem and positions a researcher's study within ongoing literature about the topic being discussed (Marshall and Rossman 2010; Creswell 2015).

Literature review was conducted in 3 stages using Google Scholar and other open-source platforms. These sources provide access to high quality peer-reviewed journals and reports published in English, which were retrieved, stored and organised using EndNote 20 software. Creswell and Poth (2016) suggest interpretive and theoretical frameworks to shape qualitative studies. This requires making assumptions, paradigms and presenting frameworks explicitly. The first stage was conducted prior to the study to examine theoretical underpinnings guiding the design of the framework (i.e. Pressure and Release model, Institutional theory and Strategic Response to Institutional Processes) as propounded by Wisner et al. (2014), DiMaggio and Powell (1983) and Oliver (1991), respectively. The second stage involved reviewing literature on institutional constituents and actor networks to identify key antecedent mechanisms and channels that facilitate response. The final stage involved the review of government reports, journal articles and conference papers to explore contextual applications of institutional responses to disaster risks and hazard events. These reviews formed the basis for the design and development of the framework guiding the study.

Approach to inquiry and analysis

As Yin (2009) suggests, case studies are suitable strategies for explanatory and descriptive studies. Other researchers agree that they are a suitable form of inquiry, design and a unit of analysis (Creswell and Creswell 2017). Creswell and Poth (2016) also state the use of multiple forms of data such as interviews, observations and documents rather than relying on a single source. The study is therefore based on an extensive literature review, primary data obtained from semi-structured interviews and textual analysis of observational findings from a 2-scenario tertiary-level disaster risk management education simulation-based learning activity conducted at the University of Newcastle, Australia. The simulation participants were assigned roles to depict relevant stakeholder groups within the DRR organisational field. The rationale for this inclusion was to explore how institutional pressures influences responses to flood risk conditions. However, for the purpose of this study, the unit of analysis was organisations and observational findings from the simulation-based learning scenarios where participating students represented communities, public

sector organisations and international non-government organisations. A human research and ethics committee approved the data collection process for the selected case studies (number H-2018-0015). Social constructivism as an approach to inquiry involves the analysis of texts (Lincoln et al. 2011). Including textual analysis based on observations from a published peer-reviewed article was crucial to indicate the significance of multistakeholder dialogue in disaster risk governance. Observations from the scenarios were coded manually and the analysis of text aided the design and development of the framework.

Analysis and discussion

Analysing the IPRM framework

The IPRM framework provides a holistic view of the cyclic interactions between institutional pressures and responses that influence DRR outcomes (see Figure 1). In this instance, dynamic pressures (section A) are manifested through institutional structure constraints such as resourcing (i.e. skill-shortages, financing, risk transfer), which lead to dysfunctions in systems and processes (i.e. outmoded

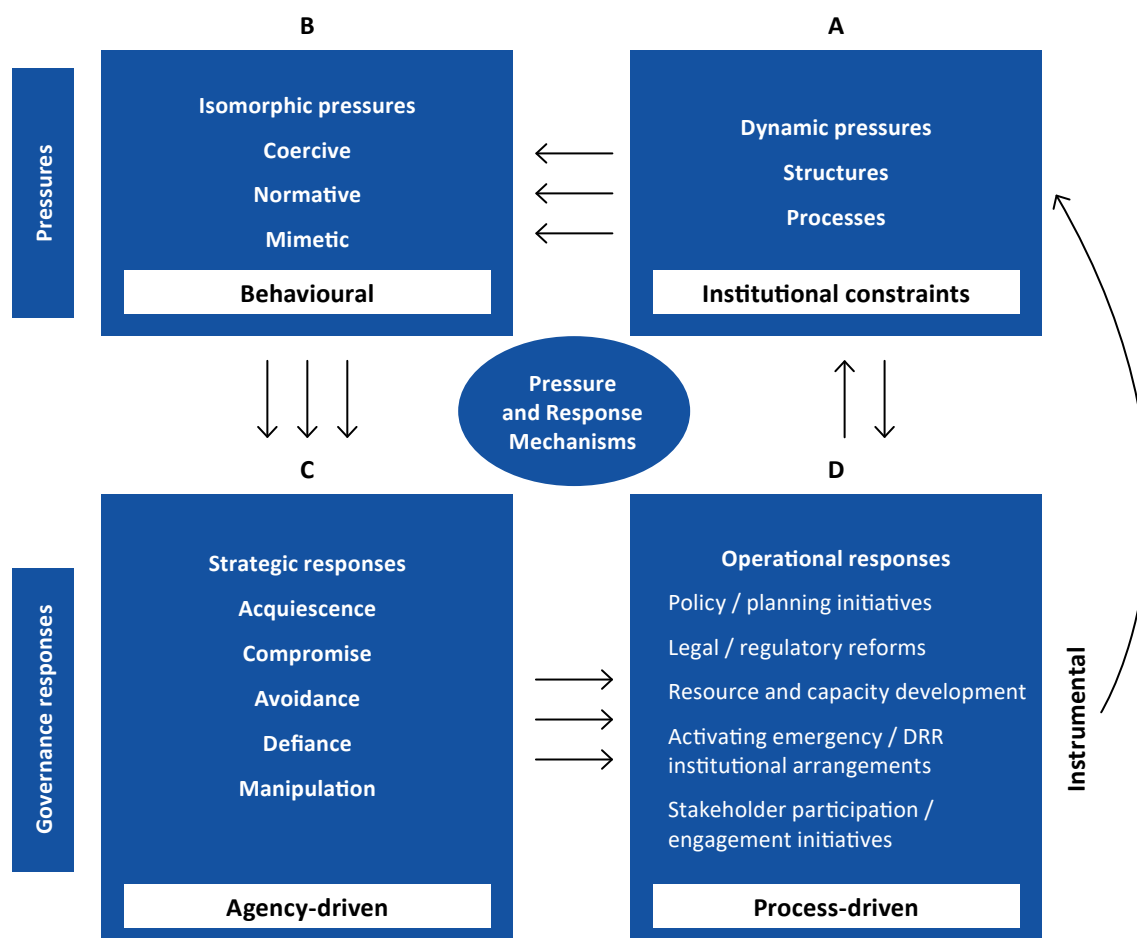


Figure 1: The Institutional Pressure and Response Mechanism framework.

planning policies, building codes and land use legislation) ultimately undermining government efforts and local capacities. Where there are limited capacities, there are tendencies for progression of vulnerability to unsafe conditions such as fragile physical environments, which increases the levels of vulnerability and susceptibility to hazards. In instances where institutional constraints are persistent, institutional constituents (stakeholders) therefore exert pressures through expectations and demands for safer physical, social, economic and environmental conditions such as updated building codes and land use legislation and resilient infrastructure (section B).

Isomorphic pressures are drivers of organisational growth, and they encourage competitive markets and propel organisational performance (DiMaggio and Powell 1983). However, the availability of resources, capacity, commitment and the awareness of the nature of pressures being exerted influences the ability for public sector organisations to perform. In any such instances, organisations are presented with the choice of responding using strategic options at their disposal, which may lead to conformance or resistance to mitigate risks (Section C). These forms of responses are often agency-driven and mainly spear-headed by constituents and decision-making entities. Depending on the strategic choices employed, public sector organisations would develop instruments (mainly process-driven) to foster actions aimed at addressing institutional constraints thereby responding to expectations and demands to enhance DRR outcomes (section D). For example, policy and planning initiatives are used as prescriptive tools and procedural guidelines to shape stakeholder behaviours. The legal and regulatory system reforms proffer updated guidelines, which other sectors have to comply with in order to foster public actions in alignment with statutory obligations. For example, existing policies and guidelines for flood risk governance in the Nigerian case study include the National Environmental (Wetlands, Riverbanks and Lake Shores) Regulations, S.I. No. 26 of 2009 and National Environmental (Soil Erosion and Flood Control) (National Emergency Management Agency [Nigeria] 2018). While some of the existing initiatives have been operationally critiqued, there are still avenues to consider updating existing frameworks and mechanisms. The World Bank's National Erosion and Watershed Management Programme has played a key role in supporting and addressing some vulnerability gaps in partnership with some state governments. Based on the selected case study, participants reflected on mechanisms that facilitate responsiveness for risk reduction, which tend towards a conformance strategy. These included media intervention, international non-government intervention and political interest, as shown in Table 2.

Media intervention

The media plays a significant role in transmitting risk information to the public. Such information is necessary for participation and engagement in DRR initiatives as well as response activations and evacuations before, during and after hazards. The media also plays a key role in shaping community perceptions by building a culture of safety through awareness of risks and measures to address them. Some of such channels include social media (e.g. Facebook, X, Instagram, WhatsApp), television, radio, newspapers and SMS.

Why that issue was resolved speedily was because we went there and granted [a] press interview on national television and the interpretation was that [...] was blaming government for what happened so immediately they swung into action...

(Public sector organisation R1)

The media was the second most cited response antecedent. Having been identified as a crucial mechanism for stimulating government responses especially in emergencies to provide information relevant for relief, identifying sources of physical, psychological, emotional or financial support. New York's notification system Notify NYC 311 was used to provide information on emergencies, public health issues and school closures (Eugene et al. 2022). In Australia, the Fires-near-me, Emergency Plus, Bureau of Meteorology weather and hazards-near-me apps have been developed to inform stakeholders on appropriate warnings and preventive measures. The Queensland Remote Aboriginal Media has also been offering a similar service for boosting communication (Commonwealth of Australia 2022).

International non-governmental organisation intervention

International non-governmental organisations such as United Nations Development Programme and United Nations Environment Programme, United Nations Office for Coordination of Humanitarian Affairs (UN-OCHA), World Bank, Food and Agriculture Organization and the World Health Organization play crucial roles in strategic and operational responses through development programmes and humanitarian assistance. This antecedent factor was referenced 9 times from 3 sources. Often times,

Table 2: Response antecedents facilitating disaster risk reduction.

Nodes	Sources	References
Media intervention	8	10
International NGO intervention	3	9
Political interest	6	11

disasters overwhelm the capacity of communities whose resources are scarce and may find it challenging to respond effectively and efficiently given the complexities and uncertainties presented.

Funding can stimulate the ministry to work hard. The government also needs to collaborate more with international agencies; United Nations World Health Organization, you know they normally have grants they give to state governments to manage such risks.
(Public sector organisation R30)

In Australia, non-government organisations have been instrumental in managing service provision on behalf of the government. For instance, the Red Cross's 'Register. Find. Reunite' and Making Cities Resilient campaign launched in 2010 by the UNDRR have been a useful avenue for encouraging effective international, transboundary and local governance for enhancing action, learning and cooperation.

Political interest

Political interest was the most referenced response antecedent (referenced 11 times from 6 sources). This response antecedent plays a dominant role in the prioritisation of risks. This is often shaped by vested interests and availability of resources for investing in DRR. Furthermore, key issues such as DRR and climate change adaptation are often not considered as major government priorities due to the pressing need for critical infrastructure services such as bridges, roads, telecommunications, schools and hospitals in some countries. However, these are indirect initiatives for addressing risks, which need to integrate aspects of DRR. In addition, resource and capacity development interventions are crucial for enhancing DRR skills and competencies as well as funding mechanisms to implement statutory functions.

The most important thing is for the people that are leading us to have interest in disaster management. If they have interest, they will fund you to carry out your legitimate activities. But where they do not have interest, you will be talking to the wrong people because they do not see the need for all that.
(Public sector organisation R3)

Further, activating emergency and DRR institutional arrangements is crucial. This requires support from governments at national, regional and local levels. Operational responses are often activated by virtue of the strategic response choices and tactics employed by public sector organisations. Based on the observations during the simulation activities, which involved the assigning of roles, participants showed that due to the persistence of risks, communities, public sector organisations and international non-governmental organisations were more

likely to experience all 3 forms of institutional pressures. We found that some participants exhibited some level of intuition and improvisation while others did not deviate from the script (acquiescence). Participants representing public sector organisations demonstrated willingness to collaborate with communities advocating for a forward-thinking approach to risk reduction (compromise). While some participants did not articulate arguments in an authoritative or tactful manner (avoidance), others felt comfortable with their power positions, as it was daunting to manage multiple interests among stakeholder groups (defiance). On the other hand, some participants displayed domineering roles, which shaped the discourses (manipulation).

Mechanisms bridging DRR organisational field response: a practical context

Given the enormous challenges presented to public sector organisations involved in policy implementation, DRR and climate change policies require bridging governance mechanisms to facilitate multi-level implementation (Raikes et al. 2022). These include inter-organisational networks established for response and recovery categorised into inter-organisational network support, adaptive networking response and interconnected network support (Mutebi et al. 2022). Inter-organisational networks play a key role in facilitating adaptive processes of change, access and distribution of aid (i.e. supply chains) and organisational learning (Thomalla et al. 2006; Forino et al. 2015). Through inter-organisational networking in Bolivia, a shared risk analysis and participatory planning tool utilised by CARE, OXFAM and World Vision was developed to facilitate a collective development process to foster DRR and climate change adaptation initiatives (Srodecki 2011). These networks of interaction are valuable in reducing policy fragmentation, changing organisational cultures, increasing productivity, enhancing efficiency, reducing redundancy and cutting transaction costs (Ward et al. 2018).

Forino et al. (2015) identified 3 forms of partnerships that act as bridging mechanisms. These include public-private partnerships, private-social partnerships and co-management. Lassa (2012) also opined that such intergovernmental interactions in a post-disaster context is characterised by complexities, which have the propensity to trigger formation of new networks and clusters. These have been exemplified through post-disaster reconstruction and the emergence of humanitarian networks for multilevel communication and coordination (Mees et al. 2017). Public-private partnerships are partnerships between state and market actors and act as motivators of investment in DRR and recovery/reconstruction projects, which grapple with limited

public financing (Lemos and Agrawal 2006; Forino et al. 2015). Public-private partnerships also aid the expansion of services beyond public sector organisation reach and improves efficiency, responsiveness and resource access (Chatterjee and Shaw 2015).

In response to climate change, Australia has developed a whole-of-economy plan to achieve net zero emissions by 2050 aligning with global commitments towards sustainability (Australian Government 2021; Gajendran et al. 2024). The Australian Government also designed institutional arrangements such as the National Climate Change Adaptation Framework, National Strategy for Disaster Resilience, National Disaster Risk Reduction Framework and Australian Government Crisis Management Framework to support this agenda. In partnership with the Global Facility for Disaster Reduction and Recovery, the Australian Government is ensuring World Bank investment in the Indo-Pacific region with a strong focus on risk financing and early action in response. An example of this is Australia's response in the aftermath of the January 2022 Tonga volcanic eruption. Australia is working with UN women in Fiji, Vanuatu and Kiribati in the Pacific to ensure systems, plans and policies are gender-responsive to empower women in leading solutions for preparedness, prevention, response and recovery (Commonwealth of Australia 2022). Other examples of response-based activations include the establishment of the National Bushfire Recovery Agency in response to the summer bushfires in 2019–20 and the National Drought and North Queensland Flood Response and Recovery Agency in response to the Queensland floods in 2019 (Commonwealth of Australia 2020).

Conclusion and recommendation

In view of the several challenges hindering the efficacy of responsiveness towards the reduction of disaster risks, this study clearly identified some response-based challenges that can be categorised as sources of institutional pressures. DRR organisational networks are therefore subject to coercive, normative and mimetic pressures and prospective studies need to focus on exploring these pressures, response mechanisms to pressures and the concomitant influences of response typologies on DRR outcomes. Although, this has been exemplified illustratively using the IPRM framework, diversifying case study contexts and applications are crucial to holistically explore and ameliorate disaster risk concerns. The findings suggest that key response antecedents may include media intervention, political interest and international non-government organisation intervention. Furthermore, this paper discusses bridging mechanisms such as public-private partnerships, private-social partnerships and co-management that can be leveraged to facilitate responses for interoperability among DRR organisational

field constituents in the study location with lessons learned from examples of best practice.

Although, response may be influenced by capacity and awareness of public sector organisations and communities to understand and act, there is need for diversifying communication channels, pedagogies or methodologies for training and retraining of personnel responsible for implementing functions. Conversely, the role of non-government organisations in emergency interventions and DRR cannot be overemphasised. Non-government organisations have over the years played significant roles in response, recovery and reconstruction through community-based disaster risk reduction initiatives, which has led to the conduct of trainings, workshops, community stakeholder meetings and other forms of engagement resulting in progressive outcomes and in raising substantial funds. However, our conceptual idea of the IPRM framework is to accelerate the DRR discourse in the context of recognising a more holistic view of responsiveness not just in the 'response phase' of the disaster management cycle, but within DRR organisational fields and particularly in pre and post disaster scenarios. This also includes harnessing and allocating resources required for efficiency of disaster risk governance mechanisms and arrangements and decision-making. Knowledge in this area is scarce and can be extended further to explore challenges and solutions to facilitate responsiveness considering other contexts.

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Leveraging Artificial Intelligence for enhanced lessons management: The RAID Model

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Abstract

This article examines the integration of artificial intelligence (AI) into lessons management processes in emergency management, focusing on the Real-time Artificially Intelligent Doctrine (RAID) model. Drawing on insights from post-event inquiries, organisational culture research and collaborative frameworks, this paper evaluates how AI can address systemic challenges in translating lessons into practice. By synthesising findings from research across 20 years, this paper demonstrates how RAID's AI-driven approach complements existing lessons management frameworks while overcoming barriers to implementation.

Introduction

Emergency management organisations globally face a recurring challenge: while lessons are often identified following a disaster event they are rarely institutionalised nor effectively applied in subsequent events (Donahue and Tuohy 2006; Glassey et al. 2020; Savoia et al. 2012). This systemic failure perpetuates avoidable mistakes and inefficiencies, resulting in unnecessary harm to communities and wasted resources. The issue is particularly acute in animal disaster management, where challenges such as inadequate training and unclear roles are repeatedly documented but seldom addressed.

Traditional lessons management processes typically involve producing after-action reports (AARs), sharing findings with stakeholders and updating policies or training program. However, these processes frequently break down due to inconsistent documentation

formats, political influences that obscure critical findings and organisational silos that prevent knowledge sharing across agencies. For example, analysis of declared emergencies in New Zealand between 1960 and 2010 by Glassey (2015) revealed that fewer than 25% had accessible documentation detailing lessons learnt. This lack of institutional memory leaves emergency managers ill-equipped to build on past experiences (Glassey 2014; 2023).

The Real-time Artificially Intelligent Doctrine (RAID) model offers a novel solution to these challenges by integrating AI into lessons management systems. Initially conceptualised as a non-AI framework known as *Evidence-Based Dynamic Doctrine* in 2014 (Glassey 2015), the model has since evolved into an AI-enhanced system that facilitates real-time learning during emergency operations. By creating comprehensive knowledge bases and enabling real-time access to insights from past events through AI-driven tools like Dante AI, RAID aims to transform how emergency organisations learn and adapt.

Lessons lost: the Edgecumbe flood case study

The consequences of ineffective lessons management are starkly illustrated by the Edgecumbe flood in New Zealand. In April 2017, a stopbank failure caused widespread flooding in the township of Edgecumbe prompting the evacuation of approximately 600 households. While no human lives were lost, over 1,000 animals were left behind, leading to New Zealand's largest companion animal rescue operation (Glassey et al. 2020). Despite this unprecedented effort, after-action reports revealed significant issues

with training capabilities, role clarity among responders, information-sharing mechanisms between agencies and deployment strategies.

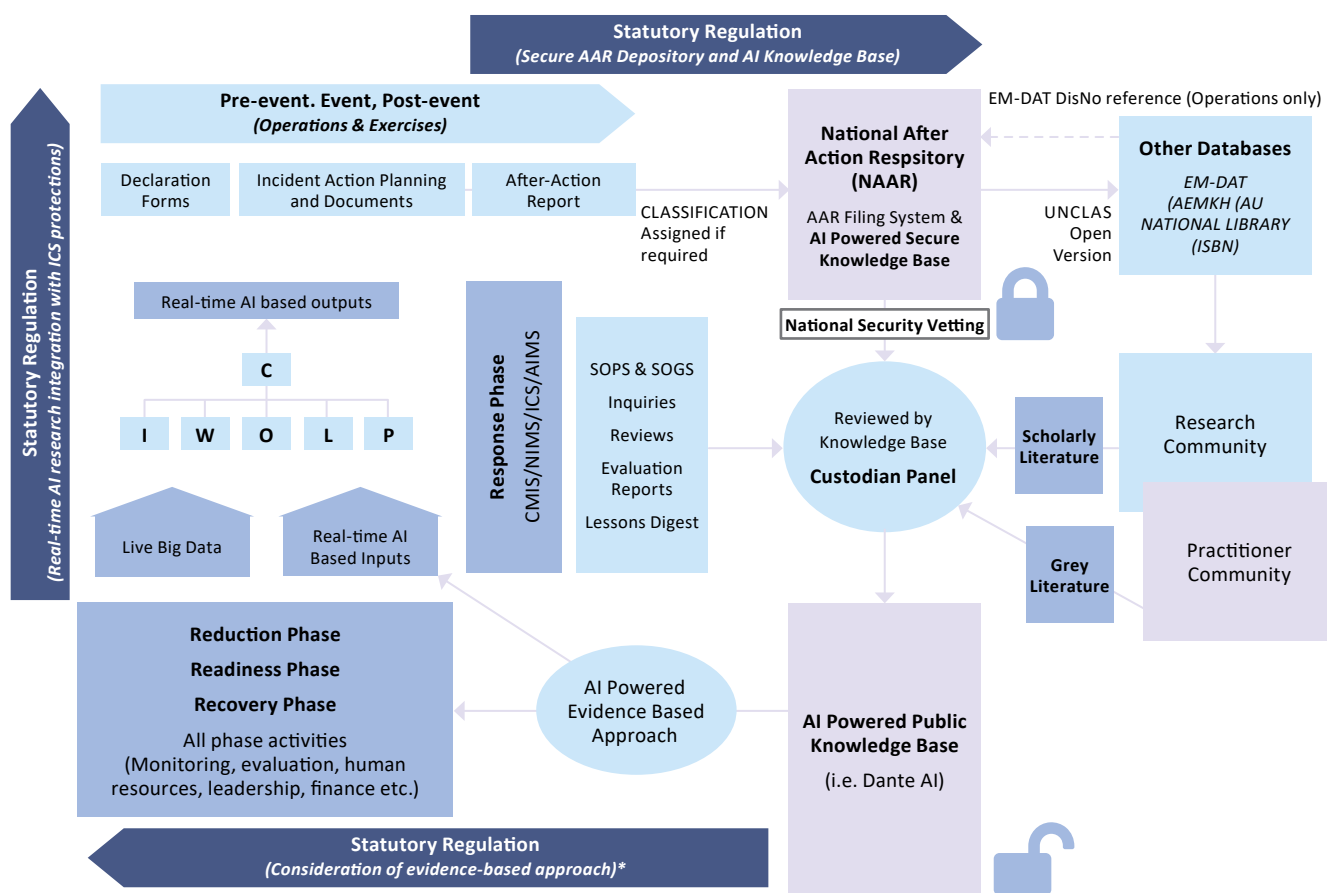
Two years later, during another disaster in the same country (a large-scale fire at Nelson) similar issues resurfaced. A study by Glassey et al. (2020) concluded that only 7% of lessons identified in the Edgumbe flood were applied at the Nelson fires. This underscores a broader issue. While lessons may be identified through post-event analyses, they are seldom institutionalised or sustainably learned.

This phenomenon is not unique to New Zealand. It reflects a global pattern identified by Donahue and Tuohy (2006), who argued that disasters often reveal the same organisational failures repeatedly due to a lack of accountability mechanisms for implementing lessons identified. Political pressures and resource constraints often deprioritise long-term improvements in favour of immediate recovery efforts.

The RAID Model: AI-enhanced lessons management

The Real-time Artificially Intelligent Doctrine (RAID) model (Figure 1) represents a significant advancement in how emergency services organisations manage lessons learnt from past events. At its core, the RAID model develops comprehensive knowledge bases using AI platforms like Dante AI. These knowledge bases serve as repositories for diverse types of documents, including after-action reports, academic research papers, operational guidelines, inquiry findings and other relevant materials. By training on these datasets, the AI system identifies patterns and recurring themes across incidents and provides a robust foundation for organisational learning and improvement.

Unlike traditional approaches that focus on post-incident analysis, RAID enables the real-time application of lessons during all phases of emergency management: preparedness, response, recovery and mitigation. Through user-friendly interfaces such as chatbots linked to AI



RAID | Realtime Artificial Intelligence based Doctrine by Dr. Steve Glassey, 2023 ©

Figure 1: Real-time Artificially Intelligent Doctrine (RAID) model.

Source: Glassey (2023)

knowledge bases, emergency managers can query specific challenges or scenarios during active operations and receive evidence-based recommendations derived from validated sources. This capability ensures that lessons are not only identified but also applied when they are most needed—during live emergencies.

RAID addresses key limitations of traditional lessons management systems by automating the analysis of large volumes of qualitative data. This automation reduces reliance on human memory and mitigates political or organisational biases that often influence lesson prioritisation. By systematically analysing multiple reports simultaneously, RAID enables the identification of recurring issues that might not be apparent when reviewing individual documents in isolation. For example, during its application in animal disaster management contexts in New Zealand, RAID identified systemic challenges such as unclear roles among responders and inadequate training for animal rescue operations (Glassey et al. 2023). These insights allow organisations to prioritise areas for improvement and allocate resources more effectively.

The model's design aligns with existing frameworks for lessons management while enhancing their effectiveness through technological innovation. For example, Lessons Management Life Cycle (Jackson 2016) emphasises observation, analysis and implementation as critical steps for organisational learning. RAID complements this framework by automating the observation and analysis phases while providing actionable insights to support implementation in real time. Similarly, it builds on collaborative models like the EM-LEARN framework used in Victoria, Australia that facilitates cross-jurisdictional knowledge sharing through its centralised repository (Jackson and Shepherd 2018).

The RAID model operates dynamically across all phases of emergency management by integrating real-time interaction capabilities with its knowledge base. Emergency managers can use the system to query specific scenarios or challenges during active operations (e.g. seeking guidance on coordinating multi-agency responses during a flood evacuation). The AI processes these queries and provides actionable recommendations based on lessons from similar events documented in its database. This real-time functionality addresses critiques by Savoia et al. (2012) who noted that after-action reports often lack mechanisms for rapid implementation during emergencies.

Another critical feature of RAID is its ability to preserve institutional memory despite staff turnover or organisational restructuring. These issues are frequently cited as barriers to effective lessons management (Donahue and Tuohy 2006). By capturing knowledge in a centralised repository accessible through AI tools, RAID ensures that valuable insights are retained and available

for future use. Furthermore, it incorporates feedback mechanisms that allow new data from ongoing operations to be added to the knowledge base. This iterative process ensures that the system evolves over time, continually refining its recommendations based on the latest evidence and experiences.

The RAID model's integration of advanced AI technologies with comprehensive data repositories represents a paradigm shift in emergency management practices. By enabling real-time access to validated lessons from past events and automating the analysis of complex datasets, RAID enhances decision-making processes and supports continuous organisational learning. Its ability to address both technical and cultural barriers to lessons implementation makes it a powerful tool for creating resilient and adaptive emergency management systems capable of responding effectively to increasingly complex challenges.

Organisational culture as a barrier to learning

While RAID offers technological solutions to many challenges in lessons management, organisational culture remains a significant barrier to its effective implementation. Jackson (2016) highlighted how cultural factors such as leadership commitment to learning and accountability influence whether organisations act on identified lessons. Resistance to change is common in hierarchical emergency management agencies where established practices may take precedence over innovation.

Victoria's EM-LEARN framework provides an example of how cultural shifts can support collaborative learning across agencies (Jackson and Shepherd 2018). By fostering a 'just culture' that balances accountability with psychological safety for staff reporting errors or failures, Victoria has created an environment conducive to sharing lessons without fear of blame or retribution. This cultural foundation is essential for ensuring that technological tools like RAID are embraced rather than resisted within organisations.

Donahue and Tuohy's (2006) findings underscore the importance of leadership buy-in for overcoming cultural inertia. They argue that without visible commitment from senior leaders to prioritise learning processes, backed by adequate resources, lessons will continue to be sidelined by competing priorities during crises.

Applications beyond animal disaster management

Although initially demonstrated within animal disaster management contexts in New Zealand, RAID has broader applications across all domains of emergency management globally. For example, Cole et al. (2018) analysed major

post-event inquiries and found recurring themes such as deficiencies in interagency coordination during bushfires or vaccine distribution challenges during pandemics. These are issues that could be addressed through RAID's cross-jurisdictional data-sharing capabilities.

Victoria's EM-LEARN initiative illustrates how collaborative frameworks can enhance multi-agency engagement during emergencies (Jackson and Shepherd 2018). RAID extends this concept by enabling real-time integration of insights from diverse regions or sectors into active operations elsewhere (e.g. applying flood response strategies developed in one region to wildfire evacuations occurring simultaneously elsewhere).

Expanding multilingual capabilities would further enhance global applicability by allowing analyses across diverse datasets regardless of language barriers. This feature is particularly relevant given increasing cross-border cooperation during emergencies driven by climate change effects.

Benefits and challenges

Benefits

The RAID model offers significant advantages over traditional approaches to lessons management. By enabling real-time access to comprehensive insights from past events during active operations, it supports evidence-based decision-making under time-critical conditions (Glasse 2023). Automated analysis reduces political influences that may minimise inconvenient findings, addressing a key barrier identified by Cole et al. (2018) who found that post-event inquiries often avoid criticising policymakers or agencies. RAID also increases accountability for implementing improvements by highlighting recurring issues over time, countering observation by Donahue and Tuohy (2006) that lessons are frequently ignored due to shifting priorities.

AI systems can process large volumes of qualitative data much faster than human researchers. This is an efficiency that enables pattern recognition across hundreds of documents simultaneously. This capability aligns with the call by Jackson and Shepherd (2018) for collaborative frameworks that aggregate lessons across jurisdictions. For example, RAID's ability to synthesise insights from bushfire responses in Australia and flood protocols in New Zealand could help agencies adopt best practices more effectively.

Challenges

Despite its potential, RAID faces implementation barriers. The effectiveness of AI analysis depends heavily on data quality. Poorly documented or inconsistent records limit its utility (Public Safety Institute 2023). Savoia et al. (2012) and Glassey (2014) note that many after-action reports lack

standardised formats or measurable outcomes that would complicate AI training processes.

Furthermore, determining which sources should be included in knowledge bases is challenging due to varying documentation standards worldwide. Within the RAID model, this challenge is addressed by a Custodian Panel composed of both practitioners and academics — rather than solely government appointees — who work together to decide which documents and data are suitable for inclusion. Cultural resistance within organisations may also impede adoption. Jackson (2016) emphasised that lessons management requires a 'learning culture' where staff feel safe reporting failures; a prerequisite often absent in hierarchical emergency agencies. Leadership commitment is critical. As Donahue and Tuohy (2006) found, lessons are deprioritised without sustained advocacy from senior decision-makers. Building comprehensive knowledge bases demands significant time and resources, which may deter underfunded agencies despite RAID's long-term benefits.

Future directions

Future developments should focus on enhancing RAID's interoperability and accessibility. Cole et al. (2018) advocate for cross-jurisdictional knowledge-sharing frameworks, which RAID could operationalise through shared repositories accessible to international partners. Expanding multilingual capabilities would improve global applicability, allowing analyses of non-English documents during cross-border emergencies such as pandemics or climate-driven disasters.

Integrating RAID with existing collaborative frameworks like Victoria's EM-LEARN could strengthen its cultural relevance. Jackson and Shepherd (2018) demonstrated that multi-agency engagement fosters trust and knowledge exchange; factors essential for ensuring AI recommendations are actioned. Improving after-action report quality through standardised templates, as suggested by Savoia et al. (2012) and Glassey (2014), would enhance RAID's analytical accuracy.

Conclusion

The RAID model represents a paradigm shift in lessons management, addressing systemic challenges documented over decades of research. By automating pattern recognition across historical data, it reduces political biases and institutional inertia that hinder traditional. However, technological solutions alone cannot overcome cultural barriers. Emergency agencies must pair RAID with initiatives that foster transparency, leadership accountability and psychological safety for staff. Victoria's EM-LEARN framework provides a blueprint for this integration, showing how collaborative learning cultures enhance policy outcomes. As climate change intensifies

disaster risks globally, RAID's ability to synthesise lessons across borders and contexts will prove invaluable. Ultimately, its success hinges on balancing technological innovation with cultural adaptation; a dual focus that ensures lessons identified become lessons applied.

View an online presentation on RAID at www.youtube.com/watch?v=dUWSGTQAhJk.

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Identifying critical road assets supporting community resilience in natural hazard emergencies

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Abstract

The road network is one component of a region's disaster resilience context and it is recognised that roads are an important factor in community safety and emergency management capability. This paper presents a case study of an innovative rapid assessment methodology that was developed to identify and prioritise the critical road assets in the vast road network of the Warrumbungle Shire local government area in New South Wales. The case study takes the perspective of roads function and value that support community resilience particularly in times of extreme flood, storm or bushfire. The structure of the methodology facilitates its expansion to include any hazards that may be relevant in an area. This model has transference to other locations where road networks require assessment to assist in emergency management planning and community safety.

Introduction

Road networks connect people and places. Roads are the foundational infrastructure on which communities depend for their daily mobility, transport of goods, access to services and, in times of emergencies, for critical support and evacuation during response and recovery from extreme events. Road networks play a significant role in a community's capacity for resilience (Anderson et al. 2022). Major investigations into Australian bushfire and flood disasters (Teague et al. 2010; Binskin et al. 2020) also confirm the importance of roads and their contribution to community safety and emergency management capability. Population growth and a changing climate combine to present growing risks of disasters caused by extreme events. The *NSW State Infrastructure Strategy 2022-2042* (INSW 2022)

states that there is a critical need to address these challenges and to:

...develop place-based resilience and infrastructure adaptation strategies that assess local risk and incorporate infrastructure and non-infrastructure solutions for vulnerable locations across NSW...
(INSW 2022, p.17).

In Australia, local councils are largely responsible for the upkeep of road networks that serve the needs of their communities, providing access to places and services as well as safe egress in emergency situations. With large geographical areas and generally a small ratepayer base, this presents a management challenge for rural and regional councils. Teague et al. (2010) notes that local councils that have the greatest need for resources to keep their communities safe are generally those that are the least well-resourced.

Warrumbungle local government area

The Warrumbungle local government area is located in the central-western region of NSW with a population of approximately 9,200 people and a land area of 12,380 kms² (see Figure 1). Towns in the area are Coonabarabran, Coolah, Mendooran, Binnaway, Baradine and Dunedoo, which are connected by an extensive network of both sealed (approx. 1,013 km) and unsealed (approx. 1,500 km) roads.

The *Warrumbungle Shire Council Community Strategic Plan 2022-2037* (WSC 2022) states the community vision as 'a peaceful and sustainable way of life built by a strong community' and recognises challenges for council of an ageing population in a large, sparsely populated rural area with a large transport infrastructure network with no corresponding economies of scale.

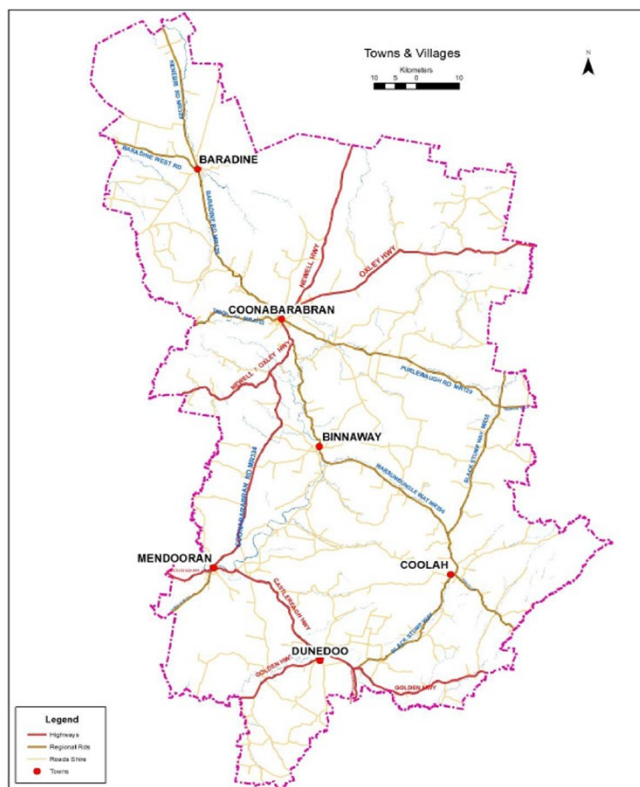


Figure 1: The Warrumbungle local government area is approximately 12,380 kms².

Source: Warrumbungle Shire Council

Extreme weather events such as storms, bushfires and floods have a significant impact on road infrastructure in the area. Damage to roads, bridges and culverts (Figure 2) can complicate or inhibit access to and egress from affected areas, potentially isolating people and property from emergency assistance or evacuation possibilities.

Warrumbungle Shire Council recognised the need to build better hazard resilience for the next 20 years. As such, they commissioned consultants to identify the priority areas in the local government area road network from the perspective of hazard vulnerability, emergency response and community value. The outcomes of the rapid assessment would feed into council's Disaster Resilience Community Strategic Plan to integrate and future-proof its planning processes.

Methodology

Figure 3 illustrates the methodology used in the project. Preliminary desktop research showed that no comparable all-encompassing road infrastructure hazard resilience assessments had been conducted anywhere in Australia, or around the world. Emergency managers consider some features of roads in evacuation modelling but particularly notable was the absence of a community voice in any such work. This observation was supported by conversations with representatives from agencies such as the NSW Reconstruction Authority and regional representatives from the NSW State Emergency Services.



Figure 2: Road damaged by flooding in the Warrumbungle local government area.

Source: Water Technology Pty Ltd

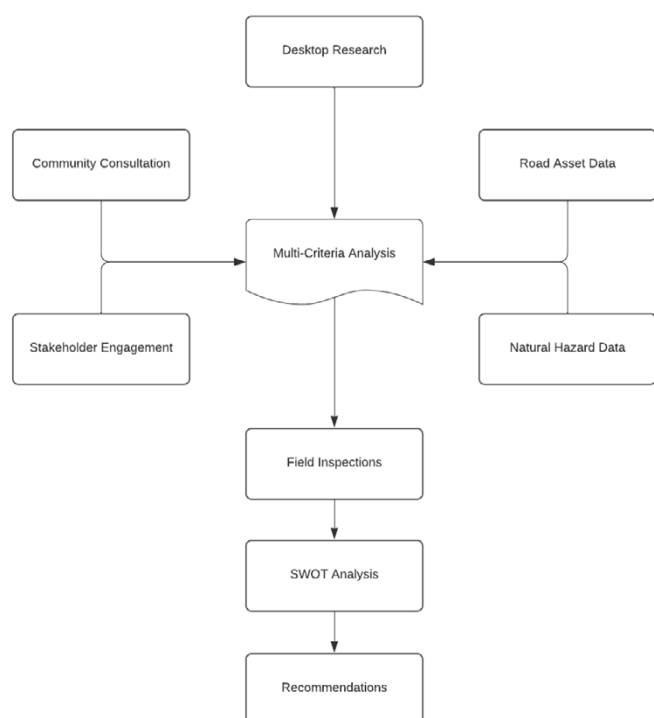


Figure 3: The project methodology from initial research to recommendations stages.

The desktop review offered many ideas that contributed to the development of a tailor-made methodology that commenced with desktop research through analysis of input, field inspections, a SWOT analysis into final recommendations for council.

Using risk-based approaches such as those set out in BITRE (2023) and LGNSW (2016), a tailor-made methodology was developed to integrate available road asset details with 3 aspects of hazard risk and resilience of hazard exposure, hazard vulnerability and road asset community value. Indicators for each of these aspects were scored for each road asset according to predetermined Likert scales. This provided a means to carry out a multi-criteria analysis and quantify an overall relative priority ranking incorporating the likelihood (probability) of impact by hazard events with the significance to the community (consequence).

Systematic field inspections of the highest-ranking road assets were carried out to ground-truth the desktop analysis results. A SWOT analysis provided guidance to determine the most plausible strategies for improvement of the road network across the local government area.

Road asset data

Council provided spatial information and attributes for road segments and road assets such as bridges, major culverts, minor culverts and causeways for the entire road network

in the local government area as well as an Excel-based natural hazard defects register for individual assets. The database presented 2,546 individual road infrastructure assets of various types for the assessment process consisting of 1,375 road segments and 1,171 road assets (see Table 1).

The asset data and associated attribute tables were mapped in GIS and set up in Excel for assessment through a multi-criteria analysis framework based on evaluations of the level of effect by storm, flood and bushfire (hazard exposure), the role and function in hazard emergencies (hazard vulnerability) and the expressed value to the community (community value).

Natural hazard exposure

Road assets were assessed for their potential exposure to hazards of flood, storm and bushfire (as per the brief for the project) but could be expanded to include any other disturbances. Quantification of the assessment was conducted using a 10-point Likert scale calibrated to the local context (Alkharusi 2022). The assessment and scoring process was informed by publicly available documentation on flood, storm and bushfire hazards in the region such as the Castlereagh Bushfire Risk Management Plan (CBFMC 2012), council's Local Emergency Management Plan (WSC 2020) and the Warrumbungle Shire Flood Emergency Sub Plan (NSW SES 2013). This was augmented with internal council documentation of historic disaster events and anecdotal evidence gathered during the community consultation and stakeholder engagement process with local emergency services and council staff.

Table 1: Number and types of road infrastructure assets in the Warrumbungle local government area.

Road segments	1,375
Highways	36
Regional roads	15
Local roads	339
Streets	509
Footpaths	476
Road assets	1,171
Major culverts	91
Minor culverts	658
Causeways	360
Bridges	62
Total	2,546

Natural hazard vulnerability

Road assets were assessed for their role and function (intrinsic value) in the road network during extreme hazard events. This value was determined by assessing several road asset characteristics such as location, context, design, size and routing. Quantification of the assessments on such characteristics was carried out using a 10-point Likert scale. The assessment and scoring process was informed by demographic analysis, spatial analysis, internal council mapping for single access trails and anecdotal evidence gathered during the community consultation and stakeholder engagement process.

Community consultation and stakeholder engagement

Council emphasised the importance of the community voice to be reflected in the process and in the outcomes of the project. This aspect of including community's views and thoughts about how the road network might – or might not – serve their needs is a prominent component of any work aimed at disaster resilience improvement (Anderson et al. 2022; National Resilience Taskforce 2018; INSW 2022).

This project connected with the local community and relevant stakeholders to identify road infrastructure deficiencies and treatments, to identify any education and awareness gaps, and to discover the community's desires to build and strengthen the road network for the next 20 years. Three approaches were employed to carry out this task:

- In-person community consultation sessions in 7 locations in the local government area.

- In-person and online stakeholder engagement with local and regional representatives of NSW SES, NSW RFS, NSW Local Land Services, Transport for NSW, Institute of Public Works Engineering Australasia NSW and ACT as well as various council committees and staff including the Local Emergency Management Committee, Urban Services Manager and the roads team.
- Social Pinpoint online engagement tool.

The Social Pinpoint online engagement tool (Figure 4) is a web-based map that enables anyone with internet access to mark specific road infrastructure components and leave their feedback on what the issues are and why this is important to them. It provides an opportunity for anyone in the communities to provide input, regardless of their location or availability to attend the local consultation sessions. This was particularly important in this large and geographically dispersed community.

The in-person community consultation sessions and the Social Pinpoint online community engagement tool were advertised and promoted by the council through the Have Your Say webpage (Figure 5), local newspapers and social media channels.

The data collected through the community consultation and stakeholder engagement process informed the scoring of aspects of hazard exposure and hazard vulnerability to develop an understanding of how and why the community appreciates and values specific parts of the region's road network. The overall data was interpreted and, to accommodate the quantitative multi-criteria analysis, expressed based on a 10-point Likert scale.

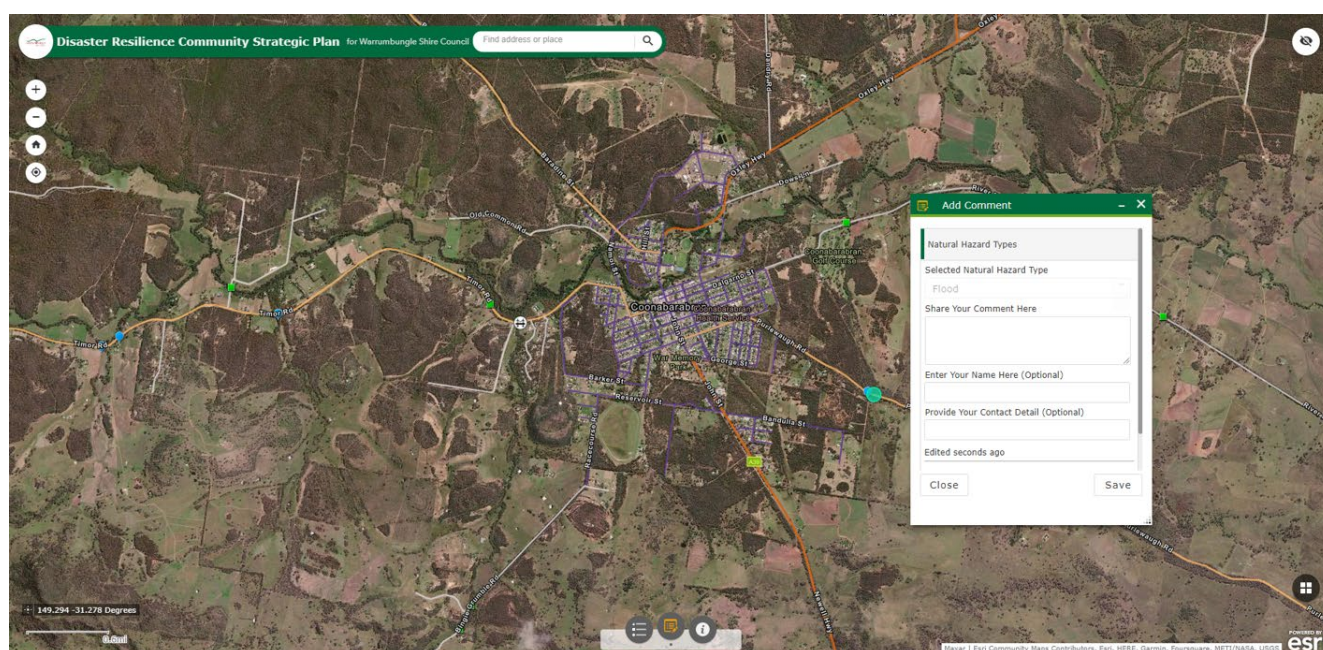


Figure 4: Screenshot of the Social Pinpoint online platform.

Source: Water Technology Pty Ltd

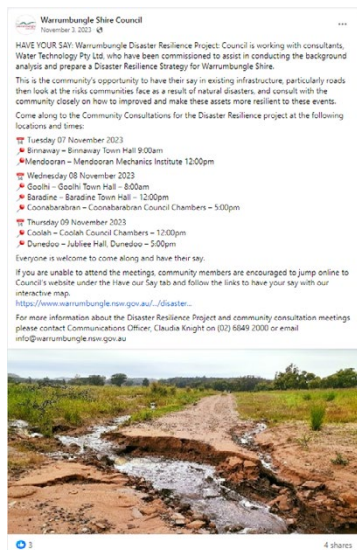


Figure 5: The council Have Your Say webpage, local newspapers and social media were used for community consultation.

Multi-criteria analysis

The scores for hazard exposure, hazard vulnerability and community value were compiled for each road asset and summed to deliver a compound score for each asset (Figure 6). This delivered a list of 144 road infrastructure assets with a relative priority ranking from which the 23 top-ranking assets were selected (Figure 7) for further review using field inspections.

Field inspections

The selected top-ranking assets were physically inspected for the purpose of ground-truthing the desktop-driven analysis and to collect condition monitoring information to support decision-making for maintenance and upgrade strategies. The field inspections were carried out in a systemic manner based on the principles set out in the

Road Inspection Manual (IPWEA 2021). The field inspections yielded some slight adjustments in scoring for several of the selected assets and prompted minor fine-tuning of the scoring and ranking methodology. A field inspection report was prepared for each of the 23 road assets.

SWOT analysis and final plan

The strengths, weaknesses, opportunities and threats associated with the natural hazard vulnerabilities and risks to the road-network infrastructure were mapped in a SWOT analysis to identify the elements for the formulation of tactical and strategic measures to improve the resilience of the road network. This review revealed a variety of actions that could be undertaken to build and strengthen hazard resilience for the next 20 years. The prioritised road assets provided a blueprint for future funding to fortify the road network to better enable community safety and protection of property. These details were provided in the final part of the project that was the development of a Disaster Resilience Community Strategic Plan.

Conclusion

The information and intelligence gathered in the desktop research, the road infrastructure network review, community consultation and stakeholder engagement, the field inspections and the SWOT analysis provided a solid basis to formulate targeted actions that Warrumbungle Shire Council might consider to strengthen its hazard resilience for the next 20 years. While the project only assessed the hazards of flood, bushfire and storms on the road network, other hazards, such as extreme heat and seismic hazards, would also compromise the road network in this region. The straightforward structure of the methodology facilitates its expansion to include any hazard that may be relevant in an area, or perhaps even other types of disturbance. The project provided a high-level identification of those assets in a road infrastructure network that can assist the

asset_id	road_name	Locality	Asset-type	NATURAL HAZARD EXPOSURE			NATURAL HAZARD VULNERABILITY		COMMUNITY VALUE	COMPOUND SCORE = SUM (Scores) Range = [0, 60]
				FLOOD	BUSHFIRE	STORM	POPULATION SERVED	ALTERNATE ROUTES	CONSULTATION RESULTS	
				0=not affected 5=moderately affected 10=severely affected	0=not affected 5=moderately affected 10=severely affected	0=not affected 5=moderately affected 10=severely affected	0= none 5= 51 to 100 10= 1,000+	0= numerous 5= Some options 10= single road access	0= very low value 5= moderate value 10= very high value	
Weighting				1	1	1	1	1	1	
Asset-ID-5	Asset-Name-5	Baradine	Local Road	8	8	0	6	7	10	39
Asset-ID-1	Asset-Name-1	Coonabarabran	Local Road	5	10	0	5	10	8	38
Asset-ID-2	Asset-Name-2	Coonabarabran	Local Road	0	8	0	8	10	10	36
Asset-ID-7	Asset-Name-7	Baradine	Regional Road	8	5	0	9	10	3	35
Asset-ID-3	Asset-Name-3	Baradine	Local Road	3	8	0	2	10	10	33
Asset-ID-6	Asset-Name-6	Binnaway	Causeway	8	0	8	9	7	8	32
Asset-ID-8	Asset-Name-8	Pilliga	Local Road	5	8	0	7	5	7	32
Asset-ID-10	Asset-Name-10	Premier	Causeway	2	0	5	7	10	7	31
Asset-ID-11	Asset-Name-11	Dunedoo	Major Culvert	8	0	0	7	7	8	30
Asset-ID-16	Asset-Name-16	Binnaway	Local Road	0	5	0	7	10	8	30
Asset-ID-17	Asset-Name-17	Goolih	Local Road	8	0	0	5	10	7	30
Asset-ID-22	Asset-Name-22	Premier	Causeway	2	0	5	7	10	6	30
Asset-ID-13	Asset-Name-13	Coolah	Major Culvert	8	0	5	7	5	4	29
Asset-ID-14	Asset-Name-14	Goolih	Major Culvert	8	0	5	5	10	6	29
Asset-ID-15	Asset-Name-15	Ulamambri	Causeway	5	0	5	7	5	7	29
Asset-ID-18	Asset-Name-18	Binnaway	Local Road	0	5	0	6	10	8	29
Asset-ID-4	Asset-Name-4	Mendooran	Local Road	0	5	8	3	5	7	28
Asset-ID-9	Asset-Name-9	Coonabarabran	Causeway	3	0	5	7	5	8	28
Asset-ID-12	Asset-Name-12	Goolih	Major Culvert	8	0	0	3	10	7	28
Asset-ID-19	Asset-Name-19	Goolih	Causeway	8	0	0	5	7	8	28
Asset-ID-20	Asset-Name-20	Nellex	Causeway	1	0	5	6	10	6	28
Asset-ID-21	Asset-Name-21	Coolah	Street	0	0	8	8	10	2	28
Asset-ID-23	Asset-Name-23	Ulamambri	Local Road	5	0	5	5	10	3	28

Figure 6: Multi-criteria analysis used to prioritise road assets.

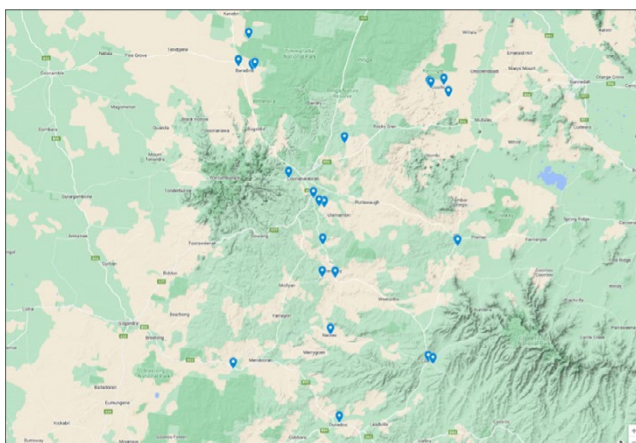


Figure 7: Location of the highest priority road assets marked as blue balloons within the local government area.

Source: Water Technology Pty Ltd

prioritisation of day-to-day management and maintenance activities of the responsible authority. It has transference to any location where road networks require assessment to assist in better management.

Acknowledgments

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Designing a scenario-based curriculum using cognitive development principles: insights from the Northern Territory Fire and Rescue Service

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Abstract

In emergency management contexts, realism in training is necessary to prepare personnel to effectively and safely undertake their roles. However, scenario-based training, if not implemented effectively, can be costly, resource-intensive and may not accurately reflect on-the-job requirements. This report offers guidance for emergency services organisations in the development and application of scenario-based training. Using examples from the Recruit Firefighter Program delivered by the Northern Territory Fire and Rescue Service, this paper exemplifies how scenario-based training methodologies, underpinned by best practice adult learning and cognitive development theories, have been used to enhance individual learning and agency training outcomes.

Introduction

In 2021, the Northern Territory Fire and Rescue Service (NTFRS) reviewed its Recruit Firefighter Program, seeking feedback from employees at all levels. In response to recommendations, the NTFRS shifted its training philosophy from a didactic, compliance-driven structure to a 'learning through doing' approach. The re-designed curriculum uses experiential, scenario-based pedagogies to create a cohesive sequence of activities to achieve industry-specific learning goals and meet national training requirements. The curriculum was also restructured to align with best-practise

adult education and cognitive development principles. This ensured that new content and information was sequenced to provide strong underpinning knowledge of particular topics before expanding and linking that knowledge to new topics.

The NTFRS Recruit Firefighter Curriculum

Feedback received from personnel during the curriculum review process highlighted the need to move towards more experiential learning models. Past participants and trainers delivering the Recruit Firefighter Program indicated that learning needed to be more 'hands-on' with learners able to 'discover' and 'internalise' knowledge rather than simply being asked to 'memorise' information and 'mimic' actions. Similarly, feedback from operational crews suggested that participants needed to understand not only how to undertake specific tasks, but also needed the knowledge to know when and why to do each task. The NTFRS uses scenario-based training to provide participants on the Recruit Firefighter Program the opportunity to experiment with and apply their learning through the reinforcement of strategies, techniques and behaviours required for operational response. Scenario-based training and assessment can simulate high-pressure response situations and test technical and behavioural skills in a safe and supportive environment (Hjalmarsson 2011; Prasolova-Førland et al. 2017; Sinclair et al. 2012),

making it ideal for use in the emergency management sector. The use of scenario-based methodologies provides simultaneous development of collaboration, teamwork, critical thinking, and problem-solving skills (Hjalmarsson 2011; Rantatalo et al. 2019).

The Recruit Firefighter Program sequences scenarios on a continuum, from concrete to abstract, following the hierarchy of Bloom's Taxonomy (Table 1). While Bloom's Taxonomy is widely used for primary and secondary (K-12) education, the underpinning education theory has a high degree of relevance and practical implementation for use within adult teaching and learning contexts (Anderson and Krathwohl 2001). Bloom's Taxonomy has been successfully used in the emergency management sector (van Haperen 2001) and is considered a highly effective approach for the sequencing of training activities in high-risk environments due to its focus on critical reflection and learner autonomy.

The Recruit Firefighter Program learning content is structured along a continuum, moving from concrete and simple to complex and abstract. The early stages of the course focus on developing understanding and application of skills and behaviours through repetition of simple drills. These drills become integrated, with time and practice, to form complex scenarios. As participants progress through the course, the complexity of tasks and realism of scenarios increases to provide ongoing challenges and development of integrated competencies, requiring decision-making, applying rationale and logic and evaluating their own judgements. The course culminates in a 14-hour simulated night shift where recruits are split into operational crews and dispatched to a series of 'call-outs'.

Table 1: Cognition levels defined by Bloom's Taxonomy.

Knowledge	The ability to recall specific and isolated bits of information, including knowledge of terminology, specific facts and repetitive sequences.
Comprehension	The ability to understand information including personal interpretation and extrapolation.
Application	The ability to apply skills and knowledge in familiar and appropriate situations (e.g. effectively using information to solve problems).
Analysis	The ability to break down knowledge into its constituent parts and consider the best application from a range of alternatives.
Synthesis	The ability to synthesise information together (e.g. application of discrete skills and knowledge into a cohesive whole in known and unfamiliar settings).
Evaluation	The ability to formulate judgement and apply knowledge and rationale to the selection of appropriate techniques and behaviours to meet task and situational needs.

Source: adapted from van Haperen (2001:39)

Table 2 illustrates how the NTFRS has structured the Recruit Firefighter Program to provide scenarios that sequence knowledge and skill development, incrementally increasing cognitive complexity until participants are competently responding to simulated real-life incidents. The Recruit Firefighter Program uses its structured sequence of drills and scenarios to get participants to trial, observe and evaluate knowledge and skills as they transition through the training program. By incorporating behavioural modelling, repeat practice and a self-reflective dialogue, participants develop their own mental models and integrate learning in ways that are meaningful to them (Ricci and Bravo 2022; Van Hasselt et al. 2008).

NTFRS recruits initially undertake short drills with a specific and singular focus, for example, donning and doffing of personal protective equipment, demonstrating different knots, erecting ladders or using stretchers to transport casualties. During repetitive drill practice, participants can try different methods, cement knowledge or adapt their performance through immediate and specific feedback. Performance during drills is benchmarked to performance criteria with knowledge also being tested through verbal questioning. Outcomes are recorded on individual drill sheets and the evidence captured provides formative assessments over time. Due to the short duration and singular focus, drills can be easily reset and rerun multiple times, which provides cost, time and reassessment efficiencies (Australian Institute for Disaster Resilience 2023).

Once participants have demonstrated competency in static drills, complexity is increased by merging short drills together. The deliberate sequencing and repetition

Table 2: The Recruit Firefighter Program scenario sequence.

Knowledge	Drills:
Comprehension	• Don and doff personal protective equipment (timed drills). • Manual handling (vehicle re-stowing). • Use communications equipment to transmit and receive messages. • Casualty handling (stretcher lift and carry).
Application	Simple scenario (extended drill): • In pairs, participants respond to suspected poisoning incident. Objectives are to demonstrate rescue techniques, teamwork, first aid procedures.
Analysis	Complex scenario:
Synthesis	• Operational crew to respond to chemical spill in a factory. Crew to identify and assess the source and extent of the spill, implement appropriate containment protocols, mitigate the environmental and health effects, and evacuate casualties.
Evaluation	Scenario debriefing: • Hot and cold debriefs for scenario incidents.

of information reaffirms underpinning knowledge that is expanded to gradually form more complex behaviours. Simple scenarios are a useful way to mimic reality and are highly effective to provide targeted practice of specific skills and competencies in discrete settings.

A simple scenario that focuses on the demonstration of specific competencies, such as the example in Figure 1, incorporates the reinforcement of other underpinning and adjacent skills. While the primary focus in this scenario is on the administering of first aid and the demonstration of casualty management techniques, additional competencies may be practised or assessed. These might include the correct use of personal protective equipment, following protocols in using communications equipment or the ability for the members to work and communicate effectively in a team.

First aid

In pairs, participants respond to a suspected poisoning incident. Objectives are to demonstrate rescue techniques, teamwork, first aid procedures, use of communications equipment, work health and safety principles.

Figure 1: Simple scenario.

As participants progress through the course, complexity is increased until participants are simulating authentic response jobs. Typically, these involve between 3-5 participants and one qualified operational member who plays the role of crew leader. As the example in Figure 2 highlights, in complex scenarios a full operational response is required.

Chemical spill

Participants respond to a simulated chemical spill in a factory. Crew to work together to identify and assess the source and extent of the spill, implement appropriate containment protocols, mitigate the environmental and health impacts, and evacuate casualties.

Figure 2: Complex scenario.

Complex scenarios integrate skills and knowledge from a range of units of competency and test the participant's ability to analyse the simulated incident through synthesis and evaluation of their prior knowledge to determine the most appropriate response options. This scenario encompasses actions from the time the call out is received until the operation is concluded. Duties include all aspects of a functional response including arrival on scene, briefings, securing the scene, identification and assessment of the source and extent of the spill, implementation of appropriate containment protocols, mitigation of environmental effects and evacuation of live role-play participants. Activities such as decontamination, debriefing and equipment maintenance are also included as part of standard procedures.

In complex scenarios, the incidents and information are structured in a way that allows participants to perform as they would operationally. Participants only complete tasks and functions as dictated by their 'role' in the crew. Validity and reliability in the assessment process is improved as learners are only assessed on tasks and competencies they individually performed. Additionally, roles within the response team can be targeted to a learner's strengths or weaknesses and can be used for reassessment purposes if competencies have not been successfully demonstrated in prior drills and simple scenarios.

Ways to enhance scenario use in high-risk training environments

Successful implementation of scenarios relies on an appropriate and realistic narrative engine (context) and a chronological sequence (timeline) to detail how the scenario will unfold, including the purpose of specific roles or trigger points that will be used to control the flow of events (Australian Institute for Disaster Resilience 2023). Instructions and briefings for scenario management should be documented and include defined aims and objectives, organisational competencies to be achieved, safety considerations and stakeholder roles and responsibilities.

A significant learning for the NTFRS was the distribution of roles and responsibilities for scenario management to ensure that participants had a 'singular' focus. Assigned roles may include safety officer, assessors and role-players. During complex scenarios, assessors are essentially 'invisible' observers with a focus on capturing and recording evidence for assessment decisions and do not intervene unless there is a safety breach or wellbeing concern. The NTFRS involves a multi-professional team of first responders, including medics, police, emergency services personnel or operational fire crews to simulate authentic interactions during scenarios. This adds additional layers of complexity to the scenarios and positions the assessors as observers to the training rather than as role-play participants.

The NTFRS brings realism to training where possible with the inclusion of special effects (smoke, fire, explosions), simulated medical injuries, use of public housing locations and incorporating interagency role-players. The effective use of role-players to simulate affected individuals or other relevant roles (e.g. crew leader, ambulance officer) adds tension and complexity and can be used to progressively develop the scenarios by posing problems, restricting options or forcing actions of participants (Australian Institute for Disaster Resilience 2023). Exposing participants to stress and decision-making in controlled and measured ways increases their tolerance for and ability to make informed and critical decisions under pressure (Hjalmarsson 2011; Rantatalo et al. 2019). Realistic scenarios also stimulate the emotions and behaviours that occur in real-life emergencies (van Haperen 2001) and promote connections between the subject matter and a participant's emotional memory, further reinforcing their learning.

Scenarios and scripts need to be developed purposefully (Rantatalo et al. 2019) to ensure scenarios play out to meet the defined aims and objectives but also so that role-players do not inadvertently influence the scenario and cause learner failure. Within the NTFRS, role-players are briefed with sufficient instruction and guidance to perform specific objectives (e.g. causing a change in incident conditions). In situations where live role-players are not possible, the same integrity can be applied by making up 'identification scripts' for mannequins (e.g. '57-year-old male, unconscious, not breathing'). The participants are able to read the identification script and understand the purpose and then act accordingly. This maintains scenario flow and focus without the need for assessors to provide cues to direct the scenario or influence participant actions.

The NTFRS employs multiple assessors to observe and record learner performance during scenarios. In some circumstances, assessors may be used to capture evidence in different locations (e.g. assessor inside a building) or divided up to assess different groups of individuals. The NTFRS uses an Assessor Observation Record to document performance during drills and scenarios. The template provides prompts to help assessors capture sufficient summative evidence of competencies. With multiple assessors used, all results are compared, discussed and aggregated to determine the assessment outcome. Assessment decisions are strengthened by assessor note-taking that captures specific details of tasks performed. Detailed notes provide evidence of assessment decisions. Using note-taking to support evidence gathering during practical and observational activities enables the outcomes to be consistently interpreted and validated as the information provided documents what was done, and also how it was done.

Learning outcomes from scenario training may not always be clear for participants and, therefore, effective debriefing is required (Rantatalo et al. 2019; Ricci and Bravo 2022). The provision of timely and targeted feedback allows assessment to be reinforced as a learning opportunity. Higher-order cognitive processing skills are developed through critical reflection and debrief (Australian Institute for Disaster Resilience 2023). Debriefs are conducted at the conclusion of all training scenarios and occur in several stages. A hot debrief is conducted by the crew leader (role-player) on conclusion of the incident following a SMEACS format (a format used to guide briefings and de-briefings) to measure the performance of the team in providing an effective operational response. The hot debrief is a key part of the scenario and, as such, assessors observe and take notes that contribute to assessment evidence and outcomes. Debriefing is a critical part of the process to stimulate learning and reflection and is essential to validate discrete components of performance. Discussion at the conclusion of scenarios is used to test foundational understanding and to determine how this knowledge contributed to learner decision-making. Notes taken during debriefs can be used to demonstrate knowledge evidence within units of competency. Participants will also receive a cold debrief from the assessors with a specific focus on individual competency demonstration. Feedback provided on scenario performance includes the combined assessor feedback and commentary and can also include reflections on participant performance from the role-players. Additionally, cold debriefs with role-players helps the NTFRS to validate the assessment process and means training and assessment activities are reflective of organisational practices and that lessons learnt can be incorporated to continually improve agency training programs and practices. This 'full-circle' feedback process makes scenario-based learning an effective tool for both individual and organisational learning (Borodzicz and van Haperen 2002).

Conclusion

Considerations of cost, risk, flexibility, fidelity and replicability are often reported as barriers to the use of complex or live role-play scenarios for emergency management training. The NTFRS found that the pedagogical change of approach in the design and delivery of the Recruit Firefighter Program has reduced costs, created greater cohesion in the training syllabus and promoted consistent outcomes for participants. The key insights that NTFRS gained through the curriculum redevelopment process are:

- increasing scenario use and slowly developing complexity has improved recruit performance
- enhancing realism and scenario scope to more accurately reflect real operations has improved 'job readiness'

- agency staff of all levels are being developed through participation in the Recruit Firefighter Program
- training is continuously being improved because there is a direct feedback loop linking operations and training teams
- decreasing reassessment has reduced training costs, and improved participant wellbeing
- note-taking as assessment evidence is more robust and outcomes are clearly contestable.

The sequenced and progressional nature of the NTFRS's scenario-based curriculum and the opportunity for learner experimentation and self-reflection responds to the needs of participants through the reinforcement of cognitive development and adult education principles. Aligning scenarios with stages of cognitive development created a training program where learning activities support individual autonomy, promote teamwork, collaboration and critical self-reflection, all of which are necessary skills to provide effective operational responses in high-pressure emergency environments. The fostering of cognitive and behavioural skills alongside technical skills enhances learning outcomes for personnel while strengthening the agency's operational response capacity. The changes to training and assessment products made as a part of the curriculum review have simplified the administrative and compliance processes of documenting training activities and outcomes. By using a scenario-based training methodology and creating sequential learning progression where participants are encouraged to explore and engage with content meaningfully, the NTFRS has created a more realistic training experience that is developing capacity at all levels.

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About the author

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We learn as one: Victoria's decade of learning lessons together

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to references in this paper
are current at the time of
publication.

Victoria's focus on multi-agency collaboration to ensure lessons can be identified, shared and learnt has been, and continues to be, integral to the implementation of an effective lessons management approach.

In 2014, the Inspector-General for Emergency Management (IGEM) published the 2013-14 Fire Season Compliance Report¹ that recommended that 'Emergency Management Victoria (EMV), in consultation with the emergency management (EM) sector, continue the development and implementation of a formal lessons management system that applies to all hazards'. As a result, Victoria's first sector-wide emergency management lessons management framework, EM-LEARN², was released in November 2015. The EM-LEARN Framework established a model for lessons management, incorporating a life

cycle that defined cultural characteristics and a lessons management process (see Figure 1). This model was developed through an environmental scan of local, national and international lessons management good practices, along with research on successful lessons management approaches in emergency management.³

Since its release, the EM-LEARN Framework has supported Victoria to learn from a significant number of emergencies. During this time, the emergency management sector has identified areas for improvement

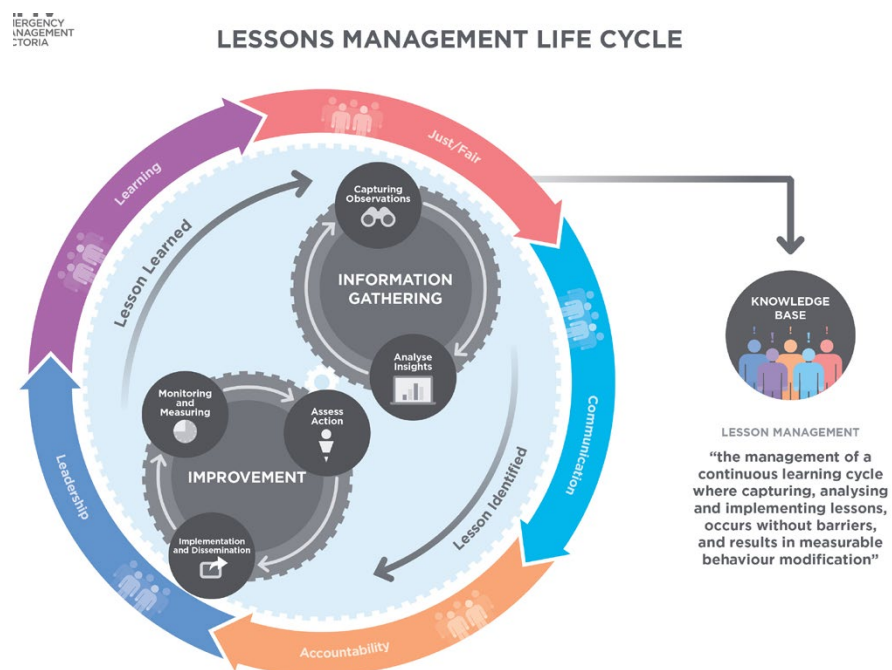


Figure 1: Victoria's lessons management life cycle is based on research and defines cultural characteristics and the lessons management process.

and opportunities to sustain good practice to support learning and continuous improvement. In particular, Victorian emergency management agencies have taken a collaborative approach to embed consistent lessons management governance, communication, doctrine, capability development and technology to facilitate an effective implementation of the EM-LEARN Framework.

The journey for continuous improvement is ever evolving with the increasing frequency and severity of emergencies. Therefore, this is an opportunity to provide an update on Victoria's journey and highlight some of the key achievements a multi-agency centred approach can support when implementing a lessons management framework.

Embed lessons management in multi-agency governance structures

Over the past 10 years, the State Review Team (SRT) has been the constant point of collaboration and consistency in lessons management by overseeing and maintaining strategic effectiveness of a common lessons management approach. This governance committee continues to support the implementation of lessons management across the emergency management sector through sharing, collaborating and identifying state-level and multi-agency trends to inform ongoing continuous improvement activities before, during and after emergencies. With 24 agencies and department representatives from across the emergency management sector (both national and state), the SRT:

- meets regularly to discuss lessons management, including updates on agency activities (for example debriefing, monitoring, exercising and reviewing activities)
- considers opportunities to collaborate and improve the way the sector works together, manages emergencies and learns from emergencies
- uses learnings to inform sector-wide improvements and contribute to a culture of continuous improvement.

The SRT was formalised as a committee under the State Emergency Management Plan⁴ (SEMP)^a in 2020 with the integration of lessons management activities outlined in individual agency role statements. These lessons management activities align to the Victorian Preparedness Framework⁵ (VPF) Assurance and Learning core capability, one of Victoria's 21 core capabilities and subsequent critical tasks that set the foundation for how Victoria effectively mitigates, plans and prepares for, responds to and recovers from major emergencies. The Assurance and Learning core capability 'supports continuous improvement to improve emergency management practice and community safety by extracting understanding from experience and research, reviewing community consequences, investigating causes and

outcomes, providing assurance and translating lessons into behaviour change'.⁶

As the Victorian emergency management sector matures in lessons management, agencies are developing and implementing their own agency lessons management frameworks in line with the EM-LEARN Framework, the Australian Institute of Disaster Resilience (AIDR) *Lessons Management Handbook*⁷ and their SEMP responsibilities. The SRT, as the main collaboration point, further supports and promotes the embedding of a common lessons management approach through sector-wide consistency in lessons management practice and effective and coordinated learning and continuous improvement.

Ensure lessons management is a key component of community-facing communication pathways

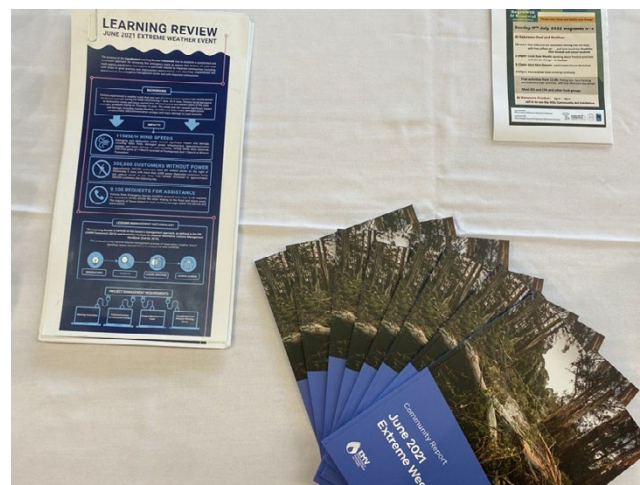
A range of communication methods and products are used in Victoria to enable lessons to be shared and inform continuous improvement before, during and after emergencies. At the regional level, Regional Environmental Scans⁸ are available to assist Regional Emergency Management Planning Committees in their planning activities, including to review of including the review of regional emergency management plans and to inform the Regional Emergency Risk Assessment process. The scans include a dedicated lessons management section highlighting insights drawn from learnings captured from 2022–24.

During operational activity, there are a range of products that are available to the sector to support real time learning and improvement:

- Before Action Reports (a summary of learnings from previous events and research based on themes and trends that may be useful for personnel involved in operational activity).
- Operational Learnings Reports (an ad hoc report summarising learnings from previous events that are provided on request from personnel involved in operational activity).
- Real Time Monitoring and Evaluation (RTM&E) Deployment Reports (a summary of insights from recent RTM&E deployments).

Post-event learning has been a particular focus area over the past decade to enable multi-agency lessons to be identified and communicated to the sector and community to inform continuous improvement through products such as Emergency Management Operations Summaries⁹ and operational reviews.¹⁰ In particular, major emergencies

a. The SEMP is authorised through the *Emergency Management Act 2013* that contains provisions for the mitigation of, response to and recovery from emergencies and specifies the roles and responsibilities of agencies in emergency management.



One of the June 2021 Extreme Weather Event Community Report community engagement sessions and materials.

Images: Emergency Management Victoria

such as the June 2021 Extreme Weather Event¹¹ and 2018 South West Fires¹² resulted in extensive post-event review processes and the development of public-facing community reports to communicate critical lessons relevant to the community.

Together, these lessons management products allow for the timely distribution of learnings and also help embed a learning culture across the emergency management sector through key supportive doctrine.

Build lessons management processes into operational practices

The Victorian emergency management sector has been embedding lessons management processes into operations. During 2015–16, the concept of an operational lessons management function was piloted at the Victorian State Control Centre (SCC). This function was initially called 'Investigation and Learning' as an expansion the Australian Inter-service Incident Management System Investigation function to include lessons management operational activities. Its purpose was to provide guidance and coordination to the State Response Controller and Emergency Management Commissioner on the delivery of operational lessons management activities.

Following the pilot's success, an Assurance and Learning function was established during 2016–17. At the same time, it was identified that there were multiple real time monitoring and real time evaluation activities being carried out independently by different agencies resulting in confusion across the sector. A formal review was undertaken during 2016–17 and a hybrid model called Real Time Monitoring and Evaluation was implemented in 2017–18 after extensive sector consultation. Victoria's RTM&E capability is defined as 'a systematic and objective function that monitors operational performance of systems and

processes and evaluates the effectiveness of emergency management activities'.¹³

In response to the significant lessons management activities that occurred after the 2019–20 summer bushfires and COVID-19 pandemic, the Assurance and Learning function was refreshed in 2021–22 and renamed State Lessons and Evaluation. This change reflected the function's evolving role and the formal integration of RTM&E as a core capability used for capturing, sharing and learning in real time.

Since the framework's release, Victoria's State Lessons and Evaluation has become embedded in the SCC, activating multi-agency surge personnel alongside dedicated staff so that lessons are integrated into preparedness, response and recovery activities.

In addition, the value of RTM&E is recognised with the capability being deployed nearly 30 times to capture and share real-time learning at the incident, region and state tiers.

Focus on building lessons management capability across the sector

Building lessons management capability across the sector has been, and continues to be, one of the main focus areas for EMV and the SRT. Strengthening this capability ensures that agencies and teams have the skills, tools and support they need to effectively identify and learn lessons. In collaboration with the SRT, a range of capability development courses has been created that support a range of training needs, both in-person and online. One of the most in-demand courses is the Debriefing Facilitation and Lessons Management Course facilitated by the SRT. The purpose of this course is to develop or refresh participant understanding of debrief planning,

facilitation and conduct as well as implementation of debrief outcomes in line with the EM-LEARN Framework and lessons management methodology. Importantly, it is enabling the sector to build a pool of skilled debrief facilitators that agencies and teams can access when they require that expertise.

Additional in-person training includes:

- RTM&E training: expanding the pool of personnel to support that operational capability
- State Lessons and Evaluation Functional Unit training: developing a surge pool to support the function at the SCC
- WeLearn Culture training: building a strong foundation for embedding lessons management and continuous improvement within teams and agencies.

As Victoria's lessons management capability and capacity grows, so too does the commitment to refining and enhancing training offerings. Following the IGEM Inquiry into the 2019–20 Victorian Fire Season,¹⁴ a dedicated uplift project was undertaken to strengthen the RTM&E capability. As a result, a range of online training modules, including video case studies, were developed to support lessons management capability building and the learning of lessons identified.

Victoria has also contributed to the development of a national lessons management online module, designed to support the national implementation of consistent lessons management methodology in line with the Lessons Management handbook. All training modules are available to the Victorian emergency management sector through the multi-agency EM-Learning platform.

Use technology to support lessons management analysis and sharing of learnings

EM-Share¹⁵ is Victoria's online lessons management outcomes repository that enables the emergency management sector to:

- share observations and files from operational and non-operational activities
- view insights and lessons
- track actions to embed learnings and facilitate continuous improvement of the sector.

Over the past decade of conducting lessons management activities and managing a significant number of observations, insights and lessons, learning has occurred on how best to use a lessons management database. One learning in particular relates to the need to differentiate between 'multi-agency' and 'agency-specific' learnings, specifically in managing the implementation of lessons identified to ensure they result in meaningful change.

EM-Share holds more than 35,000 multi-agency observations that have been analysed into nearly 4,000 insights and over 200 lessons. However, what isn't easily quantifiable is the amount of work undertaken by the SRT to support the development and implementation of enhanced EM-Share functionality, including:

- lessons implementation reporting
- expanding action tracking options
- new agency-specific functionality, to allow agencies to use EM-Share as their own management system.

This functionality has given organisations greater control of when and how to share learnings with the broader sector while ensuring a consistent approach in the way lessons management outcomes are managed and shared.

Evolving lessons management practice and implementation

While significant progress has been made in lessons management implementation over the past decade, there is always more to be done to respond to current and emerging challenges. As concurrent emergencies and climate change effects communities, there is less time to pause, reflect and conduct extensive improvement practices. As a result, the future of continuous improvement will need to adapt and evolve. An important element to facilitate this is multi-agency collaboration within Victoria, nationally and internationally to ensure trust and confidence in continuous improvement practices. Strengthening a shared-learning culture requires ongoing investment in lessons management understanding, capacity and capability to ensure we drive improvement more effectively and purposefully across the sector into the future.



Examples of post event learning products developed over the last decade to communicate multi-agency lessons and lessons relevant to communities and inform ongoing continuous improvement.

Endnotes

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DisasterWISE Communities Network

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In an era marked by compounding disasters, systemic inequities and climate uncertainty, Australia's communities are reimagining what resilience truly means. This article highlights how community-led approaches must be embedded into practice to improve recovery outcomes, build trust and drive long-term resilience.

DisasterWISE¹ is a community-led learning network pioneering new approaches to disaster resilience by centring self-determination and diverse knowledge systems. DisasterWISE operates at the nexus of social innovation, systems thinking and community development and strengthens disaster resilience by supporting communities to connect, learn and drive change.

Grounded in dynamic governance, decolonisation and trauma-informed practice, the network creates safe spaces for collaboration between communities, government, research and emergency management agencies. The DisasterWISE Communities Network has emerged as a bold, community-led learning network that disrupts discourse for stronger, just and thriving futures.

DisasterWISE sprang from the Fire to Flourish² program with funding from Monash University and The Paul Ramsay Foundation. After a co-design process by people with lived and learned experience of disaster events, DisasterWISE has grown into a movement of people who are building resilience through self-determination and community-led action.

The national network has an expanding membership and provides a vital piece of social infrastructure that:

- cultivates broad and diverse connections
- brokers varying ways of knowing across the membership
- amplifies community voices as leaders in recovery and resilience dialogue
- supports pathways to inform wider policy and practice
- advocates, promotes and supports community-led initiatives.

DisasterWISE hosts regular members meetings and monthly get-togethers to open discussion on topical issues. The network hosts a bimonthly book club and hosted an event in September showcasing and learning from community-led approaches. An online DisasterWISE learning platform provides a dynamic space for connection, sharing and dissemination for people involved in community-led approaches.

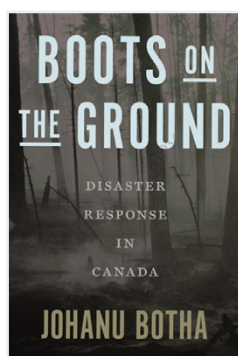
Having lived through the 2009 Black Saturday bushfires, I know it is through lived experiences and by listening deeply to local and Indigenous knowledges, that we know communities must be at the heart of decision-making, planning and renewal. Those who have lived through disasters hold invaluable knowledge; wisdom that should be shared to support others facing disasters in the future.

DisasterWISE platforms provide an exchange of knowledge and dialogue across diverse perspectives to help navigate the complexities of climate adaptation and resilience. DisasterWISE's theory of change is a commitment to decolonisation, dynamic governance, decentralisation and trauma-informed practice. This foundation creates safe spaces; environments where respectful dialogue, critical reflection and collaborative learning can thrive.

Endnotes

1. DisasterWISE website www.disasterwise.com.au.
2. Fire to Flourish, Monash University, www.firetoflourish.monash.

Boots on the Ground



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publication.

Disaster management in Canada faces many of the same challenges as in Australia. One of the contemporary issues for both countries is the role that defence forces have in emergencies and disasters. In this book, the author considers how effectively the Canadian Armed Forces have integrated into the multilevel governance of domestic disasters.

Canada has a 3-tier set of disaster arrangements involving federal, provincial and municipal responsibilities. This author's research explored the elements required to achieve effective integration of Armed Force support with civilian agencies. Three questions explored:

1. What is the role of Canadian Armed Forces in contemporary Canadian disaster response?
2. How effective is the civilian-military relationship during disaster response?
3. In what ways might the military contribution to Canadian natural disaster response be improved?

Public Safety Canada is a legislated federal department and is responsible for conferring with the Department of National Defence about requests for Canadian Armed Forces assistance from provinces. As in Australia, the Canadian Government receives requests for assistance principally through provincial governments. The book includes examples of situations where Canadian Armed Forces assistance was urgently supplied while waiting Canadian Government approval. This reflects Australia's Defence Assistance to the Civil Community Initiative (DACC) Category 1 arrangements that are for localised, short-term emergency response.

A number of limitations are identified by the author to the use and capability of Canadian Armed Force personnel. These are that their personnel are not trained in emergency services skill sets and that there are negative perceptions of the Army by some Canadian Indigenous communities that stem from the

use of Armed Forces by Quebec Province to control protests in the 1970s.

The author identifies factors that contribute to effective operational partnerships between Canadian Armed Forces and civilian agencies. The most effective civil military outcomes were associated with liaison officers being involved before disaster events in provincial emergency management planning, training and exercising. In these cases, strong relationships, clear understanding of the others' capabilities, better understanding of emergency risks and operational procedures, situational awareness and communication flows occurred. During emergencies and disasters, liaison officers provided early identification of Provincial requests, clarified Army capability and scope with requestors and ensured people with the right knowledge were talking to each other. The author highlights the additional benefits with the deployment of reservist officers due to their local networks that improved communication flows, local information and speed in identifying contacts.

Factors limiting the civil military partnership include:

- the difficulties in meeting Armed Force's core responsibilities while responding to disasters
- information systems used by force and by municipal governments were unable to build an integrated operating picture.

Achieving effective integration of effort between civil and military operations is identified as an issue. The critical concern relates to effective joint planning, language and terminology and expectations of civil and military leaders towards each other.

This book provides an interesting analysis of the context surrounding civil and military joint operations in emergencies and disasters. The author identifies issues to be considered to get the best outcome when civil and military resources work together. Although this is a Canadian case study, the issues can be replicated in the Australian context.

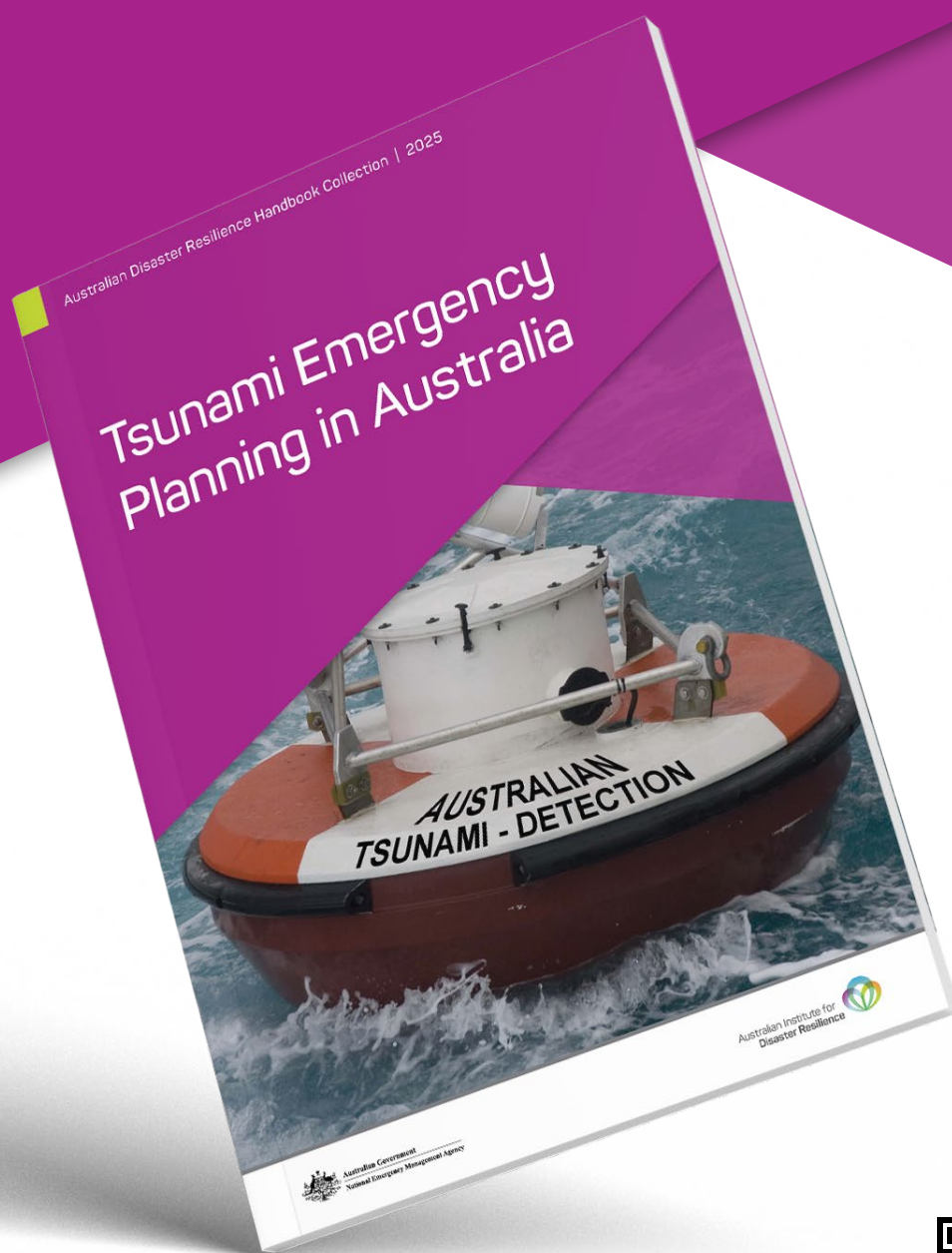


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