Australian Journal of Emergency Management

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of decision-making
framework during bushfire

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The *Australian Journal of Emergency Management* is Australia's premier journal in emergency management. Its format and content are developed with reference to peak emergency management organisations and the emergency management sectors—nationally and internationally. The journal focuses on both the academic and practitioner reader. Its aim is to strengthen capabilities in the sector by documenting, growing and disseminating an emergency management body of knowledge. The journal strongly supports the role of the Australian Institute for Disaster Resilience as a national centre of excellence for knowledge and skills development in the emergency management sector. Papers are published in all areas of emergency management. The journal encourages empirical reports but may include specialised theoretical, methodological, case study and review papers and opinion pieces. The views in the journal are not necessarily the views of the Australian Government, Australian Institute for Disaster Resilience or its partners.

Aboriginal and Torres Strait Islander peoples are advised that this publication may contain images of deceased people.

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Contents

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

Foreword

Andrew Coghlan

Australian Red Cross

I continue to reflect on the conversations and ideas shared at the Australian Disaster Resilience Conference in August, and am pleased that the Australian Red Cross could contribute to the success of this year's event through the steering committee, presentations, panel sessions and attendance.

This year saw the largest number of abstracts submitted to the Australian Disaster Resilience Conference, and the resulting program reflected a diversity of people, experiences and perspectives. The scale of interest in the conference and the significant increase in attendance highlights the growing role of resilience and its relevance to the broader emergency management sector. This was reinforced with the introduction of Resilience Lane into the AFAC23 Exhibition, a great initiative that showcased grassroots and community-based resilience initiatives, and created another resilience touchpoint within the wider AFAC23 Conference.

We welcomed a record 569 delegates in Brisbane this year, spanning representation from state and local government, fire and emergency services, non-government organisations and not for profits, community, consultancy, health and academia. Notably, 75% of delegates were attending the conference for the first time and we were delighted to welcome so many new people to the conversation. It was a valuable opportunity to connect with a diverse array of people and will no doubt lead to further collaborative efforts in the future.

I was honoured to chair a session on creative recovery that featured a number of compelling presentations to inspire new ways of thinking and seek creative ways to build disaster resilience at the community level. The power of the arts and storytelling at every stage of the disaster cycle, and the role they play in fostering transformative healing and change, was felt across the room.

The conference focus this year was to 'reimagine resilience' and it was fitting that the event was preceded by the inaugural National Indigenous Disaster Resilience Summit to open the week with First Nations knowledge and perspectives. The themes of the summit carried through to the conference, including a presentation from the Australian Red Cross First Nations Recovery team who shared the importance of mutual trust and commitment for restoring identity and cultural ties to land after disaster.

For another perspective, we looked at resilience through the lens of people living with disability, and challenged ourselves to rethink the concepts of strength, vulnerability and agency. Often individuals are held back not by a disability, but by the structures, conditions and spaces that exclude them. We heard of the progress made toward embedding disability inclusive disaster risk reduction across Australia, and the value of adopting more inclusive approaches to ensure we can bring more people on the disaster resilience journey.

The program spanned youth, cultural and linguistic diversity, investment and insurance, collaboration and nature-based solutions. We are grateful to everyone who presented, participated, and made possible the Australian Disaster Resilience Conference this year. Prominent across all sessions was that people are at the heart of what we do, and why we do it. Read on in this edition of the *Australian Journal of Emergency Management* for articles aligned to the theme of reimagining resilience.

Release of the Second National Action Plan

Andrew Minack

National Emergency Management Agency

Australia's Emergency Management Ministers have released the *Second National Action Plan to implement the National Disaster Risk Reduction Framework*, amplifying a call to action for all Australians to reduce systemic disaster risks.

Australia's disaster risk environment is complex. Recent cascading and compounding disasters have challenged us all. The decisions we make about how and where we live and work can create, amplify or reduce risk. However, it is not inevitable that disaster risk continues to grow. As a nation, we recognise the importance of reducing disaster risk and enhancing resilience beyond avoiding loss and damage. Risk reduction achieves substantial investment return, provides significant co-benefits, and enables all Australians to be safe and to prosper.

The *Sendai Framework for Disaster Risk Reduction 2015-2030* is the key international framework driving disaster risk reduction. It seeks to achieve a substantial reduction of disaster risk by 2030. Australia's National Disaster Risk Reduction Framework guides our efforts to reduce disaster risk in line with the Sendai Framework. Australia's National Mid-term Review of the Sendai Framework showed that while we have made great progress towards this goal, more work is needed.

The Second National Action Plan, released on 25 August 2023 by Australian Emergency Management Ministers, articulates the action needed in Australia to achieve the Sendai Framework Goals and Outcomes.

The First National Action Plan, released in 2020, was a starting point. It listed government initiatives aligned to the Framework already underway, championing shared responsibility and coordination across government portfolios.

The National Emergency Management Agency, in partnership with the Australian Institute for Disaster Resilience and CSIRO, invited stakeholders from across the Australian community – not just from government or the traditional emergency management sector – to shape the Second National Action Plan.

The Second National Action Plan is for all Australians – individuals, communities, organisations and sectors, and governments. By effectively coordinating and aligning action, this Plan aims to reduce systemic disaster risk to create stronger, more secure and more resilient communities before, during and after disasters.

The Second National Action Plan seeks to:

- increase our understanding of disaster risk and provide a national picture of risk
- deliver inclusive plans at the household, community, regional and state levels to mitigate those risks
- inform investments so they work to reduce disaster risk and deliver co-benefits across social, physical and economic domains
- empower all Australians to actively participate in risk planning and the decisions that impact them.

The Second National Action Plan provides direction to drive disaster risk reduction across all sectors, in all decisions, by all Australians. Disaster risk reduction is a shared responsibility. While individuals and communities have their roles to play, they do not control many of the levers needed to reduce systemic disaster risks. Governments – whether local, state or federal – have a key role in disaster risk reduction, as does industry.

Together, Australian Emergency Management Ministers, support the call for all stakeholders to implement this plan, and to continue building a disaster resilient Australia for generations to come.

The Second National Action Plan is available from the National Emergency Management Agency website: www.nema.gov.au.

How does information really flow in communities during a natural disaster?

Susan Atkinson

University of Canberra

Emergency services organisations strive to communicate important and relevant information during emergencies and disasters but research is showing that they are not necessarily the primary sources of information that people turn to. Many people rely on family, friends and local community groups to provide the information they need. This has implications for how communities prepare and respond and how the emergency management sector integrates and communicates.

Disaster management research recognises that communication with communities is critical to them responding to and recovering from a disaster and in building resilience. The public often takes an active role when disaster strikes and this is becoming more visible through the use of information and communication technologies. While information sharing and coordination are critical during a disaster event, particularly between response agencies, affected individuals and groups are sharing information and creating their own informal and formal networks, thus creating multiple levels of information sharing.

Social media is an important mode of communication as it facilitates access to timely and relevant information and provides people with opportunities to share their opinions, news and links in real-time. It promotes 'a feeling of connectedness'. It is critical to understand how people find information, co-create new information with others and share information to support each other during crises. For example, what sources do people use, what information do they look for and share and what decisions do they make?

Through understanding how community communication ecologies spontaneously form in emergency situations, we can improve cooperation and coordination between communities and response agencies and improve the outcomes for affected communities.

Bushfires, the COVID-19 pandemic and floods have highlighted the complex challenges faced by citizens and authorities in preparing for and responding to extreme events. In Australia, as elsewhere, natural high-risk hazards have enormous effects. These effects are not just physical but have long-lasting adverse consequences for individuals and communities in relation to physical and mental health and the ability to recover and thrive in the months and years that follow.

The increase in frequency and severity of separate and compounding disasters in Australia has meant more and more people are experiencing bushfires, heatwaves, droughts and floods firsthand. In addition, internal migration is changing the composition of communities and people's experiences of these events varies enormously.

Decades of emergency management research reinforces that communication with communities is critical to them responding to and recovering from disasters and in building resilience.[1] It also suggests there is a significant and growing gap between the expectations of citizens for reliable and timely information and the communication strategies and capabilities of authorities. Much research is focused on response agencies and how they communicate with affected communities and less on understanding who is being reached, what information people look for and the decisions they make.[2,3]

It is critical to understand how people find information, co-create new information with others and share information to support each other during crises.

Image: Yuri Arcurs, www.peopleimages.com

The emergency communication ecology is complex and comprises many actors. The main actors are the authorities that are charged with the formal response functions. However, they are not the only actors and, increasingly, they are not the only source of information. Other sources include community groups, individuals such as family members and friends as well as other members of social networks.

People have always talked to each other to share stories, information and to create community in social networks that share values and help each other. The foundation of community is people and relationships between people. How do we build relationships? We talk to each other. Communication is the enabler that allows relationships and communities to form. This interpersonal communication is the foundation of information ecologies that facilitate the flow of information within social groups and is more critical in times of crisis.

Prior to the advent of the internet, the main sources of news and information about emergencies and disasters were through traditional media channels such as television and radio. In addition, communities relied on the information they received from their local emergency services agencies such as the fire service and police as well as from neighbours, friends, families and other community-based groups. Community members are now using information and communication technologies that allow individuals and groups to share information and create their own informal and formal networks, thus creating multiple levels of information sharing. And people are not just sharing information verbatim. They are finding information from many sources, talking to others and creating new information that they share with their social networks.

Changes in the media environment

Social media is an important mode of communication. Since the advent of digital media, the number of people who use digital technologies and social media to access news and information as steadily, and exponentially, increased, which has influenced how people get the information they want.

Reviews following fires and floods have repeatedly found that communication with affected communities has been less than optimal and a major contributing factor to poor outcomes for people and communities. Over decades, there has been a reduction in trust in government and in its capacity to respond in timely and effective ways. There is a realisation that natural hazards may be too large and affect so many people that emergency services agencies cannot be everywhere at once. Many communities are demonstrating a preference and capability to take on a higher level of responsibility for preparedness and response activities. In addition, emergency services agencies are realising that they need to find ways to integrate with communities to leverage local knowledge, skills and experience and communication is fundamental to this.

Community connectedness – a critical element

Australian research conducted by Taylor and colleagues[4] used in-depth interviews (192 participants) and an online survey (430 respondents) to explore community experiences of the 2022 floods. Their comprehensive final report highlighted several key communication-related findings. In response to the survey question about respondent's most useful source of information on social media, 'local community groups' was the most selected option (35%) followed by 'official sources – QFES/NSW SES/BOM' (23.6%) (p.49). In addition, over 68% of the total sample strongly agreed or somewhat agreed with the statement, 'I will rely more on local information from community in future flood events'. Themes that emerged from the interviews highlighted the need for local information, changing information expectations and the role of communities in preparedness and response.

Implications for communication

In an emergency situation, the normal patterns and expectations of daily life are altered and communication flows within communities can be significantly disrupted. This triggers new ways of sourcing and sharing information and creating new communication ecologies. Understanding the information flows and existing communication ecologies within communities, as well as how new networks emerge, contributes to unified communities where information needs are better understood and people feel more connected because fewer people are excluded.

In developing communication strategies, we need to set aside assumptions that if only the message, channel and timing of communication were right, people would understand what to do and then do it. Individuals have their own perceptions of risk based on many factors and when groups of people come together there is necessarily a negotiation of what constitutes shared risk and what the responses could be. Communication is a vital part of how a community works and engages with different perspectives and experiences. During emergencies, responding agencies provide huge amounts of data, often in formats that are not easily understood and are often not specific enough to a local area to be useful for people making individual and group decisions.

Significance and innovation – why is this important?

There are several significant gaps in emergency communication research. One concerns the target population for communication. In Australia, in 2017 more than 2.8 million people did not use the internet.[5] Another large gap is the lack of research into crisis communication from the citizen's perspective, particularly related to what information they look for, where they go to look for it and what decisions they make. There is a lack of understanding of the way people source and share information. This is compounded when we consider it from a community perspective. Communities are complex ecologies that are made up of individuals and subgroups including informal social networks, neighbours and local community groups, friends and family. There are also formalised networks such as workplaces, sporting clubs and volunteer organisations.

Through placing the audience at the centre, academia, government and industry can better understand people's communication needs and information-seeking behaviours and how communication ecologies spontaneously form. Through better understanding, responsible authorities can increase communication capabilities within communities and improve cooperation and coordination between communities and response agencies.

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Resilience building: timing and messaging matter

Sue Rondeau
Mat Deans

The Six C's

Lessons learnt from large disasters continually highlight that community education and engagement programs are key to informing and empowering individuals and communities to plan and prepare for disasters.

While there is evidence of many community programs being delivered, the continual mention and recommendation of their importance suggests previous methodologies are not significantly successful or simply miss the mark.[1, 2, 3]

As a sector, and as practitioners, we understand the principles of successful community engagement methodologies and communication theory, however, we are often time poor, inadequately resourced or fail to recognise all the complexities within the communities within which the programs are being delivered. Sometimes programs are just 'delivered' with little regard of the importance of understanding the community, which results in poor attendances and wasted resources.

This is problematic as government and emergency services agencies are putting more emphasis on a shared-responsibility approach where community play important roles in all phases of emergency management. The National Emergency Management Agency (NEMA) state that:

> All sectors of society make disaster risk informed decisions, are accountable for reducing risks within their control and invest in reducing disaster risk in order to limit the cost of disasters when they occur.[4]

Having worked alongside communities for over 17 years and appreciating the difficulties in developing communication strategies using communication theory, we developed a process that has the potential to increase community engagement participation, build the capacity and capability of people within communities and provide efficiencies for practitioners. The process uses in-depth community profile data analysis that categorises segments of the community and uses profile modelling to develop a strategy that can be used by practitioners to successfully communicate with communities based on their profile needs.

This process was tested during the 2018 Victorian South-west complex fires[5] where recovery communications had to be delivered to diverse cohorts including rural and remote farming communities. Our process provided a clear plan on how and when to engage with the different segments of the affected communities and which channels to use. This implementation was recognised in the 2019 Resilient Australia Awards and the EMPA Award for Excellence in Emergency Communication.

Being provided with an easy-to-follow report that identifies segments of the community, how they prefer to receive information, at what time they prefer to receive the information and through what channels will increase the development of disaster resilience building capabilities and pave a way forward in how we work in partnership to strengthen all segments of the community.

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Accurate flood classifications are critical to keep our communities safe

Jess Carey

Stantec, Queensland

Dr Alireza Pouya

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Ensuring that flood classifications are consistent with people's understanding of their potential flood effect is critical to confirming that flood watches and warnings dissemination are timely and credible and that they evoke an appropriate response that keep communities safe.

The Bureau of Meteorology uses a simple 3-tiered naming convention (minor, moderate and major) to classify the severity of flooding expected in an area. This is based on forecast or recorded flood levels. Flooding during 2022–23 across the east coast of Australia highlighted many challenges that need careful consideration. A full and detailed review of a region's flood classifications is an activity that will deliver benefits to organisations involved in responding to flood events and achieving an expected increase in community flood resilience.

The agency responsible for providing flood forecasting and warning services in Australia is the Bureau of Meteorology (the Bureau). To ensure these classifications are attached to on-the-ground experiences, the Bureau has historically leveraged local community intelligence when setting these levels so that the expected qualitative local effects can be inferred alongside the prediction. As part of its responsibilities in disseminating flood-related advice, the Bureau assumes the existing flood classifications are accurate and fit-for-purpose at the local level. Recent inquiries and reviews into flooding in Queensland and New South Wales have identified that this isn't always the case.

The *National Arrangements for Flood Forecasting and Warning Services (2019)*[1] states that the responsibility to '*lead the determination, review and update of flood classifications sits with State/ Territory Emergency Service organisations in consultation with the Bureau and other relevant State and local agencies*'.

It is worth noting that although ultimate responsibility lies with local authorities and the relevant state and territory governments, to achieve true success, collaboration across the entire community is required. This collaborative approach is consistent with the Total Flood Warning System concept, which is part of the Australian Institute for Disaster Resilience Handbook Collection.[2]

The widespread major flooding that has been recorded over recent years provides the sector with new and valuable information that could be leveraged to define or review flood classifications across all jurisdictions. To do this effectively, it is critical that a standard approach is followed. While some jurisdictions have attempted to put rigour around this process (Queensland Reconstruction Authority provides a best-practice guide[3]) this is not available everywhere.
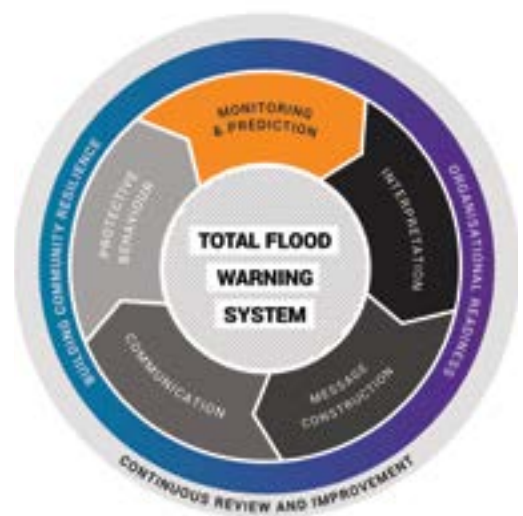

Figure 1: Total Flood Warning System

Source: Australian Institute for Disaster Resilience

The most important step in any flood classification review or development process should be negotiations with the Bureau to ensure it is aware of the intent of the review and to be given the opportunity to support any review. Once contact has been made with the Bureau, it is important to collate all available historical and contextual data, which would include items like:

- asset databases including elevation information to understand potential local infrastructure impacts from flooding
- historical data from rainfall and water level stations
- local knowledge or flood marks
- historical records in libraries or community groups.

In the absence of historical flood information or significant time passage since flood events, using recently completed flood risk modelling from a flood study can play a valuable role in understanding potential flood hazard.

The process of assessing flood risk through modelling typically begins with a review of available flood studies, flood emergency preparedness plans and flood emergency action plans that are available. Once this data collection phase is completed, a 'representative zone of impact' is determined with reference to a nearby water-level station. Following this zoning phase, fit-for-purpose criteria interpretating local conditions and available data is established against the Bureau's flood classification definitions. The final step is a thorough spatial analysis of effects within the streamflow gauge's zone of impact against the initial criteria to define the classifications and the risk.

Although using flood risk modelling is an effective method in the absence of historical or contextual information, flood classifications defined primarily from this method should be treated as provisional until a flood event is recorded. A full review and update process should be conducted shortly after to ascertain the accuracy of the provisional classifications.

Once all available historical, anecdotal and flood risk modelling information has been collated, the most effective way to propose where appropriate levels should be set is to prepare a list of local effects (from the collated information) and document levels at which flooding occurred to a consistent datum relative to the local gauge. These effects will range from very frequent small events that only produce minor inconveniencing consequences up to record flood events where large areas and properties are inundated.

Once this list is mapped relative to gauge height, reviewers define points in the list that are consistent with the effects expected to align to qualitative definitions of flood classification (minor, moderate or major). These qualitative definitions are the nationally consistent definitions for flood classifications from the *National Arrangements for Flood Forecasting and Warning Services* (see following).

Minor flooding

Causes inconvenience. Low-lying areas next to watercourses are inundated. Minor roads may be closed and low-level bridges submerged. In urban areas inundation may affect some backyards and buildings below the flood level as well as bicycle and pedestrian paths. In rural areas removal of stock and equipment may be required.

Moderate flooding

In addition to the **minor** impacts, the area of inundation is more substantial. Main traffic routes may be affected. Some buildings may be affected above the floor level. Evacuation of flood-affected areas may be required. In rural areas remove of stock and equipment will likely be required.

Major flooding

In addition to the **minor** and **moderate** impacts, extensive rural areas and/or urban areas are inundated. Many buildings may be affected above the flood level. Properties and towns are likely to be isolated and major rail and traffic routes closed. Evacuation of flood-affected areas may be required. Utility services may be impacted.

Once the new or reviewed flood classifications have been determined, the draft outcomes need to be reviewed by the Bureau before operationalisation can occur. Requests for flood classification changes follow a detailed process and to assist with this, the authority preparing the request needs to show the newly determined flood classifications in a way that gives the Bureau confidence and context as to why the classifications have been set.

Producing a 'totem pole' plot (see Figure 2) shows all relevant information (local effects, historical flood peaks, design flood levels and proposed flood classifications). This knowledge assists to justify the flood classification request and, once established, the totem pole can be referenced in future flood events by responding agencies. In addition to these operational benefits, totem poles can also be used to inform communities and help people understand what may occur when flood levels rise in their local area.

Once the request for a flood classification has been submitted, the Bureau will seek endorsement of the proposed change from the jurisdiction Flood Warning Consultative Committee. Once this endorsement is received, the changes are planned and operationalised by the Bureau via updates to the relevant regional Service Level Specification document and various systems, internal guides and the Bureau's website. This process can take time and organisational effort to complete. This underscores the priority of engaging with the Bureau early in the process to ensure involvement can be planned and resourced.

Having flood classifications set correctly ensures timely and accurate information is provided to the community to keep people and property safe. For this reason, it is just as important to ensure that a location that doesn't have significant flood exposure has its flood classifications removed. This removal ensures appropriate focus and effort can be placed on the locations of greatest need and no erosion of trust and credibility in the flood warning service occurs.
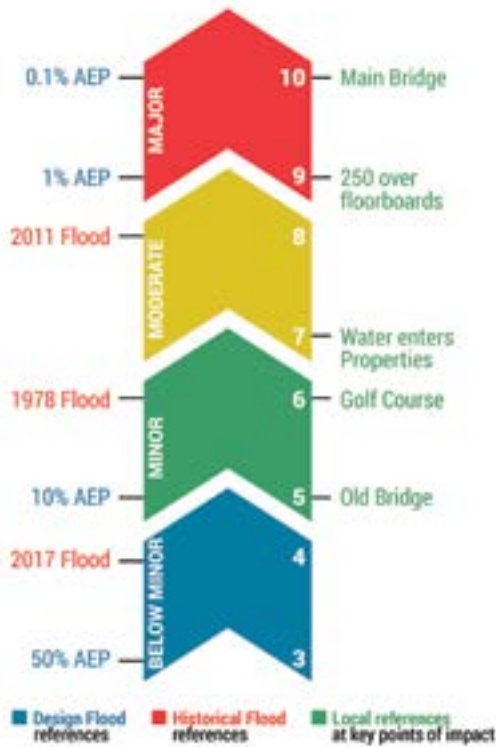
Figure 2: Flood classification totem pole.

Community action plans provide easy-to-understand triggers and actions for people to respond before, during and after flood events.

Reviewing flood classifications can take time and effort to complete effectively, but this activity should be viewed as an operational priority and is a required part of communities being as resilient as possible. Flood classifications are the foundation of flood forecasting and warning that the Bureau provides and they should be referenced in local disaster management plans and processes as well as in community-based plans.

A Community-Based Flood Action Plan uses local understanding of flood effects, plain language and issuing criteria from local, state and territory and national authorities to provide easy-to-understand triggers and actions for people to respond before, during and after flood events. These triggers might include the overflow of floodwater over a bridge upstream, the release of water from a dam or the issue of a flood warning from the Bureau. When these triggers are activated, communities have a predetermined corresponding action to carry out.

To learn from recent prolonged and devastating flooding in Australia, we need to listen, collaborate and ensure that outcomes are holistic and fit-for-purpose. The focus needs to be on building resilient and robust infrastructure as well as on resilient communities. If done effectively, reviewing a region's flood classifications is a great way to bring members of a community together with a shared goal of preparation and resilience to future flooding.

The Bureau of Meteorology video explaining the role of flood classifications is at www.youtube.com/watch?v=gKDPgp5Ds9s.

The Bureau's roles and responsibilities are at www.bom.gov.au/water/floods/document/National_Arrangements_V4.pdf.

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Preparing for flood: community insights on sandbag planning and access

Dr Michael Carroll
Linda Gordon

Queensland Fire and
Emergency Services

Only a small percentage of Queenslanders have thought about how they would access sandbags during a flood event. Could better understanding of sandbag services delivered help them plan and prepare?

The 2022 South East Queensland flood event was a highly visible reminder of the effects of heavy rainfall and the role that sandbagging of at-risk properties can play in mitigation. Emergency services agencies are often involved in the provision of sandbags to community members and there is value in understanding community awareness of this important service.

Queensland Fire and Emergency Services (QFES) conducts an annual community insights survey exploring a range of emergency and disaster events, community perceptions of risk and preparedness and service delivery and expectations of the department. The survey has been run in its current format and approach since 2018 and includes scope to capture perspectives from Queensland's geographically dispersed population.

While the questions within the survey largely remain the same from year to year, there is scope to add or alter questions when the need arises. With the annual review of survey questions following the 2022 rainfall and flood event, the importance of better understanding sandbag usage, awareness and preparedness was highlighted for inclusion.

Accordingly, questions targeting the following areas were asked:

- Have you received sandbags from QFES in the last 12 months?
- Were sandbags provided by QFES in your local area in the last 12 months?
- Has sandbag preparation or access been conducted/planned to be conducted by you or your landlord to reduce or prevent the impact of an emergency or disaster event?

Methodology

QFES community insights surveys are delivered online by a market research company, IPSOS, to Queensland residents over the age of 18 years.[1] The final number of respondents for the 2022 survey was 2,099 and this was evenly distributed across the 7 QFES regions that cover the state. The sample was ultimately weighted to reflect the state's population in terms of region, age and gender.

Sandbag access and provision: what is happening in local areas?

The percentage of respondents who reported receiving a sandbag service from QFES in the preceding year varied across the state:

- Brisbane Region – 13%
- Central Region – 6%
- Far Northern Region – 8%
- North Coast Region – 6%
- Northern Region – 16%
- South Eastern Region – 7%
- South Western Region – 7%.

The figure for across Queensland was 9%.

Responses varied when community members were asked whether QFES had delivered sandbag services in their local area, even if they had not directly received a sandbag. Figure 1 presents responses for each of the regions. The strongest

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1. IPSOS performed the market research and email addresses were not provided to QFES. The survey is disseminated through the QFES Gateway. The information is available on the Queensland Government Open Data page.
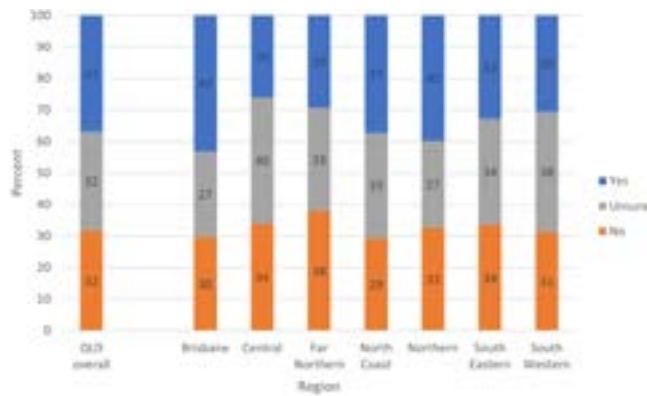
Figure 1: Responses to the survey question: Were sandbags provided by QFES in your local area in the last 12 months?

Figure 2: Responses to the survey question: Has sandbag preparation or access been conducted/planned to be conducted by you or your landlord to reduce or prevent the impact of an emergency or disaster event?

affirmative response was given in Brisbane Region, with 43% of respondents indicating that they were aware that QFES had provided sandbags in their local area. Interestingly, one of the most notable findings was that a large amount of uncertainty existed across each of the regions, with people indicating that they were unsure as to whether QFES had provided sandbags.

Preparedness and planning

The 2022 Community Insights Survey also captured sandbag preparedness and planning activities undertaken by community members. Figure 2 firstly shows variability in both 'Completed' and 'Planned' sandbag preparedness activities across the QFES regions. Of note is the significant proportion of respondents who said they had not engaged, nor did they conduct planning to engage, in sandbag access or preparedness (the 'Not Planned' category). This is of particular importance as this does not simply represent people for whom sandbags are not required due to the location of their property. These people were captured under the 'Not required' response option. Accordingly, the results indicate that there is an appreciable slice of the community that may one day need sandbags to mitigate inundation but have limited planning and self-sufficiency around this activity. It is reasonable to assume that these would be community members who relied on emergency services agencies to provide this service at the time of need.

Implications

With the increasing number, frequency and intensity of high-risk events comes a broader spectrum of community members who will be affected, including people who rarely or have never experienced such events before. Distributed across Queensland is a significant proportion of the population whose property may require sandbagging one day but who have not yet conducted or, in many cases, not even planned sandbag preparedness activities. This lack of action may result in more reactive behaviours at the time of a flooding event that could have flow-on consequences for resourcing and logistics of emergency services agencies.

When considering these preparedness findings together with the significant amount of community uncertainty around actual agency sandbag services delivered in local areas, a theme of the prominence of sandbag services emerges. Community members may benefit from better understanding the amount, demands and challenges of delivering sandbags by agencies in their local areas. This may help to improve their preparedness activities that, in addition to personal benefit, may alleviate drawing on emergency services during the acute demands of an emergency response.

The QFES Community Insights Survey 2022 Final Report is at www.qfes.qld.gov.au/sites/default/files/2023-02/QFES-Community-Insights-Survey-2022.pdf.

Better mental health care for the local communities in Queensland

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The cascading and compounding effects of recent natural hazards and disruptive events in Australia have been much discussed. It's timely to examine the cascading and compounding benefits that can be achieved through successive disaster-response initiatives.

Australia's *Disaster Recovery Funding Arrangements 2018*[1] is a joint Australian Government and state and territory funding agreement. Category C assistance is only made available when a disaster is severe. In Queensland, a community disaster mental health response has been funded under Category C for 3 consecutive activations: Monsoonal Flooding 2019 in the north and west, Eastern Queensland Bushfires 2019 in the south-east and Rainfall and Flooding 2021–22 across much of the south.

Birdie's Tree[1] is hosted by the Queensland Centre for Perinatal and Infant Mental Health within Children's Health Queensland Hospital and Health Service. Birdie's Tree provides specialist support for the mental health of expectant and new parents, babies and children in areas with an activated disaster recovery mental health response. The overlap in Queensland's local government areas receiving a mental health response related to bushfires in 2019 and flooding in 2021–22 provided the Birdie's Tree team with an unusual opportunity (dare we say a 'bird's-eye view') to observe the cascading and cumulative benefits of successive disaster-response initiatives in the same area.

'Sharing the driving' refers to the general notion of partnership, which we believe is essential to human and social recovery. This paper unpacks 5 principles that, from our experience, enable effective partnerships and are worthy of consideration in policy and practice. Practical examples of barriers and enablers are cited to demonstrate how these principles have operated in the real world over the past 4 years.

Principle 1: the recovery cycle

Preparedness, response and recovery should be considered cyclical rather than linear, with a focus on all-hazards resilience rather than a narrow approach of 'recovery' from specific events.

There is consensus in the emergency management community that natural hazards are increasing in frequency and severity.[2, 3] A theoretical model that considers natural hazards unusual, and the process of preparedness, response and recovery linear, will not prepare emergency management services and communities to cope with the cascading and compounding effects of simultaneous and consecutive events.[4]

Somerset is one of several Queensland local government areas where a disaster mental health team was still responding under the 2019 bushfire activation when the same area was hit by floods in early 2022. The Birdie's Tree team participated in a community event organised to support recovery from the fires. A group of 7 children aged 3 to 9 years old from 4 families had just lost their homes to flood. All had been evacuated under stressful conditions and had experienced family separation, financial hardship and disruption to their education and social situations. These families were concurrently dealing with the threat of COVID-19 and the effects of pandemic restrictions and shortages. Parents and caregivers were anxious about the possibility of future flooding due to an expected third La Niña weather pattern.

These families were far from unique among communities in the West Moreton, Darling Downs and Sunshine Coast areas for whom short-term recovery from floods was entangled with long-term recovery from fires, an immediate response to the pandemic and preparedness for more potential floods in the coming season. The presence of mental health teams, including the Birdie's Tree team, with authority to respond to community mental health needs as they presented, enabled effective support for individuals and families.

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1. Birdie's Tree, at www.childrens.health.qld.gov.au/natural-disaster-recovery/.

Dr Andrea Baldwin and Kathy Morrow help children develop coping skills for upheavals in their lives. Sharing the driving means partnering and working together.

Image: Angie Gorry, Children's Hospital and Health Service, Brisbane, Queensland

Principle 2: 'products' progress partnerships

The principle of 'build back better' is demonstrated, not only in the use of recovery funding to provide communities with better hazard-resistant housing and infrastructure, but also in capacity building for people's mental health and wellbeing. Just as resilient infrastructure relies on the availability of materials, technology and design to provide bushfire-resistant houses and flood-capable roads and bridges, mental health resilience requires resources, programs and training that support people's wellbeing and coping. The process of distributing resources, running programs and providing training can help partnerships quickly coalesce around a shared goal.

The Queensland Health Mental Health Alcohol and Other Drugs Branch routinely trains disaster recovery teams in a suite of programs including Stormbirds, Seasons for Growth and Trauma-focused Cognitive Behaviour Therapy. Disaster recovery teams and members of a standing program, Tackling Regional Adversity through Co-ordinated Care, are trained to deliver programs of Psychological First Aid for responders. Some disaster recovery teams also develop information sessions and training programs

to meet local needs. Rolling out these programs strengthens relationships between the teams and local service providers, supports local service providers to network with one another, builds capacity within the community to respond to and recover from recent and future events and creates referral pathways for individuals experiencing distress to access support.

The Birdie's Tree team provides 2 training programs: Birdie's Tree Early Learning Program for early childhood educators and Birdie's Tree Universal Resources Training for a wide range of personnel. It provides 2 mental health promotion programs, Birdie Calls and Birdie's Community, and a clinical early intervention program called Birdie Cares. These programs support children's recovery from recent events while growing emotional preparedness for the possibility of future events. A component of the programs is distribution of Birdie's Tree resource kits across councils, libraries, primary schools, early learning centres and other services. The training programs help to reduce the likelihood that these resources sit on shelves. Rather, they are used to help children and families recover from recent events. With this foundation of familiar characters and stories, children can better understand and cope with the response and recovery phases of future events.

Birdie and Mr Frog with books.

Image: Diane Wiki.

Principle 3: working together

Disaster response and recovery personnel distinguish between local services (that belong to a community and operate day-to-day) and external services (that come in from outside to assist in response and recovery). A common discussion topic is how best to combine the advantages of both groups in a general approach to disaster response and in the unique circumstances of a specific event. The aspiration of 'community-led response' expresses the expertise of communities in their own place, social capital and autonomy. However, the effects of the event may temporarily disable organisations and individuals tasked with response and/or rapidly exhaust the physical, mental and emotional capacities of local personnel. External organisations are sometimes termed 'expert companions', not to imply that local services lack expertise, but in recognition that people whose homes, families and businesses have recently been disrupted by an event may need to work alongside people who are not in that position.

Since 2019, the role of disaster recovery team clinicians has been gradually negotiated across the large number of local government areas in which these teams have operated. The disaster recovery team program is seen as an 'external' service as its funding is temporary (2 years), operations are centrally coordinated and teams usually work across a wide geographical area. While the individual clinician appointed to a disaster recovery team may be a long-term resident of the hospital and health service in which their team is located, they are unlikely to have existing relationships across all local government areas where they are expected to work. This means clinicians must quickly identify networks of service providers that operate in an affected area, establish relationships through these networks and deliver resources, programs and services through partnerships with network members.

The same applies for other positions funded under Disaster Recovery Funding Arrangements Category C such as community recovery and resilience officers in councils and a range of other positions funded under short-term programs. While not always explicitly outlined in role descriptions, these positions play

an important part in alleviating distress, supporting people's wellbeing and building resilience in individuals and families.

The process of introducing external services has become streamlined over the past 4 years. The Birdie's Tree team has learnt to connect early with councils, libraries and community and neighbourhood centres to identify existing networks such as Local Level Alliance, local disaster management groups and interagency groups or subgroups that focus on early childhood and/or disaster resilience and recovery.

Other external organisations, including non-government organisations whose ongoing operations are statewide or embrace several local government areas, have proved vital partners, providing access to networks and processes on the ground. Trust and goodwill has been built and relationships have been strengthened and expanded through successive responses. Joint strategic planning and statewide preparedness are becoming possible through these partnerships.

Principle 4: cooperative relationships at all levels

Cooperation at different levels of partner organisations can help deliver effective support for communities. In essence, if the same intention is shared vertically (top-down and bottom-up) through each partner organisation, as well as horizontally (across the organisations), communication and action are facilitated.

The Birdie's Tree team has pursued this goal by meeting with partner organisations. For example, the relationship between Birdie's Tree and BUSHkids began in Mt Isa under the Monsoonal Flooding 2019 activation. Under the Rainfall and Flooding 2021–22 activation, the Birdie's Tree team worked with BUSHkids clinical teams within 3 rural communities. BUSHkids has facilitated the provision of Birdie's Tree early learning programs for early childhood educators in all 3 towns. The Birdie's Tree team met with the Friends of BUSHkids community support committee and provided Birdie's Tree Universal Resources Training for the BUSHkids clinical leadership team. The intention is to provide training for individual clinical teams in future. The Birdie's

Birdie and Mr Frog on dashboard
Image: Andrea Baldwin

Tree team meets periodically with the CEO and Director of Clinical Services and Strategy of BUSHkids. The trust and understanding that has grown through meetings and activities has translated into effective support for children, communities and families.

Principle 5: continuity helps, discontinuity hinders

A complaint from communities affected by floods in 2021–22 concerned the lag between short-term counselling services ceasing at community recovery hubs and clinical services becoming available through disaster recovery teams. Processes required to set up a mental health response under a new activation can be time-consuming. These include allocation of funding, approvals and agreements among the funding and administrating areas of the Australian and state governments, establishment of positions in hospital and health services, recruitment and appointment processes and onboarding and training for new staff.

The Birdie's Tree team has been able to deliver services most effectively where there is more continuity and less disruption to staffing and relationships. A choice was made by Queensland Centre for Perinatal and Infant Mental Health to fund its team to deliver services in flood-affected areas over the gap between the end of the eastern Queensland bushfires response and the commencement of the flooding response. One council in an affected area similarly chose to fund a community development officer across this time gap. As this individual had filled the same role in a different area, their working relationship with the Birdie's Tree team had already been built over 3 years. The community development officer and the Birdie's Tree team worked powerfully together to support children and families recovering from bushfires and floods in the context of a pandemic, without the discontinuity that would otherwise have resulted from the gap in funded programs.

The challenges posed by the 2-year limit of Category C funding have been much discussed in various forums. Positions in disaster recovery teams and other roles such as community resilience and recovery officers must be established as temporary under the funded program. For Queensland Health employees, this means the successful applicant is either recruited to a temporary

position in a team or seconded from their substantive position to fill the role. Temporary employees are motivated to seek a permanent position elsewhere and therefore leave the disaster recovery role and seconded employees are often recalled to their substantive position due to operational demand. Over the past 3 activations, it has been the exception rather than the rule for clinicians to remain in the role for the entire 2-year duration. The Rainfall and Flooding activation approached its halfway mark during mid-2023 and has experienced considerable staff turnover in disaster recovery teams and community recovery and resilience officers.

Factors that help mitigate the risks associated with discontinuity of funding and staff turnover come back to the main theme of 'sharing the driving' and the policy and practice principles outlined here. These include the use of a standardised suite of programs and training delivered by disaster recovery team clinicians, networks of relationships among local and external service providers and partnerships actively nurtured at multiple levels of partner organisations. It bears repeating that the continuity of service provision that builds community resilience arises from a mindset that views preparedness, response and recovery as a cycle rather than steps in a linear and time-limited process.

A final note

It is clear from traditional environmental practices and oral histories that Aboriginal and Torres Strait Islander peoples have long understood the cycles of storms, cyclones, floods, droughts, heatwaves and fire. They also understand their place in the environment as integral rather than separate and their actions on Country as 'doing with' rather than either 'doing to' or 'being done to'. Accepting, anticipating and preparing for weather events is one of many lessons that contemporary emergency management is learning. In practice, for mental health responses, this approach suggests funding and workforce arrangements should move away from the current discontinuous responses to specific events, towards ongoing resilience building in communities.

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Sleep trial seeks participants suffering bushfire trauma

Bethany Patch

Natural Hazards Research Australia

A cognitive-behavioural clinical trial is seeking participants for a sleep disturbances treatment for people affected by a bushfire.

The trial, supported by Natural Hazards Research Australia and Federation University Australia, is aimed at anyone experiencing sleep disturbances – such as insomnia, nightmares or trauma symptoms – as a result of living through bushfire. It is an online, self-paced, sleep-specific intervention called Sleep Best-i. Participants can be community members or emergency responders and the experience of a bushfire does not need to be recent; it could be several years or even decades ago.

The trial is part of a Natural Hazards Research Australia 'Online cognitive-behavioural intervention for treatment of insomnia and nightmares in bushfire survivors' research project being conducted by clinical psychologist Fadia Isaac, Professor Gerard Kennedy and other researchers at Federation University. The study is funded through Natural Hazards Research Australia's Postgraduate Research Scholarship program.

Fadia recently won a Collaborative Research Australia Early Career Researcher Competition for this innovative study and said that early signs are promising, but more participants are required.

'Many people who are suffering post-bushfire trauma have to overcome significant barriers to receiving treatment, especially those who live remotely or feel stigma when seeking face-to-face treatment.

'This self-paced intervention is done at home, giving people self-governance and greater privacy when seeking help for their sleep disturbances,' said Fadia.

The trial takes either 4 or 8 weeks to complete, depending if the participant is assigned to the intervention or control group based on their initial assessment. Participants are asked about their experience with bushfires and asked to rate their sleep and trauma symptoms. Once eligibility for the trial is established, participants complete short assessments and provide feedback through online modules. The trial is conducted within the participant's home and at their own pace using sleep-specific technology such as Fitbits to track sleep.

'Taking part is easy and does not involve being hooked up to sleep devices. Participants can commence at any time.

'Each week participants watch a module focused on a different aspect of sleep disturbance, for example nightmares, and receive tips for the week to help tackle that particular sleep disturbance. For nightmares, this could be rewriting the nightmare in a benign way, such as changing the ending to something pleasant and rehearsing the new dream during waking hours.

'This is a proven technique and the brain is more likely to remember that benign dream than the nightmare, so this is how they can shift that nightmare from being such a bad experience,' Fadia explained.

By taking part in this trial, participants can improve their knowledge of sleep difficulties and how they develop as well as reduce mental health risks. Participants who complete the trial and provide data receive a $100 shopping voucher.

Based on the success of the trial, the intervention will be implemented widely in Phase 2 of the project. The intervention could also be developed as an evidence-based, free resource.

Recruitment is open until the end of 2023 or until participant spaces are filled.

For more information, visit: www.sleepwell1copy.healthzone.org.au or contact Professor Gerard Kennedy at Federation University: g.kennedy@federation.edu.au.

Having a seat at the table: disability and disasters

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People with disability are at increased risk during fire and other emergencies. Knowledge is critical at these times and people who do not understand fire safety and prevention can be hampered in their ability to plan for or react to emergencies. Drawing on the lived experiences of people with disability in such circumstances can change how emergency service organisations prepare and respond.

Background

People with disabilities are over-represented in fire statistics [1, 2, 3, 4, 5] and have accounted for 47% of fire fatalities in Australia between 2003 and 2017.[6] This study also highlighted a significant representation of fire fatalities with no clear declining trend in regional and remote areas. These were in locations where there are imbalances with factors involving income, ability, gender, cultural diversity and age.[7] These fire fatalities have significant social, economic and emotional effects on people, communities, firefighters and other emergency responders involved.

Problem

People with disability face heightened risks, not because of their disability but due to the lack of accessible information, support and services. A key aspect to prevention is effective communication to identify audiences and this is particularly important for people with disability as they can have very different needs for assistance. Disaster-related information can be one-way, passive distribution, frequent and changing and may be inaccessible for some people.[7] People with disability have different needs, expectations and access to information.[8] In the absence of fire messages tailored to different groups with access needs and practices, people with disability frequently rely on their support networks (family members, friends, carers, support workers and neighbours) to assist them with hearing, reading, understanding, believing, personalising, deciding and responding.[8]

In Australia, the traditional emergency management approach to planning and communication has been historically top-down and exclusionary. As such, people with disability have had decisions made for them and not by them. This results in people with disability being unseen, unheard and unaccounted for during planning.

The lack of proper mechanisms for inclusion of people with disability in emergency management planning as well as the lack of training for emergency responders on how to approach and assist people has resulted in a disconnection and mismatch of knowledge and understanding from both sides.[9] Australia has endorsed the *Sendai Framework for Disaster Risk Reduction 2015-2030* and Preamble 7 (p.10)[10] calls for a people-centred prevention approach to disaster risk. This requires stronger engagement with stakeholders, including people with disability. Meeting the varied needs of people with disability has prompted fire services organisations to reflect on whether their delivery of fire safety and prevention activities is inclusive, accessible and understood.

Solution

To redress this, Fire and Rescue NSW (FRNSW) acknowledged the challenges in meeting the needs of people with disability in emergencies and committed to meeting the Sendai Framework, Section V. Role of stakeholders. This highlights the shared responsibility between governments and stakeholders through working with communities and organisations to co-design participation in emergency and disaster management (p.23).[10] As a first step, FRNSW worked with the Australian Federation of Disability Organisations to develop and fund a staff Disability Awareness training

pilot. This formed part of the FRNSW Station Leadership and Development Program for Captains, Deputy Captains and future Captains throughout New South Wales in 2022. This initiative was led for and by people with disability as the experts with lived experiences. The Disability Awareness training challenged the biases that people may have about people with disability. It also included situations where firefighters need to assist a person with disability and how they might approach them, what appropriate language to use and how to treat them. This training gave insight into what people with disability need emergency services personnel to know about them and, in an emergency context, that they are not vulnerable because of the disability but because of the environmental and structural barriers that increase their exposure to risks. This includes the lack of accessible emergency and fire safety information.

Topics in the training include people with disability sharing their experiences about misconceptions faced, perceptions of firefighters and how they would like to be supported in emergencies. The training teaches leaders, future station leaders and their teams to understand disability through the social and human rights model instead of the medical or charity model.

Future

This collaboration has expanded and strengthened high-level relationships with peak organisations to address the knowledge gaps and identify better practices for working with people with disability and their needs. Lessons from this pilot are being applied to a larger, statewide project initiative: Fire Proofing Vulnerable Communities[11], led by the Australian Federation of Disability Organisations and funded under the Disaster Risk Reduction Fund, which is jointly funded by the Australian and New South Wales governments. This is a partnership project involving FRNSW, NSW Rural Fire Service and The University of Sydney, with the objective of co-developing resources co-designed by people with disability. The aim is to increase the capabilities of firefighters to interact and provide tailored fire safety information and messages suitable for disability groups and their access needs and practices in 14 metropolitan and regional areas across New South Wales. This will help people with disability be better represented in prevention and preparedness for bushfires and structure fires as well as reduce their risks of fire injuries and fatalities.

This project runs until June 2024 with an expected outcome that people with lived experiences of disability will lead, voice and participate in fire safety considerations that will increase their safety. Fire service organisations also benefit by being inclusionary as their planning and response will meet the safety needs of their communities.

A video of the pilot training is at www.vimeo.com/837434933/a2f98e028a.

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Building resilience to climate change: the role of volunteers

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In the face intensifying extreme weather events and changing climate, it is more urgent than ever to make sure emergency management sectors are equipped and effective. Addressing the key issues facing the volunteer workforce will be essential to strengthen the resilience to climate change.

In Australia, the Royal Commission into National Disaster Arrangements (2020)[1] found that 'supporting and sustaining an effective volunteer workforce is vital' to provide future capabilities of fire and emergency services to respond to natural hazards. Volunteers make up the majority of the fire and emergency services workforce in Australia. Over one million volunteers support Australia's crisis resilience and, of those, more than 400,000 work directly in emergency response and relief.[2]

According to the 2020 Report on Government Services, volunteers make up 90% of the firefighting and emergency services workforce across Australia.[3] Volunteers are the core responders for rural areas and provide the surge capacity needed to respond to large or concurrent events. The need for volunteers will only grow as Australia faces increasing extreme whether events in a changing climate.

Climate change and emergency management

Building resilience to climate change risks and effects remains an urgent and significant challenge for the emergency management sector.[4] AFAC, the National Council for fire and emergency services in Australia and New Zealand, released a revised discussion paper and national position on climate change for the sector.[5] Many of the climate risks and consequences for the fire and emergency service that were identified put additional demand and pressure on the volunteer (and paid) fire emergency services workforce. These included:

- changes in the frequency, severity and complexity of extreme weather and cascading events

- increasing pressure on resourcing, responders and capabilities due to the increased frequency and intensity of incidents
- increasing health and safety risks for staff and volunteers, including dealing with new technologies, as well as fatigue and mental health issues.

According to Department of Fire and Emergency Services:[6]

> *It is certain climate change will alter the frequency, intensity, spatial duration and timing of extreme weather and climate extremes, with impacts certainly worsened with an increase in compound events that will exacerbate effects of natural hazards.* (p.2)

As extreme events increase, so will the demands on full-time and volunteer emergency service workers and agencies. There will be requirements for larger numbers of staff and volunteers to be involved in emergency response activities for prolonged periods, at increased frequencies, and responding to more extreme events. This will result in greater strains on emergency management organisations, volunteers and communities.

Volunteer workforce supply issues

Despite increasing demand for emergency service volunteers, they are becoming increasingly difficult to attract and retain. Volunteering rates in Australia have been steadily declining over the past 15 years, and the problem was further exacerbated by the COVID-19 pandemic and the restrictions and

lockdowns that followed. The percentage of people in Australia who volunteered for an organisation or group in 2020 (25%) was lower than in 2019 (30%) and also the lowest rate ever recorded by the Australian Bureau of Statistics.[7] The number of volunteers in emergency services organisations has also steadily decreased since 2015–16[2] and volunteer emergency services organisations face the additional struggles of high turnover rates and an ageing volunteer workforce.

Need for evidence-based solutions

Australia's future capacity to respond to and recover from intensifying natural hazards, emergencies and a changing climate is at risk. Evidence-based solutions are urgently needed to reverse the declining volunteer workforce and ensure that emergency management sectors are adequately equipped to face the risks and effects of climate change. Such solutions required a clear understanding of the reasons underlying volunteer turnover. A Volunteering Australia research report summarised what is currently known about turnover in volunteer organisations and what factors are most important for retaining volunteer workers.[8] Some examples of evidence-based actions to reverse the decline in volunteering include:

- Enhancing support from paid staff and supervisors – allocate resources to train and develop leaders, whether they are paid staff or volunteers. The training should specifically target interpersonal skills, emphasising effective support and communication with volunteers. This focus will help build strong, supportive relationships with the volunteers, ultimately enhancing the overall quality of their volunteer experiences within the emergency services.
- Enabling greater autonomy – where possible, emergency services organisations should empower volunteers and give them freedom to make decisions, have choices, provide input and to have some level of control in how they carry out their tasks and activities.
- Helping volunteers contribute – design volunteering tasks to be stimulating and clearly related to the organisation's purpose. This may involve reducing the amount of time volunteers 'sit around' waiting to contribute.
- Addressing burnout – regularly check in with volunteers to check they have sufficient social, cognitive and physical resources to cope with the demands of their work. Increase mental health and wellbeing support for volunteers.

Strategies that address volunteer workforce planning and volunteer management practices will be vital to ensure the future sustainability of Australia's fire and emergency management organisations. To address the decline in volunteering and ensure the future sustainability of the emergency management sector, it is crucial to implement effective workforce planning and improve the quality of the volunteering experience through effective volunteer management practices.

Volunteers are the backbone of our fire and emergency services workforces. Volunteers are the cornerstone of sustainable and resilient communities that can absorb, recover from, and adapt to hazards and environmental emergencies resulting from a changing climate. Supporting and sustaining emergency volunteer workforces has never been more urgent, nor important.

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Development of the Western Australian Emergency Management Climate Change Adaptation Plan

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The Western Australia State Emergency Management Committee (SEMC) found, during the development of the State Emergency Management Sector Climate Change Adaptation Plan, that a pathway to climate resilience in the emergency management sector is to increase sectoral and community preparedness through adaptation.

It is internationally acknowledged that the effects of climate change include increased intensity, frequency and duration of extreme weather events including heatwaves, droughts, floods, storms and bushfires. The effects vary in character and scale across regions and types of events.[1, 2]

The Intergovernmental Panel on Climate Change (IPCC) published comments on the effects of climate change with stark projections regarding the future that these changes will bring.[1, 2] The IPCC has high confidence that, in Australia, the increased risks associated with climate change will partly manifest as:

- losses of natural and human systems in low-lying coastal areas from rising sea levels
- disruptions to, and declines in, agricultural production in southwestern, southern and eastern rural communities of Australia due to hotter and drier conditions
- increases in heat-related mortality and morbidity of people and wildlife due to heatwaves
- cascading and compounding consequences for cities, settlements, infrastructure, supply chains and services from bushfires, floods, droughts, heatwaves, storms and rising sea levels.

Importantly, the IPCC also indicated that Australia's increased risks associated with climate change will manifest, in part, due to an inability of institutions and government systems to manage climate risks.

National bodies that have undertaken research[3] on the effects of climate change support international publications[1, 2] and provide detail for an Australian context. Of note is the increased risk of disasters resulting from extreme weather events and instances where multiple extreme events occur simultaneously or sequentially, resulting in negative compounding effects.

The Australian Government *National Climate Resilience and Adaptation Strategy*[4] outlines the implications of climate change and the government's plans to develop resilience within communities and the public and private sectors. The *Western Australia Climate Policy*[5] is supported by the *Western Australian Climate Adaptation Strategy*[6] and sets out the state's plan for climate-resilient communities and a prosperous low-carbon future. The government has also published its investigation into the effects of climate change on human health and has identified a path forward.[7]

There are some examples where organisations have strategies for the emergency management sector to adapt to climate change.[8, 9, 10, 11] The strategies propose modification to the traditional framework of prevention, preparedness, response and recovery (PPRR). That is, that additional emphasis be placed on preparedness and prevention to focus on building resilience and prosperity.

The compounding effects of climate change are being seen across natural, social and economic systems. The complexity of the connection between these systems creates risks previously not contended with, which is amplifying existing systemic pressures and constraining adaptation options.

Why is the SEMC involved?

In Australia, there are legislative controls, plans and agencies that provide emergency management guidance and support. However, under current national arrangements, state and territory governments have primary responsibility for emergency management within their jurisdiction.

In Western Australia, there is a suite of legislation and plans pertaining to emergency management, including the *Emergency Management Act 2005*.[12] The Act establishes the SEMC to, in part, provide advice to the Minister for Emergency Services on emergency management and the preparedness of the state to combat emergencies. The provision of advice extends to public authorities, industry, commerce and communities to plan and prepare for an efficient emergency management capability.

It is broadly accepted that we are in a climate emergency. As such, it is appropriate that the SEMC is leading the development and delivery of the Western Australian Emergency Management Sector Climate Change Adaptation Plan. The intent of the plan is to provide advice, direction and support to the emergency management sector on the mechanisms of adaptation to climate change.

The approach

The development and implementation of the plan is being undertaken to guide the emergency management sector when planning climate change adaptation activities for their agencies. This includes the consideration of systemic risk reduction. The work contributes to improving resilience and aims to reduce risks of climate change. It does this by providing guidance to the emergency management sector related to preparation and adaptation to climate change. It will also assist local governments to identify and undertake preparatory work required to reduce community risk exposure.

Mechanisms for resilience are necessary to achieve long-term outcomes. The emergency management sector is acutely aware that the traditional PPRR framework struggles to remain effective in the contemporary environment. To provide the emergency management sector with good guidance and a pathway for implementation, the SEMC established the Climate Change Subcommittee in October 2022 to provide leadership, advice and oversight.

To develop the Western Australia Emergency Management Sector Climate Change Adaptation Plan, a program of robust governance was established to clarify the scope and direction that support the development and delivery of the plan's objectives and the responsibilities of those contributing. This has been essential to the progress of the work. The Climate Change Adaptation Program was established in November 2022 and Figure 1 illustrates the process undertaken to date, and the activities planned to progress the development of the plan.

The program's delivery is based on continuous improvement and draws on a culture of learning. That is, applying the principles of governance, methodology, consultation and engagement and the consideration of capability. Parallels can be drawn between this model and some of the themes being considered for inclusion in the Western Australia Emergency Management Sector Climate Change Adaptation Plan, specifically governance, capability, capacity and communities.

A program management plan was developed in February 2023 in consultation with the Climate Change Subcommittee to outline the governance and scope of the plan. Initial investigative work was undertaken to understand the progress made at state, territory and national levels that the emergency management
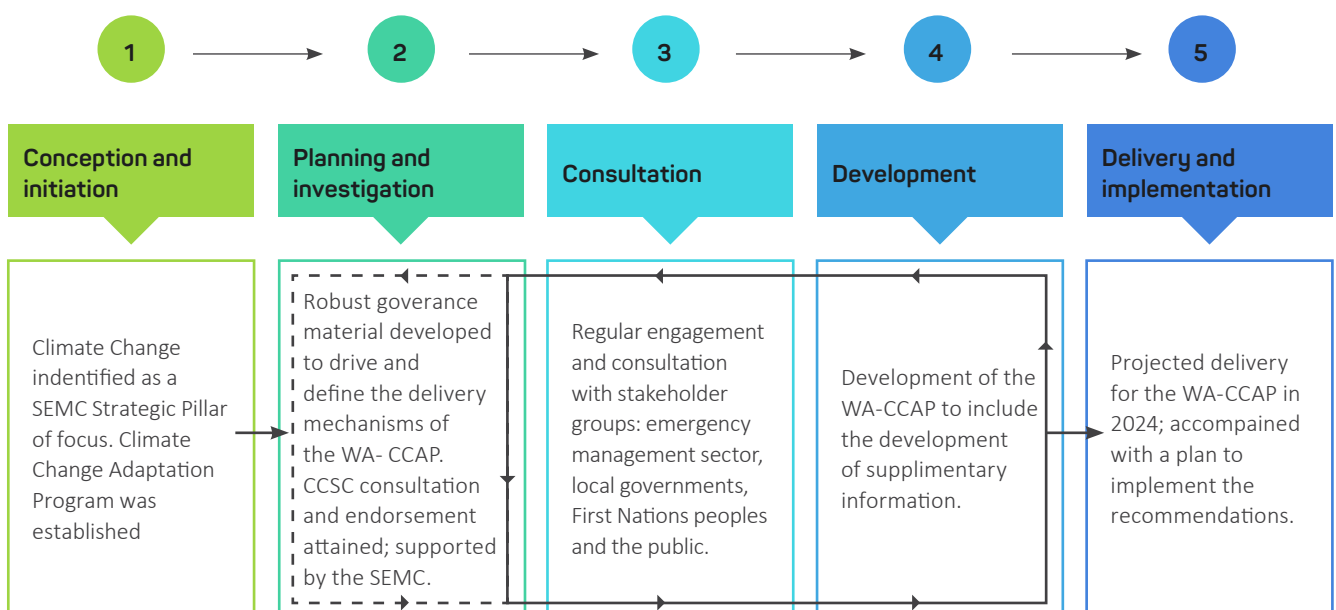

Figure 1: The WA-CCAP development process.

sector has made towards climate change adaptation. Work was also undertaken to identify the methods used to address any challenges reported when undertaking adaptation activities.

As the investigative aspects of the work progressed, other projects were identified to support the plan. One example was the development of a Climate Change Adaptation Actions Tracking Platform for the emergency management sector in Western Australia. This work is in its early design phase and was born from the need to understand what work was being undertaken to assist cross-sector engagement and to link agencies undertaking similar projects to identify collaboration opportunities. It is anticipated that the platform will assist agencies with reporting requirements regarding their progress in adaptations to climate change.

Lessons

During initial consultations with the emergency management sector, it was identified that there was a good understanding of the scope of the work and that clear and internationally accepted definitions about climate change and climate change adaptation (versus climate change mitigation) should be included. The plan will also include definitions that are generally accepted by the state as those published in the IPCC.[1]

The program found, particularly with a large and multidisciplinary sector, that scope creep is inevitable. Constant review of the scope and rearticulation to stakeholders has been important, particularly to ensure the intent of the plan is maintained, remains serviceable and is relevant to the emergency management sector.

Next steps

A directions paper is being drafted and consultation with the emergency management sector, communities, local governments and communities of Aboriginal and Torres Strait Islander peoples is planned for late in 2023. The consultation is being undertaken in line with the program management plan and at the direction of the Climate Change Subcommittee. When consultation is complete, a final directions paper will inform the ongoing development of the plan that is expected to be finalised in 2024.

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Social connection and resilience

Dominic Hilbrink

Fortem Australia

Social connection is the key to a happy life. People who have strong and authentic relationships with a range of people around them are happier, more fulfilled and tend to live longer with fewer health problems. But how do we know this?

The longest running study on life satisfaction tells us so. In 1938, researchers at Harvard University began a study that has continued to this day. The study's main goal was to find out what conditions make people happy. They followed several hundred participants from different backgrounds through each stage of their lives. They tracked a range of life circumstances, including relationships, employment, financial status and asked participants to report how satisfied they were in their lives.

What the researchers found was clear. Whether you grew up in poverty or came from a privileged background, the key to a happy, healthy and fulfilling life is connection to others.[1]

We are wired for social connection

The findings of the study make perfect sense when you think about how we evolved. Our brains, bodies and emotions were shaped over many thousands of years living in small tribal groups in hostile environments. For our ancient ancestors, social isolation from the tribe meant almost certain death from hunger or the threat of predators. Our survival depended on forming long-lasting social bonds.

Research shows how people with low social support are less tolerant to stress. When people feel that no one has their back, they are much more vigilant, with a higher resting heart rate and higher concentrations of stress hormones.[2, 3] Furthermore, threats to social connection, such as rejection and isolation, can activate many of the same neurobiological systems associated with physical threats and fear, demonstrating how social connection is deeply tied to our sense of safety.[4]

If having good social connections is tied to greater emotional and physical wellbeing, it's not surprising that social relationships are also important when it comes to resilience, because they help to reduce stress and suffering in a number of ways.

Social connection and first responder resilience

There's extensive evidence of the relationship between social support, mental health and resilience among first responders.[5] The Beyond Blue national survey of the mental health and wellbeing of first responders in Australia found that social support had the strongest relationship to resilience. While the researchers found that resilience could be eroded by operational trauma, they concluded that the negative effects of trauma could be mitigated by positive social factors.[6]

In other studies, researchers found that a sense of belonging among first responders was associated with lower distress and protected them against developing post traumatic stress disorder after trauma.[7, 8, 9]

Answering the call national survey
Beyond Blue's National Mental Health and Wellbeing Study of Police and Emergency Services – Final report

Good social connections are tied to greater emotional and physical wellbeing, Social relationships are also important when it comes to resilience, because they help to reduce stress and suffering and increase our ability to bounce back from challenges.

Image: ckstockphoto

How social connection increases resilience

Resilience is a complex thing, but researchers generally agree that it involves our capacity to cope when things get tough and bounce back from challenges in an adaptive way. It is our ability to bend and not break under stress. But most definitions of resilience focus on the individual and fail to acknowledge how individuals are embedded in social networks. These networks can be more or less resilient in their own right, but also support the individual's ability to adapt to challenges.

Physiological responses to stress

The effects of social connection are reflected in how our bodies respond to stress. Whenever we perceive a threat, which can be anything from physical danger to social embarrassment to financial trouble, our nervous system springs into action, setting off a cascade of bodily reactions. These fight-or-flight reactions, although designed to help us respond to danger, are often uncomfortable and part of what we experience as stress. Furthermore, regular exposure to stressors, which is common for first responders, can lead to overactivation of the fight-or-flight response and imbalances in the stress system. These can undermine resilience and cause chronic physical and mental health problems like weakened immunity, digestive complaints, burnout or mood and anxiety disorders.

Social connection helps to tamp down the stress response. When we feel that we have social support, we are physiologically much more at ease. The presence of supportive others during stressful events (sometimes even just in our minds or over a radio), along with specific things like eye contact and warm touch, activates the release of oxytocin, a hormone that evokes a physically felt sense of reassurance and contentment and is a direct antidote to the stress hormone cortisol.[10] So, our social connections help us to recover from stress more quickly and effectively while also providing some protection against the wear and tear on our minds and bodies that comes from regular exposure to stressful events.[11]

Social networks as a 'container'

Social connection acts like a container for stress during challenging times. With good social support, we perceive challenging events as less threatening. Strong communities naturally lean on each other in times of need. This was demonstrated in the New South Wales Bega Valley community's response to the summer bushfires in 2019–20, which saw 4 lives lost and 467 homes destroyed across the shire. The strength of the community was summed up in a poem by a student at Tathra Public School who said that 'through all the horror and fright, the community had pulled together tight'.[12]

Social safety nets are exemplified for first responders in the all-important 'backup'; being able to rely on your colleagues

to be there for you in a crisis is crucial. But equally important for resilience is the mateship and comradery in first responder teams. Beyond Blue researchers found that team cohesion was one of the most important workplace characteristics linked to resilience in first responders.[13]

Our social container reduces feelings of vulnerability and powerlessness. Though it may seem counterintuitive, having strong social support can actually improve our ability to cope with problems on our own, by increasing our self-esteem and sense of control and mastery. Furthermore, a reliable social network isn't just useful in emergency situations. Strong relationships with friends and family can also bolster our mood, improve flexibility and motivate us to adopt healthy rather than risky coping behaviours.[14]

Social connection is linked to purpose

If something feels futile or pointless, it is much more likely to wear us down. But if we have a clear mission based on shared values, the sense of purpose this creates changes how we think about challenges. Purpose makes things that are onerous a little more bearable. The mundane job of protecting a crime scene, the gruelling job of keeping a patient stable during a rescue operation, the relentlessly exhausting marathon of a bushfire or flood—our experience of these things can be improved when we have a sense that they matter.

Social connection increases our sense of purpose.[15, 16] Many first responders are driven by a sense of duty and service to the community and studies have shown how helping others has benefits for the giver as well as the receiver.[17]

Collective resilience and social preparedness for disasters

In recent years, there has been a growing focus on how the psychological preparedness of emergency responders increases their resilience. However, with the scale of recent disasters and their community effects, the importance of social preparedness is now being recognised. This becomes apparent during emergencies and disasters when people who are part of well-prepared communities or organisations tend to do better than those who are not connected to any community support.[18] Social preparedness involves fostering a sense of collective responsibility and building strong social networks that can support response and recovery efforts.

There are limits to individual resilience. Collective resilience accounts for the natural differences in capacity, where members of the community shoulder each other, support those who are struggling and reach in when one member is knocked down. This is more effective and reliable than expecting the individual to be able to resist falling or getting up on their own.

By focusing on social preparedness, whole communities can enhance their resilience and ability to recover from disasters by leveraging the strengths of their social connections, support systems and collective resources.[19]

Why focus on promoting social connection?

Resilience programs tend to focus on individual skills and capacities. But how resilient we are may have more to do with our networks of connection and support than it does with our personal strengths. Social connection could have the greatest potential to reduce risk to individuals and families, especially in the face of collective trauma.[20] To protect and enhance resilience in the first responder community, we want to go beyond focusing on personal strengths and overcoming challenges to creating opportunities to strengthen the important container of social networks.

It is possible to develop programs that harness the natural building blocks of resilience that evolved when we lived in small tribal groups. Programs are not just inclusive of families, but family-focused. Such programs shouldn't differentiate between 'work' and 'home' stress. They should improve the wellbeing and resilience of every member in the family as well as the unit as a whole. Resilience programs can foster a whole-of-community approach to first responder wellbeing and engage not just first responder families but the communities in which they are embedded through events like Thank a First Responder Day. This promotes resilience and social preparedness by strengthening relationships and networks that assist in recovery from large-scale challenges.

There are also wellbeing activities that target the modifiable determinants of wellbeing. These are controllable things that we can build into our lifestyle that are proven to increase wellbeing and social connection is the biggest.[21] In this sense, having fun and enjoying quality time with others is just as valuable to wellbeing as exercise and learning to meditate. The key is getting the right dose that counterbalances the stress inherent in first responder work.

The model of care that Fortem Australia uses differs from traditional mental health services as it emphasises supporting participants to make early and accessible investments in their wellbeing. It focuses on building resilience and facilitating early intervention rather than solely responding to ill-health. The social connection activities used are proving to be a powerful conduit for early intervention, where 17% of those who accessed the psychology support first connected with Fortem through a wellbeing activity. That's 17% who may not have otherwise accessed needed support or waited until their problems became bigger. By providing a simple, non-threatening and achievable experience of looking after mental health and wellbeing, we are also building a trusting relationship with a comprehensive mental health support service so they know where to turn and are more willing to put their hand up when help is needed.

While social connection activities facilitate prevention of mental ill-health through lifestyle factors that enhance resilience, they can also facilitate early intervention when a more targeted level of support is needed, both of which can contribute to sustainability in the first responder workforce.

Like other types of fitness, resilience is something we can develop by investing in regular, quality time with family, friends and workmates. These are as important to mental health as getting the right balance of nutrition is for physical health.

Conclusion

Social connection means having people around you that you feel are part of your life and you feel part of theirs. It involves a sense of belonging, of being part of something bigger than you, a sense of 'we-ness' rather than 'me-ness'. It involves having people that you can share your joy with and who you can turn to for support when you're in trouble, whether that's someone to talk to, someone to hold you or someone to give you a helping hand when you need it.

We are not made to survive alone. We are wired for connection and this is crucial for individual and collective wellbeing as the first responder community continues to face emergencies and disasters.

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Ethics, Law and Natural Hazards
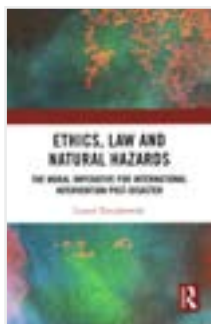
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The preface to this book tells us that 'This book argues that the international community has a moral duty to intervene on behalf of a population affected by a natural hazard when their government is either unable or unwilling to provide basic life-saving assistance'. We are told that the book is 'essential reading for researchers, academics and policymakers working in the areas of international law, humanitarian studies, human rights, international relations and political science'. By 'intervene' or 'intervention' the author anticipates the forcible delivery of post-disaster assistance – by armed forces and in the absence of consent from the government of the affected country.

That may tell readers all they need to know. This book presents an argument. It is the author's assessment of what international law should be, not a detailed analysis of what it is. The issue of whether the international community can force an affected state to receive international disaster assistance has been a matter of debate for many years. In favour of such intervention is the moral demands of the affected community, the need to preserve human rights and the moral equivalence to other areas of humanitarian intervention during armed conflict or genocide. Contrary to those arguments are the international norms, reflected in the Charter of the United Nations, prohibiting the use of force and intervention in the domestic affairs of other states.

In this short book (only 130 pages), Traczykowski gives a brief overview of those arguments and concludes that there is a moral duty to intervene that should, in turn, be reflected in an international legal norm. The problem with that conclusion is that the issue has been tested and soundly rejected by the international community.[1] Other reviews of international law have all accepted that state sovereignty is the dominant paradigm, and that assistance cannot and should not be provided without the consent of the affected state.[2] This is a reality that Traczykowski acknowledges when she discusses how previous attempts to create international law to authorise intervention 'have failed' in the face of the 'international community's adamant position that disaster assistance should be the primary responsibility of the national government affected' (p.110). Nonetheless, she argues that the international community should take steps to develop a norm of post-disaster intervention in cases of domestic neglect or failure.

We are told that 'we' should foresee the potential for disasters to threaten basic human rights and the international community should 'at least [be] prepared to respond' (p.112).

The example that scholars in this area use is the impact of Cyclone Nargis on Myanmar in 2008. At the time, the military junta ruling Myanmar (formerly Burma) refused offers of international assistance. There was, at the time, significant public demand that the countries of the world act to force humanitarian assistance into Burma.[3] Traczykowski also relies on this example to demonstrate the need for the international intervention norm. The reality is that Myanmar did accept international assistance (albeit late) after working with its ASEAN partners.

Readers of the *Australian Journal of Emergency Management* will be familiar with the prevent, prepare, respond and recover paradigm. Traczykowski is arguing for a 'response' option but preventing the need for military intervention would be better. To that end, the book is remiss in that it does not discuss how international intervention does work or the various steps that are in place to facilitate intervention. At the very least, the author should have given more attention to the *Sendai Framework for Disaster Risk Reduction 2015-2030* as a prime example of international cooperation in prevention as well as the International Law Commission's review of international law and recommendations for development in the *Draft articles on the protection of persons in the event of disasters*.[4]

There are other examples of international cooperation to facilitate disaster response including arrangements within the European Union, the Americas, ASEAN and the Asia-Pacific. Organisations like the International Search and Rescue Advisory Group have developed guidelines to facilitate international cooperation in urban search and rescue that have proved effective in the recent Türkiye earthquakes. That Syria may have been remiss in its response to the same event will be a matter for future analysis and may become the next cause celebre for the interventionists push. Until then, evidence of international cooperation and effective international disaster relief by both the government and the non-government sectors suggest that the need for intervention is better met by political engagement and the development of relationships between countries and response

agencies. Preparation in the form of anticipating the need for and working to provide international assistance will go a long way to preventing the horror scenario of delivering aid at gunpoint.

Even if Traczykowski's proposal gains traction, it will be many years before any norm of intervention is adopted given the international community's commitment to sovereignty. I would be bold enough to suggest that Traczykowski's proposals are unlikely to see the light of day. What she hopes for is for 'one country … to initiate such norm development and petition for it an international level'. This is what happened when Canada sponsored The International Commission on Intervention and State Sovereignty that wrote the report on the Responsibility to Protect (R2P)[5] that was adopted by the Unites Nations General Assembly. Although the initial R2P report recommended that intervention may be justified in the face of '… overwhelming natural or environmental catastrophes', this trigger was rejected by the United Nations. In light of that, I can see no appetite for the international community to return to the issue in the near future.

This book reads like a doctoral thesis. It sets out the author's arguments and demonstrates her engagement with the relevant literature. It is not a study of the law as it is, nor a study of how international disaster assistance is delivered. It may be of interest to diplomats and policy officials in Department of Foreign Affairs and Trade or those fascinated by international law, but it has little to offer those charged with managing the next response to the next disaster. And for those scanning the horizon for future trends, the possibility of using armed forces willing to both kill and be killed in order to deliver relief to disaster affected communities is well off the radar.

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Designing the Compassionate City
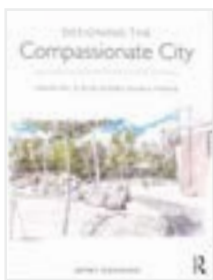
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Adelaide University

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Designing the Compassionate City by Jenny Donovan, advocates a way of undertaking urban design and redevelopment that recognises the significance of a social, holistic and collaborative approach, with the user of public space placed at the centre. In the words of the author, the book 'considers differences urban design can make to people's lives and seeks to identify the types of interventions that best facilitate people to meet their needs'.

The book is well referenced and, in the holistic and collaborative tone taken, the subject matters referenced are broad ranging including design, health, psychology, philosophy and law.

The book is divided into three main sections:

· the relationship between people and place and what it means to live together

· international case study projects that that enhance the relationship between people and place

· case study reflections, lessons learnt, barriers and potential solutions.

The author takes a life-course approach, considering the needs of young children, families and older people. The overt and visible elements of cities, for example the design and construction of infrastructure and accessibility are explored, but also the less tangible and visible emotional and emotive elements, such as experience, trust and historical and societal influences that shape communities.

The author writes as much from a philosophical standpoint as a practical one where hope, happiness, connections and choice are equally as important as design, planning and building regulations. However, the tone is in no way naïve. Barriers to inclusive and compassionate design are clearly outlined, such as resource constraints, competing interests, perception and an emphasis on risk and regulation.

The author provides design principles and processes that may overcome these issues and presents an optimistic view of what can be achieved, a firm grounding of why it should be aimed for and concludes with the characteristics of a compassionate city.

While written through the lens of 'what this means for urban designers', this book is an enjoyable, informative and valuable read for anyone interested in people and places.

Preparing for the expected: tropical cyclones in South East Queensland

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Abstract

Ask a Queenslander where tropical cyclones occur and the inevitable response will be, North Queensland. While most of the tropical cyclones have made landfall north of Bundaberg, the cascading and concurrent effects are felt much further afield. The major flooding following Tropical Cyclone Yasi in 2011 and Tropical Cyclone Debbie in 2017 are 2 examples where impacts were felt across the state, and the damage to the banana plantation following Tropical Cyclone Larry (2006) was felt nationally. Acknowledging that climate is influencing the intensity and frequency of intense severe weather hazards, understanding how tropical cyclone hazard varies under future climate conditions is critical to risk-based planning in Queensland. With this climate influence, along with increasing population and more vulnerable building design in South East Queensland (relative to northern Queensland), there is an urgent need to assess the wind risk and set in place plans to reduce the effects of a potential tropical cyclone in South East Queensland.

Introduction

Following Tropical Cyclone Debbie in 2017, the Queensland Inspector-General of Emergency Management (2017) recommended that:

...significant effort should be invested to provide disaster decision makers at every level with a shared understanding of risks, the situation and capability, so that they can agree the best decisions for the communities they serve.

Improved understanding of risk is a central pillar of the National Disaster Risk Reduction Framework (Commonwealth of Australia 2018) and the first objective of the Queensland Strategy for Disaster Resilience 2022-2027 (Queensland Government 2022).

This context led to the initiation of the Severe Wind Hazard Assessment for Queensland (the SWHA-Q project) in 2018. Outputs from the project included a public assessment of the current and future tropical cyclone wind hazard for 2 emission scenarios to 2100 (a first for anywhere in Australia), 2 scenario impact assessments for each of 7 coastal locations, the Tropical Cyclone Preparedness Guide and an operational tool to support preparedness decisions for tropical cyclones (the Tropical Cyclone Impact Model).

The SWHA-Q showed that the South East Queensland region presents an increased risk mainly due to the population density and vulnerability compared to other parts of the state. South East Queensland is home to approximately 60% of the state's population that resides in approximately one million homes. These homes are designed to resist wind effects from weakened tropical cyclones but are not designed for the effects of high internal pressurisation (e.g. resulting from a failed door or broken window) that can result in a significant increase in loads and can lead to loss of the roof (Figures 1 and 2).

Due to climate change, cyclone intensity, including the amount of rain, is projected to increase. However, it is likely there will be a decrease in the frequency of cyclones (uncertainty). This means that while there will likely be fewer cyclones affecting Queensland, when they do occur, they will be more severe with the potential to cause more damage and, therefore, implications for emergency management. Climate projections also indicate that cyclones will have the potential to travel further south, increasing the risk to South East Queensland.

The SWHA-SEQ project

A partnership was formed with 6 coastal local government areas along Queensland's coastline (Noosa, Sunshine Coast, Moreton Bay, Brisbane,

Redland and Gold Coast), the Queensland Government (Queensland Fire and Emergency Services; Department of Energy and Public Works; Department of Environment and Science; Department of State Development, Infrastructure, Local Government and Planning and Queensland Reconstruction Authority) and the insurance sector (Insurance Council of Australia, Insurance Australia Group and Suncorp) to investigate the nature of severe wind risk in South East Queensland. Geoscience Australia led a Technical Team from James Cook University Cyclone Testing Station and the University of Queensland to analyse the wind risk, the options to reduce the risk and the associated cost-benefit for 6 housing types.

The SWHA-SEQ was a major advance on the SWHA-Q. In addition to quantitatively assessing wind risk, advances included:

- incorporating thunderstorm wind gusts into the severe wind hazard assessment, with review from insurance industry experts

Wind Region C (Cyclonic)

Includes Cairns, Townsville, Mackay, and Gladstone.
Buildings in this region should be designed to resist a Category 4 cyclone with expected gust winds speeds of approximately 250km/h.

Wind Region B (Intermediate)

Includes City of Gold Coast, Brisbane, Sunshine Coast and the Fraser Coast. Generally borders Wind Region C.

Properties in Wind Region B must therefore be designed to resist weakened tropical cyclones.

Property owners in this area should also inspect and maintain their properties.

Wind Region A (Non-cyclonic)

Areas inland and south of the cyclone wind regions can also experience high winds and large amounts of rain as a cyclone decays and moves inland or further south.
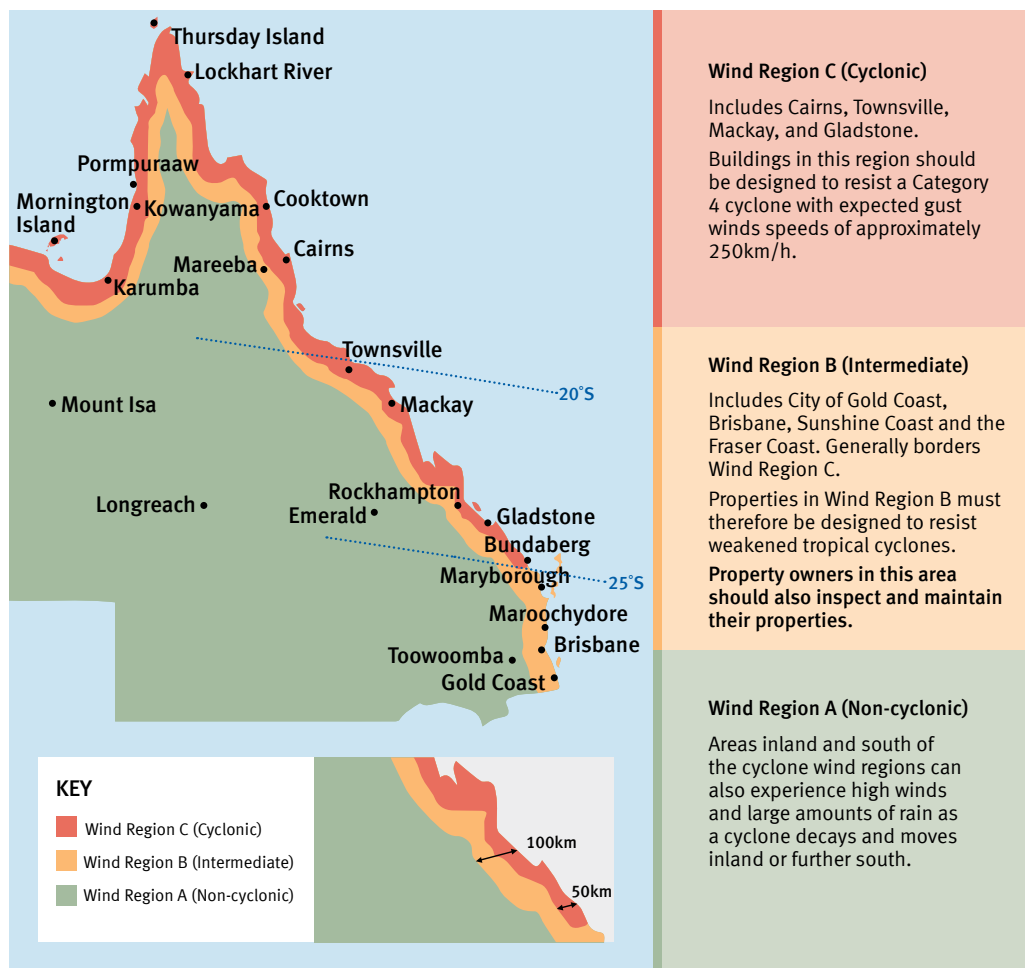
Figure 1: Wind loading regions for residential design standards (AS/NZS 1170.2 2011).

Figure 2: (a) Wind pressures on building and (b) example of damage caused by debris during a Tropical Cyclone Yasi.
Source: James Cook University Cyclone Testing Station

- developing vulnerability assessments for 6 house types
- applying known retrofit strategies to evaluate the level of risk reduction
- critically (with the support of the insurance sector) quantifying the cost-benefit of these approaches.

These advances were possible due to the enduring efforts of the Technical Team through decades of research and cross-sector collaboration to refine the understanding of hazard, exposure, vulnerability and risk. These components are summarised here at a high level with the Technical Report providing a detailed description of how each of these components was developed and integrated to build knowledge and information that can be applied to inform decision-making.

Geoscience Australia has developed open-source products and data to support hazard risk assessments for more than 20 years. Products used within this project included:

- the National Exposure Information System (NEXIS)
- the National Wind Multipliers
- the Tropical Cyclone Risk Model
- the Tropical Cyclone Scenario Selector Tool.

It is critical for local risk assessments that the estimates of wind speed at the ground level take into account the detail of the topography and built environment that is made possible through the National Wind Multipliers.

University of Queensland staff are expert in thunderstorm hazards and have collaborated with Geoscience Australia to develop a severe wind hazard assessment incorporating both thunderstorm and tropical cyclone. In addition, University of Queensland collaborates with the Cyclone Testing Station in capturing observational data to support continual research using Surface Weather Relay and Logging Network (known as SWIRLNet). A grant was awarded through the Queensland Resilience and Risk Reduction Fund to further this important work.

The Cyclone Testing Station, founded following Tropical Cyclone Tracy in 1974, has been instrumental in providing the evidence to advance the wind loading standard in Australia's National Construction Code through post-disaster damage assessments, engineering testing and research. In partnership with Geoscience Australia for more than 15 years, damage models have been developed for typical residential house options to support hazard and risk assessments. For the SWHA-SEQ project, the Technical Team determined a set of generic house types in Queensland's

building stock through street surveys and analysis of the NEXIS database.

The project developed a suite of these models for 3 retrofit options that are available through the Queensland Government's Household Resilience Program. This program has received further funding through Round 1 of the Disaster Ready Fund to continue to enhance resilience to tropical cyclone in North Queensland communities. The SWHA-SEQ project's key question is understanding the cost-benefit of the retrofit options. The reduction in insurance premiums was informed by the insurance sector to enable analysis.

The damage models were coupled with hazard scenarios to develop scenario impact models for both planning and preparedness in collaboration with the Queensland Fire and Emergency Services. For this project, 5 impact scenarios were developed and chosen from Geoscience Australia's Tropical Cyclone Scenario Selector Tool. Scenarios were based on expected maximum winds; comparison to historical events such as Tropical Cyclone Dinah (1967), Tropical Cyclone Hamish (2009) and Tropical Cyclone Oma (2019) and the effect felt across the local government areas in the study.

The project considered the role of community resilience through the use of the Australian Disaster Resilience Index[1] (ADRI) into the quantification of risk. The ADRI was used to effectively moderate the insured risk to highlight those areas that would potentially be greatly affected by tropical cyclone. The project also used the ADRI to prioritise a hypothetical resilience program, that is, to direct valuable budget (from a government and individual level) to those who need it. This relatively new approach has been adopted by Geoscience Australia in other projects (see for example, Edwards *et al.* 2015). At this stage, the cost-benefit analysis was based on direct costs only.

In 2021, during the SWHA-SEQ project, Tropical Cyclone Seroja hit the Western Australia coast in wind region B, with devastating consequences. Wind region B is known as the intermediate region, designing for wind speeds up to 205 km/hr. The coastal regions with latitudes greater than 250 in Western Australia and Queensland are defined to be in wind region B. Around 10% of contemporary houses in Kalbarri in Western Australia were significantly damaged and uninhabitable from Tropical Cyclone Seroja. That cyclone crossed the coast at approximately the same latitude as the east coast city of Coolangatta in Queensland, which reinforced the importance of the SWHA-SEQ project.
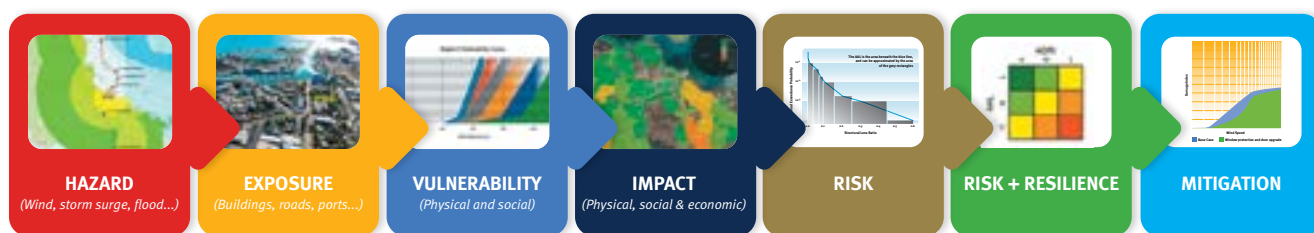
1. Australian Disaster Resilience Index, at https://adri.bnhcrc.com.au/#!/.

Figure 3: Method used for the SWHA-SEQ project.

Observations

This project started the journey to quantify and make publicly accessible the tropical cyclone wind risk. There are known gaps. The analysis doesn't include all stand-alone residential buildings, strata-title or commercial buildings nor is storm surge or flooding considered. The cost-benefit is based on direct costs of rebuild without also including the costs to the community in terms of disruption, dislocation and broader scale community affects. There is a substantial body of work to incorporate these indirect costs to the community and to government in a future analysis. Without these indirect costs included, the analysis shows that retrofit for the majority of residential houses (79%) assessed (in lower-hazard site conditions) is not cost effective. A significant degree of cost sharing is needed to adequately incentivise retrofit action for houses in higher-hazard site conditions. A program similar to the Household Resilience Program[2] in North Queensland could achieve a meaningful reduction in severe wind risk if implemented across the high-hazard sites. With strata-title properties representing an increasing percentage of the building stock, this analysis is under-estimating the cost-benefit of retrofit.

While the risk is driven by tropical cyclones, thunderstorms are a regular occurrence and present a continual risk to residents. The challenge is that while the frequency of tropical cyclones is expected to reduce, the intensity is expected to increase. The issue is exacerbated with the expected growth in populations and the pressures that will place on residential development planning. This may further concentrate current development resulting in an increase in the proportion of strata-title properties and the potential scale of damage from a single event.

Previous cyclones have highlighted that buildings can sustain damage for wind speeds less than what they are designed for. This damage results from the wind and rain. The level of maintenance, poor design and detailing may contribute. This is an additional

2. Household Resilience Program, at www.qld.gov.au/housing/buying-owning-home/financial-help-concessions/household-resilience-program.

layer to the wind loading requirements for the region. It is worth noting that Western Australia has amended these requirements in the wake of Tropical Cyclone Seroja where the affected population is significantly smaller than South East Queensland.

Quantifying wind risk is critical to support future resilience programs and any amendments to the wind loading standard. However, there are immediate, high-priority concerns for local government stemming from the project. Current homes and evacuation centres in South East Queensland may not be suitable places to shelter in a severe tropical cyclone event. The Technical Report provides guidance to assist with the identification of places of last resort that include engineering assessment and consideration of non-conventional forms, such as multi-storey car parks.

The report highlights the need for more research across a range of elements (hazard, exposure and vulnerability) to provide a complete picture on the risk posed by severe wind events and what resilience options there may be to reduce that risk. Key areas include risk to strata-title properties, uncertainty in tropical cyclone wind hazard, projections of thunderstorm hazard and a multi-hazard risk assessment including flooding and storm surge.

Applying the scenarios

Scenarios are stories that convey how a hazardous event is expected to unfold. They are often used to assist decision-making and to help understand the concurrent, compounding and cascading ways that hazardous events could unfold. As such, scenarios can support local risk-based planning including identifying risk treatments, conducting disaster exercises, developing evacuation plans and informing community awareness initiatives.

The project developed 5 impact scenarios to help stakeholders assess local effects and risks within their areas of interest. The scenarios represent wind speeds of Category 2 and 3 cyclones and were chosen based on the expected swath of maximum winds, consideration of historical events and the propensity to

Table 1: Indicative building counts of damage state in the 6 local government areas of the scenario.

| Local government area	Negligible	Slight	Moderate	Extensive	Complete
Noosa	5,500	0	0	0	0
Sunshine Coast	57,900	9,800	1,400	1	0
Moreton Bay	83,600	47,300	15,000	1,900	0
Brisbane	188,100	91,000	39,000	4,300	0
Redland	13,400	6,900	13,000	30,300	365
Gold Coast	28,400	21,000	36,900	99,400	815

affect all local government areas in the study region. While the probability of these events occurring are low, the scenarios are plausible and provide examples of the damage to stand-alone residential buildings that could occur based on detailed scientific modelling and analysis.

The first of the scenarios in the Technical Report was used for one state and 2 local disaster management exercises, being Exercise Averruncus (QFES 15 June 2022), Exercise Miberran (Redland City Local Disaster Management Group 8 November 2022) and Exercise Enigma (Gold Coast Local Disaster Management Group 24 Jan 2023). The scenario was a Category 3 cyclone crossing the coast near Wellington Point near Brisbane with strongest winds experienced across Mulgumpin (Moreton Island) and through the Gold Coast including the hinterland regions (Figure 4). The cyclone continues to dissipate as it progresses into northern New South Wales.

As expected, given the wind field, there is very limited damage sustained in Noosa and only a small fraction of buildings in the Sunshine Coast sustain moderate damage. Southwards, and closer to the track of the cyclone, the effects increase through Moreton Bay, Brisbane and Redland. The Gold Coast sustains extensive damage in this scenario, with nearly 100,000 houses extensively damaged and another near 37,000 sustaining moderate levels of damage. Only a small number of regions in the Gold Coast are rated as 'complete damage' (Figure 5) but these are in the hinterland where local wind speeds are high due to the steep topography. Table 1 summarises the residential building damage for the region.

Exercise Averruncus at Kedron-Wavell Services Club on 15 June 2022

Image: QFES
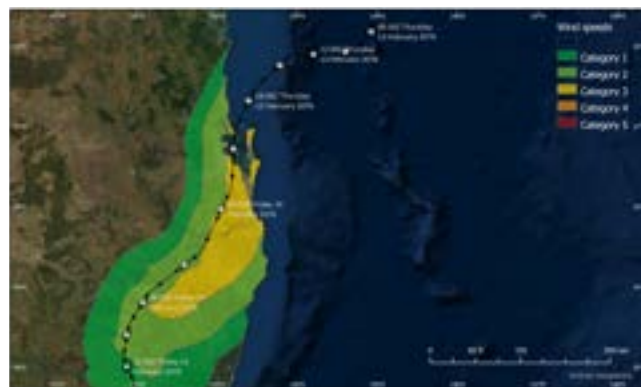
■ Category 1   ■ Category 2   ■ Category 3   ■ Category 4   ■ Category 5

Figure 4: Track and regional wind field of a hypothetical tropical cyclone passing over South East Queensland. This wind field is modified by the effect of topography, land cover and the built environment to evaluate the effects.

Average damage state

■ Negligible   ■ Slight   ■ Moderate   ■ Extensive   ■ Complete

Figure 5: Mean damage state of residential houses, aggregated to meshblock level for the Tropical Cyclone scenario used in Exercise Averruncus (and others). Damage was calculated for residential houses only in the 6 coastal local government areas.

The first state-level exercise exposed participants to a hazard many may have had very little experience with. Exercise participants were reminded that these events are possible at these southern latitudes, which the Cyclone Testing Station damage assessment from Tropical Cyclone Seroja highlighted. While the project had developed residential affect, it was important to include the effects to critical infrastructure operators (power, water, transport, communications) to the exercise. The scenario showed the significance in the scale of impact and signalled a need for a major, long-term recovery effort. The most important information provided to participants was the evacuation modelling conducted by CSIRO/Data 61 that highlighted (with optimistic assumptions) that mass evacuation would not be possible. This points to an urgent need to develop community messaging with serious consideration being given to shelter-in-place information.

This state-level exercise was followed by 2 separate, local disaster management exercises to discuss these issues in detail. The state-level exercise on its own is not sufficient to form the basis of local government planning. This needs the participation of the Local Disaster Management Group and the entities with responsibility for disaster management. The exercises were structured to identify the actions, challenges or capability gaps across 3 phases; (i) preparation (ii) warnings and evacuation and (iii) response, relief and short-term recovery. Both exercises rotated participants around the tables to provide opportunity for networking, cross-fertilisation of ideas and to maintain energy and momentum throughout the day. Both exercises used an online polling platform technology to capture participant feedback.

The outcomes of the exercises form the basis of work plans for tropical cyclone risk for Redland City Council and the City of Gold Coast. Components of these work plans include:

- developing a tropical cyclone subplan
- planning longer-term recovery
- assessing options for evacuation sites
- identifying places of last resort
- developing an engagement and education strategy
- reviewing business continuity plans
- reviewing locations of key assets (such as emergency response vessels)
- assessing harbour safety
- further exercising.

In the case of the City of Gold Coast, a stand-alone project has been initiated—Project AIR (Advocacy, Information and Resilience)—that has been resourced over 5 years to harden places of last resort, embed the engagement strategy and influence better community safety outcomes for the Gold Coast community and visitors. To begin exploring the risk to strata-title buildings, the City of Gold Coast has been successful in the first round of the Commonwealth Disaster Ready Fund with a $400,000 strata study. Project AIR influenced the construction of a new community centre to better plan for the future.

Exercise Miberran, Redland City Local Disaster Management Group, 8 November 2022.

Images: Redland City Council

Exercise Enigma, City of Gold Coast Local Disaster Management Group, 24 January 2023.

Images: Council of the City of Gold Coast

The construction will exceed the default design through the increase in the 'importance level'. This level relates to the level of consequences to people or the public. The default design is importance level 2 and this new community centre will be constructed to importance level 3.

A key insight from the exercises was that applying realistic scenarios is important and that thinking needs to be stretched to uncomfortable scenarios. Feedback from one of the exercises was:

I GET IT NOW! I learned the importance of running exercises such as these for significant large-scale events. It is by raising awareness of the possibility of this occurring that we [begin] to look at our ability to respond. I am now able to talk about the theme of your exercise with our councils to inspire them to do the same.

Further, there was feedback highlighting the benefit in using a single scenario at different levels.

The discussion exercises were established as a safe place; a venue to acknowledge that work needs to be done and that the answers are not yet known. It provides an opportunity to be prepared now, ahead of a potential future event, and uses the best available information to feed into the planning. Both local exercises acknowledged the importance of having subject-matter experts present the scenarios to provide credibility. It provides the assurance to stakeholders that there is a sound and valid reason for their input and efforts. Another insight that resonated with both groups was that of supporting people. Caring for staff is fundamental, especially acknowledging the fatigue of disasters, including COVID, over the last few years. This aspect points to having sufficient backup staff, acknowledging that the scale of potential scenarios is likely to directly effect a proportion of local government and business staff. This issue cannot be overlooked. A continual refrain in emergency management circles is the power of relationships and it is at times of significant events that established relationships become even more important.

Conclusion

Understanding risk is the first pillar of Australia's National Disaster Risk Reduction Framework and the first objective of the Queensland Strategy for Disaster Resilience. The SWHA-SEQ project contributed to these strategies and partners are applying the evidence within their emergency management planning. Further work is needed and partners are pursuing options to advance this work. The City of Gold Coast is undertaking the City of Gold Coast Severe Wind Strata Study and Industry Engagement project with support through the Disaster Ready Fund. This project was initiated in response to the SWHA-SEQ project and aims to complete a study of strata stock and deliver an industry engagement strategy to increase the city's understanding of evacuation and refuge options during tropical cyclones. Learnings and insights from this project will support other local governments and will lead, over time, to enhanced resilience to tropical cyclone in the region. In addition, guidance on the selection and assessment of places of refuge is being developed by the Queensland Government. The Queensland Government

has already developed 2 guidance documents to assist local governments with the selection and assessment of places of refuge. The first assists to identify buildings that may be used as a place of refuge during a cyclone and the second assists to identify building issues that affect the resilience of buildings to severe wind events. This guidance provides an explanation of why particular building elements are vulnerable to wind damage.

More information:

- Severe Wind Hazard Assessment for South East Queensland, has been produced to support future work in Tropical Cyclone research, mitigation, preparedness, response and recovery, at http://pid.geoscience.gov.au/dataset/ga/147446.
- Cyclone Resilient Building Guidance for Queensland Homes, at www.qra.qld.gov.au/resilient-homes/cyclone-and-storm-tide-resilient-building-guidance-queensland-homes.
- Tropical Cyclone Seroja – Damage to buildings in the Mid-West Coastal Region of Western Australia, Cyclone Testing Station Technical Report No 66, at www.jcu.edu.au/__data/assets/pdf_file/0004/1801606//Technical-Report-66-Tropical Cyclone-Seroja-2021.pdf/_noproxycache.

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Anarchy in the Uki! How a hybrid of structure and autonomy can exist in community self-organisation

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Abstract

Self-organising community-led emergency responses and recovery are here to stay. Increasingly frequent, more severe, longer and more widespread natural hazard events mean that the demands placed on official response and recovery agencies will outstrip capacity. Drawing on a mix of first-hand accounts from 2 community leaders and excerpts from research interviews with community members, this paper focuses on 2 linked case studies of community self-organisation; the experiences of greater Uki (Uki and surrounds) and the experiences of the Byrrill Creek community, which sits within greater Uki but has its own Community Resilience Team. These case studies serve as a useful comparison of how community self-organisation and activation can be successful, but different, in 2 locations despite encountering similar challenges during the same flood event. They show how pre-organised and decentralised structures combined with strong links with emergency services can be mobilised to support community self-efficacy. The requirement for flexible approaches to enable communities to plan and self-organise in ways that suit their contexts and compositions is an underlying theme. Accommodating these idiosyncrasies is one of many challenges facing emergency management organisations as they transition to a complex and balanced power-share with communities and identify ways to integrate with the cooperative, democratic and sometimes fragile forms of anarchy they possess.

Interviewer: *What was it that helped you most after the flood?*

Resident: *Community support, darling, just community... hugs, hugs and just people really caring about what's happening.*

Background

Communities will always be first responders in emergencies and disasters and will activate to protect their neighbours and friends and their animals and their possessions, especially when the scale and magnitude of an event stretches the capacity of formal response organisations. In Australia, and in the context of climate change, with expectations of more intense, prolonged, worsening and concurrent natural hazard events (floods, bushfires, cyclones, heatwaves), the need to support and enable communities to prepare, respond and recover from these events is well recognised. A recent independent review of the response to floods in New South Wales during February and March 2022 (the event focus in this paper) acknowledged the role of community activation in saving lives and assisting recovery and recommended the creation of a Community First Responder Program to support and empower community-led initiatives.[1]

Case studies of successful community-led and volunteer groups have analysed the various challenges encountered by these groups to gain

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1. 2022 NSW Flood Inquiry, at: www.nsw.gov.au/nsw-government/projects-and-initiatives/floodinquiry.

legitimacy and the authority to operate (e.g. McLennan *et al.* 2021; Nissen, Carlton & Wong 2022). Support in the formation and development of these groups by 'insiders' in the paid and volunteer workforces of emergency services organisations had been recognised, and been found to contribute to their success.

This paper includes firsthand accounts of community self-organisation and activation in the greater Uki area (that encompasses the community of Byrrill Creek) in 2022. In addition to these accounts, de-identified data were collected from interviews with Uki residents on their experiences of the 2022 flood. These had been used to provide additional information about the community activation and organisation. These data were collected as part of a Natural Hazards Research Australia funded project that was supported by New South Wales State Emergency Service (NSW SES) and Queensland Fire and Emergency Services (see Taylor *et al.* 2023). This project included interviews and surveys with residents in areas of New South Wales and Queensland who were affected by floods during the period January to July 2022. Interviews were held with 192 residents; 100 from New South Wales and 92 from Queensland. Of the New South Wales interviews, 73 were with residents of the highly affected Northern Rivers area. Eleven of these interviews were with residents from around the Uki area, including 2 that were conducted with the authors.

This research received Approval 11902 from the Macquarie University Human Research Ethics Committee.

Eastern Australia floods in 2022

During 2022, there was extensive flooding in Australia and all states and territories experienced flood events. The flood event that is the focus of this report was experienced in late February to early March. The greater Uki area is located in the Tweed Shire local government area in the north of the Northern Rivers region in New South Wales. The record flooding that was experienced followed a period of wetter-than-average conditions, with higher rainfall, greater soil moisture and higher groundwater levels. A persistent La Niña event linked to climate change created conditions that left the landscape prone to flooding.

In the period before and around the flood (23 February–15 March), rainfall exceeded 1,700mm. Uki and Byrrill Creek were within an area hit with by a 'rain bomb' and received daily rainfall of around 500–600mm; exceeding prior daily rainfall records dating back to 1911. This extreme 24-hour rainfall reached 0.2% Annual Exceedance Probability (AEP) (1-in-500-year) and was part of more prolonged record rainfall. The height of the flood occurred on Sunday 28 February 2022. The river gauge on the Tweed River at Uki showed the river level rose more than 12m to a peak of 13.45m (normally sitting around 1–2m). Recorded river volumes were more than twice as large as historical floods, including the previous major flood in 2017 (Lerat *et al.* 2022). The flooding at this time has been referred to by emergency management spokespeople and politicians as 'unprecedented' and was certainly exceptional. Importantly, this also meant that the flooding was outside the lived experience of residents who were, in general, familiar with the risks and effects of flooding in the area.

Community descriptions: the geographical and community context

Uki is a village at the base of Wollumbin (Mount Warning) in northern New South Wales. It is situated on the banks of the Tweed River high in the catchment and 12km southwest of the main urban centre of Murwillumbah. The village is surrounded by rural properties and multiple occupancy communities that are spread across thin alluvial plains and heavily forested hills with the occasional grazing plain. This landscape forms neighbourhoods, many of which were previously independent settlements. The greater Uki area has a population of approximately 3,000 people, of which around half would consider themselves to live in the village of Uki itself. The community comprises a mix of farmers and those seeking alternative lifestyles, with an increasing percentage of post-COVID 'tree-changers' who have recently settled in the area.

Byrrill Creek is one of the small communities within greater Uki and is located 12km west from Uki village. The Byrrill Creek community comprises about 150 people, mostly over 50 years of age and many retirees. There are only 4 families with children in this area. Many of the older residents settled and created multi-occupancy communities in the rainforest or on the farmland around 40 years ago with aims to be self-sufficient and away from crowds. Because Byrrill Creek is a bushfire- and flood-prone area, these older residents are used to working together in times of crisis. Most of the community would consider themselves 'alternative greenie free thinkers'.

> *We're well-positioned as far as being able to look ourselves; we come from a rural background but we're very close to Nimbin obviously, so we've got a lot of hippies – I'll just come out and say it – hippies, living in the hills around here as well, so we've got this interesting mix of farming folk and hippies in the hills, and we like each other and live very nicely next to each other but there's a wide range of capabilities within that and people needing to be looked after and people looking after others.*

[Uki resident]

Community organisation and supporting structures in place prior to the 2022 flood

The communities of Uki and Byrrill Creek are generally resilient and self-reliant. Two NSW Rural Fire Service brigades and the Uki Flood Group (now a multi-hazard organisation, Resilient Uki) and the Byrrill Creek Community Resilience Team (BCCRT) are testimony to this.

The area has been declared a disaster zone 5 times in the last 5 years. During the last big flood in 2017, Uki experienced an extremely high-risk swift water rescue of more than 20 people using kayaks. In addition, multiple houses were lost during the summer bushfire season in 2019–20 when bushfires came within 7kms of the Byrrill Creek community. In response to experiences of severe natural hazard events, a culture of disaster preparation

at the household and neighbourhood level has grown over time in Uki and Byrrill Creek.

In 2015, the Uki Flood Group began implementation of a neighbourhood system where designated neighbourhood coordinators were the point of contact between residents of their allocated area and the NSW SES. This system was formalised into the Community Action Team model by NSW SES. This model was further developed and revolutionised by the Australian Red Cross as the Community-led Resilience Team (CRT) model (Australian Red Cross 2020). The Uki Residents Association has a resilience officer and 'Get Ready Days' are undertaken annually. Active members of the community participate in regional disaster-related forums and connect with people in other towns in the Northern Rivers region. During the 2019–20 bushfires, a fact-checked emergency Facebook group for Uki was established to provide accurate disaster-related information. The Uki Flood Group also has a website with response information and access to flood gauge information.

At Byrrill Creek, floods come once or twice a year and restrict access to the community for a day or two. Generally, this is a fun time for the community as, due to flooded causeways, they can't go to work or school. Even the newer community members are prepared for staying home for a day or two. In 2017, Cyclone Debbie caused major flooding and 'Byrrill Creekers' lost the main access bridge over the Tweed River. They resorted to canoeing and rock hopping to get to work and school for several months until a new bridge was constructed.

> ...because we are high in the catchment, we're used to flooding. It's a common thing for our residents to be flooded in for a day or two, a number of times in a year; we have little causeways going over said upper-level tributaries, so you can't get the kids to school. We quite like it actually... Because of that, we're all generally a little bit prepared with things – food and stuff like that as well, and a lot of people are on standalone solar and with water tanks and those kinds of things.
>
> [Uki resident]

Communication, specifically a lack of internal community communications during the 2017 flood, had been a major challenge in Byrrill Creek. A Facebook Messenger group was set up, which slowly grew to include many of the new residents of the community as they began to reach out for help and information. Interestingly, many original residents were the last to join and use this group as they did not see nor feel the need or were too 'free thinking' to use Facebook Messenger. This forum was used to share information about flooded bridges, causeways, lost animals and other Byrrill Creek-related information.

In 2020, the Australian Red Cross advertised support for community resilience teams and the Facebook Messenger group was used to recruit interested members. Twelve people attended the first meeting and by the end of that meeting all 6 areas of Byrrill Creek had designated neighbourhood or street leaders and buddies. This group, the Byrrill Creek CRT (BCCRT), met monthly for the first 2 years to push forward disaster preparedness

activities to make their community capable and adaptive at times of need. At the time of the 2022 floods, the BCCRT was a well-developed team and was on the cusp of creating an alternative communications network using VHF radios, with assistance from Australian Red Cross.

In addition to the local community self-organisation, greater Uki receives support from the council (Tweed Shire) with a Community Resilience Network that is made up of community representatives. The network informs the response through the Local Emergency Management Committee that operates under New South Wales legislative arrangements. Solid relationships have been forged between CRT members in both case study locations and with the Australian Red Cross, local NSW RFS, the NSW SES and the local Council Resilience Officer.

Local floods and community response

At the time of the 2022 floods, greater Uki had some neighbourhoods under versions of the CRT model that were at various stages of activation, with Byrrill Creek being developed as a formal CRT. Despite the preparedness and engagement of communities, the flood events caused extensive disruption. The area experienced multiple landslips, bridge wash-outs and flooded houses as well as fences and animals being washed away. Communications and physical access to homes and services were major issues in both communities. Due to the widespread flood event, it became apparent that immediate support would not be possible.

Most residences in Uki were not directly affected but all had access restricted in some way. Local residents with excavators and tractors responded by chipping away at landslips, raising concerns for their safety. The lack of communication meant that the Resilient Uki group didn't know who was injured, where the landslips were or who was flooded and who needed help. In the early stages, they tried to organise and send out information and tried to problem-solve in an ad hoc way. Food and fuel were early priorities. In Byrrill Creek, residents experienced flood waters that were 5 metres higher than previously experienced. Power and phone connections were lost and, tragically, one member of the community was washed away and died while trying to reach his home by foot.

As in Uki, early response included assessment of the status of residents and using chainsaws, tractors, bobcats and excavators to establish roads into properties and gain access over or around landslides. When floodwaters started receding, the extent of the damage was evident. Four bridges were lost, massive landslides covered at least 8 sections of road and many roads were unusable due to wash-outs. Many driveways were covered by mudslides; one narrowly missing a house and one house was completely inundated. Three members of the BCCRT had satellite internet connection and had set up generators to enable communications. This allowed phone contact with the Mullumbimby SES Commander and other outsiders throughout the 2 weeks of the community's isolation. These 3 homes became vital communication hubs as community members tried to contact family and family tried to reach community members.

Receding flood waters exposed extensive damage to large sections of local roads.

Image: Natascha Wernick

Community self-organisation and local challenges

...it's a great little village, it's a very community-minded village. We had a community hub in our hall where services and people were connected. We had people that took on the roles of coordinating that scene; the whole hall was full of donated stuff – stuff for people to clean houses, bedding, clothing, food, everything. And there was a whole team, the "mud army" we called them, and people would just come to that hall, see who needed help, see who was stuck and needed their driveway dug out, or whatever, to get them out, and all that sort of stuff, and together with the fire brigade, that's what happened.

[Uki resident]

In Uki, the isolation experienced allowed for a sense of cohesion and connection to emerge (a 'crisitunity' – a crisis opportunity). Neighbours checked in with, and assisted, neighbours. Even those who did not usually get on together worked side-by-side with a shared sense of purpose. The situation allowed for local leadership to emerge and for individuals to assess their capacity to help others.

A mix of safety concerns and adversity created favourable conditions for the mobilisation of neighbourhoods. Predominately, these were access to food, fuel, medical services,

power, telecommunications and, in some cases, water. Creative solutions were found and implemented among clusters of neighbours and these self-led groups were largely free to work as they pleased.

Fortunately, the supermarket in Uki and the community hall and one petrol bowser remained operational. Once alternative energy sources were established for these facilities, food could be kept refrigerated and fuel was stored and distributed. Access to Murwillumbah was gained within the first week following the flood for people with 4-wheel-drive vehicles as there was 40cm of mud on roads and large sections of the road had washed away.

With no internet or telecommunications, arrangements could only be made by word of mouth. Minor medical needs were attended to by neighbours and major needs were assessed by registered nurses who lived in the village. Navigating roadblocks to gain access for medical support for the injured was a challenge. Later on, coordinated help was organised to get medication scripts filled by the pharmacy in Murwillumbah, but initially this was haphazard.

Medical needs of livestock were, in some ways, more difficult to attend to than for humans. Mud fever and infections were prevalent and many dead livestock had to be buried as a priority in the first few days. Containment was also an issue as creek-line fences had been washed away. Stock and companion animal food stores also had to be brought in. NSW Local Land Services assisted with fencing and feed was provided from public donations. A veterinarian from the Gold Coast generously donated wire and solar set-ups for temporary electric fencing. Food for household animals ran out very quickly.

In addition to the autonomous neighbourhood groups, Resilient Uki established a focal point for community support in the community hall. Butcher's paper was tacked to the walls and used to chart decisions and task jobs that needed doing. This open (visual) approach made it easy for community members to view progress and enabled those needing help to add to it while being mindful of protecting privacy of personal information.

Once a road route into Uki was established, external (spontaneous) volunteers arrived to help. This provided much-needed assistance but also raised challenges for management and coordination. The hub was able to help coordinate this and spread the help around to the broader community, albeit in a haphazard way.

So, we were just thrown into dealing with spontaneous volunteers and donations and that was hectic, it was really hectic. What we found is that all our community were busy helping either themselves or their neighbours – they were all busy, or if they weren't, they didn't have the capacity to be, so we were sort of full. We had a lot of people whose houses went under and who needed help and so the outside help was really great. It was chaos though, because we still really didn't have an overview of exactly where and who and what...

[Author, Resilient Uki]

Australian Defence Force personnel gather and dispose of rubbish at the war cenotaph in Uki.

Image: Natascha Wernick

Byrrill Creek residents Natascha Wernick, Holly Sullivan and Kaz Lopez carry supplies around a landslip.

Image: Sue Mothersole

Groceries were carried across the broken bridge over flood waters at Byrrill Creek.

Image: Natascha Wernick

After initial challenges setting up processes for coordinating help, resources and essential provisions at the Uki community hub things became more orderly. Communication was established with the Murwillumbah community hub and they were able to support each other. The local council assisted by using an emergency dashboard to request the specific donations that Uki required. Important resources were also supplied through personal contacts with businesses, individuals and communities in other areas. Marine Rescue NSW assisted by bringing much-needed fuel to the area using a trailer with a fuel pod. This support was later coordinated by the NSW SES.

The arrival of the Australian Defence Force nearly 2 weeks after the flood lifted the morale of the community, both as a source of additional support but also as a symbol of help being provided by the Australian Government. By the time they arrived, many flood-affected houses had been cleared by residents and non-local 'mud army' volunteers. People's possessions were piled outside houses and the NSW RFS had helped to hose out properties. However, with no rubbish collection service, the Australian Defence Force personnel cleared domestic rubbish as well as helped with clearing and cleaning up community spaces of schools, sports fields and helping with the heavy lifting during council collection of flood debris.

Throughout this period the Uki hub worked with a 'loose' structure. Those who were present in the hall, were the team. Decisions were made by those who were there at the time. The decision-making process was fast, fluid and on-the-fly. Likened to a 'anarchistic alliance'. The Uki hub closed down after around 3 weeks and free meals were offered for a further 3 weeks to bring the community together. The Resilient Uki group decided not to persist with recovery support or create potential dependencies. Rather, they became a bridge between government services and the community, organising outreach sessions in the hall and promoting these through informal networks.

In Byrrill Creek, the community was smaller and the BCCRT was active and engaged ahead of the 2022 flood. Also, the community was acutely affected and isolated for longer. Communication problems, due to lack of working telecommunications, meant that communication within the community was non-existent, unless face-to-face. The BCCRT team leader maintained connections with the NSW SES at Murwillumbah using satellite internet and a generator. This connection was reassuring during the prolonged period of isolation and in dealing with the various challenges that arose.

By day 4, community members with bobcats and machinery were working in a coordinated way to clear the 12–15 landslips over the roads, a 4-wheel-drive access was established and an online food order from a supermarket was coordinated. Managing urgent medicine requirements for the largely elderly community was assisted by the NSW SES. Community members gathered at a pick-up point with jerrycans to access fuel. In the evening, the community gathered at the broken bridge to carry bags of much-needed groceries over the swollen river.

On day 5, food and supplies from the NSW Police and other people began arriving by motor bike or were dropped at the broken bridge. Communication had been established with the Uki and Murwillumbah community hubs that organised volunteers from outside the affected areas to walk in the supplies over landslides, broken roads and bridges to get to the rest of the community. Such practices might be regarded as 'unsafe' but had to be undertaken by people to receive food and other supplies as there was no 'official' help.

By day 6 and 7, the BCCRT team had set up a community food hub and was able to focus on assisting community members as it had developed a method of delivery from the Murwillumbah community hub. At this time, a community member experienced a medical emergency and an access route had to be found to get them to a medical specialist. This entailed cutting a fence to access a temporary road on private property between 2 neighbours who were not on speaking terms. This was negotiated effectively.

More than 2 weeks after the flood, power and telephone connections were restored and road access was reinstated. The frustration around communications as identified before the 2022 flood was a focus for the BCCRT during the post-flood period and was raised with numerous recovery organisations when they asked what the community needed. The Australian Red Cross donated 12 UHF radios 2 weeks after the floods. The organisation, GIVIT, also organised $30,000 for the purchase of VHF and UHF radios and equipment to network the greater Uki area to enable community communications.

Reflections

These case studies of community response to the 2022 flood provides a number of insights. The Uki and Byrrill Creek communities stepped up and worked with collaboration, neighbourliness and kindness. Both communities faced similar types of effects with relatively limited flood inundation of properties but with challenges caused by isolation resulting from landslips, damage to roads and loss of electricity and telecommunications. Both communities had experiences of prior flooding and had existing relationships in place within community via CRT-style structures as well as supportive personal connections to individuals outside the community in official agencies like Australian Red Cross, NSW SES, NSW RFS and local government. Although there were differences in scale (size of each community and period of isolation), there were many similarities in the challenges that needed to be addressed. Specifically, loss of community communications, initial assessments of community safety, clearing of roads and landslips for access, managing medical needs and injuries, obtaining supplies of food and fuel, coordinating tasks and managing help and supplies.

Organisationally, although working to a community CRT model, there were noticeable differences in how community self-organisation worked in practice. In Uki, there was an agile and open 'anarchistic alliance' in the community hub that helped to direct activities across the community, while allowing neighbourhood groups to manage themselves autonomously. In Byrrill Creek, there was a structured and developed approach

that enabled BCCRT members to lead and manage different activities and coordinate through a team leader. Both approaches worked and both have left their respective CRTs with issues to resolve and improve before the next flood or bushfire.

Whether the differences in community self-organisation were driven by different community demographics, topography, existing social structures, individual capacity or leadership styles is open to debate. These case studies demonstrate the need to allow communities flexibility to self-organise as they choose.

When reviewing the challenges and lessons identified by community leaders, many similarities are noted. Community safety was an issue, with untrained people doing dangerous work. Several dangerous activities occurred as soon as the rains stopped, with people attempting to regain access to unsafe zones (e.g. crossing swollen creeks and rivers). In Byrrill Creek, the decision to walk in fuel and groceries across the broken bridge at night was clearly unsafe. The lack of communications was a fundamental challenge for both communities and was identified as essential to address and to enable their community organisations to function effectively. This was recognised as a priority and has been addressed by establishing UHF/VHF radio networks. In Uki, ad hoc approaches and lack of processes and deliberate capacity building need improvement alongside a need to increase access to resources, such as generators, gas cooking facilities, water filtration equipment and solar lighting. Plans are in place to embed skills in all neighbourhoods, including psychological first aid and physical first aid.

In Byrrill Creek, the emphasis is on building better preparedness at the neighbourhood level and also for the community leaders. The need to prioritise self-care and manage fatigue is recognised and managed in professional emergency management but is new to community leaders. The extended period of community isolation and activation was exhausting for those in the Byrrill Creek flood situation. Finally, having support from professional contacts within emergency services was incredibly valuable. The ability to ask questions day or night to trusted contacts in Australian Red Cross, NSW SES and the Resilience Officer at the local council provided great reassurance and relief from some of the pressures of personal responsibility during the many novel and uncertain situations encountered.

There was no time for the real world, or my real paid work. It began as soon as I woke until I fell asleep at night. By day 14 I was extremely exhausted... I felt very under trained and under resourced. Although I had received the Red Cross training manual, I did not really grasp the disaster cycle, the purpose of many of the agencies and the many other social, environmental and physical aspects of disasters. In addition, losing a member of our community in the flood was extremely hard and, although I know it was not my fault and I couldn't have done anything, it is very hard for me to not feel some sort of responsibility.

[BCCRT]

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Making messages effective for all: South East Queensland flood warnings and alerts

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Abstract

All people need to understand warnings and alerts in an emergency. People from culturally and linguistically diverse communities are more acutely at risk in emergencies and disaster events. They often rely on unofficial community translators or other people within their community or families to relay important information. Community translators sometimes do not find the original message easy to translate nor interpret into their own languages. Also, first-language English speakers may find some emergency messaging unclear. This paper reports on a project undertaken as part of the Queensland Office of Inspector-General of Emergency Management review of the February to March 2022 South East Queensland rainfall and flooding event. Seven text message warnings that were sent during the event were analysed using a linguistic technique, Clear Explicit Translatable Language. Four methods were used to make wordings easier to interpret and translate, simpler, clearer and updated. The result is a practical output and an accessible Aide-Mémoire for Practitioners.

Introduction

Communicating during emergencies requires messages that are simple, clear and easy to interpret and translate into other languages. Messages that are easily comprehensibile have greater effect. An Aide-Mémoire for Practitioners gives guidance on strengthening phrasing using

25 cases of wordings taken from 7 text message warnings and alerts sent during February and March 2022 during severe rainfall and flooding in South East Queensland. Figure 1 shows an example of the phrasing change from 'evacuate if required' to the simpler and clearer 'leave if it is not safe to stay'.

Figure 1: Original phrasing (orange) altered to simpler and clearer phrasing (blue).

The context

Warnings and alerts during an emergency need to be understood by as many people as possible. Although they are one part of the information ecosystem, text message warnings and alerts are very important. They should be succinct, trustworthy, carry authority and, according to Schuster *et al.* 2022, most people can receive one. In Australia, text messages are sent to language situations where not everyone speaks English. To illustrate, approximately 23% of people in Australia speak a language other than English at home and over 300 languages are spoken in the country (ABS 2022). Additionally, not all the population has a high reading level. As noted by the Australian Government (n.d), 44% of people have a low reading level and many, even those with a high reading level, do not understand emergency operational language.

People in culturally and linguistically diverse communities are particularly at risk in emergencies and often rely on unofficial community translators and interpreters during these events (Chandonnet

2021, Shepherd & van Vuuren 2014). Community leaders may distribute information through messages in their own languages, either through text or voice, using messaging apps such as WhatsApp. They may also make phone calls to community members to keep them abreast of the situation. Moreover, they may adapt messages to make them applicable and relevant to their communities.

Community translators and interpreters do not always find the original message easy to translate nor interpret into their own languages (Ogie & Perez 2020). Messages designed with translation and interpretation in mind can make the role of interpreters easier at a very stressful time. It cannot be assumed that speakers of languages other than English necessarily have access to a community leader or consider themselves part of a particular community (Grey & Severin 2022). The English text message may be one of a few information sources, so governments have a responsibility for accessibility for the original warnings and alerts.

Method

A sample of 7 text messages that were sent during the 2022 flooding event was analysed using a Clear Explicit Translatable Language (Goddard 2021). This was a project for the Queensland Office of the Inspector-General of Emergency Management to review the event. Clear Explicit Translatable Language allows people to express important thoughts and messages not in 'full English' but in a simplified version of English that is easy to translate or interpret into other languages. The technique has been used in areas such as health, education and international development. Efforts have been underway to use the technique in emergency and disaster messaging, as seen in a proof-of-concept that principally alters preparedness messages (Bromhead 2021). To demonstrate, the preparedness message 'make a plan' can be made easier to interpret and translate if changed to 'think about what you will do, write it down'.

In the project, suggestions were made for altering wordings in the warnings and alerts while keeping the original sense of the message. At all points, character counts were borne in mind, so the messages stayed sharp and within the bounds of an SMS. The warnings and alerts were divided into sentences, and if deemed necessary, adjusted to make them simpler, clearer and easier to interpret and translate into other languages. In addition, the sentences adjusted were assigned with ratings of (1) clear, (2) could be made clearer and (3) unclear. See Appendix 1 for a summary.

The intention of the analysis was to build on existing strengths in messaging and add insights brought by linguistics. The relevant Queensland Emergency Alert Manual (QFES 2021) and Australian Institute for Disaster Resilience guideline (AIDR 2021) were referenced during the research process.

Practical output

The project generated a practical output, an Aide-Mémoire for Practitioners, that could be used by message creators in a fast-paced, evolving environment. The aide-mémoire contains brief general guidance before specific suggestions for adjusting wording that is divided into 25 lettered points. These are separated depending on the reason for the suggested change:

i.   Making words easier to translate
ii. Making words simpler
iii. Unpacking ideas that may not be clear
iv. Updating old-fashioned words.

Each section is separated into the type of words, using accessible labels with technical grammar terms in brackets, for example, doing words (verbs); people, places, things (nouns); explaining words (adjectives and adverbials). A balance has been struck between making the wording accessible and keeping within character restrictions.

Aide-Mémoire for Practitioners

General

The current practice of using the 3 warning advice levels (advice, watch and act, emergency) and adding the name of the issuing authority makes warnings and alerts consistent and recognisable and is meant to add to the message credibility.

Specific

i. Making words easier to translate

Doing words (Verbs)

	Use	Avoid
A	happening now	occurring
B	have to	need
C	think carefully about	consider
D	do the things you have to do	take the necessary steps
E	stay where you are	shelter in place
F	know	plan

People, places, things (Nouns)

	Use	Avoid
G	places	areas
H	people	residents

Explaining words (Adjectives and Adverbials)

	Use	Avoid
I	if you can	if possible
J	more	further
K	other	additional

ii. Making words simpler

Doing words (Verbs)

	Use	Avoid
L	begin	commence
M	go to	attend, visit, refer to
N	go and stay	evacuate to
O	make sure your pets are safe	provide shelter for your pets
P	lock	secure
Q	leave	evacuate

People, places, things (Nouns)

	Use	Avoid
R	house or home	property
S	the way you will go	journey

Explaining words (Adjectives and Adverbials)

	Use	Avoid
T	very dangerous flash flooding	life-threatening flash flooding

iii. Unpacking ideas that may not be clear

Doing words (Verbs)

	Use	Avoid
U	expand 'check roads' to 'check where roads are closed'	'check roads' alone
V	drive, walk or ride	enter

People, places, things (Nouns)

	Use	Avoid
W	explain 'evacuation centres', for example, 'safe places, evacuation centres'	'evacuation centres' alone

Explaining words (Adjectives and Adverbials)

	Use	Avoid
X	· use 'if it is not safe' and 'if you have nowhere else to go' · unpack 'if required' and 'if necessary'	N/A

iv. Updating old-fashioned words

Doing word (Verb)

	Use	Avoid
Y	call	dial

Sample result

Figure 2 shows an example of an adjusted message.

Figure 2: Warning message adjusted using Clear, Explicit, Translatable Language.

Conclusion

Warnings and alerts provided during heavy rainfall, flooding and other hazards have many strengths. Building on these foundations, small alterations to messaging can make them simpler, clearer and easier to interpret and translate. For warnings and alerts to be effective, they need to be understandable by most, or ideally all, people in the community. Adjustments to messages do not necessarily result in longer phrasing. It is possible to remain within desired character counts. A Clear, Explicit Translatable Language approach could give interpreters and translators from culturally and linguistically diverse communities greater accessible information to distribute, either in text or voice, in a way that best resonates with their communities. Improvements in accessibility may benefit others outside culturally and linguistically diverse communities. The Clear, Explicit, Translatable Language approach given in the practical output, the Aide-Mémoire for Practitioners, may also contribute to warnings about other emergencies and contribute to information given to people to help them prepare for and recover from disasters.

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Appendix 1: Original wordings assessed for accessibility with suggested rewording

Key:

c: character numbers

italics: indicates where suggested rephrasing is different from the original

level 1: clear

level 2: could be made clearer

level 3: unclear

No.	Original	Level	Suggested
1	Evacuate now (12 c.)	1	*Leave now* (9 c.)
2	Evacuate if required (20 c.)	2	*Leave* if *it is not safe to stay* (31 c.)
3(i)	Major flooding is occurring in xxx and may impact your property. (64 c.)	2	Major flooding is *happening now* in xxx and may impact your *home.* (64 c.)
3(ii)	You may need to consider leaving your property. (47 c.)	2	You may *have to think carefully about leaving your home.* (56 c.)
4(i)	You should take the necessary steps to provide shelter for your pets. (69 c.)	2	You should *do the things you have to do to make sure your pets will be safe.* (76 c.)
4(ii)	If you need to leave then please take essential medication, secure your property and go and stay with family or friends on higher ground. (137 c.)	2	If you *have to* leave then please take essential medication, *lock your house* and go and stay with family or friends on higher ground. (132 c.)
4(iii)	If necessary, you can attend council run evacuation centres at the xxxx centre, or the xxx showgrounds. (103 c.)	2	*If you have nowhere else to go, you can go to safe places,* council run evacuation centres at the xxxx centre, or the xxx showgrounds. (133 c.)

No.	Original	Level	Suggested
4(iv)	In a life-threatening emergency dial 000. For further information please visit: https://disaster.XXXX.qld.gov.au (112 c.)	1	In a life-threatening emergency *call* 000. For *more* information *go to* https://disaster.XXXX.qld.gov.au (101 c.)
5(i)	Major Flooding likely on the Brisbane River. (44 c.)	1	
5(ii)	Stay out of flood water. (24 c.)	1	
5(iii)	Check roads and plan you journey if evacuating. (47 c.)	2	Check *where roads are closed* and *know the way you will go*. (56 c.)
5(iv)	Refer to link below for Councils evacuation centre information. Visit www.XXXX.qld.gov.au (89 c.)	2	For Councils evacuation centres information about *go to* www.XXXX.qld.gov.au (75 c.)
6(i)	EMERGENCY WARNING. From XXX. (28 c.)	1	
6(ii)	Life-threatening flash flooding is occurring. (45 c.)	2	*Very dangerous* flash flooding is *happening now*. (47 c.)
6(iii)	Shelter in place unless it is unsafe to do so. (46 c.)	2	*Stay where you are* unless *it is not safe*. (41 c.)
6(iv)	Access to area is cut and inaccessible in multiple places. (58 c.)	3	*Many roads are closed (and cars cannot leave or come into the area).*[1] (66 c.)
6(v)	Do not enter flood waters. (26 c.)	2	*Do not drive, walk or ride into* flood waters. (45 c.)
7(i)	EMERGENCY EMERGENCY EMERGENCY WARNING FLOOD. (44 c.)	1	
7(ii)	Wivenhoe dam releases will be commencing from 4am Sunday 27 February. (69 c.)	2	Wivenhoe dam releases will be *beginning* from 4am Sunday 27 February. (68 c.)
7(iii)	Additional areas are expected to be impacted by life-threatening flooding occurring across the XXXX Council area. (113 c.)	2	*Other places* are expected to be impacted by *very dangerous* flooding happening in the XXXX Council area. (103 c.)
7(iv)	Residents in low lying areas should prepare to leave and warn others. (69 c.)	2	*People* in low lying areas should prepare to leave and warn others. (66 c.)
7(v)	Evacuate to friends and family if possible. (43 c.)	2	*Go and stay with* friends or family *if you can*. (46 c.)
7(vi)	An evacuation centre is open at the xxxx Showgrounds. (53 c.)	2	*If you have nowhere else to go, go to* an evacuation centre at the xxxx Showgrounds. (83 c.)
7(vii)	For more information visit https://disaster.xxxx (48 c.)	2	For more information *go to* https://disaster.xxxx (48 c.)

1. The meaning of this sentence was not clear to the analyst. The suggestion is approximate.

Reducing community risk to coastal erosion with managed relocation

Abstract

As climate change escalates and coastal populations increase, adaptation to ongoing risks to coastal communities due to rising sea levels and storm surges must be reassessed. In Australia, over $25 billion of coastal property is at substantial risk from inundation and erosion. The response by governments to coastal hazards has been to construct artificial sea barriers in a hold-the-line approach of investing in sea walls and beach nourishments[1] to protect beachfront residential properties. However, are such structures reducing the long-term risk in an era of climate uncertainty? Is sand renourishment of beaches a sustainable solution to increasing erosion on the coast? Can planned relocations be implemented in planning policies? Sea walls perpetuate ongoing threats to coastal development and a shift in the methodology of land-use planning and adaptation for coastal communities must occur. This would be in line with the *Sendai Framework for Disaster Risk Reduction 2015-2030* (UNDRR 2015) goal of strengthening disaster risk governance. A greater emphasis must be placed on strategic planning that directs people away from high-risk beachfronts. This research uses qualitative case studies to understand how local governments in New South Wales address the increasing risks to coastal residential development and the connection between government and risk hierarchies. A framework is proposed to integrate national risk hierarchies into state and local government planning to assist in managing strategic relocations and implementing nature-based solutions.

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Introduction

Rising sea levels are one of the most significant societal challenges with extreme weather events exacerbating coastal erosion and governments looking to erosion to residential beachfront properties. The NSW Government conducted a statewide exposure assessment of coastal erosion in 2017 and identified over 2,000 residential addresses exposed to erosion risk. According to current development projections, this figure will increase to 3,700 by 2050 due to predictions of rising future sea levels (Office of Environment and Heritage 2017).

The *Special Report on Ocean and Cryosphere in a Changing Climate* (IPCC 2019) states that sea levels are projected to rise beyond 2100, with one-in-100-day marine heatwave events becoming one-in-4-day events by 2031–2050 (Collins *et al.* 2019). As oceans warm and sea levels rise, storm surges and extreme coastal events are projected to become more frequent, increasing the exposure and vulnerability of coastal urban developments and ecological systems. Australia's legislation and adaptation methodology must be reassessed to reduce these long-term risks as over $25 billion of coastal property is at substantial risk (CoreLogic 2022).

As calls from homeowners for greater protection from coastal erosion increase, the effects of bad decisions (e.g. building seawalls) will become more critical. Local governments needs to address coastal erosion adaptation and the equity between politics, private rights, environmental protections and public amenities of the beachfront. There is a growing body of literature on the adaptation frameworks and theories that are all set against evolving climate risk as discussed by Barnett *et al.* 2014; Cooper 2012; Dedekorkut-Howes, Torabi and Howes (2021); Cooper and Lemckert (2012) and O'Donnel (2016). This paper builds on this significant body of research and aims to contribute with a particular focus on beachfront developments.

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1. Beach nourishment is the artificial placement of sand on an eroded shore to maintain the amount of sand on the beach. Re-nourishment is subsequent placement of sand.

Methodology

This research investigates residential land use and adaptation to the risks of coastal erosion, which is a contemporary planning concern occurring across coastal communities in Australia and many other countries. The chosen methodology is the qualitative research method of case studies.

Questions in this research consider how local governments in New South Wales assess risk to coastal development in line with the national risk hierarchies to improve the resilience to sea-level rise and erosion. The case studies were of 2 local governments, Central Coast Council and Byron Shire Council. Both councils have residential development under the same state planning framework that is affected by ongoing coastal erosion issues.

Data for this research were obtained from investigations of legislation and coastal policy documents, semi-structured interviews with elected state government representatives and local councils as well as community focus groups. The data from the interviews, focus groups and literature review were examined by NVivo and thematic analysis.

This research received ethics approval number ME02505 from the Bond University Human Research Ethics Committee.

Legacy development

Part of the problem starts with legacy developments that includes housing in high-risk coastal erosion zones that previous planning decisions allowed to be built without considering climate change concerns, receding shorelines and rising sea levels. An example of a legacy development affected by erosion is Wamberal Beach on the Central Coast area between Sydney and Newcastle.

A parliamentary briefing paper (Smith 2010) on sea-level rise and coastal erosion acknowledged that coastal erosion was a significant concern. The erosion resulted in the loss of residential property and infrastructure related to extreme storm incidents that 'reflect the inappropriate construction of property within dynamic coastal environments' (Smith 2010, p.3).

Considering that report and ongoing coastal development with more volatile and extreme weather projected (WMO 2022), the question was put to the research participant planners of

Legacy development on the eroded beachfront of Wamberal, New South Wales.

Image: Mark Ellis, June 2023.

both councils, 'Are beachfront developments sustainable in the long term, and how do councils manage legacy development?' Participants from both councils responded that the legacy development vulnerability would increase and that not acting on legacy developments would lead to further economic and environmental damage risk. While participants from the councils and state government representatives indicated that no new housing should be built in high-risk locations, redevelopment continues. A council respondent said, 'No one is going to say yes, great, put this mapping in; we are happy not to be able to develop more in this area'. This statement highlights the issue with hazard mapping and the private rights of landholders in managing legacy development.

To fulfill the Sendai Framework goals and the United Nations 2030 Agenda for Sustainable Development, governments need to stop enabling development in high-risk zones.

The oncoming financial risks from coastal erosion

Global reinsurer AXA published a 2022 future risk report that lists climate change as the top threat to society, with the physical risks of sea-level and storms being significant consequences of the changing climate. The report states that, 'rising sea levels and more dangerous storm events could cost coastal urban areas more than USD1 trillion dollars annually by 2050' (AXA Insurance Reinsurance 2022).

Australian coastal communities will become increasingly vulnerable to rising sea levels and extreme weather events and many beachfront properties will become stranded assets due to loss of property values as well as insurance and banking sectors retracting from the coastal property market. The Reserve Bank of Australia modelled that the number of high-risk properties could grow by over 74,000 due to climate change (Bellrose, Norman & Royters 2021).

American banks and insurance companies are already selling out of beachfront properties in coastal areas in the U.S.A. (Keenan & Bradt 2020). However, coastal property prices in the case study areas have increased. Figure 1 shows the increase in coastal property land values from 2016 to 2022 in the case study areas. The 2021 report on land values by the NSW Valuer General states, 'The beachside suburbs of the Central Coast NSW experienced the most significant increases' (NSW Valuer General 2022, p.13). The property plotted for Oceanview Drive was sold in 2016 for $2.6 million, yet in 2022 the land value alone was $4.5 million.

While some insurers are opting out of the beachfront market, adaptation finance is being directed towards coastal engineering projects that perpetuate the risk to beachfront housing. Two examples are the proposal to build a pipeline in Adelaide to address beach erosion at a cost of $155 million[2] and a $4.5 million funding commitment to repair and restore 170 metres of sea wall at Caloundra.[3] The Insurance Council of Australia (2021) estimated

2. Coastal erosion mitigation measures along Adelaide beaches could cost over $150 million, at www.abc.net.au/news/2023-09-18/sa-erosion-options-adelaide-beaches/102870828.

3. Golden Beach seawall to be restored at Caloundra, at https://oursc.com.au/environment/golden-beach-seawall-to-be-restored-at-caloundra.
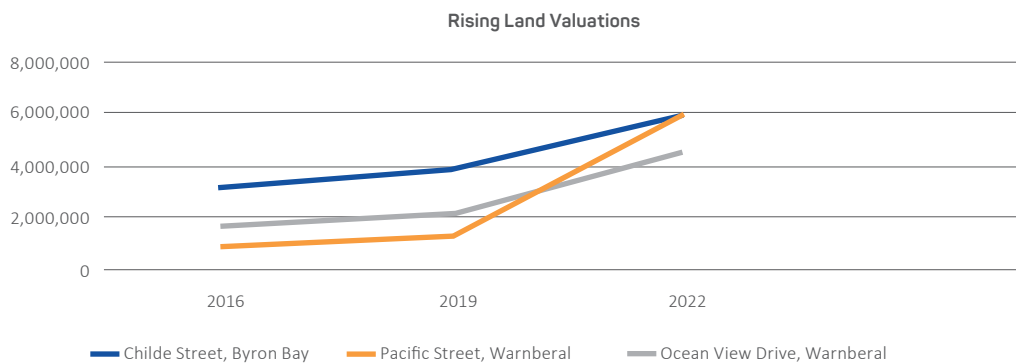
Rising Land Valuations

Figure 1: Land valuation comparison in Byron Bay and Wamberal Beach 2016 to 2022. Each plot is for a single address at the location.

Source: Data from NSW Valuer General (2022)

that $30 billion needs to be spent on coastal defence projects over the next 50 years to prevent homes from becoming uninhabitable due to the significant risks of coastal inundation and sea-level rise.

Extreme weather and its effects are further highlighted in the 2020 Insurance Group of Australia Severe Weather report that states, 'Sea level rise will contribute substantially to escalating impacts from storm surges and the effects on coastal natural systems and buildings' (IAG 2020, p.103).

Planning policy and extreme coastal risks

Storm surges attributed to east coast lows and the southern oscillation El Niño/La Niña system impact on the case study areas. These systems have become more frequent and intense and Vos *et al.* (2023) emphasise that more erosion occurs under La Niña influence on the Australian east coast. With future predictions of increasing wave intensity and height due to global warming (Morim *et al.* 2021, p.16), the risk to coastal properties from erosion will be ongoing regardless of emission scenarios (WMO 2022, IPCC 2022)

International and Australian risk frameworks are created to reduce the systemic risk of extreme weather events. Australia

Storm surge exposed rocks and damaged infrastructure at Wamberal Beach, New South Wales, July 2020.

Image: Mark Ellis

is a signatory of the Sendai Framework and local governments have a vital role to play in implementing disaster risk reduction strategies as outlined in the Making Cities Resilient campaign.

Research participants were asked, 'How do local governments address the increasing extreme weather to coastal development in line with the national risk hierarchies and the Sendai Framework to improve resilience to coastal risks?' This research identified a disconnect between global, national and local risk planning policies. Some respondents needed to be made aware of Australia's national risk reduction framework and others did not take the framework into significant consideration but only assessed their decisions on state-based coastal policies.

One participant planner (Byron Bay) highlighted that the statutory framework the councils work under is governed by state legislation. When the NSW Government changed the standard Instrument in 2014 it also standardised the template for e-zones in the new local environment plans (LEP). In doing this, any provision of a coastal hazard zone for appropriate development was removed. The respondent stated, 'There was no logical transition between councils 2014 LEP, which had an ingrained framework with erosion precincts, and development preclusion zones in the development control plans (DCP)'.

The only thing close to the previous framework of the Byron Shire Council was the 2019 Coastal Resilience State Environmental Protection Policy that morphed into the *State Environmental Planning Policy (Resilience and Hazards) 2021*.[4]

Questions about the environmental policy included how future coastal hazards can be anticipated with such complexity of weather events and why property owners can build in a hazard zone, despite the documented risk. Rebuilding in high-risk beach environments is exemplified at Wamberal Beach, where 9 multimillion-dollar developments on the beach have occurred in the last 3 years since the erosion events in 2016 and 2020.

This research also asked, 'Does there need to be a shift in land-use planning and adaptation methodology for coastal communities to address the Sendai Framework and the increasing climate risk of coastal erosion?' The responses were

4. *State Environmental Planning Policy (Resilience and Hazards) 2021,* at https://legislation.nsw.gov.au/view/html/inforce/current/epi-2021-0730.

varied. Focus group participants agreed with the question's sentiments of stopping development in high-risk zones. A respondent from the Central Coast study area considered that there was no legislation to enable such a shift. They suggested that building sea walls was the only response to protect development. In contrast, the council participants in the Byron Bay case study area agreed that a change in land-use policy needed to occur to reduce risks from erosion and that sea walls were not the ultimate answer. This was currently hindered by state legislation.

Beyond engineering

While sea walls and revetments[5] may align with a Sendai Framework key action of investing in disaster resilience adaptation, there are practical limits to the effectiveness of engineered structures. As sea levels rise and coastal hazards exacerbate erosion, hold-the-line adaptations will not be able to respond flexibly to the risk. According to Dodman *et al.* (2022), 'Globally, it is estimated that as much as USD 94 trillion of investment is required between 2016 and 2040 to replace, upgrade and extend the world's physical infrastructure' (sect. 6, 3.5).

The question asked in the research was, 'Do sea walls align with the objectives of the Coastal Management Act 2016[6] and are they sustainable in the long term?' The viewpoints of participants varied. Some considered sea walls sustainable with limited environmental effects while others were concerned about the varied environmental changes from sea walls and sand nourishment. The concept arose that while sea walls may protect what is behind them, beach erosion can still occur as the structures modify coastal processes and deflect wave energy to adjacent properties and other coastal areas. This alters sand morphology and causes erosion and edge effects as described by the Department of Climate Change and Water (2009), 'Developed areas of the coast that have had natural dune systems removed and replaced with engineer structures will become exposed to water levels and dynamic wave forces beyond their original designs'. Balaji, Sathish Kumar and Misra (2017) conclude that, 'the detrimental effects of seawall construction are overlooked in order to preserve the beach and to control the irresponsible shoreline development that takes place along it' (p.159). With expected sea-level rise and changes in storms to dominate coastal processes over the next few decades (Department of Climate Change and Water 2009, p.34), ongoing sand renourishment for the life of a sea wall will become expensive. This was reported in the cost-benefit analysis within a report to Gosford City Council that stated, 'the cost of sand replenishment is very high and outweighs the benefits of retaining a beach in front of a seawall' (Marsden Jacob Associates 2106). Considering the long lead time of adaptation funding and implementation, the moratorium[7] on offshore exploration and mining in New South Wales, the effects of coastal squeeze (the loss of beach width due to a fixed position of the revetment wall) and environmental damage, councils in New South Wales should not be allowing walls to be built. Griggs and Patch (2019) state that, 'The era of routine armour emplacement is coming to an end in California' and in other countries.

Managed relocation

Griggs (2015) states:

Coastlines globally have been migrating landwards since the last Ice Age ended about 18,000 years ago, and all indications are that this trend will continue in the decades and centuries ahead, at an increased pace as the rate of sea-level rise increase (p.129).

If the data on receding coastlines is considered along with sea-level rise and concerns raised about the exposure of houses on eroding beachfronts, then the managed relocation of residents in high-risk beach environments is a most logical and practical option to reduce vulnerability. Managed relocation, also called 'strategic retreat' or 'planned retreat', is a land-use management response that involves moving existing properties away from coastal hazards.

Other options of rolling easements, which move the property boundary as shoreline encroachment from erosion and sea-level rise increases, and sea walls that may enable properties to remain on the beachfront are a hold-the-line mentality and is not sustainable or practical in the long term. Marsden Jacob Associates (2106) suggested that retreat provided 'greater benefits than a continuation of the current approach' and was the only option with a positive net present value. However, such reports can be dismissed by councils, political representatives and authorities as unworkable due to negative effects on residential landholders' property rights versus community benefits of the beach and lack of planning frameworks. To implement retreat, councils need to look beyond self-reinforcing feedback of restrictive legislative boundaries that support private property rights. Policy pathway dependency occurs when councils are sympathetic to protecting at-risk coastal properties and are resistant to new ideas, following the status quo of existing policy.

Anderson *et al.* (2020) highlight that, 'Managed retreat has been on the global agenda as a sea level rise adaptation strategy since at least 1992'. The IPCC (1992) report stated that 'only avoidance and relocation can remove coastal risks for the coming decades' (p.59) and that retreat was a strategy to 'protect people and ecosystems to shift landward in an optimal fashion' (p.135).

Figure 2 shows the levels of impact on properties in New South Wales exposed to sea inundation and coastal erosion predicted out to 2060. This numbers of affected properties will increase as the sea level rises and storm surges intensify. The 46,000 at-risk properties could be much higher due to the uncertainties of the Antarctic ice sheet melt and other climate parameters.

5. A revetment is a type of sea wall structure that is made of concrete or armour stones and built parallel to the shoreline to absorb and reflect wave energy.

6. Coastal Management Act 2016 No 20, at https://legislation.nsw.gov.au/view/html/inforce/current/act-2016-020.

7. NSW Government policy, Offshore exploration and mining, at www.resourcesregulator.nsw.gov.au/sites/default/files/2022-10/policy-offshore-exploration-and-mining_0.pdf.

8. Coastal Lands Protection Scheme, at www.planning.nsw.gov.au/policy-and-legislation/coastal-and-marine-management/coastal-lands-protection-scheme.
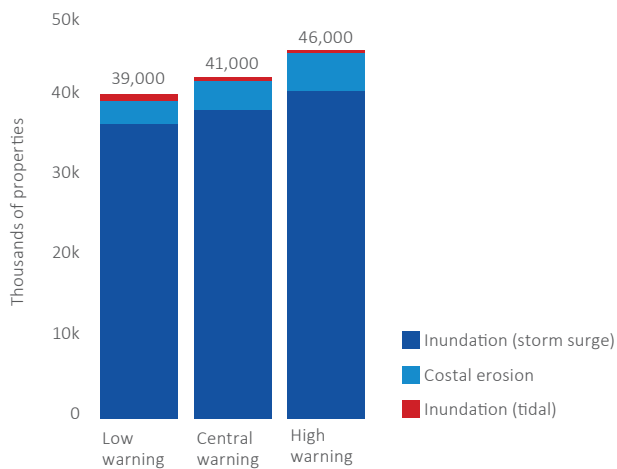
Figure 2: Properties exposed to sea inundation and coastal erosion by 2060–61.

Source: NSW Treasury (2021)

A question asked of participants in both case studies was, 'Will we build walls along the entire coastline of Australia to defend the increasing level of houses coming under risk, or is it better to implement retreat options?' A response was: 'We are running a hold-the-line strategy and there is no viable mechanism to plan retreat or any government-provided funding to buy susceptible houses out'. In New South Wales, there is the Coastal Lands Protection Scheme[8] that has legislative powers under the *Environmental Planning and Assessment Act 1979*[9] for acquiring land. The scheme has an annual budget is $3 million and its aim is to acquire scenic and environmental coastal land. However, this scheme could be expanded to purchase land deemed vulnerable to coastal erosion.

The *National Strategy for Disaster Resilience* (Commonwealth of Australia 2011) presents land-use planning for disaster resilience as essential to shaping resilient communities via adaptation. However, Kellett *et al.* (2014) recognised an absence of coastal adaptation policy at the national level. This research also found

that this problem continues. Implications from climate change demands that land-use planning be based on knowledge of past events and also on future alternative land uses to incorporate flexible responses that foresee future changes (Serrao-Neumann, Harman & Low Choy 2013)

A national settlement strategy advocated by the Planning Institute of Australia (2018) could assist in preparing cities for relocation away from coastlines and the eventual changes due to sea-level rise rather than allowing ad hoc migration during and after extreme weather events. In Australia, there has been limited success with beachfront buyouts for adaptation purposes identified within this research and O'Donnel (2019). Thus, removing the problem of risk and vulnerability in the first place can reduce the bureaucratic processes following post-reconstruction and the costs to communities from severe weather events.

Implementation framework

Risk-based land-use planning is about being responsive to and adapting to natural hazard events. In a changing climate, strategic planners need to match land use with its presented risks. Figure 3 maps a proposed implementation of managed relocation through the various layers of government and policy and identifies how local governments can achieve greater integration with Australia's national risk hierarchies. It also shows how state and territory emergency arrangements can manage relocations.

The point of this diagram is not about ownership of policy, but policy implementation from the national level to align with different state and local government policies. The flow of the diagram starts with Australian Government involvement with a national climate policy that connects with a national settlement strategy and existing national risk reduction strategies. The yellow boxes highlight the end goal of removing development from high-risk locations based on these national strategies. Boxes at the sides direct the actions of the states and territories (left-hand side) and local governments (right-hand side). Implementation

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9. *Environmental Planning and Assessment Act 1979*, at www.planning.nsw.gov.au/policy-and-legislation/environmental-planning-and-assessment-act-1979.
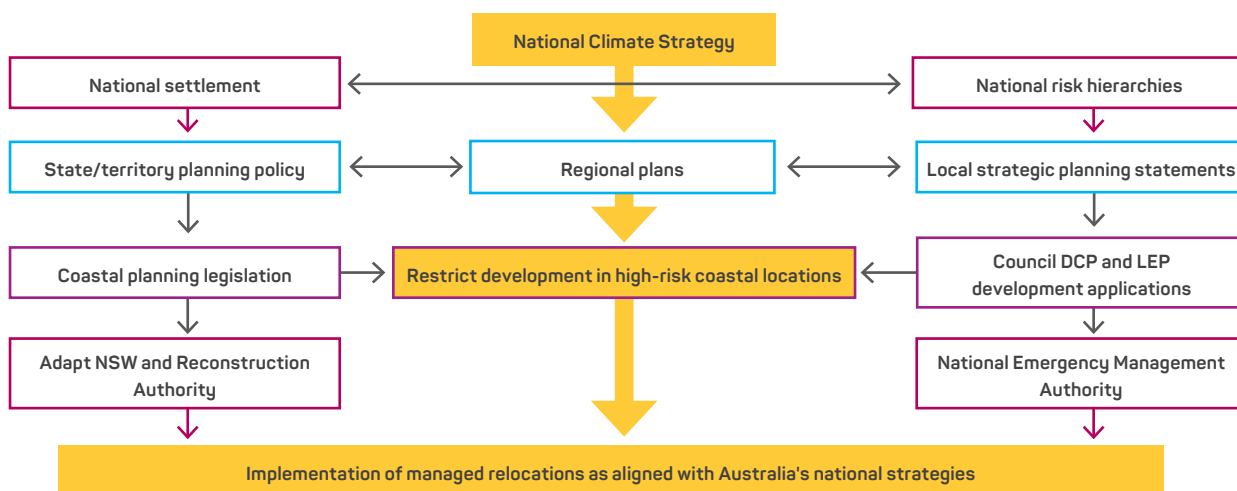

Figure 3: A framework for integrating national policies with local councils for risk reduction via managed relocation.

must be incorporated in state, regional and local planning legislation and policy implemented via local councils. Funding, machinery-of-government changes[10] and descriptions of in-depth implementation are the subject of future research.

Discussion

This study outlined aspects of coastal erosion and the risks to beachfront development from extreme weather events and rising sea levels. It highlighted the differences in adaptation strategies to reduce the risk of erosion. In the Central Coast case study, a self-reinforcing feedback and path dependency approach based on current legislation was adopted. Thus, the council is not reducing the risks from rising sea levels and storm surges by allowing development in high-risk coastal locations.

The Byron Bay case study found that the council wants to act on coastal hazards and looks beyond the current legislative path and has opted for a managed-retreat approach. However, the council is restricted because of the NSW Government intransigence that the strategy aligns with existing government planning policy.

This study did not identify any political will nor appetite for changing public policy to incorporate managed retreat as an adaptation action to reduce risk. The New South Wales planning legislation continues to provide planning mechanisms that allow development in high-risk beach locations and there is no policy to move people away from high-risk zones. With increasing climate risk and coastal erosion impacts, landholders and planners must stop relying on engineering options like sea walls to prop up properties that are no longer sustainable in a climate-affected future. A national coastal reserve that adopts nature-based solutions as a coastal defence and is legislated by state governments and implemented by local governments is a pathway towards reducing the ongoing risks of coastal erosion and sea-level rise. The mechanisms and operations of a national climate coastline reserve is a topic for further research.

Conclusions

This study used qualitative case studies to examine how 2 local governments in New South Wales address the risks to coastal residential development and the connection between government and risk hierarchies. The case studies revealed a difference in council approaches. However, neither council appeared to be effective in reducing the risks to their coastline communities from storm surges and erosion. If beachfronts continue to erode as a result of business-as-usual planning, economic losses will escalate. Current planning practices must evolve to adapt to climate risks.

The implementation of an integrated government approach will better address legacy developments and reduce post disaster reconstruction after storm events. Local councils must incorporate the objectives of the Sendai Framework within their planning structures. Doing so will enhance disaster preparedness and reduce community vulnerability.

Society must take action to address the risks of climate change and its impacts on beachfront developments. To achieve this, all levels of government must work to ensure long-term sustainability with a greater emphasis on strategic planning that directs people and business away from exposed coastline areas.

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10. Machinery-of-government refers to the structures of government and how it works including the functions and accountability of departments and how they work together to deliver results for the public.

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An operator's guide to SPAR(CD): a model to support decision-making

Peer reviewed

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Introduction

Penney *et al.* (2022) described a study of over 10,000 English-language studies on threat assessment, sense-making and critical decision-making in the fields of police, military, ambulance and firefighting. The study resulted in the improvement of the SPAR decision framework (Launder & Perry 2014) used in urban fire service operations in Australia (e.g. the South Australian Metropolitan Fire Service Operational Decision-making Model – SAMFS, 2019). The enhanced framework, known as the S(CD)PAR framework (Launder & Penney 2023), is an all-encompassing decision-making approach applicable to emergency management. It consists of 6 constructs: Situation Awareness, Context Assessment, Decision-making, Planning, Action and Review. These constructs were identified through the review of high-risk industries and, while they are typically followed sequentially, they can be used flexibly depending on the situation.

In this paper, and building upon the theoretical roots presented in Launder & Penney (2023), a concise and practical version of the S(CD)PAR framework called the SPAR(CD) model (Figure 1) is presented. The SPAR(CD) model is equally suitable for frontline novices and experienced controllers in emergency services organisations as well as in business contexts.

The SPAR(CD) model, derived from the S(CD)PAR framework, retains the main themes identified in the research but is presented in a visually simplified form. This simplification enhances its practicality for operational use, such as procedure development, training and post-incident review. The naming convention has been simplified using the acronym SPAR(CD) instead of S(CD)PAR to make it easier to remember and communicate. The SPAR(CD) model aligns with the theoretical foundation of the original framework while being accessible and practical.

The tailored version for practitioners simplifies the language and provides guidance instead of descriptive terms used in the framework. The model uses visual imagery to make it memorable for users. For example, the Situation, Plan, Actions and Review domains are colour-coded with supporting text using the same colours to enhance visibility.

Abstract

In order to explore the commonalities and differences in decision-making across emergency services organisations, a systematic literature review of over 10,000 peer reviewed English-language studies was undertaken looking at sense-making and critical decision-making in police, military, ambulance and firefighting contexts. The insights gained and lessons learnt from this research enabled the development of the Situation, Context, Decision, Plan, Act, Review or S(CD)PAR framework. The new framework is hazard and service agnostic, not only incorporating complexity analysis and contextual factors but also being applicable to the full spectrum of emergency management operations. This paper presents the operational translation of the theoretical S(CD)PAR framework into a multi-sector end-user decision SPAR(CD) model that can guide operational decision-making as well as the development of policy, procedures and learning and assessment tools. While the S(CD)PAR framework and SPAR(CD) model have been developed based on research in high-consequence and low-time emergency services and military environments, they are equally applicable in other environments including business contexts and boardrooms wherever decisions are made. This research and subsequent model are important as it supports a common approach to decision-making and also provides a foundation for teaching and assessing evidence-based decision-making across multiple contexts.

Figure 1: The operational all-hazards SPAR(CD) Decision Model in an end-user version of the S(CD)PAR Framework.

The Context domain is represented by vertical continuums, simplified to avoid overwhelming information. Additionally, 5 decision-making situations are represented with distinct colours and brief descriptions. The model also includes text to guide decision-making and emphasises the importance of considering context, prior experience and deviating from procedures only when necessary and when the decision-maker(s) have successfully managed similar situations before.

In this paper, the key elements of the simplified SPAR(CD) model are presented as well as their potential applications of developing doctrine and procedures, creating learning and assessment resources and conducting post-incident reviews.

Situation awareness

The initial phase of decision-making involves the decision-maker comprehending their surroundings by gathering and interpreting important information (Penney *et al.* 2022). While terms like 'assessment', 'threat assessment' (Martinez-Fiestas *et al.* 2020, Penney, 2019), 'perception' (Moffat & Witty 2002), 'orientation' (Bryant 2006) and 'situation assessment' (Cohen-Hatton & Honey 2015) were identified, Endsley's (1995, 2015), situation awareness was found to be the most commonly mentioned term and the one with the most applicability.

The model's description of situation awareness, although simplified, serves as the foundation for both common and industry-specific language and training. For instance, while gathering and interpreting information is necessary in any industry, there are distinct differences in the nature of the information, its meaning and how it is gathered. Paramedics, for example, seek patient symptoms to understand the extent of trauma and predict the likelihood of survival and the need for immediate hospital transfer (Gunnarson & Stomberg 2009, Ryan & Halliwell 2013). Firefighters develop situation awareness through 'size-up', which involves assessing visual cues like smoke density, colour and movement to determine the risk of flashover, survivability and structural collapse (Launder & Perry 2014). Police may engage in 'threat assessment', considering factors such as incident type, location, number of individuals involved, public visibility, suspect characteristics and behaviour to assess personal and public risk (Bonner 2018, Harris *et al.* 2017). Similarly, military personnel gather intelligence through surveillance and intercepted communications taking into account terrain, enemy disposition, morale and logistical movements to develop situation awareness (Shortland, Alison & Barrett-Pink 2018). While these examples are simplistic, they highlight the common process of understanding the relevance of industry-specific information, learning methods to obtain it and, most importantly, building experiential knowledge for interpretation, schema development and prediction.

Context

Review of the literature identified an additional set of factors that may affect the development of situation awareness. These factors include time and risk factors identified by Crichton and Flin (2002), decision-maker confidence (Launder & Perry 2014) and 'contextual' domains identified in the Cynefin

framework (Snowden 2002). The importance of context to the development of situation awareness and subsequent decision-making is recognised by the inclusion of the 'C' in the S(CD) PAR framework and SPAR(CD) model. The complexity of the operating environment is a significant factor for decision-makers. The Cynefin framework (Snowden 2002) categorises context complexity into domains: Complex, Complicated, Clear, Chaotic and Confused. These domains correspond to different levels of situation complexity and, in emergency operations, there is a potential to transition through these domains based on operational tempo, influences and changes. The perception of complexity may vary depending on an individual's perspective. For example, a large chemical warehouse fire may be rightly perceived as chaotic by someone fleeing, while an experienced fire services incident controller may view it as complicated. Experienced decision-makers must avoid becoming overly confident in their understanding of the situation as they may fail to anticipate or recognise potential changes that can cause chaos in the environment.

The connections between assessing the context type and selecting decision approaches are crucial, especially in developing personnel for such environments. Therefore, all these contextual factors, including time, risk, confidence (affective domain) and the Cynefin domains, are incorporated into the S(CD)PAR framework and the SPAR(CD) model. These factors are presented as linear spectrums representing a gradient between low and high, illustrating how this gradient corresponds to the selection of a decision. For instance, low-time, high-risk situations require the use of Type 1 (or naturalistic) decision strategies (Klein 1998), but this may pose challenges if the decision-maker lacks confidence or experience. To maintain visual simplicity, the SPAR(CD) model does not include text descriptions of these gradients and combines confidence and experience into a single continuum, with the understanding that additional information would be provided in explicit training and procedural resources.

Decision-making (Type 1)

The S(CD)PAR framework and SPAR(CD) model (see Figure 1) present a spectrum of decision approaches ranging from fast and intuitive Type 1 (naturalistic) to Type 2 formal strategies, as proposed by Crichton and Flin (2002). After reviewing various models in the literature, 5 strategies were frequently cited and widely applicable in emergency services and military contexts. The framework summarises these models, starting with those closest to the naturalistic end of the spectrum.

In all service contexts, the fastest decision strategies used in low-time, high-risk situations include recognition primed, intuitive, value-based or heuristics-based decisions. These approaches are commonly classified as naturalistic or Type 1/System 1 decisions (Kahneman & Klein 2009; Klein 1993; Klein, Calderwood & Clinton-Cirocco 2010) and are employed by firefighters, police, paramedics and military personnel in such settings (Bakken & Gilljam 2003; Jenkins *et al.* 2010; Cohen-Hatton, Butler & Honey 2015; Harman, Zhang & Greening 2019; Klein 1993, 1998; Klein, Calderwood & Clinton-Cirocco 2010; Cohen-Hatton & Honey 2015; Okoli *et al.* 2016; Pripoae-Serbanescu 2012; Murdoch 2019;

Reay *et al.* 2018). In situations with severely limited decision time, these strategies may be the only ones that can succeed.

The next type of decision strategy is 'value-based', which relies on the decision-maker's ethical or moral values or their perception of right and wrong in a given situation. While these strategies were found to facilitate rapid decision-making, they also have the potential to introduce decision errors and biases (Ferguson 2002; Kahneman, Slovic & Tversky 1982). Additionally, concerns exist that values, whether cultural or organisational, can consciously and unconsciously influence risk perception and appetite. When responders are required to participate in or make operational decisions that conflict with their own values, it can lead to long-lasting and damaging moral injury (Lentz *et al.* 2021).

The third Type 1 decision strategy is 'procedural' decisions, which are predetermined decision solutions derived from known and previously resolved situations, risks and problems. The literature indicates that inexperienced personnel are expected to closely follow documented procedures (e.g. Perona, Rahman & O'Meara 2019; Reay *et al.* 2018; Seiler, Fischer & Ooi 2010), while more experienced personnel use procedures as operational guidelines, particularly for recurrent or routine aspects of tasks (Okoli *et al.* 2016). One coronial review emphasised the importance of procedures providing simple and accurate guidance and being complemented by the teaching and practice of other decision-making strategies (Torrie 2012).

Decision-making (Type 2)

Formal decision strategies involve considering multiple options to develop optimal or innovative solutions. The literature supports the use of formal decision strategies in situations where there are risks of decisions being questioned (Seiler, Fischer & Ooi 2010) and in complex and uncertain high-risk industries. These strategies are also applicable in stabilised situations, allowing for confirmation or disconfirmation of initial Type 1 decisions as well as in complex situations where multiple decision-makers must handle extensive situational information over a prolonged period (McLennan *et al.* 2006). Formal decision strategies can be used as a training approach aligned with procedural solutions for beginners until they gain enough experience to employ faster intuitive strategies (Banks, Gamblin & Hutchinson 2020). This represents the transition from Type 2 to Type 1 thinking as discussed by Kahneman (2011).

Plan

In the sectors examined, the concept of 'planning' is well-established and widely implemented. The literature identifies common elements of planning behaviours, which include setting objectives, considering options, selecting appropriate strategies and tactics and establishing organisational or command structures to ensure coordination and logistical functions in developing the plan. The term 'planning' encompasses both the preparation for a future situation and the process of deciding on an optimal strategy.

In the SPAR(CD) model, a plan is defined as a formalised course of action resulting from conscious consideration of options through formal decision-making. Planning includes behaviours such as objective setting and the establishment of aligned strategies and objectives, which are fundamental elements in operational doctrine and practice across these industries. These behaviours are documented in frameworks like the National Incident Management System[1] in the USA and the Australasian Interagency Incident Management System.[2]

Act

In the sectors examined, the implementation of decisions, regardless of the decision-making process, was found to be a crucial factor in determining success or failure. In the original SPAR model, this phase was referred to as the 'Act' phase. The literature indicates that in situations requiring rapid Type 1 decisions, success relies on the technical and interpersonal expertise of decision-makers and their immediate team members. They must effectively manage the cognitive and emotional demands of the situation. This means that personnel on the front line need to possess situational awareness, make satisfactory and safe decisions and have the technical and emotional abilities to perform necessary actions under pressure. However, the responsibility for enacting decisions also falls on senior officers in larger incidents, where the effectiveness of plan execution is strongly linked to translating decisions into timely and effective actions.

Coronial investigations (e.g. Torrie 2012; Teague, McLeod & Pascoe 2010; BBC 2023) have highlighted the failure to employ these action or plan implementation behaviours as contributing factors to fatalities, community loss and incident management failures. Therefore, these behaviours are explicitly incorporated in both the S(CD)PAR framework and SPAR(CD) model. The framework defines actions as the behaviours used to carry out decisions by the decision-maker or those directed by them. In contrast, the model simplifies this definition and explicitly describes 4 actions that determine the success or failure of decision implementation: communication, coordination, control and capability. Specific instructions are provided for each of these behaviours in line with the findings of the literature review.

Review

The literature highlights that across the sectors examined, the effectiveness of decisions and their implementation is monitored, evaluated and adjusted as needed. The term commonly used to describe this process, and subsequently adopted in both the framework and model, is 'review.' Personnel first deployed to these high-risk environments may dynamically and intuitively review the initial situation awareness, decisions and deployments and their effectiveness. As situations become larger, more complex and higher-risk, there is a need to shift towards formal decision strategies involving higher-ranking personnel and the formalisation of planning, communication, coordination and control. Experienced individuals are more likely to recognise this

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1. National Incident Management System, at www.fema.gov/emergency-managers/nims.

2. Australasian Interagency Incident Management System, at www.afac.com.au/initiative/aiims.

need earlier and take corrective actions promptly. In declared emergencies and military operations, regular and structured reviews are conducted through situation reports and briefings. These formal reviews allow for the confirmation, disconfirmation or overriding of initial intuitive decisions or decisions implemented by personnel acting on orders from senior officers through deliberative and analytical thinking. In longer incidents where decisions are made in a series, the review process enables decision-makers to implement a decision, learn from the outcome and make corrections before making new decisions.

Application of SPAR(CD) beyond incident response

Doctrine

The literature identified strengths and weaknesses of doctrine, policy and procedure across the sectors. Doctrine is most frequently identified in the literature in the military context as a set of principles that overarch policy and procedure.

Whereas the failures of prescriptive policy and procedure were documented in the literature (e.g. Sarna 2002, Manne 2009) the need for a balanced and flexible approach to policy and procedure were also identified (e.g. Launder & Perry 2014). Therefore, the decision theory elements identified in the literature may form the basis for the development of fundamental principles that may be adopted as common elements of doctrine, policy and procedure while providing implicit and explicit guidance for how intelligent and informed decision-making can be developed and applied. For example, although the SPAR(CD) model is theoretically non-linear, it can form the basis of a multi-situational process consisting of:

1. establishing situation awareness
2. making an appropriate decision (for the context)
3. putting immediate decisions into 'action'
4. reviewing initial decisions, their implementation and the evolving situation
5. formalising operational 'planning' including objectives, strategies, tactics and management structures
6. formalising coordination, control and capability systems as scope and scale increase
7. repeating these processes dynamically until the situation is normalised
8. undertaking a post operational review of each element.

Under this proposed model, the broad approach (doctrine) is generalisable. However, for each specific situation and context, enough specific information would be required to provide clear 'rules' for novices and guidance for experienced personnel. For example, an operational structure fire procedure may provide explicit guidance on the situational information to be gathered and interpreted and how this information may be obtained. It might then specify immediate actions that must be taken to ensure firefighter safety and guidance on appropriate strategies and tactics based on what has been determined to

have been effective in previous 'like' situations. However, even well-constructed doctrine, policy and procedure are unlikely to be effective without additional explicit and implicit teaching of these underpinning decision-making principles and behaviours (Torrie 2012). Furthermore, these links between explicit principles of doctrine and the provision of learning are implicit in the definition that 'doctrine means "that which is taught"' (Australasian Fire Authorities Council 2016).

Learning and assessment

One of the findings of this study was the contention that these high-risk sectors should include implicit and explicit teaching of decision-making to personnel (e.g. Torrie 2012). Therefore, decision theory should form an explicit part of the curriculum taught across these sectors—not as a standalone element, but as a key embedded component of the development of expertise and mastery. The SPAR(CD) model is particularly compatible with contextualised learning and assessment strategies where increasingly complex simulated environments are used to develop expertise.

First, learning environments should contain and require learners to identify and understand situational factors they will encounter requiring the application of theoretical understanding. Next, they should require learners to determine a working course of action and put this into action applying technical skills and capabilities. These environments should include the requirement to reflect on decisions and actions taken and where opportune the provision of feedback and coaching. The SPAR(D) model has been applied within the fire sector as the basis for assessment of incident management competence. This includes the development of assessment rubrics for each of the model's constructs.

While the primary scope and length of this article prevents full discussion of these assessment rubrics, an example rubric element for the situation construct is provided in Table 1. In the example provided, a sliding quantitative scale supported by evidence-based objective behaviour measures enables situational awareness to be captured. With subsequent rubrics for each of the SPAR(CD) elements, the components of decision-making can be assessed separately within a single holistic training simulation (or used in real-world real-time incident mentoring and validation). Development of each of the associated rubrics in full is identified as a body of future work by the authors.

Post-situation/incident review

The SPAR(CD) model provides a framework for the consistent review and analysis of critical factors following the deployment of personnel in complex, high-risk situations. The application of a consistent cross-industry 'lens' will produce consistent findings with common constructs and terminology to ensure emerging risks and operational successes and failings are likely to be shared. An example of the application of the SPAR(CD) model for post-incident review is provided and some key findings are summarised of the Grenfell Tower fire (Moore-Bick 2019).

The Grenfell Tower fire in West London of 14 June 2017 resulted in the loss of 72 lives. The fire started in a refrigerator in an apartment on the fourth floor of the building. The fire 'flashed

Table 1: Example rubric assessing the Situation domain of the SPAR(CD) model.

Situational awareness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Uses appropriate strategies to establish Level 1, Level 2 and Level 3 Situational Awareness (Gathers the right incident information, develop a clear and accurate model of the incident and its likely progression that Includes accurate risk vs benefit assessment)	Situational Awareness is flawed: · unstructured (misses key strategies/ sources) and untimely · fails to identify or understand risks, generic or critical incident factors · inaccurate prediction of the incident progression and consequences · projections flawed/high-risk.			Situational Awareness is incomplete: · uses a limited range of information strategies · untimely (delayed or rushed) · misses critical factors or requires prompting · situational factors/risks are misinterpreted · does not verbalise an accurate model.			Situational Awareness is satisfactory: · gathers key information within required time · includes key strategies (inner/ outer, inspection) · identifies crucial generic or critical factors · verbalises an accurate model includes key (obvious) factors and risks · outlines a probable incident progression.			Situational Awareness is effective: · information gathering is efficient · rigorous, includes key strategies (inner/outer, inspection) · identifies all key and critical factors · consistent with procedure · verbalises a clear and accurate model of the incident addressing key factors and risks · outlines a logical progression of incident.			Situational Awareness is highly effective: · information gathering is prompt and efficient · comprehensive, including key strategies · identifies all key information · consistent with procedure · promptly articulates a comprehensive and accurate model of the current and future incident addressing all key factors and risks.		

over' breaking the apartment windows and igniting combustible aluminium composite panel cladding fixed to the tower.

The fire displayed behaviour that had not been previously observed by firefighting personnel in attendance. The fire spread was faster than previously witnessed, driven by a combination of highly combustible aluminium composite panels and a wind-driven (pressure-differential) effect and an eventual heated air column. A lack of previous experience with the materials burning, the speed of fire spread and misunderstanding of temperatures generated by the fire led to flawed situational awareness. Furthermore, personnel were unaware that some of the tower stairwells were compromised and access and egress was reduced. Initial decisions were made following organisational procedure. Primarily, this involved informing building occupants to remain in their premises until rescued. Firefighters would then ascend the building and clear each floor. It is noted that executing this procedure would require considerable time and resources.

Next, the deployment of personnel and the status of plan execution was severely compromised by the partial failure of communication systems (radios) and the reduced stairwell access. The failure of communication systems affected the dynamic incident review and incident commanders did not have correct awareness of the rate of progress of occupant evacuation. It was not recognised early that the heat generated by the aluminium composite panels and air column had caused the failure of external windows. This led to 'flashover' in apartments and rapid increases in the speed of fire spread. Under these hostile conditions, the initial decisions and plan to withdraw personnel had no chance of

success. However, past experience had resulted in public injuries when unsupervised evacuations were implemented. Tragically, the fire behaviour encountered at the Grenfell Tower had been observed previously with as many as one equivalent scale, albeit without the number of fatalities (Thompson 2023). Enhanced cross-industry collaboration using consistent constructs and terminology is important to develop professional wisdom and improve decision-making in such high-consequence events. We posit the SPAR(CD) model and its associated outputs supports this.

Conclusion

The modified SPAR(CD) framework describes the common constructs and concepts found in the literature regarding decision-making in these sectors and the broader field of psychology. Its purpose is to establish a foundation for enhanced communication and collaboration among these sectors by identifying shared constructs and contexts. The goal is to achieve greater consistency in the terminology used to describe decision-making. By employing a common framework, it is anticipated that cross-sector learning can be facilitated that allows for a consistent examination of high-risk, time-sensitive decisions and the identification of common decision errors. This framework can improve decision-making through initiatives such as learning and development programs, policy and procedure design and implementation. Although developed for high-consequence emergency services and military settings, the SPAR(CD) framework can be applicable in other contexts, including business environments and boardrooms.

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Operational prediction of extreme bushfires

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Introduction

Through the 1980s and 1990s, fire agencies in Australia put significant effort into using the El Niño-Southern Oscillation Index as a seasonal outlook tool. It measured reversing seas surface temperature gradients across the equatorial Pacific Ocean that affected weather patterns on a hemispheric scale. This work was supported by development efforts by the Bureau of Meteorology[1] and by the media in the reporting on approaching fire seasons. It worked well and is still widely used.

El Niño years were hot and dry (although not necessarily windy) and produced bad fire seasons. La Niña years were the opposite and these 2 states typically defined the maximum and minimum conditions facing fire services. After the 1997 El Niño event, the climate across the south-east regions of Australia began changing. In places like Canberra, the average temperature has risen over 3 degrees Celsius, while summer temperatures have risen by more (see Figure 1). This upward trend has major annual variations imposed on it, so a year that falls on the trendline may now exceed the pre-1997 El Niño peaks while a year warmer than the trendline may set new records.

Widespread firefighting operational challenges were experienced during the Australian summer bushfires in 2019–20 and suggest that the fire climate 'rule book' has been rewritten. New fire types are occurring with increasing frequency. PyroCbs are fire thunderstorms that form in violent pyro-convective plumes and these are increasing in frequency (McRae 2022) (see Figure 2). While fires driven by the foehn effect (hot, dry winds coming off higher terrain) were novel a decade ago (Sharples *et al.* 2010), they are around half of the major events that occurred during the Australian summer bushfires in 2019–20. It is clear that new tools are required.

To support adaptation, a Hierarchical Predictive Framework (HPF) has been developed. This takes lessons from recent research into extreme bushfires that have occurred and draws on long-established knowledge to show strong linkages that allow effective predictive services. Figure 3 shows the framework. It operates on a range of temporal scales, each requiring different concepts. As the fire season gets closer, the scale shrinks and new concepts are applied,

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1. Bureau of Meteorology ENSO Outlook, at www.bom.gov.au/climate/enso/outlook/.

Abstract

Fire behaviour is changing as new modes of fire spread dominate in south-eastern Australia, making extreme bushfires significant risk drivers during bad fire seasons. This is linked to changes in climate and landscape hydrology. A Hierarchical Predictive Framework has been developed specifically to predict the risk of extreme bushfires in south-east Australia. It uses temperature anomalies and the accumulation of river drying events to predict seasonal risk. If that risk is raised, a Blow-Up Fire Outlook model looks at fire weather forecasts and fireground context for specific risk prediction. This guides operational intelligence gathering to support decision-making by incident management teams. The Hierarchical Predictive Framework is based on over 20 years of archival data on extreme bushfires and their context. It is intended to work alongside, but not replace, existing operational systems. Tools like the framework can help keep fire crews safe in the face of risks like branched troughs and the rapid rise in prominence of foehn-driven fires in Australia, as well as the rapidly growing threat from fires that spawn pyrocumulonimbus clouds (pyroCbs).

producing a nested set of alerts leading up to the tools needed by an Incident Management Team to keep communities and fire crews safe.

The framework has been applied retrospectively to assess its performance. Levels 1 and 2 have been applied to more than 2 decades of data. Level 3 has been partially assessed using data from the Australia's 2019–20 bushfires land temperature anomalies. This paper describes the framework and reports the results of analysis. It shows that the hierarchic approach works well and that the HPF may be an effective operational predictive tool.

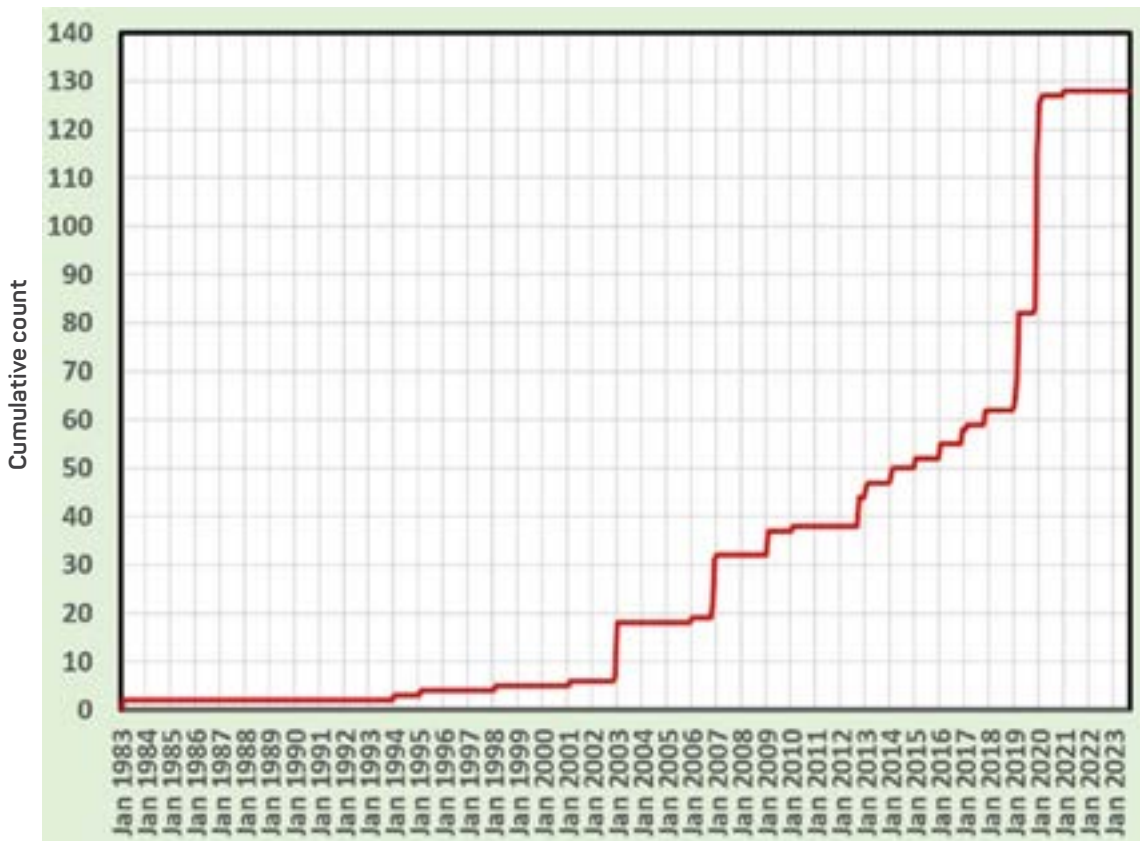Figure 1: Trends in land temperature anomalies at Canberra airport.

Figure 2: The Australian PyroCb Register, at www.highfirerisk.com.au/pyrocb/register.htm.
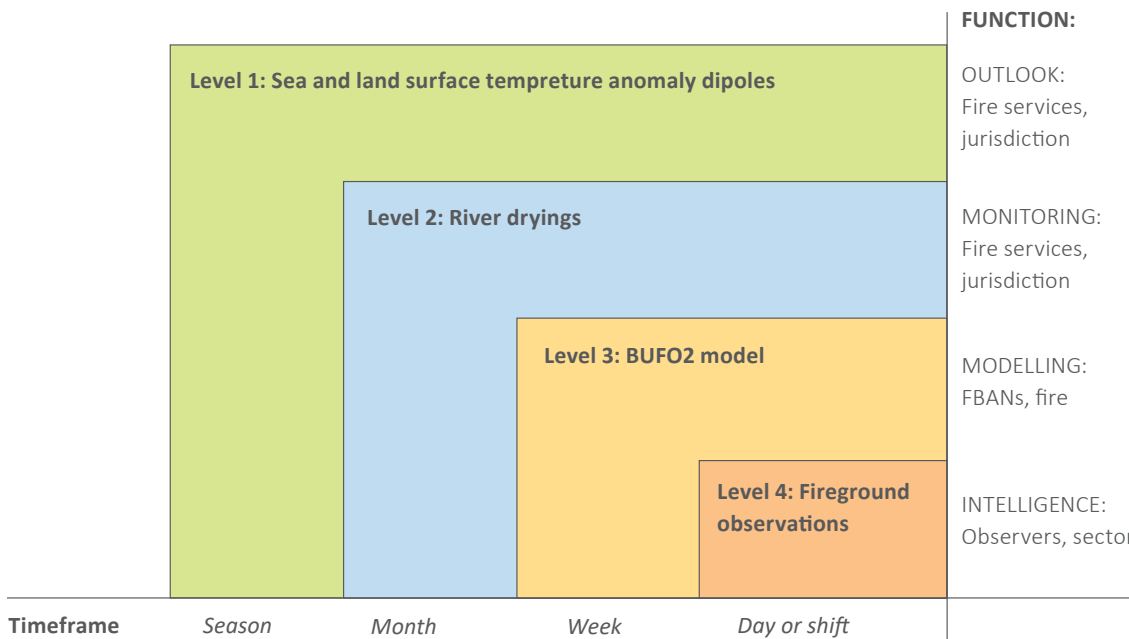
Figure 3: Schematic structure of the HPF showing the linkages between spatial and temporal scales.

Method

With the goal of predicting the potential for the most damaging class of bushfire, the HPF presented here is based on observations of environmental variables. These are brought together in a way that uses 4 levels to provide closer scrutiny if that potential increases. It is designed to support fire service operations.

Level 1

A Level 1 alert is an early monitoring stage alert. Sea surface temperatures (SSTs) started being recorded after the 1983 El Niño event. This was based on buoy and satellite imagery. A climatology of expected SSTs was developed and this is subtracted from the latest observations to derive SST anomalies. Maps were produced by the US National Oceanic and Atmospheric Administration and have been available online. The HPF uses SST anomalies averaged over a 12-month period.

Most blow-up fire events in eastern Australia are in the forests near the coast as well as in the highlands between Melbourne and Brisbane and into Tasmania. A convenient central reference site was selected at Canberra airport within the Australian Capital Territory. Land temperature anomalies are averaged over 12 months in the same way as the marine ones using a Bureau of Meteorology climatology. The difference between the 2 averaged anomalies is termed the 'Canberra Dipole' and is the basis for a Level 1 alert that is issued if the dipole is positive and increasing heading into or during summer.

Figure 4 shows that there has been a radical swing from the heat of bushfires in the 2019–20 fire season into the flooding conditions of the following years. At the time of writing, the

black line showing the Canberra Dipole is climbing and there is a potential for a Level 1 alert in either the next summer or the one after. Events from early 2002 leading up to severe bushfires in Canberra in January 2003 suggest that a 9-month lead-up may be required from the current similar situation, suggesting March 2024 is the earliest date.

When positive, the dipole shows the potential for land temperature anomalies to affect synoptic patterns that produce complex trough systems onshore that are involved in most extreme bushfire events. An example is shown in Figure 5, which is an image taken 5.5 hours before the end of 2019. Overlaid are isobars derived from observed air pressure (QNH[2], black lines), inferred trough-lines (based on observed QNH and wind vectors, black dashed lines) and the sea breeze edge (based on dew point temperature gradients, white dotted line). The complexity of the trough system affects fire weather.

It must be remembered that the bushfires in 2019–20 in New South Wales included severe drought, heatwave and raised dust events. The dipole also shows, when negative, the potential for flooding events. Thus, the dipole gives insight into some of the most elevated risks faced by communities.

Level 2

A Level 2 alert relates to the assessment of soil hydrology. Many tools have been developed to assess the dynamics of moisture exchange between soil and fire fuel lying on the ground and these have long been used operationally. This includes a Drought Factor used in the McArthur Forest Fire Danger Index and equivalent measures in Mount's Soil Dryness Index. In recent

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2. QNH is an observed measure of air pressure and is different to modelled sea level air pressure.
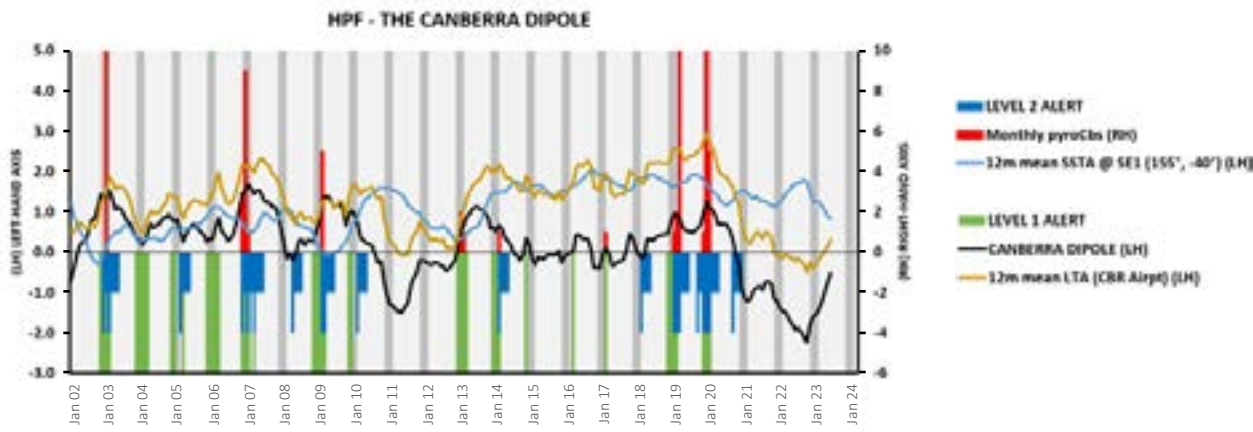
Figure 4: A sample plot of the Canberra Dipole showing the transition from negative values towards zero and positive values in the coming months. Level 2 alerts distinguish the accumulation phase from the ensuing residual phase.

Figure 5: A Himawari-8 satellite image of extreme pyro-convection over south-east Australia.

decades, satellite-based systems have been developed. While these show the flammability of fine fuel, they say little about larger fuel types.

As a drought progresses, deeper layers of the soil profile dry out. Eventually, it is all dry and rivers stop flowing. At this point, all fire fuels—from fine fuel to logs—are flammable on a day of raised fire danger. This is reflected in a formal operational concept (Figures 6a and 6b) developed by ACT hydrologist, Dr Vitaly Kulik, after the 1983 Gudgenby Fire in southern ACT (Kulik 1990). The HPF Level 2 applies that concept to a set of un-dammed reference rivers across the southeast (see Figure 7). If river drying occurs while a Level 1 alert is in place, a Level 2 alert is issued. A Level 2 alert continues for some time after new river dryings cease (the residual phase) and until their levels consistently climb, thus indicating water flowing from the deep subsoil into the stream. If river drying occurs without a prior Level 1 alert, both Level 1 and 2 alerts are issued.

Hydrological Forecast No. 1997/98 - 11
BUSHFRE POTENTIAL FOR: 1 January to 8 January inclusive
REGION: ACT and southeast ACT

Gauging station	Catchment	River Flow (l/s)	Bushfire potential level	Estimated time to next level#
410731	Gudgenby River U/S Mt Tennent	10? ??	>100 sq cm	CRITICAL
410734	Queanbeyan River U/S Tinderry	25 ??	10–100 sq km	1 week
410738	Murrumbidgee River U/S Mt MacDonald	584 ??	>100 sq km	CRITICAL
410761	Murrumbidgee River U/S Mt MacDonald	250? ??	>100 sq km	CRITICAL

• Data not available *
? Some data missing; extrapolated from available data
Estimate assumes no significant rain occurs within the catchment
U/S Upstream of:

Figure 6a: A sample operational bushfire hydrology forecast issued on 30 December 1997 by Ecowise Environmental for the ACT Bushfire Service.

Figure 6b: Subsequent bushfire activity in the hills surrounding Canberra that is rapidly suppressed.

Image: Rick McRae

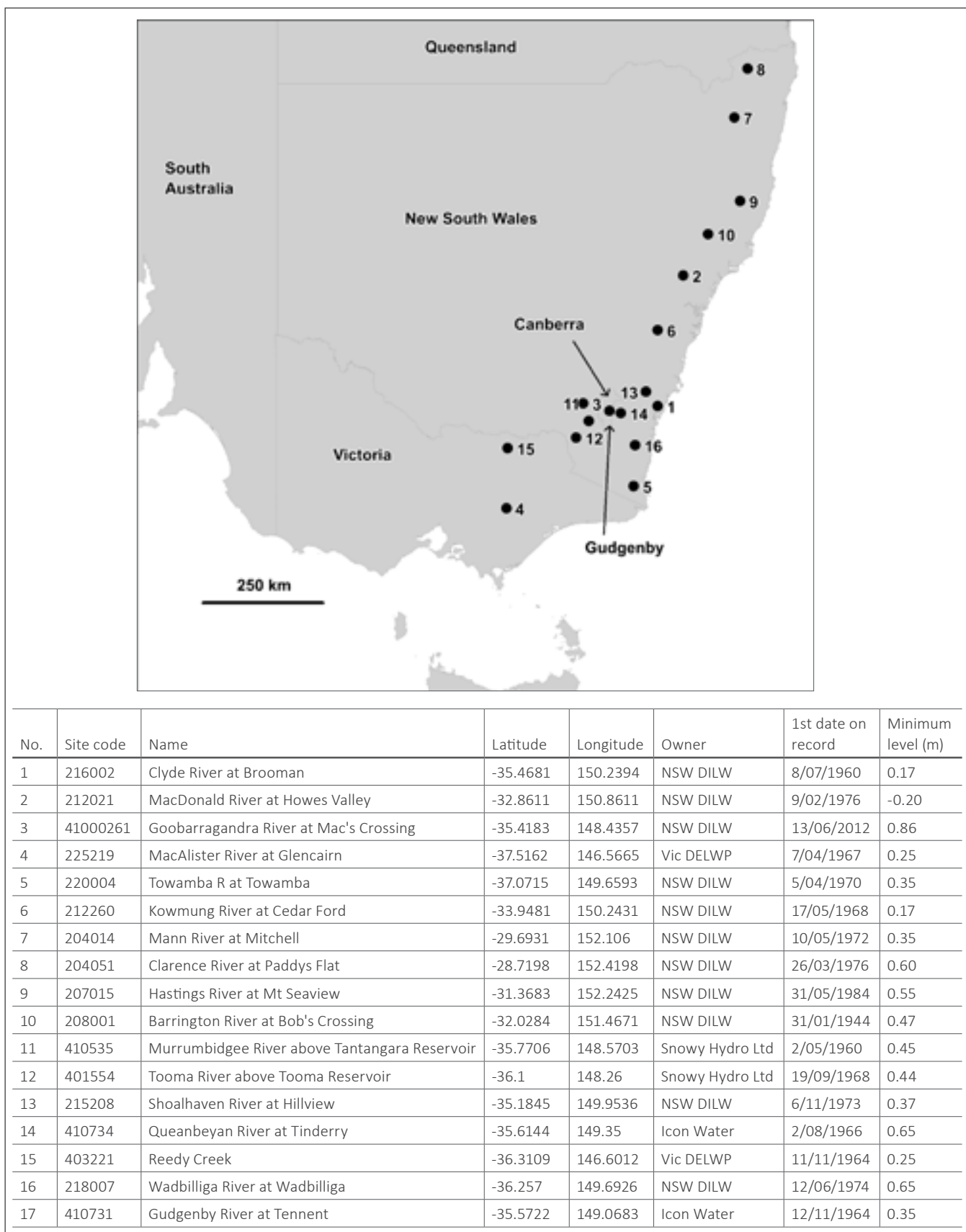| No.	Site code	Name	Latitude	Longitude	Owner	1st date on record	Minimum level (m)
1	216002	Clyde River at Brooman	-35.4681	150.2394	NSW DILW	8/07/1960	0.17
2	212021	MacDonald River at Howes Valley	-32.8611	150.8611	NSW DILW	9/02/1976	-0.20
3	41000261	Goobarragandra River at Mac's Crossing	-35.4183	148.4357	NSW DILW	13/06/2012	0.86
4	225219	MacAlister River at Glencairn	-37.5162	146.5665	Vic DELWP	7/04/1967	0.25
5	220004	Towamba R at Towamba	-37.0715	149.6593	NSW DILW	5/04/1970	0.35
6	212260	Kowmung River at Cedar Ford	-33.9481	150.2431	NSW DILW	17/05/1968	0.17
7	204014	Mann River at Mitchell	-29.6931	152.106	NSW DILW	10/05/1972	0.35
8	204051	Clarence River at Paddys Flat	-28.7198	152.4198	NSW DILW	26/03/1976	0.60
9	207015	Hastings River at Mt Seaview	-31.3683	152.2425	NSW DILW	31/05/1984	0.55
10	208001	Barrington River at Bob's Crossing	-32.0284	151.4671	NSW DILW	31/01/1944	0.47
11	410535	Murrumbidgee River above Tantangara Reservoir	-35.7706	148.5703	Snowy Hydro Ltd	2/05/1960	0.45
12	401554	Tooma River above Tooma Reservoir	-36.1	148.26	Snowy Hydro Ltd	19/09/1968	0.44
13	215208	Shoalhaven River at Hillview	-35.1845	149.9536	NSW DILW	6/11/1973	0.37
14	410734	Queanbeyan River at Tinderry	-35.6144	149.35	Icon Water	2/08/1966	0.65
15	403221	Reedy Creek	-36.3109	146.6012	Vic DELWP	11/11/1964	0.25
16	218007	Wadbilliga River at Wadbilliga	-36.257	149.6926	NSW DILW	12/06/1974	0.65
17	410731	Gudgenby River at Tennent	-35.5722	149.0683	Icon Water	12/11/1964	0.35

Figure 7: Metadata for the set of usable hydrological stations.

Source: Bureau of Meteorology

At this point, the HPF shows that there is sufficient heat and dryness in the seasonal and regional contexts to support extreme bushfire development.

Level 3

A Level 3 alert is issued when analysis of conditions raise concerns about extreme fire activity. If a Level 2 alert is issued, the next step is for Fire Behaviour Analysts attached to fires to determine if conditions are conducive to a Blow-Up Fire Event (BUFE). A BUFE occurs when a fire forms deep flames and when it stops being a line of fire and becomes an area of fire with a large firefront (see Figure 8). The convection column above this large fire behaves differently, allowing a coupling of the fire with the atmosphere above. This causes a switch from quasi-steady-state fire behaviour (where if you know the terrain, the fuel and weather you usually know what the fire is likely to be doing) to dynamic fire behaviour (where you need to know the terrain, the weather including the stability and the fire itself; fuel loading is not a key element).

Since fires in Canberra in 2003, it has been clear that firefighters are routinely dealing with 2 types of fire. Quasi-steady-state fires have been well predicted by McArthur meters and also the Australian Fire Danger Rating System. Dynamic fires have had limited validated predictive tools available; especially the Continuous - Haines Index (Mills & McCaw 2010) and the Blow-Up Fire Outlook model (McRae & Sharples 2013, 2014).

Extreme bushfires, as defined by Sharples *et al.* (2016), develop dynamic fire behaviour and form one or more BUFEs. A BUFE requires deep flaming with 7 known causes:

- Strong winds, creating deep flaming zones.
- Wind change, causing a fire flank to form a new, larger fire front.
- Eruptive growth, which requires canyon-like landforms.
- Vorticity-driven Lateral Spread, when fire interacts with eddy winds and spreads in 2 directions at once.
- Dense spotting, reflecting changes in fire intensity as spot fires merge.
- Use of accelerants, in accord with Incident Action Plans, forming certain fire patterns.
- Interior ignition, a problem in the vegetation mosaics of the Boreal Forests.

A common element is low fuel moisture for dead-and-down fuel, which allows easy fire spotting. Damaging BUFE occurrence is not strongly related to fire danger nor to fuel loads, apart from the need for a prior fire with the potential to have high intensity. Some new ignitions or break-aways escalate in this way almost immediately (e.g. Kilmore East fire on Black Saturday 2009 and the Bendora fire breakaway on 18 January 2003, west of Canberra, shown in Figure 8).

Figure 8 shows a linescan 2 hours after a spotover (shown by the arrow) of a long-held containment line (dashed line) near Bendora Dam in New South Wales on 18 January 2003. Active flaming is shown in yellow and the map grid has one kilometre
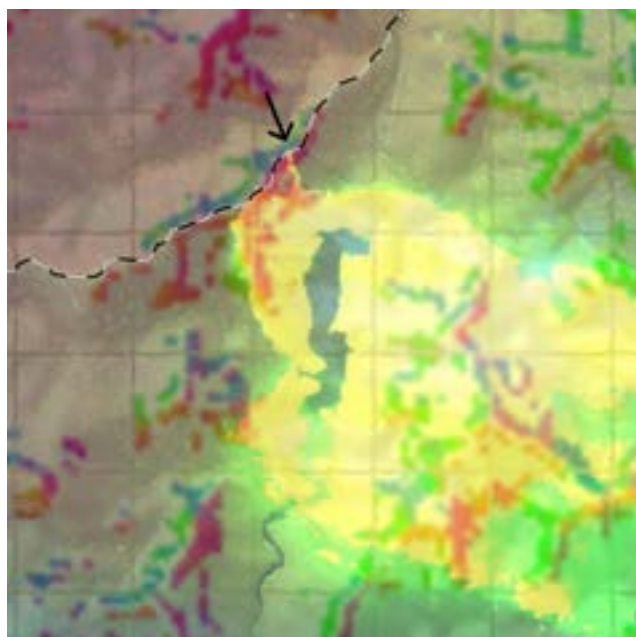

Figure 8: An example of a minor breakaway rapidly causing deep flaming and a Blow-Up Fire Event.

Image: NSW Rural Fire Service

spacing. Overlaid is a landform model of areas prone to Vorticity-driven Lateral Spread (VLS). The red colour indicates VLS generators under the then-prevailing northwest wind. Note the intense spotting on the southern edge.

A revised model for BUFE formation, the Blow-Up Fire Outlook 2 (BUFO2) has been developed. This takes inputs on the fire, the terrain, the atmosphere and the surface weather and produces a single-time or time-series outlook for steady-state fire behaviour, a BUFE, a pyroCb or a foehn-effect fire. Inputs can be from forecasts several days in advance and up to the current operational shift time. The model may lead to a Level 3 alert. A trial version of BUFO2 is included on the HPF webpage.

There are many useful sources of data on fires that are relevant. A good example for pyroCb monitoring is the NASA WorldView. Normal Bureau of Meteorology sources are used for weather data and weather balloon data is from the Bureau or from fire agencies. A range of terrain analyses for forested parts of Australia can be found on the HighFireRisk website. The VLS terrain analysis maps are also important.

Level 4

A Level 4 alert is a trigger to take action. As the Level 3 alert is a cue to collect field observation data to create intelligence products that can drive changes to an Incident Action Plan, a resulting Level 4 alert is an unambiguous and formally defined trigger to act. In such times, the baseline objective for incident management teams and fire divisions should be to save lives. BUFEs typically last for around 3 hours and may span an area ranging from 5km by 5km up to 70km by 20km. The summer bushfires in 2019–20 produced at least 170 BUFEs, allowing

Worked example of the BUFO2 model run as a time-series

BUFO2 is a spreadsheet that tests data on forecast conditions at a fire for the potential for key events to occur. These are checked to see if all precursors of dangerous fire development are expected.

The Yaouk Peak Fire was burning in NSW just south of the ACT. An analysis on 28 January showed that BUFEs could occur on the next 2 afternoons, as shown by the red dots in row 2 below. These indicate an uncontained fire under a stable profile (so not likely to form a pyroCb). Dry fuel in the rugged terrain meant that a hot uphill fire run could mix down dry air aloft, increasing fire intensity (a form of feedback loop) and perhaps form a BUFE.

As this fire was being burnt out within a containment block, avoiding hot runs and subsequent mixing down, a BUFE did not form.
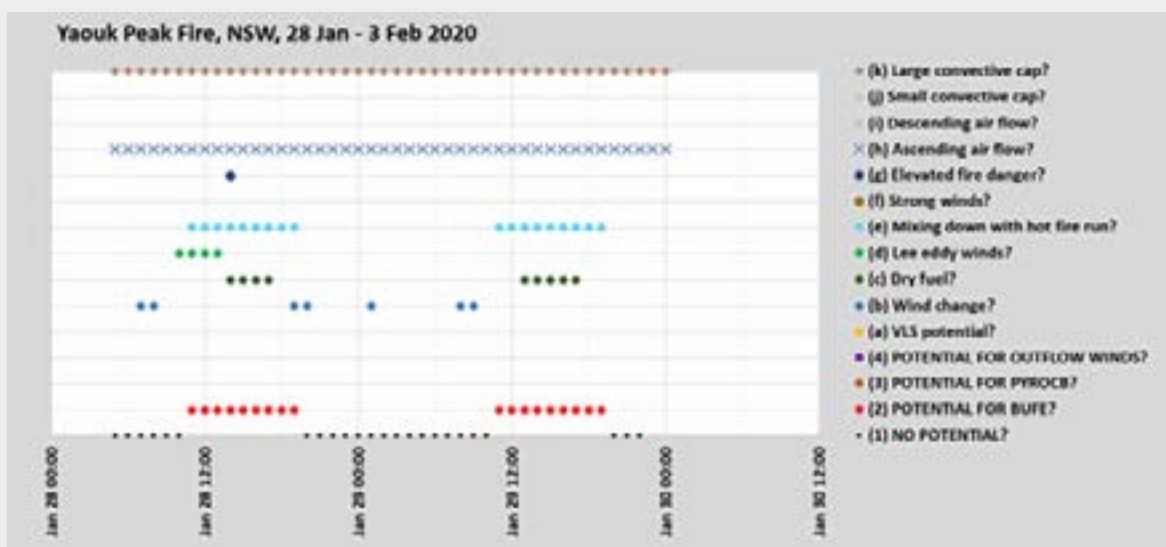
However, 2 days later a long-range breakaway merged with the ACT Orroral Valley fire. Being an unstable setting, this formed a pyroCb (event 2020k in the Australian PyroCb Register). The plot below used an earlier version of the model. The outlined window is a typical VLS event. The following afternoon lacked the low fuel moisture required for VLS.
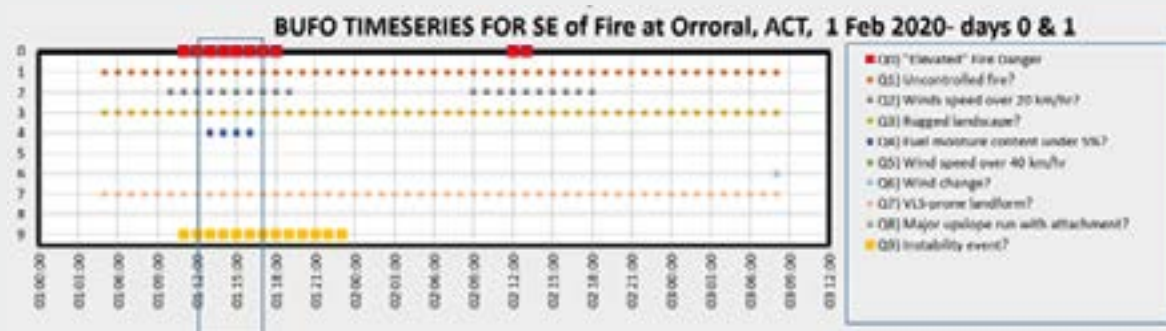
Different combinations of the fire's setting can produce different outlooks for how the fire might evolve. It is operationally significant that very different behaviour can form under the same fire danger and fuel loads. The risks to fire crews and the allowable tactics can also be very different.

the first statistical estimates of these sizes to guide Incident Management Team decision-making.

BUFO2 is not a spread model. It is a risk model to assess the likelihood of high-consequence events on the fireground. It is important to note that the aim is not fire-spread prediction. There is no headfire and fire progression is by means of medium-range spotting and lateral spread. There are no opportunities to intervene to halt the fire's spread. Ground or air observers need to look for the lead-up steps occurring such as a fire heading into terrain that is able to form deep flaming through VLS or eruptive growth, or to confirm the initiation of an event by noting changes in the smoke plume or clouds around it. Most importantly, in the future, it may be possible to use these forecasts and observations to avoid the onset of a BUFE. For example, if an area should not be allowed to burn when fine fuels are fully flammable, then it could be burnt at an earlier, safer time.

The HPF is currently in a draft form and is waiting an operational testing when the next Level 1 alert is issued.

Results

The performance of the HPF against records spanning more than 20 years is summarised in Figure 9, which shows that areas in the plot are proportional to the number of months included. A Level 2 residual phase is after river dryings stop accumulating and accounts for the delay in restoration of deep drainage when rainfall resumes.

The goal of Level 1 and Level 2 alerts is to indicate times when the more demanding Level 3 modelling is required while not missing any such times, and this has been achieved. When the modelling is required, most fires will not pass the stricter Level 3 BUFO2 test, in most cases due to a lack of any mechanism for achieving deep flaming. It is anticipated that fire behaviour analysts would get to know the local conditions needed for a Level 3 alert.

A limited operational trial of drafts of the Level 3 model during the summer bushfires in 2019–20 yielded 13 alerts issued to fire agencies. Apart from one early successful BUFE prediction,
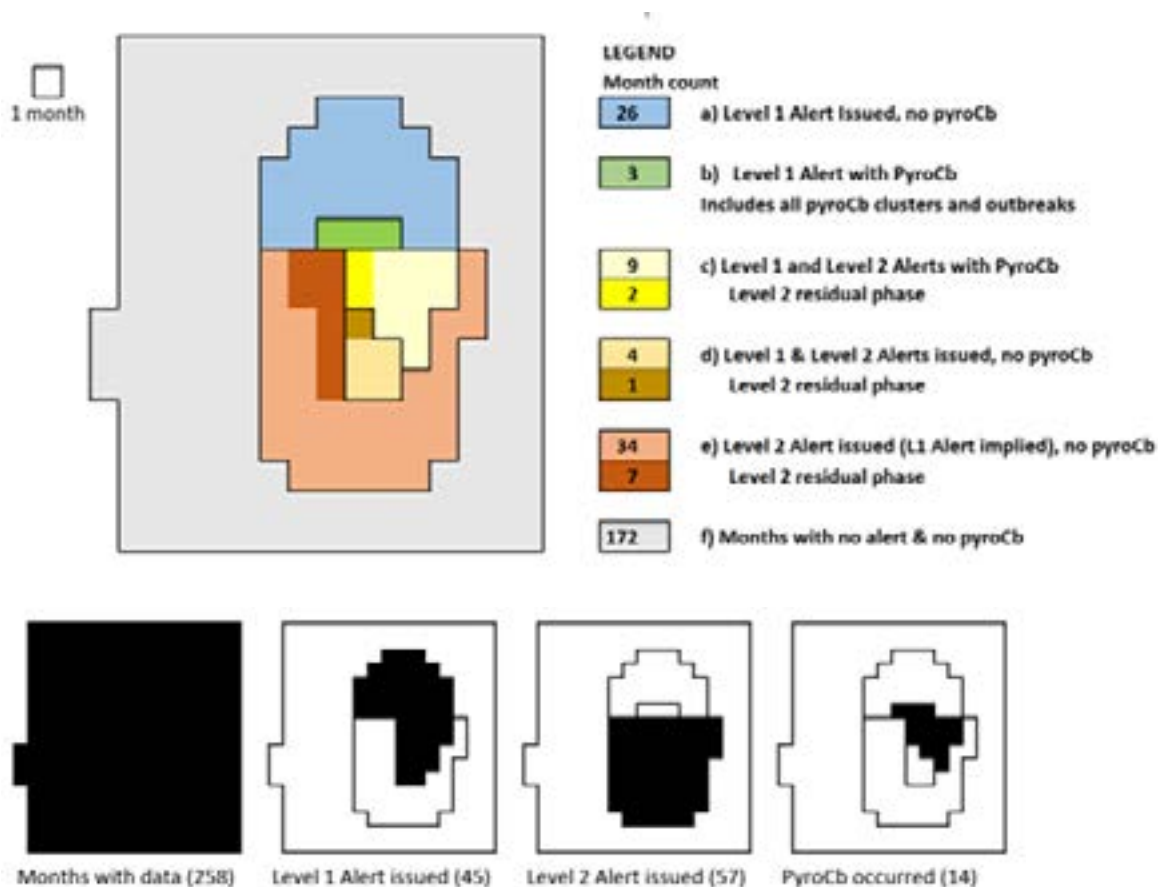

Figure 9: Breakdown of months with usable data (n=258) showing the performance of the HPF Levels 1 and 2 in terms of anticipating pyroCb occurrence. Areas in the plot are proportional to the number of months included. A Level 2 residual phase is after river dryings stop accumulating, and accounts for the delay in restoration of deep drainage when rainfall resumes.

5 early in the season were unsuccessful, largely due to underestimation of the role of the foehn effect in areas north of Sydney. After updating, the model yielded 7 alerts that covered fire activity that produced 7 BUFEs and 3 pyroCbs.

The full study uses the Australian PyroCb Register data only because the historical records for BUFEs are not complete. During the summer bushfires in 2019–20 in areas south of the Shoalhaven River including the ANYSO pyroCb super outbreak (Peterson *et al.* 2021), BUFEs and pyroCbs were recorded with a 5:1 frequency ratio suggesting a crude upper estimate of 600 BUFEs over the 20 years covered by this study. Thus, inclusion of BUFEs would be expected to reduce the size of groups (a) and (e) in Figure 9.

Discussion

It is important to remember that the HPF applies only to BUFEs. It is not intended to replace existing systems that work on steady-state fires. The HPF is intended to augment those systems by providing useful intelligence products to incident management teams on fireground elements not previously and explicitly covered.

Fire services agencies using this model would need to develop protocols to cover training, systems and operational processes ahead of the next alerts. This includes discussion, current sea surface temperature anomalies from the National Oceanic and Atmospheric Administration, riverflow data from the Bureau of Meteorology and access to the BUFO2 workbook. At the time of writing, the alert status was 'No Level 1 Alert', but an alert is possible in the months ahead requiring careful monitoring (Figure 10).

There is a need for the collection of data on the performance of the model during the trial. It is essential that future BUFEs are well documented, allowing an essential shift of operational focus away from pyroCbs. It is expected that future events will allow improvements to models and a reduction in false alarm rates in levels 1 and 2. Every major bushfire leads to new insights that cannot be anticipated. Also needed are insights into if the HPF can be reconfigured to apply to southwest Western Australia, which experiences significant numbers of pyroCbs.
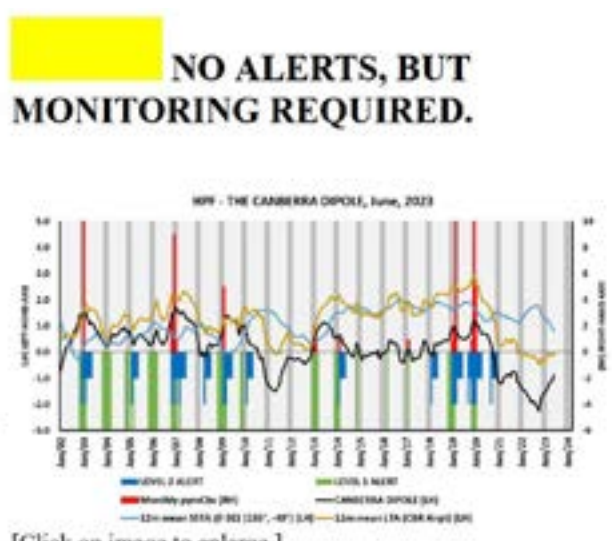

Figure 10: A screenshot of a HPF Level 1 analysis as at 30 June 2023.

Conclusion

The HPF is presented as a model that works well using 20 years of data. It is currently in a trial phase and is waiting the next onset of potential extreme bushfire development, either in the summer of 2023–24 or the following year. This depends on how rapidly the landscape and vegetation rebounds from recent wet years. Australia must do more to achieve rapid adaptation to climate change. Fromm *et al.* (2022) found no global trend in pyroCb counts over the last decade. Therefore, Australia's rapidly increasing trend raises questions about how the situation will evolve in the coming decade. Will the climb continue, or will it plateau out in line with the trend in the boreal forests? It is only through an ongoing dialogue between researchers and fire services operations that we can optimise the ability to anticipate what is the most worrying and dangerous type of bushfire.

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Adjunct Professor Rick McRae retired from a career in bushfires and emergency management spanning 3 decades. He is a visiting fellow at the University of New South Wales in Canberra. He specialised in fire behaviour and served on major fires in the ACT, Tasmania and Canada. He has served on national committees on bushfire matters and has run national emergency management workshops. He has specialised in the use of satellites, and on extreme wildfires.

Input-Process-Output of decision-making framework during bushfire

Peer reviewed

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Abstract

Australia has been grappling with recurring bushfires for over a century, significantly affecting the landscape and communities. Despite this, there has been an increase in residents moving into high-risk bushfire areas. This study aimed to develop a framework that could guide householder decision-making regarding self-evacuation during bushfires by identifying the incentives that encourage early evacuation. The study used a qualitative approach and 30 semi-structured interviews were conducted with residents in the southeast part of New South Wales; a region hardest hit during the 2019–20 summer bushfire season. Thirteen potential incentives that motivate self-evacuation were identified. The framework provides valuable insights into how incentives could influence residents' decision-making during bushfires. In addition, it serves as a useful reference for policymakers, fire services and emergency management organisations when creating effective ways to encourage early self-evacuation and, ultimately, reduce injury and fatality.

Introduction

Australia experiences severe bushfires, yet there is a rise in the number of people relocating to bushland areas and an increase in the incidence of fatalities during catastrophic bushfires (Kremer 2018, Risk Frontiers 2020). Catastrophic bushfire seasons, such as Black Saturday in 2009 and the bushfires in the summer of 2019–20, have resulted in significant loss of life, claiming 173 and 35 lives, respectively (Edgeley & Paveglio 2019a, Risk Frontiers 2020). The recorded deaths due to bushfires have surpassed 825 for over 110 years of recorded bushfire seasons; 10 were catastrophic bushfires events and accounted for more than 60% of fatalities (Ambrey, Fleming & Manning 2017, Haynes *et al.* 2010, Risk Frontiers 2020). Along with these fatalities, Kohlbacher (2020) noted that the bushfires of 2019–20 also resulted in 429 smoke-related deaths, frequently resulting from delayed or non-evacuation. The physical and mental health cost of bushfires in Australia has soared dramatically. For example, the 2019–20 summer bushfires amounted to $1.95 billion, more than 9 times the median annual cost of bushfires for the previous 19 years ($211 million) (Ademi *et al.* 2023, Grattan Institute 2020, Kohlbacher 2020). These statistics emphasise the urgent necessity to scrutinise the factors influencing people's decisions to self-evacuate from bushfire-prone areas including the increased bushfire severity due to climate change.

It is important to understand the factors contributing to people's at-risk behaviour, particularly their decision to evacuate late during bushfire events, as evidenced by Strahan (2017). The alarming number of fatalities associated with bushfires has been linked to delayed or non-evacuation decisions, underscoring the need for effective ways to promote self-evacuation in at-risk communities (Edgeley & Paveglio 2019b, Whittaker *et al.* 2017). During the Black Saturday bushfires in 2009, despite 60% of householders indicating their intention to evacuate, only 2% followed through with their decision (Venn & Quiggin 2015), leading to devastating consequences. In Western Australia, Whittaker *et al.* (2017) reported that only 12 out of 300 residents indicated their intention to leave during bushfires. Tragically, during the Eyre Peninsula bushfires in South Australia, Anton

and Lawrence (2016) found that 8 out of 9 householders died due to delayed evacuation. Their remains were discovered near their vehicles, demonstrating the severe consequences of failing to evacuate promptly. Given these findings, it is crucial to develop appropriate incentive programs that align with the factors influencing people's decision-making.

Several studies highlight the effectiveness of incentives in encouraging self-evacuation, particularly in the context of voluntary evacuation (Adedokun *et al.* 2023, Perry 1979, Perry, Greene & Lindell 1980). However, bushfire policy is advisory and gives householders freedom to stay and defend or leave early (Whittaker, Taylor & Bearman 2020). In contrast, in the United States and Canada, evacuation is frequently compulsory, especially when properties are in the likely path of bushfires (McCaffrey, Rhodes & Stidham 2015). Notwithstanding the nature of policy in Australia, Adedokun *et al.* (2023) emphasise the need to investigate the role of incentives in influencing decision-making. This study aims to develop effective measures and interventions by acknowledging the severe consequences of late or non-evacuation and understanding the factors influencing decision-making. Specifically, it seeks to develop a framework that identifies and presents the influence of incentives on the cognitive processes involved in self-evacuation decisions. Using this model will allow relevant emergency management agencies to formulate targeted plans, align their interventions with the important incentives and enhance community resilience and safety during bushfires.

Materials and methods

An inductive research approach was used, which involved collecting qualitative data through semi-structured interviews with 30 participants. The purpose of the interview was to enable researchers to identify incentives that encourage early self-evacuation with a view to developing a framework that could guide decision-making. The method was chosen because it allows researchers to gain insights into the meanings behind the participants' views. Participants were recruited from southeast New South Wales, which was severely affected by bushfires between December 2019 and January 2020.

All participants provided written informed consent before the interviews. The recruitment process involved Sendaing flyers to participants through local council newsletters, community Facebook groups and notice boards. The participants were selected purposively from 3 local councils of Bega Valley Shire (population=33,253), Eurobodalla Shire (population=37,232) and Goulburn Mulwaree (population=29,609) councils as they had indicated an interest and willingness to participate in the study (Figure 1). The population figures presented were based on 2016 census data (IPWEA 2022, Owens & O'Kane 2020).

Participants were referred to in the study using alphanumeric codes rather than their names to ensure confidentiality. The interviews were conducted using a structured interview guide. The interviews were conducted face-to-face, online via zoom and by phone. Interviews lasted between 40 and 90 minutes. They were recorded, transcribed using Otter.AI and analysed using thematic content analysis via NVivo 12 Pro. This method involves identifying, analysing and reporting patterns or themes within the data.

Figure 1: Map of New South Wales showing the study areas.

Ethical approval for the study was given by the human research ethics committee of the University of Newcastle (Protocol Number H-2021-0284).

Results

Demographic information about interviewees

Figure 2 shows that most participants were 55–74 years old, making up 80% of the research participants. Additionally, 17% of participants were between 35–54 years old and the remaining 3% were between 18–34. The average age of participants was 60 years. They had been residing in their current location for an average of 13 years. Given their long-term residency, they were considered qualified to provide accounts of their bushfire experiences. For example, 33% had been living in at-risk bushfire areas for over 20 years, while 33% had been living in these areas for 5–10 years (Figure 3). A smaller proportion of participants, 13% and 10%, had been living in bushfire at-risk communities for 16–20 years and 5–10 years, respectively (Figure 3).

Figure 4 shows information about participants' home and contents insurance status. The majority (77%) had full property insurance coverage. However, 17% did not have any insurance and 7% had partial coverage. While 93% of participants were home owners, the remaining 7% were renters or leaseholders (Figure 5). The 7% proportion might explain why some participants were not insured, as leaseholders cannot insure property they do not own.

Figure 6 shows that 80% of the participants had pets or animals, while 20% did not. On average, the interviewees lived within 59 metres of bushland (Figure 7).

Incentives that could encourage self-evacuation

Figure 8 shows an overview of the incentives that could encourage self-evacuation from bushfire-prone areas as selected by participants. The most common incentives identified by participants were information and communication (60%), adequacy of resourcing the Rural Fire Service (37%), for example firefighters, fire trucks and training and emergency

Participants Age

- 55 - 57: 80.00%
- 35 - 54: 16.67%
- 18 - 34: 3.33%
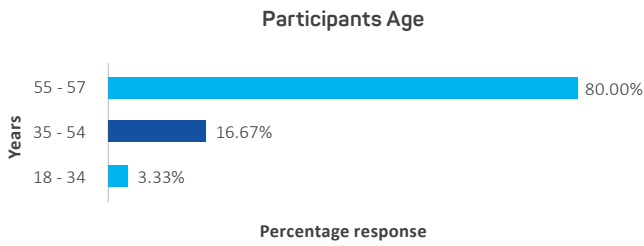
Figure 2: Percentage of participants by age.

Location Duration

- Over 20 y: 33.33%
- 16 - 20 y: 13.33%
- 11 - 15 y: 10.00%
- 5 - 10 y: 33.33%
- Less than 1 y: 10.00%
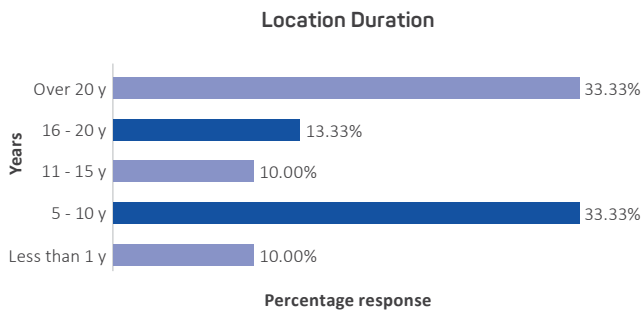
Figure 3: Years participants lived in the location.

Insurance Status

- 16.67%
- 6.67%
- 76.67%

Full Cover | Partial Cover | No Cover
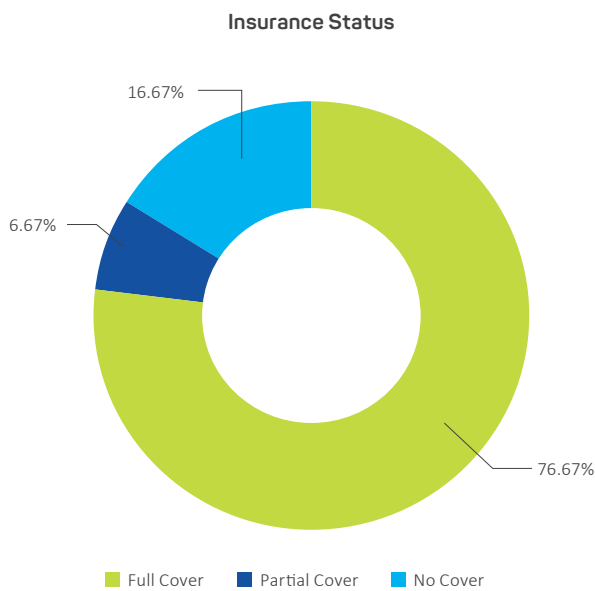
Figure 4: Percentage of participants with insurance.

Property Ownership

- 6.67%
- 93.33%

Homeowners | Rentals/Leaseowners
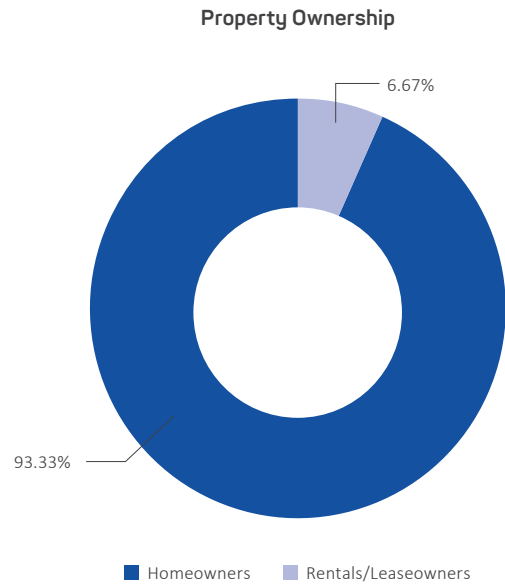
Figure 5: Percentage of participants owning or renting their home.

Pet Ownership

- 20.00%
- 80.00%

Yes | No
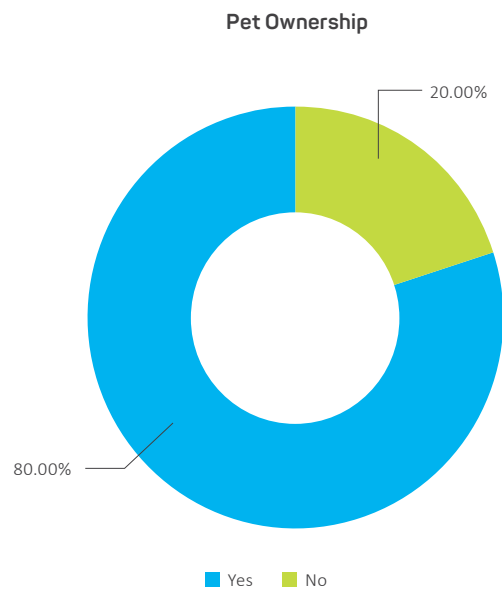
Figure 6: Percentage of participants owning a pet.

Bushland Closeness

- More than 100 m: 20.00%
- 76 - 100 m: 10.00%
- 51 - 75 m: 23.33%
- 30 - 50 m: 16.67%
- less than 30: 30.00%

Figure 7: Distance from bushland of participants.

accommodation (33%). Other incentives included bushfire education programs (27%), vegetation management (17%), financial assistance (17%), access roads (13%), security and protection of property (10%), affordable insurance coverage (10%), alternative power supplies (10%), property preparation assistance (7%), return access to properties (3%) and improved development approval procedures (3%).

Overall, 41% of male and 59% of female participants mentioned these incentives and shows that more women were willing to evacuate than their male counterparts. Participants' ages ranged between 18 and 74 years and suggests that incentives could encourage evacuation across all age groups. Most of the participants had pets, which could make evacuation challenging, while 20% did not have pets.

These data suggest that a combination of incentives could encourage self-evacuation from bushfire-prone areas, with information and communication being the essential incentives that participants identified. Adequacy of resourcing the Rural Fire Service, emergency accommodation and bushfire education programs were identified as essential incentives. These findings could help develop policies and plans to encourage self-evacuation from bushfire-prone areas, particularly among households with pets.

Development of a self-evacuation decision framework

Figure 8 shows the incentives could inform self-evacuation decisions in response to bushfire threats. The aim is to make the framework simple and easy to understand for use by fire service agencies in charge of evacuating people as well as by policymakers and academics. The shared experiences of
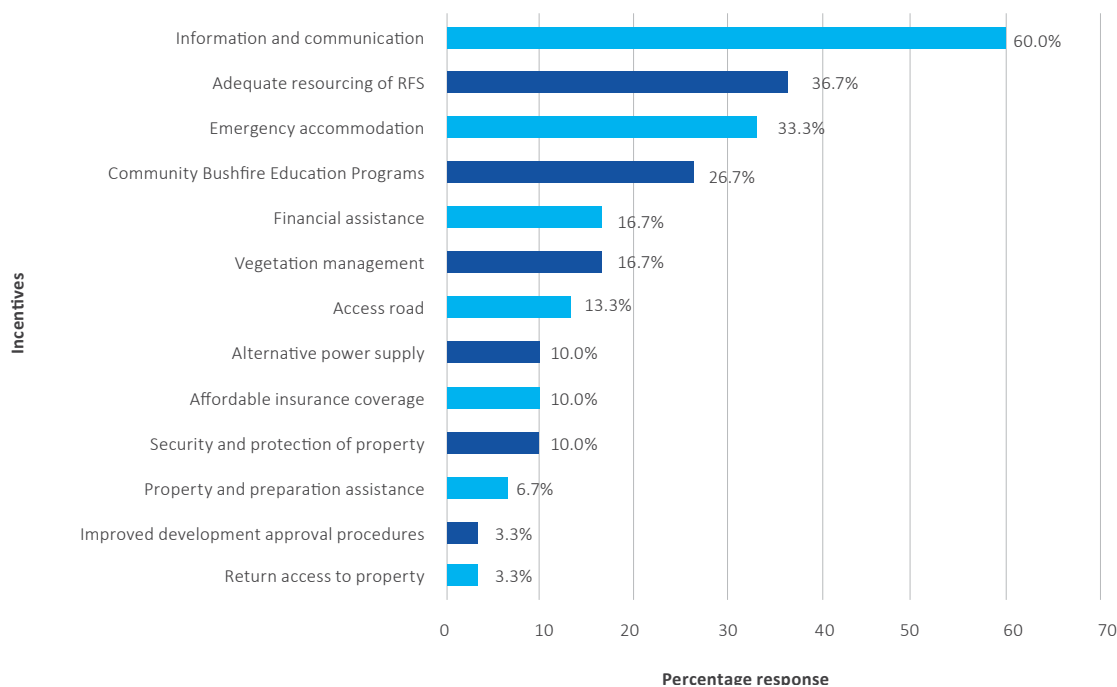
participants about the incentives that could encourage self-evacuation provides insights that can be used to identify how these incentives could influence their decision-making processes.

Figure 9 shows the framework and represents the conceptualisation drawn from the analyses of the interview data and the outcomes of the analyses in this study. The incentives were linked to threat and coping appraisal components of the framework. The threat appraisal component comprises perceived severity, vulnerability, concern, likelihood and reward (maladaptive). The coping appraisal component includes perceived self-efficacy, response efficacy and perceived cost (adaptive response) of evacuation.

Four incentives with the potential to influence both threat and coping appraisal components were identified. These are information and communication, adequacy of resourcing 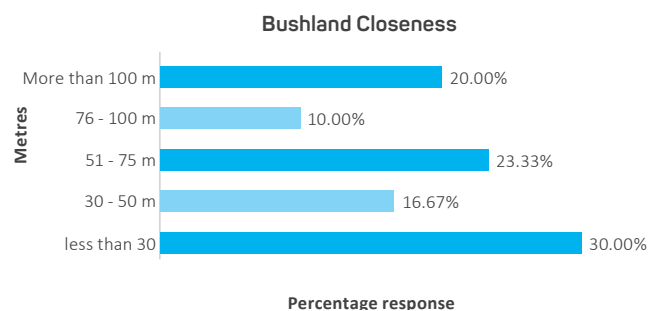the Rural Fire Service, bushfire education programs and vegetation management (Figure 9). Nine additional incentives that could affect coping appraisal were identified, including emergency accommodation, financial assistance, access roads, security and protection of property, affordable insurance coverage, alternative power supplies, property preparation assistance, return access to properties and improved development approval procedures.

The self-evacuation decision framework

Threat appraisal construct

Table 1 shows the conditions under which threat appraisal can be high considering levels of perceived concern, likelihood, severity, vulnerability and low levels of maladaptive rewards. If a householder perceives high levels of concern, likelihood, severity and vulnerability associated with a bushfire and low levels of

Figure 8: Potential incentives that could encouraging self-evacuation.

maladaptive perceived rewards, then their threat appraisal is likely to be high (Booth, Lucas & French 2022; Oswald 2021).

This concern can arise from experiencing or witnessing previous devastating bushfires or living in an area that has recently experienced high temperatures and dry conditions, which increases the likelihood of bushfires (Molan & Weber 2021, Strahan & Gilbert 2021a, Strahan & Gilbert 2021b). The severity of the potential impact on their safety, wellbeing, property and perceived vulnerability can also increase their threat appraisal (Bowman *et al.* 2020, Lake & Christianson 2020).

Coping appraisal construct

Table 2 shows the conditions under which coping appraisal can be high, considering householders perceived self-efficacy, perceived response efficacy and perceived cost. Suppose a householder perceives high self-efficacy and response efficacy and low costs (adaptive response) associated with a bushfire. In that case, their coping appraisal is likely to be high.

People who believe they have the skills, resources and knowledge required to cope effectively with a bushfire are likely to have a high coping appraisal. This can be achieved by investing in fireproof materials, having access to reliable sources of information and support and having experience responding to previous bushfires (Mortreux, O'Neill & Barnett 2020). However, if a person perceives high costs associated with responding to a bushfire, such as leaving their home and possessions behind, their coping appraisal is likely low. Those with financial resources to invest in fireproof materials and evacuation plans may perceive low-cost levels and have a high coping appraisal Wilson *et al.* (2020).

Table 1: Factors informing the threat appraisal construct.

Perceived Factor	High Level	Threat Appraisal Level
Perceived Bushfire Concern	Yes	
Perceived Bushfire Likelihood	Yes	
Perceived Bushfire Severity	Yes	High
Perceived Bushfire Vulnerability	Yes	
Perceived Rewards (Maladaptive)	No	

Table 2: Factors informing the coping appraisal construct.

Perceived Factor	High Level	Coping Appraisal Level
Perceived Self-Efficacy	Yes	
Perceived Response Efficacy	Yes	High
Perceived Cost (Adaptive Response)	No	

Self-evacuation decision-making matrix

Self-evacuation is a critical decision people make during a bushfire. Several factors, including threat and coping appraisal, influence the self-evacuation decision. Threat appraisal refers to the perception of danger or risk associated with an event while coping appraisal refers to an individual's perceived ability to cope with and manage the consequences of the event via self-evacuation. The decision matrix (Table 3) incorporated in the framework (Figure 9) uses these 2 factors to categorise householders into 4 different scenarios, each with its own recommended self-evacuation decision.

High threat appraisal and high coping appraisal

Householders who perceive a high level of danger, threat and the timing of impact and believe they have necessary resources and abilities to cope with the situation, are more likely to evacuate. According to Losee, Webster and McCarty (2022) and Stancu *et al.* (2020), individuals who perceive a high level of danger and have high coping resources are more likely to evacuate because they believe they can accommodate the consequences of the disaster. If a householder perceives a high threat and can cope with the situation, they are likely to evacuate. Therefore, increased threat and coping appraisal equals increased likelihood of evacuation.

High threat appraisal and low coping appraisal

Householders who perceive a high level of danger but have limited coping resources are less likely to evacuate. In these situations, the high threat appraisal is unlikely to override any concerns about evacuation costs (Ntzeremes, Kirytopoulos & Filiou 2020, Simpson *et al.* 2021). If a person perceives a high threat but cannot cope with the situation, they are less likely to evacuate despite the high perceived threat. Therefore, increased threat and decreased coping appraisal equals decrease likelihood of evacuation.

Low threat appraisal and high coping appraisal

Householders who perceive a low level of danger and have high coping resources are less likely to evacuate. These people may believe they can manage the consequences of the event and are not motivated to evacuate (Fraser, Morikawa & Aldrich 2021, Shoji & Murata 2021). If a person perceives a low threat but has a high ability to cope with the situation, they are less likely to evacuate because their coping appraisal is high. Therefore, decreased threat and increased coping appraisal equals decreased likelihood of evacuation.

Table 3: Self-evacuation decision-making matrix.

		Threat Appraisal	
		High	Low
Coping Appraisal	High	Tendency to evacuate	Less likely to evacuate
	Low	Less likely to evacuate	Tendency to not evacuate

Input	Process	Output

Input

Information and communication
Adequacy of resourcing RFS
Bushfire education programs
Vegetation management

Emergency accomodation
Financial assistance
Access road availability
Security and property protection
Affordable insurance coverage
Property preparation assistance
Return access to property
Improved development approval procedures

Threat appraisal

Coping appraisal

Process

Percieved bushfire concern
Percieved bushfire likelihood
Percieved bushfire severity
Percieved bushfire vulnerability

Percieved rewards (maladaptive)

Percieved self efficacy
Percieved response efficacy

Percieved cost (adaptive response)

Output

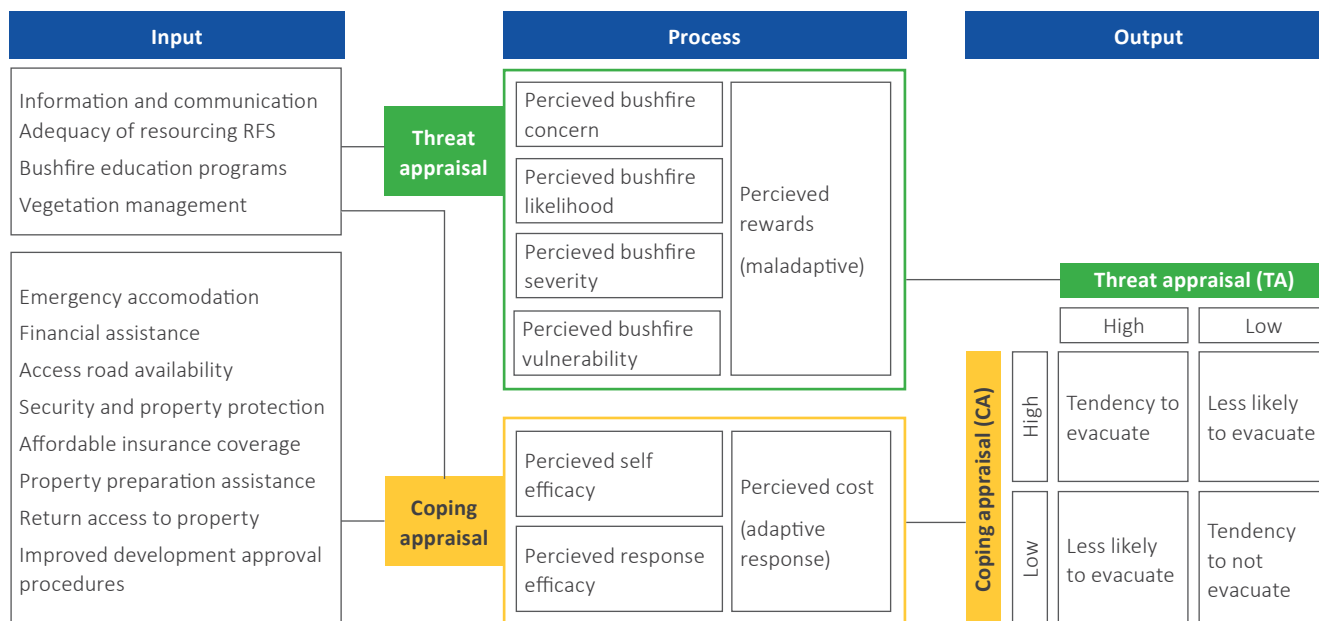|		Threat appraisal (TA)	
		High	Low
Coping appraisal (CA)	High	Tendency to evacuate	Less likely to evacuate
	Low	Less likely to evacuate	Tendency to not evacuate

Figure 9: The developed self-evacuation decision framework. Note: Coping appraisal refers to the attitude towards self-evacuation in response to bushfire.

Low threat appraisal and low coping appraisal

Householders who perceive a low level of danger and have limited coping resources are not likely to evacuate. These people may not perceive the need to evacuate, given their low threat appraisal and limited coping resources (Berlin Rubin & Wong-Parodi 2022, Katzilieris, Vlahogianni & Wang 2022). If a person perceives a low threat and cannot cope with the situation, they are unlikely to evacuate. Therefore, decreased threat and coping appraisal equals decreased likelihood of evacuation.

Role of incentives in bushfire crisis management

Table 4 shows how the concept of incentives could fit within the construct of prevention, mitigation, preparedness, response and recovery. By incorporating incentives into each phase of bushfire management, governments and communities can encourage proactive actions, promote resilience and support the recovery process.

Implications and conclusion

The findings from this study suggests that financial and non-financial incentives like insurance, government programs, clear warning systems and evacuation legislation can motivate householders to self-evacuate from bushfire-prone areas. Such incentives align with the Protection Motivation Theory, which posits that individuals are more likely to engage in protective behaviour when they perceive a level of threat and have the necessary resources and motivation to act. However, the effectiveness of incentives may vary depending on specific contexts and appreciation of threats among various householders. Therefore, policymakers and emergency management agencies can benefit from these findings to design appropriate incentives that could encourage people to self-evacuate from bushfire-prone areas.

Early self-evacuation saves lives. Appreciation of threat and coping appraisals could influence the decision to evacuate. For example, high danger perception and coping resources increase the likelihood of evacuation, while low danger perception and limited coping resources decrease it. The framework encompasses input, process and output components. First, the input component involves incentives that motivate people to prioritise their safety during bushfires, including information and communication, adequate resourcing of the fire services, emergency accommodation, bushfire education programs, vegetation management, financial assistance, access roads, security and property protection, affordable insurance coverage, alternative power supplies, property preparation assistance, return access to properties and improved development approval procedures. Collectively these can reduce self-evacuation costs and increase the perceived benefits of protective behaviour. Second, the process component focuses on the cognitive assessment phase of people when faced with the decision to self-evacuate, guided by the Protection Motivation Theory. Third, the output component encompasses the resulting evacuation decisions made by householders: the tendency to evacuate, less likely to evacuate and tendency not to evacuate indicated in self-evacuation decisions framework. These decisions can be tailored to individual needs to enhance community resilience and promote self-evacuation in bushfire emergencies.

Table 4: Fitting Incentives into the phases of bushfire crisis management.

S/N	Phase	How incentives could fit in the phases
1	Prevention	Incentives can encourage individuals and communities to undertake activities that prevent bushfires. For example, governments can offer financial incentives or grants to homeowners who take measures to reduce fire hazards around their properties, such as clearing vegetation or installing fire-resistant roofing. Incentives can also be provided for communities that develop and implement effective fire-prevention plans.
2	Mitigation	Incentives can bolster endeavours that lessening the repercussions of bushfires. This could entail compensating landowners or farmers who reduce fuel loads, such as controlled burns or strategic grazing. In addition, incentives can be extended to businesses and industries that adopt fire-resistant building materials and firebreaks to safeguard infrastructure.
3	Preparedness	Incentives to individuals and households who create and maintain comprehensive bushfire survival plan that includes evacuation routes and communication planning can be a great motivator. For example, discounted insurance premiums. Additionally, incentives could motivate communities to establish volunteer firefighting units and participate in training programs to enhance their levels of preparedness.
4	Response	Incentives that inspire individuals to take active parts in responding to bushfires. These may include financial or tangible benefits for volunteers in firefighting or emergency services. Incentives might also be extended to businesses that provide resources or services during the response phase, such as offering equipment or shelter for people who have been displaced, both human and animals.
5	Recovery	Incentives in the recovery phase might involve financial grants to businesses and individuals for rebuilding homes, infrastructure and local economies. Additionally, incentives can be offered to attract tourists and investors to the affected areas (when appropriate) to aide in the financial recovery of tourism and other business.

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Joining the dots to reimagine community resilience: empowering young people

Peer reviewed

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Abstract

Historically, disaster response management for children and young people, people from linguistically diverse cultural backgrounds and Aboriginal and Torres Strait Islander peoples have been shaped by a vulnerability and risk discourse, informed by trauma-informed and risk mitigation strategies. These are vital, but the vulnerability discourse has moved into other areas of disaster prevention, preparedness, response, recovery and resilience. Vulnerability has been linked to pre-existing, socially produced inequalities and power structures. This has worked to homogenise, marginalise and diminish the capability of community members in resilience efforts. The United Nations *Sendai Framework for Disaster Risk Reduction 2015-2030* [Sendai Framework] calls for governments and relevant stakeholders to 'advocate for resilient communities and an inclusive and all-of-society disaster risk management' (UNDRR 2015, p.23). This includes the meaningful engagement of people who are marginalised from resilience building. The Sendai Framework makes a specific argument for engaging children and young people, declaring they are agents of change who should be given the space to contribute to disaster risk reduction. The aim of this paper is to consider how the Sendai Framework has influenced the inclusion of young people in disaster resilience and to introduce emerging evidence of how young people are joining the dots to reimagine community resilience.

Introduction

The Sendai Framework (UNDRR 2015), outlined 7 global targets and 4 priorities for action. The priority actions are to understand risk, to strengthen disaster risk governance to manage disaster risk, to invest in disaster risk reduction for resilience and to enhance disaster preparedness for effective response. Not surprisingly, the result of the increasing frequency and intensity of disasters is that more people, assets and environments are being exposed or displaced. This presents new risks as the exposure of people and assets has 'increased faster than vulnerability has decreased' (UNDRR 2015, p.10). The Sendai Framework calls on nations to take a 'people-centred approach to disaster risk' (UNDRR 2015, p.10). The framework also focuses on action at all levels and sectors but advocates for 'resilient communities and an inclusive and all-of-society disaster risk management' (2015, p.23). This requires governments and stakeholders to reconsider the labelling of groups placed under a vulnerability discourse who have been disproportionately affected by disaster. The Sendai Framework calls for an engagement with all relevant stakeholders, explicitly naming women, children and young people, persons with disabilities, older people, Indigenous peoples and migrants (UNDRR 2015, p.10).

The framework singles out children and young people, declaring them to be 'agents of change' who should be involved in disaster risk reduction (UNDRR 2015, p.23). Yet, while change is evident, roles for children and young people in disasters remain firmly grounded in trauma-informed, risk discourse. Young people[1] should be included at all levels of emergency and disaster management (MacDonald 2021, MacDonald *et al.* 2023). However, the focus of this paper is on resilience building in communities as this is where the consequences of disasters is 'first and foremost experienced' (NEMA 2022, p.7).

Engaging children and young people in building community resilience is vital when we consider that 10 to 24-year-olds make up 24% of the world's population and, in some regions

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1. The phrase 'young people' in this research are those aged 12 to 24 years. This aligns with the Australian Institute of Health and Welfare definition (see www.aihw.gov.au/reports/children-youth/australias-youth/contents/introduction).

(e.g. east and south Africa and west and central Africa), they make up 32% of those nations' populations.[2] In the Australian context, children aged under the age of 15 represent 33% of Aboriginal and Torres Strait Islander peoples, compared to 18% of other people of the same age. The result is that, within Australia's 2019–2020 bushfire-affected areas, more children and young people experiencing 'the diverse effects of bushfires' were from Aboriginal and Torres Strait Islander communities (Williamson, Markham & Weir 2020, p.3).

To reimagine how young people can be active in community resilience requires new ways of thinking about children and young people to 'acknowledge young people's skills attributes and capabilities as agentic, informed and creative thinkers who are capable of constructive and active participation' (MacDonald *et al.* 2023, p.3).

Background

While all social groups have unique or specific needs, the label and dominance of a vulnerability discourse has resulted in some specific groups, such as those identified above, being 'less prepared for a natural disaster, more susceptible during it, hav[ing] higher mortality rates, and poorer outcomes in the recovery period' (Howard *et al.* 2017, p.140).An intersectional and critical perspective reveals that the vulnerability narrative in emergency and disaster contexts is related to pre-existing 'process[es] of marginalisation' (Gibb 2018, p.329). From this perspective, the intersection of vulnerabilities in disasters 'are to a large extent socially (re)produced' and recognises the entrenched and pre-existing power structures and hierarchies that exist in communities (Kuran *et al.* 2020, p.6). To achieve 'enhanced resilience for those who are currently side-lined' (Kuran *et al.* 2020, p. 6), it is important to move beyond the homogenisation of marginalised groups that pre-exists disaster events (Gibb 2018, Kuran *et al.* 2020). In doing so, we can enact the Sendai Framework's call for social action towards 'inclusive and all-of-society disaster risk management' (UNDDR 2015, p.23).

Young people are the focus of this paper and we provide evidence of how a capability and empowerment discourse around young people acknowledges their skills and capabilities as agents of change (MacDonald 2021; Macdonald *et al.* 2023). We are not alone. Researchers have long called for the skills, capabilities and capacities of young people to be recognised in emergency management (Mort, Rodriguez-Giralt & Delicado 2020; Peek 2008; Peek & Domingue 2020). These are arguments to complement the vulnerability discourse with a capability and empowerment discourse that acknowledges that engaging young people increases their resilience in disasters and 'contributes to increasing the resilience of families and entire communities' (Peek 2008, p.20).

Literature review

The urgency and call for action in disaster risk reduction identified in 2015 has intensified and we continue to experience the increasing incidence and severity of disasters around the world. Disasters are complex and Aldrich (2012) argued that it is problematic to define a disaster as either natural or man-made as the effects or destruction are often a combination of both. He described disasters as *'an event that suspends normal activities and threatens or causes severe, communitywide damage'*[3] (Aldrich 2012, p.3). The effects at the local level are significant and community resilience building is a key strategy in preparedness. Funding and other systemic enablers are required, alongside large-scale investment, to enable communities to undertake locally focused resilience building (NEMA 2023).

Our investigation of young people's active involvement in resilience building begins with the scoping review undertaken by Bessaha, Hayward and Gatanas (2022) that reviewed 214 articles published between 1990 and 2021. They identified a total of 19 articles that met their inclusion criteria. Of these, 5 focused on themes of young people's participation or youth-led efforts in community mobilisation and resilience and 9 on education-community partnerships. The majority of articles aligned with the United Nations Youth Forum for Resilience and the broader aims of the Sendai Framework but were not explicitly a response to the framework. That review is not replicated here, but we acknowledge their findings that young people 'can be actively involved in the development, planning, and engagement of future disaster risk reduction activities and interventions' (Bessaha, Hayward & Gatanas 2022) and the call for future research to focus on young people and community resilience.

Methodology

Review of literature

A traditional review was undertaken of existing literature to identify the influence of Sendai Framework over time and across research disciplines (Hart 2019). The review was not a systematic review of all literature but was a focused investigation to identify any shift in the research and programmatic and practical engagement with young people in disaster resilience. A search of Google Scholar was done of articles from 2010 to 6 June 2023 using the search phrases, 'disaster resilience', 'young people' and 'agents of change' anywhere in the article. The results are summarised in Table 1.

The search was extended to 2022–23 publications to include 'community resilience' and 'disaster'. This identified 2,300 articles, which suggests that community has been a primary focus of much of the 2,480 resilience research papers published between 2022 and June 2023.

Interviews with partner organisations

This research is part of a large-scale pilot program, 'Future Proof: young people, disaster recovery and (re)building communities' (YACVic 2023) that promotes youth participation in community resilience efforts across fire- and flood-affected communities in regional Victoria. As a part of this project, young people have been employed in local councils, Aboriginal Community-Controlled Organisations and non-government organisations across 12 regional areas in the north-east and east of Victoria.

We conducted mid-project, semi-structured interviews with the manager, youth worker and young person employed in each

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2. Statistics are taken from the global population as of mid-2022, by age (see www.statista.com/statistics/829732/global-population-by-age/).

3. Italics in original

Table 1: Numbers of articles published as identified via Google Scholar including the phrases 'disaster resilience', 'young people', 'agents of change'.[4]

Year range	Number of published articles
2010–2015	1,180
2016–2018	3,040
2019–2021	5,050
2022–June 2023	2,480

4. It is acknowledged that Google Scholar does not include reports, grey literature and non-peer reviewed publications.

organisation. The mid-project interviews captured the opportunities, challenges and barriers experienced in promoting youth participation in community resilience in regional and rural communities. The 90-minute interviews were conducted in May and June 2023. The data and the discussion present observations and participant experiences from the first 4 partner organisations interviewed in May 2023. At the time of publication, interviews and data analysis for the remaining partner organisations are ongoing. These insights from the preliminary analysis are shared to demonstrate how community resilience is being reimagined by young people and the organisations they work in.

Emerging evidence

Interviewing participants at the halfway point in the project enabled a better understanding of the specific experiences and allowed us to capture the perspectives of the people filling the roles in each organisation. There have been challenges and opportunities through this project and the findings will be detailed in future publications. At this stage of the project, our semi-structured interviews have enabled the uniqueness of each place-based organisation to emerge. An outcome has been the positive effects of employing and embedding young people in councils, Aboriginal Community-Controlled Organisations and non-government organisations and the links this creates in building community resilience. Young people, with lived experience of cumulative disaster event, employed in regional local council partners reflected:

And how do we ensure that [young people are] prepared for an emergency? I think that's why we come back to that buzzword of resilience because, if you can build resilience and get people to build relationships, that's not just going to support them for an emergency, that's going to support them in all these other worries they're having.

(Young person, partner organisation 1)

From day dot, I have just been given so much support and freedom; creative freedom. It's just unreal. I do come to work and I'm not just the token young person that sits at the desk in Council. I am part of the team – I feel as though I'm part of the team, so because of that I'm then learning skills, I'm learning communication skills, stakeholder skills, what it means to be in a team. I love buddying up with different portfolios.

(Young person, partner organisation 2)

I think it goes both ways. This program has made it evident to the emergency management team that it's important [to engage with young people] and I've learned how to communicate those needs and those recovery needs through the emergency management team.

(Young person, partner organisation 3)

A focus of the program is on professional youth work, both employing youth workers and the principles of working with young people (Corney *et al.* 2022). Youth workers are supervising the young people employed in this project. A youth worker employed in a council reflected on the value of employing young people to enable local community resilience work.

…building that resilience …building those relationships with their communities, and also building the [young people's] relationships with other key stakeholders, whether it be the CFAs or the whatever.

(Youth Worker, partner organisation 1)

It does build resilience, it does highlight young people, it does make [young] people feel valued.

(Youth Worker, partner organisation 1)

Managers in the project partner organisations play a vital role. They reflected on the value of employing and embedding young people to improve community resilience:

[Employed young person] has been able to change so many of the mentalities that might exist around young people's competence and capabilities, and she's obviously exceptional, but people are just constantly surprised and in awe of what's coming out of that team. And we would like to do this [employing young people in council] more often.

(Manager, partner organisation 2)

The other opportunity as well is that [employed young person and youth team] have really integrated themselves really well with the other departments that [community resilience project] touches. They've done a really good job reaching out to our emergency management team. So I'm actually really confident that the next time, and it's inevitable, we have a disaster we will have young people involved and leading the recovery and the response.

(Manager, partner organisation 2)

I think that the program has definitely broadened that awareness of the importance of young people in emergency management within our organisation. This has meant that this lens of young people 12–25 [years] has become more of a focus for our emergency management and resilience team and our recovery.

(Manager, partner organisation 3)

Discussion

The partner organisations have previously worked with young people, particularly in the current environment with most partner

organisations receiving disaster funding as a part of recovery efforts from different sources. Their previous and current experiences working with young people included pre-existing youth advisory groups and targeted events or activities. Participant managers and youth workers reflected that the young people were often involved in short-term projects, isolated from other parts of their organisations and had no previous involvement with emergency management teams.

The participant managers and youth workers reflected on the benefits of employing a young person with lived experience of disaster in their organisation. Managers from partner organisation 2 and 3 spoke of the building of formal and informal relationships and networks that demonstrated the competence and capabilities of those young people and, importantly, raised the profile of young people within their organisations. They linked the benefits of their young person directly to community resilience teams and the positive outcomes of these connections. The benefits are mutually beneficial with the benefits of being 'part of a team' expressed by a participant young person.

All participant managers and youth workers described a shift in their emergency management teams and stakeholders' perceptions of young people. They described how the expertise and lived experience of the young people are actively sought by emergency managers and community resilience teams within their organisations. This is consistent with the findings from a youth engagement emergency management initiative in the Macedon Ranges Shire that found that increased involvement of young people led to emergency managers coming to 'regard the ideas of young people as having a valid contribution to emergency management planning and response' (Hocking, Taylor & Tupek 2014, p.58).

The benefits for young people are also evident as they reflected on their role within organisations and in building community resilience. The effects were not constrained to their organisation. Young people are also connecting with other organisations such as the County Fire Authority (as mentioned by the youth worker in partner organisation 2).

Community resilience building is the outcome and the beneficiary. The youth workers reflected on the significance to resilience building but also their sense of value. This is evident in youth workers' reflections and also the young person in partner organisation 2 who said that they were 'not just the token young person'. Furthermore, partner organisation 1's young person recognised that building resilience has benefits for their community beyond emergencies and disasters.

Creativity and opportunity

Having highlighted how young people have been able to 'change so many of the mentalities' (Manager, partner organisation 2), we want to explore the creativity of young people and the opportunities that are missed if we don't enable a capability narrative to sit alongside the vulnerability discourse. Capturing evidence related to the roles and benefits young people bring to this program provides valuable insights into what they are capable of. Importantly, this evidence highlights what is missed if we do not enable a capability and empowerment narrative to 'flip the script' on an entrenched

vulnerability discourse. The phrase 'flip the script' is used intentionally as, increasingly, evidence supports the introduction of a capability and empowerment discourse over the dominant vulnerability and deficit discourse in which young people are viewed.

Ultimately, the Sendai Framework is calling for governments, stakeholders, community organisations, communities, everyone to try something different. Given the opportunity, young people demonstrate their ability to develop creative solutions, but they cannot do it alone. Partner organisation 1's young person acknowledged this in their reflection that the creative freedom that they had was 'unreal' because 'from day dot I have just been given so much support'.

Young people are concerned about disasters, climate change, mental health and their communities, but they are also keen to find solutions. Their perspectives about environment, climate, health and wellbeing, diversity, inclusion, human rights and social justice bring fresh and creative ideas to address issues that concern them (MacDonald *et al.* 2023, Walsh & Black 2018). They want to learn as well as be respected. The young person from partner organisation 3 acknowledged this as they reflected on how the program goes 'both ways'. For them, learning how to communicate the needs of young people to the emergency management team has been invaluable.

Building community resilience is complex with many challenges, traditional structures and multiple stakeholders. What is revealed by the reflections of the young people in this study is a desire to be involved, to share their experience and to learn. By employing young people in disaster-focused roles and allowing them to participate in resilience building, we can tap into their resourcefulness and creativity.

Australia's midterm review of the Sendai Framework

Australia's midterm review of the Sendai Framework acknowledged the progress that has been made and that there was 'still much to be done by 2030' (NEMA 2022, p.6). Work with children and young people was acknowledged, including the Future Proof project as well as work being undertaken by the Australian Red Cross and state-based projects across Australia's states and territories. The review reported that:

> *The inclusion of disaster resilience education into the Australian curriculum has the potential to spark a cultural and generational change in the way Australians interact with hazards and think about vulnerability. Until this is operationalised, as a nation, Australia could look at scaling up place-based organisations which look to embed the tenets of disaster resilience* (NEMA 2022, p.54).

This is a bold approach to cultural and generational change, but focusing on an educational curriculum for children 4–18 years and only those who access early childhood and school-based learning is not sufficient. The evidence highlights the benefits and potential of involving young people in place-based organisations. The aim is to share evidence of the benefit, potential and positive effects of young people in place-based programs, interventions and decision-making.

Conclusion

This research introduced a capability and empowerment discourse alongside the current vulnerability and risk discourse for young people in emergency and disaster management. This includes challenging the vulnerability discourse that is a product of pre-existing and socially (re)produced inequality and power structures in society. This discourse homogenises young people and restricts the 'inclusive and all-of-society disaster risk management' approaches called for by the Sendai Framework (UNDRR 2015, p.23). This paper considered how the framework's call to include children and young people as agents of change in disaster risk reduction has influenced the involvement of young people in resilience building since 2015 and introduced emerging evidence that demonstrates how young people are improving community resilience. While this research is ongoing, the emerging evidence demonstrates that employing and embedding young people in local organisations has an integrated and positive impact. Young people are creating relationships and networks within their organisations and externally with emergency management and other organisations. The benefits are evident as young people speak to their upskilling, engagement and opportunities to share their experience and expertise. Managers in partner organisations reflected on how young people have become more involved in their emergency management and resilience teams. As such, young people can help to join the dots between themselves and their organisations to reimagine better community resilience within their own communities.

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