
Embed reliability and resilience

05

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Strategic directions

- ▶ Apply a structured and systematic approach to resilience across multiple asset types, multiple risks and the infrastructure asset lifecycle
 - ▶ Establish a rigorous and funded program to identify and remedy assets most likely to cause service failure
 - ▶ Deliver assets that reduce the risk and impact of major natural hazards and shocks
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Many infrastructure assets have long lifecycles and need to be resilient to withstand shocks and stresses that compromise performance. Recent experiences have illustrated the pressures that can be placed on infrastructure systems by:

- ▶ natural hazards such as severe weather events and changing environmental conditions
- ▶ public health crises
- ▶ cybersecurity threats and systems failure.

NSW Treasury estimates the 2019-20 bushfire season alone resulted in at least \$1.8 billion in direct economic damages and \$4.4 billion in costs to the State budget over five years to 2023-24.¹⁶⁴ The floods of 2022 in Northern NSW and the Hawkesbury are too recent to accurately quantify the losses, but they have been devastating for thousands of people, businesses and communities.

The potential impacts of climate change compel the NSW Government to be more alert, more proactive and more thorough in planning, preparing, maintaining and upgrading public assets.

5.1 A whole-of-system approach to resilience

Proactive preparedness and resilience requires a whole-of system, all-hazards approach that addresses both the resilience of individual assets and the contribution of these assets to the resilience of the overall system.¹⁶⁵ This requires:

- ▶ identification of weak links and interdependencies in infrastructure systems to bolster likely points of failure by redundancy and asset hardening
- ▶ clear accountability across State organisations responsible for infrastructure resilience

- ▶ prioritisation of asset maintenance and upgrades as a critical element of the investment program
- ▶ collaboration and partnership with asset owners in local government, non-government agencies, the private sector, and local communities that contribute to system resilience.

Strong progress has been made since 2018 in applying lessons from the events experienced by the State to better prepare NSW for the future, as shown in Table 5.1.

Table 5.1 – Key resilience initiatives from the NSW Government since 2017

Strategy and Policy	Standards and Guidance	Investment Programs / Funding	Other
<ul style="list-style-type: none"> ▶ NSW Critical Infrastructure Resilience Strategy¹⁶⁶ ▶ NSW Government Cyber Security Strategy¹⁶⁷ ▶ Asset Management Policy for the NSW Public Sector¹⁶⁸ 	<ul style="list-style-type: none"> ▶ Design and Place State Environmental Planning Policy (SEPP)¹⁶⁹ ▶ Planning for a more resilient NSW: Strategic Guide to Planning for Natural Hazards¹⁷⁰ ▶ Guidelines for Resilience in Infrastructure Planning: Natural Hazards¹⁷¹ ▶ A Pathway to Infrastructure Resilience Joint INSW/IA Advisory Papers¹⁷² 	<ul style="list-style-type: none"> ▶ Critical Communications Enhancement Program (CCEP) ▶ Infrastructure Betterment Fund ▶ Safe and Secure Water Program 	<ul style="list-style-type: none"> ▶ Establishment of Resilience NSW ▶ Climate Risk Ready NSW ▶ Establishment of Cybersecurity NSW ▶ Independent NSW Bushfire Inquiry ▶ Cross-Dependency Initiative (XDI) NSW Project ▶ NSW and ACT Regional Climate Modelling (NARClIM) Regional Climate Projections ▶ NSW Climate Data Portal

The 2022 SIS outlines an approach that consolidates the progress made to date and recommends the following:

- ▶ establish a register of primary hazards and vulnerable locations across the State
- ▶ prioritise adaptation of assets and services within these locations that are:
 - most vulnerable to primary hazards
 - most significant in prevention, response and recovery
- ▶ develop place-based resilience and adaptation strategies for vulnerable locations across NSW
- ▶ targeted asset hardening and adaptation leading to:
 - a program of responses for assets most at risk
 - a comprehensive program of asset management investments and requirements.
- ▶ a program of investment in new assets to address primary hazards, including items that have already been assessed, such as Hawkesbury-Nepean Valley flood mitigation and water security projects
- ▶ improved accountability for prevention of, response to and recovery from impacts to infrastructure from hazards
- ▶ a funding and financing facility to deliver and encourage investment in infrastructure resilience.

5.2 Frequency and severity of impacts are likely to increase

Climate events and natural hazards are varied, becoming more frequent and severe

Not surprisingly, much of the recent attention on climate-induced events has focused on droughts, floods and bushfires, with well-demonstrated impacts on communities, local economies and infrastructure. These events have caused considerable suffering across NSW in just the past three years. However, other climate risks have implications for infrastructure, particularly coastal hazards and extreme heat.

Eighty five percent of the NSW population lives within 50km of NSW's coastline.¹⁷³ Approximately half of this is comprised of open-coast sandy shoreline¹⁷⁴ and exposed to significant erosion and flood risk.^{175,176} This is compounded by Australia's sea level already rising at a faster rate than global averages.¹⁷⁷ The 2021 and 2022 Eastern Australia floods demonstrated the danger of storm surges combined with extreme rainfall events. Impacts included inundation of homes, stranded communities, disrupted supply chains, damage to coastal defences and major erosion of iconic beaches.

Extreme heat also presents a challenge for critical infrastructure across NSW. This is particularly relevant to urban settings such as Western Sydney, where the urban heat island effect can add two degrees to local warming, in

contrast to surrounding vegetated areas.^{178,179} One consequence of extreme heat is the high demand placed on energy systems, primarily because of the increased use of air conditioning and cooling systems. Peaks in energy demand can result in system outages, with cascading consequences for commercial and industrial buildings, communications, and transport systems.

The health and economic impacts of heatwaves are profound. Since 1900, heatwave events have been responsible for more premature deaths in Australia than all other natural hazards combined.¹⁸⁰ As a result of climate change, more intense heatwaves are projected to occur more often and last longer: up to 3.5 days more on average by 2070.¹⁸¹ By 2061, between 700,000 and 2.7 million additional days of work are projected to be lost annually due to more frequent and intense heatwaves.¹⁸² Extreme heat and other natural hazards can also create acute demand pressures on health infrastructure, as current disaster planning processes undertaken by hospitals may not be adequate to meet increased demand during these events.¹⁸³

In the coming decades, NSW's changing climate is expected to result in a greater likelihood and severity of natural disasters.^{184,185} NSW Treasury has estimated that the economic costs of more frequent and severe natural disasters could cost the State between \$15.8 billion and \$17.2 billion a year on average by 2060-61 (real 2019-20 dollars). This is up from \$5.1 billion in 2020-21, more than a three-fold increase.¹⁸⁶ These economic costs come in the form of business disruption, lower productivity and damaged infrastructure.

Analysis indicates that a large proportion of NSW's most socio-economically disadvantaged local government areas also experience significant numbers of disaster events.¹⁸⁷ Impacts can be more severe in these communities given their reduced capacity to absorb and adapt.¹⁸⁸ For example, reduced access to services, including adequate housing, health and food services in some Aboriginal communities increased vulnerability to COVID-19 and other health conditions.¹⁸⁹

Public health crises require increased capacity

The COVID-19 pandemic has demonstrated the value of resilience planning that factors in low likelihood, high impact events. The pandemic continues to place significant stress on health infrastructure and expose vulnerabilities in supply chains, while demonstrating the value of contactless ways of working. It has revealed that policy responses to a specific public health crisis can have flow-on effects for the rest of the economy.

NSW's strong management of the health crisis protected the economy from a more severe recession, in contrast to comparable jurisdictions where health systems failed to keep up with the spike in demand for services.¹⁹⁰ Nevertheless, the Australian and State governments have incurred significant additional expenditure to provide income support and respond to higher demand for social infrastructure and services.

The pandemic response has taught government and infrastructure managers key lessons in resilience. These lessons have demonstrated that:

- ▶ Health infrastructure requires a strategic reserve capacity that can be mobilised at short notice, meaning ongoing maintenance, documentation, practice and skills are essential.
- ▶ Highly contagious airborne pathogens require new design approaches that incorporate access to fresh air ventilation, circulating clean air and mechanical air systems that can create negative pressure zones – this could apply in many types of public infrastructure including hospitals, schools and public transport.
- ▶ Telecommunications infrastructure may experience sudden and sustained spikes in demand from home working.
- ▶ Local access to green infrastructure is vitally important, especially public open space and green spaces that support mental and physical health during lockdowns.
- ▶ By contrast, some forms of infrastructure, such as airports, public transport and event infrastructure, require an ability to be put on low operational footing, with implications for design, automation and financing arrangements.
- ▶ Critical infrastructure requires a capacity for contactless, smart operation and maintenance.
- ▶ Supply chain disruption, and disruption to the movement of skilled people, is a delivery and operating risk at international and interstate levels and even between local government areas.

- ▶ Needs for personal data systems may be greater than otherwise warranted for contact identification, tracing, demographic characteristics and vaccination status.
- ▶ Increased demand for social infrastructure and housing can exacerbate vulnerability among disadvantaged communities, with wider impacts for all communities.
- ▶ Continuity in construction delivery requires methods to ensure minimal on-site transmission, as well as detection and control of movement of people working on construction sites.

Digitisation of the economy and infrastructure networks increasing cyber-risks

Infrastructure systems have become more vulnerable to cyber-attacks as the technological sophistication of assets improves.¹⁹¹ This reflects increased digitisation of infrastructure operations alongside a rise in geopolitical tensions.¹⁹² Recent examples of significant international attacks on infrastructure include attacks on the Colonial Oil Pipeline and Florida City's water supply in the United States in 2021.^{193,194} Cyber-attacks can significantly disrupt economic activity and threaten community safety. Cyber security and infrastructure are discussed further in Chapter 9.

5.3 Evidence-based assessment of risks and vulnerabilities is essential

Improving capability to understand risk

Management of risks is improved by comprehensive data on the shocks and stresses to which infrastructure networks might be exposed. This information is critical at the asset planning phase so that risks and resilience measures are identified early in the infrastructure lifecycle.

Collection and application of natural hazard data currently occurs in a fragmented way across a range of national, state and local government authorities.

Integration of data will allow a statewide, place-based risk assessment that also considers future climate scenarios. This would identify high risk zones across NSW and the key assets and services most vulnerable, or most important, in each high-risk location – enabling development of a prioritised, efficient and effective whole-of-system resilience response. Hazard and asset data should be integrated into a common model on a publicly accessible platform and should be supported by regularly updated guidance material.

Place-based strategies

Each area identified and prioritised as high risk requires place-based strategies developed in partnership with local governments, regional organisations and affected communities.

Consistent with the NSW Critical Infrastructure Resilience Strategy and other recent best practice, place-based approaches should take a system-wide view and consider infrastructure, organisational and community resilience responses. These approaches should also consider the role that nature-based assets (such as forests) and solutions (such as constructing wetlands to absorb stormwater runoff) can play in increasing the State's resilience.

Work on the Hawkesbury-Nepean Valley Flood Risk Management Strategy (see Box 5.1) provides a benchmark for the application of place-based strategies in other locations across NSW.

Box 5.1

Hawkesbury-Nepean Valley Flood Risk Management Strategy^{195, 196}

The Hawkesbury-Nepean Valley has the highest riverine flood exposure risk in NSW due to its unique geography and substantial population. *The Hawkesbury-Nepean Valley Flood Risk Management Strategy* is a place-based long-term plan that the NSW Government is implementing for improved flood resilience. The strategy comprises a mix of infrastructure interventions complemented with a range of non-infrastructure flood risk management actions to mitigate, better prepare, respond to and recover from major flood events.

Actions include: infrastructure interventions, regional flood risk coordination, monitoring and evaluation under an adaptive management framework, integrated regional land use, transport and emergency planning, contemporary flood risk information and a community resilience awareness and preparedness program.

Clearly defining accountability can improve resilience

Taking a whole-of system approach to resilience requires the involvement of many stakeholders, including all levels of government, infrastructure asset owners and operators, communities, businesses and the non-government organisations (NGOs) that deliver critical emergency and social services.¹⁹⁷ There are clear benefits from better integrating and aligning strategic resilience considerations and defining clear ownership of and accountability for resilience-related responsibilities. Taking such an approach will improve NSW's ability to plan for resilience in the long term.

Building on the significant work already underway, there is an opportunity for a whole-of-government assessment of resilience-related responsibilities and use of data. This would support the delivery of reforms designed to enhance and clarify current arrangements.

The development of the first State Resilience Strategy (SRS) by Resilience NSW provides an opportunity to commence this work and drive improvements in this area.

Box 5.2

NSW State Resilience Strategy

As a recommendation of the NSW Bushfire Inquiry, Resilience NSW will develop a State Resilience Strategy (SRS) to embed disaster resilience across the State, and to target and prioritise future investment in risk mitigation and capability development.

The SRS will establish a vision and statewide objectives for Resilience NSW, while aligning with key international and Australian Government disaster frameworks. It will acknowledge the need to engage with regional voices from across government, business, and local communities.

5.4 Resilient infrastructure demands greater investment in asset management

New infrastructure investment is exciting. Investment in asset management is not. Rarely is the public imagination captured by maintenance planning and design, asset condition assessments, asset augmentations, systems upgrades or the development of skills and capabilities in asset management skill. However, when infrastructure and services fail, it is often because good management practices have not been routinely applied; these are mundane activities until suddenly there is a catastrophic event.

In 2019, the NSW Government introduced the Asset Management Policy for the NSW Public Sector to drive better asset management practices.¹⁹⁸ Under the Policy, agencies are required to develop Asset Management Plans and Strategic Asset Management Plans. Preparation of these plans presents an opportunity to methodically improve service reliability across the Government's asset portfolio.

Agencies are at varying levels of maturity in complying with the new Asset Management Policy; consequently, reporting on risk exposures of their assets is inconsistent. Better data, standardised risk assessment approaches and ongoing improvement in asset management practices across the entire asset lifecycle could provide a greater understanding of the risks and interdependencies of state assets. With this understanding, asset planning can prioritise service reliability and contingency planning under shock and stress scenarios.

Leveraging digital and technology platforms provides a better understanding of performance, vulnerability, interdependencies and risk exposures of infrastructure. For example, the Cross Dependency Initiative (XDI) being managed by DPE establishes arrangements to share data on asset exposure and vulnerability between various asset owners. This will enable public and private sector asset custodians to make better informed decisions about infrastructure service delivery risks under a range of shocks and stresses. The efficacy and broader application of data platforms that consolidate hazard and asset information should be explored by the NSW Government.

5.5 Building back better

Damaging events have happened before and will happen again – and more frequently. When these shocks occur and damage is incurred, replacement assets need to be designed to withstand the pressure they may be exposed to over their operational lives and to fulfil the changing role they may play in system-wide resilience. This may involve adopting design standards now that build resilience to events that currently seem improbable, but are increasingly likely under changing climate conditions. Assets that are being renewed, upgraded or replaced should also incorporate digital technology as a matter of course. This can enable greater insights into and support decisions about how best to manage the asset, as well as enabling remote operations for routine maintenance and in times of shock or stress.

Funding improved resilience has been a challenge. Often, asset maintenance and renewal result in a 'like-for-like' replacement of assets, which may be unsuitable for the changing risk profiles over their operational lives. This is also the case for disaster funding and insurance arrangements, which typically replace assets on a 'like-for-like' basis or to existing design standards.

Investment in ‘building back better’ – also known as betterment – can deliver significant whole-of-life avoidance costs for infrastructure assets,¹⁹⁹ as well as ensuring that communities experiencing distress have more reliable infrastructure and services. In recognition of this, the NSW Government, together with the Australian Government, has established the NSW Infrastructure Betterment Fund to build back infrastructure assets affected by the 2019-20 bushfires and 2021 storms and floods to a more resilient standard.

This is a worthwhile step but investing in betterment and service reliability will need to be more comprehensive and more proactive. Attention is naturally high after disaster events, but investment in betterment is best done proactively, ahead of disasters, year in and year out. Government at all levels should be prioritising investment in improved asset management capabilities, as well as funding maintenance and management that achieves improved resilience.

5.6 Interdependencies and integrated risk mitigation

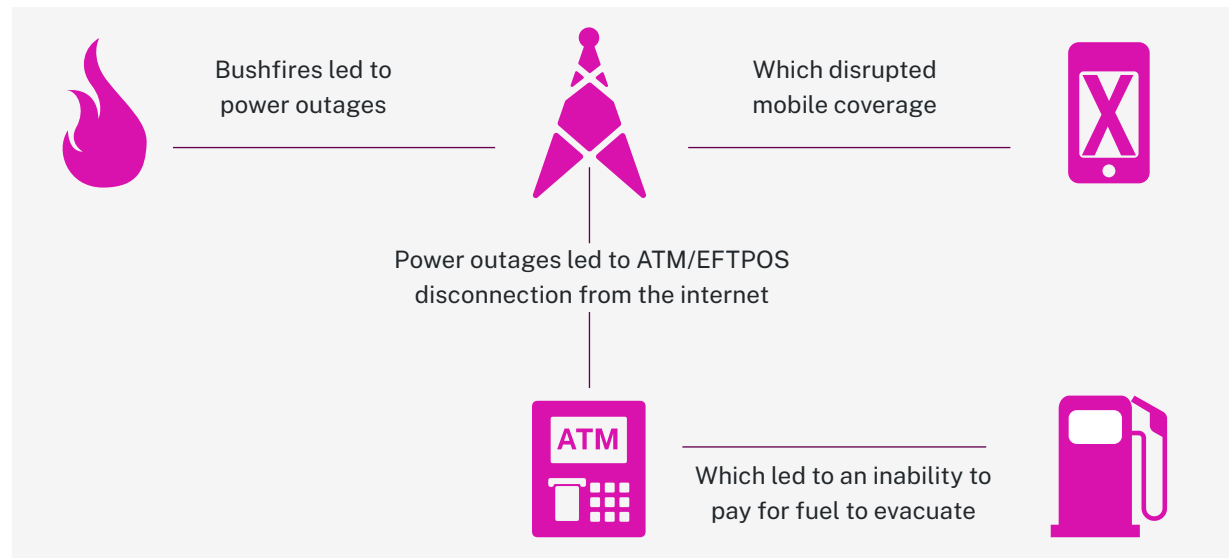
Managing systems interdependencies across infrastructure assets

Critical interdependent links in infrastructure asset systems can also require back-up or contingency management to prevent cascading system failures. Recent climate-related events in NSW demonstrated the cascading system failures that can result from low levels of resilience and redundancy in telecommunications, road and rail infrastructure (as shown in Figure 5.1). Floods and fires have illustrated that when one part of the network is unavailable, multiple assets could be compromised.

The 2019–20 bushfires highlighted critical interdependencies between infrastructure assets. Damaged powerlines caused power outages to mobile telecommunications towers, which then disrupted mobile coverage. Of the 888 telecommunication outages between December 2019 and January 2020, 779 (88%) were caused by mains power outages.^{200,201}

The power outages also affected ATMs and EFTPOS machines, which became disconnected from the internet, resulting in people being unable to pay for the fuel they needed to evacuate the immediate vicinity of the bushfire.²⁰²

Figure 5.1 – System interdependencies between infrastructure assets affected by bushfires



Source: Infrastructure NSW (2022)

The NSW Government works closely with private sector infrastructure operators in times of disruption to ensure ‘critical’ infrastructure is quickly restored but State Government agencies should also consider these inter-relationships in their own continuity planning and disaster response protocols. Some jurisdictions, such as the UK, have devised assurance and regulatory requirements for private sector asset operators to meet minimum standards for response and recovery.

Transport corridors play a key role in disaster response

Recent events have also reinforced the importance of the transport network in supporting evacuation, which is a primary response strategy to many climate and human-induced emergencies. Road network planning needs to take account of mass evacuation capacity for major events. The Hawkesbury-Nepean flood evacuation model simulates how populations in the Valley evacuate to safe locations on a defined evacuation road network under a range of different floods and conditions. The 2019-2020 bushfires highlighted the challenges of moving large numbers of people on roads, with people isolated in their cars for many hours by the extensive fire fronts across the NSW road network.

In other jurisdictions such as New Zealand and the United States, transport agencies conduct regional vulnerability assessments. These assessments give decision-makers network-level

visibility of the security of a corridor, alternative routes and their respective capacities.²⁰³

An assessment should be undertaken to plan and prioritise across the State where similar natural hazard risks are high, where the population has grown around hazards and legacy roads, or where adaptive capacity is low, such as the flood-exposed roads that connect remote and Aboriginal communities with services.

The assessment should be at a network scale, factoring in asset and network-level interdependences. The scope of the evacuation modelling should also include the road network owned and operated by local government and, in the case of some regional and rural areas, privately-owned roads. This could help to identify which future investments in transport network resilience measures should be given priority and provide the opportunity to explore and develop adaptive capacity systems.

5.7 Infrastructure assets for community resilience

Where organisational and community resilience responses alone will not be adequate to protect communities,²⁰⁴ new or improved infrastructure may be required. ‘Resilience assets’ are classes of infrastructure assets specifically designed to improve resilience to shock events and chronic stresses. For extreme rainfall events, this could include flood mitigation infrastructure, such as the proposed dam wall raising at Warragamba

Dam, as well as road and drainage upgrades to reduce impacts of flooding. For severe droughts, resilience infrastructure can include rainfall-independent sources of water supply or the capacity to draw upon, treat and sanitise alternative sources of water, which has been particularly important in regional towns. For fires, it may include constructed fire breaks and hazard reduction preparations, fire stations and control centres. For pandemics, it could include redundant capacity in hospitals or facilities that can be readily converted to health purposes.

The reasons for investments in resilience assets are different to those for infrastructure assets in daily use. Resilience assets are designed to mitigate the worst consequences of high impact, low frequency events. The best outcome is that they are never or rarely called upon. For these reasons, identification and evaluation of resilience assets require different tools. These include a willingness to evaluate probabilistically, use of scenario and real options analysis (ROA), and consideration of any trade-offs or flow-on effects from new infrastructure on natural systems. Resilience asset planning requires well-developed principles on funding, including contributions from different levels of government, households and business beneficiaries.

Not all resilience infrastructure is specialised or highly technical. Community facilities and multi-use assets such as showgrounds, community halls, schools and other local scale assets can play an important role in the prevention, preparedness, response and recovery from

shock events. However, these assets have not historically been viewed as critical infrastructure assets. Community facilities that seem mundane in normal times can become the rallying point for a community under threat. They allow people to gather when evacuated or when they have lost their homes and provide a place for emergency responders to meet and work with the community. Priorities for these assets should be developed with each local council and community.

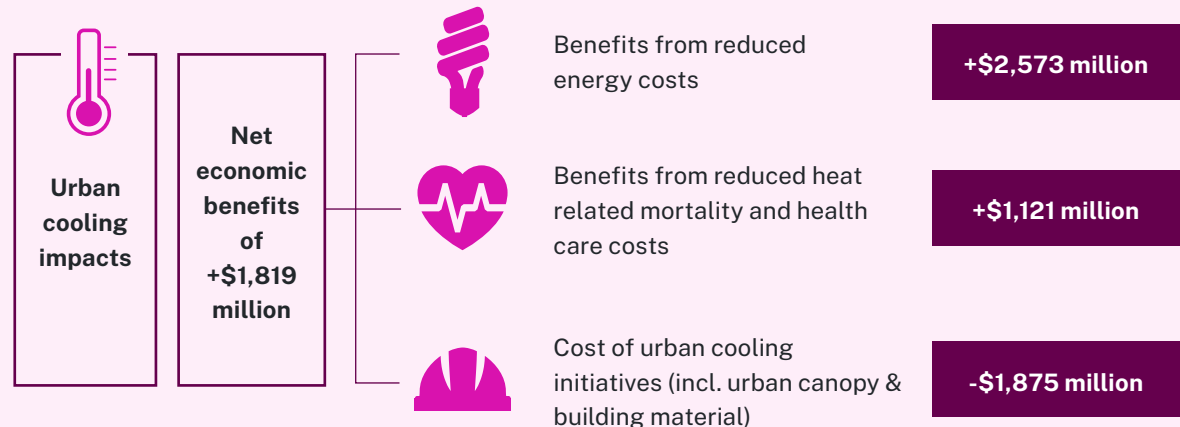
Finally, nature-based adaptation solutions are now supported as a mainstream adaptation response across the world. There is scope for their wider application in NSW.²⁰⁵ Natural or blue-green infrastructure responses are cost-effective but less immediate (see Box 5.3 on South Creek in the Western Parkland City). Combining these infrastructure responses with measures to improve community resilience has proven effective in cities like Singapore, Taipei and Chicago.²⁰⁶ Applying traditional ecological knowledge of blue-green infrastructure can reduce hazard risks to infrastructure and also build community resilience.

Box 5.3

South Creek Wianamatta – Economic benefits from urban cooling initiatives

The 2018 Western Parkland City (South Creek Catchment) Land and Water Use Strategic Options Business Case assessed different urban design options to achieve urban cooling effects.²⁰⁷ The analysis found that changes to the design of residential and commercial buildings and the provision of parks and tree canopies through urban planning could generate net economic benefits. For example, benefits could be realised directly through reduced energy consumption (such as use of air-conditioning) and indirectly from avoided heat-related mortality and healthcare costs (such as heat strokes).

Incremental net benefit of the Western Parkland City with Integrated Water Cycle Management (IWCM)



Source: Infrastructure NSW (2018)

5.8 Funding resilience initiatives

Prioritising funding for investment into infrastructure resilience, including physical and green infrastructure responses, has proven to be a challenge. Investment that avoids the costs from low likelihood but high impact events is often difficult to justify when compared to traditional investment in assets with more certain economic returns.

This is compounded by:

- ▶ a mismatch between those who typically benefit from investment and those who typically bear the costs
- ▶ difficulty accounting for project value (typically avoided cost and risk reduction benefits, as opposed to economic productivity or revenue benefits)²⁰⁸
- ▶ a lack of financial partnership models to enable shared responses to risk (such as with the private sector)²⁰⁹
- ▶ low levels of capability and capacity to fund and deliver the appropriate responses (particularly at the local government level where much of the resilience investment is needed).

In line with other jurisdictions experiencing similar challenges (see Box 5.4), dedicated multi-year funding and financing facilities can help to overcome these impediments.

The NSW Government has taken similar approaches in the past, developing policy-specific funding and financing mechanisms that are accessible only when potential applicants can demonstrate they achieve policy-specific outcomes. For example, low-interest financing facilities have been provided by the NSW Government for councils to drive housing supply.²¹⁰

Specific funding approaches like the examples in Box 5.4 can help to deliver the infrastructure investment needed to reduce the State's exposure (alongside the Australian Government) as the default insurer of last resort.

Various options, differing in the extent of fiscal resources required and the roles of local government, the private sector and non-government agencies, should be explored to fund the delivery of infrastructure to build resilience.

Box 5.4

Funding for resilience initiatives

Infrastructure Canada, Disaster Mitigation and Adaptation Fund

The Government of Canada launched a CAD 2 billion Disaster Mitigation and Adaptation Fund to invest in structural and natural infrastructure projects to increase the resilience of communities to current and future climate-related risks and disasters. that are impacted by natural disasters triggered by climate change. The Fund supports the construction or modification of infrastructure that will prevent, mitigate or protect against the impacts of climate change, disasters triggered by natural hazards and extreme weather.

New Jersey Energy Resilience Bank

The State of New Jersey developed a public finance facility to proactively build resilience against major power outages due to events such as tropical storms, hurricanes and ice storms. The Energy Resilience Bank provides grants and low-interest loans for distributed energy resources at critical facilities, such as water and wastewater treatment facilities and hospitals and related healthcare facilities. These resources, such as solar panels, battery storage and small turbines, make the facilities – and the communities they serve – less vulnerable to severe weather events and other emergencies.

5.9 Recommendations

No	Recommendations	Implementation timeframe	Lead agency
16	Adopt a whole-of-system approach to enhance risk identification and assessment		
	a. Confirm responsibilities and outcomes for a comprehensive whole-of-government resilience approach.	Immediate Priority	Stronger Communities
	b. Integrate natural hazard risk data from across government/s and develop a statewide natural hazard risk model.	Immediate Priority	Treasury & Stronger Communities
	c. Adopt climate, pandemic and other risk scenarios within the standard suite of Common Planning Assumptions.	Immediate Priority	Planning and Environment & Treasury
	d. Conduct a statewide hazard risk assessment to identify the locations and infrastructure assets most at risk across NSW.	Immediate Priority	Treasury & Stronger Communities
	e. Develop a publicly accessible digital platform for natural hazard risk and infrastructure asset data.	Medium Term Need	Treasury & Customer Service
17	Develop place-based resilience and infrastructure adaptation strategies that assess local risk and incorporate infrastructure and non-infrastructure solutions for vulnerable locations across NSW	Immediate Priority	Planning and Environment & Regional NSW

No	Recommendations	Implementation timeframe	Lead agency
18	<p>Fund and deliver an investment program designed to improve the resilience of the State's most vulnerable and critical assets</p> <ul style="list-style-type: none"> a. Adopt consistent and standard approaches to understand and measure hazard risk across the NSW asset portfolio. b. For vulnerable assets, require service reliability and contingency planning under shock and stress scenarios. c. Use asset management routines and reporting to prioritise investment in asset maintenance, upgrades, renewal and adaptation in each place and in each agency. d. Develop and apply digital approaches to collect and share asset data and asset interdependencies. e. Incorporate 'build-back better' outcomes into asset management plans, investment policies and funding mechanisms. 	Immediate Priority	Treasury, Infrastructure NSW & Planning and Environment
19	<p>Establish a program of prioritised resilience infrastructure and accelerate project delivery</p> <ul style="list-style-type: none"> a. Warragamba Dam wall raising b. Local road improvements in the Hawkesbury Nepean Valley c. Regional water security and resilience investments d. Wianamatta South Creek integrated land use and water cycle management. 	<p>Immediate Priority</p> <p>Immediate Priority</p> <p>Extended Program</p> <p>Extended Program</p>	<p>Planning and Environment</p> <p>Transport</p> <p>Planning and Environment</p> <p>Planning and Environment</p>
20	<p>Improve transport network response and recovery performance through service continuity planning, investment in evacuation and alternative routes, and infrastructure upgrades, guided by place based strategies</p>	Extended Program	Transport
21	<p>Propose new funding models for ongoing and reliable investment in resilience infrastructure and asset hardening</p>	Immediate Priority	Treasury & Stronger Communities