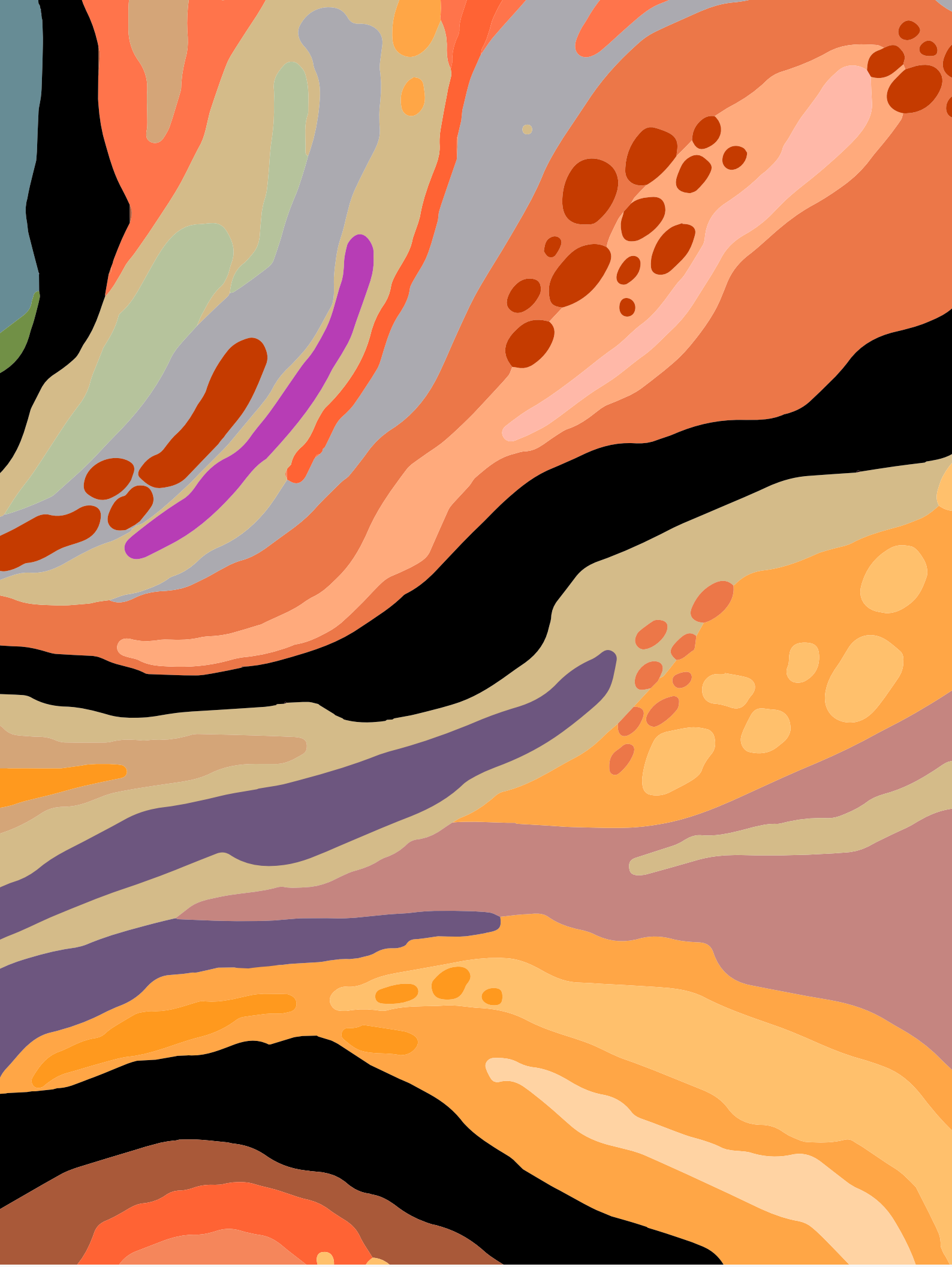
NSW Reconstruction Authority

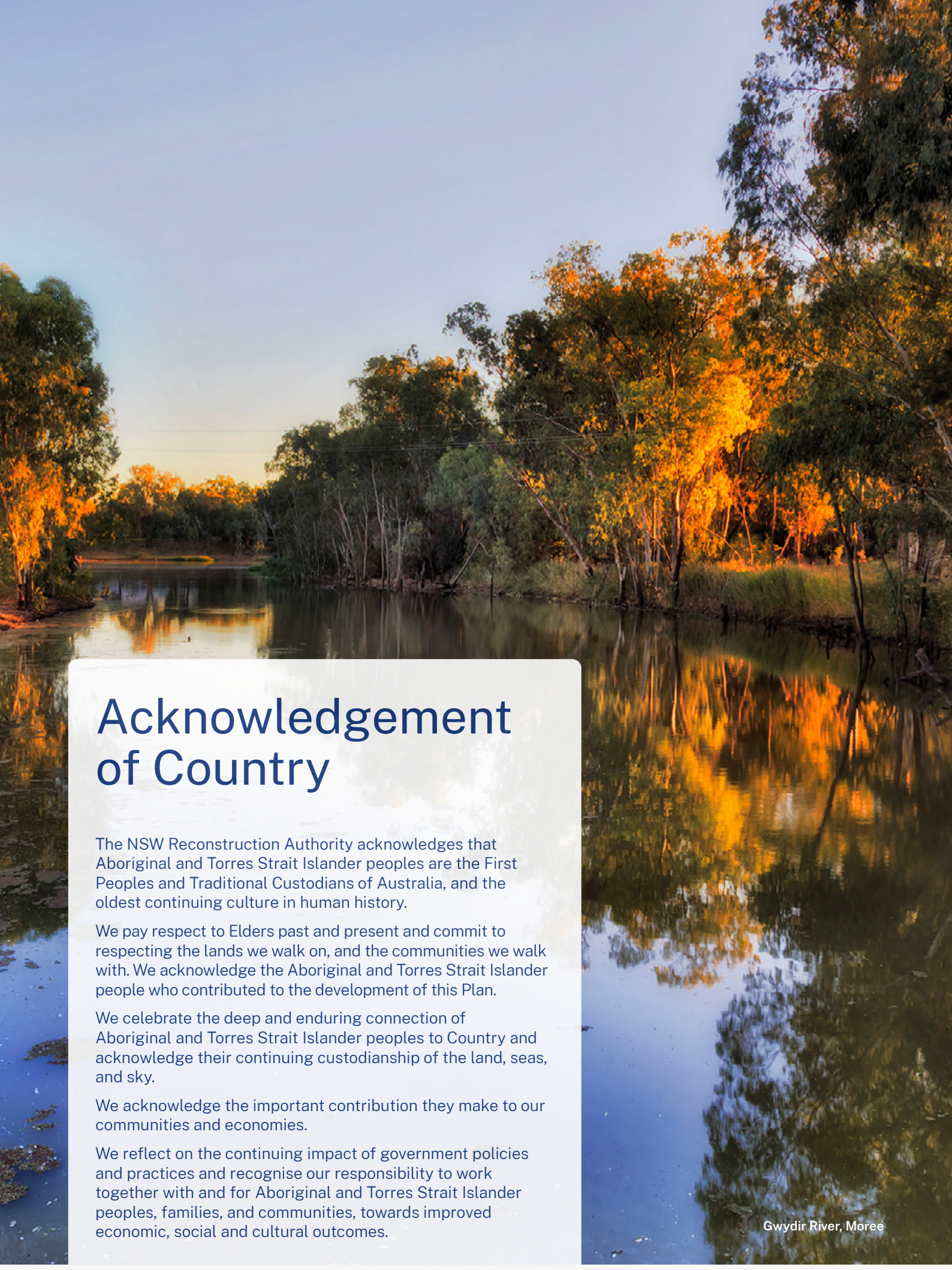
State Disaster Mitigation Plan

2024 – 2026

Cover image: Bush fire clouds over Sydney



Danielle Mate is a descendant of the Murrawari and Euahlayi people. Danielle's artwork looks at landscape from an aerial perspective, a mapping of the land as it was done traditionally. The darkest line is the deepest crevice or waterway, the surrounding colour represents the patches of flora, movement and layers of the landscape. This artwork was commissioned for this Plan.



Acknowledgement of Country

The NSW Reconstruction Authority acknowledges that Aboriginal and Torres Strait Islander peoples are the First Peoples and Traditional Custodians of Australia, and the oldest continuing culture in human history.

We pay respect to Elders past and present and commit to respecting the lands we walk on, and the communities we walk with. We acknowledge the Aboriginal and Torres Strait Islander people who contributed to the development of this Plan.

We celebrate the deep and enduring connection of Aboriginal and Torres Strait Islander peoples to Country and acknowledge their continuing custodianship of the land, seas, and sky.

We acknowledge the important contribution they make to our communities and economies.

We reflect on the continuing impact of government policies and practices and recognise our responsibility to work together with and for Aboriginal and Torres Strait Islander peoples, families, and communities, towards improved economic, social and cultural outcomes.

Gwydir River, Moree

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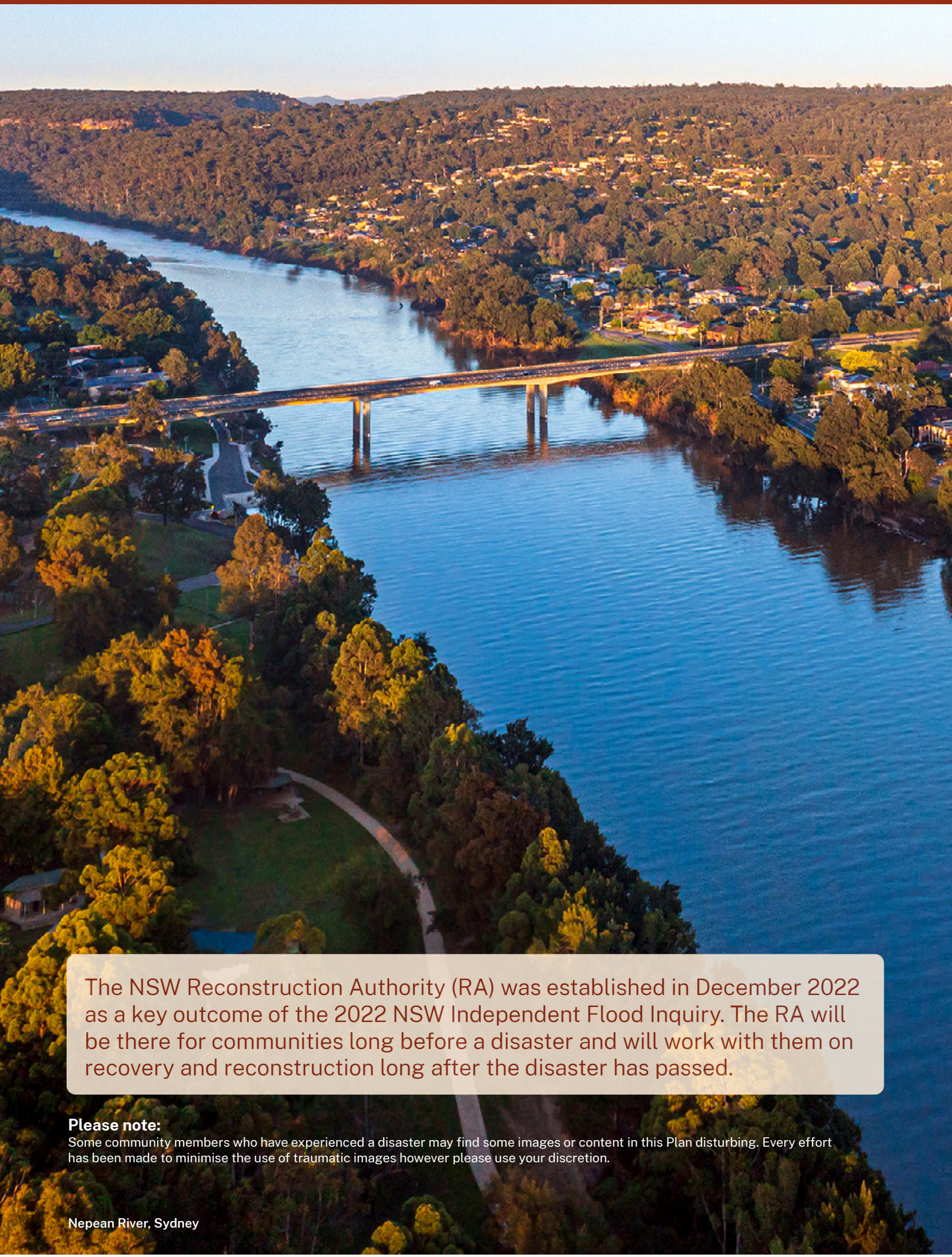


The NSW Reconstruction Authority (RA) was established in December 2022 as a key outcome of the 2022 NSW Independent Flood Inquiry. The RA will be there for communities long before a disaster and will work with them on recovery and reconstruction long after the disaster has passed.

Please note:
Some community members who have experienced a disaster may find some images or content in this Plan disturbing. Every effort has been made to minimise the use of traumatic images however please use your discretion.

Nepean River, Sydney

Ministerial message

Our State represents the diversity of the Australian landscape. From World Heritage mountain ranges and rainforests through to rugged countryside, floodplains and the stunning coastline – NSW has an incredible variety of geographic features.

This means that NSW is a wonderful place to live, work and play, but it also means that we must live with a number of natural hazards, including bush fires, floods, storms, heatwaves, earthquakes and coastal erosion. This can cause significant damage and concern within the community, but natural processes are important for both the regeneration and rejuvenation of the environment.

Historically, NSW has always been prone to disasters. Aboriginal oral history and stories, as well as European records and literature, reflect our need to understand the challenges of our landscape. More recently, the catastrophic 2022 flood events and the extreme bush fire season of 2019-2020, are a painful reminder of just how serious disasters can be.

The primary responsibility of any Government is the safety and security of the community. As our climate changes, so do the risks of natural disasters.

As the Ministers jointly responsible for the NSW Reconstruction Authority, we acknowledge the responsibility of reducing the impact of natural disasters, whilst supporting communities through recovery.

The State Disaster Mitigation Plan (the Plan) is the Government's Statewide framework for disaster risk reduction. It provides evidence-based tools for reducing risk where we can and adapting where we can't. By tackling these challenges head on, we can chart a course towards a more prepared NSW.

NSW is home to more than 8 million people across more than 800,000km^2. More than a quarter of the population was born overseas, and we are proud to have over 70 Aboriginal nations across our State. By 2041 our population is expected to grow to 9.9 million. Our rich diversity and community connections are our strength, and this is never more apparent than when our communities face the impacts of disasters.

We know that disasters relating to natural hazards will occur and that with climate change and population growth, their impact will increase. When they do, our communities must be able to rely on mitigation measures, community preparedness, well-informed recovery measures and intelligent reconstruction. In NSW, we have world-leading expertise, systems and processes for handling these disasters; but there is always room for improvement.

These past few years have been difficult for many communities affected by disasters. We have learned important lessons which are now shaping our approach to disaster mitigation, in order to make a difference to the people of NSW. The challenges of the future require us to do so.

The Hon. Paul Scully

Minister for Planning and Public Spaces

The Hon. Jihad Dib

Minister for Emergency Services

Authorisation

The State Disaster Mitigation Plan is issued under the authority of the Minister for Planning and Public Spaces and the Minister for Emergency Services pursuant to the *NSW Reconstruction Authority Act 2022*. The Plan is maintained by the NSW Reconstruction Authority on behalf of the NSW Government.

Executive summary

1

Mona Vale Beach, Sydney

NSW is exposed to a range of different hazards

With its diverse mix of iconic mountain ranges, floodplains, rainforest, hinterland, outback, and meandering coastline, NSW encompasses a varied range of topography and terrain. These features make NSW a great place to live and work, but also expose us to natural hazards including bush fires, floods, storms, heatwaves, earthquakes, and coastal erosion. For example, the map in Figure 1 demonstrates most of NSW is susceptible in some way to flood and bush fire hazard, particularly on the coast where most people live.

NSW has always experienced disasters. We know from Aboriginal oral history that bush fires, floods and storms have affected our State for thousands of years. The impact and cost of disasters in recent times has increased, with NSW experiencing multiple flooding and bush fire events over the past decade. The 2022 flood events alone affected 98 out of 128 local government areas (LGAs), damaged 15,000 homes and caused over $5.1 billion of insured damages.[1] Our communities continue to bear the social, environmental, and economic costs with people and communities displaced, critical infrastructure in disrepair and insurance either unavailable or unaffordable.

We know disasters will continue to occur. While some disaster scenarios are too terrible to imagine, they have a realistic probability of occurring over our lifetime.

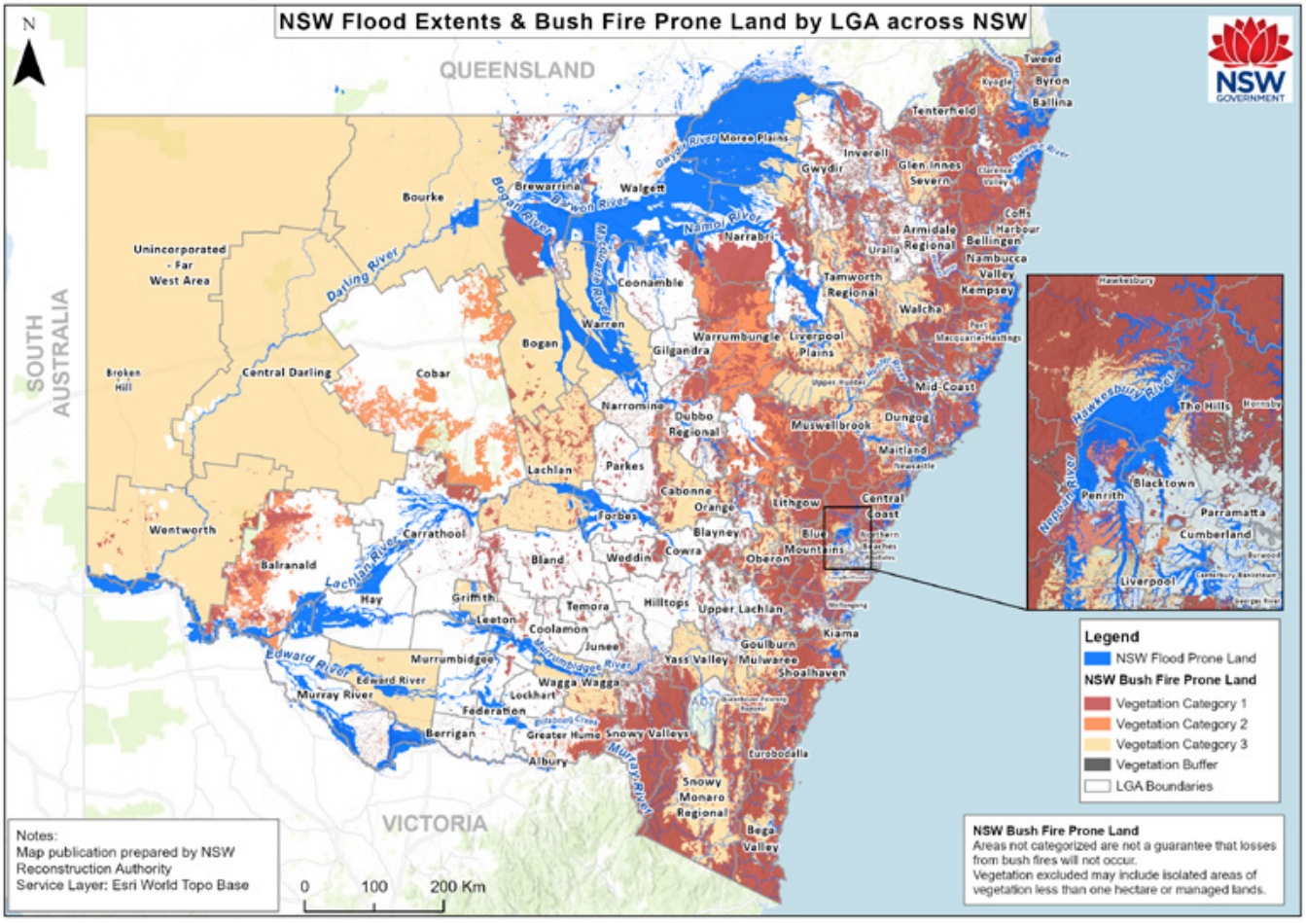


Figure 1. Flood prone land and bush fire prone land by LGA across NSW. Source: Department of Planning and Environment, 2023

Understanding disaster risk

Events like bush fire and flood play a vital, regenerative role in the function of our natural environment and ecosystems.

Natural events can become hazards when there is a potential negative impact, such as loss of life or economic or environmental damage. A disaster occurs when these natural hazard events significantly affect people, homes, livelihoods, and assets of value, and when the impact of hazards exceed a community's ability to avoid, cope or recover from them.[2]

Disaster risk results from the combination of the hazard, and the exposure and vulnerability of people and assets to that hazard.

There is often little we can do about the hazard itself. Disaster risk can be reduced by limiting the exposure of people, homes and infrastructure to hazards, or increasing their resilience, making them less vulnerable to disaster impacts.

Figure 2. Components of natural hazard risk

Taking a multi-hazard approach

A multi-hazard technical risk assessment was completed to inform this Plan. Taking a multi-hazard approach allows for an understanding of the combined risk from multiple hazards, and their relative risk to our communities. Information on the LGAs at greatest relative risk is included.

In this risk assessment, we applied the standard metric used by the insurance industry and financial markets: *average annual loss* (AAL). This is defined as the expected or average cost of damage to property and infrastructure arising from all occurrences or probabilities of that hazard in any one year. This metric is useful to compare changes in risk across different hazards as it is easier to quantify and based on established methods.

However, hazards such as bush fire may show lower average annual losses but can still have significant impacts on local communities and the natural environment. Further work is needed to better quantify hazard impacts on the social, natural and broader economic environments.

The risk assessment showed that the highest current natural hazard risks in the built environment are from storms and floods, with coastal hazards dominating risk in the future. These hazards, in addition to bush fire and heatwaves, have historically presented the greatest risk to life and injury. As a result of this analysis, these hazards are a focus of the actions in this inaugural Plan.

Secondary impacts of hazards such as air and water pollution

In addition to the impacts sustained by a primary natural hazard event, secondary impacts can occur.

A secondary impact is an indirect consequence of the hazard event such as poor air quality from bush fire smoke and burnt matter being washed into water supply sources. The risk assessment highlighted the challenge in quantifying the secondary impacts of natural hazards over the longer term on health and wellbeing due to limitations of available information. These secondary impacts of natural hazards require further work to be better integrated into the risk assessment to inform future versions of this Plan. In addition, the implementation of this Plan's actions will integrate with the NSW Clean Air Strategy 2021-30.[3]

Population growth and climate change drive increasing disaster impacts and costs

Two of the key drivers increasing exposure and vulnerability over time are population growth and climate change.

NSW's population is projected to grow to 9.9 million by 2041 with most growth expected in urban centres particularly on the coast. These areas are already at high risk due to the impact of natural hazards on the built environment, and climate change could, without action, also increase this risk in the future.

Though the impacts of climate change on all natural hazards are not fully understood, it is expected to increase the frequency, duration, and severity of extreme weather events due to greater climate variability. Climate change will affect each natural hazard differently. A summary of the climate change impact on the severity and frequency of a range of natural hazards is included in Figure 3 below.

While population growth and climate change individually affect NSW's future risk profile, the interplay between both can make them more acute. Climate change is increasing the severity and frequency of natural hazards and increased development in these areas means more people are exposed.

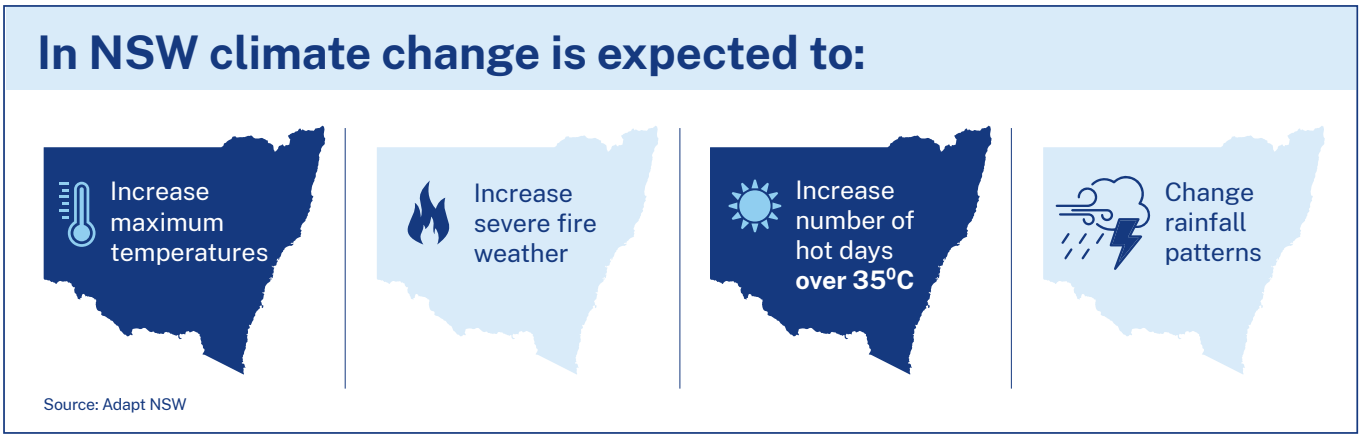


Figure 3. Impacts of climate change in NSW

Addressing disaster risk requires new ways of working and will occur over many years

As a State, we have long been aware of the need to reduce exposure and vulnerability of people and assets to natural hazards – for example, through restricting development in areas of high risk. While many government initiatives are in place, there are ongoing challenges in delivering risk reduction interventions. Recent disasters have demonstrated that people and governments have difficulty in anticipating the scale and severity of events, particularly when they exceed what has previously been experienced. Historically, over 97% of disaster-related investment has been spent on response and recovery rather than risk reduction, which leaves communities carrying the burden of risk, and increases the likelihood of greater response from emergency services.

There are a range of challenges involved in implementing risk reduction. For example, risk reduction can have significant upfront cost, such as substantial investment in mitigation infrastructure such as flood levees, or upgrades to critical infrastructure to increase its resilience. Sometimes the benefits of risk reduction and adaptation are clear only after a disaster has occurred, when it is too late to take actions that would have reduced the impact. Benefits can also be difficult to quantify as they are based on avoiding future costs and impacts. Nonetheless, many benefits are enjoyed in the here and now: confidence to invest in homes and businesses, and the ability to obtain insurance at an affordable price.

One of the key tools to reduce risk is to change how and where we live through strategic land use planning. However, this can be challenging. For example, the managed relocation of people from homes in high-risk areas (known as buy-backs or voluntary purchase) can be disruptive and traumatic due to longstanding connections to homes, places, communities, and Country.

Effective risk reduction, particularly changes to strategic land use planning, requires a high degree of collaboration between all stakeholders, and difficult decisions may need to be made. These include managing the competing priorities and values attached to growth, housing supply, equity, and environmental and social impacts. It requires open and collaborative conversations between those who benefit and those affected by different options, including community members, all levels of government, insurance and banking industries, and private businesses. This Plan and the disaster adaptation planning process provide an opportunity to enable better resolution of these competing priorities and values, which has been reflected in some of the actions identified in this Plan.

Aboriginal needs and values

Aboriginal people and communities are at a higher risk of natural disasters due to a legacy of geographic isolation and a lack of direct access to broader services particularly for Discrete Aboriginal Communities. These areas can be close to hazard risk due to their location, and can be isolated from essential services due to poor road access. All disaster adaptation planning must consider and embed Aboriginal community and cultural needs and values.

Collaborative disaster adaptation planning as the way forward

Our history of disasters means we have a strong knowledge base to build on. We have a high level of expertise in our emergency management sector, Aboriginal stewardship practices to draw upon, a focus on climate variability, change and adaptation, and mature experience in managing some of our most significant hazards, such as bush fire, storms, and floods. We also have existing NSW Coastal and Flood Risk Management programs.[4]

One of the key outcomes from the 2022 NSW Independent Flood Inquiry has been the establishment of the NSW Reconstruction Authority (RA) in December 2022. With a clear mandate to reduce the impact of disasters, the RA has gathered expertise in natural hazard risk reduction and adaptation to complement the existing knowledge across government.

The RA's State Disaster Mitigation Plan 2024-2026 is the State's first multi-hazard plan to reduce the costs and impacts of natural disasters. This Plan outlines the critical elements required for reducing risk where we can, and adapting where we can't, including:

- information required to understand natural hazard risk and how it changes over time
- the toolkit available to reduce exposure and vulnerability to natural hazards, including tools for strategic land use planning
- the short and medium-term actions to sharpen these tools, particularly addressing where there are gaps in State programs and policy.

Disaster risk reduction requires a coordinated, place and community-centred approach. Therefore, this Plan also supports and enables place-based and community-centric Disaster Adaptation Plans (DAPs). DAPs will be developed by the RA, councils, Aboriginal landowners and other organisations. The DAPs will draw as appropriate from the risk reduction toolkit outlined in this Plan and identify a suite of prioritised options that work to reduce risk at a local or regional level in partnership with the community.

Toolkit to reduce exposure and vulnerability

Disaster risk reduction requires an understanding of the range of appropriate disaster risk reduction tools to prevent new disaster risk, reduce existing disaster risk and manage residual (remaining) risk. A tool is a collective term to describe the range of different infrastructure and non-infrastructure measures to reduce risk.

Generally, no simple or single solution will significantly reduce the risk. A suite of complementary measures is required to develop the most effective mix of risk reduction tools. It is important that all relevant tools are considered for each place, with an appropriate level of assessment for evidence informed decision-making. The relevance and effectiveness of any tool depends on factors including the funding available, which hazard it is most relevant to, and the local context.

Risk cannot be fully eliminated, so we need to consider options to reduce the exposure of people, homes, and infrastructure, as well as options to reduce vulnerability by increasing the resilience of our communities and assets. The risk reduction options for consideration in disaster adaptation planning are outlined below (Figure 4).

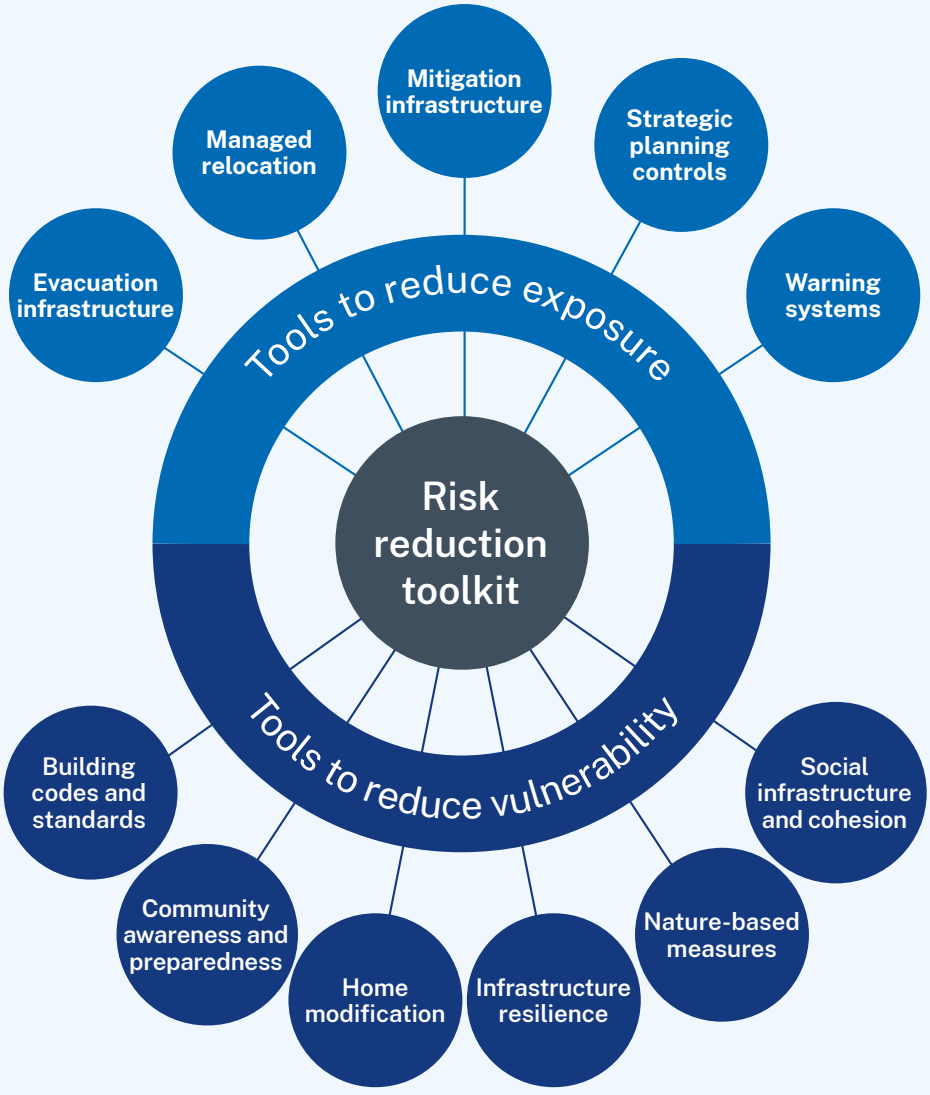


Figure 4. Tools discussed in this Plan to reduce hazard exposure and vulnerability

Enablers for successful risk reduction

To successfully support and guide disaster risk reduction efforts at both a state and local level there needs to be additional focus on:

- collaborative governance
- funding
- capacity and capability
- data
- insurance.

Actions to implement and improve these enablers are included in this Plan to support collaboration and implementation of disaster adaptation plans.

Insurance and disaster risk reduction

Insurance is not universally available for all hazards, for example coastal hazards. Where available, recent research shows that disaster insurance affordability is decreasing, with 12% of households experiencing insurance affordability stress.[5] While insurance affordability can be improved by removing levies/taxes, insurance will continue to reflect risk, meaning that premia will continue to be costly in some high-risk areas. It is essential that we continue to work with the insurance industry so that investment in risk reduction can be appropriately recognised.

This Plan supports and complements existing NSW plans

This Plan does not specify emergency and recovery management arrangements arrangements, which are set out in the State, Regional and Local Emergency Management Plans and Recovery Plans as per the *State Emergency and Rescue Management Act 1989 (SERM Act)*. This Plan is complementary to these considerations as they provide a mechanism to consider emergency and recovery arrangements in strategic land use and infrastructure planning. This Plan, and DAPs as they are developed, provide a mechanism for emergency management constraints to be considered in land use decision-making under the *Environmental Planning and Assessment Act 1979 (the EP&A Act)*, for example evacuation capacity.

This Plan also:

- builds on and complements existing arrangements for council-based hazard management under the *NSW Coastal Management Act 2016* and the NSW Floodplain Management Program
- supports the implementation of the NSW Climate Change Adaptation Strategy (CCA)
- adopts the Australian Government's Framework for Disaster Risk Reduction and Second National Action Plan for Disaster Risk Reduction.

This Plan adds to the State's considerable work by providing a long-term risk reduction program operating across multiple natural hazards. This Plan and future iterations will work to inform the investment program to be delivered over many decades.

Priority actions identified to foster risk reduction

Following extensive consultation with Australian, State and local government as well as key industry and community stakeholders, 37 actions have been determined to respond to the identified gaps. These include short to medium term actions to be delivered over 2024 and 2025 pending funding commitments. They will be delivered with collaboration across multiple government agencies and other stakeholders, and not all of the relevant stakeholders are listed. These actions are outlined in the table on the following pages.

	TOOL	ACTION	RESPONSIBILITY	DELIVERED BY
Tools to reduce hazard exposure				
1	**Evacuation infrastructure**	Develop a Statewide framework for evacuation infrastructure capacity, analysis and upgrades. The framework: • establishes processes and tools to assess or review existing and future evacuation capacity of infrastructure to ensure people can evacuate within a warning time • is embedded in transport, land-use, bush fire, flood and tsunami planning arrangements, and • identifies roles, responsibilities and resourcing requirements for the development and maintenance of evacuation infrastructure.	**Lead:** NSW Reconstruction Authority **Partners:** Transport for NSW, NSW State Emergency Service, Rural Fire Service, Department of Planning, Housing and Infrastructure, Department of Climate Change, Energy, the Environment and Water	Late 2025
2	**Managed relocation**	Develop a State policy for large-scale multi-hazard managed relocation, drawing on the experience of the Northern Rivers and other jurisdictions, to decide the appropriateness of this response in disaster adaptation planning, which includes: • mechanisms to identify criteria for areas where risks are not tolerable • guidelines to allow strong community involvement and decision making (pre-disaster, post disaster) • funding principles between governments, councils, households and businesses • principles for communicating and publishing risk information • implementation of alternative productive uses for reclaimed open space (such as agriculture) or nature-based mitigation measures and other uses (e.g. parks) • relocation of critical infrastructure and government assets • governance for management of land for relocation to occur.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2025
3	**Mitigation infrastructure**	Review governance and funding arrangements for levee maintenance.	**Partners:** Department of Climate Change, Energy, the Environment and Water & NSW Reconstruction Authority	Early 2025
4	**Mitigation infrastructure**	Assess the feasibility of large-scale offshore sand reserves and other sources for beach nourishment including where it might be suitable.	**Partners:** Department of Climate Change, Energy, the Environment and Water & NSW Reconstruction Authority	Mid 2025

	TOOL	ACTION	RESPONSIBILITY	DELIVERED BY
5	**Mitigation infrastructure**	Explore infrastructure mitigation options for landslides.	NSW Reconstruction Authority	Mid 2025
6	**Strategic planning controls**	Develop a library of standard planning controls for all natural hazards for councils to apply: • to address the key issue of heatwave, commence with 'keeping houses cool' planning controls e.g. roof colour (building on recent BASIX announcement) • controls for sensitive development e.g. hospitals.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2024 Mid 2025
7	**Strategic planning controls**	Develop framework and supporting processes and tools for determining tolerable natural hazard risk for different development types and land uses, and plan to implement in land use policy and legislation.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2025
8	**Warning systems**	Develop a strategic management plan for the NSW flood gauge network, and include solutions to the identified challenges of ownership, maintenance, and ongoing funding arrangements.	**Lead:** Department of Climate Change, Energy, the Environment and Water **Supporting agency:** NSW Reconstruction Authority	Mid 2025
9	**Warning systems**	Conduct a technology pilot program to evaluate the functionality, effectiveness, and reliability of intelligent sensors as part of flood and/or bush fire warning systems and implement technology.	**Lead:** Office of the Chief Scientist and Engineer **Supporting agencies:** NSW Reconstruction Authority, Fire and Rescue, Rural Fire Service, NSW State Emergency Service, Department of Climate Change, Energy, the Environment and Water	Mid 2026
Tools to reduce vulnerability				
10	**Building codes and standards**	Develop a policy for consideration of resilience to natural hazards as part of building codes and standards, that: • considers voluntary and compulsory application through legislation and National Construction Code • sets agreed thresholds and criteria for application • is supported with validated data/maps • considers costs to development, supply chain impacts, and environmental footprints.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2025

	TOOL	ACTION	RESPONSIBILITY	DELIVERED BY
11	**Building codes and standards**	Build a library of updated building standards to increase resilience to natural hazards and develop a plan to embed into legislation including the: • National Construction Code • Local environmental plans • State environmental planning policies • Local and State Recovery Plans.	**Partners:** NSW Reconstruction Authority & Department of Customer Service	Mid 2025
12	**Building codes and standards**	Develop a multi-pronged communications and engagement strategy targeting homeowners and the building industry to: • explain the role and importance of standards and codes in building resilience • embed changed practices with industry (e.g. suppliers).	NSW Reconstruction Authority	Mid 2026
13	**Community awareness and preparedness**	Improve multi-hazard risk awareness and preparedness in NSW through the delivery of: • a Get Ready Program Plan and Logic to reflect a multi-hazard approach to Statewide preparedness that complements emergency management agency activities. The program plan will define objectives, roles and responsibilities, funding, priorities, a monitoring and evaluation framework, and a program logic. • a 'Get Ready NSW' website that includes natural hazard risk information and guides on how to prepare for individuals, households, and businesses (including a focus on evacuation) • an annual 'Get Ready NSW' multi-hazard public awareness action campaign; measure its impact and share results with local government emergency management and key community partners • a 'Get Ready NSW' fund and guidelines to support councils and community-based organisations to deliver local awareness and preparedness activities • update the 'Get Ready NSW' baseline survey and index to reflect new data requirements to measure LGA-based levels of preparedness on a yearly basis • culturally appropriate, multilingual and accessible communications across a diverse range of formats, channels, platforms and forums to reach diverse communities including distinct cultural and linguistic groups and Aboriginal and Torres Strait Islander communities.	NSW Reconstruction Authority	End 2024

	TOOL	ACTION	RESPONSIBILITY	DELIVERED BY
14	**Community awareness and preparedness**	Identify existing gaps in education programs for young people and school communities on natural hazards, and develop an action plan to address them.	**Lead:** Department of Education **Supporting agencies:** NSW Reconstruction Authority & combat agencies	End 2024
15	**Community awareness and preparedness**	Develop a Disability Inclusive Disaster Risk Reduction (DIDRR) policy and relevant tools for supporting the implementation of the DIDRR Framework for collaborative action to increase community and inter-agency partner awareness and preparedness levels.	**Partners:** NSW Reconstruction Authority & members of the Community Engagement Sub Committee of the State Emergency Management Committee	End 2024
16	**Community awareness and preparedness**	Coordinate a review of preparedness planning for State government agencies, particularly social service providers.	NSW Reconstruction Authority	End 2024
17	**Home modification**	Drawing on lessons from the Northern Rivers, Central West and other recent disasters, develop: • a process to consider appropriate home modification requirements in building codes and standards • funding guidelines, criteria for eligibility and a funding stream to support home modification activities.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2026
18	**Infrastructure resilience**	Include a process in the DAP Guidelines and Framework for the identification of the relative criticality of assets and plans for asset resilience interventions. Ensure the process includes relevant asset owners, operators, and community representatives.	NSW Reconstruction Authority	Mid 2024
19	**Infrastructure resilience**	Engage with the private sector and regulator to develop an approach to prioritise and coordinate place-based infrastructure resilience interventions by private sector operators.	**Partners:** NSW Reconstruction Authority & Infrastructure NSW	End 2024
20	**Infrastructure resilience**	NSW Government Business Case Guidelines to include natural hazard risk and criticality assessments as part of decision making for new assets.	NSW Treasury	Mid 2025
21	**Infrastructure resilience**	NSW Government asset owners reflect DAPs in asset management plans.	All State Government asset managers	As delivered
22	**Nature-based measures**	Establish a nature-based measures knowledge hub to provide practical advice on the implementation, benefits and impacts of nature-based measures, with an emphasis on Aboriginal knowledge and land management practices, and catchment management approaches.	**Lead:** NSW Reconstruction Authority **Supporting agencies:** Department of Climate Change, Energy, the Environment and Water, Department of Primary Industries and Local Land Services.	Mid 2025

	TOOL	ACTION	RESPONSIBILITY	DELIVERED BY
23	**Social cohesion**	Include guidance in the DAP Guidelines and Framework for: • mapping of social assets (community spaces and trusted social networks and leaders) relevant to disaster risk reduction • identification of social cohesion actions that build on strengths and address gaps for disaster risk reduction.	NSW Reconstruction Authority	Mid 2024
24	**Social cohesion**	Deliver a Statewide framework for social cohesion which includes a focus on natural hazard risk. The framework will define objectives, roles, and responsibilities, monitoring and evaluation, and measurement.	**Lead:** Premier's Department **Supporting agencies:** Multicultural NSW & NSW Reconstruction Authority	Mid 2026
Enablers				
25	**Capacity and capability**	Investigate options to support resourcing and capability-building in local councils.	**Lead:** NSW Reconstruction Authority **Supporting agency:** Office of Local Government	End 2024
26	**Capacity and capability**	Provide resources, data and funding to support Discrete Aboriginal Communities and other Aboriginal landowners to develop DAPs, building on the work of the Aboriginal Communities Emergency Management Program.	**Lead:** NSW Reconstruction Authority **Supporting agency:** Aboriginal Affairs NSW	End 2025
27	**Collaborative governance**	Establish a specifically convened Aboriginal working group to: • articulate lessons from existing programs and initiatives related to Aboriginal disaster risk reduction • provide strategic advice to better inform Aboriginal disaster risk reduction at State and local levels • advise on how to achieve authentic and ongoing conversations with local Aboriginal people and communities to better understand and embed Aboriginal values and needs into disaster risk reduction planning.	**Partners:** NSW Reconstruction Authority & Aboriginal Affairs NSW	Mid 2024
28	**Collaborative governance**	Include a process in the DAP Guidelines and Framework to facilitate trusted relationships with Aboriginal local communities to recognise Aboriginal cultural values, knowledge, and practices (across all Country).	**Lead:** NSW Reconstruction Authority **Supporting agency:** Aboriginal Affairs NSW	Mid 2024
29	**Collaborative governance**	Establish an assurance and expert review function for DAPs.	NSW Reconstruction Authority	End 2024

	TOOL	ACTION	RESPONSIBILITY	DELIVERED BY
30	**Collaborative governance**	Improve Local Emergency Management Committee (LEMC) capacity and capability to support its increased role in disaster mitigation. Explore options to enhance LEMC governance and operations including increased community and Aboriginal representation.	**Lead:** Premier's Department **Supporting agency:** NSW Reconstruction Authority	End 2024
31	**Data**	Formalise natural hazard risk analysis and assessment methodologies, and establish a dedicated hub of data, platforms, people and decision support to be established in the NSW Reconstruction Authority to support disaster adaptation planning. This would include: • agreed methods and assumptions to assess hazard risk and risk reduction options • governance mechanisms that include experts across government to approve methods and assumptions • guidance on completing hazard risk and risk reduction options assessment • a centralised disaster risk hazard, exposure and vulnerability data platform drawing on existing sources • a data roadmap and research plan to continuously update data gaps on landslide risk.	**Lead:** NSW Reconstruction Authority **Key partners:** Department of Climate Change, Energy, the Environment and Water, Department of Planning and Environment, Department of Customer Service, Transport for NSW & Department of Justice and Communities	Hub established and ongoing guidance provided immediately, data platform delivered by end 2025
32	**Funding**	Progress a business case for a NSW Mitigation Fund to drive additional risk reduction, particularly for projects prioritised in DAPs.	NSW Reconstruction Authority	End 2024
33	**Funding**	Explore options for innovative funding pathways and financing mechanisms, such as the NSW Sustainability Bond.	**Partners:** NSW Reconstruction Authority & NSW Treasury	End 2024
34	**Funding**	Develop funding principles to guide cost sharing for disaster risk reduction between the Australian, State and local governments, and private asset owners.	**Partners:** NSW Reconstruction Authority & NSW Treasury	End 2024
35	**Insurance**	Review levy arrangements on insurance premia.	NSW Treasury	End 2024
36	**Insurance**	Collaborate with NEMA and the insurance sector to reflect disaster risk reduction measures in insurance pricing, and to use data on insurance affordability to inform strategic land use planning responses.	NSW Reconstruction Authority	Mid 2025
37	**Monitoring and reporting**	Develop a Monitoring, Evaluation, Accountability and Learning (MEAL) framework for the continuous improvement of disaster risk reduction in NSW.	NSW Reconstruction Authority	End 2024

Next steps

The RA is currently working on 2 regional DAPs for the Hawkesbury-Nepean Valley and Northern Rivers. We aim to commence work on a DAP for the Central West in the coming months.

A key priority is for the RA to develop a draft DAP Guidelines and Framework in mid 2024 to guide a consistent approach for disaster risk reduction planning. This will allow all areas across the State to commence work on local strategies and actions to minimise and mitigate natural hazard risks. Engagement on these draft documents will allow the RA to better identify where additional focus is required.

The RA will provide an assurance and endorsement function for disaster adaptation planning. Steps will be taken to enable the implementation and funding of a pipeline of projects identified through this Plan and the DAPs. Participating organisations will provide ongoing progress reports allowing the RA to monitor, evaluate and report on implementation across the State, with a focus on adaptive management and learning through a Monitoring, Evaluation, Accountability and Learning (MEAL) framework.

The long-term vision is that all areas in the State will benefit from having a DAP in place within the next 5 years.

- We will start to coordinate the delivery of actions outlined in this inaugural Plan, working in partnership across government and industry, pending additional funding being received.
- We will continue to engage with the community and other stakeholders and consider feedback as we implement actions, and to incorporate in the next SDMP.
- We will deliver the draft DAP Guidelines and Framework for consultation in mid 2024 to guide place-based Plans.
- We will deliver the next State Disaster Mitigation Plan (SDMP) in 2026. This will include progress and outcomes on the actions included in this Plan and identify projects for the longer term.

Disasters will still happen, but we will be better prepared to reduce the impact on NSW communities

There is no easy or simple solution to reduce disaster risk. Disasters will still happen – there will be instances where the capacity to respond to the impacts of a natural hazard event will be exceeded. This Plan demonstrates that the NSW Government is tackling challenges head on by providing a clear way forward to mitigating risk where we can with the view to developing an investment pipeline for these initiatives. Where risk can't be mitigated, prioritised funding in social cohesion and community awareness and preparedness will help our communities prepare. Where there are actions we can take Statewide, we will take them. Where place-based solutions are required, we will enable them. Where communities are required to take steps to enhance their resilience, we will ensure they are supported, resourced and prepared.

Purpose and approach

2

Road cut by flood waters of the Wollondilly River, Southern Highlands NSW

Purpose of the State Disaster Mitigation Plan

This inaugural Plan sets out the NSW Government's strategy to reduce the impact and cost of natural hazards on people, homes, livelihoods, infrastructure, and communities. It also sets out a plan of short and medium term actions required to address current challenges and strengthen State level policy and programs. Implementing these actions will support and guide the development of place-based Disaster Adaptation Plans (DAPs).

Legislative requirements

The RA was established in December 2022 as the primary State government agency responsible for disaster preparedness, mitigation, recovery and adaptation. *The NSW Reconstruction Authority Act 2022* requires that the RA prepare and implement a State disaster mitigation plan to provide guidance about the mitigation of disasters across NSW.[6]

This Plan does not specify emergency management arrangements, which are set out in the State, Regional and Local Emergency Management Plans and Recovery Plans as per the *State Emergency and Rescue Management Act 1989 (SERM Act)*. This Plan and DAPs are complementary to these arrangements as they provide a mechanism to consider emergency and recovery arrangements in strategic land use and infrastructure planning. They also provide a mechanism for emergency management constraints to be considered in land use decision-making under the *Environmental Planning and Assessment Act 1979 (the EP&A Act)*, for example evacuation capacity.

Part 4 of the *NSW Reconstruction Authority Act 2022 (the RA Act)* identifies one of the key purposes of this Plan is to be setting priorities for action to be taken under strategic plans under the *EP&A Act*. This critical relationship is reinforced by clauses in Part 3 of the *EP&A Act* requiring all planning authorities to take this Plan into consideration when making or updating any district or regional strategic plans. Immediate land use decision-making processes are also captured by s38 of the *RA Act* that requires planning authorities to consider this Plan when carrying out any of their *EP&A Act* functions, such as development assessment and providing advice. The *RA Act* also requires councils to consider this Plan when carrying out their functions under the *Local Government Act 1993*.

This Plan and DAPs will also build on and complement existing arrangements for council-based hazard management under the *NSW Coastal Management Act 2016* and the NSW Floodplain Management Program.

Links to national and international frameworks

This Plan has been underpinned by and designed to align with the directions and approach of the Sendai Framework for Disaster Risk Reduction 2015 –2030 and the National Disaster Risk Reduction Framework. The National Disaster Risk Reduction Framework is the domestic implementation of the Sustainable Development Goals and articulates Australia's 2030 vision for disaster risk reduction. Actions are progressed via National Action Plans. The National Emergency Management Agency has recently released the Second National Action Plan which identifies nationally significant actions that will reduce disaster risk.

Consideration of recent inquiries

We have considered and reviewed recommendations from recent inquiries. This includes the:

- 2022 NSW Independent Flood Inquiry.
- Select Committee on the Response to Major Flooding across NSW in 2022.
- 2019-20 Bushfire Inquiry.

NSW Government has been progressing work to address the recommendations in all of these reports, and this Plan also implements and builds on the work of these inquiries. Appendix 3 provides a summary explanation of each of these inquiries and how this Plan addresses the recommendations in them.

How we developed this inaugural plan

A number of steps were taken to develop this Plan, including a range of analysis and engagement. This included:

- Compiling available natural hazard information, including hazard susceptibility and impacts from historical events.
- A technical risk assessment for a range of natural hazards, which quantified risk from each hazard now and in the future, including impacts of climate change and population growth. This technical risk assessment also provided an understanding of which LGAs in the State had the highest combined or multi-hazard risk.
- A preliminary analysis of the number of homes and assets exposed to coastal hazard and flood was completed. This was informed by the results of the technical risk assessment.
- Compiling a range of tools available to reduce the risk – the risk reduction toolkit. These included tools that either reduce the exposure of people and assets or reduce their vulnerability.
- Identifying enablers to support the application of the tools particularly in local, regional or organisational DAPs. This includes data, funding, collaborative governance, capability and capacity and insurance.
- Evaluating the toolkit and enablers through a literature review and deep engagement detailed below. Evaluation was used to understand:
  - current arrangements and work underway and therefore gaps
  - current challenges and opportunities
  - State level actions required to address challenges and fill key policy or program gaps
- Review through formal State government governance processes.

Overview of engagement

This Plan has been informed by feedback and insights from key stakeholders and the community. State government agencies, local councils, technical specialists, non-government organisations, Aboriginal specialists and the community were engaged through workshops, webinars and conversations to ensure we captured a diverse range of views. Discussions covered the existing challenges, opportunities and actions for government to take. Collective feedback has been incorporated into this Plan.

In total, more than **290 participants** from over **30 organisations** participated in **18 workshops** on the toolkit and enablers. In addition, 10 risk assessment workshops and briefings were held with **55 participants.**

What we heard from Aboriginal participants

We worked with Aboriginal specialists from across government to make sure this Plan reflected Aboriginal community and cultural needs and values. The key themes of feedback from Aboriginal participants included:

- Aboriginal people need a strong voice at the table for inclusive decision-making, with a focus on continuous improvement for all areas of disaster management including risk reduction. In addition, local decision-making is paramount.
- The resilience of Aboriginal people needs to be recognised and supported so local Aboriginal communities have agency to manage their natural hazard risk.
- The importance of community and government co-design in the integration of relevant government programs such as Roads to Home that build local disaster mitigation infrastructure.
- Need to include cultural infrastructure and assets when considering impacts and risk reduction.
- Aboriginal-owned land including Discrete Aboriginal Communities require tailored solutions to recognise distinct needs and the current lack of funding opportunities.
- It is important to take a broader and longer-term view of Country – Aboriginal stewardship is important to reduce disaster risk over time.
- Real life challenges such as recently seen at Cabbage Tree Island indicate the importance of Aboriginal leadership in critical decision making that impacts local Aboriginal communities.

What we heard from the community

With government and community having a shared responsibility in reducing and adapting to natural hazard risk, it was important to have community knowledge, values and sentiment informing this Plan. 35 panel members from across NSW participated in 2 online workshops. Participation was voluntary and there was no prior knowledge required – some participants had experienced a natural disaster; others had some experience as a volunteer related to emergency management; others were simply interested in having the discussion around disaster risk. Key themes of the panel's feedback:

- the importance of community wellbeing and the need to better plan for vulnerable members, build community capacity, and educate communities about risk
- concern for the rising costs of renovations, building and insurance, and the necessity for better building codes, land use planning, and coordination between all levels of government
- recognition that managing risk extends beyond lives and homes to livelihoods, and that it was important for the government to consider businesses, agriculture, pets, essential services, employment and the natural environment
- when land is deemed too high risk for residential development it could be repurposed for open space/ sports or returned to its natural state or traditional owners
- the need for government to have the latest information on the natural hazards we face, and the importance of community being able to access data to enable informed choices, particularly when purchasing land or housing
- a strong sentiment to ensure any government actions are localised with the community playing a pivotal role in creating local solutions
- ensuring that individuals maintain a right to make informed, evidence-based decisions for themselves when presented with risk mitigation options that directly impact them
- to learn from the successes and failures of other Australian states or global cities and regions in formulating plans.

"Thanks ... it was a great process ... like an old school community consultation," said Michael.

How this Plan relates to the emergency management sector and other plans

Responsibilities across NSW Government: emergency response for natural hazards covered in this Plan

Emergency response arrangements for natural hazard events are set out in the State Emergency Management Plan (EMPLAN):

> Fire and Rescue NSW for a fire within cities and towns across NSW.

> NSW State Emergency Service for flood, storm and tsunami.

> Rural Fire Service for a fire within a rural fire district, as the lead agency for bush fires in NSW.

> NSW Police for earthquake (structural collapse from the impacts of earthquakes).

> State Emergency Operations Controller leads control of heatwave operations and NSW Health provides information about heatwaves.

> Landslide is managed depending on hazard impact and location. NSW Environment Protection Authority, Department of Primary Industries and Public Works Advisory can all be involved.

> Councils are responsible for developing Coastal Zone Emergency Action Sub Plans which are required as part of a Coastal Management Plan.

Relationship between this Plan, DAPs, Emergency Management Plans and strategic land use planning

- Both this Plan and DAPs set out the intent on how natural hazard risk is to be managed. All State government agencies and local governments 'must give regard to' the Plan and DAPs in their planning and functions as legislated in the *NSW Reconstruction Authority Act 2022*.
- This Plan and DAPs do not specify emergency management arrangements, which are set out in the State, Regional and Local Emergency and Recovery Plans as per the *SERM Act*. These plans are regularly trained and exercised against. This Plan and DAPs are complementary to these arrangements as they provide a mechanism to consider emergency and recovery arrangements (e.g. evacuation capacity) in strategic land use and infrastructure planning under the *EP&A Act*. They also can support emergency planning by providing additional risk information. This Plan and DAPs provide the mechanisms to apply tools to reduce natural hazard risk to the community, which will also reduce risk to the emergency management sector.
- DAPs also provide the opportunity to identify where and how to rebuild post disaster. As part of this identification process, DAPs may also identify the areas that should rebuild to new building standards set by the State.
- The Plan is legislated to inform land use planning. Both the Plan and any relevant DAPs play an important role in future land use planning decisions made in NSW. Part 4 of the *RA Act* requires this Plan to set priorities for action to be taken under strategic plans under the *EP&A Act*. This critical relationship is reinforced by clauses in Part 3 of the *EP&A Act* requiring all planning authorities to take this Plan into consideration when making or updating any district or regional strategic plans. In addition, Section 38 of the *RA Act* requires planning authorities to consider this Plan when carrying out any of their *EP&A Act* functions, such as development assessment and providing advice.
- The *RA Act* also requires councils to consider this Plan when carrying out their functions under the *Local Government Act 1993*.
- Integrating consideration of this Plan into strategic land use planning and into decision-making in this way reflects the growing understanding of the fundamental role land use planning has in avoiding, minimising and mitigating the effects of hazards on the built environment.

Figure 5. Relationship of plans

Relationship between this Plan, DAPs and the Climate Change Adaptation Strategy

- The Government's overall strategy for adaptation to climate change is outlined in the NSW Climate Change Adaptation Strategy (CCAS), and aims to make NSW more resilient and adapted to the impacts of climate change. This Plan aims to reduce the costs and impacts of natural disasters through natural hazard risk reduction including an understanding of the impacts of climate change. Therefore, these plans are complementary. Both plans require information on the climate change impacts on natural hazard risks.
- This Plan has a strong focus on integrating land-use and infrastructure planning with emergency management planning. This Plan includes actions to reduce risk from, or adapt to, climate change affected natural hazards, such as coastal hazards. This is in line with the legislative purpose of the State Disaster Mitigation Plan. The DAPs, as they are developed, will also include place-specific actions for natural hazard disaster risk reduction.
- Priorities under the CCAS include the development of the NSW Climate Change Action Plan (scheduled for release in 2024). This will include broader actions not considered in this Plan such as those required to address challenges arising from a transition to a low-emissions economy. This includes planning for industry and workforce transition, primary industry policy (drought, biosecurity risk, agricultural transition), new industry opportunities, natural resource use and allocation (water, biodiversity, minerals) and liability risk from climate change.

Geography students piloting the 'Water in the World' school geography resource. Photo by Adam Hollingworth

What natural hazard risks is NSW facing?

3

Native forest after the Black Summer bush fires of 2019-2020

Natural hazards

Natural hazards are naturally occurring processes important for both the regeneration and rejuvenation of the natural environment. Even floods or extreme events, such as volcanic eruptions, provide valuable ecosystem functions.

Natural hazards in Australia are generally driven by either:

- weather (hydrometeorological hazards) – such as floods, bush fires, cyclones, thunderstorms and heatwaves, or
- geology (geophysical hazards) such as earthquakes and tsunamis.

Natural hazards can be characterised by their magnitude (size), intensity, speed of onset, duration and the area they cover. Hazards also occur over different time scales – generally the less frequent the event, the greater the intensity. Each natural hazard event is different, for example floods reaching a similar height may have different rates of rise and duration depending on the distribution and timing of the rainfall.

Some events can trigger subsequent hazards. For example, a cyclone can bring strong winds, heavy rainfall and storm surge, and trigger secondary hazards such as landslides and flooding.

Disasters and risk

A hazard becomes a disaster when natural hazard events intersect with people and things of value, and when the type, scale, severity or intensity of the impacts is beyond the capacity of the community or society to manage.[7]

Risk is about measuring how likely it is that a hazard will do harm or damage, and the extent of the consequences. The risk varies across the State depending on the extent of the natural hazard as well as where the people of NSW live and work.

Natural hazards in this Plan[8]

This Plan has a greater focus on the following natural hazards due to the higher level of information available:

Floods | Storms and cyclones | Coastal hazards (erosion and inundation)[9] | Bush fires

The below hazards are also included in this Plan using the information available:

Heatwaves | Earthquakes | Landslides | Tornadoes

Tsunamis

There are some other significant disaster risks that have not been included, for example slow-onset disasters such as drought. Various drought preparedness measures are being progressed across NSW government agencies.[10]

Other hazards, such as cyber-attacks and biosecurity, are not detailed in this Plan. These may be considered as part of options assessed to increase infrastructure resilience or other relevant tools as part of the disaster adaptation planning.

The major focus of this Plan is risk reduction through strategic land use planning which is most relevant to reducing natural hazard risk exposure. Actions to reduce non-natural and other hazard risks do not often relate to land use planning.

Tumburumba township during Black Summer Fires January 2020. Photo by Rebekah Pholi

Hazard risk assessment

To understand the drivers of our highest natural hazard risk, and to guide where we focus our response, a multi-hazard, technical risk assessment was undertaken. Risk was measured across 4 environments – the built, natural, social, and economic. It assessed the risk now and into the future, incorporating climate change and projected population growth to 2040, 2060 and 2090.[11] This provided an understanding of the consequence of the natural hazards, that is the **natural hazard risk** on people, homes, livelihoods, infrastructure, ecosystems and communities and how the existing risk may change in the future.

This approach was guided by the international and national frameworks for disaster risk reduction with consideration of international standards (ISO31000)[12] which provides a set of principles and guidelines for a risk management framework. This assessment was limited by the available information and metrics to quantify impacts across the social, natural, and broader economic environments. Therefore, this Plan focuses on the results for the built environment which are easier to measure and quantify due to the more direct and sizeable impacts. In addition, a summary has been included on the top 3 LGAs with the highest risks in the social, natural and economic environments for the hazards considered in the multi-hazard risk assessment.

For results in the built environment, the standard metric used by the insurance industry and financial markets was applied: average annual loss.

> The Average Annual Loss (AAL) is the expected or average cost of damage to property and infrastructure arising from all occurrences or probabilities of a given natural hazard in any 1 year. It is calculated for each hazard and quantifies the expected or average yearly damage to the built environment, which spans residential and commercial property, industrial facilities and infrastructure. While this metric is weighted to the built environment it is a useful way to compare the likely impact across different natural hazards.

For this Plan this is defined as the expected cost of the damage to the built environment (such as property and infrastructure) caused by future natural hazards and provides a useful way to compare changes in risk across different hazards. Hazards which may show lower average annual losses can still have significant impacts on local communities and the natural environment. The importance of these broader impacts to the social, natural, and broader economic environments should not be diminished, and further work is needed to better quantify these. It will be important to agree on repeatable metrics for these environments for ongoing risk assessments.

The following section summarises information for each hazard including:

- its potential impacts
- areas where the current hazard is concentrated across NSW
- maps on the risk profile for the built environment for all hazards considered in the risk assessment (excludes tsunami, landslide, and heatwave)
- some information on the risk to the social, natural and economic environments
- a summary of how each hazard and risk profile is expected to change in the future.

In the multi-hazard risk assessment, climate change was represented through 3 greenhouse gas (GHG) emissions scenarios as defined by the Intergovernmental Panel on Climate Change (IPCC). These scenarios represent plausible GHG emissions trajectories – lower (RCP 2.6), intermediate (RCP4.5), and high (RCP 8.5). Results are presented for a 2060 high emissions scenario. This scenario is a reasonable time for climate change to be realised and after this point, population projections become less certain. In addition, at this point there is a notable increase in the average frequency, intensity, and severity of the hazards.[13]

It is important to note this risk assessment does not consider shorter term and seasonal risk for natural hazards. This is the remit of the Bureau of Meteorology in terms of weather predictions and for the emergency management sector to assess and respond. For example, in September 2023 the Bureau declared that El Niño and a positive Indian Ocean Dipole (IOD) were underway. These 2 climate drivers lead to more likely warmer and drier conditions over spring and summer for parts of Australia. This has implications for increased short term bush fire risk. For example, the Rural Fire Service (RFS) has identified there is a significant risk of large and destructive grass fires this 23/24 season. This ongoing, seasonal assessment of risk is standard practice for the emergency management sector. Therefore, the technical risk assessment undertaken for this Plan has a longer-term perspective and may account for differences between what has been considered in the short term. In NSW, Bush Fire Management Committees develop a Bush Fire Risk Management Plan to consider the current risk of bush fires at a local level and develop a register to mitigate the highest risks as required under section 52 of the *Rural Fires Act 1997*.

Bush fire

Bush fire is a term for unplanned vegetation fires including grass fires, forest fires and scrub fires. They can be started naturally by occurrences such as lightning strikes, or by people, either accidentally or on purpose.

Fire has been managed in Australia since Aboriginal people first used it in cooking, ceremonies, hunting, to promote forest resources and as a land management tool. Over many thousands of years Aboriginal people have developed a refined knowledge of fire and it is used to manage Country and for other purposes to this day.[14]

Fire management practices have changed significantly since European settlement. Land use changes such as industrialisation, agriculture and protected areas have altered not only the underlying fuel conditions for bush fires, but also fire regimes.[17]

> While there are many thousands of bush fires recorded in NSW each year, the area they affect varies greatly between years. Over the last 100 years there have been 10 bush fire seasons in NSW that have burnt over 1 million hectares.[15,16]

A bush fire burning on the South Coast of NSW

Bush fire hazard

The factors affecting the frequency, intensity and the extent (i.e. the hazard they present) of bush fires are shown in Table 1.

Table 1. Factors affecting bush fire hazard (frequency, intensity and extent)

Fuel (vegetation) conditions	Weather conditions
> Type of fuel available e.g. leaf litter, bark, shrubs, trees	> Temperature
> Volume of fuel	> Humidity
> Dryness of fuel	> Recent rainfall
> Fuel height and breadth	> Winds

Bush fire hazard in NSW is greatest along the coast where there are large amounts of fuel that is more combustible, such as eucalypt forests, compared with inland areas or areas which are dominated by grasslands and open woodlands. Bush fire hazard varies according to seasonality and between years due to changes in fuel and weather conditions.
In NSW, the bush fire danger season is spring to summer however bush fires can occur at any time of year. The map below shows bush fire prone land which is used as the trigger for planning for bush fire protection and provides an indication of the bush fire hazard distribution. This is highest in areas with large amounts of bushland.

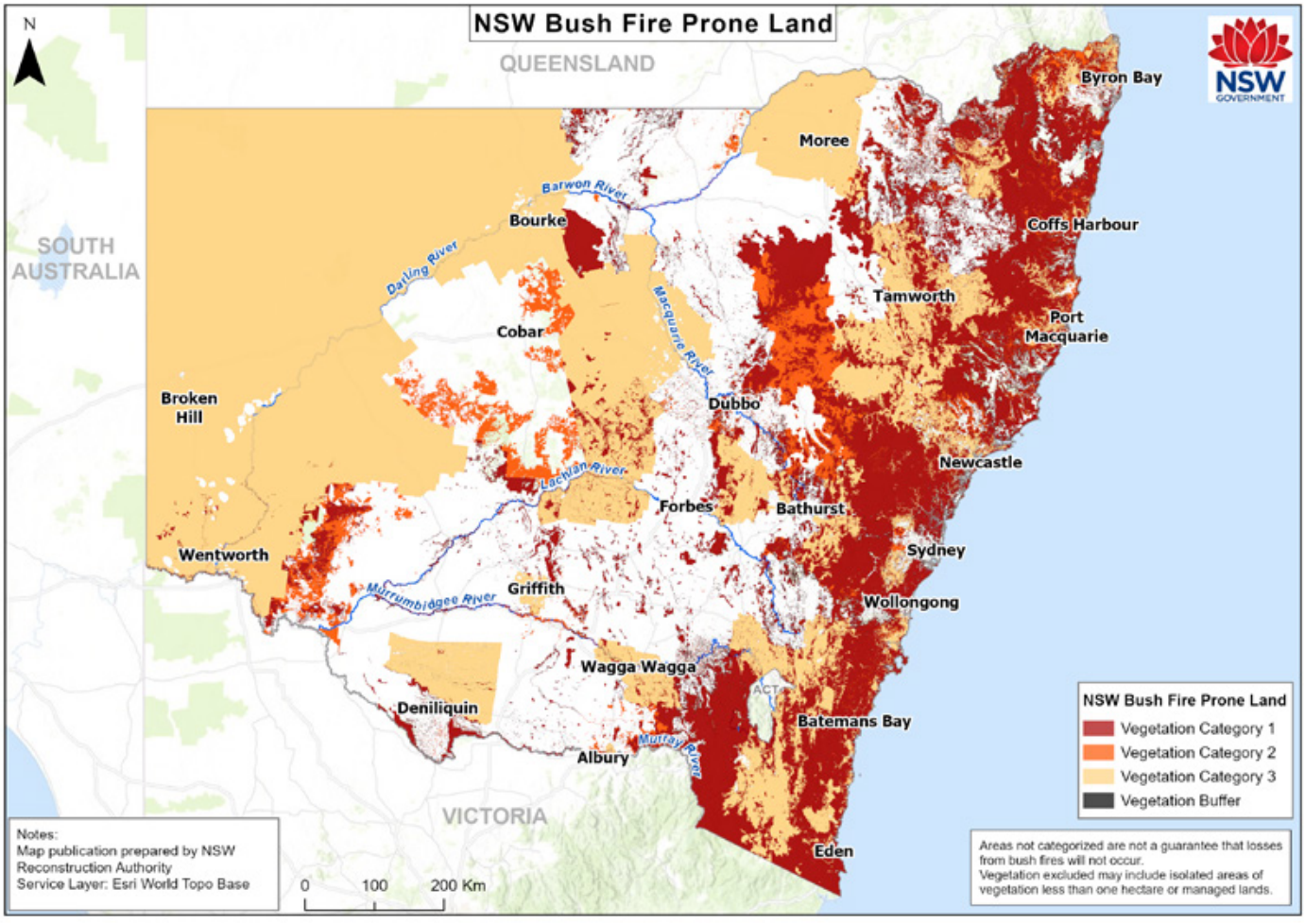


Figure 6. NSW map of bush fire-prone land (vegetation category 1 presents highest hazard). Source: RFS[18]

Bush fire impacts and risk

Bush fire hazard and bush fire risk are two different things. We have described bush fire hazard earlier. However, the areas with the highest risk can differ from those with the highest hazard because risk is measured by the exposure and vulnerability of people, their homes, livelihoods and infrastructure.

Bush fires have a range of potential impacts across the built, social, economic and natural environments, outlined in Figure 7 below. These impacts could include loss of life and extensive destruction of property, livestock, crops, and infrastructure. Not all impacts from bush fires are negative. Many ecosystems require fire or smoke for growth, germination or reproduction.

Bush fires can have other secondary impacts which can cause harm or even death. Air pollution from smoke can cause major health issues and death (due to cardiorespiratory problems) and exacerbate asthma. Bush fires can cause water pollution and landslides because they kill off stabilising vegetation and can lead to thunderstorms and tornadoes due to cloud build up.[19, 20]

Overall risk (or more severe impacts) from bush fire is greatest on the fringes of cities where built up areas meet bush or grasslands, for example the Blue Mountains. Projected population growth coupled with more development closer to bushland fringes mean the risk to life and property will continue to increase.

Built

- Damage or destruction of buildings, including homes and businesses
- Damage or destruction of essential infrastructure including power, water, sewerage, communications and transport networks
- Damage or destruction of Aboriginal cultural heritage sites
- Damage or destruction of social and community infrastructure, such as schools and national parks
- Damage or destruction to cultural heritage

Social

- Loss of life, injuries from building collapse or tree falls
- Severe health impacts from air pollution resulting from bush fire smoke, particularly for those with pre-existing health conditions such as asthma
- Displacement from homes and communities
- Mental health stress
- Disruption to essential services such as food, water, energy, communications and supply chains
- Contamination of water supply if bush fires occur in water supply catchments
- Can lead to crimes such as theft or looting of impacted communities and domestic and family violence due to psychological stress

Economic

- Damage to crops, death or injury to livestock, loss of plant or machinery impacting agricultural and forestry industries, resulting in shortages and price increases
- Business disruption due to loss of essential services
- Increased cost of insurance premiums
- Decline in local economies as a result of closures due to damage
- Demand surge following the event due to building repairs and reconstruction
- Lost productivity due to health impacts

Natural

- Death or injury of native wildlife and loss of habitat
- Carbon release contributes to climate change
- Benefits to native flora dependent on fire/smoke for germination
- Air pollution from smoke and soil salinity
- Water pollution from runoff containing ash, soil and sediment
- Changes to the natural intensity and frequency of fires can alter natural ecosystems and habitat
- Increased soil erosion
- Can compound the impacts of weeds and feral animals on native species

Figure 7. Impacts of bush fires[21]

The worst recorded fires in NSW were the Black Summer bush fires in 2019-20. 26 people died, around 50,000 head of livestock was lost as well as crops and infrastructure. A summary of the impacts of the Black Summer fires can be found in Figure 8.

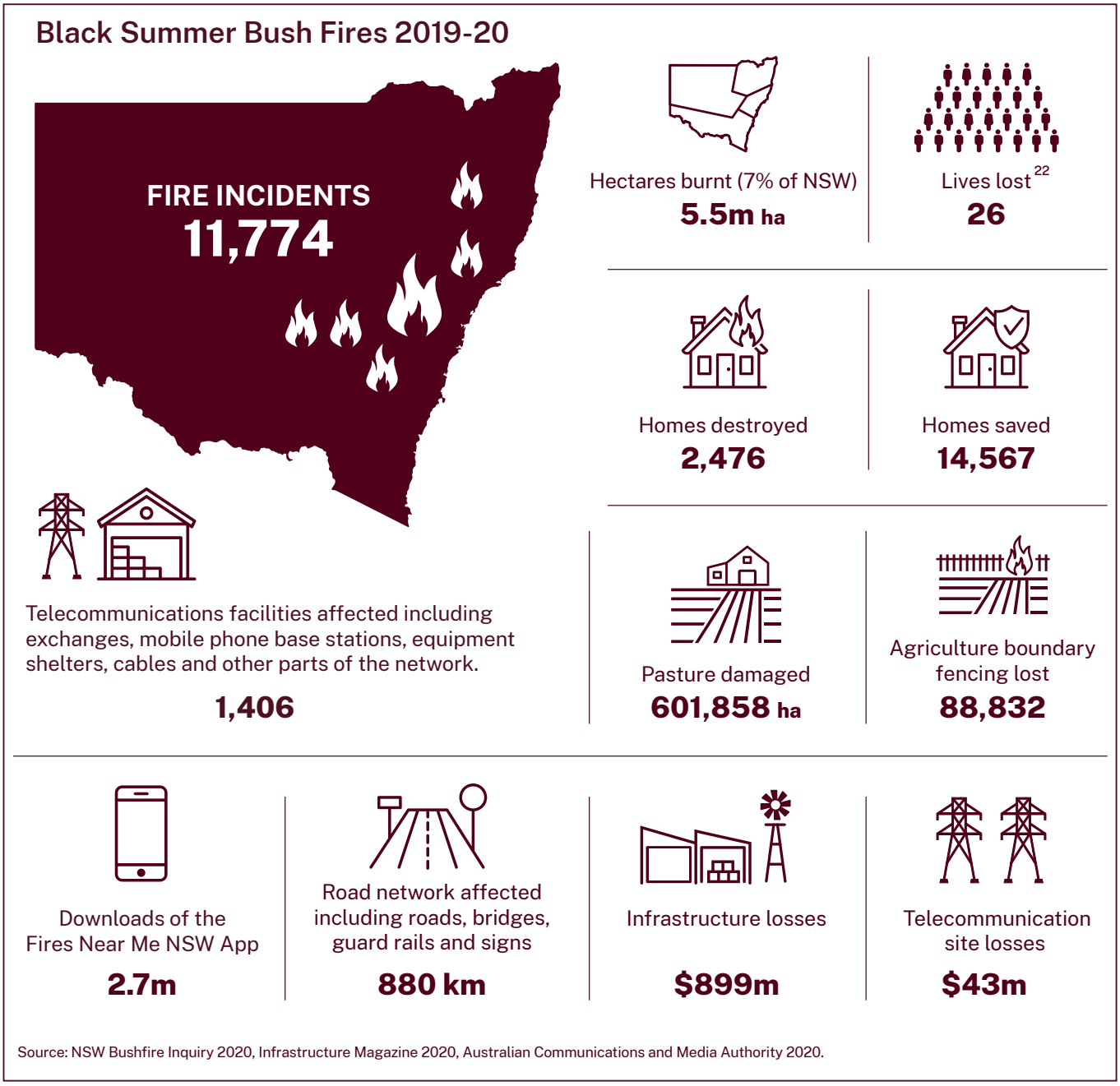


Figure 8. Black Summer bush fires

Bush Fire Management Committees made up of fire agencies, land managers and other key local stakeholders develop a Bush Fire Risk Management Plan (BFRMP). A BFRMP is a strategic document that identifies community assets and values that may be at risk from bush fire and identifies coordinated multi-agency objectives and associated treatment strategies to reduce the risk over a 5 year period. Treatment may include such actions as hazard reduction burning, mechanical clearing, targeted community engagement programs and ignition prevention activities. There are a range of other actions that the RFS manages such as Asset Protection Zones and fire trails. These actions are not included in detail in this Plan. See RFS website for more information.

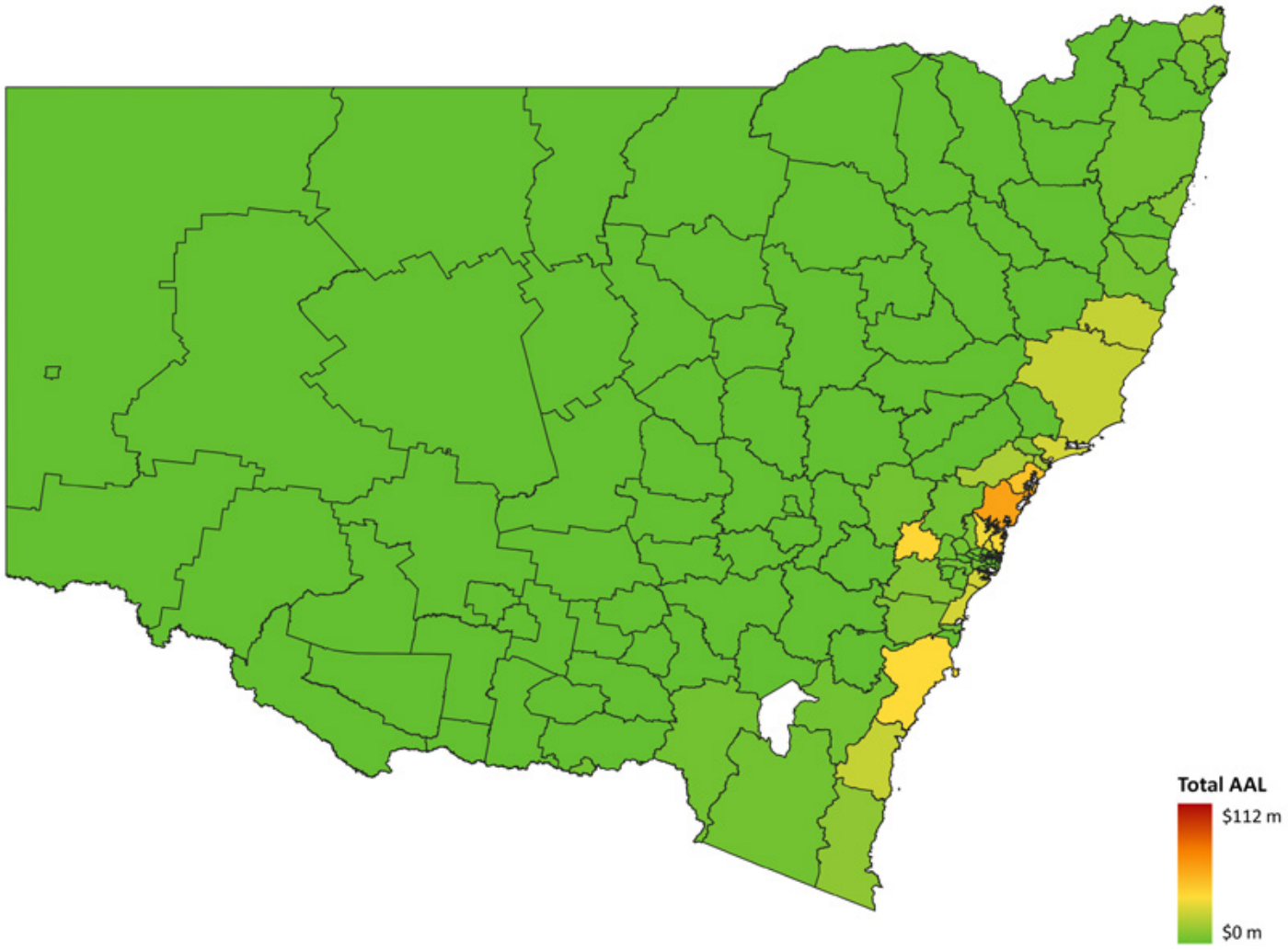


Figure 9. Bush fire AALs for the built environment 2023

In 2023:

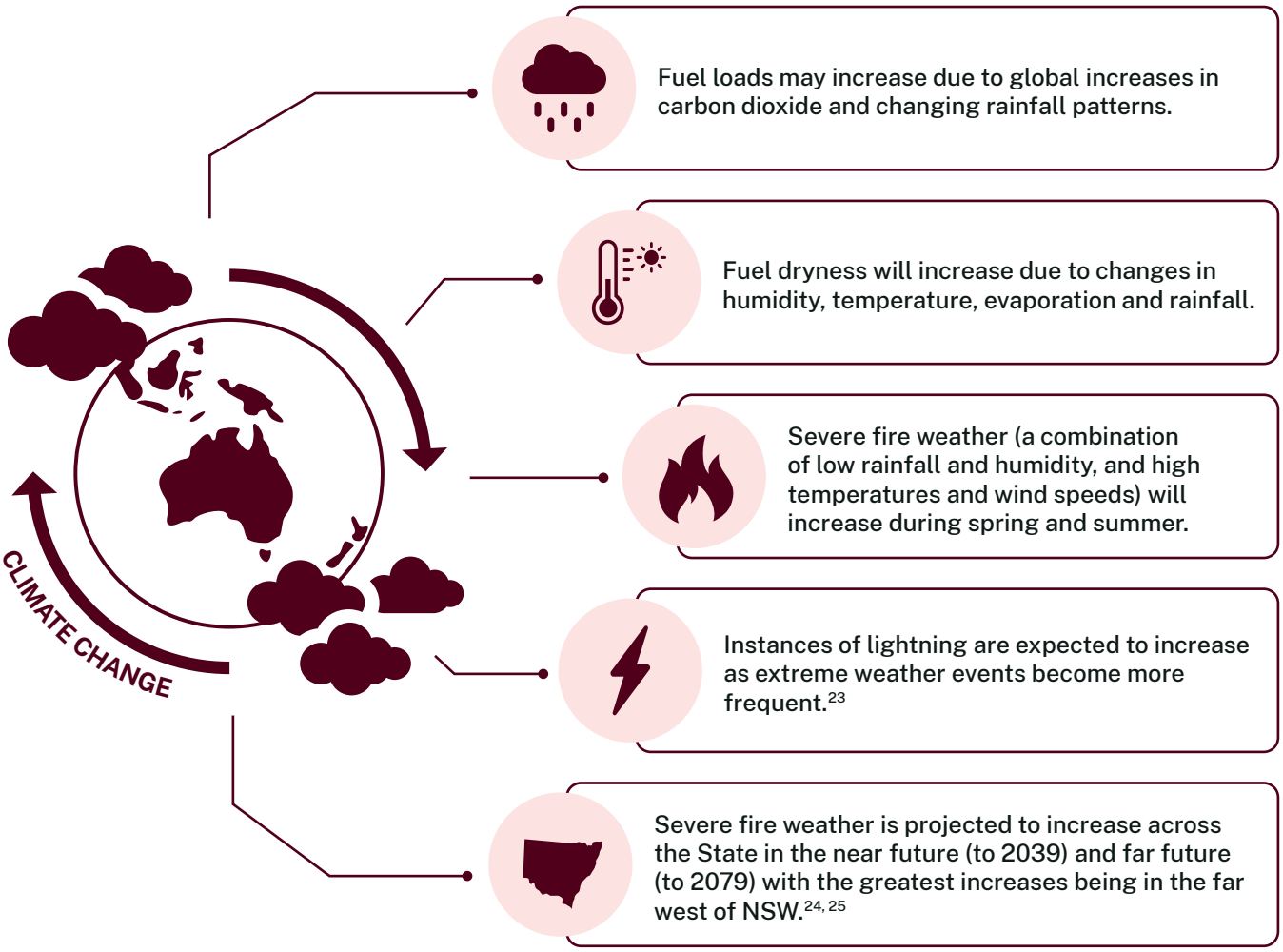
- The top 3 LGAs with the highest **bush fire hazard** are the Blue Mountains, Eurobodalla and Central Coast.
- The top 3 LGAs where the highest **bush fire risk** to the built environment are the Central Coast, Lake Macquarie, and Blue Mountains. While Eurobodalla has a higher hazard, Lake Macquarie has a higher bush fire risk due to the greater number of properties and assets exposed to the hazard.
- The top 3 LGAs with the highest bush fire risk in the social, economic and natural environment are:

Social environment	Economic environment	Natural environment
> Eurobodalla	> Carrathool	> Blue Mountains
> Blue Mountains	> Murrumbidgee	> Eurobodalla
> Bega Valley	> Upper Lachlan Shire	> Shoalhaven

How will climate change affect bush fires?

The expected impact of climate change on the bush fire hazard is mainly associated with changes to the vegetation /fuel loads and varying weather patterns particularly under medium and high emission scenarios. It may also reduce windows for hazard reduction burns.

While research is ongoing into the complicated relationship between climate change and bush fire, projections generally indicate that:



Expected changes to the bush fire hazard associated with a 2060 high emissions climate change scenario, as well as population growth closer to bushland fringes, will increase the risk to life and property.

Under a 2060 high emissions climate change scenario:

- The top 3 LGAs with the highest **bush fire hazard** are the Blue Mountains and the Eurobodalla and Central Coast, the same as 2023.
- The LGAs with the highest **bush fire risk** to the built environment change to the Central Coast, Lake Macquarie and the Blue Mountains because of expected population growth closer to bushland fringes. This will increase the risk to life and property unless managed.
- In general, climate change represents a greater driver to future risk than projected population growth for bush fire across the State.

Floods

Flooding occurs when water extends over what is usually dry land due to an overflow of water beyond the normal limits of a watercourse. It can happen when water is released from a reservoir, canal or dam, particularly if flows in rivers and creeks are already high. Flooding can also occur when rainfall is so intense that overland flows cause flooding of buildings, infrastructure and the land itself.

Floods can be described in terms of their heights, depths and extents. A 'flood peak' is the highest height observed during a flood event at a specified site on the river or floodplain. The severity of a river flood is determined by the intensity, frequency and duration of rainfall in the river's catchment area.

Often floods are referred to using the likelihood or chance of different sized floods occurring in any 1 year. This can be expressed as a percentage. A 1% annual exceedance probability (AEP) is a flood that has a 1% chance of being equalled or exceeded in any 1 year.[26]

The main types of flooding experienced in NSW are:

- **Flash flooding** – the result of intense local rain and is characterised by rapid rises in water levels when natural or artificial drainage systems are overwhelmed. The Bureau of Meteorology defines flash flooding as occurring within about 6 hours of rain[27] although flash floods can occur far more rapidly depending on the intensity of the rainfall and the nature of the catchment.
- **Riverine flooding** – inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.[28]
- **Local overland flooding** – inundation by local runoff caused by heavy rain. The duration of overland flooding is generally short, lasting only hours. The impact of this type of flooding may be significant in urban areas that may not be subject to riverine flooding.
- **Dam failure flooding** – rare but can have catastrophic impacts. The flood waters from dam failure can be fast rising with very high velocities and depths.[29] Where dam failure occurs during a severe flood, areas downstream of dams may already be flood affected, leading to compounding impacts.

South Creek flooding, Dunheved Road (10 February 2020). Photo by Adam Hollingworth

Flood hazard

Table 2. Factors describing flood hazard

Factor	Affect
Flood depth and height	The distribution and intensity of rainfall patterns determine the relative contributions of flow input to the river system. The rate of flow and the volume drives the height and depth of the flood.
Flood velocity	The faster the speed at which the water flows the greater the potential damage to assets and risk to people.
Rate of water rising	The faster the flood waters rise, the less time there is for adequate warning and evacuation.
Duration	The longer the flood waters stay high, the greater the disruption to daily life for those affected and potential for increased damage.
Extent	The extent of the flood waters is one factor that influences the level of impact. Floods with a large extent can have broad scale impacts whereas floods with a confined extent can have a greater risk to life due to concentrated, higher and faster rising floodwater.

Riverine flood **hazard** in NSW is greatest around coastal river systems including the Northern Rivers region of northern NSW and LGAs in the Hawkesbury-Nepean Valley to the west and northwest of Sydney as shown in Figure 10.

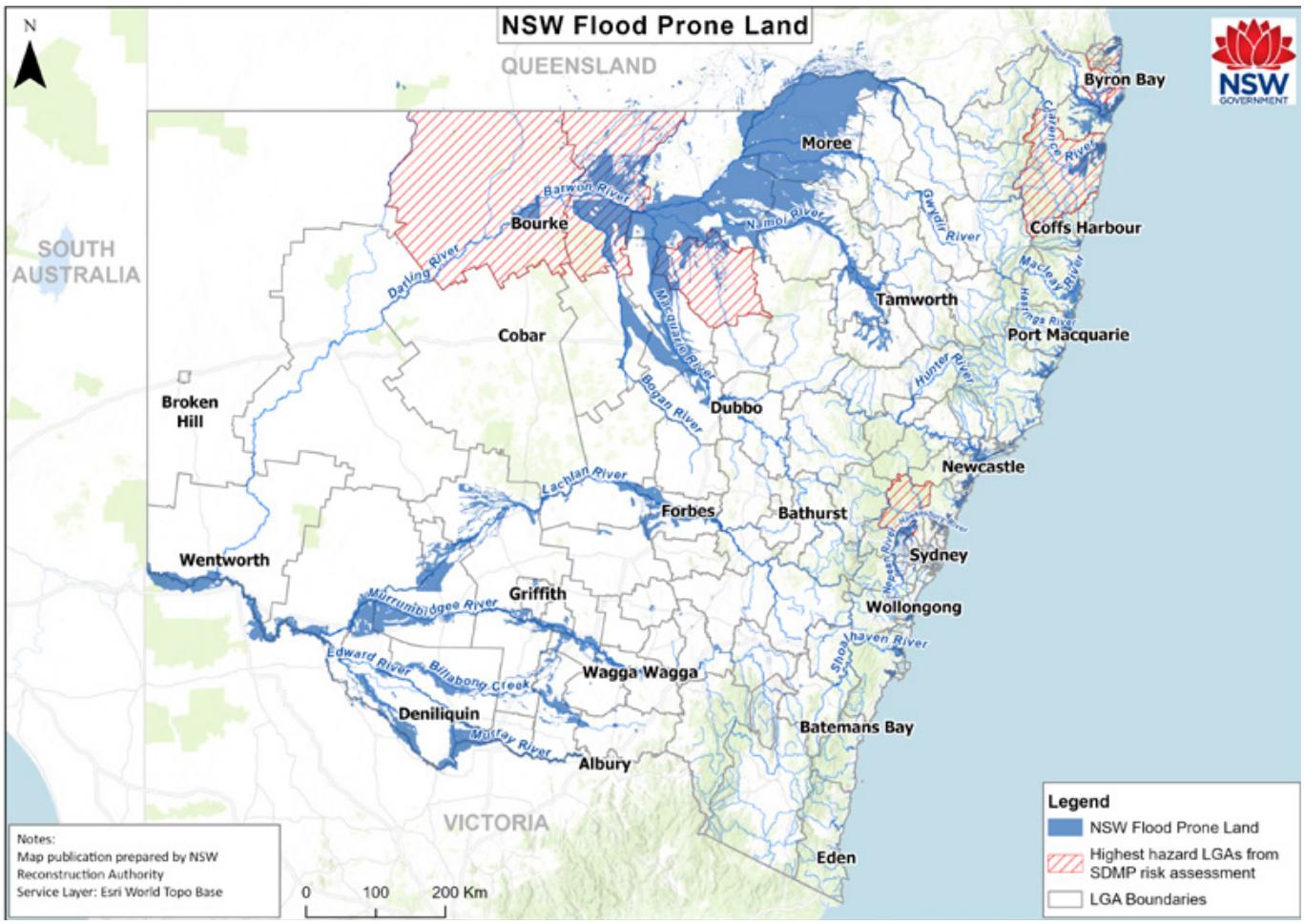


Figure 10. Map of flood prone land in NSW by LGA. Source: Department of Planning and Environment (2023)

Northern Rivers clean-up, February 2022

Flood impacts and risk

Flooding events can have devastating impacts for communities, businesses and the economy. Impacts of floods are summarised in Figure 11.

Between 1900 and 2022 there have been 950 flood events in NSW resulting in 736 lives lost, 5,066 injuries and 3,596 homes lost.[30] NSW has suffered losses of over $11.8 billion in 2022 dollars as a result of flood events between 1967 and 2022.[31]

Built

- Damage to housing and property – internal and external including contents
- Damage to transport infrastructure, roads, bridges, railways
- Loss of business and commercial assets in both urban and rural areas
- Outages and damage to telecommunications, electricity and gas supply networks
- Damage to sewerage and water services
- Damage to public assets and facilities
- Damage to motor vehicles
- Damage to cultural heritage

Social

- Deaths and injuries
- Loss of social and cultural sites
- Personal loss of memorabilia
- Mental distress
- Can lead to crimes such as theft or looting of impacted communities and domestic and family violence due to psychological stress

Economic

- Harm to crops and livestock
- Loss of productivity
- Disruption to supply chains

Natural

- Soil erosion
- Estuarine inundation and damage to unique ecosystems including seagrass, soft sediments, mangroves and saltmarsh
- Impacts to estuarine and riverine breeding habitats for marine and land species
- Riverbank erosion and destabilisation
- Regrowth of weeds
- Changes to river flow
- Water pollution impact to drinking water in some catchments
- Death and injury to wildlife
- Landslides
- Blockages to rivers and waterways
- Water quality impacts from organic entrainment – hypoxic blackwater

Figure 11. Summary of potential flood impacts

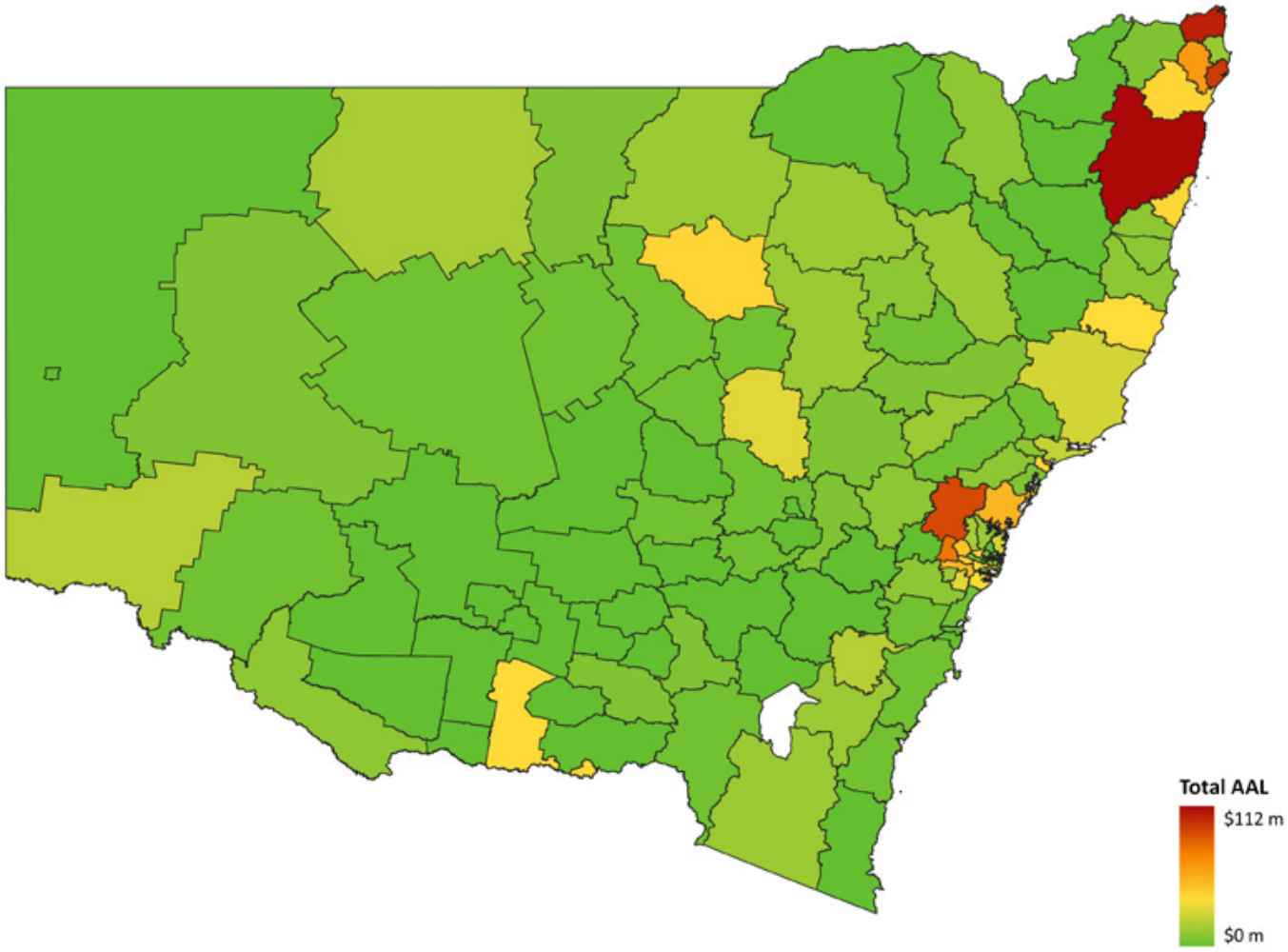


Figure 12. Flood AALs for the built environment 2023

In 2023:

- The LGAs with the highest **flood hazard** are the Hawkesbury, equal for Clarence Valley, Ballina and Coonamble.
- The LGAs with the highest **flood risk** to the built environment are the Clarence Valley, Tweed and Ballina. While Coonamble has a higher flood hazard it has a lower flood risk than Tweed Valley due to the greater number of properties and assets exposed to the hazard in the Tweed Valley.
- The top 3 LGAs with the highest flood risk in the social, economic and natural environment are:

Social environment	Economic environment	Natural environment
> Coonamble	> Ballina	> Hawkesbury
> Clarence Valley	> Clarence Valley	> Clarence Valley
> Hawkesbury	> Lismore	> Coonamble

Across NSW there are a significant number of infrastructure assets that are at risk to flood hazard, outlined in Table 3 below. This information was based on analysis by the former Department of Planning and Environment (DPE) on exposure to flooding in the 1 in 100 AEP and Probable Maximum Flood events.

Table 3. Community critical infrastructure in NSW exposed to flooding, 2022. Source: Department of Planning and Environment

Category	Infrastructure	1 in 100 AEP [32]	PMF [33]
Emergency Services	Police Station	64	98
	SES Facility	54	81
	Ambulance Station	45	77
	Fire Station	203	298
	General Hospital	19	39
Community Services	Retirement Village/ Residential Care Facilities/ Community Home	207	328
	Medical Centre/ Integrated Health	81	224
	Local Government Chambers	37	57
Education	Schools (Primary and High)	274	461
	Special Schools	15	33
	Child Care Centre/ Preschool	43	97
	TAFE/ University	37	47
Utilities	Sewerage Works	103	151
	Pumping Station	58	75
	Filtration Plant	30	44
	Power Station	1	2
	Gas Facility	4	6

How will climate change affect floods?

The role of climate change on floods is not yet well understood however evidence suggests that climate change is contributing to an accelerated and more intense hydrological cycle.[34] For NSW, the floods are projected to increase in frequency along the coast of NSW with the progression of climate change. These factors include changes in daily rainfall and increased rainfall intensity, as a result of projected increases in mean and daily temperatures.[35]

In addition, the flood hazard in coastal rivers and estuaries will also increase as climate change causes sea levels to rise.

The 2023 NSW Flood Management Guideline notes that a present day 1 in 200 chance per year event may be roughly equivalent to the 1 in 100 chance per year event in 2050 (under RCP8.5), while a present day 1 in 500 chance per year may be roughly equivalent to the 1 in 100 chance per year event in 2090 (under RCP8.5).[36] This demonstrates that less frequent, larger floods may become more common with climate change.

Under a 2060 high emissions climate change scenario:

- The LGAs with the highest **flood hazard** are similar to 2023 with Clarence Valley having the highest flood hazard.
- The LGAs with the highest **flood risk** to the built environment shifts to Penrith, followed by the Clarence Valley and Tweed Valley. The shift to Penrith reflects the greater exposure of properties and assets exposed to riverine flood hazard.
- In general, climate change represents a greater driver to future risk than projected population growth for flood across the State.

Priority catchments identified in the NSW 2022 Independent Flood Inquiry

The NSW 2022 Flood Inquiry recommended that government prioritises efforts in all high-risk catchments in the State, including the Hawkesbury-Nepean, Georges, Wilsons and Tweed rivers, and this would be extended as soon as possible to other high-risk catchments including the Macleay, Richmond, Hunter, Clarence and Shoalhaven rivers.

The Inquiry focused on river catchments rather than individual LGAs. Unlike most natural hazards, flooding can be defined within the river valleys which can extend beyond the LGA boundaries. The risk assessment for this plan used LGAs as a common boundary for comparative assessment for a multi-hazard approach. This does not necessarily capture the cumulative risks across the catchments. Catchment boundaries will be used as the basis for defining flood hazard and risk in the next version of the multi-hazard risk assessment.

On a catchment basis, the Hawkesbury-Nepean Valley between Bents Basin and Brooklyn Bridge is covered mainly by the Penrith City Council, Hawkesbury City Council, The Hills Shire and Blacktown City Council, and continues to have the highest flood exposure in NSW.

Coastal hazards (erosion and inundation)

With 1,590 km of coastline,[37] NSW has diverse coastal landscapes including beaches, headlands, dunes, lagoons, lakes and estuaries. The coastline is continually being shaped by complex interactions between waves, tides, currents, weathering, erosion and sediment transport and deposition.

The NSW coastline is affected by **coastal inundation** and **coastal erosion**, caused by sea level rises and extreme weather events.[38] Extreme weather elevates coastal water levels and creates storm surge, wave runup and can transport sand offshore.

- **Coastal and tidal inundation** is the inundation of normally dry land caused by elevated coastal water levels which are above highest tide levels. Tidal inundation does not factor the impact of storms on water levels, while coastal inundation does. This Plan uses the term coastal inundation to refer to both coastal and tidal inundation, unless specified.
- **Coastal erosion** is when material is scoured from the coast and beach (such as sand) primarily due to wave action resulting from a severe weather event. Erosion during severe storms can result in movement of the beach and shoreline, landslide and subsidence. This Plan includes coastal recession in coastal erosion.

Coastal hazards, due to climate change and expected sea level rises, are an ongoing and continued risk for all coastal communities.

Coastal hazard

The types of coast most susceptible to coastal hazards are those made up of sandy beaches, dunes and cliffs on open coasts.

Erosion at Cronulla Beach, Sydney

Present exposure to coastal erosion is highest where concentrated development has occurred near erodible shores, particularly in Coffs Harbour, Central Coast and Northern Beaches LGAs as shown in Figure 13 to the right.[39] Exposure to coastal erosion is expected to increase in all coastal regions of NSW through the present century.

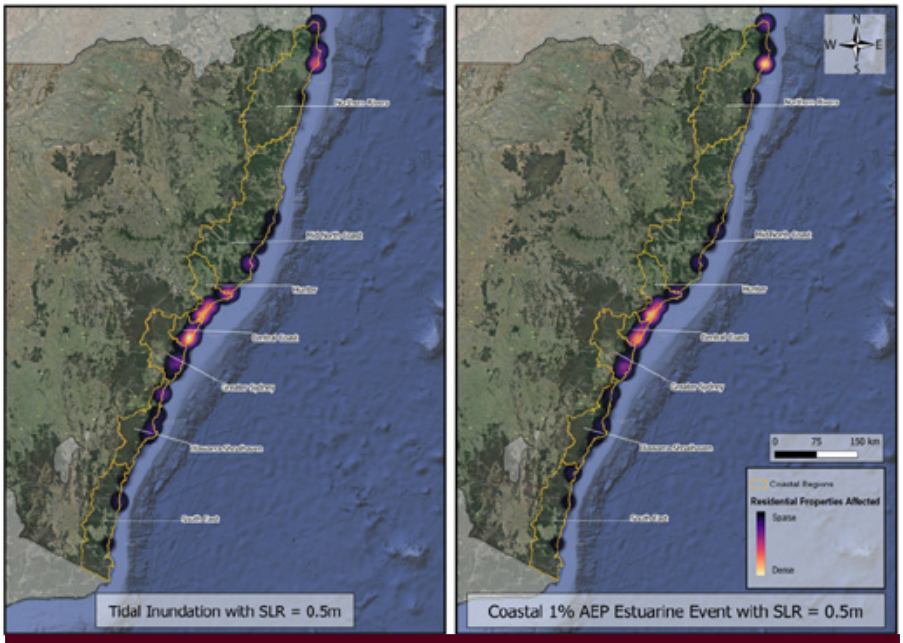


Figure 13. Heatmaps of current properties at risk of being affected by 0.5 metres of sea level rise due to tidal inundation on left, and coastal erosion (1% AEP coastal erosion event) with 0.5 metres of sea level rise on right

Coastal hazards impact and risk

Approximately 85% of the State's population resides within 50km of the coastline,[40] making it particularly vulnerable to the impacts of coastal inundation and erosion. The NSW coast provides the State with environmental, social, cultural and economic benefits. Given the importance of coastal areas, the impacts and losses from coastal hazards can be extreme. Secondary impacts can also be triggered, such as upstream riverine flooding and soil erosion. Impacts of coastal hazards are summarised in Figure 14.

Built

- Destruction and undermining of coastal houses and businesses
- Damage and/or loss to private property (land and housing)
- Damage and/or loss to infrastructure, public facilities e.g. roads, pathways, water and electricity, and amenities
- Damage to cultural heritage

Social

- Displacement from homes and communities due to building collapse or structural damage
- Reduction of social activity
- Mental distress
- Loss of Aboriginal culturally significant sites e.g. midden deposits
- Loss of life and injury, although rare

Economic

- Impact on tourism and recreation where environments become less attractive
- Potential to impact commercial fishing or shellfish farming enterprises
- Potential to impact on productivity and crops e.g. sugar cane

Natural

- Estuarine inundation and damage to unique ecosystems including seagrass, soft sediments, mangroves, and saltmarsh
- Impacts to estuarine and riverine breeding habitats for marine and land species
- Soil erosion and water pollution at beaches and in estuarine waterways
- Loss of beach amenity

Figure 14. Summary of potential impacts of coastal hazards

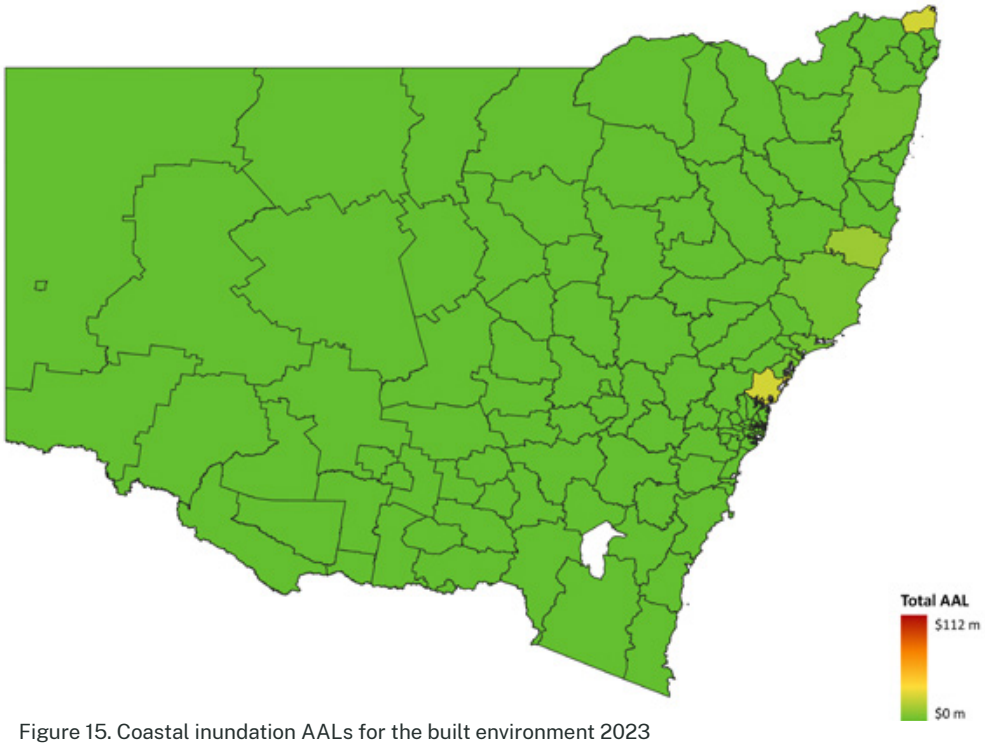


Figure 15. Coastal inundation AALs for the built environment 2023

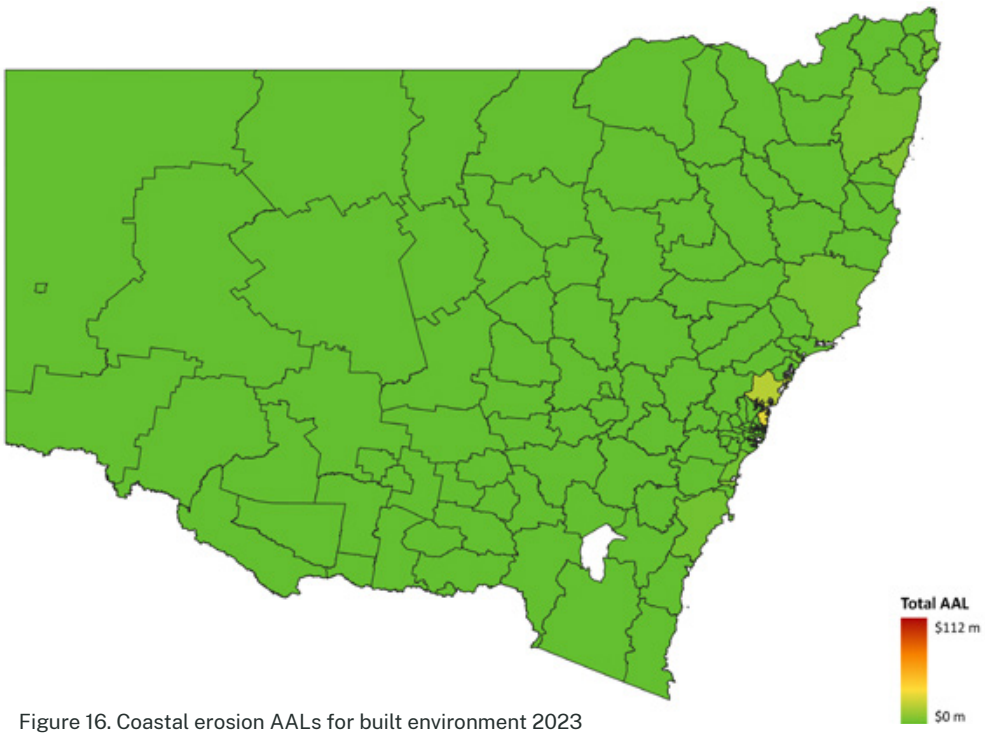


Figure 16. Coastal erosion AALs for built environment 2023

In 2023:

- The LGAs with the highest coastal hazard are Shellharbour, Newcastle and Port Stephens.
- The LGAs with the highest coastal risk to the built environment are the Central Coast, Northern Beaches and Tweed. This difference is due to a greater number of properties and assets exposed to the coastal hazard. This is the combined risk of coastal inundation (Figure 15) and coastal erosion (Figure 16).
- The LGAs with the highest coastal risk from coastal inundation to the built environment are Tweed, Central Coast and Port Macquarie-Hastings (Figure 15).
- The LGAs where the highest coastal risk from coastal erosion to the built environment are Northern Beaches, Central Coast and Shellharbour (Figure 16).

- The top 3 LGAs with the highest coastal hazard risk in the social, economic and natural environment are:

Social environment
> Shellharbour
> Mid-Coast
> Port Stephens

Economic environment
> Newcastle
> Ballina
> Wollongong

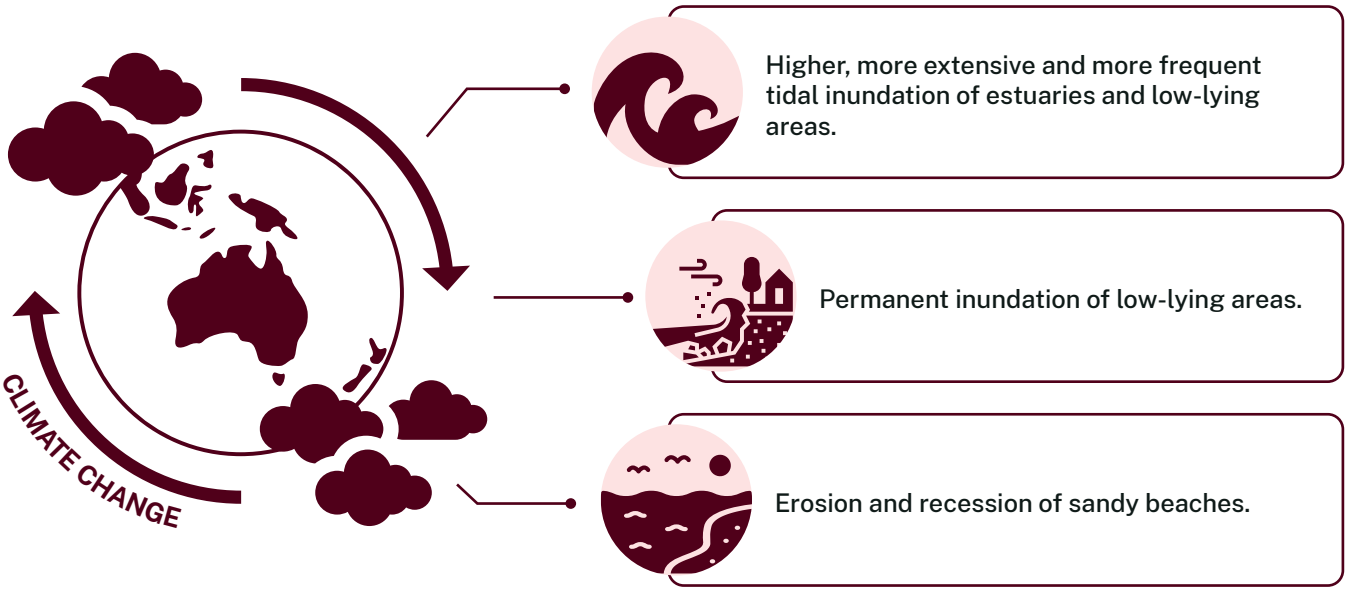
Natural environment
> Clarence Valley
> Mid-Coast
> Port Macquarie-Hastings[41]

How will climate change affect coastal hazards?

Coastal hazards will be exacerbated by climate change due to sea level rise and changes to rainfall run off and extreme weather events.

In its Sixth Assessment Report (2023) the Intergovernmental Panel on Climate Change (IPCC) has said its best estimate for the year 2030 is a global sea level rise of 18cm, although it could be as low as 8cm or as high as 29cm.[42] These predictions demonstrate the ongoing nature of coastal hazard risk.

Sea level rise is projected to exacerbate coastal hazards by causing:[43]



Under a 2060 high emissions climate change scenario:

- The LGAs with the highest coastal **hazard** will change to Port Macquarie-Hastings followed by Clarence Valley and Tweed.
- The LGAs with the highest coastal **risk** for the built environment will change to the Northern Beaches, Byron and Central Coast. This difference between the hazard and risk is due a greater number of properties and assets exposed to the coastal hazard.
- In general, climate change represents a greater driver to future risk than population growth for coastal hazard across the State.

Landslides

A landslide is the movement of a mass of rock, earth or debris down a slope.[44]

Landslides are triggered by extreme weather events or human activity:[45]

- Extreme weather triggers can include heavy rainfall, snowmelt, saturation of slope material, earthquakes, storms or undercutting of cliffs and banks from floodwater or rivers.
- Human activity triggers include vegetation removal, overgrazing, construction of roads, railways or buildings on steep terrain, blocked drainage, leaking pipes, digging slope modification for roads or development, mining activities and the displacement of rocks.

The most common trigger is intense rainfall, storms, and flooding. In NSW, landslides tend to be caused by heavy rain saturating the soil on a slope beyond the point that vegetation can support the weight of the soil against the force of gravity. This then causes the top saturated layer of soil to slide down the hill, taking with it whatever is in its path.[46]

Landslide hazard

The map below (Figure 17) indicates that most recorded landslides occurred on the East Coast of Australia, with a significant proportion occurring in NSW, on or east of the Great Dividing Range.[47]

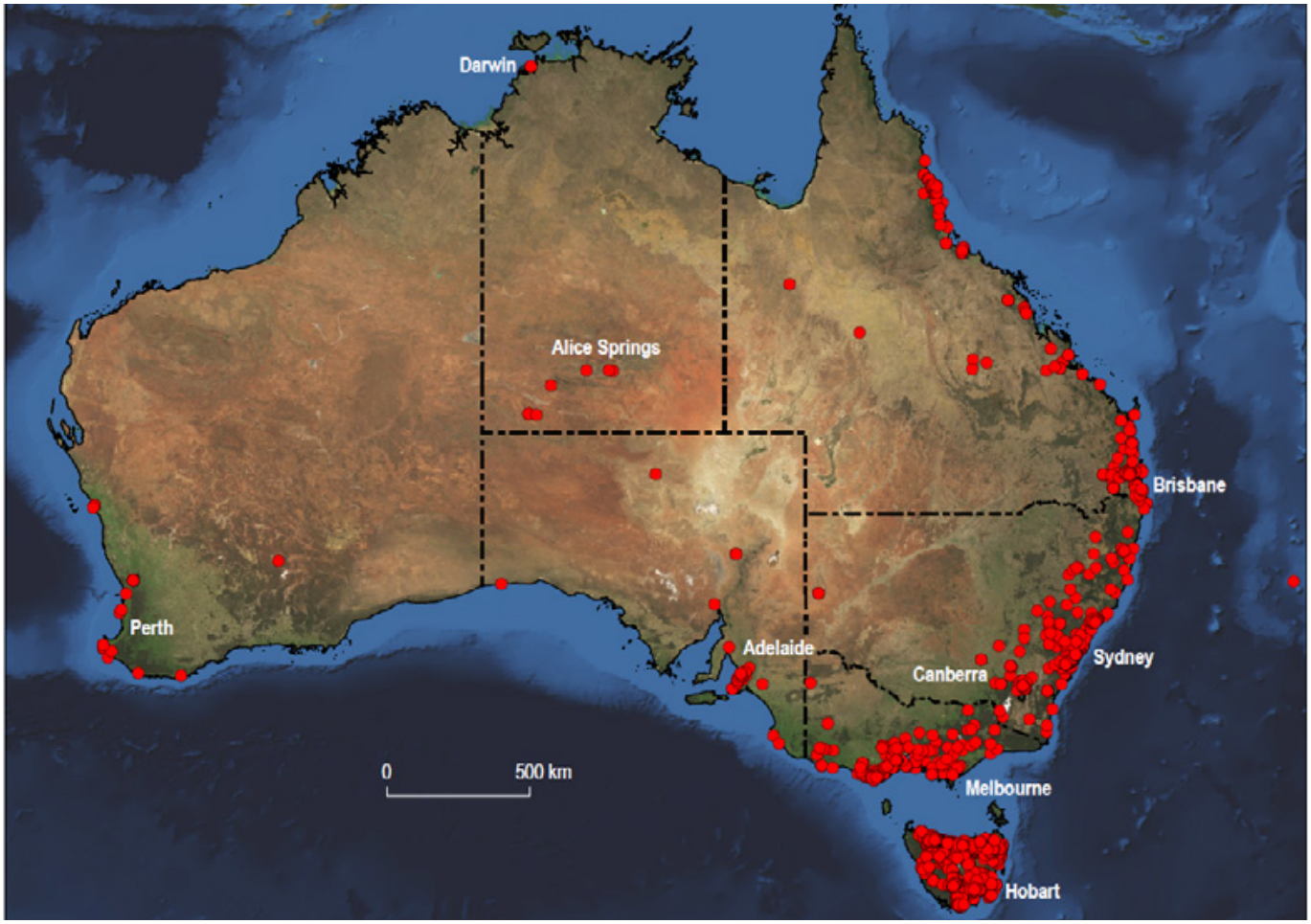


Figure 17. Recorded landslide events in Australia. Source: Geoscience Australia[48]

Landslide impacts and risks

Between 1900 and 2022 there have been 218 landslides in NSW, resulting in 46 deaths and another 46 injuries.[49]

The greatest public cost arising from landslides includes the costs to cover assistance and road maintenance, relocation and repairs.[50] A summary of the key impacts of landslides in Australia is included in Figure 18 below.

There is no consolidated Statewide understanding of future landslide risk, including geographical distribution. This means there is no information on the LGAs with the highest hazard and risk.

Built

- Damage to infrastructure and buildings
- Damage to transport infrastructure – roads and rail
- Damage to telecommunications, electrical and gas supply networks
- Damage to cultural heritage

Social

- Potential loss of life or injury
- Impact on recreational areas such as National Parks
- Loss of culturally important objects
- Adverse impacts on mental health

Economic

- Blocked waterways can impact the ability to farm livestock and crops
- Blocked roads can impact attendance at work and running of businesses where landslide impacts the only access

Natural

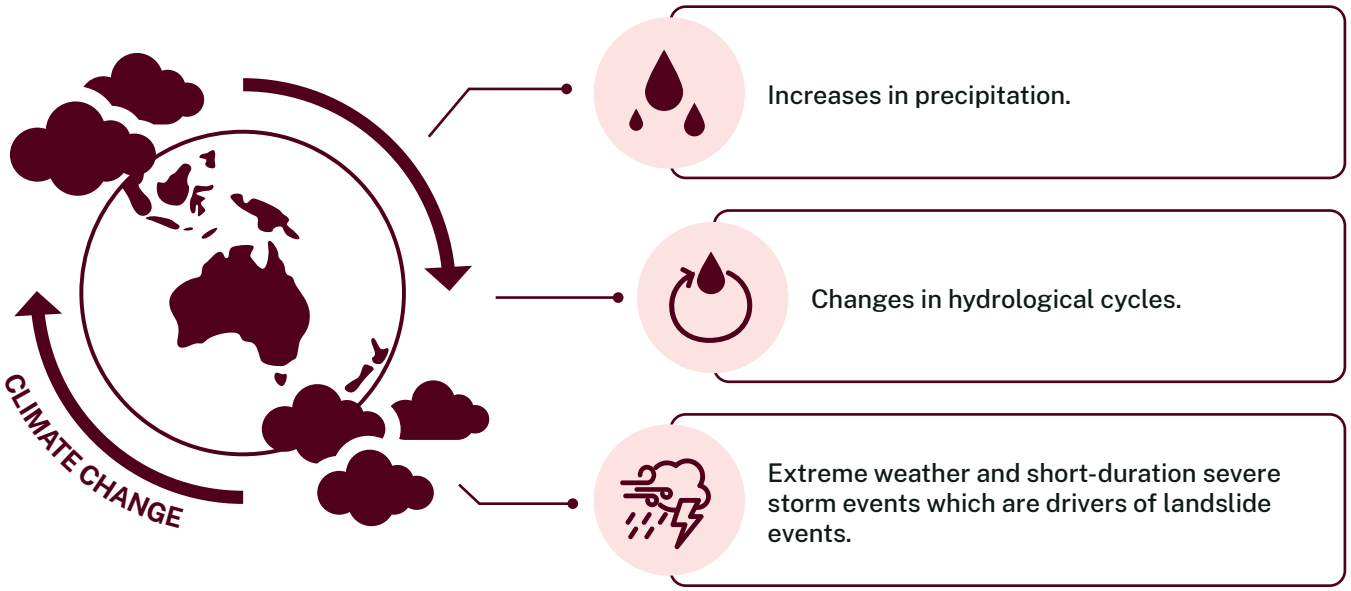
- Soil erosion
- Damage to land and loss of natural resources
- Blockages to rivers and waterways and water turbidity

Figure 18. Summary of potential impacts of landslides

How will climate change affect landslides?

Studies have observed a link between climate change and increasing occurrences of major landslides, globally.

This is due to climatic changes such as:[51]



Earthquakes

Earthquakes are vibrations caused by the sudden release of stress when rocks deep underground break and move along a fault line. While nowhere is immune from earthquakes, the largest and most frequent occur at tectonic plate boundaries where 2 plates are colliding. Large earthquakes can occur anywhere across the continent and with limited warning.[52]

Earthquake hazard

As NSW is not located near plate boundaries, earthquakes are not as common as in other parts of the world and do not follow easily recognisable patterns.

Earthquake hazard in NSW is higher toward the south of the State around the ACT and near the Victoria border – particularly LGAs of Yass Valley, Upper Lachlan Shire and Queanbeyan-Palerang Region.

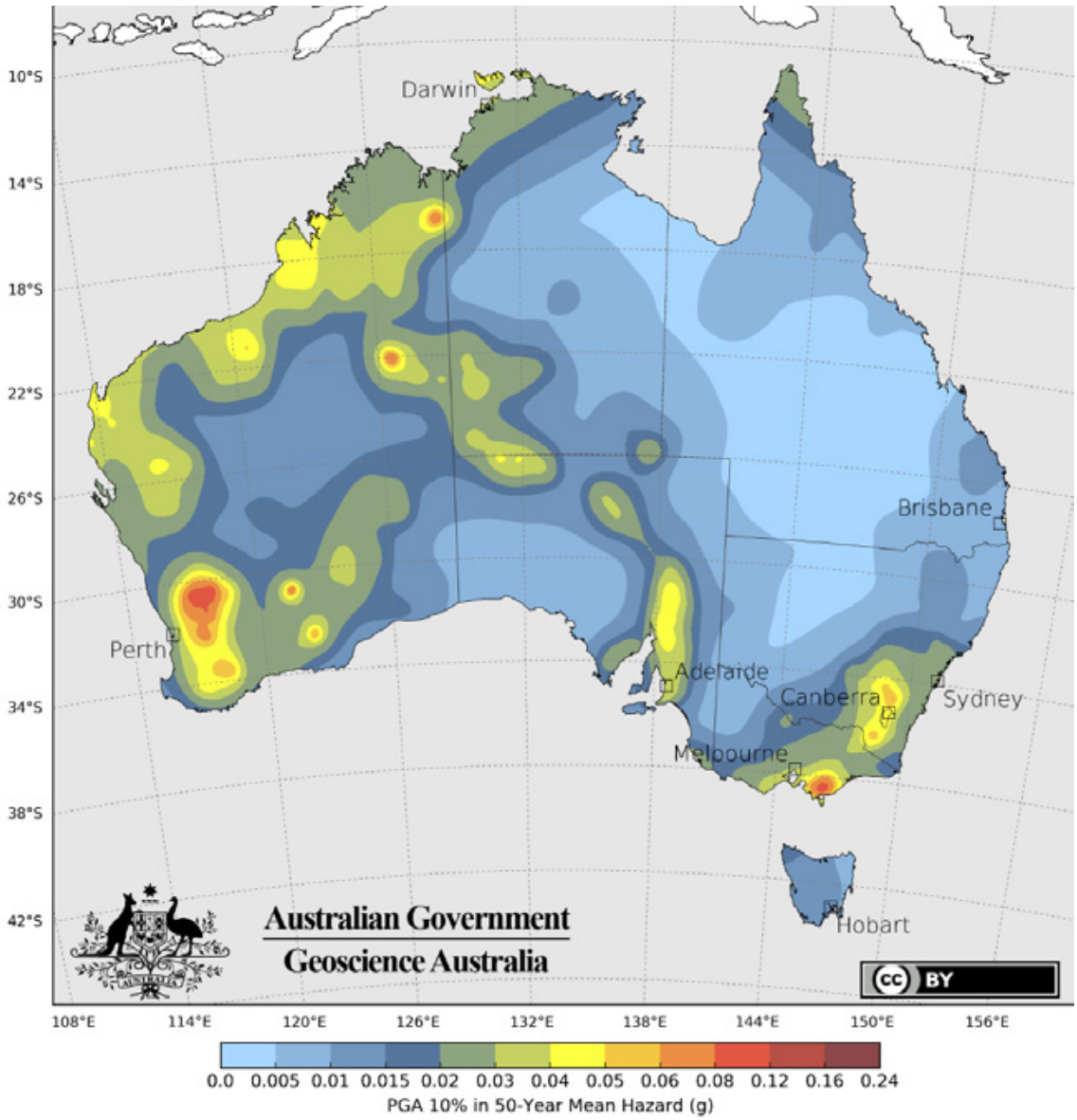


Figure 19. Hazard map showing the peak acceleration (PGA) levels across Australia for a 1 in 500 chance per year earthquakes. Source: Allen (2018)

> About 100 earthquakes of magnitude 3.0 or more are recorded in Australia each year.
> Earthquakes of magnitude 5.0 or more occur on average every 1-2 years.
> Earthquakes of magnitude 6.0 or more occur around every 10 years.[53]
> Over 5,000 earthquakes occured in NSW since records have been kept. However, only 17 of these earthquakes have been a magnitude 5.0 or greater.[54]

Source: Geoscience Australia

Earthquake impacts and risk

The impacts and losses associated with earthquakes depend on:

- magnitude
- depth
- proximity to populated and urban areas
- construction types
- quality of buildings and infrastructure.

A summary of the key impacts of earthquakes is included in Figure 20 below.

Built

> Building damage or collapse
> Damage to essential infrastructure including power supply, water, sewerage, communications and transport networks
> Secondary damage from fires caused by downed power lines or ruptured gas mains
> Damage to cultural heritage

Social

> Loss of life and injuries, generally due to building collapse
> Displacement from homes and communities due to building collapse or structural damage
> Mental health stress
> Disruption to essential services such as food, water, energy, communications and supply chains

Economic

> Business disruption due to loss of essential services
> Decline in local economies as a result of closures due to damage
> Demand surge following the event due to building repairs and reconstruction

Natural

> Ruptures and fissures – deformations or openings in the earth's surface
> Displacement of soil and/or rocks including landslides
> Liquefaction of soil in coastal, estuarine and riverine areas

Figure 20. Summary of impacts of earthquakes[55, 56]

Earthquakes can also trigger secondary hazards including tsunamis, bush fires and landslides.

In Australia, earthquakes with magnitudes less than 3.5 seldom cause damage, however, magnitude 4.0 earthquakes can topple chimneys or cause other building damage. To date, the smallest magnitude earthquake that is known to have caused fatalities was the 5.4 (MW) Newcastle earthquake of 1989.[57]

The earthquake causing the most damage in NSW was in December 1989 at Newcastle, with 13 deaths and $862 million in insured losses ($4.24 billion normalised to 2017 dollars).

Sources: Geoscience Australia,[58] Insurance Council of Australia[59]

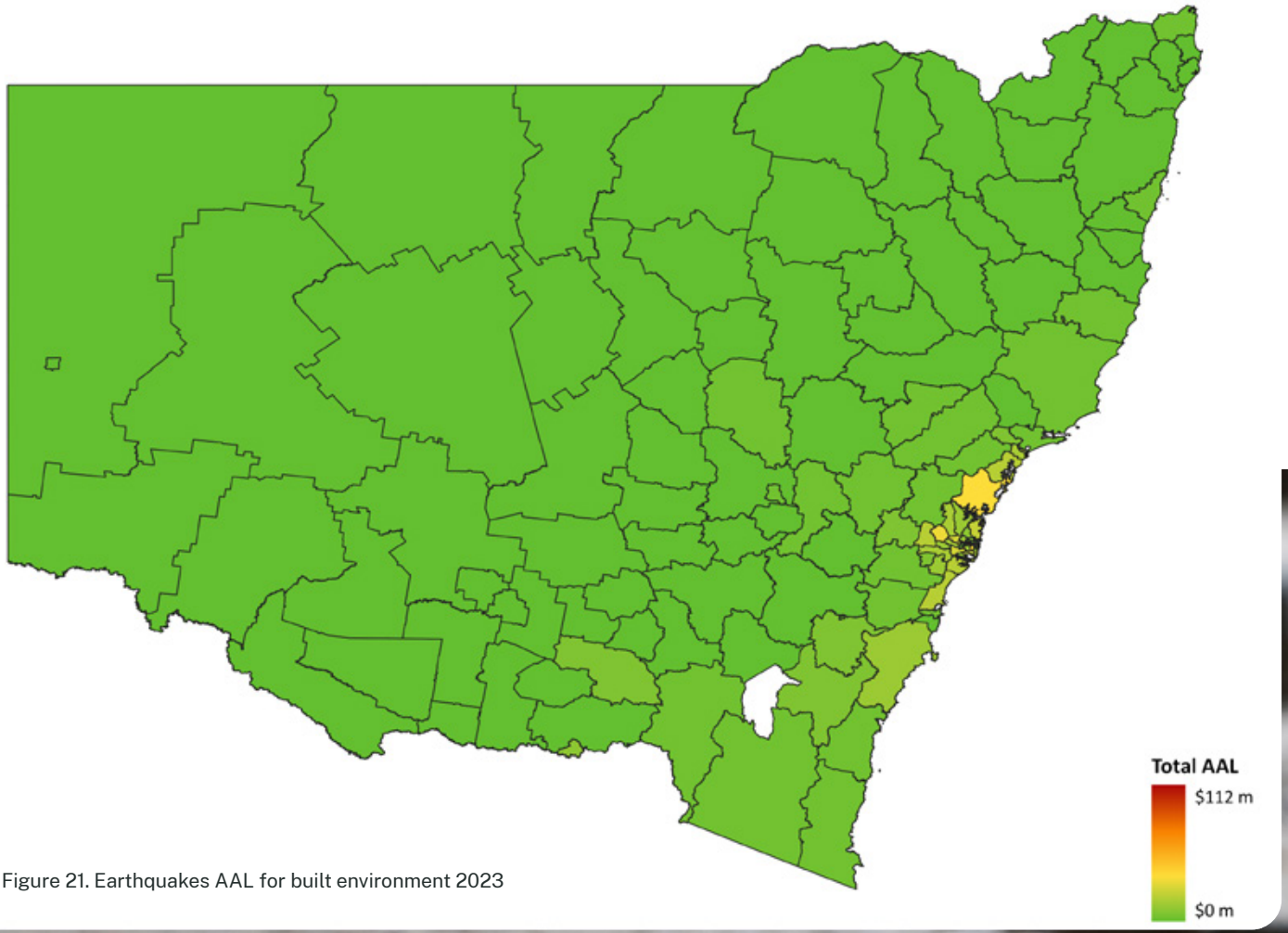


Figure 21. Earthquakes AAL for built environment 2023

In 2023:

- The LGAs with the highest earthquake risk to the built environment are Sydney, Central Coast and Blacktown.
- The top 3 LGAs with the highest earthquake risk in the social, economic and natural environment are:

Social environment	Economic environment	Natural environment
> Yass Valley	> Sydney	> Snowy Valleys
> Upper Lachlan Shire	> North Sydney	> Upper Lachlan Shire
> Weddin	> Ryde	> Snowy Monaro Regional

How will climate change affect earthquakes?

Long-term climate change does not affect earthquakes.

The steady growth in the NSW population increases the risk of damage to life and property should earthquakes occur. As populations and urban development becomes denser the risk to humans increases although by international standards earthquake hazard in NSW is low.

Under 2060 projected population, the top 3 LGAs where earthquakes have a future risk to the built environment change to Sydney, Parramatta and Blacktown.

Heatwaves

A heatwave occurs when the maximum and minimum temperatures are unusually hot for at least 3 days, compared to the area's regular conditions.[60] The temperatures for heatwaves vary across NSW and depend on the time of year, recent weather and local climate.[61]

> There have been 83 heatwave events in NSW since 1900 resulting in the loss of at least 465 lives.[62]

Based on historical records in NSW, heatwaves have increased in intensity, duration, and frequency.[63] Generally heat extremes are more likely to occur in the western parts of NSW. Further, heat island effects can be significant in urban areas as experienced in western Sydney.[64]

Heatwave hazard

Heatwave hazard is highest in inland regions of NSW, where higher temperatures and relative humidity result in high wet bulb globe temperatures.[65]

NSW hazard scores for heat stress are shown in Figure 22 below.

Note: heat stress assessment was not conducted for the built environment due to data limitations.

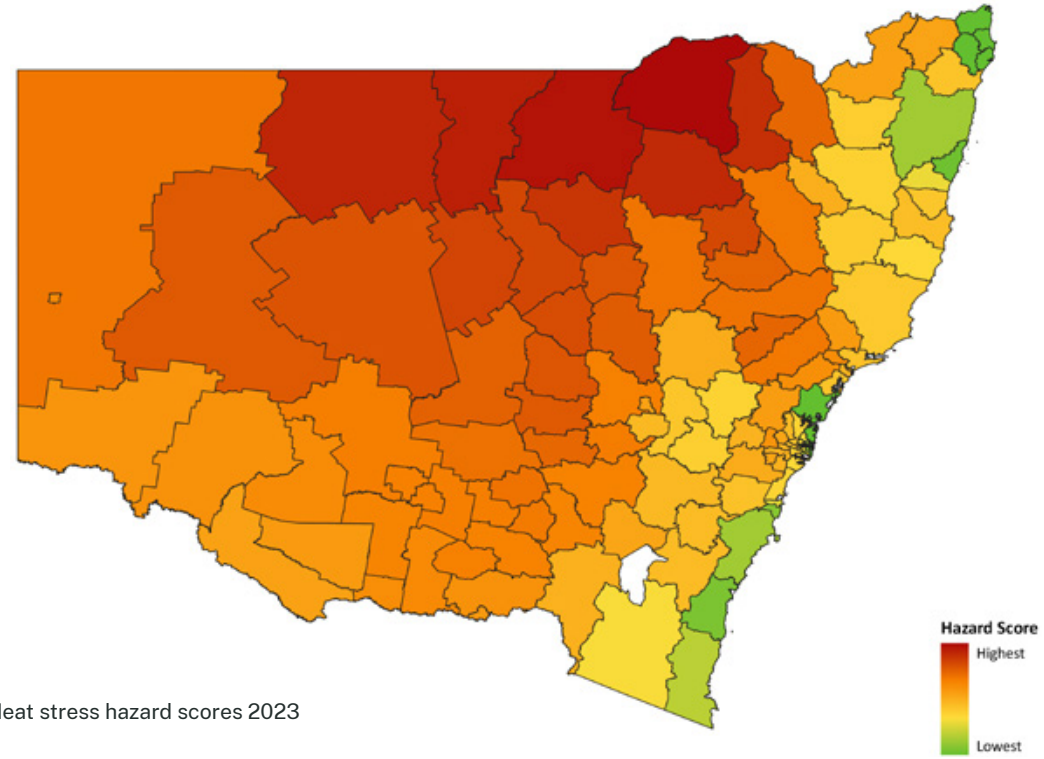


Figure 22. Heat stress hazard scores 2023

In 2023:

- The LGAs with the highest frequency and severity of heat stress hazard are Moree Plains, Walgett, and Brewarrina.
- The top 3 LGAs with the highest heat stress risk in the social, economic and natural environment are:

Social environment	Economic environment	Natural environment
> Walgett	> Carrathool	> Bourke
> Brewarrina	> Murrumbidgee	> Brewarrina
> Bourke	> Walgett	> Cobar

Heatwave impacts and risk

If care is not taken, heatwaves can cause heat-related illness and sometimes death when the body's ability to cool itself is challenged. Extreme heat can lead to dehydration, heat cramps, heat exhaustion and heat stroke.[66] It is estimated that extreme heat currently contributes to the deaths of more than 1,000 people aged 65 and over each year across Australia.[67, 68]

Heatwaves put pressure on our health and emergency services. During the heatwaves of 2011 and 2019 hospitals across NSW experienced a 14% rise in admissions.[69]

The people most vulnerable during a heatwave are:

- those aged over 75
- babies and young children
- pregnant and breastfeeding women
- those with poor mobility
- the homeless
- people socially isolated and living alone
- those working in a hot environment
- those exercising vigorously in the heat
- people with chronic illness (such as diabetes, heart disease, high blood pressure, cancer, mental illness)
- those taking certain types of medications[70]

The impacts of heatwaves are shown in Figure 23 below.

Built

- Transport and electrical infrastructure affected – buckling of train tracks, melting of asphalt roads
- Heat island effect in urban areas
- Strain on electrical and gas supply for cooling systems

Social

- Death, heat-related illness and hospital admissions
- Strain on hospital and health services due to heat-related illness
- Mental and physical distress especially when impacted by loss of community connections, and changes to childcare arrangements
- Harm to pets
- Potential domestic and family violence due to psychological distress

Economic

- Outdoor workers or those in indoor enclosed spaces adversely affected
- Crop, livestock losses

Natural

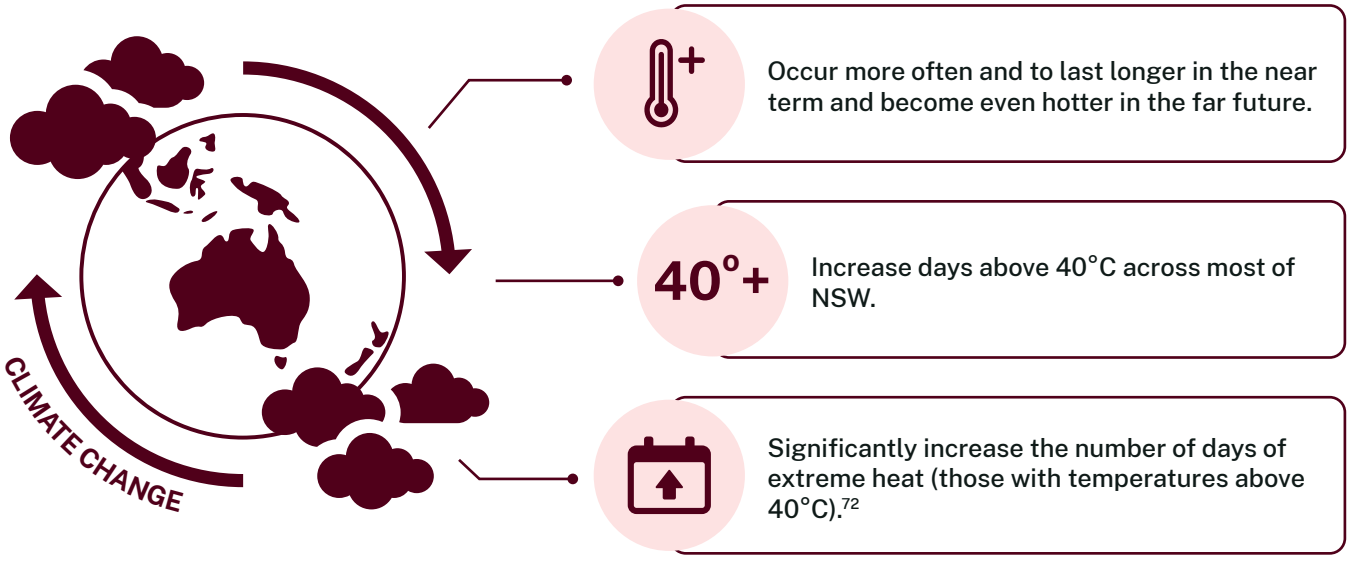
- Air quality can be degenerated through ground level ozone
- Can exacerbate drought conditions and create bush fire risk
- Death or injury to wildlife sensitive to heat stress

Figure 23. Summary of potential impacts of heatwaves

How will climate change affect heatwaves?

Climate change will have a significant effect on the intensity, duration and frequency of heatwaves in NSW. NSW has already experienced changes in heatwaves – between 1911 and 2013 heatwaves in parts of NSW have become hotter for longer and occur more often.[71]

Heatwaves in NSW are projected to:



Climate change is the key driver of future risk for heatwaves. The LGAs with the highest modelled frequency and severity of heatwaves under a 2060 high emissions scenario are Moree Plains, Walgett and Narrabri.

Storms and cyclones

Storms are atmospheric disturbances characterised by strong hazardous winds, combined with heavy rain, snow, sleet, hail, ice and/or lightning and thunder. This includes tornadoes or waterspouts.

Types of storms include:[73]

- thunderstorms
- tornadoes
- mid-latitude low-pressure systems (including east coast lows)
- low pressure troughs
- cold fronts and southerly busters
- cold outbreaks

The Bureau of Meteorology has the following thresholds for warnings of 'severe' storms:[74]

- wind of 90 km/h or more (damaging), 125 km/h (destructive), or average wind speed of 63km/h or more
- tornadoes
- rainfall which causes flash flooding
- hailstones at least 2 cm in diameter
- waves 5 metres or higher in the surf zone; and
- sea level higher than 50 cm above the Highest Astronomical Tide (Abnormally High Tides and Storm Surge).

Storms and tornadoes can also trigger secondary hazards including bush fires (due to lightning strike), coastal and other erosion, flooding and landslides.

Severe thunderstorms are the most common and most damaging types of storms in NSW. They are small scale, have a short life span and only affect areas a few kilometres across. Although severe thunderstorms can occur at any time, there is a marked tendency for thunderstorms and severe thunderstorms to occur during the months from October through to March. This period is normally referred to as the 'severe thunderstorm season'.

Tornadoes are funnels of high wind that can occur in conjunction with thunderstorms.

East coast lows (ECL) are when an intense low-pressure system develops off Australia's east coast. They are the main cause of severe storms in coastal NSW and can cause gale force winds, heavy rain and dangerous surf conditions.[75] They can occur year-round but are most frequent during the autumn and winter months. Significant east coast low events happen 10 times a year on average however their frequency has been declining in recent decades.[76]

A **cyclone** (tropical and ex-tropical) is a non-frontal low-pressure system which has developed over warm water, has persisted for at least 6 hours and has a maximum mean wind speed of 34 knots or greater. Tropical cyclones have relatively long-life cycles and can continue for up to 2 weeks. Their formation can generally be forecast 1-7 days ahead, but it is very challenging to accurately forecast the track or intensity.[77] In NSW, coastal areas in the northern parts of the State are most likely to be affected by cyclones, but the impacts can extend as far south as Sydney.[78]

The risk assessment undertaken for this plan has mapped the storm and cyclone hazard in NSW and this showed the most affected areas in NSW are on the coast, both now and into the future (Figure 24 and Figure 25).

Blackwattle Bay, Sydney. Photo by Jacqueline Allen

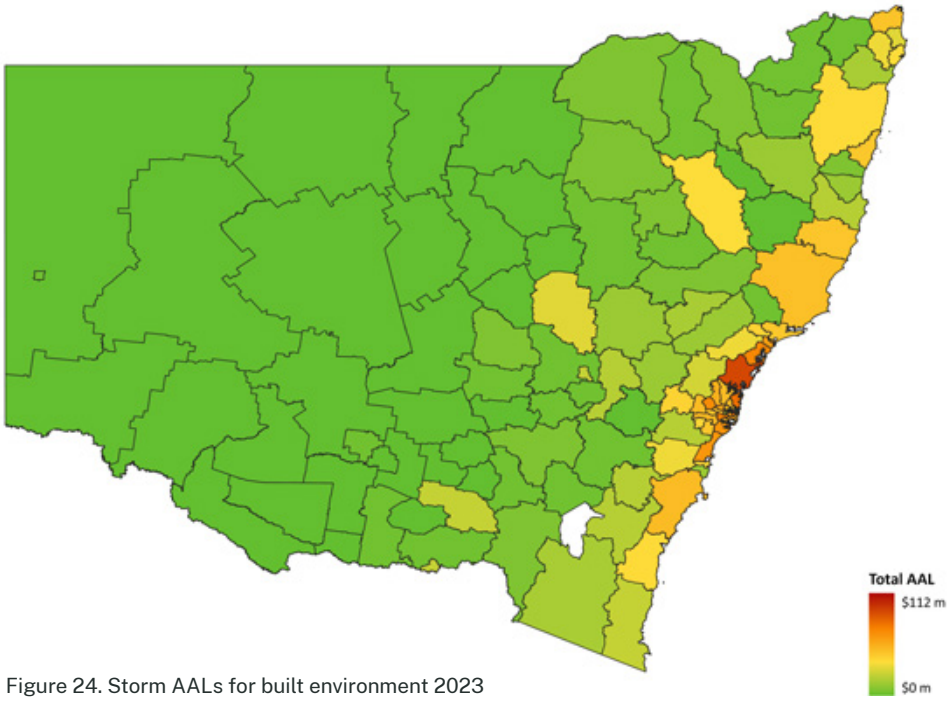


Figure 24. Storm AALs for built environment 2023

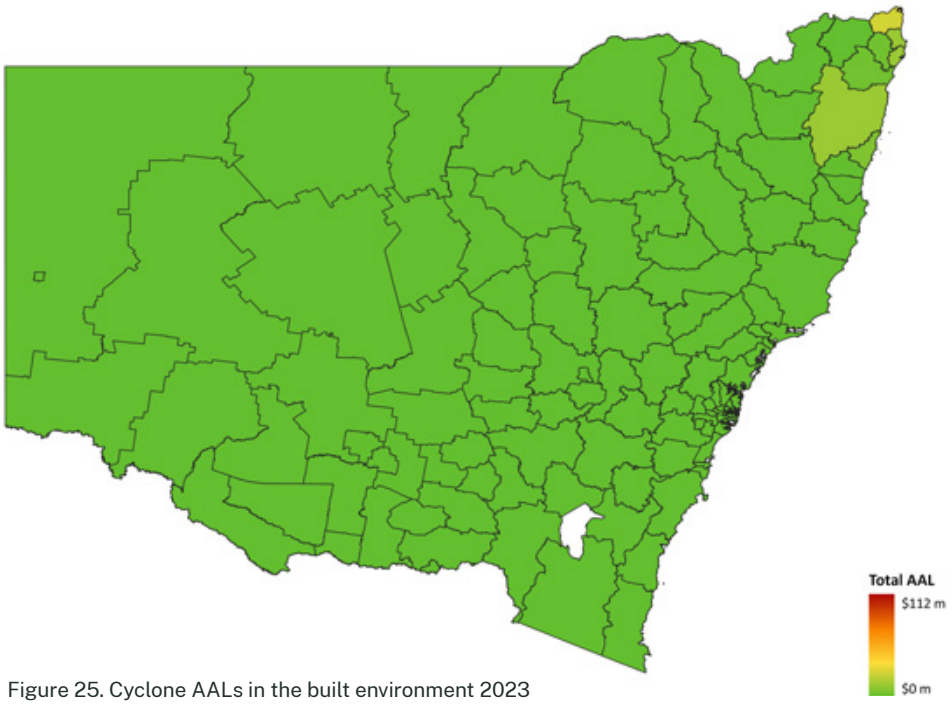


Figure 25. Cyclone AALs in the built environment 2023

In 2023:

- The LGAs with the highest combined **storm hazard and cyclone hazard** are Byron, Ballina and Tweed
- The LGAs where the highest **storm risk** to the built environment are the Central Coast, Sydney and Northern Beaches. This difference is due to a greater number of properties and assets exposed to the coastal hazard. Figure 24
- The LGAs where the highest **cyclone risk** to the built environment are Tweed, Ballina, Byron and Clarence Valley. The hazard and risk are similar except with the addition of Clarence Valley. Figure 25

- The top 3 LGAs in 2023 with the highest storm risk in the social, economic and natural environment are:

Social environment	Economic environment	Natural environment
> Richmond Valley	> Sydney	> Clarence Valley
> Kempsey	> North Sydney	> Kempsey
> Nambucca Valley	> Ryde	> Port Macquarie-Hastings

- The top 3 LGAs with the highest cyclone risk in the social, economic and natural environment are:

Social environment	Economic environment	Natural environment
> Byron	> Ballina	> Tweed
> Clarence Valley	> Byron	> Clarence Valley
> Tweed	> Clarence Valley	> Byron

Storm and cyclone impacts and risk

In NSW the most expensive insured loss on the built environment was due to the Eastern Sydney Hailstorm in 1999 which cost more than $8.8 billion (normalised to 2022 dollars).[79] In addition, lightning has claimed the lives of 265 people since 1900.[80]

The most devastating recorded storm in NSW in terms of combined impacts on fatalities, damage, and disruption was in June 2007:

- 9 fatalities
- 5 east coast lows
- Natural disaster declaration in 19 local LGAs
- Nearly 20,000 requests for assistance to the NSW State Emergency Service (SES)
- Grounded the bulk carrier ship, Pasha Bulker, on Nobbys Beach in Newcastle
- The Insurance Council of Australia estimated the storm's damage at $1.480 billion.[81]

A summary of the key impacts of storms and cyclones is included in Figure 26.

Built

- Damage to roads, bridges and buildings especially through flooding
- Lightning strike can cause direct damage to powerlines in particular
- Damage to essential infrastructure including power, water, roads, rail, sewerage systems
- Damage to vehicles and metal roofs, windows and roof tiles through hailstones
- Damage to cultural heritage

Social

- Injury or death of people and animals
- Disruption to educational, sporting, cultural and religious activities
- Displacement from homes and communities due to building collapse or structural damage
- Mental health stress
- Isolation of communities due to flooding
- Disruption to essential services such as food, water, energy, communications and supply chains
- Can lead to crimes such as theft or looting of impacted communities and domestic and family violence due to psychological stress

Economic

- Business disruption due to loss of essential services
- Disruption to manufacturing, agriculture, service, tourism, construction, transport and other industries
- Decline in local economies as a result of closures due to damage
- Harm to crops and livestock
- Demand surge following the event due to building repairs and reconstruction

Natural

- Winds can bring down or damage trees
- Airbourne debris, hailstones and flash flooding can damage or destroy vegetation or injure or kill wildlife
- Flash flooding and storm surges can reshape, damage and contaminate natural habitats
- Damage to natural forest areas and mangroves
- Coastal damage and erosion due to gale force winds and wave impacts on shorelines
- Damage to ecosystems due to increased salination of soil
- Displacement and death of stranded sea life washed ashore or carried inland

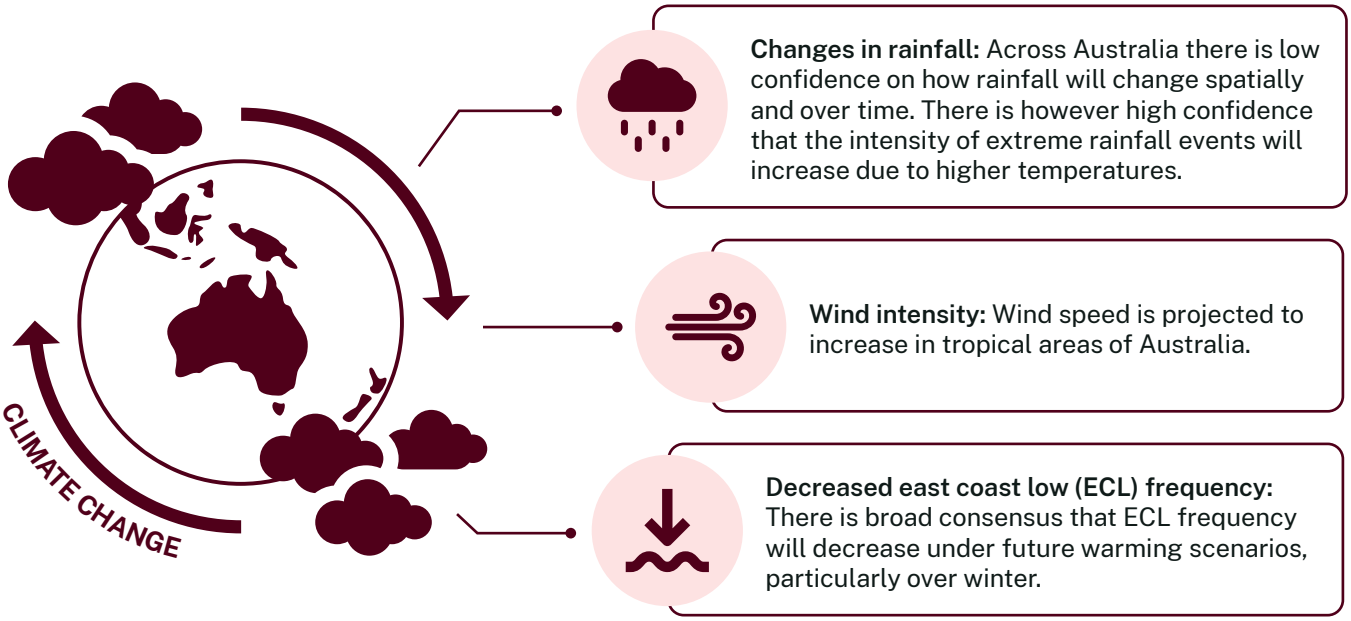
Figure 26. Summary of potential impacts of storms and cyclones

How will climate change affect the risk of storms and cyclones?

Current research indicates that the effects of climate change will result in:

- Fewer tropical cyclones, but a greater proportion are projected to be of high intensity, with ongoing large variations from year to year. The intensity of rainfall associated with tropical cyclones is also expected to increase and combined with higher sea levels, is likely to amplify the impacts from tropical cyclones that do occur.
- Ongoing sea level rise which will exacerbate the impacts of large waves and storm surges which arise from coastal storms such as east coast lows and cyclones.[82]

Across Australia, higher temperatures from climate change will result in more intense storms. Changes in storm risk will be influenced by multiple factors:



Some reduction in storm risk for NSW is projected due to a reduction in the frequency of ECLs, however this may be offset by increasing intensity of rainfall events.[83]

Under a 2060 high emissions climate change scenario:

- The LGAs with the highest **storm hazard** are Byron, Ballina and Tweed.
- The LGAs with the highest **storm risk** for the built environment changes to Sydney, Blacktown, Central Coast and Parramatta. This difference is due a greater number of properties and assets exposed to the storm hazard.
- The LGAs with the highest **cyclone hazard** are Byron, Ballina and Tweed.
- The LGAs with the highest **cyclone risk** for the built environment is similar, with additional LGAs of Clarence Valley and Coffs Harbour due to a greater number of properties and assets exposed.
- Population growth is a larger driver to future risk than climate change.

Tsunami

Tsunamis are waves with very long wavelengths (typically hundreds of kilometres) caused by disturbances of the ocean[84] such as:

- upward movement of the sea floor due to earthquake
- undersea or coastal volcanic eruptions
- meteor impacts
- landslides, either land-based or oceanic
- rapid changes in barometric pressure such as moving storm fronts known as meteotsunamis[85]

They differ from waves generated by winds or tides and only cause water movement near the surface.[86]

Travel times of tsunamis to the NSW coast vary depending on the source. **Local tsunamis** caused by coastal or submarine landslides could generate a tsunami which may arrive in as few as 20 minutes.

Regional tsunamis are generated within the south-west Pacific, potentially in zones along the Indian-Australian and Pacific tectonic plate boundary. Travel times for these would be between 2 to several hours. **Distant tsunamis** are generated by subduction zone boundaries as far away as North America, South America and Asia. Travel time to NSW is around several hours to days.[87]

The largest tsunami to have affected the NSW coast in recent times was in May 1960 after a 9.5 magnitude earthquake in Chile resulted in a 1 metre tidal fluctuation at Fort Denison in Sydney Harbour. This caused widespread damage to marine infrastructure along the NSW coast including damage to boats, wharves, jetties and beaches.

Since 2007, up to 8 tsunami events have been observed in NSW, including tsunamis originating from earthquakes off the Solomon Islands, New Zealand, Chile and Japan.

Source: SES, Tsunami: know your risk

Tsunamis impacts and risk

While these are rare events, tsunamis could have catastrophic consequences as seen in Japan in 2011 and Indonesia in 2004. A tsunami could affect the entire NSW coast or only some parts of it. A large tsunami affecting the entire NSW coast would directly threaten between 250,000 and 1.5 million people, depending on magnitude, time of day and season.[88] Secondary hazards caused by tsunamis include landslides and flooding.

Figure 27 summarises the impacts of tsunamis.

Built

- Property damage including vessels, buildings and vehicles
- Infrastructure damage especially marinas, moorings, ports and coastal infrastructure
- Damage to coastal land-based infrastructure such as roads, power and telecommunications lines
- Damage to water and sewerage treatment plants
- Damage to cultural heritage

Social

- Loss of life and injury particularly from drowning
- Social disruption due to damage to water and sewerage systems
- Adversely impacts mental health

Economic

- Losses for maritime industries and affected businesses
- Tourism industry affected by damage to environment
- Disruption to essential services such as water and sewerage and to transport and shipping routes
- Coastal agriculture may be affected

Natural

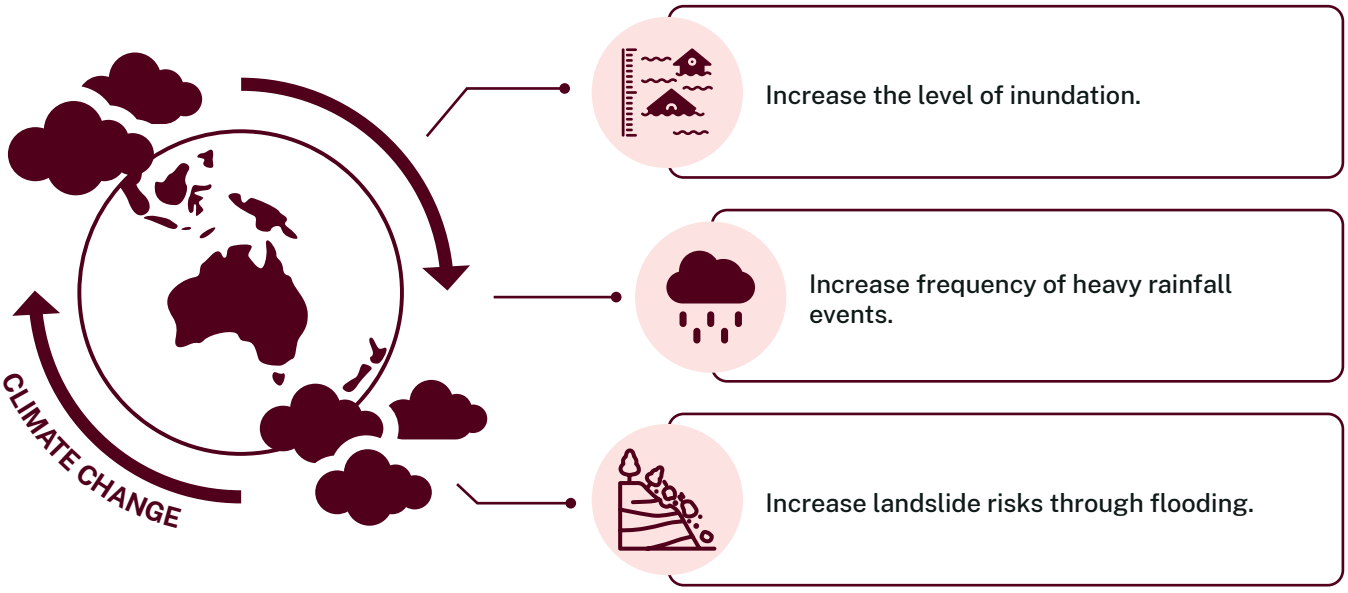
- Destruction of natural environment in the coastal zone including the marine environment through creation of shoreline waste
- Death and injury to wildlife
- Contamination to waterways and terrestrial environments

Figure 27. Summary of potential impacts of tsunamis

How will climate change affect tsunamis?

Flood impacts from tsunamis are likely to worsen as a result of climate change. With average global sea levels projected to rise coastal communities are more vulnerable to tsunamis should they hit.[89]

Hazards associated with tsunamis are influenced by climate change, for example sea level rise will:



Bondi Beach, Sydney

Taking a multi-hazard view

The previous sections explain the hazard and associated risk for each natural hazard individually.

The following section looks at the combined hazard risk in the built environment to demonstrate what is driving the highest risks. The methodology for a multi-hazard risk assessment is outlined in the earlier chapter 'How we have assessed natural hazard risk'.

Figure 28 (2023) and Figure 29 (2060 under a high emissions scenario) show the total average annual losses for all hazards combined. They show that natural hazard risk is concentrated in the eastern parts of the State, focused around where development has occurred near our river systems and coastlines. This is due to the concentration of homes, commercial property, and infrastructure that is exposed.

The purple in Figure 29 highlights the LGAs where the risk is greater than the highest 2023 result. Most of the changes to these LGAs are driven by coastal hazards and climate change, except for Blacktown and Penrith which is flood risk related and driven primarily by projected population growth.

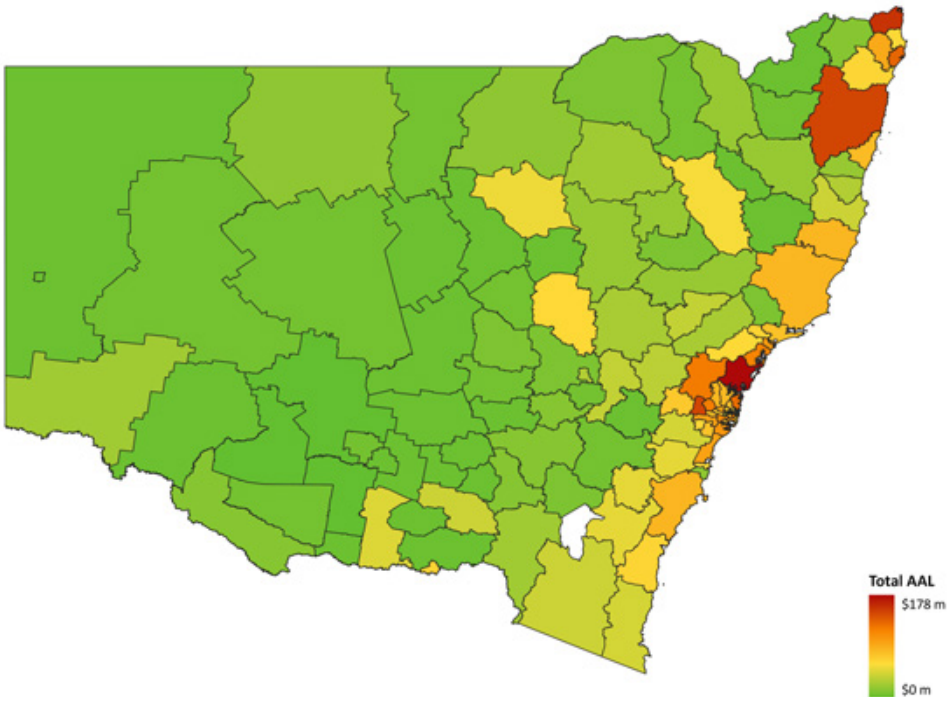


Figure 28. Total AALs for all hazards in the built environment for 2023

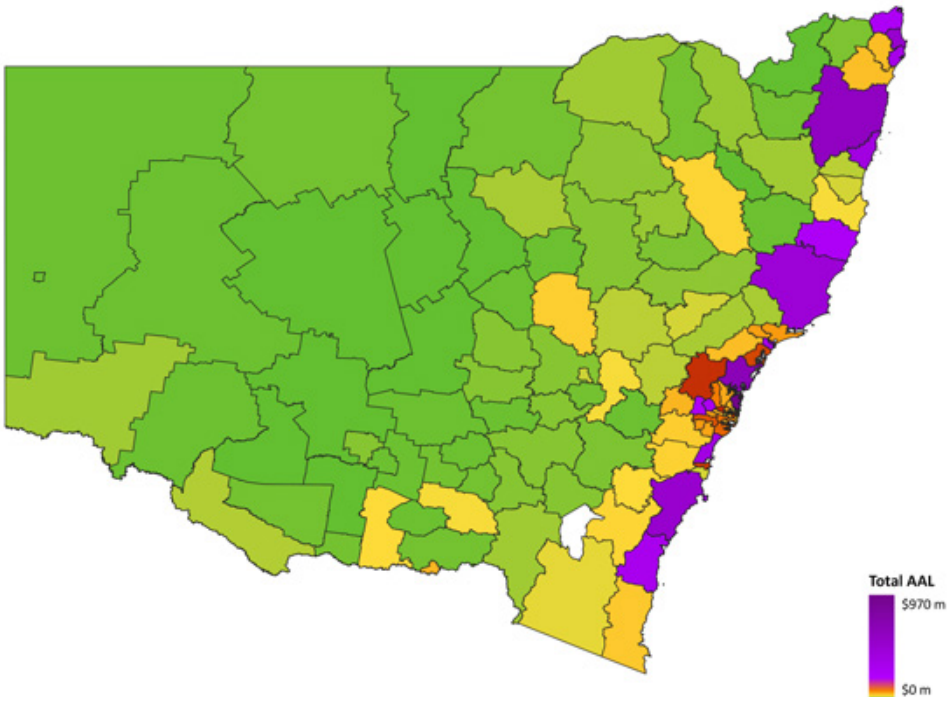


Figure 29. Total AALs for all hazards in the built environment under a 2060 high emissions scenario

20 LGAs account for 65% of the total AAL in 2023. This rises to 84% under a 2060 high emissions scenario due to coastal hazards. The top 20 LGAs can be viewed in Table 4 and Table 5 over the page.

Table 4.

Total AALs ($million) for the top 20 LGAs in the built environment (2023)[90]

LGA	Total	Storm	Flood	Bush fire	Earthquake	Cyclone	Coastal Inundation	Coastal Erosion
Central Coast	178	83	30	39	11	-	8	6
Tweed	146	24	100	3	1	9	9	0
Clarence Valley	133	12	112	2	1	4	1	1
Ballina	109	11	89	2	0	5	0	1
Northern Beaches	103	64	9	13	8	-	1	10
Penrith	97	28	61	2	6	-	-	-
Hawkesbury	94	8	82	2	2	-	-	-
Sydney	90	68	8	0	13	-	2	-
Lake Macquarie	87	52	3	23	6	-	2	0
Blacktown	85	50	23	1	11	-	-	-
Canterbury-Bankstown	81	57	14	1	9	-	0	-
Sutherland Shire	73	46	12	8	6	-	1	0
Newcastle	71	42	15	6	5	-	2	1
Bayside	68	43	17	0	8	-	0	0
Liverpool	65	30	27	2	6	-	0	0
Wollongong	64	45	2	9	6	-	0	1
Parramatta	63	40	13	1	9	-	0	-
Lismore	57	11	44	1	1	1	0	-
Shoalhaven	49	28	2	13	4	-	1	2
Inner West	49	41	3	0	6	-	0	-

The 2023 average annual loss (cost of damage) from all hazards assessed in the built environment (residential, commercial and infrastructure assets) was estimated at $3.1 billion dollars per year (2023). The hazards that drive the largest potential damage to the built environment today are storm and flood, representing 77% of this average annual loss.

Natural hazard risk will continue to increase in the future due to both population growth and the impact of climate change, and the relative contribution varies according to the hazard. Average annual losses in the built environment are set to rise by 195% to $9.1 billion dollars per year in NSW in 2060 under a high emissions scenario.

Table 5.

Total AALs ($million) for the top 20 LGAs in the built environment (2060)[91]

LGA	Total	Coastal	Storm	Flood	Bush fire	Earthquake	Cyclone
Northern Beaches	969	867	62	10	22	8	-
Central Coast	663	426	96	49	78	14	-
Clarence Valley	594	419	12	149	3	1	10
Byron	501	465	12	8	6	0	10
Shoalhaven	500	422	40	3	29	7	-
Mid-Coast	445	380	29	17	14	2	3
Coffs Harbour	378	317	24	21	5	1	10
Wollongong	363	270	61	3	19	10	-
Newcastle	334	231	51	33	12	7	-
Ballina	316	174	13	113	4	1	11
Eurobodalla	290	259	14	2	13	2	-
Blacktown	253	-	96	133	5	19	-
Tweed	235	40	26	139	7	1	22
Port Macquarie-Hastings	228	159	25	23	14	2	5
Penrith	216	-	40	160	6	10	-
Parramatta	153	1	80	46	4	22	-
Sydney	151	0	109	15	0	26	-
Hawkesbury	149	-	11	131	4	2	-
Shellharbour	139	109	23	1	3	3	-
Lake Macquarie	131	5	60	11	47	8	-

Risks are focused in coastal areas with coastal hazard accounting for 50% of the $9.1 billion total average annual losses expected in the built environment (see Table 5).

The estimated increase in average annual losses between 2023 and 2060 under a high emissions scenario are a result of an estimated $1 billion dollars in increased cost of damage to the built environment in NSW (more new exposed development) and $5 billion due to the impact of climate change (greater hazard).

Our understanding of losses from past events

Data on historical insured losses shows similar trends. From 1967 to 2022, hailstorms have been the costliest natural hazard in NSW, with total losses of $23.2 billion, as shown in Figure 30. Other storms contributed a further $10.1 billion during the same time. Floods have been responsible for $11.8 billion, followed by earthquakes with $6.9 billion and bush fire at $3.8 billion.

Normalised losses from natural hazards in NSW 1967-2022 ($ million AUD 2022)

$3,800	$580	$6,900	$11,800	$23,200	$10,100	$500
Bush fire	Cyclone	Earthquake	Flood	Hail	Storm	Tornado

Figure 30. Normalised losses from natural hazards in NSW 1967 - 2022

This is further supported by data from the Insurance Council of Australia identifying the 10 costliest individual hazard events in NSW since 1967, as shown in Figure 31. Seven of these 10 events are storms, which includes hailstorms and east coast lows.

The 10 costliest natural hazard events in NSW between 1967-2022

$8.8 billion 1999 Eastern Sydney hailstorm Storm – Hail	**$6.5 billion** 1989 Newcastle Earthquake	**$4.5 billion** 2021 South East Queensland and NSW Floods	**$3.4 billion** 2007 Newcastle and Hunter east coast low Storm	**$2.7 billion** 1989 Northern Sydney hailstorm Storm – Hail
$1.9 billion 2019-20 Black Summer NSW, Queensland, South Australia and Victoria bush fires Bush fire	**$1.7 billion** 2018 Sydney, Central Coast and Wollongong hailstorm Storm – Hail	**$1.7 billion** 1990 Sydney storms Storm	**$1.7 billion** 2014 east coast low Storm	**$1.3 billion** 1986 Western Sydney hailstorm Storm – Hail

Figure 31. The 10 costliest natural hazard events in NSW between 1967-2022[92] (normalised loss ($ AUD). Source: Risk Frontiers (2023)

Which hazards pose the greatest risk to life?

Another consideration when determining which hazards require the greatest attention is the extent to which they present a risk to life.

Historically, the greatest risk to life has been posed by floods followed by heatwaves. These hazards contribute to nearly two-thirds of natural hazard deaths, as illustrated in Figure 32.[93] Floods, bush fires and hailstorms have accounted for the greatest number of injuries in NSW since 1900.

These estimates do not consider deaths or injuries caused by secondary impacts from hazards. For example, secondary impacts from the 2019-20 bush fires were estimated to have led to 417 premature deaths, and 3,151 hospital admissions because of air pollution. Mental health impacts associated with hazard events and the compounding impacts they may have on people's underlying health conditions are also yet to be fully understood and quantified.

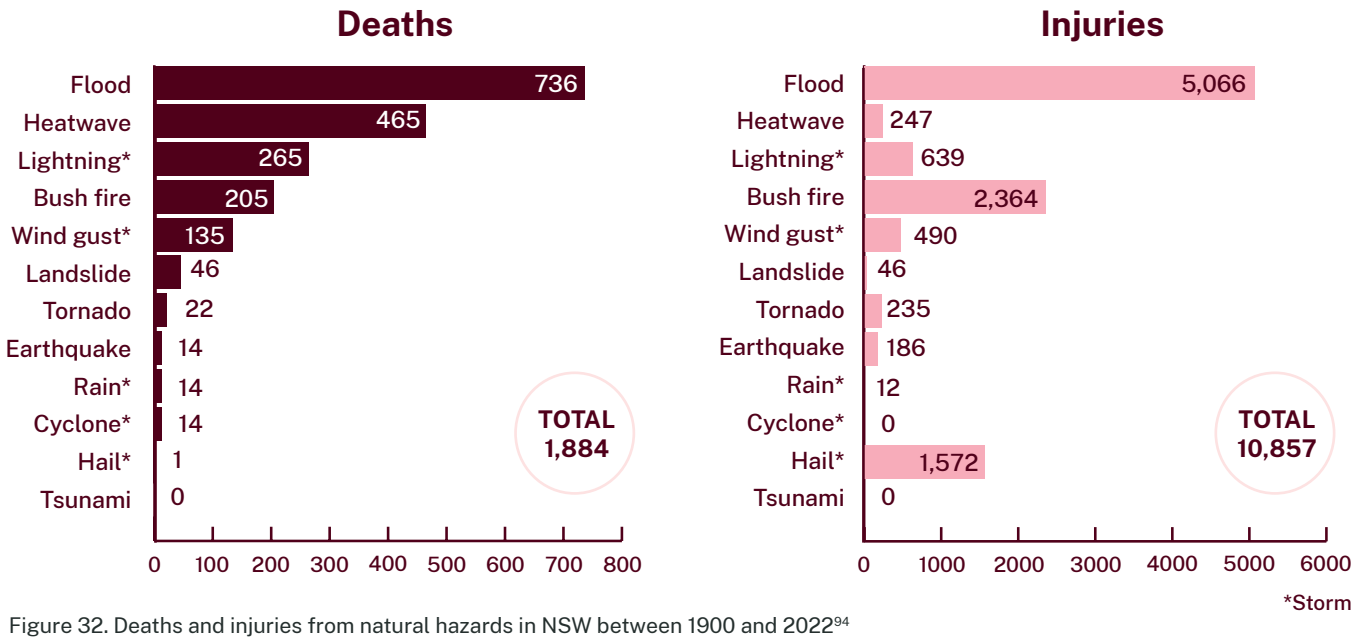


Figure 32. Deaths and injuries from natural hazards in NSW between 1900 and 2022[94]

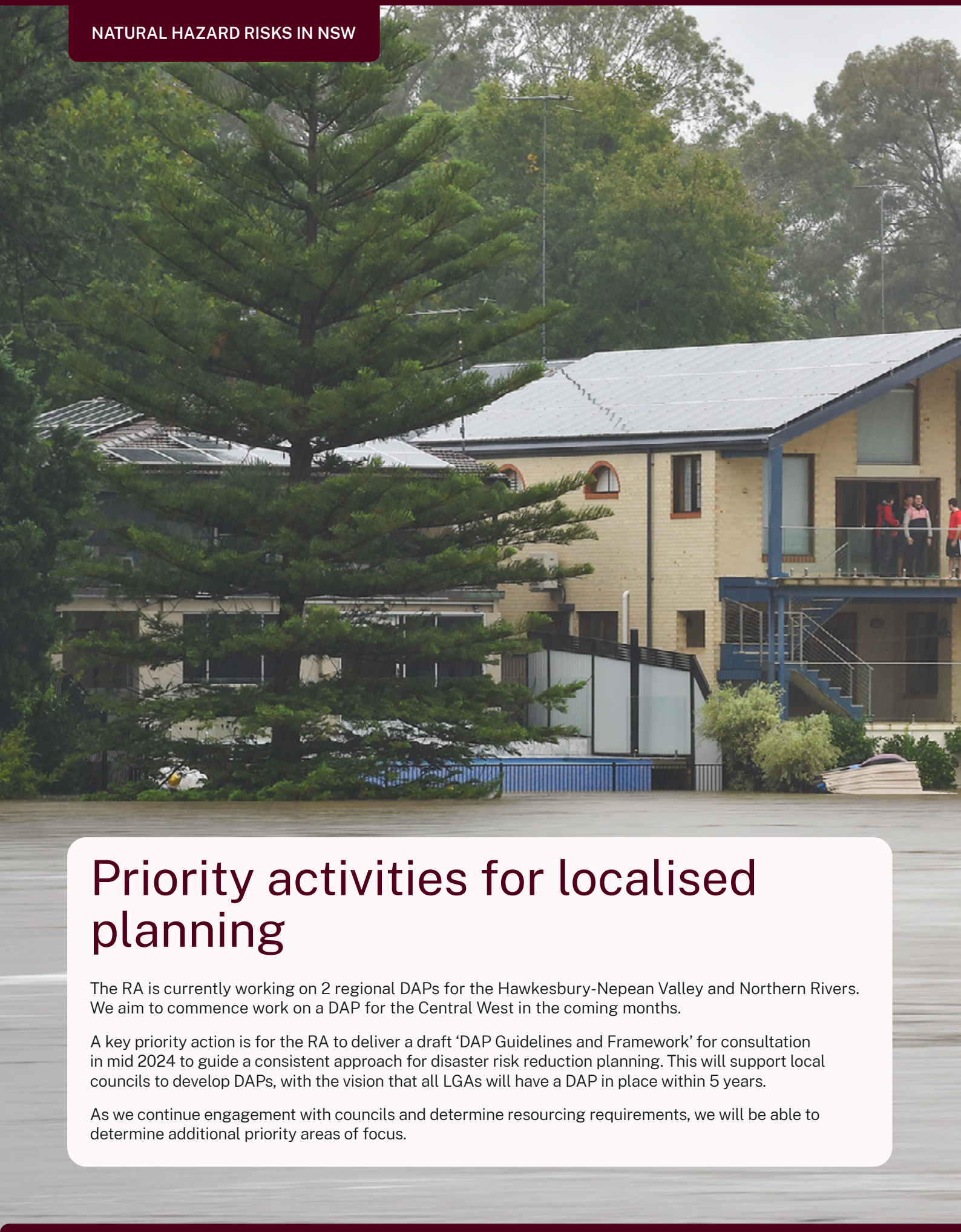
Limitations of existing multi-hazard risk assessments

The challenge of performing a multi-hazard risk assessment is having a way to compare the risk across the different hazards. It is also a challenge to assess cumulative risk, which is the combined risk from all hazards.

While we have assessed impacts in the economic, social and natural environment, for the purposes of this Plan we are focussing on the results in the built environment using the average annual losses (AALs) as it is the one metric that can be compared across the different hazards.

The built environment dominates discussions about the cost of disasters and damages because it is a quantifiable cost, and is the standard used by the insurance industry and financial markets. A focus on the built environment doesn't diminish the importance of the other impacts. Further work needs to be done to better quantify social, natural and broader economic impacts, such as mental health, wellbeing, and biodiversity. This Plan includes a range of actions to advance this work.

Comparative assessment requires similar spatial boundaries such as local government areas or statistical areas used by the Australian Bureau of Statistics. Natural hazards by their nature are not limited to administrative boundaries. The distribution of floods and coastal hazards are better known as they occur in river valleys and along coastal areas. In future risk assessments we will consider multiple spatial boundaries to better reflect the cumulative risk across geographic areas for the relevant hazards such as flood.



Priority activities for localised planning

The RA is currently working on 2 regional DAPs for the Hawkesbury-Nepean Valley and Northern Rivers. We aim to commence work on a DAP for the Central West in the coming months.

A key priority action is for the RA to deliver a draft 'DAP Guidelines and Framework' for consultation in mid 2024 to guide a consistent approach for disaster risk reduction planning. This will support local councils to develop DAPs, with the vision that all LGAs will have a DAP in place within 5 years.

As we continue engagement with councils and determine resourcing requirements, we will be able to determine additional priority areas of focus.

Floodwaters nearing homes in Regentville close to flood peak (21 March 2021). Photo by Adam Hollingworth

How can we better manage our natural hazard risks?

4

Lighthouse and sea breakwall, Wollongong

The previous chapter has outlined our understanding of current and future risk for the assessed natural hazards. In summary, in 2023 the highest impacts to the built environment result from storm and flood. In the future under a 2060 high emissions scenario, coastal hazards (inundation and erosion) become an increasing risk for NSW. Flood, storm, bush fire and heat also present significant risk to people, either through injury or death. As a result of this analysis, these hazards have been a stronger focus for this Plan.

Risk assessment is part of the process to understand risk. The next steps involve the assessment of a range of options to reduce that risk. All relevant options need to be assessed for each place and the hazards it faces.

Risk reduction options

We will never be able to fully prevent natural hazards and the impacts they cause. We can lessen or minimise their adverse impacts through the application of risk reduction options.

To understand what options are available to reduce risk, it is helpful to understand what creates risk.

Risk is widely recognised as being the result of the interaction of the:

- severity and frequency of a hazard
- numbers of people and assets exposed to a hazard
- vulnerability, or susceptibility, of those people and assets to damage. See Figure 33.

It is therefore possible to reduce risk by managing the components that determine risk – hazard, exposure, and vulnerability.

Figure 33. Components of natural hazard risk

Reviewing risk areas

Exposure

The situation (or location) of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.

(United Nations Office for Disaster Risk Reduction, 2016)

Exposure changes over time and from place to place. It is driven by the concentration of people, houses and infrastructure exposed to hazards, usually due to population growth, migration and economic development. Many hazard-prone areas, such as floodplains and coastlines, attract urban and economic development because of the benefits the natural processes afford, such as fertile agricultural land or access to shipping.

For the purposes of this Plan, a tool is a collective term to describe the range of different infrastructure and non-infrastructure measures to reduce risk.

Vulnerability

The characteristics determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

(United Nations Office for Disaster Risk Reduction, 2016)

Vulnerability can relate to a range of factors including:

- physical factors, such as poor design and construction of buildings or inadequately planned urban development
- social factors, such as poverty, disability, age or inequality
- economic factors, such as lack of insurance or a community's dependence on a single industry
- environmental factors, such as poor environmental management practices.

There are a range of tools that can reduce hazard exposure and vulnerability, outlined in Figure 34 below.

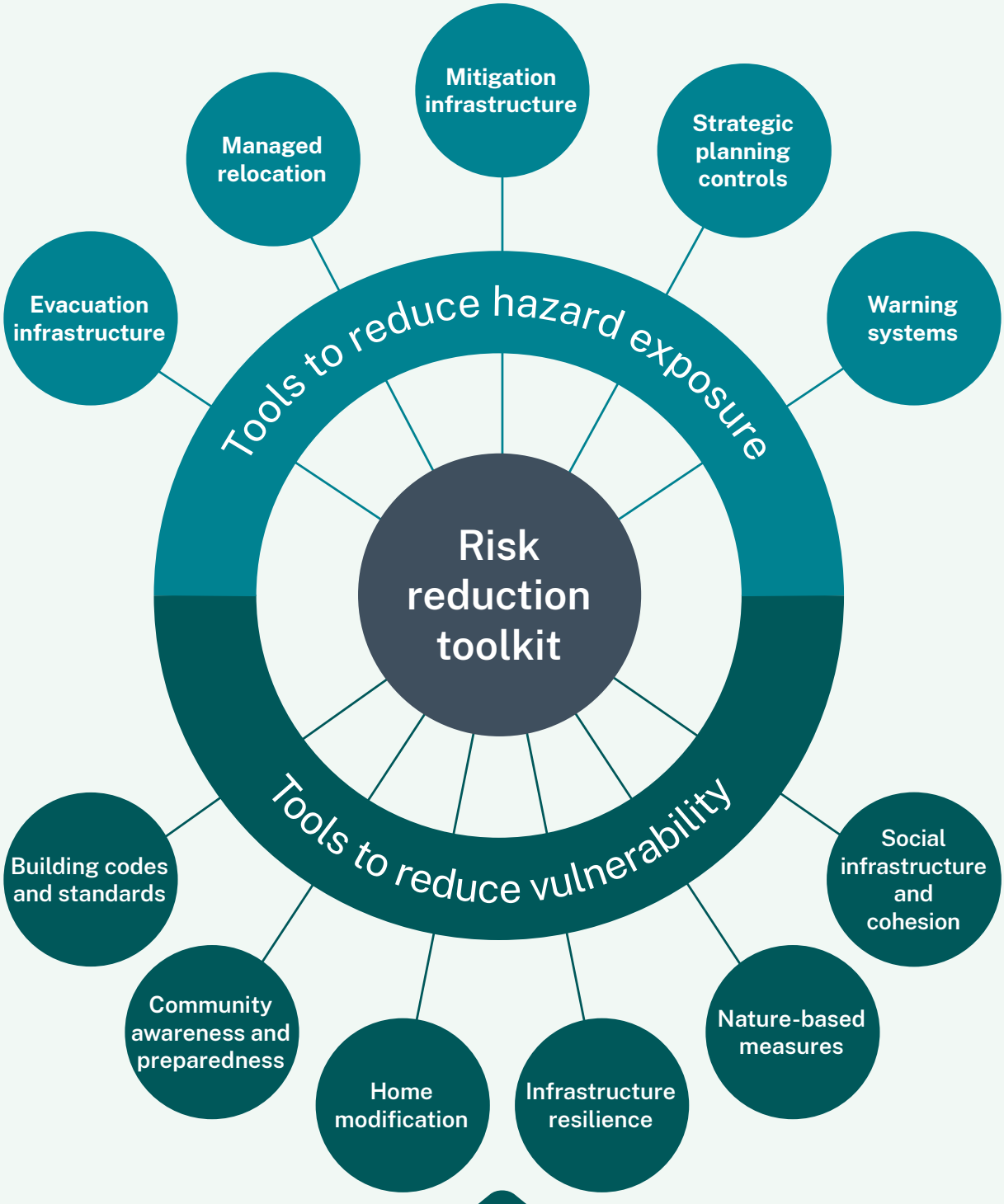


Figure 34. Risk reduction tools included in this Plan

To successfully support and guide disaster risk reduction efforts at both a State and local level, there needs to be additional focus on the 5 enablers shown on the right.

- Collaborative governance
- Funding
- Capacity and capability
- Data
- Insurance

Taking action to reduce risk

We have long been aware of the need to reduce exposure and vulnerability of people, homes and infrastructure to these hazards, for example, restricting development in areas of high risk. While many government initiatives are in place, there can be challenges to applying significant risk reduction interventions:

- Risk reduction often requires large up-front costs, such as mitigation infrastructure like flood levees, or investing in upgrades of critical infrastructure to make it more resilient.
- Recent disasters have demonstrated that people and governments have difficulty in anticipating the scale and severity of the events, particularly when they exceed what has previously been experienced. This means investment can be difficult to determine.
- Maladaptation is a real risk, with some interventions potentially having unintended consequences that increase vulnerability or create inequitable outcomes now or in the future.
- Effective risk reduction also requires a high degree of collaboration between all levels of government, the community and industry, which can be hard to achieve. Investing in mitigation can mean difficult decisions need to be made between the competing priorities of growth, housing supply, and environmental and social impacts. It requires open and collaborative conversations between those who benefit and those affected by different options, including community members, all levels of government, insurance and banking industries, and private businesses.

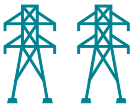
This Plan provides a strategic vision to address the Statewide challenges and to realise opportunities related to disaster risk reduction and manage natural hazard risks. This builds on our existing knowledge base and high levels of expertise. This 2024-2026 State Disaster Mitigation Plan is the State's first multi-hazard plan to manage our natural hazard risks. It aims to reduce risk where we can, adapt where we can't and achieve the vision of ensuring *'NSW is well-prepared and successfully manages natural hazard risks to reduce the costs and impacts of disasters on communities'.* See box on the next page.

This Plan works to achieve this vision by outlining a range of short and medium-term actions to enable the application of the risk reduction tools outlined in this section. The actions work to build on the existing work underway and address the immediate gaps in policy or understanding, or identify where State programs are required.

Vision and principles

NSW is well-prepared and successfully manages natural hazard risks to reduce the costs and impacts of disasters on communities. These principles guide the consideration of the actions presented in this section.

Preserve and protect life as the highest priority.



Reduce damages and minimise disruption to essential services.

Reflect experiences and needs of communities and ensure coordinated, community and place-centered approaches are taken.

Enable individuals and communities to make informed decisions through transparency on natural hazard risk.

Respect and embed Aboriginal cultural values and perspectives.

Lead by example from within the NSW Government.

Consider all likely impacts and look holistically when risk reduction decisions are made.

Coordinate and cooperate across government and jurisdictions to manage hazards that don't recognise administrative boundaries.

How risk reduction options will be applied

In outlining the toolkit and enablers, as well as the actions related to them, this Plan will support and guide the development of local, regional, or organisational DAPs with a focus on localised solutions for reducing disaster risk. Options from the toolkit will be assessed in DAP development. The relevance and effectiveness of any tool depends on factors including the funding available, which hazard it is most relevant to, and the local context (Figure 35).

In summary, the 5 key steps involved are:

1. Local objectives

Developing key outcomes that each DAP seeks to achieve and will engage the community to ensure values are identified and the plans are community-centric.

2. Risk assessment

Understanding the current and future exposure and vulnerability of built assets (e.g. infrastructure), social assets (e.g. networks) and environmental assets, and the people that occupy them, to all natural hazards. It also includes how these natural hazards change in frequency, duration, and severity with climate change. Future risks are a factor of how population and demographics change over time. This assessment process requires appropriate and transparent data.

3. Options assessment

Assesses different risk reduction options from the toolkit, such as mitigation infrastructure and planning controls, related to each place. The process includes undertaking an appropriate level of evaluation of each of the options (e.g. cost benefit analysis) and prioritisation of the options, including were options are complementary or can be substituted for each other. It will also consider options which affect neighbouring areas, with collaboration between neighbouring councils and communities essential to ensuring negative outcomes are avoided, and the costs and benefits are shared.

4. Endorsement

Securing official endorsement of the options prioritised for support and potential funding.

5. Funding, implementation, and monitoring

Funding the prioritised options and monitoring implementation. Monitoring of implementation is required to ensure transparency around the degree of risk identified, the progress on each option's execution, and the outcomes of each option's implementation on risk reduction.

Figure 35. High level process for delivering a DAP

The place-based process for developing DAPs will be further detailed in the DAP Guidelines and Framework to be released in 2024.

Focus on land use planning

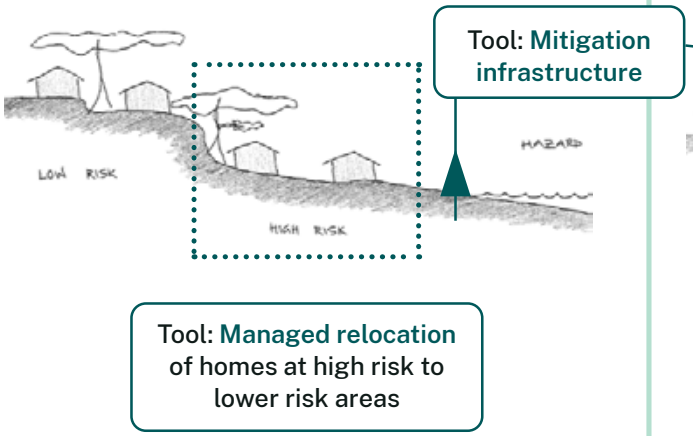
There is a range of tools that provide land use planning mechanisms including strategic planning controls, managed relocation, and building codes and standards.

Some of the key tools to reduce exposure for existing development, homes and properties are mitigation infrastructure and managed relocation.

Planning controls are important to manage future development, so they do not occur in high-risk areas, either in existing brownfield or new greenfield developments.

Land use planning tools are a key focus of this Plan due to their effectiveness in reducing risk. See Figure 36 below.

Existing development



Future development

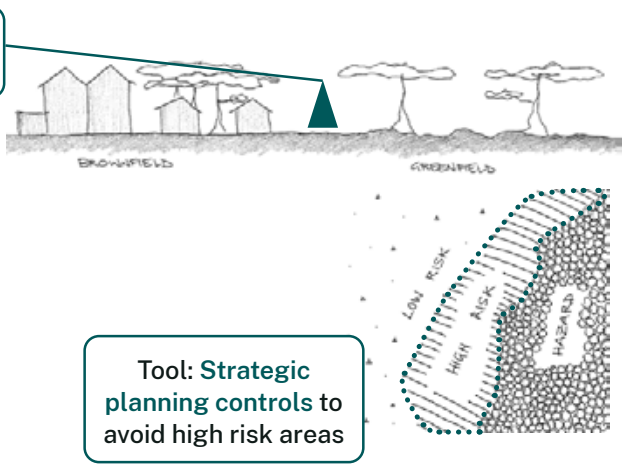


Figure 36. Examples of where managed relocation, mitigation infrastructure and strategic planning controls may be used

Tools to reduce hazard exposure

Evacuation infrastructure

HAZARDS

Evacuation involves the movement of people to a safer location and their return home once it is safe to do so. It is a risk management strategy that may be used to mitigate risk to life by reducing exposure to the hazard. For an evacuation to be effective, it must be appropriately planned and implemented. Evacuation emergency planning is the responsibility of emergency response agencies.[96]

Evacuation infrastructure includes assets such as roads that have been identified as most suitable to use to evacuate from bush fire, flood, storm, tsunami and/or coastal hazard risks. Improvements to evacuation infrastructure may include raising roads to provide increased flood immunity, adding lanes to increase capacity and support from directional signage or additional lighting. This infrastructure is often managed by local councils and Transport for NSW.

There are some areas across the State where communities are more reliant on the capacity of evacuation infrastructure to minimise risk to life. This is primarily where the time it takes to evacuate people is close to or exceeds the hazard warning time. This can be due to the geography of an area, number of people living there, and the available warning time. See the case study on Hawkesbury-Nepean Valley as an example.

Road infrastructure should have the capacity to meet the needs of mass evacuations. In some areas, there is only 1 road in and out; sometimes these roads have existing damage. This impacts the choices available for communities to evacuate, and seeking safe shelter may be the only available option. Risk to life is increased when evacuation routes have insufficient capacity to allow for 100% of people to evacuate within the warning time for forecastable hazard events.

To reduce risk from natural hazards, it is therefore important to assess and plan for evacuation infrastructure and increase capacity where necessary. Population, demographics, and climate change need to be considered in this strategic planning, along with the impact of potential new development on evacuation infrastructure capacity. This will support the emergency response agencies responsible for managing evacuation during natural hazard events.

Current challenges related to evacuation infrastructure

There is no Statewide methodology for assessing evacuation capacity to inform land use and transport planning. This leads to varied approaches to analysing evacuation infrastructure capacity across the State and for each hazard.

There are already capacity issues on road evacuation routes, particularly in situations of mass evacuation, meaning roads may not allow all those that need to evacuate to evacuate in time.

Pressure from new homes, adding more residents and cars on evacuation routes, is often underestimated and not well understood, particularly where those new homes themselves may not be affected by natural hazard risk.

There is often over-confidence about evacuation roads as a solution to disaster risk. The evacuation task is underestimated and the impacts on people, homes, assets and livestock that remain in the path of the hazard are ignored.

Evacuation infrastructure capacity is inconsistently monitored across all hazards.

The policy position for using private roads for evacuation is unclear.

The roles, responsibilities and funding arrangements for evacuation infrastructure maintenance and improvements are unclear.

CASE STUDY
Case Study: Hawkesbury-Nepean Valley flood evacuation model

Evacuation is critical

High population

Flood prone

The Hawkesbury-Nepean Valley is on a floodplain of around 500km^2 in Western Sydney and has one of the highest flood risks in Australia. Due to its topography and large existing population, there is a high risk to life during flood events. Evacuating ahead of a flood is the only option in the valley, as staying at home is not safe due to deep and extensive flooding. To understand this risk to life, the NSW Government worked in partnership with industry experts to develop a Flood Evacuation Model (FEM).

This innovative tool allows us to understand the evacuation capacity of the road network by simulating how the population evacuates during a flooding event. Using key inputs including population data, flood modelling and evacuation procedures, the FEM models thousands of different scenarios for current, short and long-term projections against a range of different flood events. The FEM has been critical to demonstrate how the risk to life changes over time, influenced by population growth and climate change, and this is used to inform emergency, land use and road infrastructure planning. This cutting-edge technology could be expanded to other floodplains, as well as other natural hazards where evacuation is required to reduce risk to life.

Current arrangements and work underway

State

- Bush fire Coordinating Committee policy 1/2012: Community Safety and Coordinated Evacuation
- State Evacuation Management Guidelines
- Road network maps
- Combat agencies risk practices e.g., Bush Fire Risk Management Plans
- State Bush Fire Plan (2017)
- Developers of 'at-risk developments' are required to develop evacuation plans under 'Development Planning, A Guide to Developing a Bush fire Emergency Management and Evacuation Plan'
- Guidance on Neighbourhood Safer Places
- State Emergency Management Plan Evacuation Management Guidelines 2023, NSW SES State and local Flood and Tsunami Plans
- Development of a Shelter-in-place guideline (drafted January 2023)
- Flood Evacuation Modelling for the Hawkesbury-Nepean Valley

Council

- Flood risk management plans which assess evacuation constraints
- Local Environmental Plans

Local Emergency Management Committee and Regional Emergency Management Committees

- State Emergency Management Plans (EMPLANs), some of which include evacuation plans
- Consequence management guide

Other

- Australian Institute of Disaster Resilience (AIDR) Evacuation Planning Handbook (2013)

ACTION	RESPONSIBILITY	DELIVERED BY
Develop a Statewide framework for evacuation infrastructure capacity analysis and upgrades. The framework would: • establish processes and tools to assess or review existing and future evacuation capacity of infrastructure to ensure people can evacuate within the warning time • be embedded in transport, land use, bush fire, flood and tsunami planning, and • identifiy roles, responsibilities and resourcing for both development and maintenance of evacuation infrastructure.	**Lead:** NSW Reconstruction Authority **Partners:** Transport for NSW, NSW State Emergency Service, Rural Fire Service, Department of Planning, Housing and Infrastructure, Department of Climate Change, Energy, the Environment and Water	Late 2025

DESIRED OUTCOMES

An approved Statewide framework and policy for coordinated, multi-stakeholder evacuation infrastructure and planning for bush fire, flood, and tsunami hazards, supported by appropriate planning instruments, regulations and standards.

Managed relocation

HAZARDS

Managed relocation is defined as the permanent and purposeful movement of people and existing homes and infrastructure exposed to existing or anticipated effects of natural hazards. It is an option to consider for reducing risk from most natural hazards and their cascading and secondary impacts. However, the significant economic, psychological, and social challenges of managed relocation must be considered.

Managed relocation can broadly be categorised into two approaches:

- **Buy-back scheme** – where government purchases a property at risk and the property owner is responsible for finding a new location to move to. Some programs provide social support to assist people in relocating, including finding employment.
- **Community relocation** – includes not only removing the people from the area at risk, but the subsequent resettlement of those people in an alternative location. These programs aim to move a number of people and keep those people together in their community.

Some mechanisms that might be used include a:

- voluntary scheme where the owner can elect to sell to the government or another private party
- voluntary scheme where the government has sole rights to purchase the property
- voluntary scheme which reverts to compulsory once a trigger point has been realised (for example, erosion of land reaches a certain point)
- fully compulsory scheme.

In terms of private property, the majority of managed relocation programs to date (both in Australia and internationally) have used a voluntary or opt-in approach. Generally, compulsory schemes have less support from the community.

There have been multiple historical examples across NSW, Australia and globally, where managed relocation has been implemented and some case studies are provided in the coming sections. Most recently, communities in the Northern Rivers have been part of the State's first large-scale managed relocation program following the devastating floods in February 2022. The lessons learnt from the implementation of this program so far are also outlined in the sections ahead.

Engagement in the Northern Rivers of NSW

Current government programs include:

The DPE (2022) Guidelines for Voluntary Purchase Schemes

These Guidelines provide key objectives and eligibility criteria for voluntary purchase. The objectives are generally broad and allow voluntary purchase to be considered against other mitigation measures for a particular area. It has historically been small in scale, involving grants of approximately $2 million per year (generally matched by councils), covering a small number of homes per year.

The NSW Coastal Lands Protection Scheme

The *Coastal Management Act 2016* sets out coastal management process for local councils to develop coastal management programs (CMPs) which can consider relocation. CMPs are co-funded by State and local government, prepared in consultation with affected communities and include actions for management of and adaptation to coastal hazards. Grant funding is available for implementation of actions within CMPs that have been certified by the Minister.

Flood risk management studies

A number of flood risk management studies and plans identify properties for voluntary purchase. These are prepared under the Floodplain Management program and are adopted by the relevant local council. These programs have generally been focused on homes where there are no other options available and present a significant risk to life.

The Northern Rivers Resilient Homes Program (RHP)

This Program is a $700 million program co-funded by the Australian Government and NSW Government. It includes a buy-back scheme. The other component is the $100 million Resilient Lands Program which aims to support delivery of additional housing.

Current challenges and gaps related to managed relocation

There is no agreed approach for large-scale managed relocation or criteria for tolerable risk

One of the challenges for the recent Northern Rivers Resilient Homes Program was the absence of a pre-existing agreed approach and criteria for large-scale relocation based on an agreed threshold of what level of disaster risk the community is willing to accept (i.e. 'tolerable risk'). The areas where risk is not tolerable for any habitation would be where properties become eligible for relocation in the context of available funding and other mitigation options.

Before the flooding event in the Northern Rivers, only a small number of properties had been identified for voluntary purchase in extremely high-risk areas under the smaller scale pre-existing Voluntary House Purchase scheme. This scheme has been in place to support councils to manage flood risk with funding of around $2 million per year from the State, generally to be matched by councils.

In addition, there is no agreed approach or identification of tolerable risk for large-scale relocation in response to other natural hazards, such as coastal hazard.

Equity considerations and affordability of insurance

Where risk is tolerable it may also be influenced by the affordability of insurance. Insurance affordability is driven by the amount of the insurance premium as well as the home or asset owner's ability to pay. Socioeconomic disadvantage can lead to the inability to pay for insurance and analysis has shown that socioeconomic disadvantage is particularly concentrated in high flood risk areas.

Independent analysis has shown that there is a significant number of properties where insurance may be unaffordable for flood risk. This includes:

- **Properties within more probable flood zones such as the 1 in 20 to 1 in 50 chance per year flood extent.**
- **100,000 properties where insurance is likely to be unaffordable within the 1 in 20 chance per year flood across NSW.**

The ability for homeowners in high flood risk areas to recover by accessing their insurance could influence whether the risk to remain in those places is tolerable for the community.

Equity considerations will also be relevant when assessing cost sharing approaches for responses to climate change impacts on coastal hazard risks.

Current challenges and gaps related to managed relocation (continued)

The size and cost of potential large-scale Statewide managed relocation is not well understood

Decisions around managed relocation that are made post disaster have the potential to set unsustainable expectations for the future. For flooding, there has been recent interest in managed relocation as an appropriate method for risk mitigation. However, the size and cost of what may be required under different criteria is not well understood. For example, there can often be a perception that all properties in the floodplain should be part of a buy-back scheme, without a full understanding of the number of properties this would entail.

Independent analysis has shown that the number of properties exposed to natural hazards, including flooding and coastal hazards, is significant:

- **In the 1 in 100 chance per year flood, there are more than 220,000 urban residential properties in NSW[97] affected by flooding, increasing to nearly 500,000 properties in the Probable Maximum Flood (or the largest possible flood event).[98]**
- **The number of buildings at risk from a 1% coastal erosion event is roughly 800 – 900, and this is expected to increase to around 3,300 in 2050.**
- **Around 1,800 residential properties are anticipated to be affected by tidal inundation with 0.5 metres of sea level rise, rising to 14,000 properties with 1 metre sea level.**

Further to flooding and coastal hazards, other natural hazards are likely to contribute to the demand for potential managed relocation funding. For example, in the 2019 – 2020 bush fires in NSW, around 2,500 properties were destroyed.[99]

Given the scale of the potential properties involved, care needs to be taken in setting an appropriate policy for managed relocation.

Preliminary analysis has been undertaken to provide an understanding of the potential scale of a managed relocation program for flooding at a Statewide level. This included application of criteria on tolerable risk used for the Northern Rivers Resilient Homes Program which targets properties at high and frequent hazard risk in more likely events up to the 1 in 500 chance per year extent. These criteria are not necessarily recommended to be applied but are intended to provide an understanding of the scale of implementing a program at a Statewide level.

If the criteria are extended to focus on all properties within the 1 in 100 chance per year flood extent, there would be 200,000 eligible with a current value of over $150 billion.

The influence of climate change is expected to further influence decisions around appropriate criteria for managed relocation. For example, Figure 37 over the page shows 2 example criteria for coastal erosion and tidal inundation and demonstrates the significant increase in potential funding required to meet the ongoing obligations related to the impacts of projected sea level rise.

> Application of the Northern Rivers Resilient Homes program criteria to all other floodplains across the State would mean over 12,000 existing properties would be eligible for managed relocation at a current value of around $10 billion, with the criteria including high hazard areas up to the 1 in 500 chance per year flood extent.

The graphs show that for example, the 14,000 properties affected by 1 metre sea level rise have a current value of around $18 to $23 billion.

Figure 37. Example of the potential number of properties for managed relocation under hypothetical criteria – coastal erosion (properties within 10% erosion extent left) and tidal inundation (right)

A large number of community critical infrastructure assets are located in high-risk areas

In addition to the private properties that could be affected by managed relocation, there is also a large amount of critical infrastructure and assets that could be impacted and require consideration.

For example, in NSW there are 64 police stations, 54 SES facilities, and 19 general hospitals in 1 in 100 chance per year flood extent. Schools, community centres, and other community critical infrastructure are also affected.

This is further outlined in the previously covered flood hazard and risk sections. A significant number of assets are also affected by coastal hazard, with over 800 kilometres of local roads that could be affected with 1 metre of sea level rise.

Community concerns and needs are complex and will affect the level of participation

Participation levels of various managed relocation programs have been variable, as can be seen below in Table 6.

Table 6. Examples of participation rates in recent managed relocation schemes[100]

Managed Relocation Program	Hazard	Participation Rate	Notes
Northern Rivers RHP	Flood	~55 – 70%	Based on status as of September 2023. Represents the number of properties registered for the scheme vs those that were not. Rates vary by locality.
Christchurch Residential Red Zone	Earthquake	>90%	
Grantham Relocation Scheme	Flood	~75%	Estimated based on a reported 100 properties relocated and 130 homes that were severely damaged in the 2011 floods.
Lower Prospect Creek Voluntary Purchase Scheme (Fairfield LGA)	Flood	~78%	Commenced in 1990, with the last property purchased in 2002. Strong opposition from remaining landowners.
Milperra Voluntary Purchase Scheme (Canterbury-Bankstown LGA)	Flood	~84%	Program commenced in 1984.

Community concerns and needs can be highly complex and are often location-specific. Under a voluntary program, the level of participation in a scheme can be dependent on several factors, such as those outlined in Table 7. Unless the barriers to community participation are adequately addressed, a number of properties and people will remain in high hazard areas regardless of the funding allocated. These complex issues highlight the importance of working with communities closely in any implementation of these schemes.

Table 7. Examples of factors affecting community participation. Source: Rhelm (2023)

Community Theme	Discussion
Perception of risk	The perception of risk within the community can affect the level of participation in a particular scheme. This perception of risk can be heightened immediately following a significant event, but conversely may be reduced if a natural hazard event has not occurred for a number of years. A further consideration is the perceived risk of moving elsewhere, as identified in International Federation of Red Cross and Red Crescent Societies (IFRC) Global Plan (2021). This may relate to some of the issues identified in this table (e.g. affordability) as well as many other community and social issues.
Sense of place	A strong sense of place and/or community can result in community resistance to relocate.[101] Further, the process of relocation can result in a significant loss of place value, having further psychosocial impacts.
Timeframes	Some managed relocation schemes are implemented following a major natural disaster. After a traumatic event, the community may require additional time to reach a decision to participate due to the psychosocial impacts of significant events. Conversely, schemes need to be agile. For example, some existing schemes have long lead times between a decision to sell and approval of funding, which may lead the individual to sell to another party.
Flexibility/options	It is important to offer choice and flexible options which reflect differences in circumstances for individuals. For example, the flexibility for an individual to relocate their house to the new site, if feasible, rather than the construction of a new home only. The general perception being the more rigid the scheme, the lower the participation.
Affordability	Affordability is a key consideration. In flood affected areas, for example, often the lowest cost housing is within the highest risk areas. Under a buy-back scheme, unless there is sufficient equivalently priced housing stock, the ability of many people to relocate becomes a significant issue. This can lead to affordability issues, particularly following a disaster event where individuals may already be under financial stress.
Groups with specific needs	While groups with specific needs, such as the elderly and people with disabilities are often the most at risk from a natural hazard, there can be many social barriers for them to relocate. Specific support is needed to relocate and integrate into new areas. While many schemes focus on the property owners, the displacement of tenants, particularly where similarly affordable dwellings may not exist in an area, becomes a challenge.
Social infrastructure/ support for integration	Provision of appropriate social support for integration into new communities can assist in improving outcomes, both for the relocated community, as well as the community that receives the relocated residents.
Diversity of views	More broadly, a community is not homogenous, and there can be a variety of perspectives and opinions.

Managed relocation for Aboriginal communities requires specific approaches and strategies

Connection to Country is a significant determinant of health and wellbeing for Australia's First Nations people and is a part of their self-determination. Connection to Country along with a range of other values and issues specific to Aboriginal people will require close consideration in any managed relocation program. Customised approaches are required.

The management of larger scale schemes are complex and require specialist disciplines

The management of a larger scale managed relocation scheme requires a range of skills, including specialists in community engagement, property purchase and acquisition, land development and financing.

Smaller scale schemes, such as the NSW Voluntary Purchase Scheme, have largely been delivered by local government. These have traditionally involved no more than a couple of properties per year. However, local government generally does not have the resources, skills and expertise to adequately manage and implement a larger scheme.

Limited funding for existing programs has caused a number of challenges

Managed relocation programs, such as the DPE Voluntary House Purchase Program, have generally had low levels of funding. This leads to a number of challenges, including:

- limited ability to develop specialised teams within State government to deal with this type of project
- unreliable funding for councils, making it difficult to implement voluntary purchases when there is a delay in gaining approval
- voluntary purchase for flooding is generally co-funded by council, which requires additional approvals through the councils, further delaying the purchase of a property
- various studies and plans will generally not consider these options as viable, given the challenges in seeking funding.

There may be potential opportunities to leverage private sector funding to assist in managed relocation, for example using potential planning mechanisms, such as transferable development rights, to provide incentive for intervention by the private sector. Research has explored this further from a coastal managed relocation perspective.[102] However, this approach could similarly be adopted in a flood context.

It may also become necessary to tailor the level of public funding and support to the needs and means of individual households. Public money will go further if those in a position to draw on their own incomes, wealth and insurance do so, at least up to a reasonable threshold.

Decisions around open space management are challenging

There is no agreed policy, funding or management framework for managing open space that is deemed too high risk for residential development. Where voluntary purchase schemes are implemented, a "checkerboard" effect can occur, where some residences are left, resulting in a patchwork of houses and open space. This means community infrastructure, such as roads and garbage services, need to be maintained despite a reduced rates base to pay for them. In areas with lower socio-economic resources, this open space can become unmaintained, causing amenity or health and safety issues. While there is potential for open space to be used for leisure facilities, or returned to its natural state or to Traditional Owners, a consistent approach to funding and management is required.

MANAGED RELOCATION CASE STUDY
Grantham QLD

Grantham residents were offered the chance to move to a new estate on a ridge after the 2011 flood
Source: Brisbane Times

Natural hazard

Flood

Scale

Community relocation of around **100 properties**

Cost

around **$30 million**

Description

In January 2011, the Grantham area, situated in Queensland's Lockyer Valley, was severely affected by flash flooding that resulted in devastating property damage and loss of life. Around 150 houses were severely damaged or destroyed and 12 people were killed. In response to the events of January 2011, the Lockyer Valley Regional Council committed to developing a master plan and land swap program for Grantham and the surrounding area.

Lessons learnt

The key factors for success[103] included community leadership, the speed of program development following the event, and that the program was locally driven. It was supported by the small scale of the relocation of around 100 properties and the fact that the Council sponsoring the relocation already owned a large tract of suitable land for relocation. This was further supported by the Queensland Floods Commission of Inquiry (2012)[104] which suggested it was a timely and effective floodplain management response.

While the program is generally seen as a success, community stakeholders have noted [105] that there were some challenges from a community perspective:

- timeframes were short and the speed at which people needed to decide may have compounded post-event stress and anxiety for some members of the community
- it provided the land only and eligible property owners were required to finance the build of their new home either through insurance pay-outs or other private means (or through relocation of their existing dwelling). This was challenging to finance for some members of the community and meant that some people were not able to participate.

CASE STUDY
Recent lessons from the Northern Rivers Resilient Homes Program

One of the homes purchased as part of the Resilient Homes Program in the Northern Rivers

The Northern Rivers Resilient Homes Program (RHP) is still being implemented, and it is too early to formally evaluate. However, there are significant learnings we can draw from community feedback, input from community leaders and organisations, council advice, and the experience of agencies responsible for implementing the program. These learnings have allowed us to respond, iterate, and evolve the program.

Implementing relocation after a major disaster is a poor second choice to proactive planning

In the Northern Rivers, it was understandable that the Resilient Homes Program was initiated after the devastating Northern Rivers floods of 2022. A similar scheme had commenced 6 months earlier in Queensland, providing a model. However, buybacks and relocation are highly disruptive and even divisive in a community. This is not an easy process to commence with a traumatised community, still suffering the impacts of a disaster.

It is by far preferable to work through the decisions and approach to relocation before a disaster, even though it is likely that communities may be most responsive to the need to relocate following a disaster.

Local community decision-making is essential to understand and address the specific needs of households

In the Northern Rivers, a specific agency was established to implement the program, and there was considerable pressure to provide clarity for the community as quickly as possible. Ensuring the best information is at hand and following appropriate processes while being as responsive as possible to the community is a balance that must be achieved quickly in a post-disaster environment.

After disasters, councils are often deeply disrupted. Their own elected officials, employees and infrastructure are often significantly affected. Their workload can become extreme and their financial capacity can become stretched beyond breaking point. Nonetheless, councils are a key stakeholder regarding relocation programs.

Councils are a step closer to the community than State Governments. They know their local areas and priorities and have responsibility for strategic planning and services. There are different models for council involvement, but in all relocations, councils should be deeply involved in decision-making using policies, tools, and funding programs available from the State, with Australian Government support.

As the program has progressed, there has been more active involvement of community leaders and councils in decision-making and ongoing amendments to policies to address emerging issues including:

- protection for tenants in rental properties
- greater flexibility for homeowners in the timing and sequence of purchases to match their needs for a new home, this can involve more

rapid release of funds for people who have new homes ready to purchase, and much more extended processes for people who need time to find and develop a new property

- relocation of homes to allow reuse of existing family homes and to reduce the cost of re-establishing on a new site
- reuse of materials from existing houses where a house cannot be relocated
- review and appeals processes
- consideration of home refits and raisings where buybacks are not a solution.

Recovery first, adaptation after

It became clear in the Northern Rivers that the program designed to move people out of harm's way for long-term reasons was not addressing the desperate and immediate recovery needs in some communities. While work was diligently proceeding on analysis of registered homes and rolling out the program, many people remained in inadequate and unsafe properties. Homes that were assessed as destroyed or severely damaged were prioritised for early buyback and over 500 temporary homes were provided to deeply affected households, but many people who did not meet this threshold were also in need.

In a post-disaster situation, it may be that repairs need to proceed on homes that may ultimately be bought back or relocated. This allows people and communities to recover at their own pace and be in a better position to make a considered decision on their future.

In the Northern Rivers there were Commonwealth programs to undertake such repairs, but they targeted a small group of the most financially vulnerable households. There were also NSW Government grants of up to $20,000 to allow people to undertake repairs and replace household goods but households have not taken up these grants or been able to use the funding in an effective way. Community organisations have provided a vital service in undertaking home repairs, particularly focused on functioning kitchens, bathrooms and habitable rooms free from electrical hazards, mould and damage. This was initially largely funded by private donors and charitable organisations, with the NSW Government now investing $5 million.

In any case, recovery after disasters should not rely on relocation programs that are, by their nature, disruptive, selective and lengthy to implement. This is particularly the case where there has been no approach to relocation agreed prior to a disaster.

Communities need time to digest and consider information about risk

In the Northern Rivers, there was an undertaking to determine and advise prioritisation of buybacks, raisings and retrofits by mid 2023. At that time, there were over 7,000 homes registered for the program (which has since grown to over 8,000). Because the scheme was focused on relocation and had finite funds, criteria for prioritisation was developed for buybacks that focused on risk to life. Established methods were used that reflect the heights and velocity of flood waters in the most likely scenarios. Maps were published with a view to explaining the approach and providing transparency and to show the risks to properties. This did not match expectations as people in the Northern Rivers were drawing on their experience of floods, particularly the 2022 floods, to form a view on where buybacks should happen. Flood mapping is a technical process and it was confronting for people to understand their property's high risk. It is also confronting for people who have experienced traumatic loss to be told that their home is not in the highest risk category (although it is in a high-risk zone).

This experience demonstrates that discussion of risk and adaptation should proceed long before a disaster with plenty of clear information, adequate time to digest that information and multiple opportunities for discussions to occur.

Relocation needs new home sites and affordable solutions

Many prospective recipients of buybacks face a challenge in finding another property within their means. In the Northern Rivers, there was no ready-to-go alternative land for relocation to occur and there was significant pressure on housing availability and affordability, and financial vulnerability. This increased the complexity of the program. Relocations should be expected to occur over several years with financial arrangements and houses that are transferrable between locations.

ACTION	RESPONSIBILITY	DELIVERED BY
Develop a State policy for large-scale multi-hazard managed relocation, drawing on the experience of the Northern Rivers and other jurisdictions, to decide the appropriateness of this response in disaster adaptation planning, which includes: • mechanisms to identify criteria for areas where risks are not tolerable • guidelines to allow strong community involvement and decision making (pre-disaster, post disaster) • funding principles between governments, councils, households and businesses • principles for communicating and publishing risk information • implementation of alternative productive uses for reclaimed open space (such as agriculture) or nature-based mitigation measures and other uses (e.g. parks) • relocation of critical infrastructure and government assets • governance for management of land for relocation to occur.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2025

DESIRED OUTCOMES

There is a State policy and framework for large-scale multi-hazard managed relocation of existing development with clear criteria and equitable arrangements for compensation. There is a clear understanding of which properties and assets meet these criteria, subject to alternative mitigation measures being considered.

This policy and framework would provide a structure to allow for the consideration of managed relocation as a potential mitigation strategy in the DAPs, Flood Risk Management Plans and coastal management programs (and other relevant natural hazard planning documents).

Adequate resourcing is provided at State level to ensure a sustainable program can be developed that is equipped with the specialist skills required to implement managed relocation.

Mitigation infrastructure

HAZARDS

Mitigation infrastructure is defined as structural measures that lessen or minimise the adverse impacts of a natural hazard event by reducing the exposure of assets and people to the hazard. It is a key risk reduction strategy that can significantly reduce the frequency and severity of hazard impacts.

Examples include:

- sea walls, shoreline controls, and beach nourishment to mitigate coastal erosion
- flood protection levees
- temporary water storage to mitigate floods
- slope stabilisation measures to reduce landslide risk.

Case studies detailed in pages 92-105 outline mitigation infrastructure options costs, benefits, and relevant key considerations. These case studies highlight:

- that any management action has associated environmental, social and economic impacts
- these impacts must be considered to comprehensively understand the benefits and costs
- this understanding informs the most appropriate management actions and associated investment decisions.

These examples are not exhaustive.

Key challenges in implementing mitigation infrastructure

Limited understanding of the relative effectiveness of mitigation infrastructure

Community perception can be that engineered mitigation infrastructure will provide protection against natural hazard events. However, while mitigation infrastructure can significantly reduce risk, it does not eliminate it.

There are limitations in our ability to fund, design, construct and maintain the infrastructure. For example, in some locations, it is not feasible from an engineering perspective to reduce risk to an acceptable level without significant costs to natural, social and economic values. Mitigation infrastructure should be considered in conjunction with other tools to ensure the best possible combination of management actions are identified.

Consideration of large-scale infrastructure mitigation measures can be limited

A large-scale infrastructure mitigation measure can be difficult to develop and implement where it involves multiple jurisdictions or is of such complexity that it requires State resourcing, leadership and management.

Under the NSW Floodplain Management Program and NSW Coast and Estuary Management Program, planning and responses to manage flood and coastal hazards are undertaken by local government with funding and technical support from the NSW Government. In the case of mitigation infrastructure for landslide mitigation, roles and responsibilities primarily lie between councils and Transport for NSW. Measures adopted through these processes are generally locally focused which can limit the consideration of regional solutions.

Any place-based investigations should consider whether large scale or complex infrastructure can provide a more effective solution.

However, the capacity for councils to deliver larger scale infrastructure solutions that cover multiple LGAs can be limited. For example, a large-scale offshore beach nourishment program can be challenging to deliver at a local government level due to legislative and approval requirements and implementation costs.

Mitigation infrastructure needs ongoing monitoring, maintenance and compliance

The ongoing effectiveness of mitigation infrastructure requires continued investment in maintenance to realise the benefits of the original intervention. Without ongoing monitoring, maintenance and compliance, the risk of failure can gradually increase as the function of the infrastructure is reduced. For example, Figure 38 shows reduced flood protection for a typical levee bank with underinvestment in maintenance.

For some infrastructure, such as detention basins and levees, this underinvestment in maintenance and monitoring can lead to potential failure risk and associated significant consequences. While some infrastructure has a regulated compliance requirement, such as that set out by Dam Safety NSW, other infrastructure, such as levees, does not have the same level of regulation.

There is ongoing work in the NSW Government to improve the understanding of existing assets, including their condition and maintenance requirements. The DPE has developed levee audit guidance to assist local councils in implementing regular audits of their flood levees. However, a key challenge is the availability of sustained funding for periodic audits and maintenance.

The capacity for government, and in some cases the private sector, to fund the maintenance of these assets can be limited. Whole of life cycle costs for existing and new infrastructure requires committed funding to realise their risk reduction benefits.

Figure 38. Influence of maintenance on levee performance (adapted from Public Works Advisory, (2022)[106])

A residual risk remains for areas protected by mitigation infrastructure

Mitigation infrastructure is generally designed to withstand up to a certain magnitude or size of natural hazard event.[107] Above this magnitude, the area protected may experience similar or higher risk than before the mitigation was implemented. Concurrent with the limit is the risk of exceedance over the design life. For example, a coastal revetment (like a barricade) might be designed to withstand a 1 in 100 ocean storm event with a design life of 50 years, but there is approximately a 30% chance that the design event will be exceeded over that life. Flood levees, for example, will be designed for a certain size flood event (say the 1 in 10 chance per year flood event). For example, the North Wagga levee provides protection up to approximately a 1 in 8 chance per year flood event,[108] but is exceeded in greater events, causing flooding and inundation of the properties behind the levee for a number of days. Residents behind the levee may not understand the level of protection is limited and may delay evacuation posing a risk to life. This is often referred to as the levee paradox.

Delivering mitigation infrastructure is complex and can be controversial

There are multiple factors and values that should be considered when assessing options for mitigation infrastructure, and the community needs to be engaged to understand its concerns. For example:

- While sea walls can protect infrastructure and homes, they have the potential to impact the environment, amenity, and recreational value of the beach.
- Levees and conveyance solutions that change the flow behaviour of a river may have an adverse impact on downstream environments, such as wetlands.
- Flood mitigation dams where water supply levels are lowered to create airspace to temporarily mitigate floods can have significant impacts on water security and water sharing arrangements.

In Australia, development proposals for interventions require detailed assessment to evaluate the benefits of flood mitigation against impacts to biodiversity, Aboriginal cultural heritage and social values. These projects are often expensive to implement and must deliver significant quantifiable benefits which can be difficult to achieve outside highly populated areas. This is an important measure to consider, and should be accompanied by significant community engagement and an understanding of the long-term benefits and impacts of the project.

Specifically, mitigation infrastructure proponents need to work closely with Native Title holders through all phases of mitigation infrastructure projects (early planning to delivery) to ensure that Native Title rights are respected.

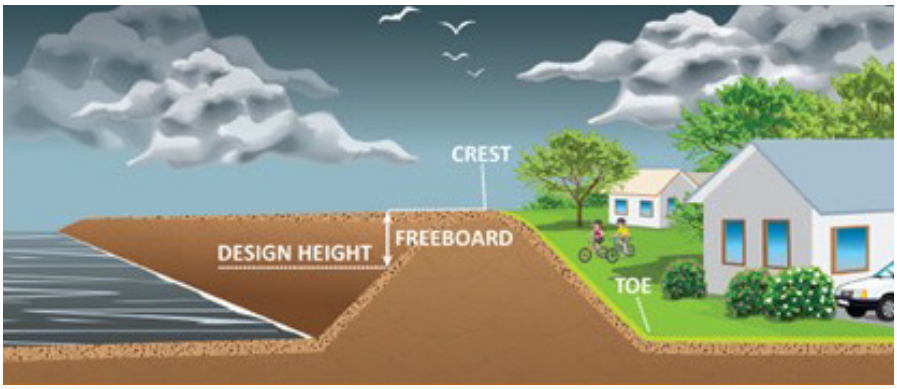
Landslip on Armidale Road, Devil's Nook. Source: Kempsey Shire Council

Mitigation infrastructure options

Levees

A flood levee is a physical barrier to floodwaters, providing protection for a community up to the levee design flood event. A levee can comprise of the levee structure, together with gates, pumps, drainage and spillway systems.

For events in excess of the design flood event, overtopping will occur and result in inundation of the area behind.



Sectional view of typical levee. Source: SES[109]

Natural hazard

Flooding & coastal inundation

Cost

Costs can be highly variable and depend on the complexity of the levee. Costs can range from $7 million to in excess of $25 million per kilometre of levee.

Benefits

The key benefit of levees is the protection they provide up to their design flood event. This can significantly reduce, for the community, the frequency of impacts and flood damage and the risk to life, for events up to the design event for the levee.

Levees need to provide significant benefits to the community for them to be viable, this includes protecting sufficient assets.

Considerations

Maintenance: if the levee is not maintained throughout its design life, then the condition of the levee, and its associated protection, will reduce at an accelerated rate. Previous investigations demonstrates the service life can be significantly reduced if a low maintenance regime is adopted.

Failure risk: levees are always at risk of failure, however low, but this may be exacerbated if not constructed properly, or maintained, which may lead to more significant consequences than if the levee was not there. While some levees may have a significant consequence of failure, they may not be adequately managed, audited or maintained to ensure they function as intended.

Residual risk: there remains a residual risk for those flood events in excess of the design flood event for the levee. Levees can instil greater community confidence, leading to complacency toward the flood threat, such as delaying evacuation which increases the risk.[110]

Additional development: protection provided by the levee may encourage additional development up to the design flood event, leading to greater risk in rarer and more extreme events.

Flood behaviour impacts: while the levee will prevent entry of water into a particular area of the floodplain up to its design event, the resulting loss in flood conveyance and storage may result in adverse flood impacts on other areas if the levee is constructed in a floodway or flood storage area. This will need to be considered in the design. Unless drainage is appropriately designed, levees can cause adverse impacts on local catchment runoff.

Land impacts: levees require available land on which to be constructed, which will either result in the reduction of environmental land or the acquisition of private land.

Temporary water storages (dams and detention basins)

Temporary water storages provide an opportunity to 'hold back' some flood water and release it at a slower rate. Temporary water storages can come in a number of different forms:

- **Detention basins:** are usually kept as dry storages during non-flood events. They are often incorporated as a part of parks and reserves and are allowed to inundate during the event.

Example flood detention basins – Foothills Rd, Mt Ousley[111]

- **Dams:** can only be relied on where there is sufficient air space above the normal operating level to provide for flood storage. Most dams are primarily designed as water storage facilities, but some dams, like Wivenhoe in Queensland, have a flood detention storage incorporated as a part of their design.

Natural hazard

Flooding

Cost

The costs of detention basins can be highly variable and depend on the type of construction as well as the land required. They generally tend to be implemented for smaller catchments, as the storage, land area, and associated costs become significantly greater as the catchment area increases.

As an example, recent cost estimates for a detention basin of around 300ML for 8km^2, were over $5 million.

A cost for a 10GL storage, for example, may be anywhere between $50 million to $200 million and greater.[112]

Benefits

Temporary storages can reduce the downstream peak flood flow, reducing the peak flood levels in an area. The level of benefit depends on the type of flood behaviour that occurs downstream.

Considerations

Potential impacts on flooding: while detention basins perform relatively well where flow is the primary driver of the flood behaviour, they can be less effective where volume is a key driver of flooding, as the detention basin will only delay the runoff volume. In some cases, delaying the runoff volume may exacerbate the flood behaviour downstream. Maintenance is another challenge of detention basins – these can fill up with silt and debris and lose capacity.

Dam safety risk: while a detention basin can assist in reducing flows for the design flood event, it introduces a different risk associated with dam failure. Depending on the size of the storage and the risks downstream, a detention basin may be "declared" by Dam Safety NSW. A declared dam may result in additional maintenance requirements and studies, larger capacity spillways and design, to accommodate larger and more extreme flood events than the design flood event.

Environmental impacts: temporary storages can require a large footprint, both in terms of the dam wall/embankment, as well as the temporary storage area. This can result in environmental impacts for sensitive areas, together with potential need for land acquisition. They can also temporarily increase upstream flood levels and impact underwater cultural heritage.

Flow and drainage solutions

Flow and drainage solutions aim to increase the capacity of the channel flow, to reduce the overbank flow in an area. They can involve a range of measures such as improving the capacity of an existing channel (for example, widening a channel) or creating a diversion channel.

Flow and drainage to new housing

Natural hazard

Flooding

Cost

The cost of these solutions is highly variable, given the range of potential options that might be implemented.

Benefits

The benefits associated with these measures include reduced overbank flows and reduced impact on the community. The level of benefit is dependent on the design flood event.

Considerations

Maintenance: ongoing maintenance is required to ensure the conveyance solution performs as per the design. This may include continued removal of vegetation from a channel or ensuring sedimentation occurs within a bypass channel.

Transfer of flow: the improved conveyance can result in transfer of flow more quickly downstream, which can then impact communities in those areas. It may impact on velocities and flood heights upstream. Impacts are often under-estimated and disregarded.

Environment: there can be impacts to riverine geomorphology e.g. alignment, erosion and deposition, and other environmental implications including removal of riparian vegetation, and potential impacts on sensitive environmental features downstream (e.g. wetlands) which may be affected by faster or more frequent inundation. Underwater cultural heritage can also be impacted.

Sea walls/revetments ('hold the line')

A 'hold the line' approach seeks to prevent the erosion through physical barriers such as sea walls and revetments – a type of coastal protection work which shields assets from coastal erosion by armouring the shore with erosion–resistant material. Large rocks/ boulders, concrete or other hard materials are used, depending on the specific design requirements.

Collaroy Beach sea wall, Sydney (March 2023)

Natural hazard

Coastal erosion & coastal inundation

Cost

Preliminary analysis shows that construction costs for sea walls and revetments in the past range from $10,000 to $40,000 per metre, with costs influenced by construction materials, design standards, and characteristics of the coastal processes impacting the site. This does not include maintenance costs, such as that required to nourish sand in front of the wall to maintain the beach or to rebuild the structure at the end of its life.

This also does not include the cost of environmental and social impacts (detailed in considerations over the page).

Benefits

Sea walls provide a benefit to private property and public assets by protecting them from coastal erosion and, where they are designed for this, coastal inundation.

Previous work has shown that under the right circumstances, a sea wall can achieve a positive benefit cost ratio. However, it is important that this type of economic analysis also includes considerations of the beach amenity loss, the impact on natural coastal processes away from the site, and potential environmental impacts.

Considerations

Ongoing maintenance: coastal protection structures require ongoing maintenance to successfully maintain their protection function throughout their design life.

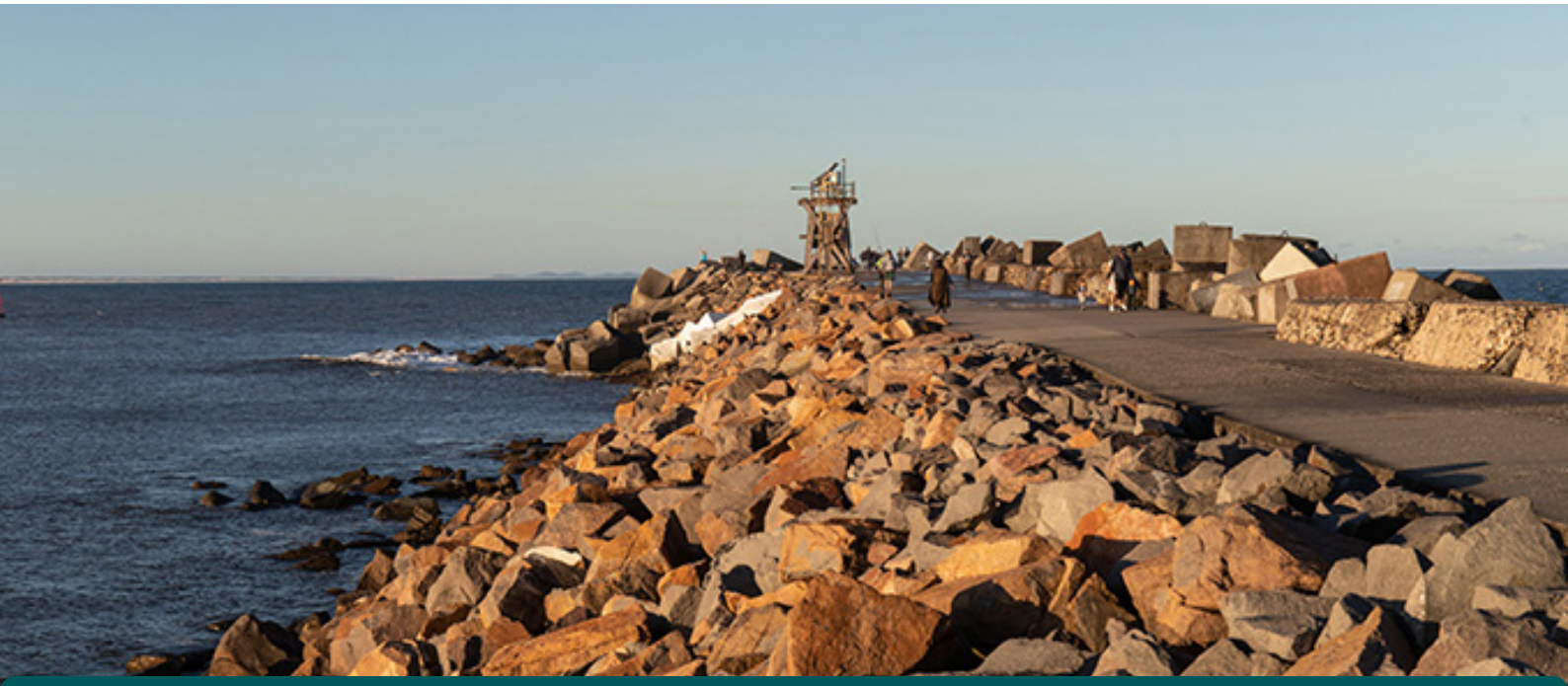
Loss of beach amenity: unless beach nourishment accompanies a sea wall there will generally be a progressive reduction in beach width under projected sea level rise or in some circumstances, a complete loss of the beach over time. This can impact on public access and other elements of beach amenity. Extra beach nourishment may be required to compensate for this loss. Coastal protection structures can also interfere with natural coastal processes, impacting on shorelines beyond the footprint of the structure. For example, end effects of sea walls can exacerbate erosion where the structures end, effectively transferring any erosion issues to adjacent properties (referred to as 'edge' or 'end' effects).

Environmental impacts: coastal protection structures on the open coast generally replace a natural dune system (where present), which can provide important habitat for coastal species. While some ecofriendly designs can be incorporated, a reduction in this habitat type is likely. Underwater cultural heritage can also be impacted.

Limitations of controls: the type and form for the protection can be limited by the types of planning controls in place. The NSW coastal framework contains several controls on the design, approvals, funding and management of coastal protection structures. For example, Section 27 of the *Coastal Management Act 2016* specifies the conditions under which development consent can be granted for coastal protection works. This ensures such projects will neither limit public access to beaches or headlands nor pose safety threats.

Funding: the current position of the NSW Government is that coastal protection works that primarily provide a private benefit are eligible for less funding compared to works providing public benefit, with the remainder to be funded by the properties benefitting. There are also challenges in getting agreement from property owners (particularly where the works span multiple properties) to fund the sea wall or revetment.

Limited design life: coastal protection structures have a design life and with sea level rise and natural recession, their performance will inevitably degrade over time, eventually requiring replacement, refurbishment, or upgrade.



Example of coastal revetment at Newcastle, NSW

Shoreline controls

Shoreline controls include measures such as groynes (a structure usually built perpendicular to the shoreline to trap littoral drift of sand or reduce shoreline erosion)[113] and breakwaters (a structure built into the sea to protect a shoreline from wave erosion). They seek to reduce erosion by preventing or reducing littoral drift along a beach, trapping sediment in the desired location. Large shoreline control structures can act as an artificial headland, modifying wave energy and altering the shoreline geometry in the wave shadow of the structure.

Example of a groyne system at Silver Beach in Kurnell NSW. Source: Nearmap

Natural hazard

Coastal erosion

Cost

The costs for shoreline controls are highly variable and depend on the scale of works and local site characteristics.

Benefits

Groyne systems and other shoreline controls can effectively trap sand, causing a build-up of the shoreline in front of the targeted area. This depends on a reliable supply of sand being transported alongshore into the structure.

Considerations

Downstream impacts: generally, shoreline controls result in a reduction of sand migration beyond the control, causing erosion in new locations, or exacerbating existing issues.

Ongoing maintenance: shoreline control structures require ongoing maintenance to successfully maintain their protection function throughout their design life.

Reduced beach amenity: as unnatural and prominent structures, groynes can reduce beach amenity, especially when they block alongshore access for beachgoers. While some groynes are used for recreational fishing, the large boulders can be difficult to traverse and can pose a threat to public safety.

Sand management

Sand management involves the movement of sand, usually within the same coastal compartment. These activities consider the natural coastal processes and an understanding of sediment transport patterns and sediment sinks. Sand management can involve interventions with respect to longshore transport as well as on-shore/off-shore transport (for example, beach scraping).

Dredge in entrance of Narrabeen Lagoon in 2021

Natural hazard

Coastal erosion

Cost

The cost for sand management is highly variable and depends on local site characteristics and the frequency/magnitude of coastal erosion events. Unless they involve a permanent pump/pipeline solution, these works are typically recurrent, and planned to occur periodically to maintain the protection benefits over time.

For example, the Narrabeen Lagoon entrance clearing and associated sand backpassing (via truck) moves an estimated 30,000 – 40,000m^3 per campaign (roughly every 3-5 years) at a cost of about $1 million. Comparatively, the Tweed sand bypass system (a fixed pump and pipeline system) moves about 500,000m^3 per year with an annual operating budget of about $6 million.

Benefits

Sand management activities are designed to work with existing sediment processes, while accelerating or reversing some aspects in order to achieve a desired shoreline. A managed shoreline can offer increased protection by maintaining a sand buffer in front of exposed assets. Sand management can also preserve beach amenity by maintaining sandy beaches, public access, and natural coastal processes.

Considerations

Limited protection: while sand management can increase the sand buffer in front of exposed assets, it mostly serves to maintain the optimal shoreline within the beach's natural range. A severe erosion event is likely to deplete the protection offered by sand management activities.

Frequent reoccurrence: sand management activities require frequent and repetitive implementation to provide ongoing benefits.

Downstream impacts: when sand is artificially kept in the system via sand management it can reduce the sediment supply to locations down-drift of the natural transport pathway. Over time, as campaigns are repeated, this can have a cumulative effect away from the management site.

Impacts on beach amenity: sand management activities must consider a range of potential impacts on general beach amenity. Works must consider the seasonal variation in coastal processes and resulting beach profile fluctuations, threats to beach fauna, seasonality in beach usage, and favourable conditions for dune revegetation (which will accompany sand management to stabilise relocated sand).

Beach nourishment

In general, beach nourishment involves the introduction of additional sand from outside the active beach system, thereby artificially increasing the local sediment. In NSW, sand for beach nourishment typically comes from marine sand causing navigational issues within an estuary, as beneficial reuse of dredged material from nearby waterways. However, it can also be sourced from offshore areas. Beach nourishment using offshore sources involves obtaining marine sand from deep water and relocating it en-masse into the active beach profile.

Dredge pumping sand from offshore into the active beach zone[114]

Natural hazard

Coastal erosion

Cost

To understand the potential cost of applying this mitigation measure, a preliminary analysis was undertaken to understand the potential protection required.

It is estimated upwards of 50km of NSW coast may require some form of coastal protection by 2050. The estimated total volume of sand needed to maintain and enhance existing shoreline profiles and provide a storm safety allowance[115] is around 55,000,000m^3, noting this nourishment might occur over a number of years. Further volume may be required to maintain beach amenity at other beaches across the State if a very large storm occurred.

Costs can vary substantially based on the source of sand and distance to transport the material from the source. An estimated cost range is upwards of \$15/m^3 – \$50/m^3 depending on volume, distance, depth, and vessel.

These costs are preliminary and require further assessment.

Large scale beach nourishment requires significant funding commitments, and there is a community expectation for future nourishment. Typically, these projects need a large internationally sourced dredging vessel, which comes with substantial cost. A large-scale Statewide program would be more cost-effective, but it also requires significant coordination and planning.

Benefits

Beach nourishment, when implemented to contemporary standards[116] and with sufficient appropriate material, offers substantial protection from coastal erosion, albeit temporarily when considering longer timeframes or successive erosion events. Sand placed on beaches is subject to natural coastal processes and behaves as a natural dune would, eroding and accreting in a cyclical fashion depending on conditions.

Additional benefits include preservation of beach amenity by keeping a sandy beach with full access and public safety benefits.

Wamberal Beach, Central Coast, NSW

Considerations

Sand compatibility: matching sediment characteristics (grain size, shape, mineralogy) to the natural beach is important in ensuring the longevity and effectiveness of nourishment.

Sand availability: there are vast quantities of useable sand on the inner continental shelf of NSW in water depths ranging from 20m to 70m. Accessing these sand reserves economically is a challenge requiring the mobilisation of large dredgers from overseas.

Time to implement: obtaining approvals for exploration licences and environmental approvals takes time before any actual offshore nourishment can commence.

Regular reoccurrence: beach nourishment activities require regular implementation to provide ongoing benefits over time.

Environmental impacts: include changes to wave refraction, beach shoreface impacts, burial of reefs and underwater heritage items, such as shipwrecks, and disturbance of sea floor habitats.

Landform change

There are large areas of low-lying land that will become increasingly subjected to regular tidal inundation and temporary coastal inundation with the impacts of climate change. Landform change as a mitigation measure looks at progressive raising of land as lots are redeveloped to gradually achieve a longer-term higher landform to offset the impacts of climate change.

For example, large parts of Davistown and Empire Bay in the Central Coast will become affected by sea level rise between 2050 and 2100, leading to significant challenges in the viability of residential dwellings in that area. A masterplan was developed by Central Coast Council for the 2 suburbs to leverage the anticipated redevelopment of around 800 homes in the next 50–100 years. This masterplan provided guidance on potential fill depths as properties were redeveloped, as well as a staged approach to raising the roads within the urban area.

Map showing areas below 1 m AHD[117] in Davistown, Central Coast Council (source: Rhelm[118])

Natural hazard

Tidal inundation, coastal inundation

Cost

Costs associated with this type of mitigation can be spread over a number of years and will depend on the depth of fill required. From projects like the Davistown case study, the assumption is generally that the fill only occurs when the property is redeveloped, and therefore the net cost of this mitigation measure is associated with the filling of the land.

Based on a sea level rise of 0.5 metres, and a typical property size of 500 to 1,000m^2, the cost of fill would be in the order of $12,000 to $25,000 per property.

However, in addition to the property, surrounding roads and services (such as water supply, drainage, power etc) also need to be raised. Rhelm[119] provided an estimate of these costs for the road network and services in Davistown. On a per property basis, this cost represented around $75,000 per property.

Therefore, in total, the cost per property inclusive of surrounding roads and services is around $100,000. However, this estimate depends on the density of residential dwellings relative to public infrastructure services.

Benefits

There are a significant number of properties exposed to tidal inundation under projected sea level rise scenarios. These properties will progressively become unviable unless mitigation is implemented. Raising the properties and supporting services in this way provides one way to mitigate against loss of land.

Considerations

Differences in timing: there are challenges in the interim period when individual properties fill, but neighbouring properties do not. Consideration is required for the potential for retaining walls and requirements around groundwater to be managed.

Suburb age: in newer suburbs, the turnover of housing stock may not be as great as a locality such as Davistown. Therefore, this option may not be suitable in these types of areas.

Infrastructure timing and cost: the raising of roads and services in the surrounding areas needs to be staged to align with property filling. While the costs can be somewhat spread, there will still be substantial public infrastructure upgrade costs required.

Impacts on neighbouring areas: impacts on surrounding properties, including drainage and flooding impacts, would need to be considered.

Landslide at Oxley Beach, Port Macquarie

Storm surge barriers

Storm surge barriers are engineering structures designed to prevent sea water from flooding inland areas during storm surges. They play a crucial role in coastal defence in many parts of the world. Some notable examples of storm surge barriers are provided below.

These barriers vary in design, size, and function, but they all serve the primary purpose of protecting densely populated, major metropolitan coastal areas from storm surges. Some are permanent structures, while others are movable and can be activated when needed.

Thames Barrier (top)[120], Maeslant Barrier, Netherlands (left)[121] and New Bedford Hurricane Barrier, USA (right)[122]

Natural hazard

Tidal inundation, coastal inundation

Cost

Storm surge barriers are immense infrastructure projects with associated design, construction and maintenance costs. The total cost of a storm surge barrier is highly dependent on site-specific characteristics. Some indicative costs[123] for international examples are provided below:

- Thames Barrier (UK) – A$3.1 billion
- Maeslant Barrier (Netherlands) – A$1.9 billion
- The New Bedford/Fairhaven Hurricane Barrier (Massachusetts, USA) – A$0.3 billion
- The Saint Petersburg Dam (Saint Petersburg, Russia) – A$6.0 billion
- Venice MOSE Project – A$9.2 billion
- Ike Dike (Texas, USA) – A$31 billion
- The Verrazano-Narrows Storm Surge Barrier (New York, USA) A$10.2 billion

In addition to the capital costs, there can be large operational costs for some of this infrastructure. For example, the Venetian MOSE project reportedly costs nearly $500,000 for each closure, with 13 closures in 2020 and 20 closures in 2021. Similarly, the Thames Barrier is estimated to cost around $12 million per year.

In addition to high costs, there are significant potential environmental costs to such a large-scale intervention, such as modifications to the estuarine water level regime. If this approach were to be implemented, it would likely be supported by large scale nature-based solutions that would seek to offset environmental impacts and adjust to the altered estuarine water level regime.

Benefits

Storm surge barriers offer several benefits when compared to other methods of reducing risk from storm surges. Some of the primary advantages include:

- **Effective protection:** when designed and maintained properly, storm surge barriers can provide almost immediate protection against incoming surges, reducing the risk of flooding in vulnerable areas.
- **Flexibility:** movable barriers, like the Thames Barrier or the Maeslant Barrier, can be opened or closed as needed. This allows for normal tidal flow and navigation when the weather is calm but offers protection during storm events. This can also minimise the impact on estuarine intertidal habitats.
- **Economic benefits:** by protecting densely populated and economically vital areas from flooding, these barriers can prevent billions of dollars in damages. They can also safeguard critical infrastructure like ports, industrial areas, and transportation networks. With the assurance of protection from storm surges, areas behind the barriers can see increased urban development, tourism, and economic growth.
- **Long-term solution:** once constructed, storm surge barriers provide protection for many decades, making them a long-term solution to the threat of rising sea levels and increased storm activity.

Considerations

NSW coastal context: storm surge barriers are typically only practical to protect major metropolitan or industrial areas at high risk from storm surge. Importantly, to maintain an open connection to the ocean required by such places, any barrier would need to be movable and therefore only closed in anticipation of extreme water levels. Due to its geographical context, NSW is not subject to substantial storm surge levels, especially when compared to other cities where this approach is being implemented. This is an important consideration because a movable barrier would not protect against tidal inundation, which is a long-term risk. Additionally, many of the coastal waterways in NSW are subject to significant flooding from catchment rainfall, and the installation of a storm surge barrier would likely reduce the conveyance capacity of waterways, increasing the risk from coincident catchment and oceanic flooding.

Maintenance and failure risk: regular maintenance and monitoring are essential, which means ongoing costs and potential vulnerabilities. A mechanical or structural failure in the barrier could lead to catastrophic flooding. The presence of a barrier can lead to complacency among residents and policymakers, instilling a false sense of security, and potentially neglecting other essential disaster preparedness measures.

Significant environmental disruption: storm surge barriers substantially alter numerous environmental processes including tidal movements, sediment transport, and ecological interactions. Introduction of such a structure would cause a significant and irreversible shock to these processes, requiring a long timeframe to reach a new equilibrium. This would incur uncertain and complex changes to the system, potentially introducing additional management challenges. Underwater cultural heritage can also be impacted.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Review governance and funding arrangements for levee maintenance.	**Partners:** Department of Climate Change, Energy, the Environment and Water & NSW Reconstruction Authority	Early 2025
As a first step, assess the feasibility of large-scale offshore sand reserves and other sources for beach nourishment including locations where it might be suitable.	**Partners:** Department of Climate Change, Energy, the Environment and Water & NSW Reconstruction Authority	Mid 2025
Explore infrastructure mitigation options for landslides.	NSW Reconstruction Authority	Mid 2025

DESIRED OUTCOMES

The relative effectiveness and implementation risks of large infrastructure mitigation measures to manage natural hazard risk is understood.

There is capacity and funding to assess, plan, deliver, and maintain effective large scale mitigation infrastructure.

Bombo Beach, Kiama. Source: Kiama Council

Strategic planning controls

ALL HAZARDS

Strategic planning controls are a key tool to consider natural hazard risk in land use planning legislation. They can support future development being located in areas where risk is more tolerable for community and government.[124] Controls can be prepared to respond to any natural hazard and address future development in areas that are currently developed (brownfield) as well as future development in areas that are currently undeveloped (greenfield).

There are 3 main types of planning controls:

1. **Zoning of land** establishes a prescribed list of permitted and prohibited types of development for particular areas. Zoning can be used to limit or increase residential densities, restrict employment uses to limit their impact on nearby development, and to set aside land for public space, recreation and environmental purposes.
2. **Land-based exclusion controls** establish rules which prohibit certain types of development – say, residential dwellings or residential care facilities – from being approved on land that has particular characteristics. This can include, for example, being positioned in a floodway or having a certain bush fire attack rating.
3. **Development controls** can limit the physical characteristics of development, such as the height, setbacks, landscaping requirements, etc.

Planning controls can establish what development is permissible on certain land. For example, land may be too hazardous for residential care facilities or residential development due to risks such as the ability to evacuate safely but may be suitable for employment use or agriculture where this risk is more manageable.

Current challenges related to planning controls for disaster risk reduction

- The number of future assets and properties exposed to significant natural hazard projects will continue to grow under current planning controls.
- There is ongoing pressure for new housing in both regional and metropolitan areas, including housing required to support relocations for purposes of adaptation.
- There are no agreed processes to balance tolerable hazard risk with housing supply and development. This means there is currently no agreed criteria and thresholds for what makes land 'too hazardous' for different types of development across all natural hazards. For example, there are currently no clear planning controls on most sensitive uses such as hospitals across all natural hazard risk.
- Planning controls have generally been developed on an as-needs basis, rather than in a proactive, strategic and standardised manner, and have focused on individual hazards. This has resulted in inefficiencies and high resourcing requirements for both State and local government when attempting to implement planning controls.
- Planning controls also need to be considered in the context of other risk reduction options in place, such as mitigation infrastructure and evacuation infrastructure. This requires a holistic place-based assessment such as that offered by DAPs.

CASE STUDY OF FICTITIOUS LGA (KOALA BAY)
Where we want to get to

Shellharbour. Source: Shellharbour City Council

After witnessing the recent damage caused to housing and to major transport and evacuation routes from landslides following floods in 2022, council planner Eva begins a proactive project to identify landslide-prone land in her LGA (Koala Bay). Relying on nationally agreed standards of risk for landslides and technical expertise from geotechnical engineering studies of Koala Bay, Eva's project categorises all land in the area (both publicly and privately owned) into 4 geotechnical hazard categories – minimal, low, medium and high hazard – based on geology and slope.

Using these categories, Eva and her team draft new planning controls for Koala Bay, restricting sensitive developments like residential care facilities and hospitals from being built in the highest hazard areas. They also develop new engineering requirements for all building applications for low, medium, and high hazard land, to ensure the design of new developments factors in the potential for landslide.

As planning controls will not have eliminated all risk, and having identified the council assets and roads with the highest hazard risk, the Koala Bay council begins an infrastructure renewal project to identify required infrastructure resilience engineering work to mitigate and minimise the impact of future landslides. As a result, the council starts urgent work on 2 council roads to ensure local evacuation routes are as safe and secure as possible before the next storm season.

Current arrangements and work underway

There is significant and ongoing work to build on existing measures in the planning system to manage and mitigate natural hazards, including:

- existing hazard specific controls, e.g. cl3.5 of the Codes State Environmental Planning Policies (SEPP) specifies that housing is not / may not be carried out as complying development in a flood storage area or floodway , cl1.19 prohibits new residential, industrial and business development in coastal hazard areas
- existing and ongoing work and processes to consider bush fire risk in planning
- the guide: 'Planning for a more resilient NSW: A strategic guide to planning for natural hazards'
- current and proposed work relating to standard instrument Local Environmental Plan (LEP) hazard clauses
- National Cabinet investigation / paper on principles for development on floodplains – led by NSW.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Develop a library of standard planning controls for all natural hazards for councils to apply which: • address the key issue of heatwave, commence with 'keeping houses cool' planning controls e.g. roof colour (building on recent BASIX changes) • provide controls for sensitive development e.g. hospitals • ensure councils are appropriately trained to access, consider, prioritise and apply controls.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2024 Mid 2025
Develop a framework and supporting process and tools for determining tolerable natural hazard risk for different development types and land uses; and plan to implement through land use policy and legislation.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	2025

DESIRED OUTCOMES

NSW has an agreed framework, including process and tools, to develop planning controls to proactively restrict future development in high-risk areas, including:

- criteria that identifies what risks are tolerable for different developments
- mechanisms for communities to decide what is tolerable risk
- managing housing supply and affordability implications.

The framework is embedded in land use policy and legislation and applied through local and regional processes in DAPs. This makes it easier for local government to put planning controls in place that protect communities from hazards, encourage adaptation, and outline appropriate standards for new development.

Warning systems

ALL HAZARDS

Warnings provide point-in-time information about a hazard that is impacting, or expected to impact, a community. It describes the impact and expected consequences and advises what people should do.[125]

Providing warnings is a critical part of emergency response and warnings are important for many reasons:

- they save lives and minimise harm by facilitating protective action
- they empower people and foster shared responsibility
- communities expect government agencies and emergency services to provide timely and targeted warnings.[126]

A warning system is the complete process of:

- monitoring and predicting threats from hazards
- communicating warnings to those likely to be affected about the expected impacts and consequences
- advising communities what to do and / or where to go.

Failure in one of these steps, or lack of coordination across them all, can lead to failure of the whole system.[127]

This Plan focuses on monitoring and predicting threats, with particular focus on the infrastructure component. The other stages of the total warning system process are the focus of emergency response agencies.

Current work underway to improve monitoring and predicting threats includes

> $15 million program funded under the Australian Government's Emergency Response Fund coordinated by the Department of Climate Change, Energy, the Environment and Water to improve warning systems in coastal catchments[128]

> A national investment of $236 million in flood warning infrastructure from 2023 to 2033 led by the Bureau of Meteorology[129]

> RFS has a range of innovative work underway including satellite detection for enhanced bush fire predictions.

Current challenges related to monitoring and predicting threats

Ownership: there are currently complex ownership and access arrangements for flood gauges, and there is no one government agency responsible for installing and maintaining them. This creates complexity for consistency of upgrades and maintenance compliance.

Installation: it can be difficult to install new gauges due to planning and environmental considerations.

Scope and coverage: the scope and coverage of the current rain and river gauge network can be improved – which has previously been identified in various audits led by NSW Government and the Bureau of Meteorology.

Purpose: gauges are often installed for reasons other than flood prediction.

Funding: gauge owners may not allocate sufficient ongoing funding for asset maintenance or reconstruction following hazard events.

Market capability: in addition to limitations in funding, there is limited market capability to install or upgrade gauges and integrate them into the gauging system.

Technology: there are a range of new sensor technologies coming onto the market, particularly for bush fire, and NSW has strong capabilities and systems in remote sensor research. These technologies require testing, verification and then integration into warning systems arrangements with the Bureau of Meteorology. Recent disaster Inquiries outlined a need to investigate these options, particularly for bush fires.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Develop a strategic management plan for the NSW flood gauge network, and include solutions to the identified challenges of ownership, maintenance, and ongoing funding arrangements.	**Lead:** Department of Climate Change, Energy, the Environment and Water **Supporting agency:** NSW Reconstruction Authority	Mid 2025
Conduct a technology pilot program to evaluate the functionality, effectiveness, and reliability of intelligent sensors as part of flood and / or bush fire warning systems, and implement technology.	**Lead:** Office of the Chief Scientist and Engineer **Supporting agencies:** NSW Reconstruction Authority, Fire and Rescue NSW, Rural Fire Service, NSW State Emergency Service & Department of Climate Change, Energy, the Environment and Water	Mid 2026

DESIRED OUTCOME

The design, installation and maintenance of flood gauges are well coordinated, reflecting their criticality.

Warning systems in NSW leverage the appropriate technology to detect and provide warnings on natural hazards, such as bush fires, to best protect the NSW community.

Tools to reduce hazard vulnerability

Building codes and standards

130

HAZARDS

Building standards and controls set the required performance standard for a material or built element in a development.

In relation to natural hazards, they can perform at 3 levels:

- reducing the damage to a building or cost to repair, by improving the structural resilience of a building to hazards such as floods
- improving the comfort of the occupants by improving the building materials' resilience to the effect of hazards such as extreme heat
- allowing for the building to be relocated.

In NSW, there are various building standards and controls applicable for some natural hazards, with differing degrees of enforceability:

1. Building controls relating to fire hazards are contained in the National Construction Code (NCC), local planning controls and the Planning for Bush fires Protection 2019. These standards are designed to reduce property damage.
2. Building standards in the NSW BASIX scheme cover a wide range of areas including insulation, heat transfer through walls, roofs, windows and floors, and water usage, all of which can work together to improve a building's internal and external heat load, and its ability to withstand periods of extreme heat and water insecurity.
3. In local council guidelines, there can be considerations of hazard resilient materials
4. In local council and State rebuilding guidelines, there is the consideration of wall and floor systems that allow for panels to be replaced rather than needing to replace entire structures.

CASE STUDY
Building controls for storms and cyclones in QLD and NT

Building controls relating to storms and cyclones are in place in QLD and the NT. These govern characteristics like roof angles and tie-downs to reduce suction forces from the wind that might tear the roof off, and materiality, in order to reduce gaps and opportunities for wind and water to penetrate the external skin of the building. These controls align with mapped wind regions, relating to maximum expected wind speeds and terrain types. Higher wind speeds require stricter building controls. As climate change increases the likelihood of severe storms in NSW and bring the cyclone belt further down the east coast, these building controls may become more necessary in NSW.

Current challenges related to building codes and standards

Scope of building codes and standards is currently limited

To date, the National Construction Code (NCC) is based on the principle of requiring minimum necessary standards to ensure the occupant of a building will survive in an extreme weather event. The building itself does not need to survive the event to be deemed "successful" under the NCC. There is an opportunity to expand the scope of building codes and standards to consider the long-term resilience of the buildings themselves, so that homes are still standing after a disaster and they are easier to repair, reducing damage bills and the time taken to recover after a major event.

Limited understanding of costs and benefits of different building standards

There is limited understanding of the costs and benefits of applying different building standards and controls to mitigate natural hazard risk, and the thresholds where they should apply. To ensure all future development is designed and constructed in the most resilient way possible, we need agreed State government decisions on:

- the costs and benefits of applying different building standards and controls to mitigate all natural hazard risk (taking a multi-hazard approach)
- where they should apply
- which standards are appropriate as code or enforced standard and which are suitable as optional standards
- appropriate building standards and controls, including retro-fits, on a location-basis when considering multi-hazard risks (see home modification tool)
- how to consider the complex interactions with emission reduction-related building standards and controls.

As our understanding of hazards and climate change improves, so too does our understanding of ways to change methods and standards of construction to respond to natural hazard risk. Any changes to building standards must take into consideration the impact on cost and times for construction, and supply chain issues for both materials and capable installers and assessors.

In addition, standards to reduce emissions are sometimes complementary and at times create complexity when considered in the context of disaster risk reduction. A combined approach will be needed to confirm any final building codes and standards for disaster risk reduction.

Understanding the costs and benefits to community and industry of different building standards can also be limited, which is a further challenge that needs to be addressed to enable application of new building codes and standards where appropriate.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Develop a policy for consideration of resilience to natural hazards as part of building codes and standards, that: • considers voluntary and compulsory application through legislation and National Construction Code • sets agreed thresholds and criteria for application • is supported with validated data / maps • considers costs to development, supply chain impacts, and environmental footprints.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2025
Build a library of updated building standards to increase resilience to natural hazards and develop a plan to embed into legislation including the: • National Construction Code • Local environmental plans • State environmental planning policies • Local and State Recovery Plans.	**Partners:** NSW Reconstruction Authority & Department of Customer Service	Mid 2025
Develop a multi-pronged communications and engagement strategy targeting homeowners and the building industry to: • explain the role and importance of standards and codes in building resilience. • embed changed practices within industry (e.g. suppliers).	NSW Reconstruction Authority	Mid 2025

DESIRED OUTCOMES

Cost effective building standards are applied and enforced to ensure that buildings are more resilient and better able to withstand the impacts of unavoidable hazards. These standards are well understood by community and industry. Buildings are cheaper to maintain over their life, due to lower running costs, and reduced need to rebuild or replace elements damaged by hazards.

Future standards to achieve emissions reduction are integrated into building standards for hazard mitigation to achieve lower environmental footprint.

Community awareness and preparedness

ALL HAZARDS

Community awareness and preparedness is defined as the capacity of people and their communities to effectively anticipate, respond to and recover from the impacts of disasters.[131] It is supported by the social cohesion risk reduction tool in this plan.

High levels of awareness and preparedness are central to building community capability to respond to disasters, which decreases the reliance on emergency services and loss of life and property. This improves recovery and builds the overall disaster resilience of communities across NSW. However, across NSW, community awareness of natural hazard risk and preparedness for impacts is low.

The '2021 NSW Get Ready' survey identified barriers to preparedness including cost, time and complexity of preparedness activities. Research shows other barriers include language, digital literacy, time between disasters, prioritising more pressing needs and underlying social inequities.[132] Funding for preparedness is also a challenge. Many past pilot projects and one-off grants have not translated into models that can be adapted locally and replicated at scale.

Raising levels of awareness and preparedness

Preparedness is an iterative process that needs to be sustained and continually redeveloped over time. Communities are dynamic and their needs, interests and capabilities must be considered along with their varying concern about natural hazards, depending on how recently they have experienced one. Raising awareness and preparedness requires an integrated and holistic approach to risk reduction, including community engagement, campaigns, communications material and education activities supported by partnerships and advocacy at all levels of government. See Figure 39.

Figure 39. Community awareness and preparedness must be driven by an interconnected suite of measures

Current challenges related to community awareness and preparedness

- An absence of an online 'single source of truth' for communities and households to source multi-hazard risk data and relevant preparedness actions.
- Inadequate resourcing for councils and community organisations as key agents for community awareness and preparedness.
- Lack of collaboration and coordination between single and multi-hazard campaigns that translate into measurable action to increase outcomes.
- Limited multi-hazard risk reduction education that is child-centred.
- Lack of collaboration to support people with disability to take charge of their own preparedness, while ensuring their rights to safety and protection are upheld.
- Inadequate tracking of changes in community preparedness outcomes over time at an LGA and State level.

CASE STUDY
Building community resilience in the Hawkesbury-Nepean Valley

Floods in the Hawkesbury-Nepean Valley can be extensive, rapid and deep, causing significant impacts to people's lives, livelihoods and homes. To address this flood risk, the NSW Government has been delivering a range of initiatives including a Community Resilience Program.

This innovative program has focused on raising community awareness of flood risk and embedding preparedness behaviours, underpinned by quantitative and qualitative social research. Through a suite of integrated actions including award-winning campaigns, cross-government collaboration, community outreach programs, online resources and tools, and a school curriculum program, the program has involved 14 community sectors, 38 project partners and more than 300 organisations to achieve change.

Research in 2021 showed that since the program began in 2017, 75% of the community has seen flood information – up from 26%; 66% of residents now believe they need to be prepared for floods – up from 33%; 48% of residents were able to identify three things to do in an evacuation – up from 25%. New flood emergency procedures are now in place with many community sectors including aged care and schools, and it is now a regulatory requirement for caravan parks in the Hawkesbury to have a flood risk management plan.

The Community Resilience Program has been recognised for implementing best practice engagement, receiving the Floodplain Management Australia – NRMA Insurance 'Flood Risk Management Project of the Year' award for 2021.

Flood awareness workshops with diverse communities in Western Sydney. Photo by Adam Hollingworth

Current NSW arrangements and work underway

- As of December 2022, the RA has a mandate to coordinate disaster prevention and preparedness activities and is delivering a preparedness function that will coordinate whole-of-government activities.
- Combat and Functional Areas have a key role to play in prevention and preparedness as outlined in sub plans (hazard specific plans by combat agencies) and supporting plans (outlining the roles and responsibilities of Functional Areas).
- The Aboriginal Communities Emergency Management Program Pilot, which is aimed at improving resilience and emergency management processes in four Discrete Aboriginal Communities, was implemented by Aboriginal Affairs NSW and its partner, the NSW Reconstruction Authority. Phase two of the project will work with up to 8 Discrete Aboriginal Communities (DACs) to support disaster preparedness, response and recovery from disasters.
- The Department of Education is building the emergency management and disaster preparedness capability of staff through the development of micro-credential e-learning modules, and partners with emergency service agencies to implement relevant curriculum programs.

Get Ready Program – a whole of NSW Government multi-hazard initiative

- Since 2014, the NSW Government has engaged in a multi-hazard approach to disaster preparedness through the Get Ready program which has sought to create awareness of natural hazard disaster preparedness through consistent messaging, activities and evaluation.
- In 2021, the Get Ready survey sought to provide a baseline measurement of multi-hazard preparedness trends at State and local government levels and a Program Logic and Index was developed. This work is implemented through the Community Engagement Subcommittee and the NSW Bush Fire Coordinating Committee which includes 20 member agencies responsible for driving community preparedness initiatives regarding bush fire, including State and local government agencies, local Aboriginal Land Councils, combat, and functional agencies.

Red Cross Pillow Case Program

- Delivered by Red Cross volunteers and staff, the workshop encourages children to be active participants in their own emergency preparedness.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Improve multi-hazard risk awareness and preparedness in NSW through the delivery of: • to develop Get Ready Program NSW Plan and Logic to reflect a multi-hazard approach to Statewide preparedness that complements emergency management agency activities. The program plan will define objectives, roles and responsibilities, funding, priorities, a monitoring and evaluation framework, and a program logic. • a Get Ready NSW website that includes natural hazard risk information and guides on how to prepare for individuals, households, and businesses (including a focus on evacuation). • an annual Get Ready NSW multi-hazard public awareness action campaign; measure its impact and share results with local government emergency management and key community partners. • a Get Ready NSW fund and guidelines to support councils and community based organisations to deliver local awareness and preparedness activities. • update the Get Ready NSW baseline survey and index to reflect new data requirements to measure LGA-based levels of preparedness on a yearly basis.	NSW Reconstruction Authority	End 2024
Identify existing gaps in education programs for young people and school communities on natural hazard risk, and develop an action plan to address them.	**Lead:** Department of Education **Supporting agencies:** NSW Reconstruction Authority & combat agencies	End 2024
Develop a Disability Inclusive Disaster Risk Reduction (DIDRR) policy and relevant tools for supporting the implementation of the DIDRR Framework for collaborative action to increase community and inter-agency partner awareness and preparedness levels.	**Partners:** NSW Reconstruction Authority & members of the Community Engagement Sub Committee of the State Emergency Management Committee	End 2024
Coordinate a review of preparedness planning for State government agencies and social service providers.	NSW Reconstruction Authority	End 2024

DESIRED OUTCOMES

All members of our communities are aware, capable and prepared for multi-hazard and compounding natural hazards risks. This can be achieved through better resourced, more localised partnership-based approaches between government, local councils, NGOs, community organisations and businesses. It also requires better evidence-based decision-making and policy development by government.

Home modification

HAZARDS

Home modification includes any alterations made to homes to reduce their vulnerability to natural hazards. This often refers to modification that is voluntary rather than required in building standards and controls. There are a range of standards and controls already in place to reduce the vulnerability of buildings to bush fire. In the case of flood, home modifications have not been standardised. Some standards may be in place for coastal hazard in particular council areas. In Table 5, 3 examples of modifications have been considered in detail – foundation strengthening, house-raising and flood proofing (retrofit). These focus on flood and coastal hazards.

Example of house-raising in Mullumbimby, NSW (left) (source: Rhelm, 2023) and example of foundation strengthening through piling (right). Source: Federal Emergency Management Agency, 2014

Table 5. Overview of home modification tools and their applicability

Home modification	House raising	Flood proofing (retro-fit)	Foundation strengthening
Description	Raising the floor of a house to reduce the frequency of overfloor flooding and inundation.	Incorporating flood resilient building elements to reduce damages associated with flooding and coastal inundation e.g. raising electrical sockets, washable flooring.	Retrofitting foundations of a building through piling to prevent building collapse from coastal erosion.
Natural hazard	Flooding; coastal inundation	Flooding	Coastal erosion
Approximate cost per dwelling	$120,000	$20,000 – $50,000 depending on scope.	Uncertain, limited examples.
Benefits	Reduces frequency of overfloor flooding, leading to less damage, and associated household disruption and trauma. Generally, only economically viable for more frequent inundation (for example, 1 in 20 AEP).	Results in a small reduction in property damage (generally less than 20%). Can be implemented in a range of building types. Less household disruption if recovery time is reduced.	Reduces vulnerability to coastal erosion.
Issues for consideration	Generally only suitable for existing timber homes. Potential increase in risk to life, as modification may result in a false sense of security for rarer, larger events. There are numerous examples where houses which have been raised to reduce flood exposure, have been infilled for extra living space. There is limited enforcement of this practice. Can be quite expensive, particularly compared to the value of the house. Can pose issues with accessibility, particularly for people with disability. Lack of consideration of underfloor structural integrity elements and potential foundation work in new builds.	Retrofit measures may need to be removed after a flood to repair what is underneath (e.g. waterproof gyprock being removed to allow proper drying of the wall cavity) Does not reduce contents damage. Only limited elements of the building are protected unless dry floodproofing is used. Should be considered against the non-resilient alternative (e.g. might be more cost effective to replace materials if flooding is infrequent).	Challenges in retrofitting building foundations without temporary relocation of the structure. Therefore, this may be better suited to lightweight structures (e.g. timber). Costs are likely to be relatively high given the heavy machinery required. Costs would need to be compared with the construction of a new dwelling.

Existing NSW guidelines and policies:

- Guidelines for the Voluntary House Raising Scheme (DPE, 2023).
- Flood Risk Management Manual (DPE, 2023) as well as the associated management guideline Flood Risk Management Measures MM01.
- Reducing Vulnerability of Buildings to Flood Damage – Guidance on Building in Flood Prone Areas (HNFMSC, 2006).
- Northern Resilient Homes Program.

Current challenges related to home modification

Lack of understanding of the risk reduction effectiveness of home modification measures

As identified in Table 5, there are limitations in the effectiveness of these measures, including:

- limited reduction in flood damages for flood proofing (retrofit)
- limitations in the types of dwelling suitable for house raising / foundation strengthening
- ongoing, or potential increase, in risk to life.

While they have a role to play in overall risk mitigation, they will not necessarily solve the problem associated with flooding, coastal inundation and coastal erosion.

There are also high-risk locations where these types of tools are not appropriate. For example, in a flooding context, there may be areas where a residential dwelling may not be able to withstand the forces of the flood.

Areas where they may be appropriate are not consistently identified across the State, and related building controls and standards are not in place.

Mitigation delivered at a household level requires ongoing local engagement to increase participation

These schemes have generally been voluntary and require property owners to opt in to participate. There are barriers to participation, including the cost of the scheme (particularly where it is only partially reimbursed), the intrusive nature of the works, the false sense of security these modifications might provide, aesthetic considerations as well as accessibility considerations (particularly for house raising). Ongoing engagement with property owners is required to increase the level of participation in a scheme. Many councils do not have the resources or skills to deliver these schemes, although support is provided by DPE.

Funding to date has been ad-hoc

Funding for home modification currently competes with other flood risk management measures, meaning that it can be ad-hoc across the State. This can lead to challenges in establishing recognised providers and economies of scale in delivering a larger cohesive scheme. Funding has largely been on a per floodplain basis (for example, recommended in a flood risk management plan), and drawn from a larger flood grant pool.

In addition, in the future in areas where these interventions are considered appropriate and included in building standards and controls, the gap between the cost of the intervention compared with a simple rebuild of what was in place, may require further funding support. This is particularly so where there are equity concerns. There are a range of cost-sharing options that need to be considered also between State government and insurers.

ACTION	RESPONSIBILITY	DELIVERED BY
Drawing on lessons from the Northern Rivers, Central West and recent disasters, develop: • a process to consider appropriate home modification requirements in building codes and standards • funding guidelines, criteria for eligibility and a funding stream to support home modification activities.	**Partners:** NSW Reconstruction Authority & Department of Planning, Housing and Infrastructure	Mid 2026

DESIRED OUTCOMES

A comprehensive understanding of where these tools are most effective and a pro-active plan for their implementation and inclusion in building codes and standards where appropriate. A resolved understanding of the shared costs between homeowners, State government and insurers.

Land use planning in multimodal transport environment

Infrastructure resilience

ALL HAZARDS

Communities rely on infrastructure for a range of services. The interconnected nature of infrastructure can result in significant consequences for the communities they serve. When infrastructure is affected by natural hazards, consequences can include power outages, which can cause disruption to public transport services and telecommunications. Infrastructure that is more resilient to natural hazards such as transport networks, energy infrastructure, local halls and government service centres, can make a significant difference to how effectively communities can respond and recover from natural hazard triggered disasters.

The NSW Critical Infrastructure Resilience Strategy defines infrastructure resilience as the capacity of physical infrastructure assets to withstand disruption, operate effectively in crisis, and deal with and adapt to shock and stresses. It includes the flexibility to adapt to present and future conditions.

In 2022, Infrastructure NSW recommended the NSW Government reorient its long-term infrastructure investment program to focus more on small and medium size programs which increase infrastructure resilience through engineering works, relocations, increased redundancy in systems and much better service reliability. This Plan adopts that approach.

Current challenges related to infrastructure resilience

There is a lack of data and guidance to support infrastructure risk assessment and resilience planning

There is limited data and guidance to support asset owners, operators and planners to assess the hazard risk profile and criticality of each asset, and identify resilience responses. This includes inconsistent availability and assurance of data on current asset vulnerability and exposure.

Actions to address exposure and vulnerability of infrastructure through asset 'hardening' via asset design or material upgrades are more commonly assessed. There is limited guidance on the application of options, such as relocation of assets or investing in technology to enable remote or alternative service delivery.

Consideration of resilience is not a requirement for new government assets

It is important that new infrastructure assets are justified and are not putting important services in harm's way. Consideration of resilience is not a requirement for new government assets in the NSW Business Case Guidelines. However, NSW Treasury has recently developed a Disaster Cost-Benefit Framework which will support consideration of resilience in decision making.

Coordination is required to identify appropriate infrastructure resilience responses

As funding is limited to increase infrastructure resilience, it is important to identify the most effective and important interventions via coordination across asset owners, regulators, operators and planners and the community. Coordination is required to look at the most important asset for each place.

This will allow for collaboration across borders of councils and states. It will also provide an opportunity to coordinate any investments already being made to maximise impact. The disaster adaptation planning process provides a mechanism for this.

Under the NSW Government Asset Management Policy, NSW Government agencies are required to develop annual long-term Asset Management Plans. The outcomes of any DAP risk and criticality assessment should be reflected in these asset management plans to ensure they are considered as part of agency budget cycles.

A combination of criticality and hazard risk assessments can be used to support this coordination and to enable the identification and prioritisation of the highest risk and highly critical assets which require the greatest attention for resilience responses:

- **Criticality assessments** enable prioritisation of infrastructure assets based on their function and the relative dependence by a community or a service network on their continued operation during a crisis.
- **Hazard risk assessments** can illustrate the relative exposure and vulnerability of infrastructure to expected natural hazard events.

As illustrated in Figure 40 over the page, these 2 assessments support asset owners, operators and planners to better prioritise future mitigation actions.

Current work underway

This chapter builds upon research and actions identified as part of 'State Infrastructure Strategy 2022: Staying Ahead' and engagement with other State, local and private sector organisations seeking to improve resilience and adaptation of their assets. Engagement occurred with the following organisations:

- Infrastructure agencies as part of the Authority's Reconstruction Readiness Review
- Independent Pricing and Regulatory Tribunal of NSW (IPART)
- Asset Management Policy owners

Existing guidance:

In addition to findings and recommendations from recent public Inquiries into various disaster events, key documents were reviewed including:

- NSW Treasury Disaster Cost-Benefit Framework
- Guidelines for Resilience in Infrastructure Planning: Natural Hazards
- Planning for a more resilient NSW: A strategic guide to planning for natural hazards
- National Emergency Risk Assessment Guidelines Handbook (Australian Institute for Disaster Resilience)
- NSW Climate Risk Ready Guidance
- Northern Rivers Community Critical Infrastructure Inventory Methodology.

Critical Communications Enhancement Program, NSW Telco Authority

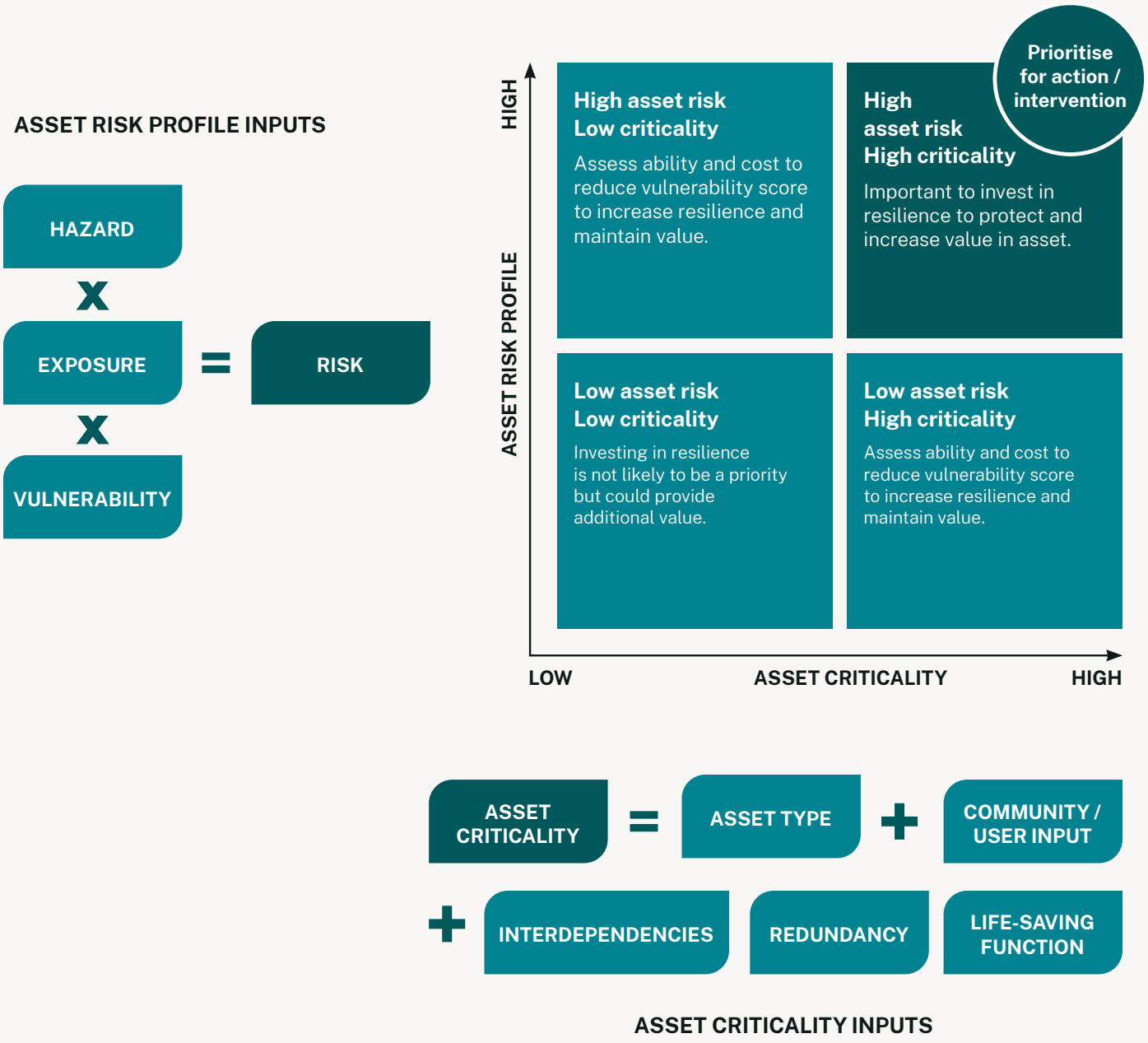


Figure 40. Asset Risk Matrix

CASE STUDY
Adaptation Planning for Critical Infrastructure in the Northern Rivers

The Northern Rivers Reconstruction Corporation was tasked with coordinating the significant reconstruction and place-based adaptation efforts across the region. As part of this it has delivered the first stage of the Critical Infrastructure Inventory project, which included the development of a criticality assessment methodology and a proposed approach to collecting data. Future stages will consolidate and synthesise data to inform future community engagement on potential adaptation strategies.

What we heard: Critical Infrastructure Roundtable

A Critical Infrastructure Resilience Roundtable was held in August 2022. It brought together industry sector leaders, NSW Government agencies and the Australian Government to discuss how to guide, collaborate, and share capabilities and considered how to reduce the long-term impact and overall cost of disasters to the community. The Roundtable agreed on some prioritised action areas including:

Shared vision: coordination of efforts across the sector would reduce duplication of efforts and fatigue across the sector. Improved communication, collaboration and an agreed, shared plan of work would minimise disruption to communities and benefit all.

Joint investment: strategic investment led by a central authority to lower the high cost of disasters was considered a high priority. An agreed investment framework to prioritise and guide the sector was considered essential.

Shared data and insights: readily accessible, shared data that can forecast impacts, identify vulnerabilities, and support resilient planning is needed. Establishing a coordinated natural hazard database would improve planning.

Improved data technologies: sector leaders are investing in new technologies to model extreme weather and disaster impacts, but capabilities need to be extended to open-data platforms and collaborative decision-making.

Model vulnerabilities: identification of the most vulnerable areas based on climate modelling and recent experience would help prioritise asset hardening, new technology trials and managed relocation.

Role clarity: participants cited greater role clarity across all levels of government, a defined operational framework and improved processes would improve gaps in planning to reduce hazard risk impacts.

This feedback has been incorporated into broader recommended actions throughout this plan.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Include a process in the DAP Guidelines and Framework for identification of the relative criticality of assets and plans for asset resilience interventions. Ensure the process includes relevant asset owners, operators, and community representatives.	NSW Reconstruction Authority	Mid 2024
Engage with the private sector and regulators to develop an approach to prioritise and coordinate place-based infrastructure resilience interventions by private sector operators.	**Partners:** NSW Reconstruction Authority & Infrastructure NSW	End 2024
NSW Government Business Case Guidelines to include natural hazard risk and criticality assessments as part of decision-making for new assets.	NSW Treasury	Mid 2025
NSW Government asset owners reflect DAPs in asset management plans.	All State Government asset managers	As delivered

DESIRED OUTCOMES

Owners, operators, and planners are supported to deliver more resilient infrastructure through data, guidance and coordination. Disaster adaptation planning processes formalise minimum requirements for asset risk and criticality assessments. Risk and criticality assessments are used within early decision-making processes for new infrastructure such as business cases.

Nature-based measures

ALL HAZARDS

Nature-based measures, sometimes referred to as green infrastructure, are actions that work with nature to reduce natural hazard risk through protecting, preserving, restoring, and enhancing nature. Implementing these measures can lead to multiple social, environmental and economic benefits including supporting livelihoods, health, culture, climate change mitigation, biodiversity and conservation. Nature-based measures can be cost-effective and used to enhance other risk reduction tools such as planning controls, mitigation infrastructure or relocations.

These measures recognise people are dependent on functioning and resilient natural systems, and their ecosystem services[133] which can provide defences to natural hazard impacts. The decline and degradation of natural buffers and environmental protections – including river and coastal systems, plant and animal species – is placing pressure on ecosystems and communities and increasing natural hazard risk.[134]

Examples of nature-based measures and their benefits:

- restoring ecosystems through re-planting on slopes can reduce flood and landslide risks after heavy rain
- development controls to help protect coastal assets like wetlands and sand dunes that provide natural buffer defences to hazards such as coastal storms[135]
- urban greening[136] provides shade to reduce the urban heat island effect and provides space for encouraging social interactions.

These measures can have a range of positive and negative flow-on effects depending on the context, scale and how well understood and accommodated the existing ecosystem functions are. For example, in addition to reducing heat, revegetation can sequester carbon and improve air and water quality. This means nature-based measures may reduce the secondary impacts of natural hazard risks by improving ecosystem function and health.

An example of a potential negative consequence of greening or revegetation could be an increased bush fire risk or flood risk if unmanaged. It is important to consider local and site-specific considerations, including understanding the consequences of interventions in the short and longer term.

Wollemi National Park

Current challenges related to nature-based measures

Across NSW, use of nature-based measures to reduce natural hazard risk is constrained by some of the following challenges:

- Limited quantification of the value of ecosystem services, meaning that the benefits of nature-based measures may be underestimated.
- Planning decisions often prioritise urban development over natural ecosystem processes, services and functions.
- Limited understanding and consensus on how nature-based measures may mitigate against multiple hazards, including monitoring of the costs and benefits of measures. The negative impacts of these measures on bush fire and flood risk are also not well understood.
- Limited guidance on the implementation of nature-based measures.
- Uncertainty over who is responsible for assessing and planning for nature-based measures for disaster risk reduction and setting Statewide policy.
- Limited coordination of management of catchments which reduces ability to understand and manage nature-based measures.
- Difficulty in managing and investing in nature-based measures on privately owned land.
- Limited Statewide funding solutions and pathways across government for nature-based approaches to reduce disaster risk.

Nature-based measures for disaster risk reduction

Protect and restore landscapes through revegetation and Aboriginal Country management.

How does it reduce disaster risk?

Moderating the hydrological cycle (i.e. maintaining soil moisture during drought and moderating water flows during floods).

Co-benefits

Improved air and water quality, access to natural environment for Indigenous cultural, tourism and community activities.

Protect and restore rivers through revegetation and Aboriginal Country management.

How does it reduce disaster risk?

Moderating water flows, stabilising river banks and maintaining better water quality.

Co-benefit

Protecting water quality for animals and plants, improves biodiversity, and reduces impacts to primary producers e.g. oyster farms.

Mountains and bush

Rivers and wetland

Figure 41. Nature based measures for disaster risk reduction

Maintain ground cover and incorporate native vegetation planting in the farm's plan.

How does it reduce disaster risk?

Reducing evaporation, maintaining soil moisture in dry times and reducing erosion.

Co-benefit

Improved biodiversity, improved ecosystem services such as shelter for livestock and improved water quality.

Increase tree canopy and green spaces in urban areas.

How does it reduce disaster risk?

Reduces the risk of heat islands on extreme heat days and reduces temperatures in urban areas.

Co-benefits

Recreation spaces for community connection and increasing habitat for plants and animals.

Protect and restore vegetation in estuaries, coastlines, and waterways including mangroves, marshes, and reefs.

How does it reduce disaster risk?

Natural defence to coasts and waterways from storm damage and wave erosion.

Co-benefits

Carbon sinks and improved local marine life.

Primary production | Urban areas | Coastal

The bank area along Wagonga foreshore. Credit: Rosy Williams

CASE STUDY
Restoring natural systems for coastal protection

The **Wagonga Inlet Living Shoreline Project**[137] is a natural approach to coastal protection replacing an existing failing rock wall with banks of low-growing riparian vegetation, restoring salt marsh and rock oyster reef and creating access points for visitors. The benefits of the project are improved foreshore protection and water quality, enhanced access and recreation opportunities, revival of lost oyster reefs, enriched estuarine habitats, improved habitat for fish, and stored carbon.

The Blue Carbon[138] Demonstration at **Duck Creek** Research Station involves converting a 13 hectare peninsular paddock, currently used for cattle grazing, to a mangrove and saltmarsh ecosystem that generates Australian Carbon Credit Units (ACCUs). The project works to restore tidal flows and ecological processes enabling natural regeneration of mangroves and saltmarshes. The project is also expected to generate other benefits such as foreshore protection, water quality improvements, improved fisheries production and biodiversity benefits, as well as social and cultural value. For example, the project provides traineeship opportunities for rangers from the Jali Local Aboriginal Land Council.

The site at Duck Creek is typical of many areas on NSW coastal floodplains, with large areas at or below the height reached by most high tides. With extreme weather and sea level rise from climate change impacting land historically used for agriculture, there is opportunity for landholders to reinstate intertidal wetlands and natural ecosystem services creating economic benefits through Australian Carbon Credit Units.

NOTE: The Duck Creek project is subject to successful registration with the Clean Energy Regulator.

Current arrangements and work underway

Some examples of current and ongoing in nature-based disaster risk-reduction work underway across NSW government includes:

- Connecting with Country Framework
- Sea Country Plans[139]
- Blue Carbon Strategy
- Coastal Management Framework
- Resilience and Hazards SEPP (State Environmental Planning Policy)
- Aboriginal Land SEPP: Guideline
- NSW Coastal Design Guidelines (2023) work in progress
  - Blue/Green Infrastructure
  - Biodiversity Indicators Program, Connectivity and Restoration
- Natural Capital Statement of Intent
- Strategic Guide to Natural Hazards
- DPE NSW Bushfire and Natural Hazards Research Centre
- Flood Risk Management Measures Guideline
- Biodiversity offsets scheme
- Seabirds to Seascapes – Project Restore (living sea walls)
- Carbon Markets
- Framework for valuing green infrastructure and public spaces – (DPIE)
- Greener Places – Urban green infrastructure design framework for NSW[140]
- Water Sensitive Urban Design Guideline

ACTION	RESPONSIBILITY	DELIVERED BY
Establish a nature-based measures knowledge hub to provide practical advice on the implementation, benefits and impacts of nature-based measures, with an emphasis on Aboriginal knowledge and land management practices, and catchment management approaches.	**Lead:** NSW Reconstruction Authority **Supporting agencies:** Department of Climate Change, Energy, the Environment and Water, Department of Primary Industries & Local Land Services.	Mid 2025

DESIRED OUTCOMES

NSW Government identifies, prioritises and invests in nature-based solutions that value, maintain and enhance natural ecosystem contributions to reducing primary and secondary disaster risk.

Drone shot of the Duck Creek Point Paddock. Source: Daniel Cohen, DC Sports Photography

Social infrastructure and cohesion

ALL HAZARDS

The quality of people's connections can keep them safe in times of crisis, and a sense of belonging encourages people to look after one another when disaster occurs. Social cohesion strengthens community bonds to ensure support is available to those who need it most. Research has shown that strongly connected communities tend to suffer less severe impacts, recover sooner, and demonstrate better mental health and wellbeing years after disaster.[141,142] Investment in organisations and activities that support social cohesion has been shown to be one of the most cost-effective ways to reduce disaster risk and can lead to lower loss of life as well as a faster recovery.[143]

In this plan social cohesion is about having better connected, more inclusive communities, with strong networks, trust and shared safe social spaces such as parks and libraries. It is about organisations (e.g resilience networks, neighbourhood organisations) and activities (e.g. festivals, fairs) that support people to build stronger networks and social ties locally, and which build social cohesion and help communities to be better prepared for, respond to, and recover from natural hazards. These organisations and activities are also supported by safe physical 'social' infrastructure such as parks and libraries.

Beyond reducing disaster risk, stronger networks / social ties, and safe community spaces, mean that communities can be more inclusive and harmonious. Deloitte estimates that the economic dividend to Australia from having a more socially inclusive society to be $12.7 billion annually.[144] This means that actions to support organisations, activities and places that build social cohesion will have multiple benefits.

Current challenges related to social infrastructure and cohesion

Lack of clarity on how to build social cohesion and what its impacts are

Despite evidence showing clear benefits of social cohesion, it is not fully understood how supporting activities, organisations and social spaces can build resilience to reduce disaster risk in NSW. Ways to measure the social impact of disasters and social cohesion are limited. There is opportunity to build on existing activities led by Premier's Department and Multicultural NSW (MNSW) to measure and support social cohesion more broadly. This information is required to help target activities to build social cohesion to reduce disaster risk and also achieve broader outcomes. This will then demonstrate the benefits and return, to better target activities, organisations and spaces to increase social cohesion.

Funding is piecemeal, limited and not coordinated for maximum impact

Historically, support and funding to build social cohesion through support for activities, organisations and social spaces as a disaster risk reduction tool has been ad-hoc and implemented in a piecemeal way. As funding for these activities can deliver multiple benefits there is opportunity to coordinate funding. There is also opportunity for State government to strengthen partnerships with community and social service organisations and local government to better coordinate support and funding. An existing program that can be built upon is the Premier's Department's 'Partnering With Local Government to Strengthen Social Cohesion Framework (2022)'.

Social networks and assets not fully utilised

Social networks are not well relied upon and integrated into disaster risk reduction such as using networks for preparedness and awareness messaging. Local service providers, community leaders and established community networks best understand the needs, strengths, priorities, and aspirations of their communities. They can therefore act as trusted conduits to support disaster risk reduction. Local networks can also identify relevant cultural, customary, traditional, or spiritual approaches that can be reflected in activities to reduce disaster risk. It is important that community organisations are recognised as key government partners and that they have a voice at the table to share local knowledge. Mapping of social networks and assets would facilitate this effort and can be included in emergency and recovery plans as well as DAPs.

CASE STUDY
'Connect and Prepare' program in Dungog, NSW

Following the 2015 floods, in which 3 members of their community died, the Dungog community developed a local 'Connect and Prepare' program. This work was led by staff of the local neighbourhood centre[145] who had been providing services, support, and case management for their community long before the disaster and who also led the community response when the disaster hit.

Their approach was to harness existing relationships, trust, and strong knowledge of who in their community was most in need. The program encouraged people to reach out to others before a potential crisis and offer the types of support they could provide. This established network, pre-event, could assist during a potential crisis.

Current arrangements and work underway

- 'Partnering With Local Government to Strengthen Social Cohesion' framework (2022) and program logic (2023), Premier's Department. This was implemented by local governments and championed by 33 councils in Resilient Sydney.
- Bushfire Community Recovery and Resilience Fund projects and Disaster Risk Reduction Fund projects.

Multicultural NSW

- 'Stronger Together, the Multicultural NSW Strategic Plan 2021-2025'. Multicultural NSW's goal under this strategic priority is to expand robust relationships that inspire people to foster social cohesion, stand united against divisive forces, and come together in times of need
- Multicultural NSW's (MNSW) 'Community Resilience framework', which adapts disaster resilience models to a social cohesion context by supporting community preparedness, prevention, response, and recovery (PPRR) in relation to any potential threat or risk to social cohesion and community harmony in NSW. Under this framework, MNSW aims to proactively build and maintain strong, cooperative, cross-cultural, cross-sector networks that can mobilise in response to challenges and threats to community harmony, resolve issues relating to cultural diversity, and actively promote social cohesion
- 'Community Partnership Action (COMPACT) Program' (funded under the NSW Countering Violent Extremism Program). The project supports an alliance of over 60 grassroots community organisations, peak charities, NGOs, private sector partners, schools, universities, government agencies, and police. The COMPACT Alliance comes together regularly as a community of practice and community resilience network committed to safeguarding social cohesion against hateful and divisive forces.

University of Sydney

- Work has been underway to develop a Disability Inclusive Disaster Risk Reduction (DIDRR) Framework led by Centre for Disability Research and Policy at the University of Sydney. This will build on a preparedness tool (Person-Centred Emergency Preparedness (P-CEP)) that the centre has developed to enable personal emergency preparedness tailored to individual support needs. It will also build on a tool to develop forums hosted by local government to activate inclusive community-led preparedness actions of multiple stakeholders that focus on pre-planning for the extra support needs of people with disability in emergencies, so that nobody is left behind. To date, six local governments have held these forums, building community willingness and capability to share responsibility for the organisation and delivery of supports across emergency services, people with disability and the service organisations that support them.
- A National Forum on Disability Inclusive Disaster Risk Reduction (DIDRR) was held in June 2023 to discuss and debate research findings that will form the basis of a national framework for DIDRR.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Include guidance in the DAP Guidelines and Framework for: • mapping of social assets (community spaces services, groups and trusted social networks and leaders) to identify gaps relevant to disaster risk reduction • identification of social infrastructure and cohesion actions that build on strengths and address gaps for disaster risk reduction.	NSW Reconstruction Authority	Mid 2024
Deliver a Statewide framework for social infrastructure and cohesion which includes a focus on natural hazard risk. The framework will define objectives, roles, and responsibilities, funding, priorities, monitoring and evaluation, and measurement.[146]	**Lead:** Premier's Department **Supporting agencies:** Multicultural NSW & NSW Reconstruction Authority	Mid 2026

DESIRED OUTCOMES

Activities, organisations and spaces that build social infrastructure and cohesion for disaster risk reduction are valued, supported, resourced, and invested in by State government, and coordinated with broader government efforts to support social cohesion outcomes.

Community engagement in Western Sydney

Supporting the delivery of risk reduction efforts

To successfully support and guide disaster risk reduction efforts at both a State and local level there needs to be focus on enablers including:

- Collaborative governance
- Capacity and capability
- Data
- Funding
- Insurance

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Collaborative governance

Effective disaster risk reduction requires integration across all levels of government, the community and industry, involving new ways of working that facilitate difficult decisions to be made. For example, investing in mitigation to reduce future effects of natural hazards can mean difficult decision-making about managing the competing priorities of growth, housing supply, equity, environmental, and social impacts. Risk reduction requires open and collaborative conversations between those who benefit and those affected by different options, including community members, all levels of government, insurance and banking industries, and private businesses. This Plan and the disaster adaptation planning process provide an opportunity and mechanism to enable better resolution of these competing priorities and values. Action needs to be taken to set up the collaborative governance mechanisms required to enable this place-based and community-oriented collaboration to occur.

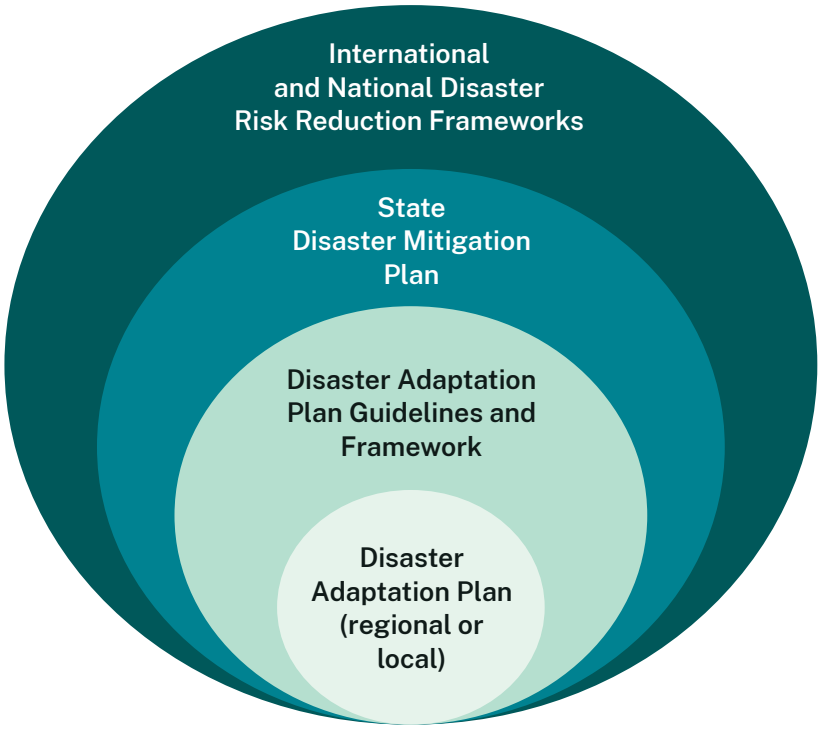

Figure 42. Hierarchy of plans

It is essential that community and local knowledge is drawn upon in the design and implementation of DAPs, so that risk reduction initiatives better respond to the strengths and needs of local communities. We have heard from the community and community organisations that further collaboration is required with community organisations to support locally-led risk reduction approaches, including linking the work of community organisations with emergency management arrangements. We also heard that Aboriginal needs and values must be better understood and embedded into disaster adaptation planning.

This Plan sits within a recognised International and National Disaster Risk Reduction framework and includes actions to fill policy and program gaps required to support disaster adaptation planning. The relationship between these plans is displayed in Figure 42. The guidelines and framework to deliver DAPs (due by mid 2024) will provide more detailed guidance on the process for the organisational, regional or local disaster adaptation plans. A high-level overview of 5 key steps of the disaster adaptation planning process is outlined earlier on page 74.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Establish a specifically convened Aboriginal working group to: • articulate lessons from existing programs and initiatives related to Aboriginal disaster risk reduction • provide strategic advice to better inform Aboriginal disaster risk reduction at State and local levels • advise on how to achieve authentic and ongoing conversations with local Aboriginal people and communities to better understand and embed Aboriginal values and needs into disaster risk reduction planning.	**Partners:** NSW Reconstruction Authority & Aboriginal Affairs NSW	Mid 2024
Include a process in the DAP Guidelines and Framework to facilitate trusted relationships with Aboriginal local communities to recognise Aboriginal cultural values, knowledge, and practices (across all Country).	**Lead:** NSW Reconstruction Authority **Supporting agency:** Aboriginal Affairs NSW	Mid 2024
Establish an assurance and expert review function for DAPs.	NSW Reconstruction Authority	End 2024
Improve Local Emergency Management Committee (LEMC) capacity and capability to support its increased role in disaster mitigation. Explore options to enhance LEMC governance and operations including increased community and Aboriginal representation.	**Lead:** Premier's Department **Supporting agency:** NSW Reconstruction Authority	End 2024

DESIRED OUTCOMES

Effective collaboration mechanisms for disaster adaptation planning are established and supported, including ways to facilitate dialogue across community, council and State government. Disaster adaptation planning embeds place-based, community-centric processes, and Aboriginal knowledge.

Capacity and capability

To deliver DAPs, the appropriate capacity and capability is required across councils and State government agencies, including for options assessments and risk assessments. Capacity refers to current ability and resourcing, whereas capability refers to higher levels of expertise.

Local councils have underscored the importance of increased ongoing resourcing to fulfill their role in natural hazard risk reduction, to create greater equity. This will build on other work underway such as Climate Risk Ready.

We have also heard that Aboriginal-owned land and communities require targeted investment due to the disproportionate exposure of Aboriginal populations to natural hazards.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Investigate options to support resourcing and capability-building in local councils.	**Lead:** NSW Reconstruction Authority **Supporting agency:** Office of Local Government	End 2024
Provide resources, data, and funding to support Discrete Aboriginal Communities and other Aboriginal landowners to develop DAPs, building on the work of the Aboriginal Communities Emergency Management Program.	**Lead:** NSW Reconstruction Authority **Supporting agency:** Aboriginal Affairs NSW and Aboriginal Housing Office	End 2025

DESIRED OUTCOME

Councils and State government agencies have the necessary capacity and capability to support disaster adaptation planning. There is capacity and sustainable funding to manage natural hazard risk on Aboriginal-owned land and improve the resilience of Aboriginal communities.

Council staff working together

Data

We have heard from stakeholders that data to deliver DAPs needs to be transparently provided, supported by guidance, with clear assumptions outlined. Training and coordination is also required to facilitate the use of data in effective decision-making. Some data is available but it can be difficult to access for some stakeholders due to limitations in data use agreements and perceived risks in data sharing. Other data is simply unknown as they are generated by one organisation without awareness of it in other sectors, leading to the same data being procured many times. Clear assumptions and coordination of what data to use, related to relevant decision-making, is also required to drive consistency.

There is work underway across NSW Government to improve data, such as improving climate change data through the NSW Climate Change Adaptation Strategy. Other gaps include the impacts and benefits of nature-based measures, benefits of social cohesion on natural hazard risk, and heat and landslide risk. Actions to address some of these gaps have been included in relevant sections within this Plan. The key action to improve data for disaster adaptation planning is to better coordinate the use and application of appropriate data for decision-making.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Formalise natural hazard risk analysis and assessment methodologies and establish a dedicated hub of data, platforms, people and decision support to be established in the NSW Reconstruction Authority to support disaster adaptation planning. This would include: • developing agreed methods and assumptions to assess hazard risk and risk reduction options • governance mechanisms that include experts across government, to approve methods and assumptions • training and guidance on completing hazard risk and risk reduction options assessment • centralised disaster risk hazard, exposure, and vulnerability data platform, drawing on existing sources • a data roadmap and research plan to continuously update data gaps, including gaps on landslide risk.	**Lead:** NSW Reconstruction Authority **Partner:** Office of Environment and Climate Change	Hub established and ongoing guidance provided immediately, data platform delivered by end 2025

DESIRED OUTCOME

Accessible and endorsed data appropriate for disaster adaptation planning decisions.

Funding

At present, overall funding available for risk reduction is proportionally small. Historically, around 97% of disaster funding is spent on response and recovery, leaving just over 3% spent on disaster risk reduction. The scale of reducing natural hazard risk is large and increasing and the significant funding required has not yet been quantified.

The Australian Government has increasingly turned towards risk reduction programs which is an important shift. An independent review of the Commonwealth Disaster Funding is also underway, due by mid 2024. State and local governments are similarly focused on mitigation and risk reduction including during reconstruction programs, where Disaster Recovery Funding arrangements allow. There are also some existing State funds to support local councils under the Floodplain Management and Coastal Management Programs.

However, the existing programs require expansion to meet the scale of the need both now and into the future. Some existing funding programs are not guided by well-developed multi-hazard risk reduction planning and require competitive application processes that consume council resources and favour the most readily available action, rather than those with the greatest impact. Existing Australian government funding programs have sometimes sought to target projects not yet part of mitigation planning. However, this can mean that important, previously prioritised initiatives are overlooked in favour of more marginal projects. The development of this Plan and the DAPs is designed to provide greater guidance and assurance on funding for new investments and initiatives.

Local government has told us that the current model of competitive grant funding is inefficient and not effective. Councils must have adequate capability to both apply for funding and to deliver multi-year disaster risk reduction projects, especially those that are large and complex. Funding administered to councils and NGOs from competitive grant rounds generates value and is likely to reduce risk, but it is not always coordinated, and some funded projects may overlap. In addition, funds from other sources including philanthropy require better coordination.

It is also important to harness private sector investment in disaster risk reduction by providing a recommended pipeline of aligned and effective projects for investment. Avoiding disaster risk may provide direct economic benefit to non-government actors (for example, insurers and banks), and private sector businesses have a stake in avoiding disaster risk impacts to supply chains and customers. At present, however, these benefits are not well quantified or understood, limiting this type of investment. In addition, financing structures and approaches to facilitate funding mechanisms such as social impact bonds need further investigation.

Risk reduction will only be delivered with time, careful prioritisation, considered staging and contributions from all levels of government, private businesses, and homeowners. Investment can be sourced both directly from government, as well as via cost sharing mechanisms between all sectors, including private asset owners, insurers, and the banking industry.

The implementation of this Plan and DAPs provides an opportunity to identify a suitable and prioritised pipeline of investment for risk reduction. In addition, a consistent source of funding allocated to risk reduction is required to the prioritised investment, with a move away from specific programs. There is an opportunity to set up a fund specifically for this investment: the NSW Mitigation Fund.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Progress a business case for a NSW Mitigation Fund to drive additional risk reduction investment, particularly for projects prioritised in DAPs.	NSW Reconstruction Authority	End 2024
Explore options for innovative funding pathways and financing mechanisms, such as the NSW Sustainability Bond.	**Partners:** NSW Reconstruction Authority & NSW Treasury	End 2024
Develop funding principles to guide cost sharing for disaster risk reduction between the Australian, State and local governments, and private asset owners.	**Partners:** NSW Reconstruction Authority & NSW Treasury	End 2024

DESIRED OUTCOME

Adequate, effective and consistent investment in risk reduction, improved prioritisation of currently available funds for disaster risk reduction, and increased opportunities for investment in risk reduction.

Insurance

Insurance plays a key supporting role in helping people rebuild post disaster, whether in supporting households and businesses to rebuild more quickly or reducing the financial impacts and stress experienced after a disaster. Insurance availability also allows businesses to operate effectively before disasters by supporting investment. Insurance is not universally available for all hazards, for example coastal hazards.

Insurance affordability is decreasing with 12% of households experiencing insurance affordability stress, as shown by the Actuaries Institute Home Insurance Affordability Update of 2023.[148] This report also notes insurance affordability stress is currently driven by flood insurance unaffordability concentrated in northern NSW.

There are some ways to innovate on the design of natural hazard insurance, which are outlined on the following page.

Insurance Design

Parametric insurance

Parametric insurance is a type of insurance that could be put in place where traditional insurance may not be available.[149] It describes a type of insurance contract that insures a policy holder against the occurrence of a specific event or specific 'disaster parameter' by paying a set amount based on the magnitude of the event, as opposed to the magnitude of the losses in a traditional policy. This means that the losses do not need to be assessed, which could mean that claims are faster and easier and put to what is most needed.

This is different to traditional insurance because it does not seek to cover the total cost of the actual loss. The parametric cover would only be available when a certain event parametric is met or exceeded, which could be a certain size or magnitude event e.g. if a magnitude 6 earthquake occurs.

Insurance pools

In Australia disaster insurance reflects the risk to individual policy holders. In an insurance pool, a consistent fee to cover a range of natural hazard events regardless of where the policy holder is located is possible if several insurance companies pool (or combine) all their policies. This does not imply that the premia will be affordable but rather the same across all policy holders. An example of this is the Swiss natural perils pool, which is a joint enterprise by 12 private insurance companies that cover over 90% of the market. Losses due to natural hazards are spread among pool insurers according to their market share in Switzerland, thereby guaranteeing that risks in especially endangered regions remain insurable.[150]

It is important the NSW Government continues to work with the insurance sector to support increasing insurance affordability. NSW Government's greater focus on risk reduction options should increase the affordability of insurance premiums. There is opportunity to leverage the Hazard Insurance Partnership (HIP), a partnership established in 2023 between the Australian Government and the insurance industry and managed by the National Emergency Management Agency (NEMA). The objective of the HIP is to reduce risk with a view to improving insurance affordability and availability and its aims include actions to:

- identify and seek to better understand the most pressing insurance issues driven by natural hazard risk, to enable better targeting of policy solutions
- work to understand how insurance costs can be reduced through risk mitigation
- consult on relevant programs and initiatives, including risk-reduction funding guidelines and consumer-facing improvements related to natural hazard insurance
- identify opportunities to replicate and scale successful initiatives, and
- collaborate to support the development of a centralised data asset on insurance affordability and availability.

While insurance affordability can be improved by removing levies (and a review of these arrangements has been announced) insurance may continue to be unaffordable in areas of high risk. As a result, disaster adaptation planning should reflect insurance affordability and identify actions to reduce risk where insurance is unaffordable. This is because a lack of affordable insurance may be a factor in deciding what risks are tolerable, and where action and investment is required to reduce that risk.

ACTIONS	RESPONSIBILITY	DELIVERED BY
Review levy arrangements on insurance premia.	NSW Treasury	End 2024
Collaborate with NEMA and the insurance sector to reflect disaster risk reduction measures in insurance pricing, and to use data on insurance affordability to inform strategic land use planning responses.	NSW Reconstruction Authority	Mid 2025

DESIRED OUTCOMES

Insurance affordability is a key driver of disaster adaptation planning. Government and industry collaborate to improve insurance affordability.

Monitoring and reporting

Outcomes related to the recommended actions in this Plan will be periodically reviewed under an adaptive management framework which involves continuous Monitoring, Evaluation, Accountability and Learning (MEAL). The purpose of regular reviews is to evaluate the effectiveness of this Plan in meeting its objective and to ensure the expected benefits are realised. Lessons learned from the review will be used to improve outcomes.

Monitoring is also required to ensure transparency on the level of risk, including ensuring accountability is clear for the progress on implementation of risk reduction options across all collaborators.

ACTION	RESPONSIBILITY	DELIVERED BY
Develop a Monitoring, Evaluation, Accountability and Learning (MEAL) framework for the continuous improvement of disaster risk reduction in NSW.	NSW Reconstruction Authority	End 2024

DESIRED OUTCOMES

Progress on disaster risk reduction is measured and reported, lessons are learnt and inform continuous improvement.

A way forward

5

The Blue Mountains , photo by Jacqueline Allen

There is no easy or simple solution to reduce disaster risk. Disasters will still happen – there will always be instances where the capacity to respond to the impacts of a single or compounding natural hazard event is exceeded. However, the NSW Government is committed to being better prepared for natural hazards and working to reduce the exposure and vulnerability of our communities. This will require us to take a multi-hazard approach to enable the most effective risk reduction responses, working collaboratively across all stakeholders and our community.

Following the Independent 2022 NSW Flood Inquiry, the establishment of the RA in December 2022 was a critical step forward in our State's commitment to disaster risk reduction. While there has been substantial work across all levels of government to manage and reduce natural hazard risk and disaster impacts, we know there is more work that must be done. This Plan is the RA's response, developed on behalf of the NSW Government, to address the existing gaps in State programs and policies, and provides a road map of short and medium term actions for the State to deliver. These actions will also enable place-based and community-centred solutions through Disaster Adaptation Plans. Together, these State and local approaches will guide us to become a more prepared NSW.

We know that disaster risk is not uniform across the State. Some places are more susceptible to natural hazards than others. Key findings of a multi-hazard risk assessment have been presented as summaries of overall risk by local government area. While useful, this has limitations as natural hazards are not confined to these boundaries. Therefore, we are also taking a regional or catchment approach in responding to natural hazard risks where required. We will also work on enabling improved information on these risks, including impacts on our social, natural and broader economic environments. We need better understanding of hazards such as heatwaves and landslides and the appropriate Statewide actions to manage them.

We face increasing risk in the future from projected population growth and climate change which will result in more people becoming more exposed and vulnerable to natural hazards. With climate change, we expect an increase in the severity and occurrence of disasters, exceeding what we have experienced before. This Plan has demonstrated the importance of understanding the relative contribution of these key drivers over various timeframes and scales.

While this Plan has focused on climate change and projected population growth, there are other factors that could affect risk exposure and vulnerability, such as the role of technology. This will be considered in future versions of the SDMP as new information becomes available to improve our understanding of how risk may change over time.

The RA will immediately begin to coordinate the delivery of actions outlined in this Plan pending funding commitments. We will continue to engage with the community and stakeholders and consider feedback as we implement actions and incorporate for the next SDMP. The draft Guidelines and Framework for the DAPs will be available for consultation in mid 2024 to guide place-based plans to be delivered by the RA, councils, Aboriginal landowners and other organisations. The RA will provide an assurance and endorsement function for disaster adaptation planning. Steps will be taken to enable the implementation and funding of a pipeline of projects identified through this Plan and the DAPs.

The next SDMP will be delivered in 2026, which will include progress and outcomes on the actions included in this Plan. Through these actions, along with continued collaboration and a dedication to continuous improvement, we will deliver on our commitment to reducing the cost and impact of natural hazards across our State.

Appendices

6

Northern NSW near Murwillumbah

Appendix 1: Acronyms

Acronym	Description
AAD	Average annual damage
AAL	Average annual losses
ACCU	Australian carbon credit units
ADRI	Australian Disaster Resilience Index
AEP	Annual exceedance probability
ARI	Average recurrence interval
BoM	Bureau of Meteorology
CCAP	NSW Climate Change Action Plan
CESC	Community Engagement Subcommittee
COMPACT	Community Partnership Action
DAC	Discrete Aboriginal Communities
DAP	Disaster Adaptation Plan
DFE	Design flood event
DPE	NSW Department of Planning and Environment
EMPLAN	State Emergency Management Plan
FEM	Flood evacuation model
FRNSW	Fire and Rescue NSW
IFRC	International Federation of Red Cross and Red Crescent Societies
IPART	Independent Pricing and Regulatory Authority
LEP	Local Environmental Plan
LEMC	Local Emergency Management Committee
LGA	Local government area

Acronym	Description
MERI framework	Monitoring, evaluation, reporting and improvement (framework)
MNSW	Multicultural NSW
NCC	National Construction Code
NCCAS	NSW Climate Change Adaptation Strategy
NEMA	National Emergency Management Agency
NGO	Non-government organisation
PMF	Probable maximum flood
PPRR	Preparedness, prevention, response, recovery
RA	Reconstruction Authority
REMC	Regional Emergency Management Committee
RFS	Rural Fire Service
RHP	Resilient Homes Program
SDMP	State Disaster Mitigation Plan
SEMC	State Emergency Management Committee
SEPP	State Environmental Planning Policy
SES	State Emergency Service
UNDRR	United National Office for Disaster Risk Reduction
UNHCR	UN Refugee Agency
XDI	Cross dependency initiative

Appendix 2: Definitions

Word or phrase	Definition
Disaster	A serious disruption to the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts. The effect of the disaster can be immediate and localised but is often widespread and could last for a long time. The effect may test or exceed the capacity of a community or society to cope using its own resources, and therefore may require assistance from external sources, which could include neighbouring jurisdictions, or those at the national or international levels. (United Nations Office for Disaster Risk Reduction 2016)
Disaster adaptation planning	Disaster adaptation planning integrates disaster risk reduction and adaptation measures into planning and governance decision making processes, to respond to natural hazards and climate change, and improve the long-term resilience of built and natural environments.
Disaster adaptation plans	Disaster adaptation plans set out the vision and implementation plan for disaster risk reduction and adaptation strategies, actions and projects that respond to the current and future natural disaster hazards, risks and vulnerabilities identified and analysed in the Plan. They are legislated documents under the *NSW Reconstruction Authority Act 2022*.
Disaster risk	The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity. The definition of disaster risk reflects the concept of hazardous events and disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socioeconomic development, disaster risks can be assessed and mapped, in broad terms at least. (United Nations Office for Disaster Risk Reduction 2016)
Disaster risk management	Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses. Disaster risk management actions can be distinguished between prospective disaster risk management, corrective disaster risk management and compensatory disaster risk management, also called residual risk management. (United Nations Office for Disaster Risk Reduction 2016)
Disaster risk reduction	Disaster risk reduction is aimed at preventing new, and reducing existing, disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development. Disaster risk reduction is the policy objective of disaster risk management, and its goals and objectives are defined in disaster risk reduction strategies and plans. (United Nations Office for Disaster Risk Reduction 2016)
Evacuation	Moving people and assets temporarily to safer places before, during or after the occurrence of a hazardous event in order to protect them. Evacuation plans refer to the arrangements established in advance to enable the moving of people and assets temporarily to safer places before, during or after the occurrence of a hazardous event. Evacuation plans may include plans for return of evacuees and options to shelter in place. (United Nations Office for Disaster Risk Reduction 2016)
Exposure	The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest. (United Nations Office for Disaster Risk Reduction 2016)

Word or phrase	Definition
Hazard	A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. A hazard is characterised by its location, intensity or magnitude, frequency and probability. Hazards may be natural (associated with natural processes and phenomena), anthropogenic (induced entirely or predominantly by human activities and choices) or socio-natural (a combination of natural and anthropogenic factors) in origin. (United Nations Office for Disaster Risk Reduction 2016)
Infrastructure resilience	The NSW Critical Infrastructure Resilience Strategy defines Infrastructure resilience as the capacity of physical infrastructure assets to withstand disruption, operate effectively in crisis, and deal with and adapt to shock and stresses. It includes the flexibility to adapt to present and future conditions. (NSW Critical Infrastructure Resilience Strategy)
Mitigation	The lessening or minimising of the adverse impacts of a hazardous event. The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness. (United Nations Office for Disaster Risk Reduction 2016)
Preparedness	The knowledge and capacities developed by governments, response and recovery organisations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters. Preparedness action is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response to sustained recovery. (United Nations Office for Disaster Risk Reduction 2016)
Prevention	Activities and measures to avoid existing and new disaster risks. Disaster prevention expresses the concept and intention to completely avoid potential adverse impacts of hazardous events. While certain disaster risks cannot be eliminated, prevention aims at reducing vulnerability and exposure in such contexts where, as a result, the risk of disaster is removed. Examples include dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high-risk zones, seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake and immunisation against vaccine-preventable diseases. Prevention measures can also be taken during or after a hazardous event or disaster to prevent secondary hazards or their consequences, such as measures to prevent the contamination of water. (United Nations Office for Disaster Risk Reduction 2016)
Reconstruction	The medium and long-term rebuilding and sustainable restoration of resilient critical infrastructures, services, housing, facilities and livelihoods required for the full functioning of a community, or a society, affected by a disaster, aligning with the principles of sustainable development and “build back better”, to avoid or reduce future disaster risk. (United Nations Office for Disaster Risk Reduction 2016)
Recovery	The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and “build back better”, to avoid or reduce future disaster risk. (United Nations Office for Disaster Risk Reduction 2016)
Residual risk	The disaster risk that remains even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained. The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery, together with socioeconomic policies such as safety nets and risk transfer mechanisms, as part of a holistic approach. (United Nations Office for Disaster Risk Reduction 2016)
Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management. (United Nations Office for Disaster Risk Reduction 2016)

Word or phrase	Definition
Response	Actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. Disaster response is predominantly focused on immediate and short-term needs and is sometimes called disaster relief. Effective, efficient and timely response relies on disaster risk-informed preparedness measures, including the development of the response capacities of individuals, communities, organisations, countries and the international community. The institutional elements of response often include the provision of emergency services and public assistance by public and private sectors and community sectors, as well as community and volunteer participation. "Emergency services" are a critical set of specialised agencies that have specific responsibilities in serving and protecting people and property in emergency and disaster situations. They include civil protection authorities and police and fire services, among many others. The division between the response stage and the subsequent recovery stage is not clear-cut. Some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage. (United Nations Office for Disaster Risk Reduction 2016)
Risk	The effect of uncertainty on objectives. (AS/NZS ISO31000:2009 Risk management - Principles and guidelines
Risk assessment	The overall process of risk identification, risk analysis and risk evaluation. ((AS/NZS ISO31000:2009 Risk management - Principles and guidelines)
Risk reduction	A selective application of appropriate techniques and management principles to reduce either the likelihood of the occurrence of an event or its consequences, or both. (Australian Institute for Disaster Resilience 1998)
Slow-onset disaster	A disaster that emerges gradually over time e.g. drought, desertification, sea-level rise. (United Nations Office for Disaster Risk Reduction 2016)
Social cohesion	Social cohesion is about having better connected, more inclusive and harmonious communities, with strong networks, trust and shared safe social spaces. In the context of the State Disaster Mitigation Plan, social cohesion includes the actions and activities that support people to work together to build stronger networks and social ties at the local level which assist communities to be better prepared for, respond to and recover from natural hazard disruptions. Public spaces and social infrastructure (such as community halls, cafes, places of worship, libraries, online social spaces, and parks) play a key role in providing better outcomes for disaster risk reduction through increased connection between and across individuals, groups and institutions.
Tolerable risk	The extent to which a disaster risk is deemed acceptable or tolerable depends on existing social, economic, political, cultural, technical and environmental conditions. In engineering terms, acceptable risk is also used to assess and define the structural and non-structural measures that are needed in order to reduce possible harm to people, property, services and systems to a chosen tolerated level, according to codes or "accepted practice" which are based on known probabilities of hazards and other factors. (United Nations Office for Disaster Risk Reduction 2016)
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. (United Nations Office for Disaster Risk Reduction 2016)
Warning system	An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities, systems and processes that enable individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events. (United Nations Office for Disaster Risk Reduction 2016)

Appendix 3: Recent independent Inquiries into natural hazards in NSW – incorporation into the State Disaster Mitigation Plan

Following significant disasters in recent years, the NSW Government and Parliament have conducted inquiries into the circumstances and responses to these events. Specifically they are:

- 2022 NSW Independent Flood Inquiry
- Select Committee on the Response to Major Flooding across New South Wales in 2022
- 2019/20 NSW Bushfire Inquiry

NSW Government has been progressing work to address the recommendations in all of these reports, and this Plan further builds on the work of these inquiries. This Appendix provides a summary explanation of each of these inquiries, and a table that demonstrates which recommendations from each inquiry this Plan's actions address.

Reporting the status of NSW Government's progress in implementing the findings of these inquiries will take place through the State Emergency Management Committee's Annual Report, led by the Premier's Department.

1) NSW Independent Flood Inquiry

The NSW Government established an independent flood inquiry to examine and report on the causes of, preparedness for, response to and recovery from the 2022 catastrophic flood event. Professor Mary O'Kane AC and Michael Fuller APM were engaged to lead the Inquiry. The Inquiry was tasked with examining and reporting on:

- causes of, and factors contributing to, the frequency, intensity, timing and location of floods and preparation and planning by agencies and the community for floods in NSW
- responses to floods, particularly measures to protect life, property and the environment
- the transition from incident response to recovery
- recovery, including housing, clean-up, financial support, community engagement and longer-term community rebuilding.

The Inquiry was asked to consider and, if warranted, make recommendations on matters, including:

- the safety of emergency services and community first responders
- current and future land use planning and management and building standards in flood prone areas across NSW
- appropriate action to adapt to future flood risks to communities and their surrounds
- coordination and collaboration between all levels of government.

Recommendations
The Flood Inquiry made 28 recommendations. The Government response supported all 28 recommendations, either in full (6) or in principle (22).

2) Select Committee on the Response to Major Flooding across New South Wales in 2022

This inquiry was set up to consider the NSW Government's preparedness, coordination, and response to the 2022 flooding events. NSW Government considered the Select Committee's findings and recommendations in the context of work already underway to respond to the recommendations of the Independent Flood Inquiry Report. Of the Committee's 37 recommendations, the NSW Government supported 17 recommendations, and supported in principle 20 recommendations, with further work required on implementation.

3) 2019/20 NSW Bushfire Inquiry

In January 2020, the NSW Government commissioned an independent expert inquiry into the 2019-20 bush fire season. Dave Owens APM, former Deputy Commissioner of NSW Police, and Professor Mary O'Kane AC, Independent Planning Commission Chair and former NSW Chief Scientist and Engineer, led the 6-month inquiry, which reviewed the causes of, preparation for and response to the 2019-20 bush fires. The Inquiry report was released on 24 August 2020, with the NSW Government accepting all recommendations.

Quarterly reporting on Government progress in implementing these recommendations has been taking place on the Premier's Department website.[151]

Table 6. Incorporation of the findings of recent natural hazard Inquiries into the SDMP

SDMP Tool	SDMP Actions	Related Inquiry Recommendation
Evacuation infrastructure	Develop a Statewide framework for evacuation infrastructure capacity, analysis and upgrades. The framework: • establishes processes and tools to assess or review existing and future evacuation capacity of infrastructure to ensure people can evacuate within a warning time • is embedded in transport, land-use, bush fire, flood and tsunami planning arrangements, and • identifies roles, responsibilities and resourcing requirements for the development and maintenance of evacuation infrastructure.	**Independent Flood Inquiry** Recommendation 19 proposed that DAPs be created for all cities and towns with prioritised modelling of the impact of and evacuation possibilities from likely potential disasters as well as modelling the direct impact of the potential disasters themselves. Recommendation 26 proposed the development of a Statewide road evacuation plan to establish a coordinated view of evacuation routes. **Parliamentary Flood Inquiry** Recommendation 13 proposed that the NSW Government work with local governments to identify alternative routes to vulnerable roads, and that the NSW and Australian Governments fund the construction of these important routes to improve evacuation and access options in times of disaster.
Managed relocation	Develop a State policy for large-scale multi-hazard managed relocation, drawing on the experience of the Northern Rivers and other jurisdictions, to decide the appropriateness of this response in disaster adaptation planning, which includes: • mechanisms to identify criteria for areas where risks are not tolerable • guidelines to allow strong community involvement and decision-making (pre-disaster, post disaster) • funding principles between governments, councils, households, and businesses • principles for communicating and publishing risk information • implementation of alternative productive uses for reclaimed open space (such as agriculture) or nature-based mitigation measures and other uses (e.g. parks) • relocation of critical infrastructure and government assets • governance for management of land for relocation to occur.	**Independent Flood Inquiry** Recommendation 20 proposed that the economic, social, and environmental potential of floodplains should be unlocked by treating them as an asset. **Recommendation 22 proposed** relocating communities most at risk with good homes and amenities by identifying and prioritising those communities most at risk from future disasters, and for whom relocation may be appropriate or necessary. **Parliamentary Flood Inquiry** Recommendation 26 proposed that the NSW Government consider investing in supporting relocations, land swaps, and providing fair and adequate compensation for landowners who wish to relocate from severely flood-impacted areas. **Bushfire Inquiry** This builds upon recommendation 27 in the Bushfire Inquiry to shift to a strategic approach to planning for bush fire to build greater resilience in both existing and future communities to reduce costs associated with recovery and rebuilding.
Mitigation infrastructure	Review governance and funding arrangements for levee maintenance. Assess the feasibility of using large-scale offshore sand reserves and other sources for beach nourishment. Explore infrastructure mitigation options for landslides.	**Independent Flood Inquiry** Recommendation 28 proposed that floodplain infrastructure items (drains, levees, flood gates) are all assigned to an appropriate lead agency which has responsibility for ensuring they are fully maintained and functioning especially when floods are likely.

SDMP Tool	SDMP Actions	Related Inquiry Recommendation
Strategic planning controls	Develop a library of standard planning controls for all natural hazards for councils to apply: • to address the key issue of heatwave, commence with compulsory 'keeping houses cool' planning controls e.g. roof colour • controls for sensitive development e.g. hospitals Develop framework and supporting processes and tools for determining tolerable natural hazard risk for different development types and land uses, and plan to implement in land use policy and legislation.	**Independent Flood Inquiry** Recommendation 18 proposed a risk-based approach to calculating flood planning levels. This work is being undertaken in coordination with the Department of Planning and Environment's 'Flood Risk Management Understanding' and 'Managing Flood Risk Guide' which has been released as part of 'Flood Risk Management Manual' package. Recommendation 20 proposed that the economic, social and environmental potential of floodplains should be unlocked by treating them as an asset. Recommendation 21 proposed that the NSW Reconstruction Authority provides the necessary tools and advice to enable planning authorities to incorporate cumulative impacts of potential natural disasters into strategic plans. These tools should ensure the DAPs can be given real effect in strategic plans for settlement and local planning controls. **Parliamentary Flood Inquiry** Recommendation 36 proposed that the NSW Government work with local government, industry and sustainable planning experts, including the Government Architect, on policy initiatives in the New South Wales planning system that will help deliver more resilient and sustainable homes, buildings, and places. **Bushfire Inquiry** This builds upon recommendations 27 and 28 in the Bushfire Inquiry to shifting to a strategic approach to planning for bush fire to build greater preparedness and resilience into both existing and future communities to reduce costs associated with recovery and rebuilding.
Warning systems	Develop a strategic management plan for the NSW flood gauge network, and include solutions to the identified challenges of ownership, maintenance, and ongoing funding arrangements. Conduct a technology pilot program to evaluate the functionality, effectiveness, and reliability of intelligent sensors as part of flood and / or bush fire warning systems and implement technology.	**Independent Flood Inquiry** Recommendations 1 and 18 proposed that the NSW Reconstruction Authority should, in collaboration with State, local and non-government partners, enhance work around the monitoring of the flood warning and sensing environment as well as support local councils to improve modelling of and ensure adequate and appropriate alarm systems for flash flooding. **Parliamentary Flood Inquiry** Recommendation 7 proposed that NSW advocate (through the National Cabinet for the Bureau of Meteorology) to review its rain data infrastructure and flood modelling tools, to ensure forecasting locations, rain, and flood gauges and other infrastructure are appropriately placed, maintained, and updated. **Bushfire Inquiry** This builds upon recommendations 4, 5 and 22 to establish NSW as a major world centre of bush fire research and technology development and commercialisation, for establishment of a spatial technology acceleration program to maximise the information available for various remote sensing technologies currently in use and including new remote sensing systems, and deployment of remote sensing technologies to monitor asset protection zones and defendable space.

SDMP Tool	SDMP Actions	Related Inquiry Recommendation
Building codes and standards	Develop a policy for consideration of resilience to natural hazards as part of building codes and standards, that: • considers voluntary and compulsory application through legislation and the National Construction Code • sets agreed thresholds and criteria for application • is supported with validated data/maps • considers costs to development, supply chain impacts, and environmental footprints. Build a library of updated building standards to increase resilience to natural hazards and develop a plan to embed into legislation including the: • National Construction Code • Local environmental plans • State environmental planning policies • Local and State Recovery Plans. Develop a multi-pronged communications and engagement strategy targeting homeowners and the building industry to: • explain the role and importance of standards and codes in building resilience • embed changed practices with industry (e.g. suppliers).	**Independent Flood Inquiry** Recommendation 24 proposed adopting building standards to rebuild after floods so that new housing stock is as flood proof and flood recoverable as possible, as well as developing a code for flood resilient, environmentally sustainable building. **Bushfire Inquiry** This builds upon the delivered recommendation 28 to protect, prepare and build resilience into existing communities by taking a strategic approach to planning for bush fires.
Community awareness and preparedness	Improve multi-hazard risk awareness and preparedness in NSW through the delivery of: • to develop a Get Ready NSW Program Plan and Logic to reflect a multi-hazard approach to Statewide preparedness that complements emergency management agency activities. The program plan will define objectives, roles and responsibilities, funding, priorities, a monitoring and evaluation framework, and a program logic • a 'Get Ready NSW' website that includes natural hazard risk information and guides on how to prepare for individuals, households, and businesses (including a focus on evacuation) • an annual 'Get Ready NSW' multi-hazard public awareness action campaign; measure its impact and share results with local government emergency management and key community partners • a 'Get Ready NSW' fund and guidelines to support councils and community-based organisations to deliver local awareness and preparedness activities • update the Get Ready NSW baseline survey and index to reflect new data requirements to measure LGA-based levels of preparedness on a yearly basis	**Independent Flood Inquiry** Recommendation 15 proposed the creation of the NSW Reconstruction Authority dedicated to disaster recovery, reconstruction and preparedness, including a disaster-preparedness funding envelope, providing advice and support to local governments to maximise the effectiveness of their disaster preparedness and reconstruction programs, and coordinating disaster recovery activities that help communities recover from disasters and build their preparedness for future events. Recommendation 14 proposed that to build disaster resilience in future generations, an evidence-based, targeted education campaign in schools should be designed and delivered.

SDMP Tool	SDMP Actions	Related Inquiry Recommendation
Community awareness and preparedness (continued)	• culturally appropriate, multilingual and accessible communications across a diverse range of formats, channels, platforms and forums to reach diverse communities including distinct cultural and linguistic groups and Aboriginal and Torres Strait Islander communities. Identify existing gaps in education programs for young people and school communities on natural hazard, and develop an action plan to address them. Develop a Disability Inclusive Disaster Risk Reduction (DIDRR) policy and relevant tools for supporting the implementation of the DIDRR Framework for collaborative action to increase community and inter-agency partner awareness and preparedness levels. Coordinate a review of preparedness planning for State government agencies, particularly social service providers.	
Home modification	Drawing on lessons from the Northern Rivers, Central West and other recent disasters, develop: • a process to consider appropriate home modification requirements in building codes and standards • funding guidelines, criteria for eligibility and a funding stream to support home modification activities.	**Independent Flood Inquiry** Recommendation 23 proposed the development of housing and funding options to avoid significant impacts from flood as well as drive broader investment in adaptation.
Infrastructure resilience	Include a process in the DAP Guidelines and Framework for the identification of the relative criticality of assets and plans for asset resilience interventions. Ensure the process includes relevant asset owners, operators, and community representatives. Engage with the private sector and regulator to develop an approach to prioritise and coordinate place-based infrastructure resilience interventions by private sector operators. NSW Government Business Case Guidelines to include natural hazard risk and criticality assessments as part of decision-making for new assets. NSW Government assets owners reflect DAPs in asset management plans.	**Independent Flood Inquiry** Recommendation 19 proposed the creation of Disaster Adaptation Plans. Recommendation 16 proposed that a cost benefit framework be created to enable a more systematic prioritisation of investment options in risk mitigation, which has been completed by NSW Treasury and will assist with embedding these considerations in the NSW Government Business Case Guidelines. **Bushfire Inquiry** This builds upon Recommendation 18 in the Bushfire Inquiry to equip NSW with comprehensive information on all structures and assets at risk of bush fire that use the State Digital Twin. This is currently being progressed by NSW Government. This builds upon recommendations 29 and 30 to maximise the protection and resilience of critical infrastructure in bush fires. Delivery of both these recommendations are in progress by NSW Government.

SDMP Tool	SDMP Actions	Related Inquiry Recommendation
Nature-based measures	Establish a nature-based measures knowledge hub to provide practical advice on the implementation, benefits and impacts of nature-based measures, with an emphasis on Aboriginal knowledge and land management practices, and catchment management approaches.	**Independent Flood Inquiry** Recommendation 27 proposes that to maximise protection for the environment in and around floodplains, Government, working with local communities especially Indigenous communities, the NSW Reconstruction Authority, other agencies and local councils to ensure Indigenous voices are well heard in land use planning and natural resource management. **Parliamentary Flood Inquiry** Recommendation 33 proposes that the NSW Government invest in the restoration of the Wilsons and Richmond Rivers to include riparian restoration, water quality and river health improvement. **Bushfire Inquiry** This builds upon the delivered recommendation 36 in the Bushfire Inquiry to invest in long-term ecosystem and land management monitoring to track what is happening to ecosystems over time, better understand changes in the landscape and better understand the influence of different land management practices.
Social infrastructure and cohesion	Include guidance in the DAP Guidelines and Framework for: • mapping of social assets (community spaces and trusted social networks and leaders) relevant to disaster risk reduction • identification of social cohesion actions that build on strengths and address gaps for disaster risk reduction. Deliver a Statewide framework for social cohesion which includes a focus on natural hazard risk. The framework will define objectives, roles, and responsibilities, monitoring and evaluation, and measurement.	**Independent Flood Inquiry** Recommendation 19 proposed that DAPs be created for all cities and towns to establish realistic expectations of safe spaces to live, working with local government including planning instruments discouraging development in disaster-likely areas. **Parliamentary Flood Inquiry** Recommendations 17 and 18 proposed that the NSW Government ensure that community groups, both existing and emerging, including First Nations groups, are well integrated into disaster recovery, by incorporating them into state recovery plans and engaging with them in between and in the lead up to natural disasters. **Bushfire Inquiry** This builds upon the Bushfire Inquiry recommendations (25 and 26) to increase the respectful, collaborative and effective use of Aboriginal land management practices in planning and preparing for bush fires.

SDMP Tool	SDMP Actions	Related Inquiry Recommendation
Capacity and capability	Investigate options to support resourcing and capability-building in local councils. Provide resources, data and funding to support Local Aboriginal Land Councils as owners of Discrete Aboriginal Communities and other Aboriginal landowners to develop DAPs, building on the work of the Aboriginal Communities Emergency Management Program.	**Independent Flood Inquiry** Recommendation 15 proposed that the NSW Reconstruction Authority should have responsibility for providing advice and support to local governments to maximise the effectiveness of their disaster preparedness and reconstruction programs. **Parliamentary Flood Inquiry** Recommendation 28 proposes that the NSW Government work with First Nations People to support Aboriginal organisations in their capacity to operate and respond in times of natural disasters. Recommendation 35 proposed that the NSW Government significantly increase its investment in flood mitigation and preparation, including its support of local governments to do the same. **Bushfire Inquiry** This supports and builds upon recommendation 26 to increase the respectful and effective use of Aboriginal land management practices and pursuing greater application of Aboriginal land management. This recommendation is currently being progressed by NSW Government.
Collaborative governance	Establish a specifically convened Aboriginal working group to: • articulate lessons from existing programs and initiatives related to Aboriginal disaster risk reduction • provide strategic advice to better inform Aboriginal disaster risk reduction at State and local levels • advise on how to achieve authentic and ongoing conversations with local Aboriginal people and communities to better understand and embed Aboriginal values and needs into disaster risk reduction planning. Include a process in the DAP Guidelines and Framework to facilitate trusted relationships with Aboriginal local communities to recognise Aboriginal cultural values, knowledge, and practices (across all Country). Establish an assurance and expert review function for DAPs. Improve Local Emergency Management Committee (LEMC) capacity and capability to support its increased role in disaster mitigation. Explore options to enhance LEMC governance and operations including increased community and Aboriginal representation.	**Independent Flood Inquiry** Recommendation 6 proposed that to ensure Indigenous communities are included in emergency planning and preparation, emergency management processes incorporate the needs of Indigenous communities including ensuring Aboriginal Community Liaison Officers form part of the Local Emergency Management Committees and are present at evacuation centres during a disaster to better serve Indigenous communities. **Parliamentary Flood Inquiry** Recommendations 17 and 18 proposed that the NSW Government ensure that community groups, both existing and emerging, including First Nations groups, are well integrated into disaster recovery, by incorporating them into state recovery plans and engaging with them in between and in the lead up to natural disasters. **Bushfire Inquiry** This supports and builds upon work already underway by NSW Government on the partially delivered recommendation 72 to ensure Aboriginal people can access appropriate support during evacuations.

SDMP Tool	SDMP Actions	Related Inquiry Recommendation
Data	Formalise natural hazard risk analysis and assessment methodologies and establish a dedicated hub of data, platforms, people, and decision support to be established in the NSW Reconstruction Authority to support disaster adaptation planning. This would include: • agreed methods and assumptions to assess hazard risk and risk reduction options • governance mechanisms that include experts across government to approve methods and assumptions • guidance on completing hazard risk and risk reduction options assessment • a centralised disaster risk hazard, exposure, and vulnerability data platform, drawing on existing sources • a data roadmap and research plan to continuously update data gaps on landslide risk.	**Independent Flood Inquiry** Recommendation 17 proposed that landholders can access information on previous disasters through an online visualisation tool to prepare for and respond to emergencies. This work is being undertaken in co-ordination with the State Emergency Service's Flood Risk Assessment and Visualisation Project. **Bushfire Inquiry** This builds upon Recommendation 18 in the Bushfire Inquiry to equip NSW with comprehensive information on all structures and assets at risk of bush fire that uses the State Digital Twin.
Funding	Progress a business case for a NSW Mitigation Fund to drive additional risk reduction investment, particularly for projects prioritised in DAPs. Explore options for innovative funding pathways and financing mechanisms, such as the NSW Sustainability Bond. Develop funding principles to guide cost sharing for disaster risk reduction between the Australian, State and local governments and private asset owners.	**Independent Flood Inquiry** Recommendation 15 proposed that the NSW Reconstruction Authority should have responsibility to source and acquit reconstruction funding from state, Australian Government and philanthropic sources as well as the creation of a NSW Adaptation Fund. It also proposed that proposed that the NSW Reconstruction Authority should work with disaster-prone communities, local government and agencies across state government to develop a SDMP and scope, source funding for and lead special disaster-prevention and mitigation projects identified in that Plan. Recommendation 23 proposed that to avoid significant impacts from flood as well as drive broader investment in adaptation and NSW Reconstruction Authority establish a NSW Mitigation Fund. **Parliamentary Flood Inquiry** Recommendation 35 proposed that the NSW Government significantly increase its investment in flood mitigation and preparation, including its support of local governments to do the same.
Insurance	Review levy arrangements on insurance premia. Collaborate with NEMA and the insurance sector to reflect disaster risk reduction measures in insurance pricing, and to use data on insurance affordability to inform strategic land use planning responses.	**Independent Flood Inquiry** Recommendation 23 proposed that the NSW Reconstruction Authority work with the insurance industry to ensure that works are undertaken such that they would improve access to lower cost insurance products.
Monitoring and reporting	Develop a Monitoring, Evaluation, Accountability and Learning (MEAL) framework for the continuous improvement of disaster risk reduction in NSW.	**Independent Flood Inquiry** Recommendation 15 proposed that NSW Reconstruction Authority develop a State Disaster Mitigation Plan. Recommendation 18 proposed that evaluation is undertaken of the cost and effectiveness of risk mitigation efforts, including land preparation, planning use and management, to enable a better understanding of what works.

Appendix 4: Endnotes

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123 Cost estimates compiled from a variety of sources, and approximated in equivalent present day AUD. Conversions to present day values were based on local country inflation rates, which may underestimate construction indices. These values should be treated as indicative.

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131 This definition is adapted from the United Nations Office for Disaster Risk Reduction (UNDRR) source: UNDRR – Sendai framework terminology on disaster risk reduction

132 See the social cohesion risk reduction tool section for more detail

133 Ecosystem services: Ecosystem services are the benefits provided to humans through the transformations of resources (or environmental assets, including land, water, vegetation and atmosphere) into a flow of essential goods and services e.g. clean air, water, and food (Costanza et al. 1997).

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146 Part of identifying and measuring social cohesion for disaster risk reduction will include consideration of how the Australian Disaster Resilience Index and other such indices measure social cohesion

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