Natural Hazards Research Australia

Research priorities for disaster risk reduction and community resilience to the impacts of natural hazards

Discussion paper

Based on outcomes of national workshops (August) and partner surveys

Publisher: Natural Hazards Research Australia

October 2021

We acknowledge the traditional custodians across all the lands on which we live and work, and we pay our respects to Elders both past and present. We also acknowledge that these lands have been, and always will be, places of teaching, research and learning.

To contact Natural Hazards Research Australia, email office@naturalhazards.com.au.

Australian Government

Australia's research centre for natural hazards resilience and disaster risk reduction

On 1 July 2021, the Australian Government announced the establishment of a new natural hazards and disaster research centre.

Natural Hazards Research Australia (the Centre) is working closely with the Australian Government to develop a new strategic research agenda for Australia along with its partners, including state-based emergency service agencies, universities and industry.

Natural Hazards Research Australia is now in its establishment phase and has conducted an online survey and an extensive series of sector-wide workshops and meetings with potential end-user and research partners, to define and develop a long-term research program.

The establishment of Natural Hazards Research Australia continues the coordinated national research effort of two Cooperative Research Centres – the Bushfire CRC and the Bushfire and Natural Hazards CRC – over the last 18 years and will address the major challenges arising from recent natural hazards.

Objectives

The Centre supports the needs of emergency service agencies and communities in preparing for, responding to and recovering from natural hazard disasters. The Centre has three overarching objectives:

1. The protection of human life, minimised harm and suffering – towards zero preventable deaths
2. Well-prepared and resilient communities
3. Research that translates into action

Scope

This scope may be widened during the lifetime of the Centre as needs change, but is expected to remain focused on natural hazards research:

- bushfires
- heatwaves
- earthquakes
- floods
- storms
- tsunamis
- cyclones
- sea level rise – inundation and erosion
- landslides

The global context

In Australia, and internationally, natural hazards are inevitable and frequent, but the impacts are felt unevenly throughout our communities. The Centre's objectives and activities are informed by initiatives at the international, national and local level to better understand how these impacts can be reduced for people of all social, economic and cultural backgrounds. This includes, but is not limited to, Indigenous people and communities, people from culturally and linguistically diverse backgrounds, people from remote and rural areas, people with disabilities, the aged and the very young, people identifying as LGBTIQ+, people without permanent housing, and newly arrived migrants.

The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) has clear targets and priorities to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.

The four priorities for action are:

1. understanding disaster risk
2. strengthening disaster risk governance to manage disaster risk
3. investing in disaster reduction for resilience
4. enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.

The Intergovernmental Panel on Climate Change – the United Nations' body for assessing the science related to climate change – recently released the Sixth Assessment Report. This is the most up-to-date physical understanding of the climate system and climate change, bringing together the latest advances in climate science and combining multiple lines of evidence from paleoclimate, observations, process understanding, and global and regional climate simulations.

This is one of the guiding statements on the observed changes in extreme natural hazards:

> *Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, and heavy precipitation, agricultural and ecological droughts in some regions, and proportion of intense tropical cyclones, as well as reductions in Arctic Sea ice, snow cover and permafrost.*

The Australian context

The National Strategy for Disaster Resilience (2012) is about better understanding risk, communicating with individuals and communities to help understand the risks we face, and empowering people to take responsibility.

The Strategy's seven priorities are:

1. leading change and coordinating effort
2. understanding risks
3. communicating with and educating people about risks
4. partnering with those who effect change
5. empowering individuals and communities to exercise choice and take responsibility
6. reducing risks in the built environment
7. supporting capabilities for disaster resilience.

The National Disaster Risk Reduction Framework (2018) guides national, whole-of-society efforts to proactively reduce disaster risk, to minimise the loss and suffering caused by disasters. The Framework establishes a 2030 vision, goals and priorities aligned to the Sendai Framework and the 2030 Sustainable Development Goals.

The four framework priorities are:

1. understand disaster risk
2. accountable decisions
3. enhanced investment
4. governance, ownership and responsibility.

The Royal Commission into National Natural Disaster Arrangements (2020) identified opportunities for all levels of government in Australia to improve national coordination of disaster arrangements. The Royal Commission called for a national system that provides a comprehensive understanding of the risks associated with mitigation, preparation for, response to and recovery from disasters:

> *Such a system must have unbroken linkages in place from the highest levels of government to individuals in the community; provide decision makers with timely, consistent and accurate information; be structured for decisions to be made at the most appropriate level; allow decision makers to understand and mitigate all risks so far as reasonably practicable; enable stakeholders to understand the residual risk and inform others so that they may take appropriate actions; and it must be resourced to fulfil these functions.*

The Preparing Australia Program (2021) is providing a new framework of funding to make Australia stronger in the face of natural hazards like bushfires, floods and cyclones, and reduce the cost of recovery support.

Developing the research priorities

Understanding the context of the research priorities

Development of the *Research priorities for disaster risk reduction and community resilience to the impacts of natural hazards* by Natural Hazards Research Australia has focused on understanding the areas where end-user stakeholders believed that additional research could provide evidence and capabilities that they can use to:

- reduce disaster risk
- promote national disaster resilience.

The approach recognises important considerations about the research priorities contained in this document:

- The research priorities are national in scale. They can (and should) be used by organisations beyond the Centre for developing or investing in research projects and programs, and for developing collaborative research initiatives.
- The research priorities have been identified by the stakeholders who have participated in the development of this discussion paper. They do not attempt to cover all possible research related to natural hazards, disaster risk reduction and national resilience.
- Natural Hazards Research Australia will use the finalised research priorities to develop its initial research program.

Where we started

In March 2021, the Bushfire and Natural Hazards CRC (the CRC) circulated a concept note '*Framing a disaster resilience research portfolio*' among its end-users and other stakeholders, seeking feedback on the shape of the research program that would be developed by what is now known as Natural Hazards Research Australia.

The CRC used the feedback to develop the research plan, focused on eight broad research themes, that was submitted as part of the funding application for the Centre.

Progress so far

Following the announcement from the Australian Government that Bushfire and Natural Hazards CRC Ltd (the company that operated the CRC) was successful in its funding application for Natural Hazards Research Australia, the Centre began consultations to understand the research priorities from the perspectives of our end-user stakeholders.

This began with a survey of end-user stakeholders, which was followed by national workshops for each of the eight research themes. Information provided through those workshops has now been compiled into this discussion paper.

Next steps

This discussion paper will now be used to seek broader input on the research priorities to ensure that significant research needs are being addressed and that the priorities identified in the national workshops reflect the national needs.

Feedback can be provided until 11:59pm on 24 October 2021 through an online feedback form.

Guide to reviewing the research priorities

The intention of this discussion paper is to provide interested stakeholders with an opportunity to comment on the research priorities that emerged from the initial survey and national end-user consultation workshops.

The outcomes of this discussion paper will inform the production of the initial research priorities for natural hazard disaster risk reduction and community resilience.

For end-users

End-users = people and organisations that will be the beneficiaries of the outcomes of the research.

As an end-user, you can provide feedback on this document using the online feedback form.

When providing feedback, we ask that you please:

1. Review the research themes that are relevant to you. You can provide feedback on as many of the research themes that you see as relevant to you.
2. For each research theme you provide feedback on, please give that feedback from an end-user perspective – thinking about how research that addresses the relevant priority will be used by, or otherwise benefit, the organisation you work or volunteer with.
3. Consider the following questions:
    a. Are the descriptions of the research priorities clear? If not, how could they be improved?
    b. Do the research priorities cover the specific needs identified by you and your organisation, and will outcomes from this research contribute to the required development of knowledge and capability?
    c. Are there additional research priorities that you would like to suggest?
4. Review the two supplementary sections in the discussion paper:
    a. Data collection, access, management and curation (page 55): data-relevant research priorities are present throughout the research themes, but we have separated some of the common data-related research priorities to avoid repetition. To provide feedback on the data priorities, please follow the instructions in Step 3 above.
    b. National systems and capabilities (page 57): These systems and capabilities were identified in the survey and workshops and include details of the research theme(s) where they were mentioned. If there are any additional systems or capabilities that you believe the Centre needs to be aware of, please include that information in your feedback.
5. Provide all feedback using the online feedback form.
6. Online feedback will be accepted until 11:59pm on 24 October 2021.

For researchers

Researchers = people and organisations that undertake the research.

As a researcher, you can provide feedback on this document using the online feedback form.

When providing feedback, we ask that you please:

1. Review the research themes that are relevant to you. You can provide feedback on as many of the research themes that you see as relevant to you.
2. For each research theme you provide feedback on, please give that feedback from a researcher's perspective – thinking about the research that you do, or believe needs to be done, and whether that research would be aligned to one or more of the research priorities.
3. Consider the following questions:
    a. Are the descriptions of the research priorities clear? If not, how could they be improved?
    b. Do the research priorities allow inclusion of research that you believe needs to be done? If research that you believe needs to be done does not fit within the current priorities, please suggest additional priorities for consideration.
    c. If there is any research that is in progress, or just completed, that you think addresses any of the research priorities, please include this in your feedback.
4. Review the two supplementary sections in the discussion paper:
    a. Data collection, access, management and curation (page 55): data-relevant research priorities are present throughout the research themes, but we have separated some of the common data-related research priorities to avoid repetition. To provide feedback on the data priorities, please follow the instructions in Step 3 above.
    b. National systems and capabilities (page 57): These systems and capabilities were identified in the survey and workshops and include details of the research theme(s) where they were mentioned. If there are any additional systems or capabilities that you believe the Centre needs to be aware of, please include that information in your feedback.
5. Provide all feedback using the online feedback form.
6. Online feedback will be accepted until 11:59pm on 24 October 2021.

Developing the Centre's research projects

Development of the Centre's portfolio of research projects is occurring in parallel with the development of the research priorities. Projects that are currently being considered for funding are:

- extension or utilisation of projects undertaken following the Black Summer fires
- projects identified during the development of the research priorities that:
  - fit within the research themes and emerging research priorities
  - have active support from a significant group of end-users.

If you have a project that you believe we should consider for funding now that meets the criteria above, please send details to us at research@naturalhazards.com.au.

The major investment into new projects will begin once the research priorities are finalised. This will ensure that the investment decisions are based on a full understanding of where and how the research can be best used, and that the investment will be balanced across disaster risk reduction and resilience projects that address the impacts of natural hazards.

Research collaboration

The scale of the research required to address all the identified research priorities is beyond the capability of any single research organisation.

Capturing the research priorities identified by the Centre's end-users and other stakeholders creates opportunities to support connected research activities across Australia and New Zealand, and internationally, and identifies opportunities where those collaborations can open access to additional funds for research.

Contextualising the research themes

The proposed research themes for Natural Hazards Research Australia are grouped at three levels:

Foundational themes – these are the foundations that underpin disaster risk reduction and disaster resilience and will inform and enhance the remaining themes.

Functional themes – these themes draw upon the core elements of the foundational themes and extend the research into specific issues and needs.

Driving change themes – these themes draw on research to inform institutional and organisational change.

Foundational themes

1. **Communities and workforces of the future:** research focused on those working and living five to 10 years from now.
2. **Sustainable, safe and healthy natural landscapes**: research that promotes disaster risk reduction and disaster resilience in the natural environment that support where people live, work and play.
3. **Resilient built environment:** research that promotes disaster risk reduction and disaster resilience in the built environment where people live, work and play.

Functional themes

4. **Resilient communities**: research that builds capacity and capability in communities to be resilient to the impacts of natural hazards.
5. **Situational awareness**: research that provides risk, exposure and vulnerability information to communities, governments and businesses to assist in planning, preparation, response and recovery.
6. **Operational response and innovation**: research that supports response systems to be safe, efficient and effective in:
    a. reducing vulnerabilities exposed by natural hazards
    b. minimising the impacts of hazards
    c. minimise disruption of essential services
    d. enhancing community and system recovery.

Driving change themes

7. **Evidence-informed policy, strategy and foresight**: research and other evidence to inform and influence policies and practices at all levels of government and society, and to innovate and prepare for possible futures.
8. **Learning from disasters**: research and evidence from disaster events to support recovery, reduce disaster risk and increase community resilience.

Foundational themes summary (for detail, see pages 15–31)

1. **Communities and workforces of the future:** research focused on those working and living five to 10 years from now.

Emerging Priorities

- Understand how communities are changing and the drivers of those changes.
- Develop strategic business and workforce models that allow for major fiscal, demographic and environmental disruptions.
- Provide an operating environment that supports sustainable, integrated workforces across all phases of disasters and across all hazards.
- Develop equitable, diverse, inclusive, skills-based workforces.
- Understand approaches to education, training and retention that support and recognise the value of the workforce and an individual's participation in that workforce.
- Develop place-based workforce models.
- Ensure the health and wellbeing of communities and workforces.

2. **Sustainable, safe and healthy natural landscapes**: research that promotes disaster risk reduction and disaster resilience in the natural environment that support where people live, work and play.

Emerging Priorities

- Protect and manage environmental and cultural assets and values.
- Understand and demonstrate the benefits of traditional knowledge (including Indigenous knowledge) and cultural land management.
- Understand the impact(s) of the changing climate on the natural environment.
- Understand the movement of water in the landscape.
- Develop a set of values across the landscape that can be used to determine the overall benefits or deficits of development (built environment, agricultural), risk reduction and mitigation activities.
- Develop land-use planning and land-use interfaces (including built environment and agriculture).
- Assess the impacts of fire and storm in the landscape.
- Manage vegetation and fuel (combustible material).
- Understand, build and maintain social licence for natural hazard risk reduction activities.
- Integrate landscape-wide risk management (including decision-support tools).
- Monitor and evaluate risk mitigation.

3. **Resilient built environment:** research that promotes disaster risk reduction and disaster resilience in the built environment where people live, work and play.

Emerging Priorities

- Understand the risks and opportunities from emerging technologies, including renewable energy systems risks.
- Gather and share available and accessible data.
- Build and maintain safe operating environments for emergency responders in the built environment.
- Influence building codes and regulations.
- Understand the interaction of people with the built environment.
- Ensure a resilient supply of essential services.
- Restore the built environment after disasters.
- Contribute to built environment planning.
- Avoid community disadvantage.
- Monitor and evaluate initiatives.

Functional themes summary (for detail, see pages 32–47)

4. **Resilient communities**: research that builds capacity and capability in communities to be resilient to the impacts of natural hazards.

Emerging Priorities

- Recognise, understand, manage and communicate risk.
- Understand, develop and measure resilience in communities.
- Enable and support effective post-disaster recovery.
- Influence land use, infrastructure planning and service delivery.
- Strengthen awareness and capability-building through community education and knowledge sharing.
- Create economically viable models for sustainable mitigation and resilience-promoting activities.
- Understand drivers of behaviour.
- Drive shared participation from all parts of the community including participatory design.
- Provide timely access to relevant data and information.
- Influence policies, rules and regulations.

5. **Situational awareness**: research that provides risk, exposure and vulnerability information to communities, governments and businesses to assist in planning, preparation, response and recovery.

Emerging Priorities

- Develop improved/automated data collection.
- Enable effective data access, sharing, management and curation.
- Develop cost-effective, reliable communication and data networks.
- Analyse and visualise data.
- Strengthen fire-focused predictive services, including landscape and fuel data, simulation and prediction models.
- Strengthen predictive modelling and impact forecasting for non-fire hazards, including more sophisticated damage models.
- Provide capacity to deliver timely advice on situational awareness.
- Create data-rich case studies to support systems development, testing and validation.
- Ensure evidence-informed decision-making.
- Contribute to shared understanding of changing and evolving risk.
- Ensure an up-to-date, validated evidence base.

6. **Operational response and innovation**: research that supports response systems to be safe, efficient and effective in: reducing vulnerabilities exposed by natural hazards; minimising the impacts of hazards; minimise disruption of essential services; enhancing community and system recovery.

Emerging Priorities

- Improve the effectiveness of current operational systems.
- Enable access to real-time and historic data, and field-testing capability: to test, validate and verify the performance of new and improved systems and technologies.
- Develop evidence to support the introduction of new systems and technologies.
- Enable effective change management processes to introduce, monitor and evaluate operational innovation(s).
- Develop a deep understanding of future operating environments through use of scenarios and foresight programs.
- Ensure operating models are co-developed with workforce and community resilience strategies.
- Provide evidence to support updates and changes to rules, regulations and standards.
- Ensure national and inter-organisational consistency in operating systems and principles.
- Inform incident management and decision-making.

Driving change themes summary (for detail, see pages 48–54)

7. **Evidence-informed policy, strategy and foresight**: research and other evidence to inform and influence policies and practices at all levels of government and society, and to innovate and prepare for possible futures.

Emerging Priorities

- Model and test approaches to collaborative, forward-looking natural hazard risk reduction in the face of possible futures.
- Build confidence in research, evidence and data to inform adaptive and forward-looking policy, strategy and decision-making.
- Provide evidence to support investment in long-term programs for mitigation and risk reduction.
- Support policy frameworks that provide healthy, sustainable, inclusive and engaged workforces.
- Demonstrate the value of ongoing investment in national systems and in technology evaluation and assessment programs.
- Measure, monitor and evaluate costs to support the recognition and understanding of economic, social, cultural and environmental values and benefit.
- Develop models and practices that improve the effectiveness of recovery programs and community participation.
- Understand the place and purpose of rules and regulations, their effectiveness and their relationship with social licence.

8. **Learning from disasters**: research and evidence from disaster events to support recovery, reduce disaster risk and increase community resilience.

Emerging Priorities

- Streamline data collection and collation.
- Provide accessible, integrated data repositories.
- Contribute to continuous improvement in hazard prediction and behaviour.
- Develop evidence, case studies and research findings to support inquiries and investigations (and education and training).
- Inform disaster risk reduction strategy and planning.
- Improve outcomes from mitigation, operations and recovery investment and activities.
- Inform forward-looking scenarios to build resilience.
- Build leadership capability to effectively translate evidence, case studies and research into actionable improvements.
- Create datasets from real events that can be used for discovery, testing and validation.

Foundational themes

Communities and workforces of the future

People are fundamental to the development, strengthening and effectiveness of risk reduction and disaster resilience through their roles as community members and within workforces across businesses, government agencies and not-for-profit organisations. In different ways, each workforce group influences the development of resilience and the outcomes of emergencies and disasters. There is a need to understand the complexities around communities of people, including how these change over time and how they impact awareness, knowledge, behaviour and action.

National demographics are always in a state of evolution, taking paths that are influenced by local, national and global factors, and by personal priorities, particularly in the light of COVID-19. Within such environments, groups of people are intimately connected, including within workforces and communities that comprise many overlapping groups with competing interests.

The common link across this theme is people, with relevant research possible from many perspectives, including:

- understanding how to manage the health and wellbeing of workforces into the future
- future workforce planning
- linkages between communities and workforces
- new models of volunteering and community participation
- understanding future population demographics and dynamics that will influence future communities
- forecasting workforce dynamics and practices
- understanding the influences of technological advancements on workforces and communities
- effective participation of people in their communities and in relevant workforces
- evolving engagement, participation and inclusion of diverse groups
- avoidance of isolation, disconnection and natural-hazard-induced disadvantage.

Finally, communities have the capacity, ability and willingness to learn from their experiences and the experiences of others, in ways that enable them to identify and minimise their exposure to the impacts of natural hazards.

Emerging sector priorities

Emerging priority	Details
Understand how communities are changing and the drivers of those changes	It is important to understand the changes that are anticipated to occur in communities – to understand the drivers of those changes and how they will affect or influence the vulnerabilities, risks and resilience of communities. This will include: → considering workforce and community needs, cultures, mobility, diversity, strengths and pressures → informing current and future community safety, exposure, and evacuation challenges and opportunities → assessing how climate change, or repeated exposures to natural hazards, might influence communities.
Develop strategic business and workforce models that allow for major fiscal, demographic and environmental disruptions	Strategic workforce models are needed that can be integrated into business models with the capacity to withstand, or only be minimally affected by, major and unpredictable disruptions. This will include: → adaptable and sustainable workforce models (including volunteering) → potential benefits of place-based workforces → volunteer mobility across emergency services and other relevant volunteer organisations to enhance rapid mobilisation → sustainability in the context of the changing nature of volunteering, changing natural of natural events and better integration of spontaneous volunteers → greater workforce integration with communities, their activities and initiatives → understanding how workforces and communities are changing and using this to enhance service delivery → understanding relationships between employees and volunteers, and what works best for each organisation and role.

Emerging priority	Details
Provide an operating environment that supports sustainable, integrated workforces across all phases of disasters and across all hazards	Organisation-based management of individual workforces is unlikely to continue to deliver the most successful and productive approach for reducing natural hazard risk and exposure. While there has been progress towards inter-organisational collaboration and cooperation, there remain many opportunities for improvement, including: → improving approaches to shared responsibility across agencies and between agencies and communities → achieving strong, healthy, engaged and skilled workforces → better understanding changes in vulnerability and exposure patterns in communities, and how that will influence workforce needs (including the provision of new training and development over time).
Develop equitable, diverse, inclusive, skills-based workforces	Future organisational cultures should be diverse and inclusive and be able to benefit from the breadth of skills, experience, knowledge and capabilities within diverse workforces, including volunteers and communities, and be open to new thinking. This includes: → promoting diversity in people in all roles → looking at all roles through an inclusion lens → ensuring physical requirements for roles are developed for safety but do not exclude anyone able to safely undertake those roles → greater inclusion of First Nations people → recruiting approaches that link to the workforce strategy and actively support employment or volunteering based on skills and capability.
Understand approaches to education, training and retention that support and recognise the value of the workforce and an individual's participation in that workforce	Develop opportunities for nationally agreed education and training programs/frameworks that allow personal development and mobility between organisations and between states and territories. This will provide career opportunities (for employees) and lifetime pathways (for volunteers) where past learning and skills are easily transferable.

Emerging priority	Details
Develop place-based workforce models	Opportunities exist to strengthen the focus on place-based workforce models – as a contributor to strengthening both the resilience of communities, and the understanding of local strengths, vulnerabilities, needs and values. This includes: → evidence to support a community strengths-based approach, and operational response model(s) that are flexible and supplement place-based community capability, rather than enforcing agency capability on top of a community → building capacity by integrating local and Indigenous knowledge and local connections → linking community structures with the makeup and direction of emergency services and other supporting organisations → supporting the sustainability and effectiveness of volunteer emergency services → establishing sustainable emergency service and land management capabilities in rural and regional areas, with changing demographics linked to local and regional economies → committing time and energy to volunteering and building community resilience in a world of competing and changing priorities that define how to recruit, train and educate individuals in community, volunteer and paid roles → supporting businesses/employers (large and small) to better understand the value and benefits of supporting volunteering, including how it adds value to the business and the communities where they operate, and how that support may increase the sustainability of volunteer workforces over time.

Emerging priority	Details
Ensure the health and wellbeing of communities and workforces	For workforces and the community to be sustainable, engaged and effective in providing services requires that people remain healthy, and that the organisations that they work or volunteer for have a strong focus on their wellbeing. This includes: → workforce health for managing compounding and cascading events appreciating that there is less recovery time between events → managing workloads that are increasing physical and mental fatigue → understanding and addressing impacts of climate change on workforce health and wellbeing → understanding the evolving mental and physical health needs of communities → understanding the links between community health and wellbeing and workforce health and wellbeing → implementing effective approaches to maintaining good physical and mental health in workforces → acknowledging the essential links between health and wellbeing, workforce sustainability, workforce flexibility and workforce diversity and inclusivity.

Sustainable, safe and healthy natural landscapes

Effective risk reduction and resilience-building across diverse natural landscapes can be measured in values of sustainability, safety and health of those landscapes. Projects in this theme, while focusing on specific areas of interest, will make a demonstrable contribution to the overall objective of sustainable, safe and healthy natural landscapes. This will include contributions from traditional knowledge holders such as First Nations people, land management agencies and other relevant groups.

Acknowledging that cultural practices have been used for millennia as part of a living landscape, there is a need to more fully understand how to benefit from the combined traditional and modern knowledge, to be effective custodians of the land and to reduce the risks posed by natural hazards. This will draw on knowledge holders of all relevant communities and groups.

Measuring effective risk reduction and resilience-building across diverse landscapes needs to develop and incorporate accepted values of sustainability, safety and health of those landscapes.

Research in this theme is expected to explore the topic through a natural hazards lens from a range of perspectives, including:

- the role of cultural and Indigenous-led land management
- biodiversity
- all-hazard risk reduction
- environmental recovery
- water availability
- recreational land use
- fuel management
- sustainable forestry
- quantifying the benefits of investing in healthy landscapes and mitigation activities
- understanding values and values trade-offs across the landscape
- urban intrusion and changing land use
- interfaces with settlements, infrastructure and agricultural production
- the impact of climate change on local and regional landscapes.

Emerging sector priorities

Emerging priority	Details
Protect and manage environmental and cultural assets and values	Spread across the natural landscape, there are many significant environmental and cultural assets and associated values that are acknowledged and understood in principle, however, the translation of that understanding into actions and practices is not well advanced. Opportunities include: → ensuring that First Nations values are included and integrated in a culturally appropriate way → understanding the challenges associated with floodplains and coastal areas where important or essential mitigation activities may damage or destroy these assets and values → appropriately incorporating these assets and values into risk management plans.
Understand and demonstrate the benefits of traditional knowledge (including Indigenous knowledge) and cultural land management	Indigenous peoples and Traditional Owners are the custodians of cultural land management knowledge and practices that focus on the health, safety and sustainability of the land. With the introduction of Western practices and developments across the landscape – now compounded by the changing climate – there is a real opportunity to demonstrate the benefits of cultural land management, and ways in which cultural practices can be partnered with modern practices to get the best outcomes for the natural landscape, including: → 'two-eyed seeing' (or *etuaptmumk)*, a phrase used by the Mi'kmaw Indigenous peoples of Canada, meaning "learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of mainstream knowledges and ways of knowing, and to use both these eyes together, for the benefit of all" → acknowledging the contribution of knowledge in landscape management, beyond cultural burning, and recognising the cultural knowledge and co-design of landscape management strategies and practices → understanding the importance of land to Traditional Owners → ensuring Indigenous voices are represented, amplified and respected in governance structures.

Emerging priority	Details
Understand the impact(s) of the changing climate on the natural environment	Climate change will produce new challenges for the natural environment, including changes in biodiversity (including species and growth patterns for existing species) in many locations. Coastal inundation and erosion will become more significant, and the complex ecosystems (land, air and water) are going to be affected. Needs include: → planning now for what can be done in the short term to promote 'future' healthy natural landscapes → predicting and preparing for rapid change in landscapes that have developed over centuries → considering pre-emptive recovery strategies to avoid loss of landscape values → seeking clarity on changes in the likelihood and consequences of natural hazards on the natural environment.
Understand the movement of water in the landscape	Water is an essential part of the landscape and human survival. Changes to the density, location, persistence and quality of water will all have impacts on risks and exposure to the impacts of natural hazards. Significant issues with water in the landscape include: → coastal erosion and inundation → exposure of agriculture in fertile flood plains → management of water storages and hydro-power generation → fire risk from a lack of water, flood and erosion risk from high or intense water movement (including immediately after fire or an extended drought).

Emerging priority	Details
Develop a set of values across the landscape that can be used to determine the overall benefits or deficits of development (built environment, agricultural), risk reduction and mitigation activities	To be able to determine how to compare mitigation and risk reduction options across the natural landscape, there first needs to be an agreed set of measurable values (both tangible and intangible) that can be used to determine the relative cost-benefit of different approaches, and to better understand possible gains and losses for each option. Critical to the identification of values is understanding and incorporating the values from the perspectives of all relevant stakeholders. Needs include: → developing nationally agreed values and measures that can be used to determine and define what constitutes a healthy natural landscape → developing measurable values of trade-offs and priority values for all landscapes (for example, flood plains, coastal areas, urban fringe) – while reducing the impact of damaging fires or floods is intended, mitigation may also reduce the impact of beneficial fires or floods → quantifying lesser-understood values (for example, water supply, ecosystem function, endangered species, tourism, recreation, apiculture and timber). There are currently no agreed ways to estimate overall outcomes across multiple values.
Develop land-use planning and land-use interfaces (including built environment and agriculture)	Land-use planning and the ongoing use of the land is critical for disaster risk reduction and can both increase or decrease risk and vulnerability, depending on how they are applied and managed. Where human settlements, agricultural activities or other built infrastructure join the natural landscape (for example, forest, grasslands, lakes, rivers, oceans, etc), particular attention needs to be paid to the planning and management of the interfaces with the natural landscapes to effectively minimise disaster risk exposure.

Emerging priority	Details
Assess the impacts of fire and storm in the landscape	All natural hazards have an impact on the natural landscape – and importantly the impacts of any one of them can increase the vulnerability and associated risk to the landscape from other hazards. It is important to be able to understand and model the interactions to inform management and mitigation activities. Impacts include: → post-hazard erosion (for example, from flood, storm, rain, fire, wind) → changes to the prevalence of individual species and emergence of new species → loss of vegetation and topsoil → water contamination (runoff) → coastal pollution.
Manage vegetation and fuel (combustible material)	It is important to consider the holistic management of the 'lifecycle' of vegetation, rather than the strong focus on fuel management. This will: → better support the use of planting, agriculture and forestry practices → allow the selection and use of species that contribute to the management and preservation of biodiversity → address the need to manage the quantity and structure of the combustible fuels.

Emerging priority	Details
Understand, build and maintain social licence for natural hazard risk reduction activities	The purpose of risk reduction activities is to reduce the impact of natural hazards on the natural landscape, on people (communities) and the built environment (including essential services). Fundamentally, the diversity of views on what different groups value in each of those settings will contribute to tensions if there are no effective and practical means for reaching an agreed approach to risk reduction activities. Reaching and maintaining social licence (the ongoing approval within the local community and other stakeholders) for risk reduction activities is critically important. Social licence will require: → consensus on what is an acceptable risk – when you are mitigating risk there is a need to find the sweet spot → an understanding of why people or groups do not support particular risk mitigation approaches → finding common ground (for example, a desire to protect a specific value). It is important not to leave anyone behind as approaches and systems are built that can adapt to change.
Integrate landscape-wide risk management (including decision-support tools)	Effective decision-support tools are required to better inform long-term strategic natural landscape management and near-term mitigation plans. These tools would incorporate: → the best available knowledge → lessons learned from previous risk reduction activities → agreed values for measuring the relative benefits and costs to those values of the proposed risk reduction activities. These would allow different risk mitigation approaches to be compared using a standard, and agreed, methodology. Other factors to consider: → Effective land management requires a tenure-blind and integrated approach at a landscape scale. → Communities are now sprawling into places that were previously not planned for communities.

Emerging priority	Details
Monitor and evaluate risk mitigation	Without monitoring and evaluating risk mitigation activities, and openly sharing that information, it will be difficult to maintain the social licence that is so critical to the success of the risk reduction activities. This is intimately linked to the agreed values, how they are measured, and the purpose for which the outcomes will be used.

Resilient built environment

The built environment represents all that we have built to support and connect our way of life. It includes critical infrastructure, transport and road infrastructure, public, business and private buildings, and the provision of lifeline services and utilities, including food, health, water, electricity, and communications. There are complex relationships between the many different contributors to a functional, effective, safe and resilient built environment – with cross-dependencies that need to be understood, strengthened and managed.

Research in this theme can explore this area from many perspectives, including:

Physical built environment

- understanding resilient built environments at the local, regional and national scale
- funding of built assets, including insurance and insurability
- damage and reconstruction modelling of built assets affected by cascading hazard events
- retrofitting and strengthening of built assets

Physical systems, regulations and connections

- hazard-risk-informed land-use planning
- operating environments and regulations for essential services
- building standards and designs for new constructions and retrofit of existing structures

Human factors

- the way that people use and interact with the built environment to increase or decrease natural hazard risk
- human inputs into the development, maintenance and operation of the built environment
- why and how people make decisions at household and community levels to reduce natural hazard risks

Emerging sector priorities

Emerging priority	Details
Understand the risks and opportunities from emerging technologies, including renewable energy systems risks	New technologies and new uses of existing technologies are constantly being introduced. The impact of these technologies and their use on disaster risk needs to be understood before it can be effectively managed. Examples include: → distributed energy technologies (including energy generation and storage systems, electric vehicles and electric vehicle charging stations) → automation technologies (such as warehouse storage technologies) → manual and automated fire and other hazard protection systems → manned and unmanned technologies (such as drones).
Gather and share available and accessible data	Timely access to trusted data continues to be one of the biggest challenges. The range of decentralised and offline data makes it difficult to analyse and identify the biggest areas of risk and to identify opportunities for improvement. There is a need to access the right data to inform future research and policy.
Build and maintain safe operating environments for emergency responders in the built environment	Building design needs to consider not only the building itself but the broader built environment context, including the safety of occupants and emergency responders when impacted by natural hazards. This design approach will link with operating models for all responder organisations.

Emerging priority	Details
Influence building codes and regulations	The rules, codes and regulations that are used to design, construct and maintain buildings must be informed by the best research and knowledge. Identified challenges include: → balancing building controls across all hazards – currently there are more for fire → community development expectations, for example, many in the community still support development in flood prone areas → questioning whether enough has been done to assess the performance of current codes and standards against real-world experience of natural hazards → demonstrating what 'good' solutions look like – regulation most often just outlines *what* you must do and are often not very well quantified, while the deemed to satisfy (or exemplars) tell you *how* to do it to meet the intentions of the regulations → questioning whether building codes should take account of landscape design – sometimes landscape can achieve some of the building design elements outcomes, for example, low flammable vegetation protection, landscaped shade for cooling of buildings → understanding drivers and motivators for homeowners to upgrade their homes over time and to maintain insurability – future proofing assets before an event occurs.
Understand the interaction of people with the built environment	The functionality and effectiveness of the built environment is intimately linked with the people that live, work, travel and play in it. Understanding how these interactions work, how they are evolving and what future interactions might look like is an important contributor to risk reduction in the built environment. Also important is an acknowledgement that population growth will occur based on the location(s) of new infrastructure.
Ensure a resilient supply of essential services	Critical infrastructure exists for the purpose of providing supplies and services to the communities in which they are located, or which they serve. The continuity of those services and the service level agreements with the governments, businesses and communities that use and rely on those supplies and services are significant contributors to disaster risk reduction and community resilience. There is a need to manage expectations of communities and businesses when critical assets are damaged and supplies are disrupted.

Emerging priority	Details
Restore the built environment after disasters	From a risk and resilience perspective, the process, regulations, consultation and decision-making that are involved in restoration of the built environment are critically important in reducing ongoing trauma and dislocation. These allow governments and businesses to return to work, and for communities to rebuild their lives and connections to place. Observations on insurance should include: → Insurance smooths out the costs but does not provide protection of life, or avoidance of injury. → Insurance does not cover the psychological trauma associated with displacement, losing a home or community. → Insurance is wrongly classified as a mitigation tool.
Contribute to built environment planning	The risk, exposure and vulnerability of people and the built environment are determined by the way in which the use of land is planned. It is helpful to understand how broader business losses can be incorporated into built environment planning, including losses associated with built environment, intangible value, avoided injuries, social disruption and mental health impacts, disruption of utilities and services, and loss of place of business. → Planning needs to consider all likely hazards for the life of the asset(s). → Planning needs to consider risk understanding and risk appetite. → Land-use planning needs to ensure that developers put in place future-appropriate risk management strategies. → The fundamental principle of not putting people/assets in harm's way, and to build better in the first place, creates a conundrum that can be politically and socially challenging. → Reducing damage from a disaster will reduce costs and effort of recovery – prevention and protection of assets. → Increasing natural hazard risk exposure is challenging 'old thinking' and exposing all the challenges – real or imagined – that come with proposals for disruptive change.

Emerging priority	Details
Avoid community disadvantage	While the resilience of built infrastructure gradually increases, people experiencing disadvantage are at risk of being left behind because of less resources to rebuild or pay for upgrades to mitigate risks. In the community sector, funding and tenancy arrangements are major contributors to disadvantage. Vulnerable communities are often not equipped with simple means to becoming more resilient – underground power lines, microgrid capabilities, in-situ water filtration and purification means, communications systems with backup power and solar.
Monitor and evaluate initiatives	Understanding how well current and past initiatives have performed is important in developing future initiatives that build resilience and reduce disaster risk. Defining and agreeing on the outcomes to be measured is important. Effective and timely monitoring and evaluation can help: → identify which actions are having the greatest benefits → expose existing vulnerabilities that were not known, or considered not important → expose new vulnerabilities.

Functional themes

Resilient communities

Communities are integral to society and are subject to a wide range of short-, medium – and long-term impacts from disasters caused by natural hazards.

We know that disaster exposure, risk and impact is context-specific, being felt immediately and intensely at the local level. To reduce this exposure, approaches that enhance resilience within and between communities to single and cascading hazards (and learning from past experiences) is an important goal in a world exposed to increasing natural hazard risk from a changing climate.

During the development of the Australian Disaster Resilience Index, it was apparent that the capacity for resilience has many facets that cannot simply be averaged across a country or region. Within a region, resilience differs depending on the nature of the hazard. Building capacity and capability for disaster resilience needs to reflect the understanding, engagement and capacity of all groups and sub-groups within any given community, including those experiencing any form of disadvantage or vulnerability, and more transient groups such as tourists, new arrivals and itinerant workers.

Community resilience will be strongly influenced by:

- the way in which a community is likely to evolve over time, and the shocks and stressors that will drive, or influence that change
- the built environment, critical infrastructure and lifeline services that support a community
- the natural landscape, its proximity to their community, and the current and future risk(s) and benefits that the natural landscape will provide to the community.

There is still no agreeance on the core features or capabilities of truly multi-hazard disaster-resilient communities. In the absence of this information and understanding, it will continue to be difficult to determine which approaches will best achieve outcomes that truly strengthen disaster resilience.

Research in this theme can explore this area from many perspectives, including:

- disaster relief and recovery
- community mental health
- risk understanding and communication
- individual and community behaviour under pressure
- economic impacts of natural hazards on communities
- community participation in hazard risk identification and mitigation
- resilience of essential lifelines
- roles of, and benefits for, governments, businesses and community groups
- community strengths and capacities
- sources of vulnerability.

Emerging sector priorities

Emerging priority	Details
Recognise, understand, manage and communicate risk	Awareness and acknowledgement of risk(s) is an essential first step in development of resilient communities. Without that acknowledgement, it is difficult to describe what resilience might look like, and what needs to be done to strengthen it. Communities are all unique in their own way, and while they will share some similarities, there is a need for bespoke solutions – not a one-size-fits-all approach – to minimising risk. A priority is to be able to communicate local (and regional) risk in ways that are understood across all elements within communities, and where required actions can be debated and agreed on. Once risk is communicated and understood, people need to feel supported and empowered to take necessary action to address those risks.
Understand, develop and measure resilience in communities	Despite the significant interest in community resilience, there is no consensus on how to measure it in practice. The Australian Disaster Resilience Index measures the *capacity* for disaster resilience but does not attempt to define how to measure actual resilience (demonstration by lived experience) to disasters. Actual resilience can only be measured after a disaster and it is difficult to track annual progress, as this would require averages over decades. Ideally, disaster resilience measures will incorporate: → culturally appropriate resilience → nationally consistent indicators and performance measures → business measures that cover the types of businesses and the nature of natural hazards → broader metrics that include physical health, mental health and insurance take-up → better understanding drivers of resilience activities, including financial support for enacting solutions that protect against future shocks and stressors → an understanding that resilience may vary across hazards and the magnitudes of those hazards → an understanding that interdependencies between things is important – community resilience and a placed-based focus are needed.

Emerging priority	Details
Enable and support effective post-disaster recovery	Recovery is an essential process in a world exposed to natural hazards – a complex, non-linear, multi-layered process that occurs as people and communities work to resolve the impacts of a disaster. It is intertwined with disaster prevention, preparedness and response, and can provide an opportunity to improve pre-disaster circumstances and increase resilience. There are many significant areas where increased knowledge is important for improving recovery outcomes: → understanding the roles of different community organisations on recovery outcomes such as mental health, wellbeing and poverty → the short-term and long-term benefits of providing financial assistance in the Australian context → community mobilisation and community-led recovery when face-to-face engagement is not possible, and communities are more reliant on digital means → social and economic inequality structures that are reinforced through recovery activities and approaches → Indigenous experiences of disasters → recovering from the impacts of multi-hazard, compound, cascading or concurrent hazard events → understanding and measuring best practice in community-based risk reduction and its measurement → understanding the benefits of psychological preparedness programs for individuals on their decision-making during disasters.

Emerging priority	Details
Influence land use, infrastructure planning and service delivery	The physical elements of a community play a significant role in its resilience – most significantly in: → where assets and services are built → how those assets are built, funded/financed and services provided → avoiding the construction of assets or services with known current and anticipated future risk → the concept of 'accepted' risk and the individual right to choose to live in an area with inherent risks (for example, a beautiful old-growth forest or an area with 1-in-100-year risk likelihood of a flood) → how 'in-fill' assets change the risk of existing assets → setting the performance/service delivery parameters that are agreed with the community → perception of resilience in regulated industries (for example, electricity), where resilience is not 'valued' by governments or industry regulators, as the focus tends to be on everyday reliability – this means costs increase and/or service quality to customers decay as assets fail and need to be replaced → developing rules and regulations that are fit for purpose to ensure service providers and customers can partner to deliver resilience.
Strengthen awareness and capability-building through community education and knowledge sharing	A continued focus on education, knowledge-sharing and community engagement is important in the development and maintenance of disaster resilience. These activities should focus on all hazards, and the influence of tourism and seasonal workforces on place-based resilience, and what those aggregated communities look like. Importantly, the awareness activities need to focus on areas including: → situational awareness – knowing how to maintain awareness of what is happening around you, and the benefits and limitations of different sources of information → information and warnings – knowing what actions to take based on the information and warnings that are received → building hazard-agnostic capabilities that improve awareness and capability across all hazards.

Emerging priority	Details
Create economically viable models for sustainable mitigation and resilience-promoting activities	Being able to effectively model the cost-benefit of national and place-based individual, and combined mitigation and resilience-promoting initiatives, is an important contribution to decision-making for the implementation of effective and sustainable initiatives. The community sector faces perennial funding challenges and short-term contracts. This inhibits: → long-term planning and building organisational resilience, including planning for emergencies and disasters → planning and participation in broader community resilience to challenges like climate change and disasters → modelling of interventions against resilience frameworks.
Understand drivers of behaviour	The way that individuals, groups and organisations behave will have a significant impact on community resilience and disaster risk reduction. Utilisation of behavioural insights can inform how and why people, groups and organisations respond to events and can be used to design policy interventions (for example, nudge theory).
Drive shared participation from all parts of the community including participatory design	Participatory design (such as participatory action research) is an emerging capability in programs focused on developing and sustaining community resilience. This includes: → the need for inclusion of the voice of children and young people in policy and practice development → mitigating impacts of natural hazards → understanding the contribution, and value, of socially diverse input into operations planning and delivery → integration of emergency preparedness into everyday experiences of communities, because keeping the treatment as 'separate' means that solutions around resilience are also treated as separate → understanding that focusing on a single hazard in isolation, for example, is not conducive to total resilience.

Emerging priority	Details
Provide timely access to relevant data and information	Timely access to relevant information in an easily understandable form is critical across all timeframes – from purchasing and investment decisions, through mitigation, preparation, response relief and recovery. This would help with: → communicating with communities → being more strategic → arguing the case for more targeted investment, for example, data from heatwaves comes 18 months after the event, which means accessing syndromic data in a timely manner is almost impossible (such as people that present to hospital with co-morbidities) → conversations about trade-offs (that is, the cost of reliable and resilient essential services).
Influence policies, rules and regulations	Policies, rules and regulations are intended to encourage and support safe communities. However, at times, the rules are too slow to change or do not appropriately consider their impact on unlinked but related outcomes – leading to adverse outcomes on natural hazard risk exposure and community resilience. For example: electricity regulations and rules focus on everyday reliability but do not value resilience of the network for delivering electricity to consumers.

Situational awareness

Situational awareness in its broadest sense is a continuum from the collection of data relevant to a range of natural hazards, through the transformation of that data into valuable and meaningful information, and its effective communication to a diverse group of users, each with their own needs, including:

- emergency services
- governments
- businesses and critical infrastructure owners and operators
- humanitarian and other not-for-profit organisations
- communities
- individuals.

All of these users or beneficiaries of information share a common need for awareness of the environment in which they work, live or travel, and current and emerging threats that may cause increased risk to their life or property.

Situational awareness (being aware of what is happening, or is likely to, happen around you) is something that everyone should be doing every moment of the day – and something that becomes far more time-sensitive and life-critical during periods of heightened natural hazard risk and exposure.

Research in this theme can explore many perspectives, including:

Technological research

- exploring data from all sources, including terrestrial and earth observation
- analytical tools, including artificial intelligence and machine learning
- data and information visualisation

Impact forecasting

- understanding, predicting, and modelling hazard behaviour
- enhanced extreme weather forecasting
- hazard simulations
- test and validation datasets

Social research

- public, business and government information and warnings
- community understanding and responses to emergency information
- human factors and decision-making
- the impact of stress and uncertainty on the effectiveness of communication
- motivators of action and inaction

Emerging sector priorities

Emerging priority	Details
Develop improved/ automated data collection	Increasing the accessibility of data by reducing manual collection and (where feasible) automating that data collection can effectively: → reduce data gaps → provide timely (near real-time) access to that data. Accurate, concise, relevant and current data feeds are critical (from terrestrial, aerial and space platforms), ensuring that, where practical, stable existing technologies are being leveraged.
Enable effective data access, sharing, management and curation	Where data is (or should be) collected, it needs to be: → available to those who need it, when they need it (subject to privacy and commercial considerations) → managed and quality assured → curated to ensure that quality and access is maintained over time.
Develop cost-effective, reliable communication and data networks	To allow access to data and to communicate situational awareness information, there needs to be stable nation-wide access to consistent data systems and communications networks. Better, stronger, more-reliable data communications are the backbone to all future capability that enables situational awareness. It is important to understand the different scales of operating environments, from small local governments and organisations through to national operating environments for telecommunications, transport, food, medicines and fuel.
Analyse and visualise data	Having access to the knowledge, tools and systems to effectively analyse and transform data into information, and to visualise that information, is critical to understanding current and future (modelled) risk exposure. When people are overwhelmed with data, it is hard to make best sense and find the triggers that draw attention to important pieces of data. Improved data, analysis and visualisation means people can identify patterns, alter practices and develop decision-support tools.

Emerging priority	Details
Strengthen fire-focused predictive services, including landscape and fuel data, simulation and prediction models	All response organisations, governments and businesses have specific needs for situational awareness that support their predictive services' needs. Key areas of interest include: → climate change – influencing fuel availability, fire risk and fire behaviour → uncertainty in fire behaviour and fire hazard models, including their lack for many fuel types → significant deficiencies in fire behaviour and fire growth modelling for New Zealand fuels → mapping of fuel types to support fire prediction → improved gridded weather models that consider the full range of topographical influences (for example, elevation, aspect and slope).
Strengthen predictive modelling and impact forecasting for non-fire hazards, including more sophisticated damage models	Understanding the likelihood and potential impact of natural hazard (excluding bushfires) risks is less developed than the equivalent capabilities for bushfires. Both deterministic and probabilistic forecasts are being enhanced for meteorological hazards – but still have a degree of uncertainty that is challenging for operational organisations, and for the communities and businesses, that are potentially exposed to the hazard risk. Key areas of interest include: → damage models: currently based on observations, improving these models will allow us to better predict the future so as to minimise the consequences of events and make risk-informed decisions → predictive modelling of risk, exposure and vulnerability of critical infrastructure (for example, electricity and communications) → intelligence gathering using common tools that are currently available is more difficult for storms and floods than it is for bushfires.

Emerging priority	Details
Provide capacity to deliver timely advice on situational awareness	This capacity is often separated from the process of gathering data and using that knowledge to provide situational awareness for emergency services operations. It is important to ensure effective, timely and relevant/appropriate delivery of information and associated calls to action to those who need that information. Of particular importance is: → coordination of information, especially in multi-agency events → enhanced capabilities in the protection of the community from the impacts of natural hazards → the broad range of current and future products → maintaining awareness within the continually evolving influence of global warming and climate change, and the potential for an increasing likelihood and consequence of extreme events → building community and sector trust in the sources and evidence supporting the information being provided → providing consistent prediction products to the community → understanding the risks to critical infrastructure → reducing uncertainty around making functional decisions → the challenge of maintaining an informed and prepared community with multiple organisations in the emergency management sphere, all trying to share their own messaging with the same community → interoperable use of words and consistency of meaning → providing an effective service to tourists, new residents and transient workers.
Create data-rich case studies to support systems development, testing and validation	Comprehensive, data-rich case studies are required for many purposes, including: → to develop and train new predictive and modelling technologies → to validate system enhancements (such as AFDRS and Spark) → for the private sector to use industry-qualified data to develop and test commercial solutions.

Emerging priority	Details
Ensure evidence-informed decision-making	Decision-making needs to be based on evidence – derived from research and organisational learning. Many investment decisions have long-term implications, for example: → electricity distribution businesses are making 70-year investment decisions → vehicle assets are 10–20-year investments. Organisational strategic and business planning needs the right evidence to maximise its relevance. Policy needs to be grounded in evidence and based on practice.
Contribute to shared understanding of changing and evolving risk	Risk perception and understanding of risk is an individual perspective. The challenge to be managed is how to effectively communicate the current risks and vulnerabilities that can be caused by natural hazards, and how those risks and vulnerabilities can be affected by a range of factors, including: → climate change → land-use planning → prevailing weather conditions → changes in the community and the way it lives, works and plays. Better awareness of emerging and realised risks will enable a coordinated approach to risk reduction, readiness and response, which will benefit community-based recovery and resilience in the long term.
Ensure an up-to-date, validated evidence base	Ensuring that evidence is collected, validated, curated and accessible. This is closely linked to the research theme of evidence-informed policy, strategy and foresight.

Operational response and innovation

The performance of response systems, response capabilities and regulated industries will be informed and enabled through innovation and different ways of thinking and operating. This will provide opportunities to:

- increase the safety of responders to emergencies and disasters at all levels – from single local incidents through to national response capabilities
- make the most efficient use of resources
- be informed by effective situational awareness
- maximise collaboration, cooperation and coordination between all organisations providing response services/activities.

Research in this theme may explore many perspectives, including:

First responders

- enhanced vehicle design and capability
- remote and autonomous response operations
- improved safety
- data – and evidence-informed asset management and deployment
- better use of real-time data feeds
- testing and trialling capabilities
- enhanced automation of in-field data collection
- future operating environments

Essential services

- critical infrastructure operation, including electricity supply and communications services
- protection of business and community lifelines
- impact forecasting
- transport and supply chains (food, etc)

Local and community-based activities

- evacuation centres
- approaches to recovery
- relief services
- activation and engagement

Emerging sector priorities

Emerging priority	Details
Improve the effectiveness of current operational systems	There are many operational systems relied on, which may fail, come under significant pressure, or not perform in the way intended in the lead-up, response and recovery phases of a disaster. There are many elements to be considered, including: → resistance to the adoption of new systems/too many systems → the overall aims and desired end points → interoperability for intelligence systems – current integration is poor, especially in multi-agency response → ensuring insights from the legacy systems are not lost.
Enable access to real-time and historic data, and field-testing capability: to test, validate and verify the performance of new and improved systems and technologies	The nature of disasters and emergencies caused by natural hazards makes the testing, calibration, validation and verification of new and improved systems a particularly difficult challenge. While improved real-time data can allow side-by-side comparisons with current systems, there is a strong need for access to historic datasets for the development and early testing of these systems. Benefits from access to this data include: → the ability to analyse data to inform future research, policy and legislation → being able to analyse and adopt new solutions that allow us to respond more efficiently.

Emerging priority	Details
Develop evidence to support the introduction of new systems and technologies	The effective introduction of new systems and technologies requires the adoption of an approach to the development and assessment of new technologies that incorporates: → agreed and robust evidence of the performance of new systems and technologies under agreed conditions → agreement on the performance targets that need to be/have been achieved → an assessment of the changes and change-management required to introduce the new systems and technologies → a cost-benefit analysis for the implementation and operation of the new systems and technologies → an approach to life-cycle management for the systems or technologies, and how they will be maintained and incorporate innovation and change through their operational lifetime → maturity in the approach to new technologies that is based on operational need and opportunity, rather than being driven by a fascination with new technology → integration/ alignment of new technologies and systems with tacit knowledge and human capability used in decision-making during emergencies.
Enable effective change management processes to introduce, monitor and evaluate operational innovation(s)	Effective change management is a critical component in the introduction of operational innovation. In addition to having access to the evidence to support the change, there is a need to have the capability to introduce the change, and to undertake monitoring and evaluation of the change. Organisational strategy, capability and decision-making will have an influence on the timeliness and effectiveness of proposed changes, including: → the balance between new innovative systems and everyone having consistent data → variability (jurisdictional) of capacity to profile effectiveness → willingness to adopt and take advantage of new and emerging technologies → retention of outdated equipment and technology and the slow uptake of new ideas, technology and equipment.

Emerging priority	Details
Develop a deep understanding of future operating environments through use of scenarios and foresight programs	There is a need to be able to understand what systems, capabilities and technologies are required in the future, and what levels of performance are required in those time scales. While it is not possible to be certain of future operating environments, it is possible to create plausible futures that convey the range of operating environments in which these systems, capabilities and technologies are expected to work. This approach will allow: → comparisons of strategic investments → organisations to have more information about how their operations and programs can be more resilient and flexible, including understanding what emergencies are likely to occur in their area as the climate changes, and how this will affect staff members and clients → more sophisticated capability planning.
Ensure operating models are co-developed with workforce and community resilience strategies	Operating models that understand and integrate all the relevant inputs will best prepare organisations for operations in future years. This includes people-related strategies (workforce and communities) and the physical environment (natural landscapes and the built environment). Important considerations include: → understanding an organisation's risk appetite to take a chance to innovate under pressure as a result of necessity → developing an idea of what the future might look like before having some confidence in the operating environments to be prepared for → co-developing models that are more likely to have agreed expectations on the roles of all groups and what is expected from those groups → recognising the different pace at which jurisdictions, businesses and other organisations can upgrade or enhance systems (time and money) → considering areas where communities will not move to due to their past experiences and their understanding of vulnerability of their community being impacted, their lack of resources to evacuate, or their understanding that they would still be safe where they are.

Emerging priority	Details
Provide evidence to support updates and changes to rules, regulations and standards	Robust, relevant and trusted evidence is needed to ensure that rules, regulations and standards reflect the best available knowledge, and contribute effectively to disaster risk reduction and community resilience. This can include: → providing evidence to accompany updates to tools and standards to explain the rationale behind standard → national, central source (library) that is accessible for agencies and other organisations to reference → changes to a range of standards, building codes, land-use guidelines → informing such regulations rather than responding to regulations changes → evidence to drive changes to regulation rather than being responsive.
Ensure national and inter-organisational consistency in operating systems and principles	To ensure national capability under the most extreme circumstances, common/consistent operating systems and principles are essential. This would include: → improved data sharing of intelligence on vulnerable assets – for example, fire, flood vs critical infrastructure → end-user ease of use and integration → integration between operational systems within and between agencies → avoiding stovepiping of technical systems → planning for and ensuring interoperability and compatibility between operational systems across jurisdictions → a national innovation governance approach.
Inform incident management and decision-making	Effective incident management requires decisions to be made – often without all the information that would ordinarily be required. Building and maintaining the skills of incident management teams to work effectively in this environment is an important step in building trust in the decisions being made by Incident Management Teams.

Driving change themes

Evidence-informed policy, strategy and foresight

Developing robust, relevant, understandable and defensible evidence and knowledge to support new and improved policy and strategy is a critical contribution to sustainable national disaster risk reduction and the strengthening of resilience to the impacts of disasters.

The evidence needs to combine an understanding of the past, (learning from disasters and more broadly from history), present (current operations and research) and future (predicting what the future is likely to look like, and what will be needed to live and operate in that time). The latter is often referred to as 'foresight'.

Foresight uses thinking systematically about the future to inform decision-making today, rather than attempting to provide solutions for challenges as they are currently being experienced.

Strategic foresight is used to encourage decision-makers to explore the likely nature of the challenges in multiple futures – where each of those futures are plausible. This approach can ensure that thinking about the future is not based on 'blue-sky' or invented creative thinking, but is systematic, rigorous, explicit and evidence based.

Strategic foresight can be used to explore many perspectives, including:

- where and when the underpinning systems required for disaster management become stressed and their interdependencies
- changes in risks and vulnerabilities that will affect people, communities, the built environment and the natural landscape
- adaptive and participatory approaches for policy development for disaster resilience and disaster risk reduction.

This research theme will provide a mechanism for discussion, debate, testing and development of new policy and strategic approaches to seemingly intractable problems, and to determine the value and continued relevance of current and past policies and strategies.

Research in this theme is expected to explore the topic through a range of outcomes, including:

- short – and long-term benefits of different investment options
- modelling to understand the evolution of risk and compare mitigation options
- understanding of new and emerging policy and strategy options
- understanding and communicating complexity and value of systems-based approaches
- monitoring and evaluation of current policies and strategies
- integrated decision-support tools
- concept development and testing for new business models
- analysis and evaluation of current and past policy initiatives.

Emerging sector priorities

Emerging priority	Details
Model and test approaches to collaborative, forward-looking natural hazard risk reduction in the face of possible futures	Development and validation of approaches and models that can be used to model plausible future natural hazard risk, and the benefits of individual and multiple mitigation options, will become increasingly important in policy and strategy development. Evidence from this approach can be used to inform a shared vision at a national level (and minimise politicisation when emergencies occur). A goal of this priority is a national approach and consistency across agencies, businesses, organisations and communities, to address the challenges and implications of climate change, natural hazards, changes in weather, communities and technology.
Build confidence in research, evidence and data to inform adaptive and forward-looking policy, strategy and decision-making	Without trust in, and understanding of, the evidence and data being used to inform policy, strategy and decision-making, the interpretation, validity and effectiveness of those policies, strategies and decisions are at risk of being changed or ignored. It is not about using evidence to support positions, but about basing positions on evidence. This requires: → research to be 'updatable' and available within required time constraints → access to knowledge and expertise to support adaptive policy and strategy → evidence-based decision-making being trusted and valued at all levels of government, emergency management organisations, community and business sector for mitigating against risk of disasters → transparent links between the decision and the underlying data (which is current and fit for purpose, updated and relevant) and effectively communicated → accountability at different links in the research value chain – asking who is responsible for applying systems and processes for enabling the research → demonstrating the value and trusted outcomes from the use of research outcomes (for example, with the Australian Fire Danger Ratings System or the Australian Disaster Resilience Index)

Emerging priority	Details
Provide evidence to support investment in long-term programs for mitigation and risk reduction	Mitigation and risk reduction are typically part of integrated long-term strategies. Partial investment will invariably lead to partially effective, or incomplete mitigation – effectively failing to achieve the long-term risk reduction objectives. This includes evidence to support: → investment in social and community resilience activities and accessibility and application of research outcomes → an understanding that circular economies are required in all industry lifecycles (an end-to-end approach) → the importance of measuring the success of what is being done well, especially in recovery or resilience activities → the development of effective incentive-based risk mitigation models.
Support policy frameworks that provide healthy, sustainable, inclusive and engaged workforces	An essential element in disaster resilience and disaster risk reduction is the people that do the work and enable the outcomes. It is essential that policy frameworks are supported by engaged workforces that are valued and believe that they are engaged in the process. Considerations include: → investing in non-government organisations and local government workforces to enhance sustainability of emergency management-related workforces → workforce models that are sustainable in the face of demographic trends (for example, ageing populations or fewer volunteers) and shared across the sector so limited resources can be best directed → navigating industrial relations challenges associated with workplace change.
Demonstrate the value of ongoing investment in national systems and in technology evaluation and assessment programs	Significant time and money are invested into national systems and in the evaluation of new technologies. To see an appropriate return on these investments, and to ensure support for ongoing adoption, maintenance and upgrading of national systems and technologies, will require a periodic demonstration of the ongoing value of those systems and the technological investments.

Emerging priority	Details
Measure, monitor and evaluate costs to support the recognition and understanding of economic, social, cultural and environmental values and benefit	A full understanding of the benefits (and costs) of risk reduction and resilience-building initiatives requires an integrated approach across multiple values, including tangible and intangible costs – and an approach that values avoided costs. Such approaches use methods that proportionally value economic, social, cultural and environmental benefits (or losses), and which are agreed by relevant stakeholders and decision-makers. This approach will provide informed advice on: → where to best invest in research → a better articulation of the right research questions and understanding the gaps rather than being led by rapidly conducted inquiries.
Develop models and practices that improve the effectiveness of recovery programs and community participation	Post-disaster recovery activities are long-term and can frequently be overlapping – with new disasters being experienced while individuals and communities are still only part-way through their own recovery journeys. The outcomes from research, and from monitoring and evaluation can be used to ensure that recovery programs are applying the best available knowledge.
Understand the place and purpose of rules and regulations, their effectiveness and their relationship with social licence	Rules and regulations are an important part of society. However, they are often based on a specific set of circumstances and expectations. When disasters happen, these rules can work in perverse ways that risk exacerbating distress, displacement and disadvantage. There is a need to question the feasibility of avoiding these negative outcomes during times of crisis, or minimise unintended policy outcomes, actions and behaviours in mitigating the impact of disasters.

Learning from disasters

Lived experience from emergencies and disasters caused by natural hazards provides important learning and research opportunities to:

- understand the underlying risks and exposures
- understand the behaviour of communities, private sector players and government entities across all tiers and knowledge before, during and after an event
- explore the effectiveness of responses through all stages of the event
- collect data and information that can be used to test and trial new approaches.

The Centre will actively engage in learning from disasters and will:

- work with partners to undertake research in the aftermath of relevant events
- contribute to relevant inquires and related activities
- assist in addressing recommendations relevant to the objectives of the Centre
- contribute to engagement opportunities to strengthen lessons management.

Information captured after natural hazard emergencies and disasters represents a significant source of data for monitoring and evaluation, and as a resource to support additional research. The Centre will have the capacity to support the collection of information following significant emergencies and disasters caused by natural hazards.

Research in this theme will collect social and physical information that contributes to resilience and risk reduction, including:

- community development and resilience measures
- operational improvements
- expanding accessible research and operational data collections
- providing data records that can be used to validate, develop and test new systems, tools, programs and strategies.

Emerging sector priorities

Emerging priority	Details
Streamline data collection and collation	See Data collection, access, management and curation priorities, page 55.
Provide accessible, integrated data repositories	See Data collection, access, management and curation priorities, page 55.
Contribute to continuous improvement in hazard prediction and behaviour	Effective learning from disasters will translate and incorporate findings, knowledge and capabilities from research, to understand and develop a better understanding of natural hazard impact and exposure predictions and hazard behaviours. These can be translated into improved preparedness, response and recovery outcomes.
Develop evidence, case studies and research findings to support inquiries and investigations (and education and training)	Being able to provide timely and trusted contributions based on experience and learnings from disasters will: → make a significant contribution to informing actions and recommendations for continuous improvement → be informed by an understanding of opportunities to introduce or contribute new research findings to better predict or understand what has been observed → provide rich resources for education and training.
Inform disaster risk reduction strategy and planning	Trusted evidence developed in effective 'learning from disasters' programs should be used to evaluate and inform disaster risk reduction strategies and the planning of risk reduction programs. Maintaining best practice across emergency management portfolios is driven by improved understanding of disasters, especially considering potential impacts of climate change.
Improve outcomes from mitigation, operations and recovery investment and activities	Effective monitoring and evaluation programs, combined with commitment and capability to use the findings to continuously improve, are essential to reducing disaster risk and strengthening community resilience.

Emerging priority	Details
Inform forward-looking scenarios to build resilience	It is important to develop an agreed set of plausible futures to inform the natural hazard context, understand the risks and impacts, and understand what needs doing to strengthen resilience. Climate change is already presenting new situations that are beyond the scope of existing models and science. Forward-looking scenarios can be used to inform future systems and policies.
Build leadership capability to effectively translate evidence, case studies and research into actionable improvements	Leadership teams that empower their organisations to support people with the skills, experience and interest in continuous improvement (and to translate evidence into actionable improvements) will create the environment for those actions to be implemented.
Create datasets from real events that can be used for discovery, testing and validation	See Data collection, access, management and curation priorities, page 55.

Data collection, access, management and curation

The survey and the workshops revealed a common focus on data across all the research themes. It makes sense to aggregate the common data needs into a single section of this discussion paper so that the approaches and benefits can be applied across the research themes – rather than being applied multiple times for related, but different, purposes.

There are still data priorities embedded in the research themes, where this appears to reflect a specific need for those themes.

Emerging sector priorities

Emerging priority	Details
Provide timely access to relevant data and information	Timely access to data will ensure that the best information is available to all decision-makers.
Enable accessible, integrated data repositories	Data needs to be accessible and available, or it is at risk of being lost or ignored.
Create datasets from real events that can be used for discovery, testing and validation	Data-rich case studies will provide a valuable collection of datasets that can be used for many things, from developing new technologies and validating system change proposals, to educating current and future workforces and communities.
Strengthen access to spatial information	Access to accurate spatial, location-based information will increase place-based knowledge.
Provide reliable data that can be used to inform future research and policy	See Evidence-informed policy, strategy and foresight theme, page 48.

Known data initiatives

Data initiative
Australian Climate Service
ARDC Bushfire Data Challenges program
Australian Fire Danger Rating System
National Bushfire Intelligence Capability
TERN – Australia's land ecosystem observatory
Australian Urban Research Infrastructure Network (AURIN)
National Environment Science Program (NESP 2) Hubs
Bureau of Meteorology
Geoscience Australia
Proprietary industry data
Information and data held by communities

National systems and capabilities

National systems and capabilities were often mentioned throughout the survey and workshops. This section represents the collected views on the systems and capabilities that could benefit from connection to the research priorities, and the research activities of the Centre and other interested research groups.

System/capability	Relevant theme(s)
Skills forecasting	→ Communities and workforce of the future
Juvenile Fire Lighter Intervention Program	→ Communities and workforce of the future
Australian Fire Danger Rating System	→ Communities and workforce of the future → Sustainable, safe and healthy natural landscapes → Resilient communities
Fire simulation	→ Communities and workforce of the future → Sustainable, safe and healthy natural landscapes → Situational awareness
Australian Warning System	→ Communities and workforce of the future → Sustainable, safe and healthy natural landscapes → Resilient built environment → Resilient communities → Situational awareness → Evidence-informed policy, strategy and foresight
Register. Find. Reunite	→ Communities and workforce of the future
Emergency Management Professionalisation Scheme	→ Communities and workforce of the future
National Bushfire Intelligence Capability	→ Sustainable, safe and healthy natural landscapes → Situational awareness
Northern Australian Fire Information (NAFI)	→ Sustainable, safe and healthy natural landscapes

System/capability	Relevant theme(s)
National data collections, repositories and registries	→ Sustainable, safe and healthy natural landscapes → Resilient built environment → Resilient communities → Situational awareness → Evidence-informed policy, strategy and foresight → Learning from disasters
Fire hotspot detection	→ Sustainable, safe and healthy natural landscapes → Situational awareness
Savanna Monitoring and Evaluation Reporting Framework (SMERF)	→ Sustainable, safe and healthy natural landscapes
Prescribed Burning Atlas	→ Sustainable, safe and healthy natural landscapes
Australian Flammability Monitoring System	→ Sustainable, safe and healthy natural landscapes → Situational awareness
Standards, rules and regulations	→ Resilient built environment → Evidence-informed policy, strategy and foresight
Planning schemes, building codes	→ Resilient communities
Bushfire management overlays, inundation maps, flood maps, etc	→ Resilient communities
Australian Disaster Resilience Index	→ Resilient communities → Evidence-informed policy, strategy and foresight
Smoke modelling (AQFx)	→ Situational awareness
Emergency websites and apps	→ Situational awareness
Community awareness programs	→ Situational awareness → Evidence-informed policy, strategy and foresight
Common operating picture	→ Situational awareness
ARENA – national aerial firefighting management system	→ Operational response and innovation

System/capability	Relevant theme(s)
National Disaster Risk Reduction Framework	→ Operational response and innovation
AEMO's Distributed Energy Resource Register	→ Operational response and innovation
National Environment Science Program (NESP 2)	→ Evidence-informed policy, strategy and foresight
Educational curriculum	→ Evidence-informed policy, strategy and foresight
Foresight and futures thinking	→ Evidence-informed policy, strategy and foresight
Inquiries and Reviews Database	→ Evidence-informed policy, strategy and foresight → Learning from disasters
Lessons Management Framework	→ Learning from disasters
National Disaster Recovery Monitoring and Evaluation Database	→ Learning from disasters