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CASCADING EXTREME WEATHER BEYOND OUR EXPERIENCE: ARE WE READY?

A report on the 12th Australasian Natural Hazards Management Conference

HOSTED BY THE BUSHFIRE AND NATURAL HAZARDS CRC

Australian Government
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Australian Institute for Disaster Resilience

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Integrated Research on Disaster Risk

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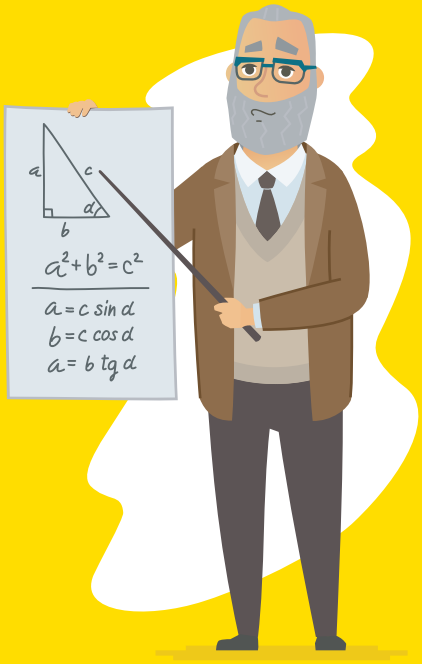

Table of contents

4

Foreword

Dr Richard Thornton, Chief Executive Officer

5

Conference report

Dr John Bates, Research Director

19

Conference program

23

Participants list

26

What participants said

28

About us

Foreword

The 12th Australasian Natural Hazards Management Conference was a little different from what you might expect from a conference. It started with questions and worked through to a strategic view on whether we have the best knowledge to deal with the extreme hazards of our future that are of a nature and scale beyond our current experience.

As natural hazards continue to increase in frequency and severity, it is more important than ever to provide decision-makers with the evidence, information and tools to make the necessary critical decisions. As our demographics change, cities expand further into the bush and dependence on technology increases. Our exposure to risk intensifies. The economic, social and environmental costs are forecasted to rise in a way that is unprecedented and unsustainable. These challenges are complex, and we should be wary of quick fix solutions.

The Bushfire and Natural Hazards CRC undertakes research with a vision that firmly imagines what we can do now to improve outcomes in the future. Our research explores what is possible and then develops evidence, knowledge and tools to help improve outcomes.

But the CRC is not a decision maker. The decision makers are governments, response agencies, organisations and communities. We all make choices and compromises: we make decisions on where to live, what to invest in and how prepared to be for the hazards we are familiar with and the ones we are yet to face – the cascading, extreme hazards of our future.

This conference was an opportunity for us to explore the decisions available to us that can be made to reduce the impacts of these inevitable natural hazards. We drew together a diverse cross-section of industries that deal with natural hazards and provided them with opportunities to stretch their thinking beyond their current experiences. We invited them to contribute to the development of pathways to take research, knowledge and lessons into policy and practice.

To navigate the challenges of the changing risk profile in our region, we must act upon the knowledge generated through research and through the relationships cultivated at this conference. We encourage decision-makers at all levels to make courageous and creative choices to improve Australia's resilience.

The CRC draws together all of Australia and New Zealand's fire and emergency service authorities with the leading experts across a range of scientific fields to explore the causes, consequences and mitigation of natural disasters and, ultimately, contribute to a more disaster resilient Australia.

The 12th Australasian Natural Hazards Management Conference was integral to this process and this report provides a summary of the discussions to extend our collective strategic view into the coming years.

Dr Richard Thornton

Chief Executive Officer
Bushfire and Natural Hazards CRC

Conference report

"The era of hazard-by-hazard risk reduction is over. We need to reflect the systemic nature of risk in how we deal with it."

Global Assessment Report on Disaster Risk Reduction 2019

At its core, natural hazards research aims to develop knowledge, tools and concepts to reduce the impacts associated with exposure to the perils of natural hazards. Research can minimise the disruption by:

- reducing or removing the likelihood of impacts
- improving emergency response
- enhancing recovery.

Fundamentally, research produces evidence that is reliable and trusted and can be used to support public debate, policy development, decision making and capability development.

To explore the value of Australian and New Zealand investment in natural hazards research the Bushfire and Natural Hazards CRC, in conjunction with the Bureau of Meteorology, Geoscience Australia and Risk Frontiers, created a scenario for the 12th Australasian Natural Hazards Management Conference based on what it believes the future may look like considering changing demographics, new technologies, climate extremes and new and persisting vulnerabilities.

The tone was set by Robert de Castella, former director of the Australian Institute of Sport, Olympian and member of the ACT Bushfire Recovery Taskforce after the 2003 Canberra bushfires. The conference then explored what we can do, both now and over the next decade, to take the outcomes of natural hazards research to minimise the impacts of major cascading emergencies caused by natural hazards on our infrastructure, our economy, our way of life and on the people of Australia and New Zealand.

This report is a summary of comments made by conference attendees during sessions or submitted through the online platform Slido, which was run as an engagement tool during the conference.

The question put to panellists and attendees was: *if we know what the research is telling us today, how can we use that knowledge to make our world a safer place to live, work and play?*

Animesh Kumar, Deputy-Head, Asia-Pacific United Nations Office for Disaster Risk Reduction, was the opening keynote speaker.

RESILIENCE, RISK AND VULNERABILITY IN AUSTRALIA AND NEW ZEALAND

The cost of disasters is growing and the proportions absorbed by governments and its citizens (uninsured losses) are growing even more. The flow-on effects that are not directly caused by the natural hazard itself, but from the consequences of the damage and destruction are significant and tend to be underestimated in the preparation of business and community continuity plans.

Much is changing in where and how we live:

- Populations are increasing.
- The built environment is increasing at a rapid rate.
- Dependence is increasing on a wide array of products, services and technology, much of which is inter-dependent.
- The hard-fought gains of economic development, growth, prosperity and wealth are facing challenges.
- Significant natural hazards are more frequent and intense.

Scenes from the fictional warning videos developed by the Bureau of Meteorology.

At the same time, vulnerability and exposure has been increasing:

- The population is ageing, has large migrant communities, and disadvantage still exists in many areas.
- Core infrastructure and building stocks are ageing and all have weaknesses.
- Essential services are more interconnected and interdependent than ever.
- Disaster impacts are long-term and complex, and the costs of disasters are growing.
- People are living in increasingly marginal (at risk) locations, particularly around the coast.
- The fiscal climate means that governments and communities must do more with less.

On the flip side, momentum is building to address the financial impacts of the changing climate[1].

It is important too, to think about what the near future looks like. The concept of Life 3.0 was introduced, a brave new world where things will be different:

- Technology will be a core part of everyday activities, with unprecedented connectivity and data richness, and autonomy and automation embedded invisibly around us.
- There will have been significant growth in the sharing economy.
- The balance of power between institutions and individuals will have changed, and the roles of the public and private sectors, and civil society, will have become more blurred in the drive for 'shared value'.

THE SCENARIO – HOW IT UNFOLDED

The scenario, developed in partnership with the Bureau of Meteorology, Geoscience Australia and Risk Frontiers, had New South Wales experience a significant and prolonged drought through 2020, with higher than normal temperatures, which limited the amount of prescribed burning undertaken. Water storages were also at extremely low levels. Multiple bushfires started and spread quickly in September 2020, and while they were ultimately brought under control, houses were lost and significant environmental damage occurred, including in water catchments. Just weeks later in October 2020, an East Coast Low brought flash flooding, hail, storms and coastal erosion to NSW, directly hitting Sydney, with damage north to Newcastle and south to Wollongong. The scenario detailed a series of impacts: extreme flash flooding, communications failures, cracked high rise buildings, inundated car parks and significant disruption to Sydney's shipping, airport, roads and public transport. It didn't end there: central Sydney and the greater Sydney basin experienced prolonged power outages. The next day, a severe hailstorm hit Bathurst with little warning. At the time, there were more than 33,500 campers on site for the Bathurst 1000 V8 Supercar race.

The storm and the reaction of the campers combined to cause fatalities and severe injuries, with significant damage to vehicles, campsites, power, buildings and public infrastructure. This left those 33,500 campers without any shelter, viable transport options or services at midnight on a Saturday night. And for the V8 Supercar race organisers, a decision to be made on whether or not, to proceed with the big race the following day.

In retrospect, many of the elements of this scenario have now become reality for much of the south eastern parts of Australia in the spring and summer of 2019/2020.

WHAT WOULD A SCENARIO LIKE THIS MEAN IN THE YEAR 2020[2]

The expert panel agreed that the scenario was plausible. Despite some initial scepticism, the consensus at the end of the conference was that any future scenario should be more challenging.

1 A climate risk reporting framework has been developed by the G20 Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD).

2 Panel: Andrew Buay (Optus Singtel), Andrew Coghlan (Australian Red Cross), Darren Spoor (Australian Energy Market Operator), Melissa Pexton (Western Australia Local Government Association), Justin Dunlop (Ambulance Victoria), Doug Smith (Queensland Fire and Emergency Services), Rob Cameron (Department of Home Affairs), Sharanjit Paddam (QBE Insurance)

The emergencies and disasters caused by natural hazards during the spring and summer of 2019/2020 have more-or-less delivered most of the elements of the scenario. Fortunately, the events did not have a significant impact on any open-air mass gathering events.

For the purpose of the scenario, the focus during the conference was on the immediate impacts and not on the relief and recovery activities. Discussion focused on the events themselves, and the scale of the impact, rather than on how any individual agency would respond to a specific impact or event.

There was an open acknowledgement that there would be significant disruptions across the affected area that could have prolonged effects on individuals and communities[3].

Information, coordination and managing finite resources were recurrent themes across the panellists – from every perspective. When this is explored a little, what that means is that:

- Resources in local government will be stretched beyond their comfort zones, and in many cases, current plans will not provide clear guidance and direction on what to do. At the same time, communities will overwhelm local governments seeking advice, support and assistance.
- Health systems are typically running close to capacity without any disaster overlay. Ramp-up of demand could see services focus more on relief of suffering in the immediate response. The complexity of the health response could unexpectedly escalate if there were any secondary impacts or hazards – for example population-wide respiratory complications from thunderstorm asthma.
- Inevitable loss of power and degradation of communications systems will introduce inefficiencies into the response agencies and uncertainty and confusion into the impacted parts of governments, businesses and the community. The focus of the electricity 'system' (regulator, operator and delivery networks) will be to preserve the performance of the state network as a whole (system security, will include load shedding), and to de-energise any high-risk parts of the network.
- Coordination across relief, response and information-sharing organisations and businesses will be crucial.
- Limited on-ground capacity for repair of communications and electricity networks will delay reconnections where the impact area has a large footprint. And where they exist, and are functional, battery backups have limited service capacity, which will degrade more rapidly with increased demand for the service.
- With ample warning, non-government organisations and state agencies could establish pre-evacuation centres, and have teams set up and ready to deploy. This would work where the event was identified in advance (the East Coast Low), but not in the hailstorm that battered Bathurst – which was likely to create the greatest immediate need for relief and support.
- Whilst emergency services would expect to have the capability to meet the immediate public safety needs for the early bushfires and the major storm on the NSW coast and Sydney, it is likely that resources would have been drawn from regional areas around Sydney to support the ongoing response. This would likely delay the ability to mount a rapid night-time response to Bathurst, where the emergency response capabilities on location would have been rapidly overwhelmed following the arrival of the hailstorm at Bathurst.
- The scale and broad impact of the cascading events would make it certain that there was political leadership and participation in the evolving situation, the response, and support for the community. Coordination and sharing of situational awareness within NSW, and with the Commonwealth (for national coordination and activation of relevant programs and activities) and neighbouring jurisdictions (with exposure to the events, for support in operations, or because their residents are being impacted), would be a consideration, to ensure effective coordination.
- Some of the panellists questioned the depth of their own business continuity plans, given the broad scale of the events, and with the flooding and associated damage in a city like Sydney there were concerns that some services may be unexpectedly disrupted.

3 Details of the scenario and a limited set of impacts caused by the cascading events can be found in the supporting document, *East Coast Low extreme weather scenario (2020), Bushfire and Natural Hazards CRC*.

- It is likely that many small businesses will be impacted by the weather events. Whilst insurers are getting better at settling claims quickly, it is likely that two to three per cent of all claims will be protracted and difficult to settle. The efficiency of this process will influence the economic impact of the disruptions.
- The most concerning expectation is that there will be multiple points of failure across the impacted areas, and that the extent of interconnections between systems and services is still not clearly and widely understood.
- Decision making at Bathurst was likely to be fluid, and it would have been difficult to make safe and effective solutions in such a complex environment. In that context, shelter in place was the likely decision, due to the late warning and limited escape options. At the site, the most likely observations would be:
  - Very limited capability to increase capacity in the immediate aftermath.
  - A small number of pre-placed resources. Maybe two to three ambulances, two to three fire trucks, plus first aid.
  - Demand will quickly overwhelm local capacity.
  - Those affected would experience contradictory cues – from media, social media and what they can see themselves. Some will not have seen the collapse of the grandstand and will have a different understanding of what was going on.
  - Social media stories (or word of mouth stories if communications is lost) will evolve quickly during and after the event.

Accelerating the journey: from research to improved public safety

Having seen the impacts that a significant series of cascading natural hazards would have across a large portion of the eastern NSW if they were to have occurred in September/October 2020, the next sessions at the conference explored the current research and operational knowledge that could reduce or remove the hazard exposure, if a similar series of cascading events were to occur in the period 2030–2035.

Participants chose streams to attend based on their interest in the thematic topics. In each of the following sections, the first paragraph is the question or statement that was provided as a starting point for discussion on the topic.

IMMEDIATE RESPONSE

> *Preparation for massive extreme weather events with catastrophic impacts on human life and human injury is uncommon in Australia. In preparing for a disaster with thousands of deaths, tens of thousands of injuries and mass loss of housing and identity, how do our business-as-usual operations and surge capacities need to evolve? What decision making needs to be put in place to cope with these massive impacts?*

Regardless of the response being discussed, people, their health and wellbeing, their ability to work and communicate effectively with others, and more broadly the diversity of human behaviours, were core to many of the discussions on this topic. In an environment where:

- an emergency is unfolding
- there is insufficient information to have full situational awareness
- there is a high degree of uncertainty
- people working together that may not have worked together before
- people within one or more communities are seeking emergency assistance
- emotions are running high (in operational agencies and in communities).

Recurring themes in inquiries[4] following disasters caused by natural hazards are:

- doctrines, plans, standards and legislative reforms
- land use planning, building codes and regulations
- community warnings and communication
- agency organisation management and authority
- incident management teams
- training, skills and behaviours.

Current research is providing new tools that will:

- improve human systems and the interactions between people and systems
- provide greater predictive capability to assist in modelling and predicting the impact of natural hazards on people, assets and the environment
- provide evidence on the effectiveness of different resource types in fire suppression
- assist in supporting culture change within traditional emergency service organisations
- help to better understand human behaviours, behavioural triggers and opportunities for improvement
- enhance leadership at all levels, including modelled behaviour. Traits learned in the field ('I can do long shifts and expect my crew to stay out with me and still turn up the next day') are no longer appropriate
- move decision making from an art drawn from personal observation and experience, to digitally informed situational awareness
- develop new skills in schools (decision making, team engagement, building trust relationships, influencing and negotiating, working under pressure, conflict resolution, communication)
- improve volunteer engagement and participation
- develop national evacuation simulations
- embrace media channels (ABC and others)
- embrace the business sector.

Future workforce focused strategies within agencies are currently limited and will benefit from current and ongoing research. With artificial intelligence and simulation expected to replace field-based learning, the education of the future workforce will be substantially different from that experienced by those currently in the workforce.

Other influences that research is helping to provide evidence to inform decision making are:

- Changing exposure and vulnerability driven by climate change will likely drive constant change in hazard threat exposure, including overlapping and cascading disasters.
- More sophisticated weather forecasting will better inform planning, asset movement, communications and warnings.
- Seamless team membership and handover from the top of incident management to crews in the field is required.
- Exercising and scenario-based learning is the new normal and can be used to support an evolution from blame culture to learning culture.

CLIMATE, WEATHER AND THE ENVIRONMENT

How will changes in the climate affect our environment and exposure to natural hazards? How will our ability to better model and predict extreme weather contribute to reducing the impacts of severe fire and weather on people, infrastructure and the environment?

Forecasting has moved to probability-based – to better inform risk-based decision making for those responsible for emergency management, and for the community. All of this relies on extensive computerised analysis of large datasets.

Probabilistic forecasting is not able to provide 100 per cent certainty of any individual event occurring. It does provide guidance to people on their location-based risk and as a way of localising forecasting. This approach does not provide certainty of the actual weather that will be experienced at a particular location. For example, high impact localised weather events – like the hailstorm in the scenario – are not yet able to be predicted with high accuracy or with a specific location until they form, which is often less than 30 minutes before the impact is experienced.

Predicting extreme events uses ensemble-based forecasting – combining multiple model runs, to represent the range of future weather possibilities. The greater the number of members in the ensemble that have a similar outcome, the higher the confidence in the predictions.

Pushing weather forecasting even further, the ability to link weather and fire forecasting models is starting to allow for the understanding and prediction of significant fire weather risks and threats:

- to identify thresholds for the formation of pyrocumulonimbus weather systems
- to use coupled fire-atmosphere modelling to identify anomalies in fire behaviour based on dynamic interactions.

Computer run-time remains challenging for real-time forecasting of fire atmosphere interactions. Currently the coupled models are used post-event to look at the impact of fire-atmosphere coupling – which for now is not systematic (no clear standard set of rules).

Vegetation interacts with climate and with fire and other influences. It is important to acknowledge that different vegetation types burn in different ways. With changes in the climate, we are also expecting to see changes in to local composition of vegetation – which we expect will be accelerated with vegetation re-growth after bushfires.

4 See Inquiries and Reviews Database www.bnhcrc.com.au/utilisation/ddr

Looking forward to 2035, a number of improvements are predicted to occur that will increase the ability to mitigate against the impacts of cascading natural hazard events:

- New data streams will aid in situational awareness; but we first need to do the knowledge development required before progressing towards real-time forecasting. This will be work done with global weather modellers.
- Integrated fire-atmosphere forecasting will be available to fire managers.
- We will be much more likely to be able to forecast the location and impact start and end for high impact weather.
- It will be possible to link weather and climate forecasting into future work arrangements and school attendance to avoid unnecessary exposure to hazard environments.
- There will be greater visual representation of forecasts and impacts – risk acceptance.
- The Australian continent will be in an altered state – hotter and drier, with more extreme weather events and bushfires that are likely to have multiple impacts, including on forested catchments and water supplies that are essential for providing drinking water to human settlements.

Some of the unknowns that will need to be considered are:

- There is not a good handle on ecosystem effects of climate change.
- Bushfires, landslips and droughts will all have an impact, and the interactions will be multifaceted.
- The geopolitical outlook will be complex:
  - Conflicts will begin over water and food.
  - Climate refugees may well be emerging.

RESILIENT CITIES, COMMUNITIES AND INDUSTRIES

Major cities are highly developed and complex. They are at once expanding and becoming denser. By 2035, the world will have changed such that, if climate trends continue, major population centres will be massively exposed to natural hazards. What are the changes that need to be implemented at the local, regional and national levels to avoid massive threats to life and livelihoods? How will we justify the investments for relatively uncommon events with governments that have increasing demands for a limited annual budget?

Planning, by its nature, is focused on the long-term. What are the timeframes we are looking at to initiate change? Depending on the scale, how long will it take to get enough change to see a noticeable impact? Given the current approach to land use in Australia, what are the essential needs for change? Will they be driven by evolution or revolution? What are the key decisions that need to be made, and by when, to reduce exposure and impacts by 2035?

Without resilient cities and communities, society and the economy as it is now known will change. Tools like the Australian Natural Disaster Resilience Index can be used to understand the resilience (or vulnerability) of regions across Australia, and forward-looking decision support tools can analyse investment options to mitigate risk and vulnerability.

Today, there are opportunities to:

- improve the approach to land use planning – where we are good at hard structures, and there is room to improve on long-term risk minimisation connectedness of new developments. The forward-looking policy planning window needs to be a minimum of 30 years
- better integrate the nature of people living in a place and their sense of belonging and being part of a community
- embrace and openly explore the tension between flexibility and strategic planning – using emerging tools to help us understand the benefits and trade-offs of planning decisions.
- ensure that planning legislation recognises the impact on biodiversity that will come with climate change
- explore reforms that manage the expectations of people in communities and local businesses to avoid or minimise, rather than postpone, future risk, such as:
  - Do not rebuild in high risk areas.
  - Compulsorily, but equitably, acquire at-risk land.
  - Build better before.

There was a strong view amongst participants that local governments (on the whole), despite the primary connection with local communities and businesses, were substantially disconnected from the emergency management system. Local governments individually, and as a collective, are well placed to:

- connect with communities and minimise fear-based emotional reactions to change what threatens their personal assets and way of life
- play a major role in place-based actions and activities, including working to a consensus on values and what local communities' value
- work closely with sister cities as a mechanism to adapt to climate change at scale: not to exploit but to share, accommodate, assist and integrate. But where relocation (short-term or permanent) is required, how do we create a receiving environment that will avoid conflict and resentment?
- develop effective local government emergency management and mitigation plans for periods of 10 years or more and to include workforce development
- consider relocation into cities from coastal and other high-risk environments. Coastal inundation is seen as a much more permanent and real risk.

It became clear that we need, but don't have, a nationally shared end-state that we are trying to achieve. Whilst acknowledging that it was difficult to get consensus when so many people have not lived through a disaster caused by natural hazards, it is an essential thing to have.

If we are committed to an effective planning framework, we need to understand that we are actually planning for a situation that we have not yet experienced – and that plan cannot be based on the past.

Threatened species must be part of planning – but climate change means that all the planning in the world will not save some. We will be required to consider putting our resources into protecting species that we can save or protect.

In the 2019/2020 NSW bushfires, ancient Wollemi Pines that were restricted to a small and remote area, were under threat. Fire and land management agencies were able to protect this small and vulnerable population that is not adapted to fire, albeit at a significant cost.

LIFELINES AND CRITICAL INFRASTRUCTURE

> *Reliance on critical infrastructure and services are key vulnerabilities globally. In the Australian environment, what can and should we be doing now to minimise reliance on these lifelines, or build resilience to massive impacts simultaneously in one or more major capital cities? The sources of exposure go beyond Australia's borders and into our future. How will fuel, food and other essential supplies be sourced internationally in times of crisis and when other countries may also be in crisis?*

Critical infrastructure is often viewed as a national, or at least regional obligation and capability. Future thinking is now talking more about connected, but localised capabilities, systems and services. Examples include renewable energy and green infrastructure, being enabled through locally led innovation and adaptability.

Australia's built infrastructure has inherent existing risk:

- Roads are 75 per cent locally owned. Maintenance is not properly resourced, and roads are exposed through increased freight movements.
- With population growth, freight movements are expected to grow exponentially. The current network is substantially disconnected and to a great extent relies on shipping for import and export and roads for distribution.
- It is vulnerable to heat and other natural hazards.
- Assets are exposed to natural hazards, industrial action and an increasing vulnerability of ports with sea level rise.
- Short-term solutions aggregating infrastructure is creating additional risk. Adding telecommunications infrastructure to existing electricity assets (power poles) is likely to affect life and hazard exposure, and in the event of failure, both services will fail simultaneously.

Sustainable solutions are likely (in most cases) to be complex, and we need to be wary of creating new risks by putting in place simple, but expedient solutions. All systems have some vulnerability and we need to understand what our local and national appetite for these risks are.

No discussion of critical infrastructure would be complete without some discussion on regulations, standards and rules:

- Design guidelines can be confusing, which can compromise the resilience of infrastructure. We need to be better educated to make informed decisions, including a broader assessment of impacts of loss of infrastructure that takes into account the critical importance of resilience and the connections between the different types of infrastructure. For example, water utilities do not liaise with electricity networks when planning, funding and approving the building of future assets.
- What do we do with disconnected communities with people who are already disadvantaged? There is a need to focus more on resilient recovery and rebuild, and less on response.
- We have large cities that are changing (edge vs infill development) but are not taking into account scenarios of hazard events. For example, when we lay in large powerlines, what will happen in this area?
- Increasingly, modelling must effectively value risk and quantify the impact.

A future strategy should consider:

- incentive models that step-up investment and investment models of all aspects of resilience, including social resilience, social impact and innovation
- changing dynamics for agriculture, population distribution and regional isolation

- expectations for reliability of systems and services
- very long planning windows
- mass movement of people in normal and crisis settings.

As with the other areas explored in this conference, the power of modelling and scenario studies has given infrastructure and other providers clarity around coordination and business cases in order for these groups to better work together in disaster and other events. The scenarios have provided opportunities to strengthen resilience strategies.

COMMUNICATION, EDUCATION AND BEHAVIOUR

> *It is an ongoing challenge to communicate risk, deliver effective calls to action and empower individuals, families and communities. How can we integrate each of these activities into a capability that delivers a safer and more resilient future?*

Great improvements have been made to warnings and communications since 2009 but we still need to refine and improve warning messages to ensure they are logical, simple, creative and engaging. Information/education and warnings must be appropriate to different time scales. Not just when the hazard arrives, but through life-long learning. There is a non-linear relationship between hazard warnings and instructions; individual comprehension and behavioural intention; and action.

All hazards have their impact locally, so the best risk adapted communities have locally developed plans for their neighbourhoods, including working with children in schools and working with different cultural and ethnic groups, businesses and other groups in their communities.

Preparedness is difficult to facilitate 'in the moment'. In the scenario, Bathurst was hit hard and fast, and there were significant challenges, including:

- access – one road in, one road out
- people struggling to prioritise their actions in the preparatory phase
- effective decision making under pressure, which is often difficult in a severe and catastrophic event with only partial information
- visitors to Bathurst being unfamiliar with the surroundings and not knowing what to do or where to go.

In this mass gathering environment:

- It would be very difficult to communicate with the V8 Supercar crowd at Mount Panorama.
- There would be contradictory cues, adding an additional layer of challenge (media, social media, environment etc).
- Vulnerable sub-populations warrant careful attention.
- Most peer-reviewed literature focuses on health hazards during mass gatherings (outdoor music festivals, religious events etc), rather than disasters caused by natural hazards.
- A systematic literature review indicates that the evidence is strongest on the importance of localised, contextualised risk information and acknowledges the need for research on strategies and tactics to improve participation and engagement of the public.
- There is a need to understand 'embodied uncertainty': response capacity is influenced by social identity, lived experienced, and is highly individualised.
- Clear information is needed about hazard type, severity, likelihood, timing, possible impacts, location, timeframe and reliable sources for additional information.

Citizen science is one approach that has been used. This example is from New Zealand:

- survey of Petone and Eastbourne residents, using a citizen science approach to understand tsunami response and evacuation behaviours
- only 11 per cent evacuated because of an earthquake
- emphasise the need to engage communities to enhance capacity to respond appropriately to both natural and agency-generated tsunami warnings
- people do not often know what a risk is. What will

a 120 kilometers per hour wind do? Will it mess up your hair or flatten your house?

Educating young people through disaster resilience education programs for young people has the potential to provide long-term benefits:

- During natural hazards, children will not be passive, they will be actively involved in response, relief and recovery.
- Done well, we will all understand causes and consequences of what was happening, have knowledge, skills, attitudes and values to work individually and collectively to reduce existing risks, preventing creation of new risks and strengthening resilience at local national and international levels.
- Good disaster risk reduction and disaster resilience education is wholistic as children need to understand the hazard, why they and their community are vulnerable and what capacities exist to reduce the vulnerability. This can empower children, and the best education is place-based, and participatory.
- Scale is a challenge:
  - What if disaster resilience education was embedded into the school's emergency management planning activities? For example, safe school programs are aligned with the curriculum.

Post disaster research into community actions and behaviours continues to inform improvements to communications and warnings, and community information:

- Significant proportions of the community are not aware they are at risk – therefore they are not identifying messages as affecting them. For example, during the 2018 Reedy Swamp bushfire in NSW, people living in the 'town' area of Tathra didn't seem themselves as being at risk until they were overwhelmed by ember storms.
- People planning to leave are less likely to have a plan on how they will leave, and less likely to have prepared their property because they were intending to leave.
- Smoke and visible cues are most often the first sign that things are happening. They then go to emergency services for more information.
- Messages are informative, but don't necessarily translate to action. Many residents need to confirm warnings by some other means.
- Good warnings do not necessarily translate into safe and effective and timely actions:
  - In some studies, it was found that almost two thirds of people who were away from home tried to return home as their first action.
  - It is difficult to send heavy rainfall and flood warnings into fire-affected areas.
- Some events, like Bathurst in the scenario, will come with minimal warning – earthquake, locally triggered tsunami, thunderstorm, hailstorm.

POLICY, ECONOMICS AND IMPACT

Evidence to support investment in resilience and mitigation at a national scale remains sparse. What new concepts and models can we use to inform and influence policy debate and development?

We need new models and concepts to inform the policy debate. Whilst systems analysis has improved the way people think about their place in the hazard landscape, this reductionist approach works up to a point. The changing environments that are being experienced are not conducive to a complete reductionist approach. In this complex setting, there are several concepts that need to be integrated into the analysis.

Risk ownership is an important concept – where people (and businesses) make decisions determined by their values. Where there is a risk there needs to be an owner, otherwise it is not being managed. Research has shown that there is an inconsistent approach to risk across jurisdictions and across categories of risk owners. Often, groups are unaware that they have risk ownership obligations.

People are reactionary – we often don't look at risk, vulnerability, resilience and planning for disasters until a disaster has affected us. Furthermore, the political cycle is short-term: politicians frequently do not want to touch things that are not going to impact their future electoral ambitions. It is also accepted that there is frequently a misalignment between community values and those of government. The challenge is to find shared values and ways of measuring them that are both meaningful and trusted by all parties.

Financial tools provide one lens into the impacts or exposure to natural hazards:

- Income is a good tool to measure impact, but is not enough by itself, as a disaster outside of where someone lives can impact places of work.
- Casual employees are a good example of those who can be negatively affected by disasters in their place of work – as measured by income.
- Indirect non-market impacts (intangible impacts) of disasters are not yet a well acknowledged impact measure in Australia.

Policy is a major driver of behaviour and of change. To be effective policy needs to be informed by both reliable evidence and innovative thinking and to include measures that can demonstrate whether or not it is having the intended impact.

RISK, VULNERABILITY AND INSURANCE

What are the current exposures across Australia that we can reduce or mitigate? Does current research provide clues or guidance on how to reduce our exposure? What can be done to ensure affordable insurability for the places we choose to live, holiday and invest in?

Risk and vulnerability have already been built into residential and commercial property and key infrastructure – these define the strength and performance of those assets and are used by insurers to determine the price for insuring those assets. Research and lived experience tell us that:

- Building codes and standards are minimum criteria – they may protect during a natural hazard, but in many cases, the building may not be able to be lived in after the event, which raises the question of the standard to which a structure should be built: life safety vs continued ability to use for the intended purpose.
- Building code minimum standards should lead to survivability, but they won't guarantee that it will be liveable after the event.
- We manage to sell cars with a safety rating, a maintenance manual and service schedule – we don't have any of these for our houses. And substantially, other than some insurance incentives, there are no obvious incentives to maintain existing housing.

Elected officials and policy advisers need to be informed and equipped to make decisions in a changing environment. These decisions need to be informed by an understanding of the impact, depth and breadth of these actions and what they will affect, both directly and indirectly.

The insurance industry is seen as a significant influencer in the risk and vulnerability debate but is constrained in the products it can offer by the profile of the market(s) in which it operates:

- Sustainable insurance provides stability in Australia – for businesses, shop owners, and others. Insurance allows us to take some reasonable risks.
- Data is the key to insurance risk pricing – and transparency of that data to assist governments, businesses and households to understand, and where practical, mitigate their risk exposure.
- Insurance risk is all estimated at the address level:
  - For natural hazard risk and land use planning, building codes and mitigation actions are what insurance companies look at to price their risks and premiums. This exposure is currently based on the land parcel, not the asset.
- At an insurance level, some people are oblivious to the risk to their property.
- It is not clear how an insurance company should price a property if it is built above the minimum standard.
- The time is right to explore different investment strategies and models to encourage insurers to co-invest in mitigation. This should include new forms of governance and organised decision making that can benefit from the collective knowledge and experience across the spectrum of stakeholders.

There are disadvantaged elements in the community for whom insurance is not a viable option, and with an anticipated increase in insurance premiums in increasingly at-risk locations, the number of people experiencing disadvantage is expected to increase:

- The insurance industry is failing those with low incomes, particularly where they reside in locations at high risk of damage form natural hazards.
- Poverty in all its forms is a major issue, including low income property owners living in high value properties.
- There is a need to think about how to set standards for landlords to implement hazard prevention/risk mitigation to known hazard risks.

Step-changes need to be made in lots of connected places to be sustainable and prepared for the future. Incrementalism – thinking we will solve our natural hazards risk and vulnerability by doing lots of small things is no longer expected to keep pace with the rate of change. The assumption of stability in the world around us is no longer a safe option; it isn't working for ecology, and climate change is not a cycle, it is a trend.

RELIEF, RECOVERY AND MITIGATION

> *Is it best to prepare for a major catastrophe through mitigation for a rare event, or build a surge capacity then deal with the mitigation during the rebuild? How do we arrive at an answer to this quandary? What are the implications of these approaches? How will we decide which path to follow, and what do we need to do to make it happen?*

It is generally acknowledged that post disaster recovery typically costs many times what is spent on preparedness (said to be more than 20 times the investment) and will go on for many years after the event. Engaging effectively and regularly with the community is not easy but needs to take place. Organisations like the Australian Red Cross use its volunteers and members as its ears and eyes into the community.

Research and field experiences have identified opportunities for improvement that can be grouped by capability.

Leadership and governance:

- There is an expectation that shifting from government to governance is more likely to bring communities and others to the front of disaster risk reduction.
- Models of volunteering are continuing to change and need to remain dynamic. We need to shift our approach to volunteering and how we engage productively with different approaches to volunteering.
- At a state and territory level – we need to deal with mitigation on an all hazards basis, using research and field evidence to inform strategy and policy development, and decision making that engages across government to mitigate against the impacts of natural hazards.

Education and awareness:

- Working with schools and children provides an important pathway to actively engage with young people and to capture and tap into generational shift.
- The capacity to learn from the past must be improved.

Program delivery:

- Australia has not yet had to deliver support at a massive scale within the experiences of those currently in the workforce. It has not had a massive catastrophe of a scale that could put long-term pressure on infrastructure, emergency management operations and government services.
- There are connections that need to be strengthened, including between local governments and the community sector.
- In the relief and early recovery stages, there is pressure on non-government organisations and others to get donations out into the community. But there are limitations on what the money can be used for and whether or not some of that money can be used to mitigate against future events.

Health, poverty and disadvantage:

- Mental health is an issue for the workforce post disaster. What are we doing? From a policy perspective and recovery space our priorities are incorrect. Mental health recovery takes a long-time but current programs are limited to two years. This is not enough. This can also be said of economic recovery.
- Poverty can be entrenched and created by disaster events. This can be seen through: loss of property, jobs, renters unable to find rentals in rising rental prices, businesses unable to operate and unable to employee staff (this is critical for casual staff).
- Post-event community sector organisations may not be able to recover.

Emerging themes

Across the discussions on research and impact, several clear themes emerged that provide a way to summarise the topics the participants felt were most important to them in minimising the impacts of major, cascading natural hazard emergencies.

FUTURE WORKFORCE

An educated, informed, engaged, diverse and healthy workforce emerged as a common thread across all areas. Specific elements of importance were:

- health and wellbeing
- understanding and embracing technological developments
- opportunities must be available for education and capacity building in the existing workforce and for introducing and embracing new people and capabilities
- models of volunteering will continue to evolve and will always be dynamic
- ensuring a regular injection of new people into the sector – bringing new ideas and transferring knowledge from other fields.

LEADERSHIP, POLITICS AND POLITICISATION

Any discussion on significant disasters caused by natural hazards will always touch on leadership, politics and politicisation:

- Regulation of essential industries – substantially, discussions on these industries is highly politicised, and is coupled with an expectation that these industries will maintain safety and meet cost efficiencies required to deliver their regulated service. Tight regulation is perceived to have a negative influence on innovation. Opportunities for new business models and incentives should be considered.
- We need to make big changes across the board and look beyond incremental progress to achieve the mitigation objectives expected of governments. We can already begin to do this in many areas based on the current evidence, but we do need to better enable evidence-informed courageous decision making.
- We need to have a shared view of the big picture – only then can we all work together to develop the right evidence and knowledge that informs the strategy and policy that will guide what we do and the roles that each of us play individually and collectively.

PLANNING AND LAND USE

Long-term planning is fundamental to most discussions, across a diversity of topics:

- Climate induced changes are already evident and unless the trajectories being predicted are accepted and adapt land use planning and other regulatory and legislative levers, new risks will simply be built into an already challenged built environment.
- Place-based actions and decision making that supports locally led innovation and adaptability will empower communities to minimise their own vulnerabilities – under an umbrella that minimises regional and national vulnerabilities.
- Strategic policy and planning must have a timeframe of at least 20 years to allow for a cohesive and effective approach – with implementation minimally influenced by political cycles.

RISK, VULNERABILITY AND MITIGATION

Most discussions on natural hazards inevitably end up talking about risk and vulnerability:

- At risk communities generally don't think about natural hazards, unless there is a good reason or trigger. How can risk be communicated to people who have never experienced it? Personalising messages remains a critical need. Research has improved knowledge, but human behaviour is complex:
  - Embodied uncertainty remains a challenge. An individual's social identity and lived experience affects their understanding of risk and willingness/ability to respond in an emergency.
- Scenario planning and modelling is an important tool to understand the cost-benefits and trade-offs in investment decisions. Modelling needs to account for cross system risks. Tools, including the CRC's UNHaRMED decision support tool, allow mitigation options to be explored and compared for future hazard scenarios to determine the relative benefits of the options.

TECHNOLOGIES

New technologies are emerging at a significant rate. Two of the examples discussed were:

- use of digital twins (that is, a digital 'copy') of buildings or regions will allow for scenario and impact analyses
- expected reliance on assistive technologies and 'just in time' delivery will affect the expectations of the future workforce, and services are expected to be delivered in the future.

RESEARCH

Embedded in every discussion was the need for ongoing research and the development and promotion of research skills – to expand the evidence base, to test new hypotheses, to promote public debate and to assist in learning and continuous improvement.

MASS GATHERING EVENTS

Mass gathering events represent an ongoing challenge. In the scenario:

- those affected were in an unfamiliar regional environment
- the severe weather warning was received very late
- decision making at Bathurst was likely to be fluid, and it would have been difficult to make safe and effective solutions in such a complex environment. In that context, shelter in place was the likely decision, due to the late warning and limited escape options. At the site, prior emergency management planning had assumed emergencies at a race meeting in a regional environment would have included grass or bushfires, heat, alcohol and drug-related impacts, food poisoning, or a race car crash.

KEEPING BUSINESSES AND COMMUNITIES VIABLE

Should lifelines be the focus (infrastructure for a purpose rather than infrastructure as a business) as one driver of mitigation investment, rather than talking about critical infrastructure more as a 'thing'? This includes:

- fuel
- food
- water and sewerage
- health
- communications
- transport.

Conclusions

SCENARIO RE-RUN

Clear steps were identified by conference participants. If implemented effectively and in a timely manner they would reduce the impacts of cascading natural hazard events that collectively would have created major damage, injury and loss across major areas of NSW – and would have had a similar impact if they had occurred

in other major populated areas across Australia or New Zealand.

There are also some sobering conclusions that need to be considered. It is not clear whether anything, even if started today, would have more than a modest mitigating effect on a similar weather event if it were to occur in 2035:

- Coastal retreat and buy-backs along the coastal regions of NSW, without massive community support, is likely to face a significant period of discussion, supported by legislative change and financial investments on a massive scale. Balancing pre-emptive action with waiting until properties become uninhabitable is likely to be the subject of fierce public debate.
- Natural hazards with little or no warning of their arrival will continue to be problematic and cause losses if the areas that are exposed are not built or retrofitted to withstand the impact of those hazards.
- There is a significant amount of existing built risk in communities. Looking at the impact of the East Coast Low scenario on Sydney, to avoid much of the flooding associated damage and disruption would likely require major upgrades to stormwater management systems. That would require many years of construction work to upgrade.
- There are likely to be many unknown risks that will only become apparent when the asset or systems are exposed to a disaster – for example, in the scenario, movement of foundations, leading to structural defects appearing in major residential or commercial buildings.

IMPROVEMENTS TO REDUCE THE IMPACTS CAUSED BY THE SCENARIO

Strategies implemented to manage forested water catchments to ensure water quality is more likely to be maintained, include:

- fuel and fire management strategies to minimise fire spread into essential water catchments
- new and improved fire prediction tools to provide better decision support and situational awareness information to fire management agencies
- satellite data that rapidly identifies fire starts across the continent and deploys rapid fire suppression assets to minimise the likelihood of fires developing
- linked fire-atmosphere models allow the Bureau of Meteorology to provide detailed information that:
  - allows fire behaviour analysts to predict fire progression with increasing accuracy; and which can be combined with an in-depth understanding of the rates at which firefighting assets can suppress fires. Allowing incident management teams to more accurately dispatch the right mix of assets to suppress fires.

Status: This work has commenced and is ongoing. The outcomes will be achieved through the integration of ongoing research and from the experience and observations of the agencies responsible for controlling bushfires.

Improved weather forecasting of real-time weather up to two weeks in advance will allow more effective decision making, and would be expected to:

- identify the East Coast Low impact on Sydney with a start and end time, to allow workplaces, schools and services to plan for a disruption and ensure people can be in the safest place for the expected impact. This would be reflected in future workplace arrangements
- identify the severe hailstorm that impacted Bathurst – well before most of those attending the race had even left home, allowing race organisers and NSW emergency management advisers to make an informed decision based on the likely impact of the weather during the event and on the people attending the event
- allow emergency services to pre-deploy resources, knowing substantially where the events will occur.

Status: Research to date has demonstrated the feasibility of this approach, and there are international collaborations bringing global experiences to this challenge. Work already completed is improving the probabilistic forecasting of large extreme weather events. Predicting localised extreme events remains a challenge.

Significant upgrading of land use planning, standards and building practices are essential long-term initiatives that will, in combination, reduce the burden of built risk. Research has been used in Queensland to implement a government initiative to retrofit houses to increase their resistance to cyclonic winds. This has been an effective program that has seen insurance premiums drop in retrofitted properties. Whilst other mitigation initiatives can reduce already built risk, the opportunity today is to stop building new risks into the landscape.

There is already a body of knowledge that identifies land that should not be residential, or where additional protective measures are required to make cost-effective human habitation a viable long-term proposition.

In the scenario presented, this would lead to benefits linked to the bushfires and the East Coast Low. Interestingly, much of the carnage at the Bathurst event was to temporary structures, tents, caravans and mobile homes. The challenge is extended to other mass gathering events – using the broad definition of places where people gather, and this could include camping grounds and caravan parks as well as events like the Bathurst 1000.

Status: Initiatives to strengthen land use planning, standards and building practices should be developed and be implemented as soon as possible. Using home start forecasts[5], every day of delay in implementing a disaster resilient approach to residential housing will see construction start on almost 500 new homes every day that implementation is delayed.

Effective collaboration and communication between all levels of government, businesses and communities is described by some as the 'holy grail'. If the view taken (correctly) is that the right people need to be mobilised, in the right place, at the right time, then the only conclusion is that these interactions must happen seamlessly. Trust is a concept that is used often, and in this case, it is important that trusting relationships are built to have a chance of achieving this outcome. The discussions at the conference talked about new governance models that supported creativity and innovation – supported by evidence, but not constrained by bureaucracy.

Status: Research is beginning to build the evidence that will support the effectiveness of trust relationships. There is growing evidence that this works well at the local level but does not easily scale to regional and national levels.

Underpinning all the initiatives above is an absolute need to educate and develop the current and future workforces. Workforce development is a multi-pronged opportunity:

- improving the capability of those already working in the area
- educating additional expertise in natural hazards to reflect the impact that disasters caused by natural hazards can have across most sectors of our economy
- educating and inspiring the next generation of the natural hazards/disaster management workforce – who will need to have an ability to integrate new technologies and systems with an understanding of the natural environment.

There are some challenges yet to be effectively managed:

- Cascading or sequential natural hazard emergencies will create health and wellbeing issues for the workforce.
- Provision of support for post-event recovery is a long-term journey, measured in many years. Without investing to mitigate the impacts of natural hazards on individuals, communities and the economy, providing a responsible and effective recovery program will become unachievable.

Status: Initiatives are in progress to address elements of the workforce of the future. A sustained program of research, implementation and program evaluation will be important to achieve this goal and have an inspired, committed and enthusiastic workforce available 'on demand'. In the context of this scenario, events of this scale will need a sophisticated workforce making informed decisions to effectively minimise the short and long-term impacts.

POSTSCRIPT

In the spring and summer of 2019/2020, Australia experienced a major series of bushfires and severe weather events that bore striking similarity to the events contemplated in the scenario used for this conference. The only element missing was the impact on a major mass gathering event.

What that has reinforced is that:

- the landscape must be managed as a whole, rather than managing independently for bushfire, flood, storm, etc.
- sequencing of natural hazard events has an impact on outcomes. For example:
  - During times of drought, when water storage in catchments and waterways are low and there are major bushfires devastating the landscape, subsequent heavy rainfall will create landslides, debris flows into waterways, erosion and mass removal of seeds from burnt areas.
  - Major storms, including cyclones and East Coast Lows, will create flooding and storm related damage, and will also increase fuel loads on the ground resulting from the damage caused by the storms on the vegetation.
- we need to plan and contemplate how well we will be prepared for and respond to ever-increasing impacts from complex and cascading severe and extreme natural hazard events, and to help focus mitigation investment in the right places
- forward-looking, evidence-based mitigation and prevention remain the best investments to provide the joint benefits of harm minimisation and expenditure management
- there will be inevitable trade-offs in mitigation investments that will balance the effects of:
  - human life, safety and amenity
  - biodiversity and preservation of species
  - lifestyles and freedom of choice
  - access to funding.

How do we tell people in 20 years?

"It's not that we didn't know the problems, it's more that we didn't know how to implement change."

"Sorry, we just didn't have the money to do that."

5 https://www.afr.com/property/number-of-houses-and-units-built-across-australia-forecast-to-drop-by-25-per-cent-20190124-h1afod

Conference program

MONDAY 17 JUNE	
MARATHON ROOM	
17:30	Registration
18:00	Welcome – **Katherine Woodthorpe AO**, Independent Chair, Bushfire and Natural Hazards CRC
18:05	Keynote – **Robert de Castella**, Indigenous Marathon Foundation, The role of sport and community in post-disaster recovery
18:35	Networking and refreshments
20:00	Conclusion
Shuttle bus	*Shuttle buses to central Canberra depart AIS: 19:45, 20:00, 20:30, 20:45, 21:15*

TUESDAY 18 JUNE	
CHARLESWORTH THEATRETTE	
8:30	Registration
9:00	Welcome to country – Aunty Violet Sheridan, Ngunnawal Elder & Knowledge Holder Introduction and overview: **Richard Thornton**, Bushfire and Natural Hazards CRC **Jeff Butler**, Australian Capital Territory State Emergency Service
9:30	Keynote – **Jo Horrocks**, Ministry of Civil Defence & Emergency Management, New Zealand
10:00	Keynote – **Mark Crosweller**, National Resilience Taskforce, Department of Home Affairs
10:30	Morning tea
11:00	**EXTREME HAZARDS SCENARIO 2019**
	John Bates, Bushfire and Natural Hazards CRC **Andrew Gissing**, Risk Frontiers Scenario developed in partnership with the Bureau of Meteorology and Geoscience Australia.
11:30	**SCENARIO OUTLINE** **EXPERT PANEL: SCENARIO DISCUSSION**
	Andrew Buay, Optus-Singtel **Andrew Coghlan**, Australian Red Cross **Darren Spoor**, Australian Energy Market Operator **Justin Dunlop**, Ambulance Victoria **Doug Smith**, Queensland Fire and Emergency Services **Melissa Pexton**, Western Australian Local Government Association **Rob Cameron**, Emergency Management Australia **Sharanjit Paddam**, QBE Insurance
12:30	Lunch

	CHARLESWORTH THEATRETTE	GOLD ROOM	SILVER ROOM
	RESEARCH SESSIONS		
13:30 - 15:00	**CLIMATE, WEATHER AND ENVIRONMENT**	**RESPONSE**	**RESILIENT CITIES AND COMMUNITIES (INC PLANNING & MITIGATION)**
	Will Grant, Australian National University (Chair) **Beth Ebert**, Bureau of Meteorology **Jeff Kepert**, Bushfire and Natural Hazards CRC & Bureau of Meteorology **Thomas Duff**, Bushfire and Natural Hazards CRC & University of Melbourne	**Alen Slijepcevic**, Country Fire Authority (Chair) **Chris Bearman**, Bushfire and Natural Hazards CRC & CQUniversity **Harald Richter**, Bushfire and Natural Hazards CRC & Bureau of Meteorology **Sally Ferguson**, CQUniversity	**Catherine McGrath**, Catherine McGrath Media (Chair) **Alan March**, Bushfire and Natural Hazards CRC & University of Melbourne **Barbara Norman**, University of Canberra **Ellie Kay**, Resilient Organisations **Holger Maier**, Bushfire and Natural Hazards CRC & University of Adelaide **Melissa Parsons**, Bushfire and Natural Hazards CRC & University of New England
Session guide	How will changes in the climate affect our environment and exposure to natural hazards? How will our ability to better model and predict extreme weather contribute to reducing the impacts of severe fire and weather on people, infrastructure and the environment?	How will we improve preservation of life and provide positive outcomes for responders and communities in the face of severe of catastrophic natural hazards?	Cities and communities are the foundations upon which we live in Australia. How should we develop safer cities? What will 'cities and communities' mean in 2035? How can communities best participate in building resilience to disasters?
15:00	Afternoon tea		
	RESEARCH SESSIONS		
15:30 - 17:00	**LIFELINES AND CRITICAL INFRASTRUCTURE**	**COMMUNICATION, EDUCATION AND BEHAVIOUR**	**POLICY, ECONOMICS AND IMPACT**
	Jillian Edwards, National Resilience Taskforce, Department of Home Affairs (Chair) **Barbara Norman**, University of Canberra **Damminda Alahakoon**, Bushfire and Natural Hazards CRC & LaTrobe University **Jill Cainey**, Energy Networks Australia **Sujeeva Setunge**, Bushfire and Natural Hazards CRC & RMIT University **Garry McDonald**, Market Economics	**Amanda Leck**, AFAC (Chair) **Briony Towers**, Bushfire and Natural Hazards CRC & RMIT University **David Johnston**, Massey University **Josh Whittaker**, Bushfire and Natural Hazards CRC & University of Wollongong **Vivienne Tippett**, Bushfire and Natural Hazards CRC & Queensland University of Technology	**John Handmer**, RMIT University (Chair) **Adriana Keating**, International Institute for Applied Systems Analysis **Celeste Young**, Bushfire and Natural Hazards CRC & Victoria University **Farah Beaini**, Bushfire and Natural Hazards CRC & Deakin University **Richard Smith**, Resilience to Nature's Challenges **Veronique Florec**, Bushfire and Natural Hazards CRC & University of Western Australia
Session guide	Without access to the services that we rely upon to support life and wellbeing at the most basic level, Australians will be vulnerable to major, overlapping crises. What are the emerging options and opportunities to re-imagine or re-engineer the lifelines?	It is an ongoing challenge to communicate risk, deliver effective calls to action and empower individuals, familes and communities. How can we integrate each of these activities into a capability that delivers a safer and more resilient future?	Evidence to support investment in resilience and mitigation at a national scale remains sparse.What new concepts and models can we use to inform and influence policy debate and development?
17:00	Conclusion of day		

WEDNESDAY 19 JUNE			
CHARLESWORTH THEATRETTE			
8:00	Registration		
8:30	Announcements and introductions		
8:45	Keynote – **Animesh Kumar,** Deputy Head of the United Nations Office for Disaster Risk Reduction, Regional Office for Asia and Pacific		
	CHARLESWORTH THEATRETTE	**GOLD ROOM**	**SILVER ROOM**
	IMPACT SESSIONS		
9:30 - 11:00	**RISK, VULNERABILITY AND INSURANCE**	**RESPONSE CAPABILITY**	**LIFELINES AND CRITICAL INFRASTRUCTURE**
	Catherine McGrath, Catherine McGrath Media (Chair) **David Henderson**, Bushfire and Natural Hazards CRC & Insurance Australia Group **Jillian Edwards**, National Resilience Taskforce, Department of Home Affairs **Karl Sullivan**, Insurance Council of Australia **Paul Barnes**, Australian Strategic Policy Institute **Sharanjit Paddam**, QBE Insurance	**Iain Mackenzie**, Inspector-General Emergency Management, Queensland (Chair) **Justin Dunlop**, Ambulance Victoria **Simon Heemstra**, New South Wales Rural Fire Service **Sascha Rundle**, ABC Emergency **Rob Webb**, Bureau of Meteorology	**Leesa Carson**, Geoscience Australia (Chair) **Andrew Buay**, Optus-Singtel **Eleanor Homersham**, Australian Government Department of Infrastructure, Regional Development and Cities **Darren Spoor**, Australian Energy Market Operator **Jill Cainey**, Energy Networks Australia **Yew-Chin Koay**, VicRoads
Session guide	What are the current exposures across Australia that we can reduce or mitigate? Does current research provide clues or guidance on how to reduce our exposure? What can be done to ensure affordable insurability for the places we choose to live, holiday and invest in?	Preparation for massive extreme weather with catastrophic impacts on human life and human injury is uncommon in Australia. In preparing for a disaster with thousands of deaths, tens of thousand of injuries and mass loss of housing and identity, how do our business-as-usual operations and surge capacities need to evolve? What decision making needs to be put in place to cope with these massive impacts?	Reliance on critical infrastructure and services are key vulnerabilities globally. In the Australian environment, what can and should we be doing now to minimise reliance on these lifelines, or build resilience to the impacts of a massive impact simultaneously in one or more major capital cities? The sources of exposure go beyond Australia's borders and into our future. How will fuel, food and other essential supplies be sourced internationally in times of crisis and when other countries may also be in crisis?
11:00	Morning tea		

	IMPACT SESSIONS		
11:30 - 13:00	**LAND USE PLANNING AND MANAGEMENT**	**RELIEF, RECOVERY AND MITIGATION**	**RESILIENT CITIES AND COMMUNITIES**
	Neil Cooper, ACT Parks and Conservation Service (Chair) **Anthony Rowe**, Emerge Associates & Planning Institute of Australia **Duncan McLuckie**, Office of Environment and Heritage, New South Wales **Mark Stafford-Smith**, Green Cross **Naomi Stephens**, Office of Environment and Heritage, New South Wales	**Amanda Lamont**, Australian Institute for Disaster Resilience (Chair) **Andrew Coghlan**, Australian Red Cross **Brendan Moon**, Queensland Reconstruction Authority **Kellie Caught**, Australian Council of Social Service **Mal Cronstedt**, Department of Fire and Emergency Services, Western Australia	**Melissa Pexton**, Western Australian Local Government Association (Chair) **Michael Morris**, Fire and Rescue New South Wales **Jo Horrocks**, Ministry of Civil Defence & Emergency Management, New Zealand **Russell Wise**, National Resilience Taskforce, Department of Home Affairs
Session guide	Planning, by its nature, is focused on the long-term. What are the timeframes we are looking at to initiate change? Depending on the scale, how long will it take to get enough change to see a noticeable impact? Given the current approach to land use in Australia, what are the essential needs for change? Will they be driven by evolution or revolution? What are the key decisions that need to be made, and by when, to reduce exposure and impacts by 2035?	Is it best to prepare for a major catastrophe through mitigation for a rare event, or build a surge capacity then deal with the mitigation during the rebuild? How do we arrive at an answer to this quandary? What are the implications of these approaches? How will we decide which path to follow, and what do we need to do to make it happen?	Major cities are highly developed and complex. They are at once expanding and becoming more dense. By 2035, the world will have changed such that, if climate trends continue, major population centres will be massively exposed to natural hazards. What are the changes that need to be implemented at the local, regional and national levels to avoid massive threats to life and livelihoods? How will we justify the investments for relatively uncommon events with governments that have increasing demands for a limited annual budget?
13:00	Lunch		
CHARLESWORTH THEATRETTE			
13:45 - 15:30	**EXTREME HAZARDS HYPOTHETICAL 2035 SCENARIO** **PANEL: FOCUS SESSIONS REPORT BACK**		
15:30	Closing comments		
16:00 - 16:10	Conclusion – **Richard Thornton**, Bushfire and Natural Hazards CRC		

Participants list

FIRST NAME	LAST NAME	ORGANISATION
Sascha	Rundle	ABC
Greg	Brown	ACT Ambulance Service
Jeff	Butler	ACT Emergency Services Agency
Mark	Harriott	ACT Emergency Services Agency
Giel	Van Noorden	ACT Emergency Services Agency
Antonio	Di Pietro	ACT Fire and Rescue
Sam	Evans	ACT Fire and Rescue
Wieslaw	Lichacz	ACT Fire and Rescue
Brian	Mexon	ACT Fire and Rescue
Claire	Beale	ACT Parks and Conservation Service
Neil	Cooper	ACT Parks and Conservation Service
Adam	Leavesley	ACT Parks and Conservation Service
Greg	Esnouf	AFAC
Hiru	Jayatunge	AFAC
Noreen	Krusel	AFAC
Amanda	Leck	AFAC
Justin	Dunlop	Ambulance Victoria
Kellie	Caught	Australian Council of Social Service
Darren	Spoor	Australian Energy Market Operator
Christine	Belcher	Australian Institute for Disaster Resilience
Amanda	Lamont	Australian Institute for Disaster Resilience
Michael	Eburn	Australian National University

FIRST NAME	LAST NAME	ORGANISATION
Will	Grant	Australian National University
Paul	Barnes	Australian Strategic Policy Institute
Beth	Ebert	Bureau of Meteorology
Jeff	Kepert	Bureau of Meteorology
Shannon	Panchuk	Bureau of Meteorology
Harald	Richter	Bureau of Meteorology
Rob	Webb	Bureau of Meteorology
John	Bates	Bushfire and Natural Hazards CRC
Leanne	Beattie	Bushfire and Natural Hazards CRC
Desiree	Beekharry	Bushfire and Natural Hazards CRC
David	Boxshall	Bushfire and Natural Hazards CRC
David	Bruce	Bushfire and Natural Hazards CRC
Greg	Christopher	Bushfire and Natural Hazards CRC
Matthew	Hayne	Bushfire and Natural Hazards CRC
Nathan	Maddock	Bushfire and Natural Hazards CRC
Nicklaus	Mahony	Bushfire and Natural Hazards CRC
Sarah	Mizzi	Bushfire and Natural Hazards CRC
Amy	Mulder	Bushfire and Natural Hazards CRC
Vaia	Smirneos	Bushfire and Natural Hazards CRC
Kelsey	Tarabini	Bushfire and Natural Hazards CRC

FIRST NAME	LAST NAME	ORGANISATION
Richard	Thornton	Bushfire and Natural Hazards CRC
Gabriel	Zito	Bushfire and Natural Hazards CRC
Katherine	Woodthorpe	Bushfire and Natural Hazards CRC Board
Catherine	McGrath	Catherine McGrath Media
John	Gilbert	Country Fire Authority, Victoria
Alen	Slijepcevic	Country Fire Authority, Victoria
Chris	Bearman	CQUniversity
Sally	Ferguson	CQUniversity
Farah	Beaini	Deakin University
Malcolm	Cronstedt	Department of Fire and Emergency Services, WA
Leon	Gardiner	Department of Fire and Emergency Services, WA
Kelli-Ann	Kerin	Department of Foreign Affairs and Trade
Jennifer	Noble	Department of Foreign Affairs and Trade
Ceri	Teather	Department of Foreign Affairs and Trade
Robert	Cameron	Department of Home Affairs
Mark	Crosweller	Department of Home Affairs
Ciara	Crowley	Department of Home Affairs
Jillian	Edwards	Department of Home Affairs
John	Gibbon	Department of Home Affairs
Alexandra	Nichols	Department of Home Affairs
Jessica	Raine	Department of Home Affairs
Rhiannon	Scheerlinck	Department of Home Affairs
Russell	Wise	Department of Home Affairs

FIRST NAME	LAST NAME	ORGANISATION
Ella	Homersham	Department of Infrastructure, Transport, Cities and Regional Development
Michael	Angus	DMA Creative
Anthony	Rowe	Emerge Associates
Evelyn	Moses	Emergency Management Australia
Elizabeth	Van Boogard	Emergency Management Australia
Jill	Cainey	Energy Networks Australia
Ian	Fitzpatrick	Essential Energy
Rachael	Thorp	Fire and Emergency New Zealand
Michael	Morris	Fire and Rescue NSW
David	Tchappat	Fire and Rescue NSW
Leesa	Carson	Geoscience Australia
Rikki	Weber	Geoscience Australia
Iain	Mackenzie	Inspector-General Emergency Management Queensland
David	Henderson	Insurance Australia Group
Phil	Lockyer	Insurance Australia Group
Karl	Sullivan	Insurance Council of Australia
Adriana	Keating	International Institute for Applied Systems Analysis
Damminda	Alahakoon	La Trobe University
Darryl	Glover	Local Government Association of South Australia
Garry	McDonald	Market Economics
Nicky	Smith	Market Economics
Kate	Akers	Massey University
Denise	Blake	Massey University
Emily	Campbell	Massey University
David	Johnston	Massey University
Emily	Lambie	Massey University
Martin	Braid	Metropolitan Fire & Emergency Services Board
Darren	Conlin	Metropolitan Fire & Emergency Services Board

FIRST NAME	LAST NAME	ORGANISATION
Maurice	Gubiani	Metropolitan Fire & Emergency Services Board
David	Harris	Metropolitan Fire & Emergency Services Board
Guy	McCrorie	Metropolitan Fire & Emergency Services Board
Jo	Horrocks	Ministry of Civil Defence and Emergency Management, NZ
Jonathan	Jull	Ministry of Civil Defence and Emergency Management, NZ
Richard	Smith	New Zealand Resilience Challenge
Claire	Higgins	Northern Beaches Council
Robyn	Smith	NSW Environment Protection Authority
Carl	Hollis	NSW National Parks and Wildlife Service
Naomi	Stephens	NSW National Parks and Wildlife Service
Simon	Heemstra	NSW Rural Fire Service
Tony	Jarrett	NSW Rural Fire Service
Joanne	Humphries	NSW State Emergency Service
Craig	Ronan	NSW State Emergency Service
Samuel	Beattie	Office of Emergency Management, NSW
Melinda	Hillery	Office of Environment and Heritage, NSW
Andrew	Buay	Optus-Singtel
Sharanjit	Paddam	QBE Insurance Group
Doug	Smith	Queensland Fire and Emergency Services
Brendan	Moon	Queensland Reconstruction Authoirty
Melissa	Teo	Queensland University of Technology
Vivienne	Tippett	Queensland University of Technology
Kaitlyn	Watson	Queensland University of Technology

FIRST NAME	LAST NAME	ORGANISATION
Ellie	Kay	Resilient Organisations
Sujeeva	Setunge	RMIT University
Briony	Towers	RMIT University
Greg	Nettleton	SA Country Fire Service
Ali	Walsh	SA Country Fire Service
Edward	Pikusa	SA Department for Environment and Water
Antony	McLoughlin	SA Fire and Emergency Services Commission
Graeme	Wynwood	SA State Emergency Service
John	Handmer	The Risk Laboratory
Animesh	Kumar	United Nations Office for Disaster Risk Reduction
Holger	Maier	University of Adelaide
Rachel	Lawson	University of Auckland
Barbara	Norman	University of Canberra
Thomas	Duff	University of Melbourne
Lisa	Gibbs	University of Melbourne
Constanza	Gonzalez Mathiesen	University of Melbourne
Alan	March	University of Melbourne
Phoebe	Quinn	University of Melbourne
Melissa	Parsons	University of New England
Barbara	Ryan	University of Southern Queensland
Tim	Ramm	University of Tasmania
Veronique	Florec	University of Western Australia
Josh	Whittaker	University of Wollongong
Sophie	Lewis	UNSW Canberra
Yew-Chin	Koay	VicRoads
Celeste	Young	Victoria University
Sarah	Martin	Volunteering Tasmania
Melissa	Pexton	Western Australian Local Government Association
Jonathan	Clayson	Western Australian Department of Health

What participants said

slido 18 Jun, 12:19pm

FB Farah Beaini

Deakin University

How can we tackle these issues with courage and creativity that inspires rather than makes communities more fearful?

slido 18 Jun, 12:32pm

AM Antony McLoughlin

South Australian Fire and Emergency Services Commission

Land use planning is likely the most cost-effective mitigation activity. How are we going to use our limited mitigation funding towards this?

slido 19 Jun, 2:51pm

EH Ella Homersham

Department of Infrastructure, Transport, Cities and Regional Development Australia

Will insurance, government disaster recovery funding and public goodwill be viable long-term?

slido 19 Jun, 2:21pm

MP Melissa Parsons

University of New England

Thinking 20 to 50 years into the future is not valued in three year political and funding cycles.

slido 19 Jun, 10:52am

ME Michael Eburn

Australian National University

Risk is not universal. What government and emergency mangers see as an unacceptable consequence may not be the same for others. The sector is not the arbiter of what is acceptable risk.

slido 19 Jun, 4:55pm

CH Claire Higgins

Northern Beaches Council

How can climate change resilience compete with an economy that fosters perpetual economic growth and flow on impacts? E.g. land use planning for population growth?

slido 19 Jun, 3:04pm

Anonymous

All panellists have described a 'plan' for the response of the event in their work, but what about when those plans fail? What about plans b-z? Do they exist?

slido 19 Jun, 10:31pm

WL Wieslaw Lichacz

ACT Fire and Rescue

Who owns the risk and will affected populations be looking for someone to blame as insurance companies and courts look for who is, or was, at fault or negligent?

slido 19 Jun, 12:19pm

GB Greg Brown

ACT Ambulance Service

Cultural change (e.g. investing in youth) also applies to emergency response agencies. Cross pollination of ideas to build interdisciplinary cooperation is vital.

slido 18 Jun, 12:27pm

SP Sharanjit Paddam

QBE Insurance

Is our fear of being 'too negative' stopping us from having frank conversations with community about risk?

slido 18 Jun, 12:35pm

Anonymous

There are limits to adaptation. What are we going to choose not to do? How do we decide?

slido 19 Jun, 3:25pm

VT Vivienne Tippett

Queensland University of Technology

Are we focusing too much on known, historic event types? Do we need to understand impacts of new event types e.g.: thunderstorm asthma, heat, disease?

slido 19 Jun, 2:21pm

MM Michael Morris

Fire and Rescue NSW

We keep talking community at scale, but do we start today, talking to individual community members to change understanding of risk.

slido 19 Jun, 4:50pm

Anonymous

Canberra is set to entirely use renewable energy by 2020, what does the future of green energy look like in relation to major towns and cities?

slido 19 Jun, 12:19pm

DG Darryl Glover

Local Government Association of South Australia

I pay my emergency services levee with my rates. You are providing a service to me that infers you take responsibility for my risk.

t +61 3 9412 9600
e office@bnhcrc.com.au
w www.bnhcrc.com.au
@bnhcrc

bushfire&natural HAZARDSCRC

BUSHFIRE AND NATURAL HAZARDS CRC

WAS DELIGHTED TO HOST THE

12TH AUSTRALASIAN NATURAL HAZARDS MANAGEMENT CONFERENCE

17–19 JUNE 2019, AUSTRALIAN INSTITUTE OF SPORT, CANBERRA

The CRC conducts a multi-disciplinary research program on the major national issues across the natural hazards spectrum. The CRC is a partnership of all Australian and New Zealand fire, land and emergency service agencies; more than 30 universities; plus many federal, state and local government departments; professional and volunteer associations; and non-for-profit organisations.

The CRC is providing a long-term knowledge base that directly supports emergency services and other government and non-government agencies to protect their communities through work to prevent, prepare for, respond to and recover from natural disasters.

The utilisation of the research by the end-users to the benefit of the broader Australian community is critical to the whole process. The research program comprises three broad themes, covering 12 clusters of projects, most of which span the priorities for those working in a multi-hazard environment. The themes are:

- Economics, policy and decision making
- Resilient people, infrastructure and institutions
- Bushfire and natural hazard risks

The CRC was created with a mission to:

- Reduce the risks from bushfire and natural hazards
- Reduce the social, economic and environmental costs of disasters
- Contribute to the national disaster resilience agenda
- Build internationally renowned Australian research capacity and capability