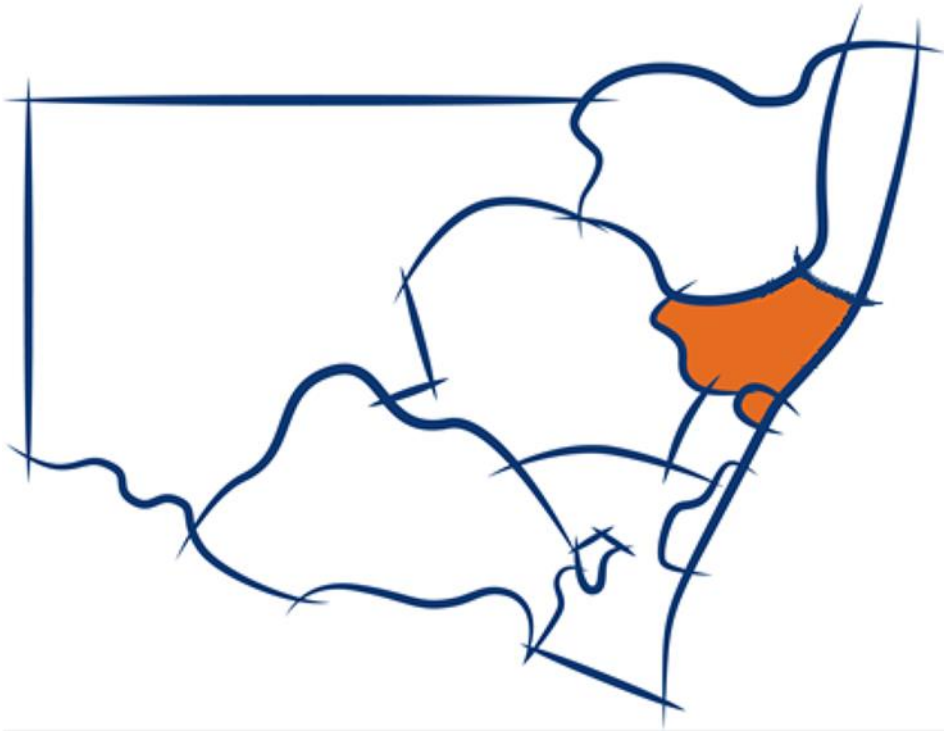
DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

# Hunter and Central Coast Enabling Regional Adaptation



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**Acknowledgements**

The authors would like to begin by acknowledging and honouring Aboriginal people as the First Peoples of New South Wales, and in particular, the Awabakal, Worimi, Wonnarua, Geawegal, Birrpai, Guringai and Darkinung peoples are acknowledged as the traditional custodians and occupants of their lands in the Hunter and Central Coast regions.

The authors thank staff from the Hunter and Central Coast Regional Leadership Executive and the Project Steering Group for their support in guiding this process and driving participation in the workshops. We are indebted to staff of the NSW Government and local governments throughout the NSW Hunter and Central Coast for generously sharing their local knowledge, ideas and expertise. We also acknowledge the significant contribution and analysis provided by Dr Brent Jacobs and the research team at the Institute for Sustainable Futures, University of Technology, Sydney in the development of this report.

Published by:

Environment, Energy and Science
Department of Planning, Industry and Environment
4 Parramatta Square, 12 Darcy Street, Parramatta NSW 2150
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment, Energy and Science enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
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ISBN 978-1-76039-015-0
EES2020/0451
October 2020

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# Contents

# List of tables



# List of figures

# Executive summary

The Hunter and Central Coast Enabling Regional Adaptation (HCC ERA) project builds on local knowledge to understand climate vulnerabilities in the Hunter and Central Coast (HCC) regions and identify opportunities to respond. The project supports regional decision-makers to enhance government service delivery and planning at a regional and subregional scale in the context of climate change.

The ERA process was designed in conjunction with the University of Technology Sydney Institute for Sustainable Futures (ISF) to develop a shared understanding among regional stakeholders of the likely vulnerability to climate change and stimulate regional action to plan adaptation. The HCC is the last NSW region to undertake the ERA process. The HCC project now joins the South East, Shoalhaven Illawarra, North Coast, Riverina Murray, New England North West, Central West Orana and Far West regions as having successfully completed an ERA project.

This report presents the outputs from the project, which was guided by a regional project steering group with representation from state and local government agencies. The project held a series of workshops in the HCC during 2019 and engaged with a total of 150 regional stakeholders. Workshop participants developed transition pathways for key regional systems to build resilience to climate extremes and minimise impacts on their local communities. The report outlines the workshop process, and potential projects to activate the transition pathways and strengthen key regional systems in the HCC. It provides a potential roadmap for improved government service planning and delivery now and into the future.

Nine system transition models were developed through the HCC ERA project and are discussed in detail:

1. Aboriginal cultural values
2. Circular economy
3. Community resilience
4. Emergency management
5. Industry transformation
6. Planning
7. Protection of natural systems and environment
8. Transport and infrastructure
9. Water and water security.

Two strong themes emerged throughout the project: the need for collaboration between agencies, and integration of knowledge and governance.

A survey of stakeholders in the HCC was undertaken in conjunction with the project to understand current action, awareness and adaptive capacity. The results showed that action on climate change is a priority and while there are actions underway, more support is needed to increase organisational capacity to implement climate change adaptation. These findings were echoed by the project steering group, who support the need to increase resilience to climate change and build the adaptive capacity identified in the region through a whole-of-government approach.

# Report overview

This report contains a collective understanding of the likely vulnerability to climate change of the Hunter and Central Coast (HCC) regions and aims to stimulate action to plan adaptation. It documents regional challenges and actions identified by local decision-makers as critical to their community's prosperity and endurance. Local councils and state agencies will need to continue to collaborate and look for opportunities and policy windows to enable transformation of the nine systems identified in this report.

To address the HCC regions' vulnerability to climate change, regional administrators, businesses and communities can begin by pursuing the following opportunities and be on the lookout for new ideas as well:

- **Understand regional vulnerability** – Table 2 in Chapter 3 of the report outlines the exposure and sensitivity of the regions to climate and other regional drivers of change. It provides a lens through which the specific attributes of the regions can be viewed as a means of addressing threats (adaptive capacity). Adaptive capacity can also help to identify what attributes are absent or negative, highlighting which adaptive responses will be constrained, leaving the regions vulnerable (see Figure 15).
- **Understand the flow-on impacts of climate shocks and stressors across the community** – The impact chains in Figure 17 in Chapter 4 show how climate variability and extreme events will affect biodiversity, the cost of recovery as well as the demand of health services in the region and illustrates the complexity of consequences from the main climate drivers that were identified.
- **Assess climate change adaptation progress in the HCC** – The survey results in Chapter 6 outline the key climate change risks and the status of adaptation currently underway. This provides a benchmark against which future action can be measured.
- **Embed the transition models into regional and local strategic plans** – The nine transition models in Chapter 2 look at key regional systems that will need to be significantly different in the future due to climate change, and other specific regional drivers of change. Identifying actions in the transition pathways during project and program development will aid cross-sectoral adaptation and support regional efforts to transform to a desirable future. This can be achieved through strategic planning or operational opportunities at a regional and local level.
- **Seek funding to activate transition pathways** –The assessment method used to identify the regional vulnerabilities is a peer reviewed methodology, meaning it provides a robust and scientifically rigorous way to prioritise adaptation projects and responses. It provides a sound evidence base to support adaptation projects and justify subsequent investment.
- **Communicate the expected physical changes** – Table 7 and Appendix A summarise the changes to climate variables that can be expected in the future as well as the likely impacts across different sectors. Community education and staff training will help the whole region to increase its preparedness.
- **Leverage existing cross-jurisdictional leadership groups** – These groups are central to coordinating and driving climate change adaptation in the HCC and are a valuable resource to help build momentum.
- **High priority pilot projects** – Table 6 in Chapter 5 lists 23 potential pilot projects identified by workshop participants that could be developed as first step actions from a range of transition pathways.

Collaborative and proactive action by administrators, businesses and communities is the key to minimising the impacts of climate change on the local economy and environment of the HCC. This report is designed to facilitate that action and enable transition for the regions.

# 1. Introduction

The climate is changing, and global modelling indicates that further change is already locked in. As a result, there is a growing risk of climate related impacts on our state's natural, social and economic systems. Regional administrators, businesses and communities need to identify their strengths and weaknesses in the face of climate impacts – deciding how they will act together to minimise the impact of climate change on their local economy, environment and society.

Climate affects multiple systems and so risks from climate require a systemic and coordinated response. From a practical perspective, this requires input, agreement and collaboration of multiple stakeholders, amongst whom there may be no history of cooperation. In partnership with leading researchers, the Department of Planning, Industry and Environment (DPIE) has developed and delivered processes that enable regional scale consideration of climate projections and investigation of related impacts.

The Hunter and Central Coast Enabling Regional Adaptation (HCC ERA) project builds on local knowledge to understand climate vulnerabilities in the HCC and identify opportunities to respond, enabling regional decision-makers to enhance government service delivery and planning at a regional and subregional scale.

The HCC ERA project provides a structured process for participation by representatives of NSW Government agencies, local government and key regional stakeholders, using their tacit local knowledge to identify and capture opportunities to build regional resilience. By enabling participatory learning, the Enabling Regional Adaptation (ERA) process develops new and expanded professional networks which can be mobilised to respond to climate change. This operational knowledge of how regional systems interact informs the development of adaptation responses that are sensitive to the reality of local systems.

The HCC ERA project has sought to:

- provide a credible evidence base for regional adaptation planning by developing a regional understanding of the impacts of projected climate change, and vulnerability to the expected impacts for the HCC
- build on the capacity of regional decision-makers to undertake adaptation action by improved understanding of regional climate change impacts, adaptive capacity, vulnerability and adaptation options, and
- strengthen relationships between sectors across local and state government in the HCC, with a view to capturing opportunities for regional climate change adaptation projects.

This report presents the output from a series of workshops held in the HCC during 2019. Workshop participants developed transition pathways for key regional systems, to build resilience to climate extremes and minimise impacts on their local communities.

The conclusions in this report reflect the views of those present at the workshops and may not represent NSW Government policy.

The report also outlines the workshop process, and potential projects to activate the transition pathways and strengthen key regional systems in the HCC, and support improved government service planning and delivery now and into the future. The final chapter of the report gives proactive ways to turn the report's findings into action.

# 2. What changes are suggested in the Hunter and Central Coast regions?

## 2.1 Vulnerable regional systems

The state's regions are subject to a broad range of drivers of change (economic, technological, social and environmental). Regions such as the HCC are made up of many component parts (or systems) that all contribute to how the region currently functions (business-as-usual) and its trajectory of future development. A region's resilience in response to drivers of change relies on its capacity to adapt. For temporary drivers (such as fluctuations in agricultural commodity prices), basic alterations to business-as-usual may be an adequate response; however, for persistent and disruptive drivers such as climate change, more fundamental and transformative change may be required to adapt regional systems.

For the HCC, nine regional systems were identified as particularly vulnerable and in need of change to ensure effective ongoing government service planning and delivery:

- Aboriginal cultural values
- Circular economy
- Community resilience
- Emergency management
- Industry transformation
- Planning
- Protection of natural systems and environment
- Transport and infrastructure
- Water and water security.

## 2.2 Transition models for key regional systems

For each of the key regional systems identified, a change model was developed to describe:

1. the regional system (or set its boundaries)
2. the most important drivers acting on the system, which currently may not be climate related; however, the impacts of non-climate drivers will likely be amplified by climate change
3. business-as-usual (or the way the system currently operates)
4. a series of transition pathways that emerge from business-as-usual in response to the need for change, and
5. a desirable future system transformed by progress along the transition pathways.

## Aboriginal cultural values

The Aboriginal cultural values system for the HCC was defined as Aboriginal people leading integration of Aboriginal culture into a sustainable future for everyone (Figure 1).

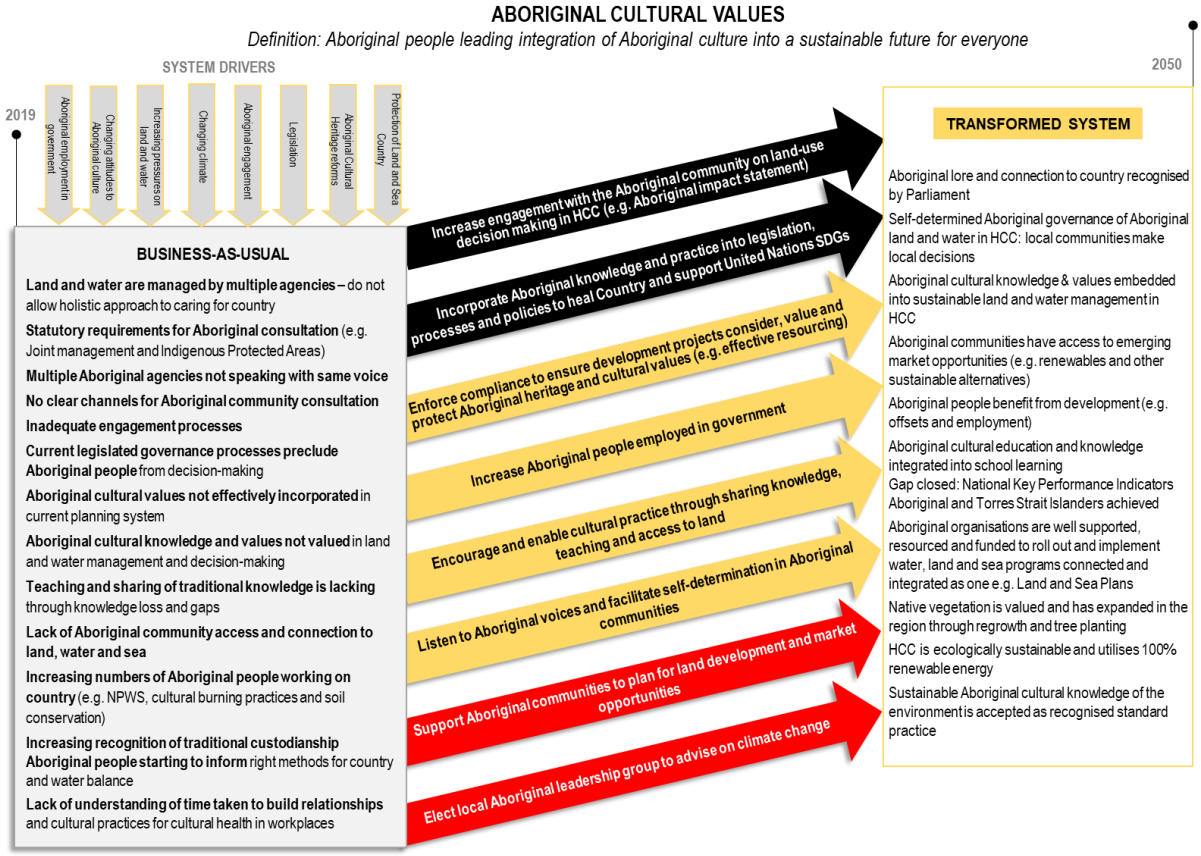


**Figure 1 Change model for Aboriginal cultural values**

In the HCC, consideration of Aboriginal cultural values is influenced by a range of drivers including legislation and Aboriginal cultural heritage reforms. While there are opportunities for Aboriginal engagement in regional decision-making, Aboriginal employment in government is generally limited. Further drivers include climate risks, increasing pressure on land and water, changing attitudes to Aboriginal culture broadly across Australia and specifically within the region, and Aboriginal advocacy for protection of land and sea Country.

The HCC region's natural environment is managed by multiple agencies, often across policy and administrative silos. This can create fragmentation and may undermine a more holistic approach to caring for Country. However, the numbers of Aboriginal people working on Country (such as in the National Parks and Wildlife Service (NPWS), cultural burning practices and soil conservation) are increasing and recognition of traditional custodianship is beginning to inform the alternative approaches to Country. There are statutory requirements for Aboriginal consultations (e.g. joint management and Indigenous protected areas); however, capacity to appropriately engage with and ensure the involvement of multiple Aboriginal organisations is often lacking and may result in groups 'not speaking with the same voice'. Some legislated governance processes do not adequately support involvement of Aboriginal people in decision-making and incorporation of Aboriginal cultural knowledge and values in land and water management. This is also seen in the current planning system, which contributes to a lack of Aboriginal community access and connection to land, water

and sea. There is a lack of understanding of the time required to build relationships and cultural processes for cultural health in workplaces. There is also a lack of teaching and sharing of traditional knowledge leading to its loss in the region.

Pathways to a more desirable system include increasing engagement with Aboriginal communities on land use and decision-making in the region (e.g. Aboriginal impact statements), incorporating Aboriginal cultural knowledge and practice into legislation, processes and policies to help 'heal Country' and support the United Nations Sustainable Development Goals (SDGs). Compliance with action on SDGs needs to be enforced to ensure development projects consider, value and protect Aboriginal heritage and cultural values (such as through effective resourcing). There is a need to increase Aboriginal employment in government and further encourage and enable cultural practice through sharing knowledge, teaching and access to land. Pathways include listening to Aboriginal voices and facilitation of self-determination in Aboriginal communities. The transition would be further accelerated if Aboriginal communities were supported to plan for land development and market opportunities. There is also a need to elect a local Aboriginal leadership group to advise on climate change.

*The transformed system has Aboriginal lore and connection to Country recognised by Parliament and self-determined Aboriginal governance of Aboriginal land and water realised. In the HCC region this allows for local communities to make local decisions. By 2050 the transformed system has Aboriginal cultural knowledge and values embedded into sustainable land and water management. Aboriginal communities have access to emerging market opportunities including renewable energy and other sustainable alternatives and Aboriginal people benefit from developments (such as biodiversity offsets and employment opportunities). Aboriginal cultural education and knowledge are integrated into school learning. The 'gap'[1] is closed and national Key Performance Indicators for Aboriginal and Torres Strait Islanders[2] achieved. Aboriginal organisations are well supported, resourced and funded to roll out and implement water, land and sea programs. These are connected and integrated (such as in Land and Sea Plans). Native vegetation is valued, and its area expanded in the region through regrowth and tree planting. The region is ecologically sustainable and utilises 100% renewable energy. Finally, sustainable Aboriginal cultural knowledge of the environment is accepted and recognised as standard practice.*

[1] The Closing the Gap: Indigenous Health Campaign is a program in partnership with Australia's peak Indigenous and non-Indigenous health bodies with aims to close the gap in health and life expectancy between Indigenous and non-Indigenous Australians by 2030.

[2] National Key Performance Indicators for Aboriginal and Torres Strait Islander Primary Health Care: Results to June 2018 presents data from the national Key Performance Indicators (nKPIs) data collection for the reporting periods June 2017, December 2017 and June 2018 across 24 indicators, focusing on maternal and child health, preventative health, and chronic disease management (AIHW 2019).

## Circular economy

A circular economy for the HCC was defined as the redesign of systems to ensure land and resources are used and reused to maximise efficiency and create jobs, resulting in a net positive impact (Figure 2).

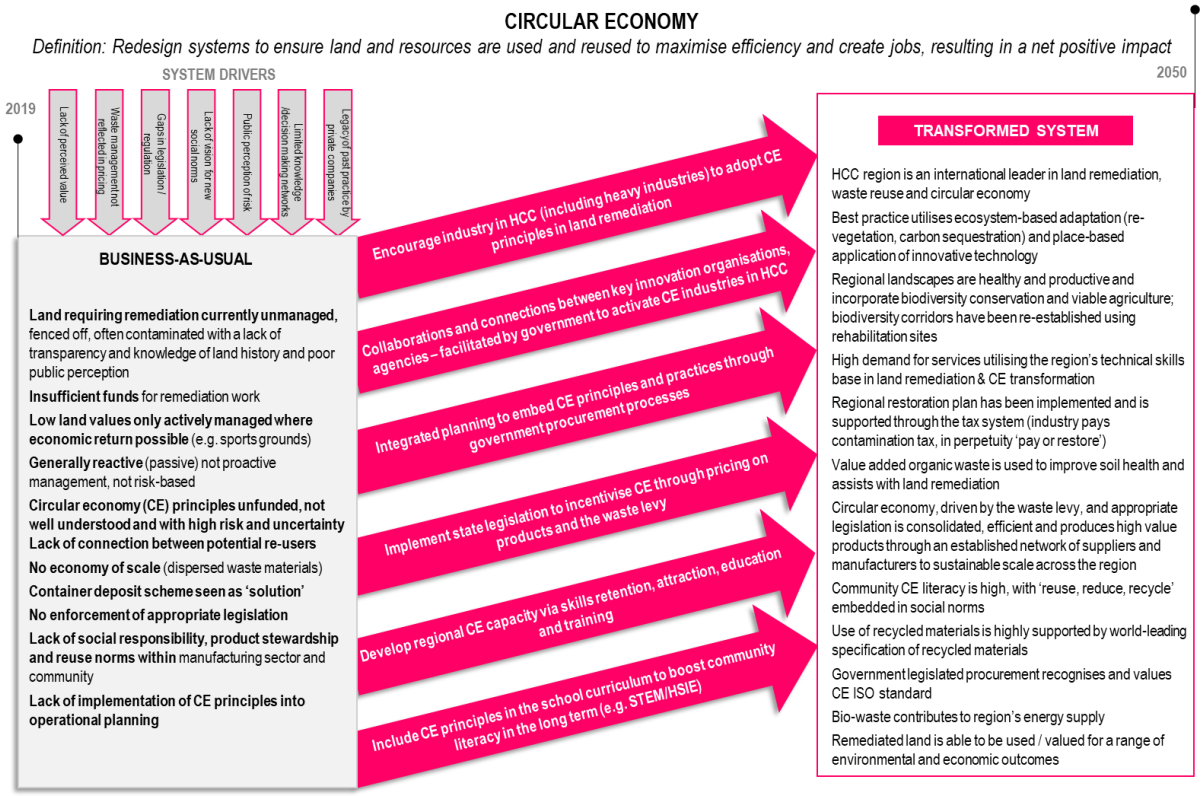


**Figure 2 Change model for a circular economy**

Regional drivers of the current system include a lack of perceived value in pursuing circularisation, public perceptions of risk, legacy of past practices by private companies, and the cost of waste management not reflected in pricing of products. Further drivers include knowledge gaps and limited decision-making networks, a lack of vision for new social norms and gaps in legislation and regulation to support a circular economy.

Regarding land management, at present some land requiring remediation in the HCC is unmanaged and fenced off, and knowledge of the land's history can be difficult to access. There is often poor public perception regarding land remediation and little appreciation of the links between remediation and a circular economy. There are insufficient funds for remediation work and low land values lead to active land management when an economic return is possible (such as creating sports grounds). Remediation processes tend to be reactive rather than proactive and are not risk-based.

Circular economy principles tend to be unfunded and are not well understood, so they come with a high level of risk and uncertainty. There is a lack of connection among potential re-users of materials and currently there is no economy of scale as the supply chain of waste materials is dispersed across the region.

Regarding recycling, actions such as the container deposit scheme are seen as the 'solution' rather than a starting point. There is a lack of social responsibility for product stewardship and reuse norms both within the manufacturing sector and the broader community. Circular economy principles are not widely incorporated into operational planning, which currently limits uptake.

Pathways to a transformed system include encouraging industries within the HCC (including heavy industries) to adopt circular economy principles in land remediation and in decision-making and planning more broadly. Collaborations and connections are needed among key innovation organisations and agencies, facilitated by government, to activate circular economy industries in the region. Embedding circular economy principles may be encouraged through integrated planning and government procurement processes. Pricing incentives and interventions such as a waste levy would also be beneficial. Development of capacity for a regional circular economy requires skills retention, attraction, education and training within the region. Inclusion of circular economy principles in the school curriculum (science, technology, engineering and mathematics (STEM) and Human Society and its Environment (HSIE) studies) can boost community literacy in the long term.

*The transformed system is one that ensures the region is an international leader in land remediation, waste reuse and circular economy principles. Best practice is embedded, utilising ecosystem-based adaptation, including re-vegetation, carbon sequestration and place-based applications of innovative technologies. Regional landscapes are healthy, productive and incorporate biodiversity conservation and viable agriculture with biodiversity corridors to be re-established using rehabilitation sites in the region. By 2050, there is a high demand for services utilising the region's technical skills base in land remediation and circular economy transformation. A regional restoration plan is implemented and supported through the tax system (e.g. industry pays contamination tax in perpetuity 'pay or restore'). Organic waste is used to improve soil health and assist with land remediation adding value to these 'waste' products. A circular economy, driven by the waste levy and appropriate legislation is consolidated, efficient and produces high value products through an established network of suppliers and manufacturers to a sustainable scale across the region. Circular economy literacy in the community is high with 'reuse, reduce, recycle' embedded in social norms. The use of recycled materials is supported by world-leading specifications of recycled materials and government legislated procurement will recognise and value the circular economy ISO standard. Bio-waste contributes to the region's energy supply and remediated land is used and valued for a range of environmental and economic outcomes.*

## Community resilience

Community resilience for the HCC was defined as building preparedness and capacity in communications to prepare, respond and recover while generating cohesion through connected networks and maximising social capital (Figure 3).

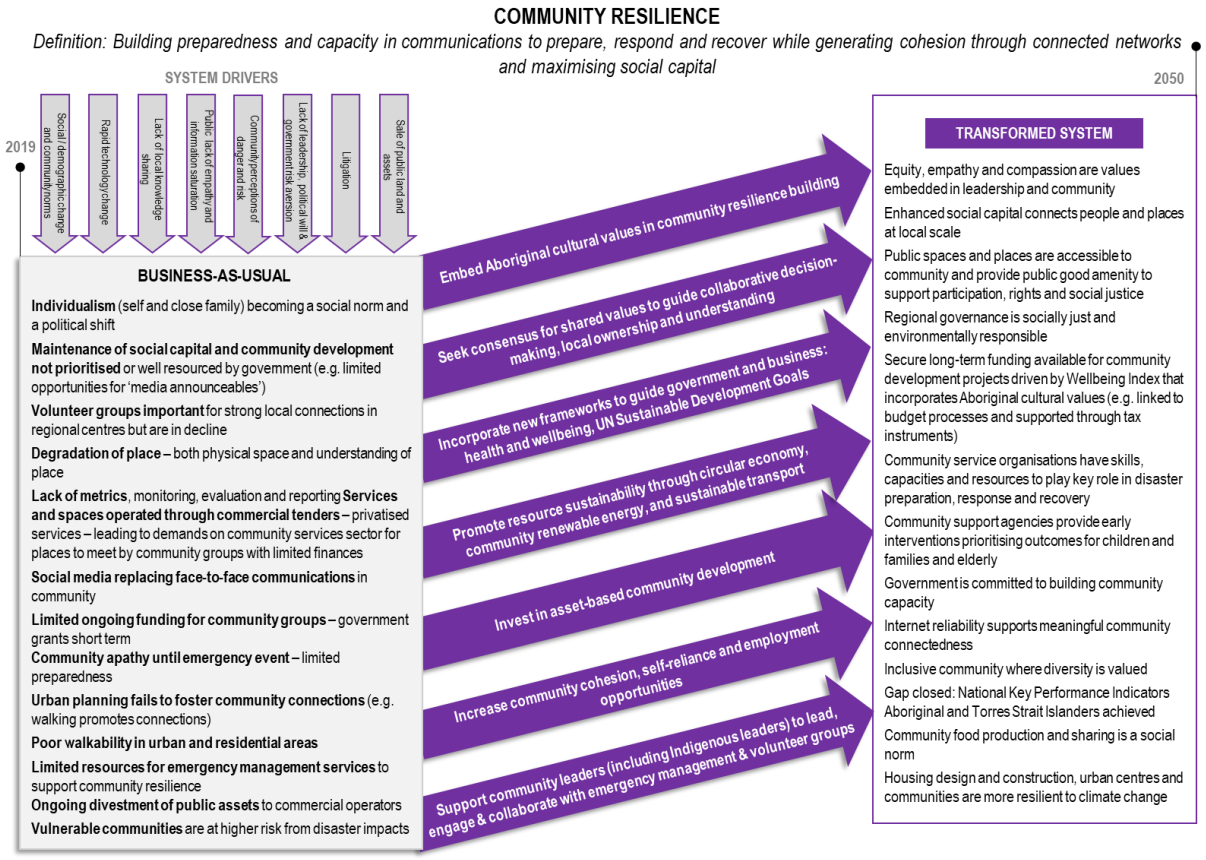


**Figure 3 Change model for community resilience**

Change in this system is constrained by the sale of public land and assets, a lack of leadership, risk aversion, communities' perceptions of danger and risk, litigation, information saturation, rapid technology change, lack of local knowledge sharing alongside social and demographic changes and shifting community norms.

Community resilience for the HCC is currently characterised by individualism being the social norm that prioritises the individual and close family members above collective public benefit. This is reflected in a political shift away from the collective common good with greater responsibility put on individuals and households. The maintenance of social capital and community development is not consistently funded over time. There are limited opportunities in the media to explore such issues due to the nature of the 24/7 news cycle.

Volunteer groups are important for strong local connections in regional centres; however, the volunteer member base is in decline. This includes membership and volunteering within the Rural Fire Service (RFS), State Emergency Service (SES), Country Women's Association (CWA), Rotary Club, Lions Club, Police and Community Youth Club (PCYC), Young Men's Christian Association (YMCA) and others.

There is a degradation of space, both in terms of physical space and an understanding of place. Social media is replacing face-to-face communications within the community. Services and spaces are largely operated through commercial tenders (privatised services), which leads to demands on the community services sector for places to hold meetings by

community groups with limited finances. There is an ongoing divestment of public assets to commercial operators. Further, there is limited ongoing funding for community groups with many government grants being short-term or project based.

Urban planning often fails to foster community connections (e.g. walking promotes connections), there is currently poor walkability in urban and residential areas. The concept of resilience is not consistently considered in community decision-making until there is an emergency event, leading to limited preparedness within communities. This is compounded by limited resources for emergency management services to support community resilience. As a result, vulnerable communities are at higher risk from disaster impacts.

The pathways to a transformed system call for embedding Aboriginal cultural (i.e. relational) values in community resilience building. There is a need to seek consensus for shared values to guide collaborative decision-making, local ownership and understanding as well as to incorporate new frameworks to guide government and business to support community health and wellbeing and support the United Nations SDGs. Further investment in asset-based community development is required as well as the need to promote resource sustainability through circular economy, community renewable energy and sustainable transport. Community cohesion, self-reliance and employment opportunities need to be increased and community leaders require support (including cultural and Indigenous leaders) so they can lead and engage in collaboration with emergency management and volunteer groups.

*In a transformed system, equity, empathy and compassion are values embedded in leadership and the community. Social capital is enhanced to connect people and places at the local scale. Public spaces and places are accessible to communities and provide good amenity to support participation, rights and social justice. Regional governance is socially just and environmentally responsible. Secure long-term funding is available for community development projects driven by the Wellbeing Index[3] that incorporate Aboriginal cultural values (e.g. by linking budget processes and support through tax instruments). Community service organisations have the skills, capacities and resources to play key roles in disaster preparation, response and recovery, and community support agencies provide early interventions, prioritising outcomes for children, families and the elderly. Government is committed to building community capacity. The internet is reliable and supports meaningful community connectedness. Inclusive communities exist, and diversity is valued. The 'gap' is closed (see footnote 1) with national KPIs for Aboriginal and Torres Straight Islanders achieved. Community food production and sharing is a social norm. Housing design and construction in urban centres and communities is more resilient in a changing climate.*

[3] The Australian Unity Wellbeing Index (AUWI) is a barometer of Australians' satisfaction with their lives and life in Australia.

## Emergency management

Emergency management for the HCC refers to the capacity to prevent, prepare for, respond to and recover from disaster events (the PPRR framework), which includes both the state and federal governments' influences on local government (Figure 4).

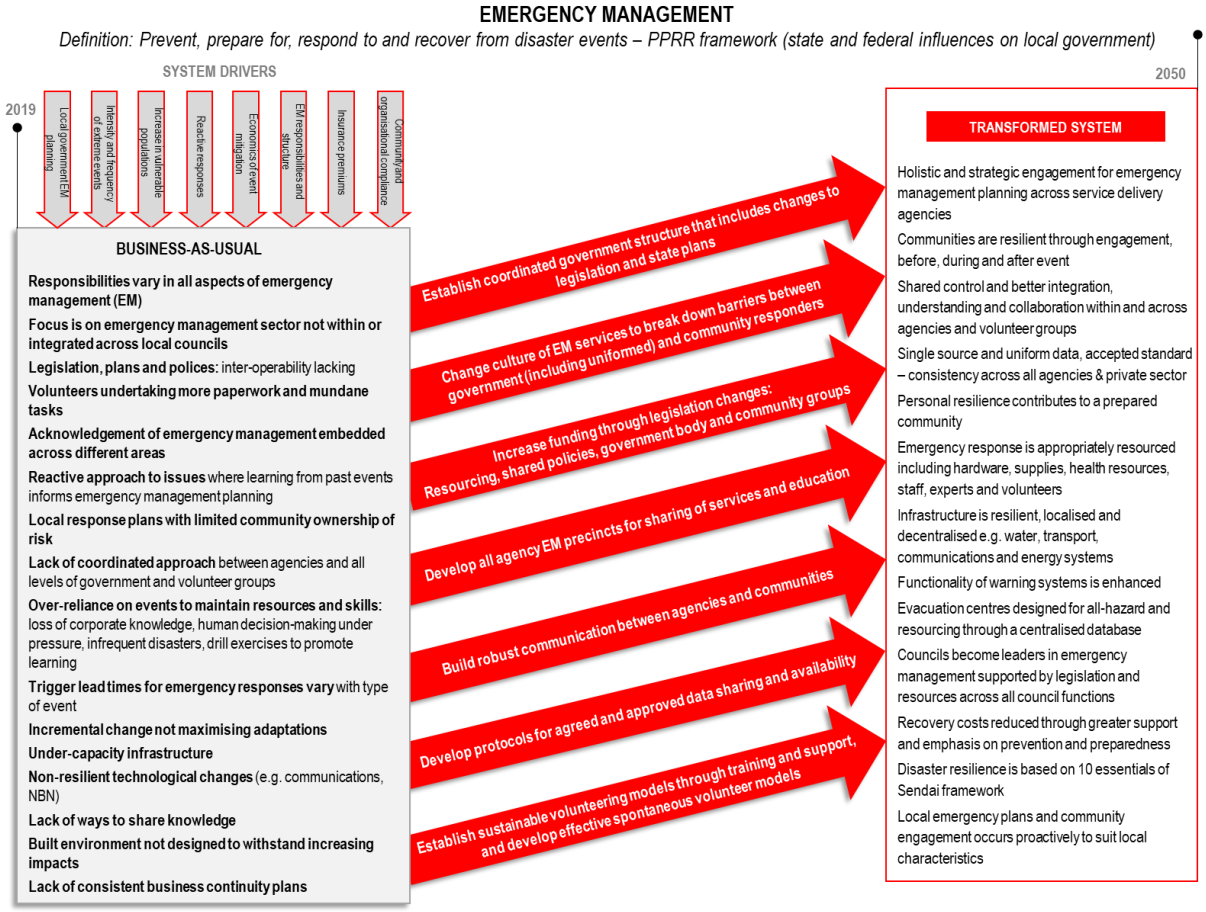


**Figure 4 Change model for emergency management**

The current system is influenced by community and organisational compliance, local government emergency management planning, emergency management responsibilities and structures. The economics of event mitigation currently focus on recovery rather than prevention and preparedness, creating a reactive response. The intensity and frequency of extreme events is increasing, which increases costs of insurance premiums, and vulnerable populations in the region are expanding.

Currently in HCC emergency management, responsibilities vary in all aspects of the sector's work. There is a sectoral focus rather than service integration across local councils, although there is acknowledgement that emergency management should be embedded and coordinated across the range of regional actors (agencies, all levels of government and volunteer groups). There is a lack of inter-operability across current legislation, plans and policies.

Volunteers are increasingly undertaking more administrative tasks, which limits their interest in participation. The approach is currently reactive to issues, where learning from past events informs future emergency management planning. The local response plans have limited community ownership and understanding of risk. There is an over-reliance on emergency events to maintain resources and skills; over time there is a loss of corporate knowledge as

volunteers ‘retire’, which may undermine the speed and quality of decision-making under pressure during events. When disasters are infrequent drill exercises are held to promote learning.

The transition pathways to transformed emergency management for the HCC call for establishing a coordinated government structure to break down barriers between agencies and community responders and encourage cultural change. This needs to be coupled with a long-term increase in funding for resourcing, shared policies, government bodies and community groups.

Under the transition pathways all agency emergency management precincts are developed to enable the sharing of services and education. Robust and transparent communication needs to be built between agencies and communities. Protocols for agreed and approved data sharing require development. Sustainable volunteering models need to be established through training and support, and development of effective ‘spontaneous’ volunteer models.

The emergency management system seeks to incorporate disaster resilience and preparedness into the HCC disaster and hazard response.

*A transformed system for emergency management encompasses a holistic and strategic engagement in emergency management planning across service delivery agencies. Communities are resilient through engagement before, during and after events. There is shared control and better integration, understanding and collaboration within and across agencies and volunteer groups. There is a single source of uniform data of an accepted standard that is consistent across all agencies and the private sector. Personal resilience contributes to a prepared community. Emergency responses are appropriately resourced including hardware, supplies, health resources, staff, experts and volunteers. Infrastructure is resilient, localised and decentralised (e.g. water, transport, communications and energy systems). The functionality of warning systems is enhanced, and evacuation centres are designed for all hazards and resourcing through a centralised database. Disaster resilience is based on the 10 essentials of the Sendai Framework for Disaster Risk Reduction (2015–2030) (UNDRR 2019) and local emergency plans and community engagement will occur proactively to suit local characteristics. Councils are leaders in emergency management, supported by legislation and resourced across all council functions. Recovery costs are reduced through greater support and an emphasis on prevention and preparedness.*

## Industry transformation

Industry transformation was defined as transformation of food and energy sectors to achieve sustainable diversified industries; this included both primary and secondary industries (Figure 5).

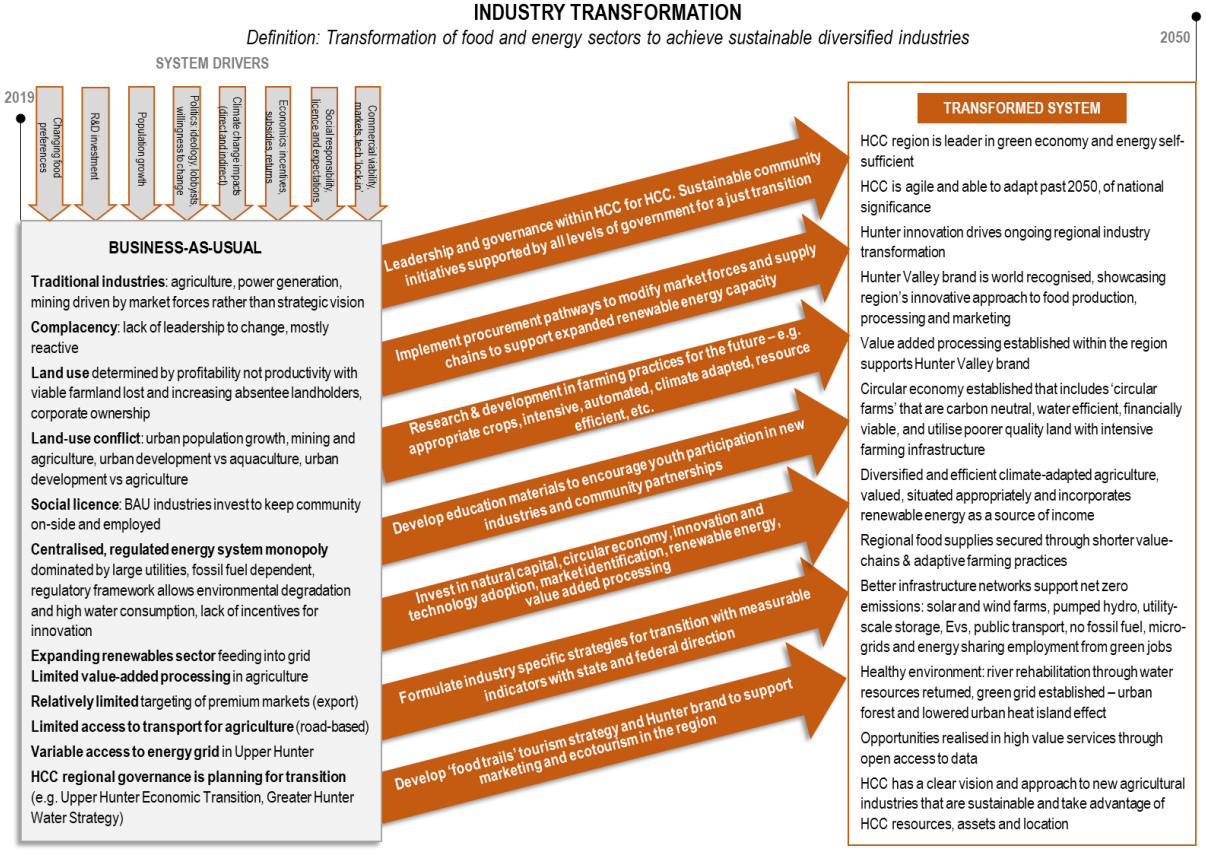


**Figure 5 Change model for industry transformation**

Industry transformation is influenced by a range of complex drivers that include commercial viability, markets and technology 'lock-in', social responsibility, social licence and expectations, current economics, incentives, subsidies and financial returns. Political and economic ideologies may undermine a willingness to change that drives business-as-usual. Further drivers include climate change impacts (both direct and indirect impacts), population growth, changing food preferences and research and development investment.

Currently, the traditional industries within the HCC (such as agriculture, power generation and mining) are driven by market forces rather than strategic vision. There is a lack of leadership to support change, with decisions often being reactive. Land use is determined by profitability, not productivity, with viable farmland being lost to increasing absentee landholders and corporate ownership. Conflict over land use occurs through urban population growth, mining and agriculture with urban development competing with both agriculture and aquaculture land use.

The traditional industries invest to keep community on-side and employed within these industries, leading to a lack of social licence to change. Centralised, regulated energy systems have a monopoly that is dominated by large utilities being fossil fuel dependent. There are barriers to avoiding and addressing environmental degradation, and a lack of incentives for innovation to address issues such as high water consumption.

There is an expanding renewable sector feeding into the energy grid, although there is variable access to the grid within the Upper Hunter. Value-added processing within the agricultural sector is limited and little effort is made to target premium food markets, particularly for export.

Access to transport is limited for the agriculture sectors with a heavy reliance on road-based transport. Regional governance is planning for transition with some programs underway such as the Upper Hunter Economic Transition Strategy and the Greater Hunter Water Strategy.

Transition pathways in industrial transformation prioritise the need for leadership and governance within the HCC. Sustainable community initiatives will need to be supported by all levels of government for a just transition. Procurement pathways need to be implemented to modify market forces and supply chains in order to support expanded renewable energy capacity. Research and development in farming practices for the future is necessary, such as looking at appropriate crops, intensive and/or automated farming that is resource efficient and climate adapted. Education materials need to be developed to encourage youth participation in new industries and community partnerships. Investment is required in natural capital, circular economy, innovation and technology adoption, market identification, renewable energy and value-added processing. Formulations of industry-specific strategies for transition are required that include measurable indicators with state and federal direction. A 'Food Trails' tourism strategy should be developed with regional specific brands to support marketing and ecotourism in the region (e.g. Hungry for the Hunter, Bush to the Beach).

*Industrial transformation in the region has the HCC as a leader in the green economy and energy self-sufficiency with a shift away from coal exports. The region is agile and able to adapt past 2050, is of national significance and has a clear vision and approach to new agricultural industries that are sustainable, taking advantage of the region's resources, assets and location. HCC innovation drives ongoing regional industry transformation. 'Hunter Valley' brand is world recognised, showcasing the region's innovative approach to food production, processing and marketing. Value added processing is established within the region and support the 'Hunter Valley' brand. Circular economy principles are established and include 'circular farms' that are carbon neutral, water efficient, financially viable and utilise poorer quality land with intensive farming infrastructure. Diversified and efficient climate-adapted agriculture is valued, situated appropriately and incorporates renewable energy as a source of income. Regional food supplies are secured through shorter value-chains and adaptive farming practices. Better infrastructure networks will support net zero emissions; this includes solar and wind farms, pumped hydro, utility-scale storage, electric vehicles, electrified public transport (not fossil fuel reliant), micro-grids, energy sharing and employment green jobs. The region benefits from a healthy environment including river rehabilitation through the return of water resources, green grid establishment and an urban forest that lowers the urban heat island effect. Opportunities are realised in high value services through open access to data.*

## Planning

The planning system for the HCC was defined as one that proactively embeds climate change appropriately in all decision-making to build community resilience (Figure 6).

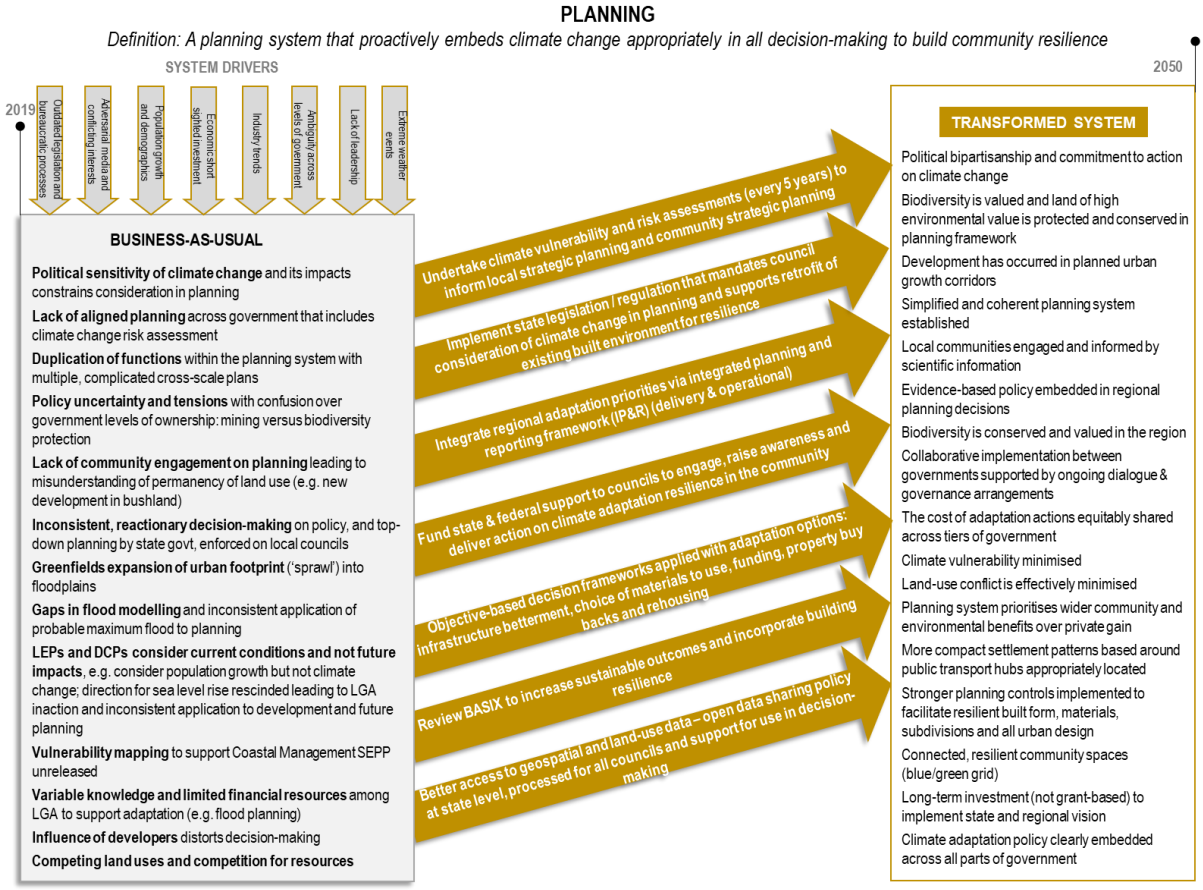


**Figure 6 Change model for planning**

Currently the system is influenced by extreme weather events, a lack of leadership, policy ambiguity, industry trends, economically short-sighted investment, population growth and demographics, adversarial media and conflicting interests and outdated legislative processes.

The current system is heavily impacted by political sensitivity to climate change and this constrains its consideration in planning. There is a lack of aligned and integrated planning with duplication of functions within the planning system through multiple, complicated, cross-scale plans. Policy uncertainty exists regarding planning objectives, such as mining versus biodiversity protection. The permanency of land use (e.g. new development in bushland) may not be well communicated to communities. Planning decisions are often top-down and may be seen as reactive. Greenfield expansions are occurring, with the urban footprint (or urban sprawl) moving into vulnerable floodplains. There are gaps in flood modelling and inconsistent application of probable maximum flood planning. Local environmental plans (LEPs) and development control plans (DCPs) consider current conditions and not future impacts; for example, they consider the impacts of population growth but not climate change. Knowledge is variable and financial resources are limited among local government authorities to support adaptation (e.g. flood planning). The influence of developers distorts decision-making and there are competing land uses and competition for resources in the region.

Pathways towards a transformed system include undertaking climate vulnerability and risk assessments (every five years) to inform local and community strategic planning, implementing staged legislation and regulations to mandate council consideration of climate change in planning, and supporting retrofitting of existing built environments for resilience. Regional adaptation priorities should be embedded within regional integrated planning and reporting frameworks (IP&R) (delivery and operational). State and federal financial support to councils should be continued to engage, raise awareness and deliver action on climate adaptation in communities. Objective, evidence-based decision frameworks need to be applied to adaptation options (such as infrastructure betterment, choice of materials to use, funding, mechanisms for property buy-backs and rehousing). A review of the Building Sustainability Index (BASIX) is needed to increase sustainable outcomes and incorporate building resilience. Better access to geospatial and land-use information is required through an open-data sharing policy at a state level, with data processed for all councils for use in decision-making.

*The transformed planning system has embedded political bipartisanship and commitment to action on climate change. Biodiversity is valued, and land of high environmental value protected and conserved through planning frameworks. Development occurs in planned urban growth corridors. A simplified, coherent planning system has been established. Local communities are engaged and informed by scientific information. Evidence-based policy is embedded in regional planning decisions. Collaborative implementation of planning among governments is supported by ongoing dialogue and governance arrangements, with the cost of adaptation actions equitably shared across tiers of government. Climate vulnerability and land-use conflict (including legacy issues) are minimised or overcome. The planning system prioritises wider community and environmental benefits over private gain. More compact settlement patterns are appropriately located and based around public transport hubs. Stronger planning controls are implemented to facilitate resilient built forms, materials, subdivisions and all urban design. Community spaces (such as blue/green grid) are connected and promote resilience. There is long-term investment (not grant-based) to implement state and regional vision, and climate adaptation policy is clearly embedded across all parts of government.*

## Protection of natural systems and the environment

The definition of the protection of natural system and environment for HCC was to maintain, protect and enhance the resilience of natural systems into the future, including green and blue infrastructure (Figure 7).

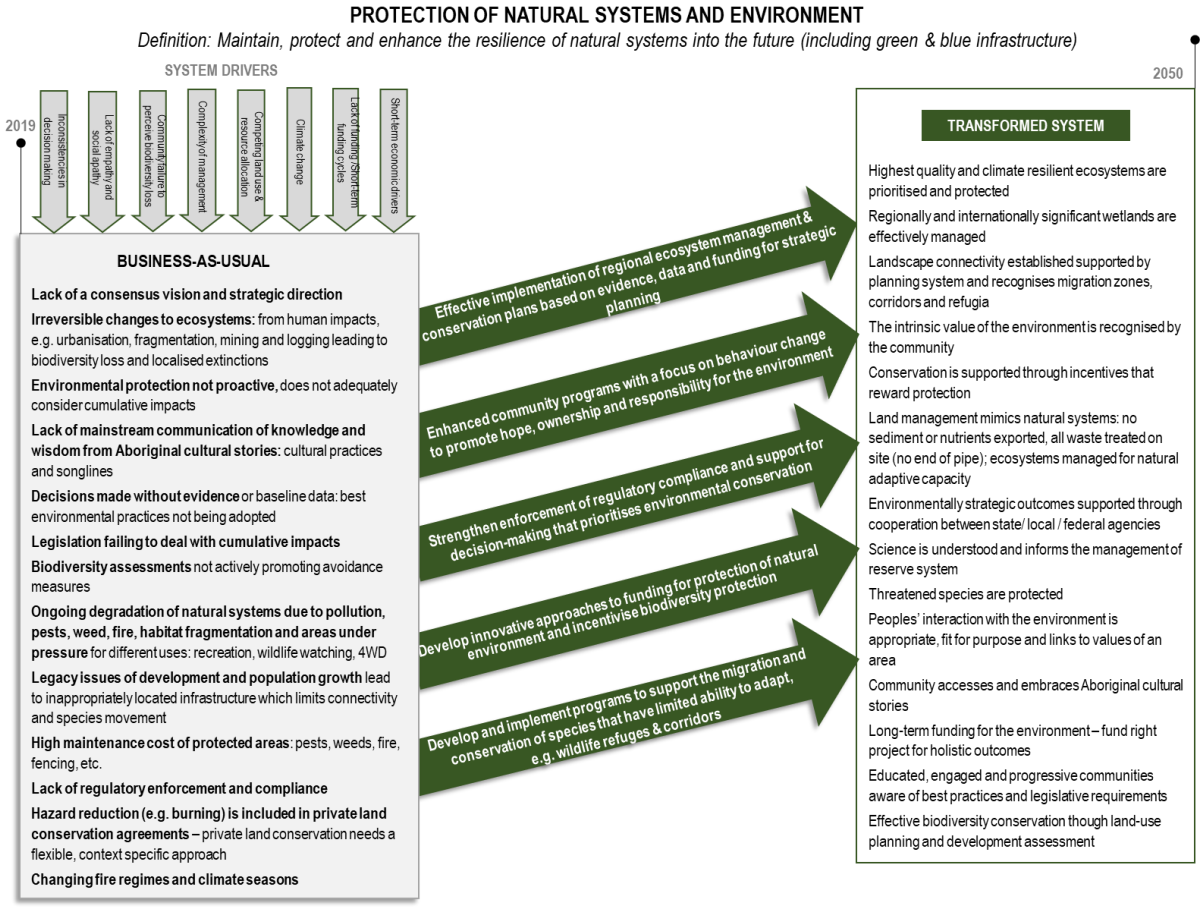


**Figure 7 Change model for protection of natural systems and the environment**

Factors that currently influence the region include short-term economic drivers, lack of funding and short-term funding cycles, climate change, competing land use and resource allocation, complexity of management, community failure to perceive biodiversity loss, lack of empathy and social apathy and inconsistencies in decision-making.

The current system is characterised by a lack of a consensus vision and strategic direction, irreversible changes to ecosystems from human impacts such as urbanisation, fragmentation, mining and logging leading to biodiversity loss and localised extinctions. Environmental protection is not currently proactive and does not adequately consider cumulative impacts. There is a lack of mainstream communication of knowledge and wisdom from Aboriginal cultural stories, cultural practices and song lines. Decisions are made without evidence or baseline data with best environmental practices not being adopted. Legislation fails to deal with cumulative impacts, and current biodiversity assessments do not actively promote avoidance measures.

Within the region there is ongoing degradation of natural systems due to pollution, pests, weed invasions, fire, habitat fragmentation and pressure for amenity: recreation, wildlife watching, and off-road vehicles. Connectivity and species movement are limited by legacy issues from past development and population growth leading to inappropriately located

infrastructure, and the high maintenance cost of protected areas (management of pests, weeds, fire, fencing, etc.). Regulatory enforcement and compliance are lacking. Hazard reduction (e.g. burning) is included in private land conservation agreements reducing their flexibility to account for context specific approaches to conservation under climate change-induced alterations to fire regimes and seasonal events.

Transition pathways focused on effective implementation of regional ecosystem management and conservation plans. These should be based on evidence, data and funding for strategic planning alongside enhanced community programs with a focus on behaviour change to promote hope, ownership and responsibility for the environment. There is a need to strengthen enforcement of regulatory compliance and support for decision-making that prioritises environmental conservation. Innovative approaches to funding should be developed for the protection of natural environments and to incentivise biodiversity protection. Finally, programs to support the migration and conservation of species that have limited ability to adapt (e.g. wildlife refuges and corridors) need to be developed and implemented.

*Transformation in the protection of natural systems and the environment ensures that the highest quality and climate resilient ecosystems are prioritised and protected, and regionally and internationally significant wetlands are effectively managed. Landscape connectivity is established and supported by a planning system that recognises migration zones, corridors and refugia. The intrinsic value of the environment to regional wellbeing is recognised by the community. Conservation is supported through incentives that reward protection. Land management mimics natural systems: no sediment or nutrients exported; all waste treated on site (no end of pipe); ecosystems managed for natural adaptive capacity. Environmentally strategic outcomes are supported through cooperation between state/ local / federal agencies. Science is understood and informs the management of the reserve system. All threatened species are protected and peoples' interaction with the environment is appropriate, fit for purpose and links to values of an area. Communities access and embrace Aboriginal cultural stories and are educated, engaged, progressive and aware of best practices and legislative requirements. Effective biodiversity conservation occurs though land-use planning and development assessment and long-term funding for the environment exists to ensure funding of projects for holistic outcomes.*

## Transport and infrastructure

The regional transport and infrastructure system was defined as movement of goods, people, energy and information via rail, road, air, water, wires and wireless networks (Figure 8).

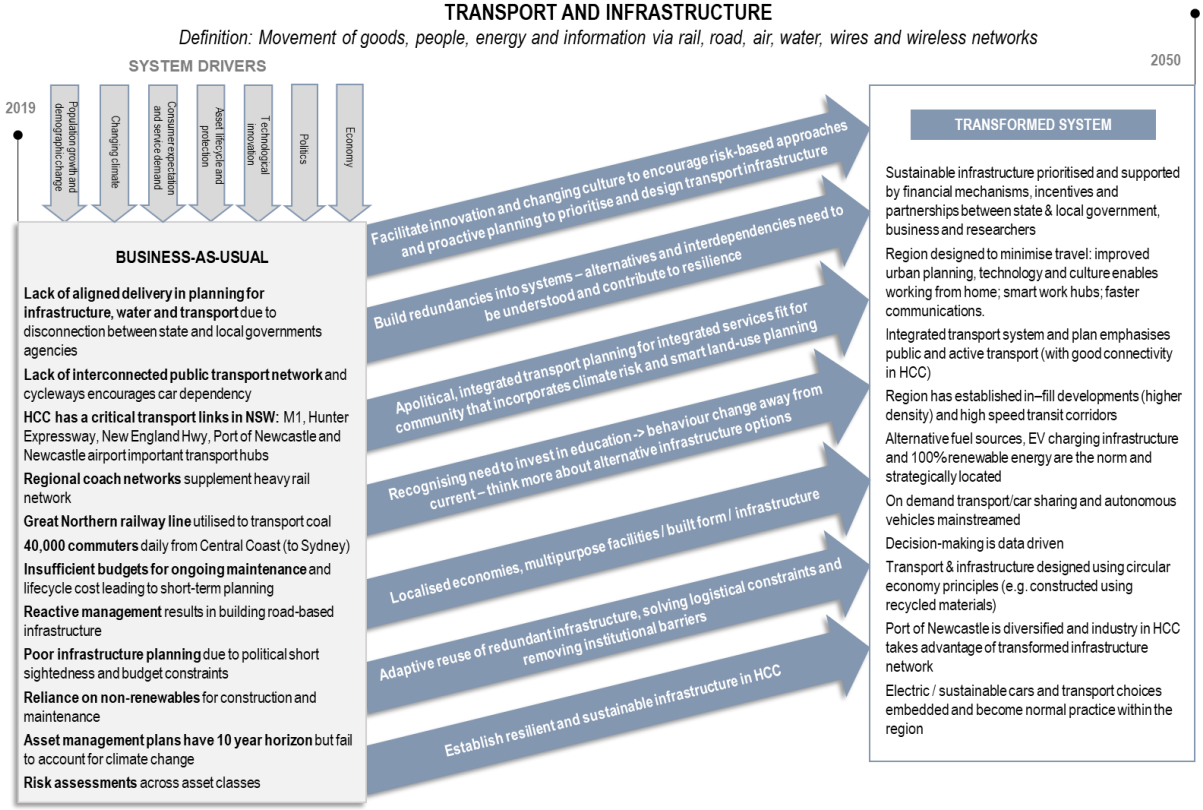


**Figure 8 Change model for transport and infrastructure**

This system is currently driven by the economy, politics, technological innovation, asset lifecycles and protection, consumer expectations and service demand, population growth and demographic change, and a changing climate.

Planning for and delivery of water and transport infrastructure is not aligned between state agencies and local governments. The lack of an interconnected public transport network and cycleways encourages car dependency. A number of transport links critical to New South Wales are situated in or pass through the region: M1 Expressway, Hunter Expressway, New England Highway; the Port of Newcastle and Newcastle airport, significant transport hubs; the regional coach networks supplementing the heavy rail network; and the Great Northern railway line transporting coal to port facilities. Regional road and rail networks transport approximately 40,000 commuters daily from the Central Coast (to Sydney). Poor infrastructure planning, short decision-making cycles and limited budgets for ongoing maintenance and lifecycle costs are currently leading to short-term planning and reactive management, increasing the reliance on construction of road-based infrastructure and non-renewables for construction and maintenance. Asset management plans have a 10-year horizon but fail to account for climate change. Risk assessments are being conducted across asset classes.

Pathways to a transformed system require facilitated innovation and cultural change to encourage risk-based approaches and proactive planning in prioritisation and design of transport infrastructure. Redundancies need to be built into the system, and alternatives and interdependencies need to be understood and contribute to resilience. Apolitical transport

planning for integrated services is required that considers climate risk and smart land-use planning to ensure infrastructure meets community needs. Investment in education and changing behaviours away from current practice would assist consideration of alternative infrastructure options. These alternatives may include locally adapted multipurpose facilities, built form and infrastructure projects. In some instances, this may require legislation change; for example, to allow for direct potable and indirect potable water reuse. Adaptive reuse of redundant infrastructure, solving logistical constraints and removing institutional barriers would assist in the establishment of resilient and sustainable infrastructure in the region.

*Transformation in transport and infrastructure ensures that sustainable infrastructure is prioritised and supported by financial mechanisms, incentives and partnerships between state and local government, business and researchers. The region is designed to minimise travel through improved urban planning; technological and cultural change enables working from home in addition to smart work hubs and faster communications. This new work environment is integrated with the transport system and with planning emphasising both public and active transport. Connectivity within the region and with Sydney is efficient and reliable. The region has established infill developments (higher density) and high-speed transit corridors. Alternative fuel sources, electric vehicle (EV) charging infrastructure and 100% renewable energy is the norm and charging facilities are strategically located. On demand transport/car sharing and autonomous vehicles are embedded in the region. Decision-making is data driven and transport and infrastructure is designed using circular economy principles (e.g. constructed using recycled materials). The Port of Newcastle is diversified and new industries have emerged in HCC to take advantage of the benefits offered by the transformed infrastructure network.*

## Water and water security

Water and water security for HCC was defined as including drought response for the environment, water quality, and catchment to tap integrated water cycle management including groundwater, soil moisture, waste, drinking, natural flows, recycling, stormwater harvesting and irrigation (Figure 9).

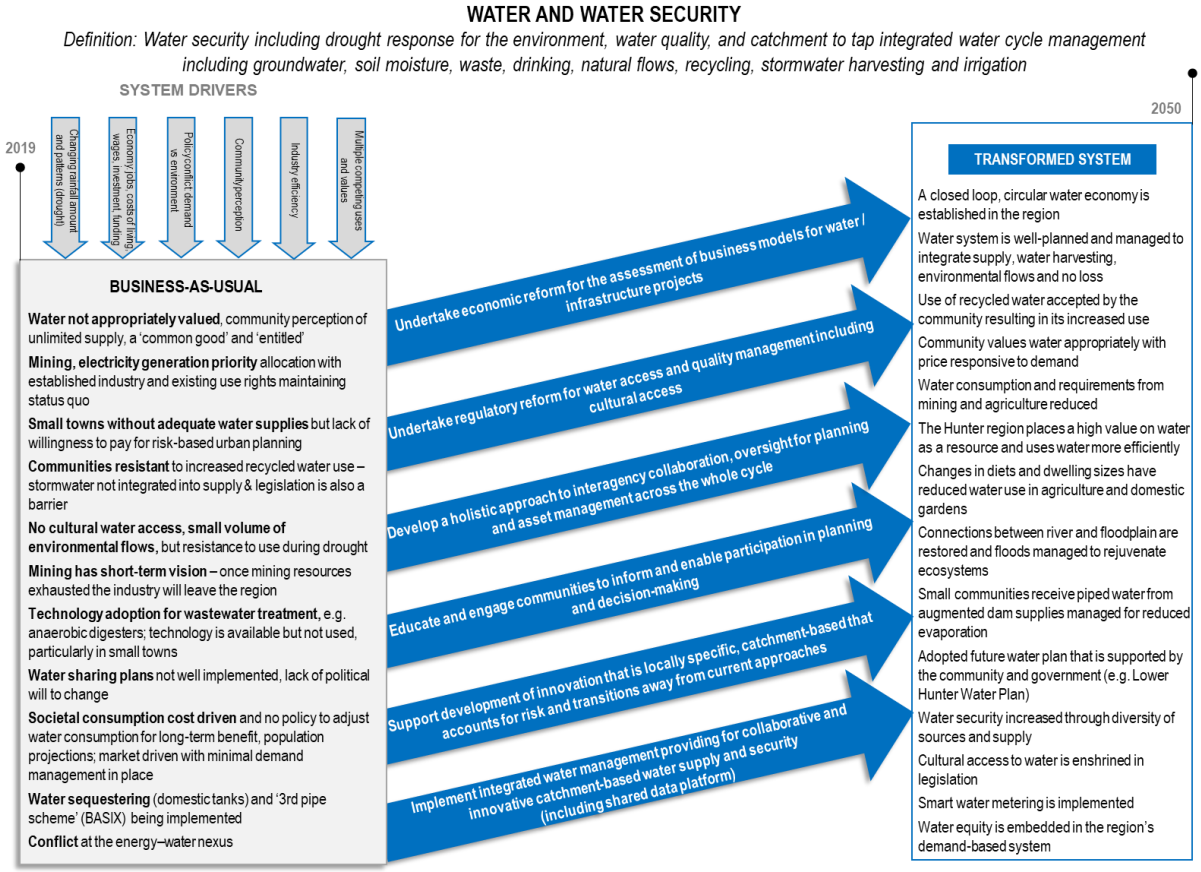


**Figure 9 Change model for water and water security**

The key drivers in the system include multiple competing uses and values for water, industry efficiency, community perception, policy conflict (demand versus environment), economy, jobs, costs of living, and wages, investment and funding priorities and availability, and changing rainfall amounts and patterns (flood and drought).

Within the region there is a community perception that water resources are from an unlimited supply. Water is considered a 'common good' and consumers are 'entitled'. Mining and electricity generation have priority allocation with established industry and existing use rights maintaining the status quo. Small towns are without adequate water supplies but there is a lack of willingness to pay for risk-based urban planning.

Communities are resistant to increased recycled water use, stormwater is not integrated into supply and legislation is a barrier to change. Cultural water access is limited, volumes allocated to environmental flows are small, and there is resistance to use of these flows for environmental benefits during drought. Mining has a short-term vision; once mining resources are exhausted the industry will leave the region. There is some technology adoption for wastewater treatment, e.g. anaerobic digesters, and technological improvements are available but not fully utilised, particularly in small towns. Water sharing plans on regulated rivers are inconsistently implemented, and there are several unregulated

rivers in the region leading to considerable regional variation in water use and availability. Societal consumption is cost driven and there are some policy gaps to adjust water consumption for long-term benefit. Water sequestering (domestic tanks) and '3rd pipe schemes' (BASIX) are being implemented but there is conflict at the energy–water nexus.

Transition pathways include undertaking economic reform for the assessment of business models for water and infrastructure projects alongside regulatory reform for water access and quality management that includes cultural access. A holistic approach to interagency collaboration needs to be developed with oversight for planning and asset management across the whole cycle. Communities need to be educated and engaged to inform and enable participation in planning and decision-making alongside support for innovation that is locally specific, catchment-based and that accounts for risk. Integrated Water Management (IWM) needs to be implemented providing for collaborative and innovative catchment-based water supply and security (including a shared data platform).

*The transformed system features establishment of a closed loop, circular water economy in the region. The water system is well-planned and managed to integrate supply, water harvesting, environmental flows and limited loss. The use of recycled water is accepted by the community resulting in its increased use, with communities' valuing of water appropriately demonstrated through demand responsiveness to price. Water consumption and requirements from mining and agriculture will be reduced. Changes in diets and dwelling sizes have reduced water use in agriculture and domestic gardens. Connections between river and floodplain are restored and floods managed to rejuvenate ecosystems. Future water plans are adopted and supported by the community and government (e.g. Lower Hunter Water Plan). Water security is increased through the diversity of sources and supply, and cultural access to water is enshrined in legislation. Smart water metering is implemented. Small communities receive piped water from augmented dam supplies managed for reduced evaporation, and water equity is embedded in the region's demand-based system.*

# 3. How is the Hunter and Central Coast vulnerable to climate change?

In partnership with regional decision-makers, the ERA process considers the climate vulnerability of regional communities in the context of biophysical impacts and socioeconomic change, with a focus on government service planning and delivery. By drawing on regionally specific data and local knowledge under the five capitals framework, an integrated understanding is developed of the relationships within key systems, and desirable adaptive responses and futures are identified.

The HCC covers an area of approximately 35,000 square kilometres (Figure 10) and has a population of approximately 1.1 million people who are primarily located in the major regional centres along the Central Coast (Gosford and Wyong), Lake Macquarie (Swansea and Belmont) to Newcastle, and in a few large regional centres such as Muswellbrook, Singleton, Cessnock, Maitland, Taree and Forster-Tuncurry.

The Central Coast between Sydney and Newcastle is in the state's fastest growing corridor (DPE 2016c). Rapid population growth and economic changes are expected in the period leading up to 2036. Newcastle is the focus of significant economic activity and includes the largest coal port in the world. The region supports retail, hospitality, tourism, agriculture, forestry, fishing, education, professional services and is a centre for clean energy technologies.

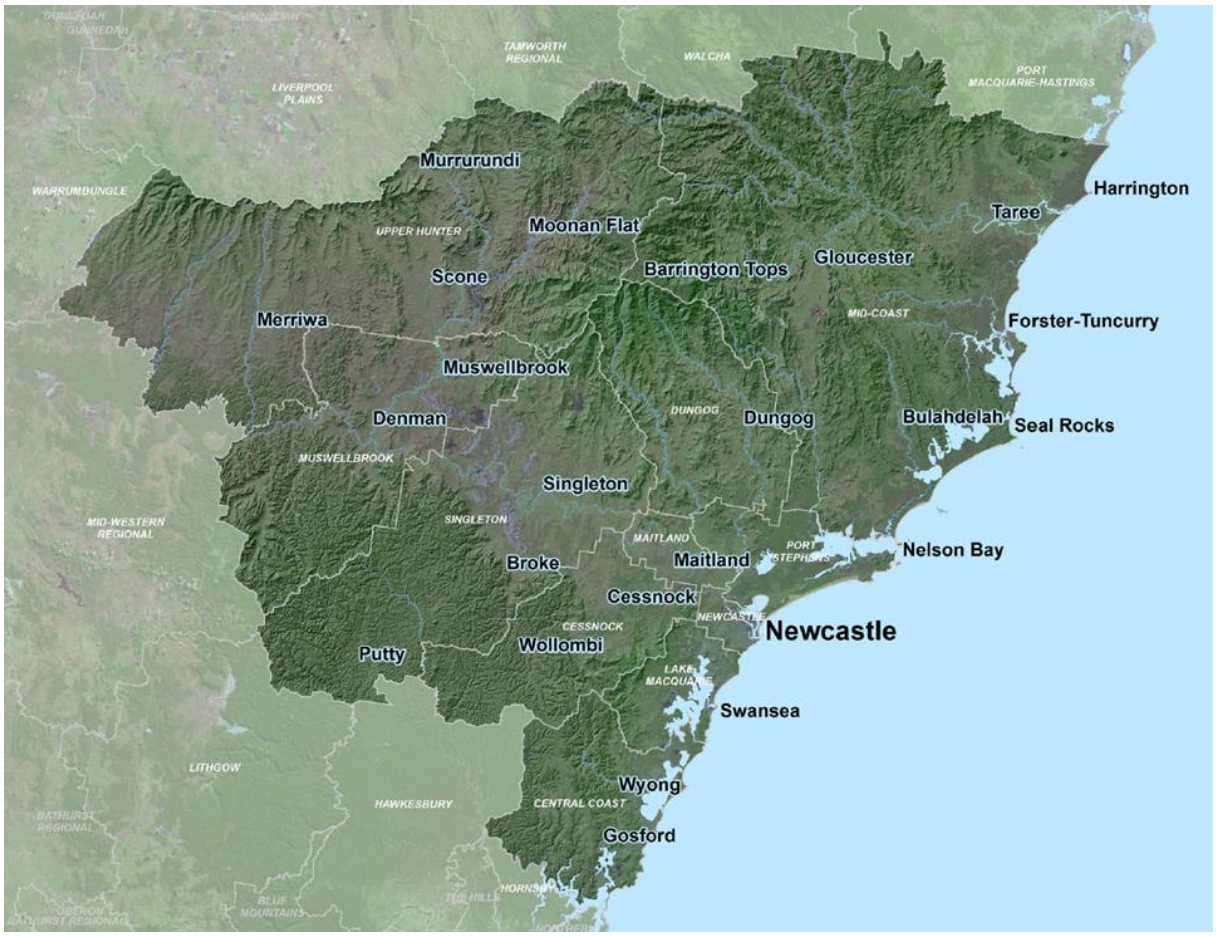


**Figure 10 The Hunter and Central Coast regions of New South Wales**

The HCC is inhabited by the Awabakal, Worimi, Wonnarua, Geawegal, Birrpai, Guringai and Darkinung Aboriginal tribes. Indigenous people called the Newcastle area *Mulubinba*, after an indigenous fern called the mulubin, and the Hunter River was known as *Coquun*. European settlement began in 1797 with the settlers' discovery of coal and the deep-water port of the Hunter River.

## 3.1 Human and social capitals

Human capital considers the skills, health and education of individuals that contribute to the productivity of labour and physical capability to respond to climate. Based on 2016 Census data key attributes of human capital for the region, compared to the whole of New South Wales, are that people living in the region:

- were more likely to have left school at Year 10 or below (Torrens University Australia 2019)
- were more socioeconomically disadvantaged, with three local government areas (LGAs) showing significant disadvantage according to the Socio-Economic Indexes for Areas (SIEFA): Cessnock, Mid-coast and Muswellbrook (ABS 2013) (Figure 11).

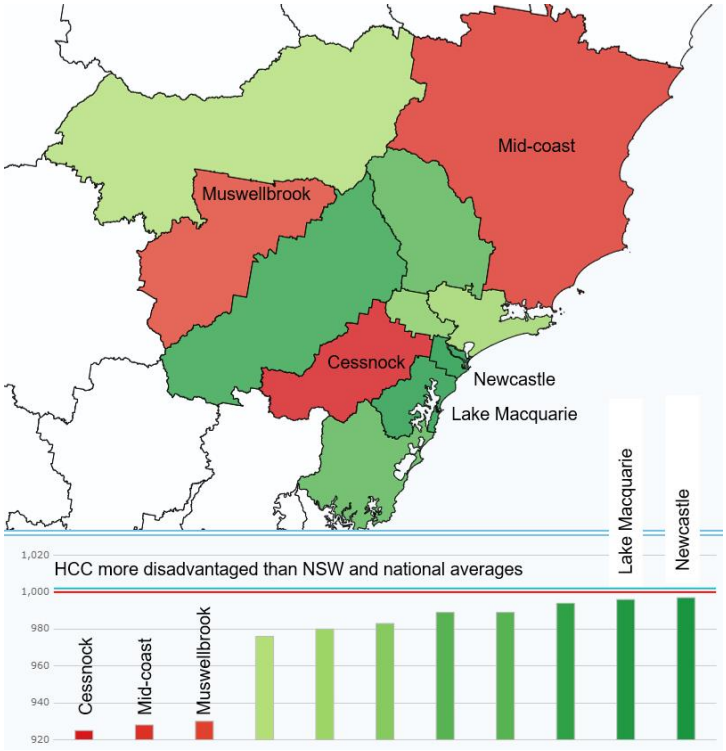


**Figure 11** **Index of relative socioeconomic disadvantage (SIEFA) 2016 for HCC**
Source: Torrens University Australia (2019)

The HCC's combined population in 2016 was around 1,061,832 (DPIE 2020), growing on average at 1% per year (ABS 2019a). The Central Coast's population is expected to grow by 24% to 417,500 in 2036. Over the same period the population of the Hunter is expected to grow 16% to 839,939 (DPIE 2020). The strongest growth within the Hunter is expected in the Greater Newcastle area, particularly in the Maitland, Cessnock and Port Stephens LGAs. This suggests an increasing dominance of urbanisation in the combined regions.

The HCC has an ageing population peak of about 60 years old (Figure 12). The Mid-coast and Port Stephens LGAs have large proportions of population in this demographic and older, while conversely the Newcastle LGA is dominated by a younger population between 20 and

40 years (Figure 12). The population of over 65 years in the HCC is expected to grow from 20% in 2016 to 25–26% in 2036, with more than half of expected growth to be in this older age bracket (ABS 2019b).

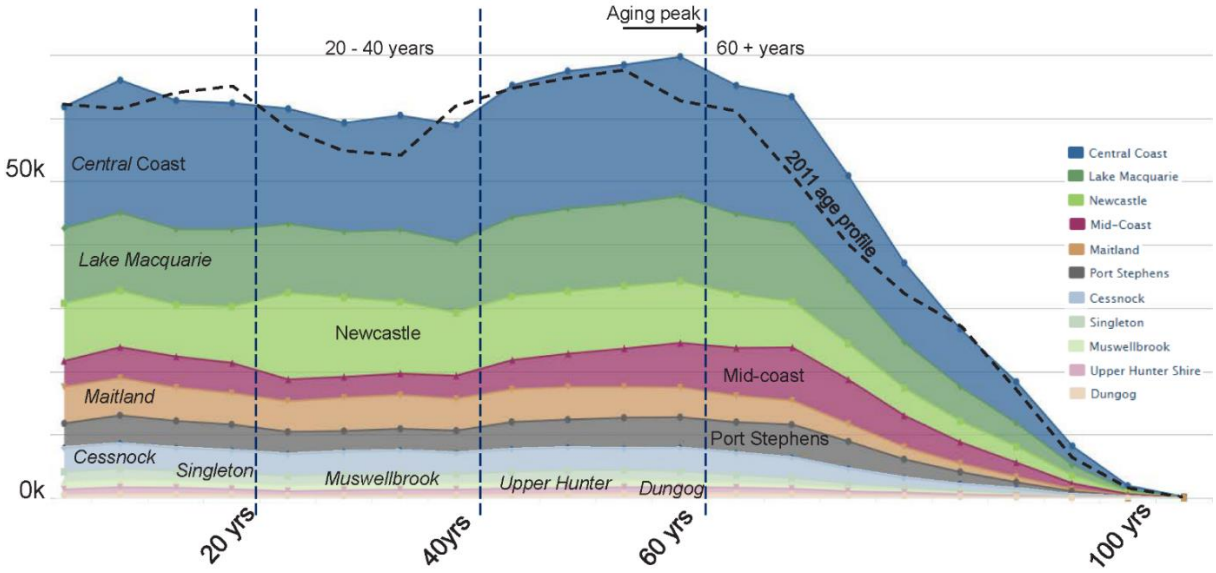


**Figure 12** **Age profile (stacked LGAs) 2016**
Source: ABS (2019b)

Labour force participation is on average similar to New South Wales as a whole, but well above average in some LGAs such as Singleton and well below average in others such as the Mid-coast (Figure 13).

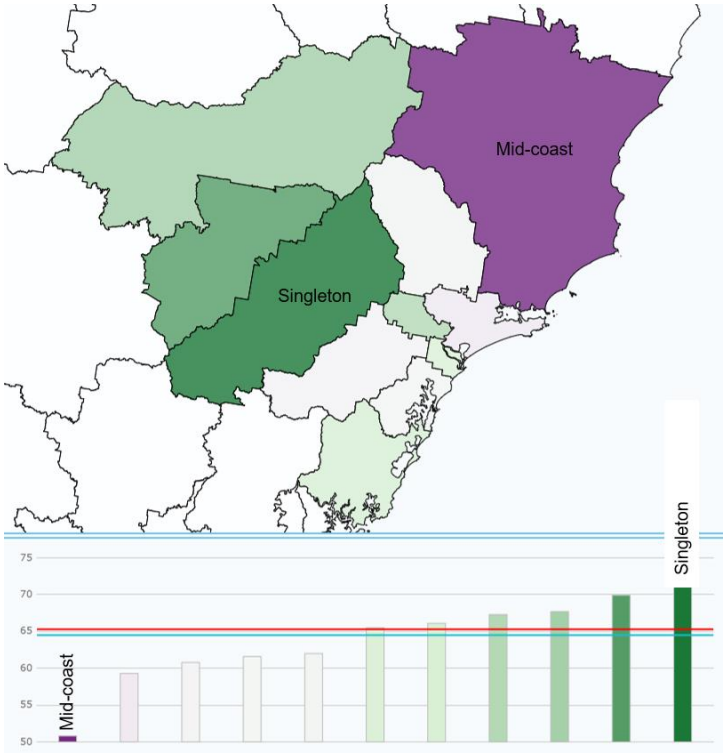


**Figure 13** **Labour force participation 2016**
Source: Torrens University Australia (2019)

The HCC ERA project area is administered as two NSW Government regional planning regions, but these are often considered together, such as in DPIE's Hunter and Central Coast Branch and the Hunter Joint Councils. The area comprises the LGAs of Upper Hunter, Mid-Coast, Muswellbrook, Singleton, Dungog, Port Stephens, Maitland, Cessnock, Newcastle, Lake Macquarie and Central Coast.

The Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS) has been in place since 1996 and is considered to be a forerunner to the newly adopted model of Joint Organisations (JOs) of councils. This organisation is now the Hunter Joint Organisation (HJO) and has been active in climate change mitigation and adaptation work since 2009 with a climate modelling downscaling project, climate change risk analysis and adaptation planning, and has continued to ongoing community resilience, disaster and heatwave preparedness projects.

The University of Newcastle (UoN) is the major tertiary education institution in the region, with campuses in Callaghan (near Wallsend), Ourimbah (Central Coast) and Newcastle City, which is currently seeing relocation of large parts of the university into new building developments in the city centre and in the Honeysuckle precinct. The university has other regional centres such as in Taree, Port Macquarie and Armidale. Notably, it has developed a research hub (UoN Upper Hunter) based in Muswellbrook, in close proximity to the coal mining and energy production industries, which seeks to have a role ' *… in the Hunter's economic transition into a knowledge-based economy*' (University of Newcastle 2019).

## 3.2 Natural, physical and economic capitals

The HCC region stretches from the Hawkesbury River and Gosford, just north of Sydney along the coast to Taree in the north-east, and inland to Scone and Merriwa in the west.

The region encompasses the catchments of the Hunter and Manning rivers, World Heritage listed Barrington Tops and Wollemi national parks, and the Port Stephens – Great Lakes Marine Park. The region supports diverse environments from coastal systems and major floodplains, to dry sclerophyll forests and the woodlands of the Sydney sandstones.

Coal mined from the Newcastle area was the NSW colony's first export and coal mining continued in Newcastle and surrounds until the 1960s. Coal and the related energy industry remains the largest economic driver of the Hunter Valley.

In 1911, BHP chose Newcastle as the site for its steelworks due to the abundance of coal. The land put aside was prime real estate, on the southern edge of the harbour. In 1915, the BHP steelworks opened, beginning a period of over 80 years dominating the steel works and heavy industry and going on to become the region's largest employer. In 1999 the steelworks closed after 84 years operation. The closure of the steelworks is considered locally as an example of transition in the community.

The Hunter region on its own is the largest regional economy in Australia, ranking above Tasmania, the Northern Territory and the Australian Capital Territory in terms of economic output. It drives around 28% of regional New South Wales' total economic output (DPE 2016b) and is the largest regional contributor to the state's gross domestic product. The Central Coast region is located at the centre of the state's fastest growing corridor – between Sydney and Newcastle – where the population is estimated to grow to 1.1 million by 2036 (DPE 2016a), with a significant proportion of the residents travelling to Sydney for work.

The largest employment sector in the HCC is 'Health Care and Social Assistance' with 'Retail Trade' and 'Construction' following as second and third highest employers (Figure 14). The spread of employment by industry is generally consistent across all LGAs except for the notable exceptions of 'Mining' and 'Agriculture, Forestry and Fishing'.

As seen in Figure 14, ‘Mining’ has a large proportion of employment from Maitland, Cessnock, Singleton and Muswellbrook. ‘Agriculture, Forestry and Fishing’ is similarly higher in the Mid-coast, Dungog and Upper Hunter populations. The remaining LGAs, Central Coast, Lake Macquarie, Newcastle and Port Stephens are not as affected by these industries and are largely more coastal and urban in nature.

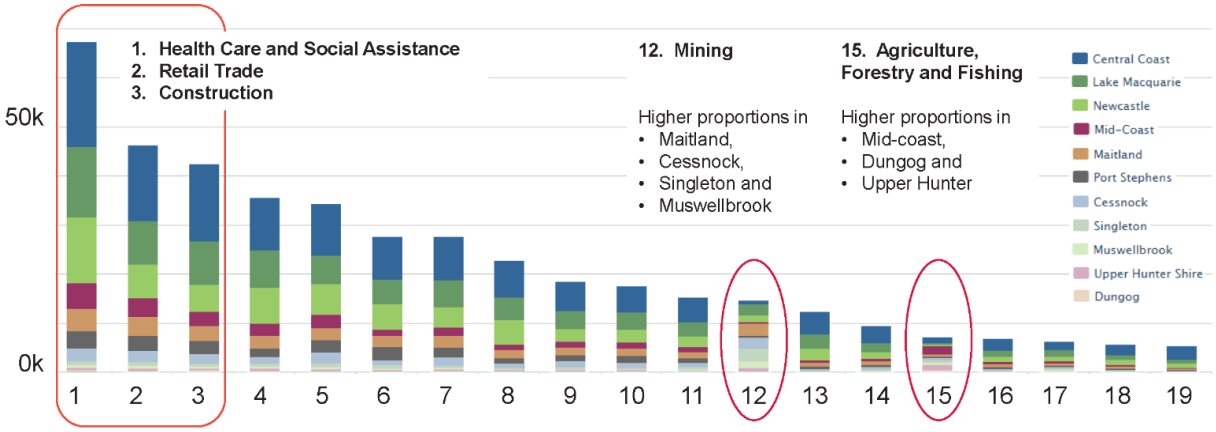


**Figure 14** **Employment by sector (stacked LGAs) 2016**

Source: ABS (2019b)

Physical capital comprises the items produced by economic activity from other types of capital such as the built environment, infrastructure and equipment (houses, schools, clinics, roads, farm machinery, and producer goods accessible by the community).

The major focus of urban development in the HCC is the Greater Newcastle Metropolitan area, which encompasses Cessnock, Lake Macquarie, Maitland, Newcastle and Port Stephens LGAs. These areas, along with the Central Coast, are the most urban in nature with the remaining areas of Mid-coast, Upper Hunter, Muswellbrook, Singleton and Dungog having the lowest densities overall.

Most significant infrastructure runs parallel to the coastline, linking the north coast and Brisbane to Sydney, or parallel to the Hunter River, linking the port of Newcastle to the Upper Hunter and inland New South Wales.

The Newcastle Airport is located just north of Newcastle close to the junction of these two corridors, alongside the Royal Australian Air Force (RAAF) Base Williamtown, which is one of four RAAF bases in New South Wales, and is a significant part of the region’s economy and community (RAAF 2019). The commercial airport services direct flights within Australia, and serves as an important transport hub for the regions. Under the airport’s strategic plan ‘… *passenger numbers are anticipated to double, possibly even triple current numbers travelling through Newcastle Airport by 2036*’ (Newcastle Airport 2019).

Frequent passenger rail services run from Sydney to Newcastle and Newcastle to Scone, while the less frequent CountryLink services extend this network from Scone to Tamworth and Armidale, and north of Newcastle to Brisbane. Long-standing investigations into the feasibility of high speed rail between Sydney and Brisbane would likely follow a similar route to the current rail infrastructure (DITRDC 2017), with stations at Ourimbah, West Wallsend and Taree.

## 3.3 Expected regional climate change

Climate change projections for the region can be found in the Hunter Climate Change Snapshot (OEH 2014b) and Central Coast Climate Change Snapshot (OEH 2014a) on the AdaptNSW website Climate projections for 2020–2039 are described in the snapshots as *near future*, or as 2030 to represent the average for the 20-year period. Climate projections for 2060–2079 are described in the snapshots as *far future*, or as 2070 to represent the average of the 20-year period (see Table 1).

Projected changes in regional climate include:

- an increase in all temperature variables (average, maximum and minimum), more hot days, and fewer cold nights in the near and far future. Heatwaves are projected to increase, be hotter and last longer
- seasonality of rainfall will change. Autumn rainfall (and summer rainfall at the coast) will increase in the near and far future
- the majority of models agree that spring rainfall will decrease in the near future. Seven out of 12 models project a decrease in rainfall in winter for the near future but projections for the far future are less clear
- fire risk will increase during summer and spring, with projected increases in average and severe Forest Fire Danger Index values in the near and far future.

**Table 1 Combined climate change projections for the Hunter and Central Coast regions**

| Climate variable (average across the region) | Trend | Projections | |
|---|---|---|---|
| | | Near future (2030) | Far future (2070) |
| Atmospheric $CO_2$ | Increase | A2 IPCC emissions scenario | |
| Max. temperature | Increase | 0.3 – 1.0°C | 1.4 – 2.6°C |
| Min. temperature | Increase | 0.4 – 1.0°C | 1.4 – 2.5°C |
| Hot days | Increase | 0 – 7 days | 5 – 19 days |
| Cold nights | Decrease | 4 – 8 days | 12 – 19 days |
| Heatwaves | Increase (frequency)<br>Increase (intensity [a])<br>Increase (duration) | 0.9 – 1.5 events<br>1.5 – 7.5°C$^2$<br>0.5 – 2.5 days | 2.5 – 4.5 events<br>3 – 15°C$^2$<br>3 – 9 days |
| Annual rainfall [b] | Drying & wetting | –15% to +16% | –7% to +23% |
| Changes in average rainfall by season [b] | Drying & wetting | Summer: –18% to +23%<br>Autumn: –21% to +48%<br>Winter: –15% to +30%<br>Spring: –25% to +24% | Summer: –12% to +31%<br>Autumn: –15% to +46%<br>Winter: –32% to +39%<br>Spring: –18% to +42% |

[a] Amplitude is the hottest day of the hottest heatwave of the year. Units are °C$^2$ because it is the product of two temperature anomalies.

[b] Negative values represent drying and positive values represent wetting under projections for annual rainfall and seasonality rainfall. Source: OEH (2014a,b).

Climate change will impact a range of regional systems including agriculture (affecting crops, evaporation of surface water, and stock), vulnerable groups within regional communities (such as the ill, very young and the elderly), natural ecosystems, regional infrastructure and fire management (see Appendix A).

## 3.4 Vulnerability affecting government services

Local decision-makers identified seven key factors that affect the vulnerability of the HCC and which interact to set constraints and opportunities that influence the ability of government to service the community. Already influencing the region, the importance of these vulnerabilities is likely to be amplified by continued changes to climate.

1. **Natural resource management** – The region has high value environmental assets that support endangered ecological communities and contribute to the region's economy, recreation, food and water security, human health and wellbeing through local ecosystem services; however, a lack of strategic planning, coordination and enforcement of environmental laws threatens ecosystem services in the region.
2. **Renewable energy potential** – There is strong potential for renewable energy integration in regional industries; however, this requires community support for renewables and demonstration of a plan for workforce transition in mining communities.
3. **Regional economy** – While the region has a culture that encourages technological innovation, the economy is heavily dependent on mining, agriculture and coastal tourism, which are vulnerable to the impacts of climate change.
4. **Workforce skills and knowledge base** – An agile and skilled workforce will be needed to support the emergence of innovative industries and novel business models that will be required to adapt to a changing climate. Ongoing support and collaborative partnerships between government, business and the education sector are needed to ensure the regional knowledge and skills base matches industry needs.
5. **Regional identity** – The HCC has a strong sense of regional identity supported by the action of local government; however, local community networks require ongoing support and engagement to ensure they drive better planning, economic development and service delivery in the region.
6. **Aboriginal and cultural heritage conservation** – The region has a strong Aboriginal identity and significant cultural assets; however, there is a need to empower and better engage Aboriginal communities to ensure learning from cultural heritage and Indigenous knowledge informs broader adaption to climate change.
7. **Modern transport infrastructure** – The region's transport infrastructure is critical to its industry and economy; however, the modes of transport, types of vehicles, and public transport infrastructure will require significant investment to ensure they continue to service community and business needs and support emissions reduction targets.

### Vulnerability

Regions across New South Wales vary in their vulnerability to climate change. Figure 15 shows a snapshot of vulnerability for the HCC that is synthesised from workshop activities, project survey, discussions and supporting literature and data. It illustrates regional vulnerability as three components:

- **red boxes** – defined as the community's exposure to the range of biophysical and socioeconomic drivers that could potentially stress the ability of the region to function
- **orange boxes** – show the sensitivity to the diverse impacts that result from exposure to drivers of change, and
- **green box** – adaptive capacity represented by a set of attributes that act to determine how the region might respond to reduce future vulnerability. If present, these attributes can enable adaptation. If they are absent or negative, then adaptive responses will be constrained.

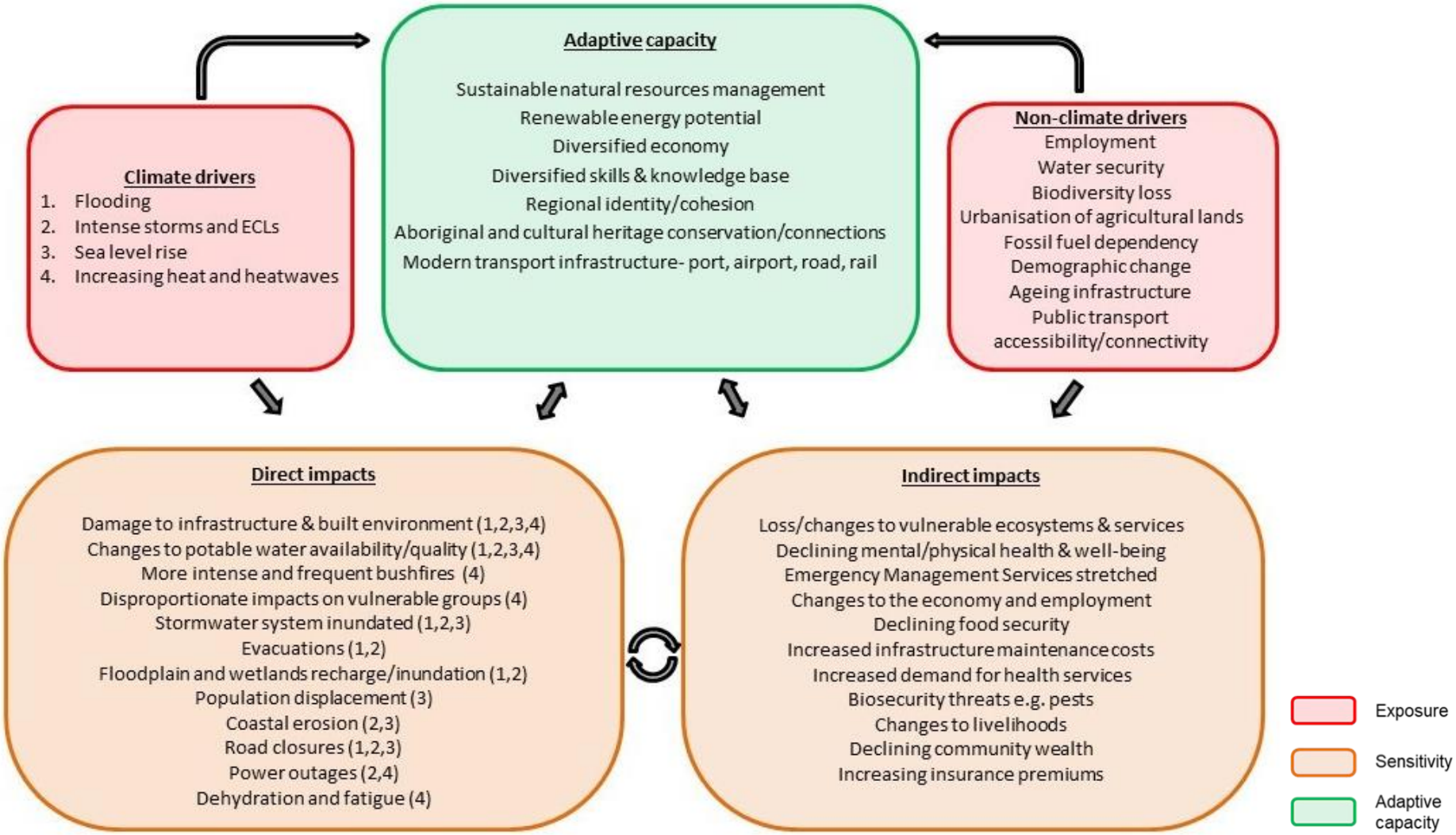


**Figure 15** **A snapshot of vulnerability in the Hunter and Central Coast regions**

Note: Numbers in brackets under direct impacts link to numbers in climate drivers.

## Exposure

### Climate drivers

Participants identified flooding, intense storms with high winds, sea level rise and increasing heat and heatwaves as the main climate drivers of the HCC. Of these drivers, increasing heat and heatwaves are projected in the regional climate modelling.

### Non-climate drivers

Non-climate drivers are drawn from the system transition models representing the range of socioeconomic and biophysical changes currently affecting the HCC. They operate at a range of scales from national (fossil fuel dependency and extensive coal mining in the region) to regional (biodiversity loss, demographic change, water security) and local (employment, urbanisation of agricultural lands).

While the non-climate drivers act independently of climate drivers, they may interact with climate impacts within the region. For example, demographic change is in part influenced by Sydney metropolitan house prices, employment, migration, and the natural environment of the region. However, in combination with climate drivers, demographic change, for instance, increases local exposure of the community to impacts of climate change (such as flooding and storm events) especially if more housing developments are situated along the coast or in low-lying areas. During extreme events, demand increases for emergency management and other government services, such as the State Emergency Service (SES). In addition, lack of public transport connections increases car dependency, which contributes to emissions and fossil fuel dependency.

## Sensitivity

### Direct impacts

The impact of climate change on the HCC manifests, most immediately, through the effects of extreme events. These direct impacts, shown in Figure 17, summarise the initial interconnected effects that ripple through the region's systems. For example, all four key climate drivers directly impact the built environment in the form of damage to infrastructure as well as changes to the availability and quality of potable water. Increasing heat and heatwaves have multiple direct impacts as they contribute to bushfire risk in the form of more intense and frequent bushfires as experienced this past spring and summer. Severe storms with high rainfall over a short period of time and flooding inundate the stormwater system, also affecting water quality, and can displace people from low-lying or flood prone areas. On a positive note, these events are historically a natural feature of riverine ecosystems vital to recharge floodplain and wetlands areas.

Increasing heat events negatively affect human health contributing to dehydration and fatigue, with the disproportionate impacts on vulnerable groups such as the socioeconomically disadvantaged or those with compromised health, including mental health.

### Indirect impacts

These are the concluding impacts, which have 'snowballed' along the impact chains. They represent further socioeconomic and biophysical drivers of change that affect the region, culminating from climate drivers, and are also heavily influenced by non-climate drivers in complex ways. The combination of climate impacts and non-climate drivers, such as urbanisation and the loss of biodiversity, may significantly alter ecosystems and can lead to a loss of vulnerable ecosystems and associated ecosystem services, which may affect food and resource security.

The various negative effects on human health from climate change, for example, smoke from bushfires, can result in declining physical and mental health and wellbeing, which contribute to increasing demand for health services via more presentations at medical centres and hospitals. The impact of intense storms and flooding puts an extra strain on emergency services especially from multiple events in short succession. The indirect impacts also culminate in declining wealth in the community as funds need to be directed to repair damaged infrastructure, and as repair costs and insurance premiums rise, which impacts regional and national economies.

### Sectoral impact priorities

Participants identified both the direct and indirect impacts of concern to the five major service delivery sectors of the region (Table 2). In general, the impacts of concern aligned closely with the service delivery responsibilities of the sector; however, there were some crossovers between sectors. For example, the declining mental and/or physical health and wellbeing was a concern for the industry and economy sector, presumably due to changes in workforce productivity, but also to the settlements and infrastructure sector and emergency management. Similarly, the loss of, or changes to, vulnerable ecosystems and services was a concern to the landscapes and ecosystems sector but also to industry and economy, and settlements and infrastructure.

**Table 2 Climate impacts of most concern to sectors**

| Direct climate impacts | Indirect climate impacts |
|---|---|
| **Industry and economy** | |
| Changes in potable water availability and quality<br>Road closures<br>Power outages | Loss/changes to vulnerable ecosystems and services<br>Declining mental/physical health and wellbeing |
| **Human services** | |
| Disproportionate impacts on vulnerable groups<br>Damage to infrastructure and the built environment | Increasing demand for health services<br>Changes to the economy and employment |
| **Settlements and infrastructure** | |
| Damage to infrastructure and the built environment<br>Changes in potable water availability and quality | Declining mental/physical health and wellbeing<br>Loss/changes to vulnerable ecosystems and services |
| **Landscapes and ecosystems** | |
| More intense and frequent bushfires<br>Floodplain and wetland recharge/inundation | Loss/changes to vulnerable ecosystems and services<br>Biosecurity threats |
| **Emergency management** | |
| More intense and frequent bushfires<br>Damage to infrastructure and the built environment | Emergency management services stretched<br>Declining mental/physical health and wellbeing |

## Adaptive capacity

The attributes listed under adaptive capacity represent a set of available resources, or changes to resource use, that provide options to act to reduce regional vulnerability to climate change in the face of uncertainty.

For example, climate-adaptive infrastructure and community risk preparedness will assist during and after extreme events. The HCC has strong local social networks that are able to share accessible regional knowledge. This increases the sense of community and assists in the ability of these communities to recover after events.

The transition pathways identified in the system transformation models (Chapter 1) and the 'first steps' projects outlined in Chapter 4 provide a mechanism to support and enhance regional adaptive capacity.

## Sectoral adaptive priorities

While sectors of the regional economy may prioritise differently the various aspects of vulnerability that affect their service delivery, there is some overlap among them. Table 3 lists the sectoral priorities for the adaptive capacity indicators; for example, the sustainable use of natural resources was prioritised by four sectors: settlements and infrastructure, landscapes and ecosystems, emergency management, and industry and economy. Human services, settlements and infrastructure, and industry and economy prioritised a diversified economy and renewable energy potential as important factors contributing to adaptive capacity.

**Table 3 Adaptive capacity sectoral priorities**

| |
|---|
| **Human services** |
| • Renewable energy potential<br>• Diversified economy |
| **Settlements and infrastructure** |
| • Sustainable natural resource management<br>• Renewable energy potential |
| **Landscapes and ecosystems** |
| • Sustainable natural resource management<br>• Aboriginal and cultural heritage conservation and connections<br>• Diversified economy |
| **Emergency management** |
| • Sustainable natural resource management<br>• Diverse skills and knowledge |
| **Industry and economy** |
| • Diversified economy<br>• Renewable energy potential<br>• Sustainable natural resource management |

# 4. How do we know?

## 4.1 Description of the ERA process

The Enabling Regional Adaptation process has been designed to develop a shared understanding among stakeholders of the likely vulnerability to climate change and stimulate regional action to plan adaptation. To undertake the assessment, state and local government participants from different sectors (Table 4) are engaged to ensure cross-sectoral and cross-scale operational knowledge and constraints are considered.

**Table 4 Sector and scope for HCC ERA**

| Sector | Scope |
|---|---|
| **Emergency management** | Emergency management (fire, flood, heat, bushfire), infrastructure and utilities, public health / disaster management |
| **Human services** | Education, health, senior, youth and child services, meals on wheels, library services, disability services, community services, health and education asset management and planning |
| **Economy, industry and agriculture** | Business development, tourism, legal, professional services |
| **Landscapes and ecosystems** | Natural resource management, biodiversity, conservation, Aboriginal and historic heritage |
| **Settlements and infrastructure** | Regional and local strategic planning, local development, buildings and settlements, transport (rail, road, freight, buses) water (stormwater, sewer, water), energy, telecommunications, community infrastructure |

Due to the complexity inherent in analysing adaptation at regional scale, the HCC ERA approach utilised both qualitative and quantitative techniques to integrate multiple lines of evidence gathered throughout the assessment. Evidence was gathered through the following means:

- five participatory workshops with regional decision-makers – three initial workshops and two integration workshops, and
- two online surveys that focused mainly on local government administrations and state government agencies in the region.

The ERA process engages participants in cross-sectoral workshops where they are provided with regional climate projections, socioeconomic data and regional knowledge. Through a series of hands-on activities participants determine impact chains, adaptive capacity and key regional systems. Final outputs of this process provide a description of regional climate vulnerabilities, system transition models and projects to activate pathways (Figure 19). An online survey was also undertaken before and after the workshops (see Chapter 6).

The ERA process has been carried out in such a way that it incorporates:

- a system thinking approach that acknowledges communities exist within human–natural (or social–ecological) systems
- participatory engagement in which stakeholders co-create an understanding of vulnerability through their deep understanding of the region
- a focus on developing an understanding of the constraints to adaptation, and on identifying opportunities for building adaptive capacity so communities can deal better with climate shocks regardless of their nature or timing
- qualitative analysis supported wherever possible with quantitative data, which acknowledges that societal interactions are complex and contradictory in nature, and not amenable to expert-led, reductionist approaches to problem analysis.

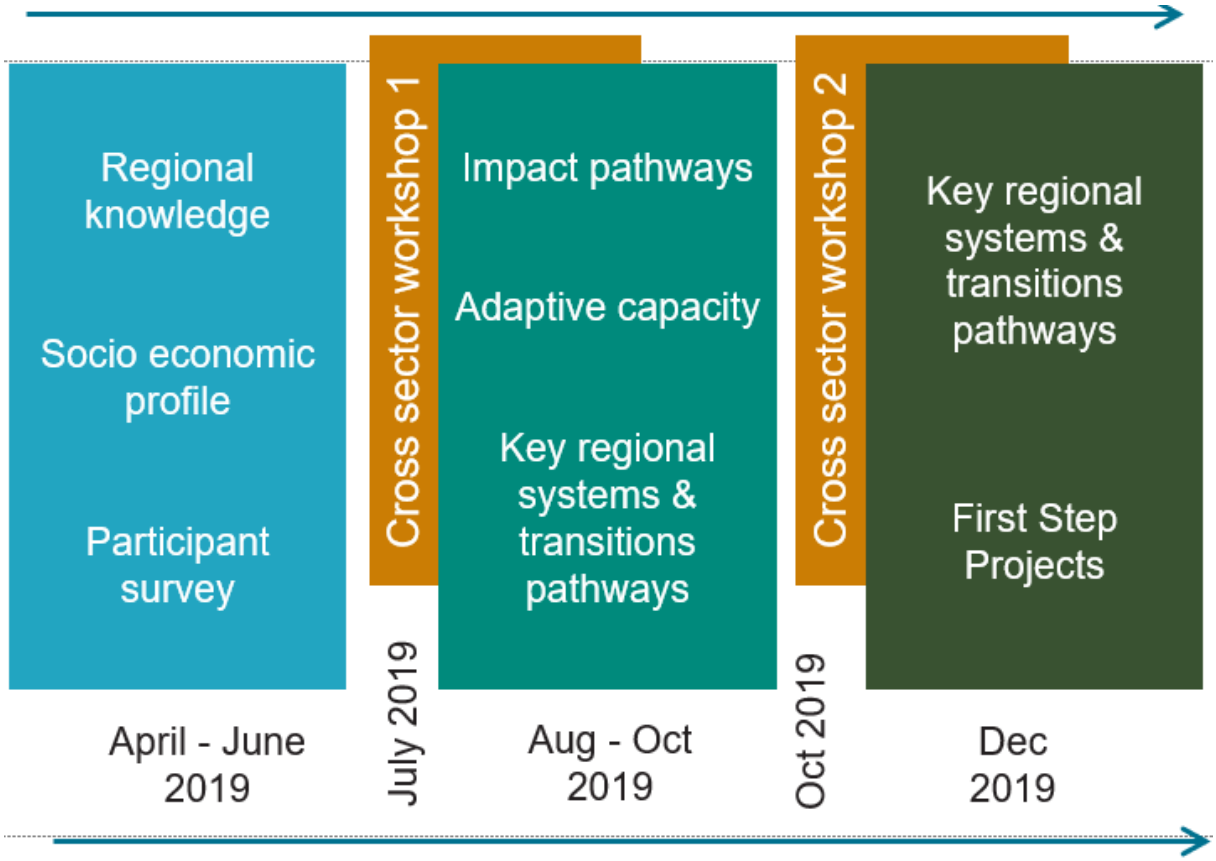


**Figure 16** **Enabling Regional Adaptation process**

## 4.2 Hunter and Central Coast regional workshops

In 2019, the Office of Environment and Heritage (now DPIE) and the University of Technology Sydney Institute for Sustainable Futures (ISF) led a series of four workshops in the HCC as part of the ERA process. The workshops used participatory learning techniques to discuss, explore and gather information and data on the impact of climate change on regional systems and opportunities to respond.

Three initial workshops were held on 30 and 31 July 2019 in Singleton, 1 August 2019 in Lake Macquarie, and 16 October in Rutherford. The first two workshops facilitated a consultation with 86 decision-makers drawn from local councils, NSW Government agencies and federal agencies. These workshops were designed to:

- present the latest climate projections for the HCC
- conduct a rapid Integrated Regional Vulnerability Assessment (IRVA) to identify the climate impacts for the region and the adaptive capacity to respond
- present the latest climate projections for the HCC
- construct a climate impact timeline to encourage consideration of climate projections in light of extreme climate events, regional socioeconomic trends and policy processes
- identify key regional systems that need to change
- begin to develop qualitative, system change models that identify transition pathways leading to a transformed future.

The third workshop on 16 October was held specifically for Aboriginal stakeholders and followed a similar process as above, without the summarising of rapid IRVA results. This workshop facilitated a consultation with 15 decision-makers drawn from local not-for-profit organisations and state government agencies. Having met for the previously stated purpose of developing a regional system model relating to Aboriginal cultural values, attendees:

- confirmed that Aboriginal cultural values was a key regional system that needs to change, and
- began to develop the qualitative, system change model to identify transition pathways leading to a transformed future.

Two integration workshops were held on 29 and 30 October 2019 in Lake Macquarie and Singleton respectively, with a total of 49 participants. These workshops built on the outcomes of the initial regional workshops to:

- further develop qualitative, system change models that identify transition pathways leading to a transformed future
- prioritise regional adaptation actions (through discrete projects) to promote transition and limit maladaptation
- create visualisations of regional adaptations
- construct a climate impact timeline to encourage consideration of climate projections in light of extreme climate events, regional socioeconomic trends and policy processes, and
- formulate cross-sector transition projects that occur along the transition pathways
- continue to build the regional capacity to deliver best practice adaptation.

Across the five workshops, a total of 74 attendees were from HCC local government agencies, 57 from NSW Government agencies, and 19 from State Owned Corporations or not-for-profit organisations.

The various groups represented at the workshops include:

- Aboriginal Affairs*
- Central Coast Council*
- Central Coast Local Health District*
- Cessnock City Council
- City of Newcastle
- NSW Crown Lands
- Department of Community & Justice (FACS)*
- Department of Defence
- Department of Planning, Industry and Environment*
- Department Premier and Cabinet*
- Department of Primary Industries*
- Forestry Corporation of NSW
- Hunter Central Coast Development Corporation
- Hunter Joint Organisation*
- Hunter New England Local Health District*
- Hunter Water*
- Inner West Council
- Lake Macquarie City Council
- Local Land Services*
- Maitland City Council
- MidCoast Council
- Muswellbrook Shire Council
- National Parks and Wildlife Service (NPWS)
- NSW Aboriginal Land Council
- NSW Police*
- NSW Rural Fire Service
- NSW Volunteer Rescue Association
- NSW Aboriginal Land Council
- Office of Emergency Management
- Port Stephens Council
- RMS / Transport NSW
- State Emergency Service (SES)
- Singleton Council
- Soil Conservation Service
- TAFE NSW*
- Taree Indigenous Development and Employment Ltd (TIDE)
- Upper Hunter Shire Council
- Wonnarua Nation Aboriginal Corporation

*Note: An asterisk denotes organisations represented on the project steering committee.

The workshops attracted a wide range of stakeholders, representing all five government service sectors: landscapes and ecosystems (38%), settlements and infrastructure (33%), human services (12%), emergency management (10%), and economy and industry (7%).

## 4.3 Impact chains

Understanding how climate variability and extreme events will affect the region is a vital first step towards planning and implementing adaptation responses. In light of the regional climate projections and socioeconomic information, participants constructed influence diagrams to illustrate impact chains and influence relationships stemming from each of the major climate variables (Figure 17). These diagrams allowed two types of impacts to be identified along impact chains: direct impacts were those that were directly attributable to climate change and appear on impact chains in close proximity to climate variables; indirect impacts resulted from the flow-on effects of climate variables and were also influenced by external regional drivers. Indirect impacts appeared further along the impact chains.

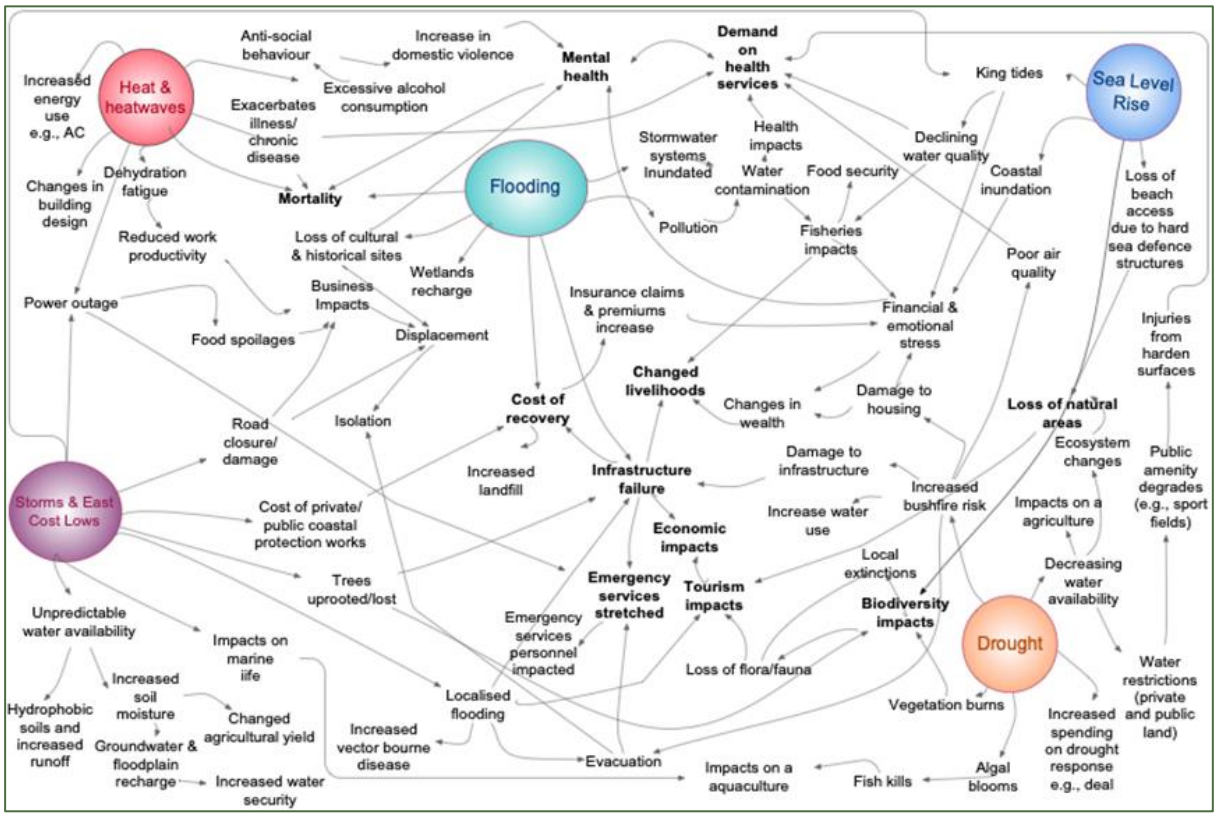


**Figure 17 Map of climate impacts for the Hunter and Central Coast regions**

## 4.4 Climate timeline

A climate timeline (Figure 18) was constructed during the integration workshop as a place-based, sense-making exercise. The timelines allowed climate projections to be interpreted through the local, collective experience of past extreme climate events and the likelihood of their future occurrence until 2050. The timeline showed planning projections of regional socioeconomic statistics (population growth, proportions of the population over 65 and under 15 years of age and levels of housing stock) to provide a link with other drivers of government services. Participants were provided with a series of images that represented the major climate impacts for the region (droughts, floods, heatwaves, etc.) and asked to consider the influence of these events on policy processes, such as the opening of policy windows, as opportunities to influence adaptation action through strategic regional planning.

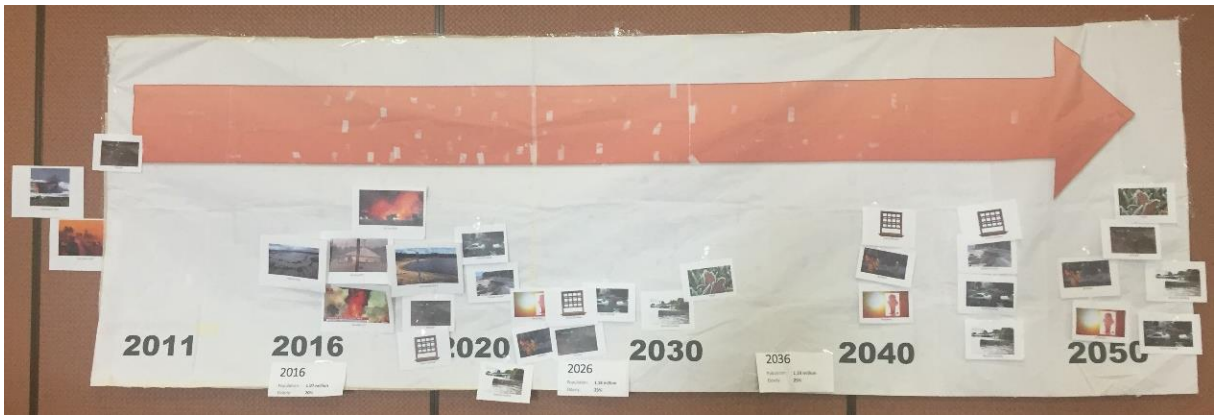


**Figure 18 Climate timeline for the Hunter and Central Coast regions, Singleton workshop**

## 4.5 Key regional systems

The subregional workshops identified nine key regional systems considered most in need of transformation to adapt to climate change. These systems were refined in the integration workshops to reduce redundancy and focus specifically on systems that could be influenced through action at regional scale. The models are not intended to represent all aspects of the region; rather they reflect the expertise of workshop participants and provide a mosaic of the major systems of the region. The systems developed are:

- Aboriginal cultural values
- Circular economy
- Community resilience
- Emergency management
- Industry transformation
- Planning
- Protection of natural systems and environment
- Transport and infrastructure
- Water and water security.

## 4.6 System change models

The conceptualisation of adaptation as a series of planned strategic pathways to transition away from business-as-usual was an effective technique to engage workshop participants in a discussion of system transformation in the region. The approach envisions transformational change toward a desirable future as a series of transition pathways that emerge from current practice either through existing innovations or as a result of new drivers of change (Figure 19).

For each of the selected systems the workshop participants discussed:

- **business-as-usual (BAU)** – what constitutes business-as-usual (BAU) in their service delivery area and what changes or ‘tweaks’ are being made to ensure resilience of the current system
- **system drivers** – the relative strengths of multiple drivers determine the extent and direction of change within the system. Drivers of change lead to the emergence of ‘pockets’ of innovation that offer transition pathways to a ‘planned’ transformation
- **transition pathways** – any new practices/changes/trends that may serve as an alternative to business-as-usual that are emerging now or may in the near future. These pathways could emerge from changes in the economy, society, the environment, technology development or politics

- **barriers and enablers** – for selected transition pathways participants identified the barriers to and enablers of change, who do they need to work with to effect change, and any aligned processes or policies, and
- **transformed system** – participants were asked to identify their vision of service delivery in 2050 and articulate what would be the features of the transformed system.

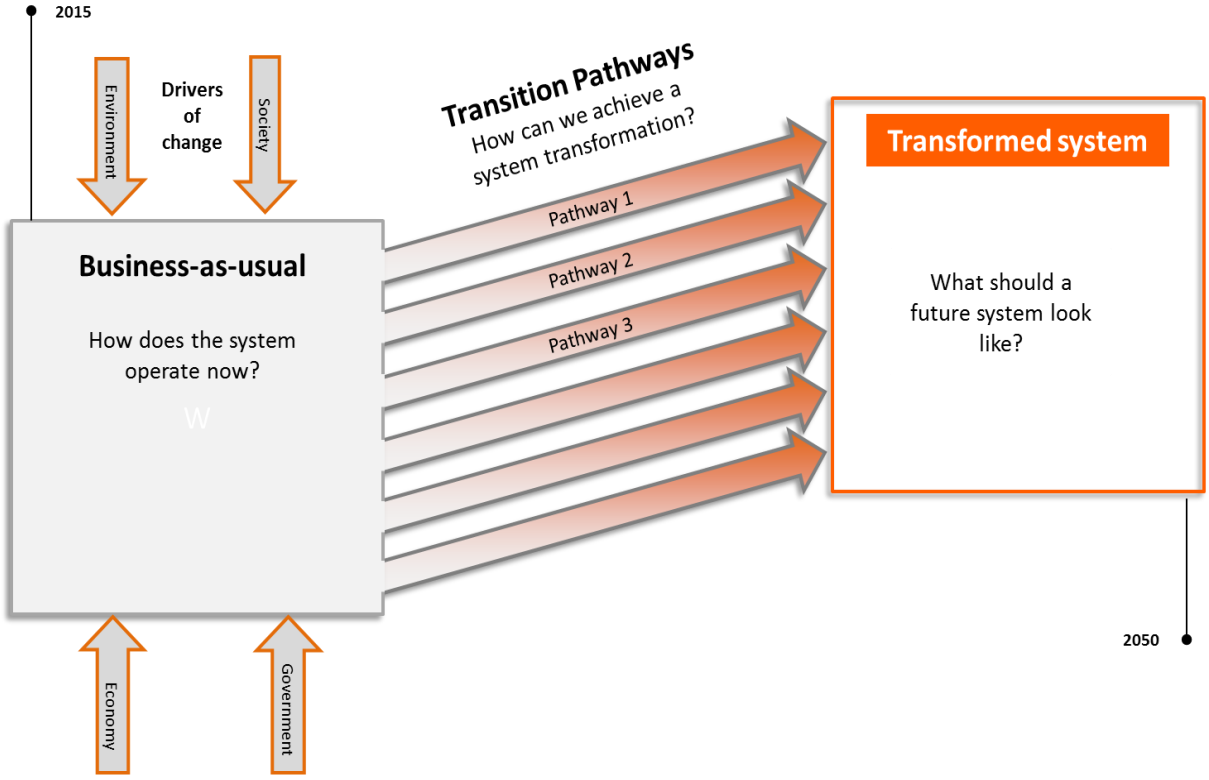


**Figure 19 Conceptual model of transformative change** Source: adapted from Jacobs et al. (2016).

The resulting transition models for key regional systems developed over the project workshops are documented and discussed in Chapter 2.

## Priority pathways for transition systems

During the second series of workshops, attendees were asked to determine priority pathways for each of the transition systems developed. Using sticky dots the workshop participants voted on the various pathways for each of the seven regional systems to determine the key priorities for government from the range of transition pathways (Table 5). Two clear priority pathways were identified for each system.

A strong theme of collaboration and integration of data and governance ran through the pathways prioritised in several models, either through incorporating Aboriginal cultural knowledge and practice into legislation, processes and policies to heal Country and support United Nations SDGs (Aboriginal cultural values), collaborations and connections between key innovation organisations, agencies – facilitated by government to activate circular economy industries in the HCC – establishing coordinated government structure that includes changes to legislation and state plans (emergency management), integrating regional adaptation priorities via integrated planning and reporting framework (planning) and the effective implementation of regional ecosystem management and conservation plans based on evidence, data and funding for strategic planning (protection of nature and environment).

**Table 5 Priority transition pathways for government in the Hunter and Central Coast regions**

| System | Key pathways |
|---|---|
| **Aboriginal cultural values*** | • Incorporate Aboriginal cultural knowledge and practice into legislation, processes and policies to heal Country and support United Nations SDGs<br>• Increase engagement with the Aboriginal community on land-use decision-making in HCC (e.g. Aboriginal impact statement) |
| **Circular economy (CE)** | • Collaborations and connections between key innovation organisations, agencies – facilitated by government to activate CE industries in HCC<br>• Implement state legislation to incentivise CE through pricing on products and the waste levy |
| **Community resilience** | • Promote resource sustainability through CE, community renewable energy and sustainable transport<br>• Increase community cohesion, self-reliance and employment opportunities |
| **Emergency management** | • Establish coordinated government structure that includes changes to legislation and state plans<br>• Build robust communication between agencies and communities |
| **Industry transformation** | • Develop 'food trails' tourism strategy and Hunter brand to support marketing and ecotourism in the region<br>• Implement procurement pathways to modify market forces and supply chains to support expanded renewable energy capacity |
| **Planning** | • Fund state and federal support to councils to engage, raise awareness and deliver action on climate adaptation resilience in the community<br>• Integrate regional adaptation priorities via integrated planning and reporting framework (IP&R) (delivery and operational) |
| **Protection of natural systems and environment** | • Effective implementation of regional ecosystem management and conservation plans based on evidence, data and funding for strategic planning<br>• Enhanced community programs with a focus on behaviour change to promote hope, ownership and responsibility for the environment |
| **Transport and infrastructure** | • Apolitical, integrated transport planning for integrated services fit for community that incorporates climate risk and smart land-use planning<br>• Facilitate innovation and changing culture to encourage risk-based approaches and proactive planning to prioritise and design transport infrastructure |
| **Water and water security** | • Educate and engage communities to inform and enable participation in planning and decision-making<br>• Undertake economic reform for the assessment of business models for water / infrastructure projects |

*Note: The Aboriginal cultural values model was developed both at the ERA workshops and through additional DPIE consultations with regional stakeholders separately to the ISF led workshop process documented here.

# 5. What can we do about it?

## 5.1 Projects to activate pathways

Workshop participants were encouraged to develop ideas for ‘first step’ projects for the priority pathways identified in each regional system. These pilot projects could activate pathways and begin the incremental change needed to move towards regional transformation. Descriptions of these projects are outlined in Table 6 below.

**Table 6 Pilot projects to activate pathways**

| Pilot project | Description | System |
|---|---|---|
| General Health Practitioners (GPs) to evacuation centres | A network of health professionals are linked with emergency services in setting up evacuation centres to ensure GP, nurse and pharmaceutical services are available to evacuees | Community resilience |
| Tax deductions for volunteering in emergency management | Setting up legal opportunity for emergency management volunteers to claim tax deductions for costs associated with volunteering | Emergency management |
| Sustainable volunteer Emergency Force in NSW (satisfying needs and drivers of all volunteers) | Review of emergency management volunteering models and determine major drivers and thereby instigate effective benefits and incentives to reward and encourage volunteering | Emergency management |
| Community values for climate action (on the Central Coast) | Review and strengthen community values in support of climate change adaptation | Community resilience |
| Regionally developed transition planning | Develop policy and advocate for changes to legislation in support of climate change adaptation | All |
| Regional adaptation priorities integrated into council planning & delivery | Integrate regional adaptation priorities via local government integrated planning & reporting (IP&R) framework | Planning |
| Expansion of renewable industry in HCC | Champion and facilitate expansion of the renewable energy sector | Industry |
| Cultural flow calendars / water shed management using traditional ways | Transition of sick Country to healthy Country through indigenous methodology & science | Aboriginal cultural values |
| Birth certificates that connect all Australians to Country | Encourage connection to Country by recording Aboriginal knowledge of land and cultural significance on birth certificates | Aboriginal cultural values |
| Listen to Aboriginal knowledge that has come through past climate change events | Engagement with Aboriginal elders to develop transition planning and climate change adaptation | Aboriginal cultural values |
| Aboriginal Cultural Sea Country Management | Protection of biodiversity and knowledge of marine ecosystems | Aboriginal cultural values |
| Aboriginal Cultural Burn Program | Land management through Aboriginal cultural burning knowledge and practice | Aboriginal cultural values |

| Pilot project | Description | System |
|---|---|---|
| Reconnecting urban population with environment & biodiversity | Biodiversity education program to encourage protection of natural environment by urban populations | Natural systems |
| HCC Integrated Planning (focus on transport infrastructure) | Integrated planning for transport and infrastructure | Circular economy / industry transformation |
| Circular economy certification – A methodology for rating the circularity of products & services | Revised methodology for rating the circularity of products & services in support of circular economy industries | Circular economy / industry transformation |
| Aboriginal cultural values – competency education | Education program promoting Aboriginal knowledge and cultural values | Aboriginal cultural values |
| Self-Determined Risk Resilience (SDRR) of communities in HCC | Resilience planning for local communities | Community resilience |
| Diversifying energy production (focus on renewable energy) | Research in renewable energy in support of industry diversity | Industry |
| Water in Harmony – collaboration and solutions for long-term water planning | Integrated water security planning | Water |
| Strategic vision for ecosystem management & conservation | Development of a strategic vision in support of climate change adaptation and biodiversity in ecosystems | Natural systems |
| Seed and plant bank for HCC | Seed bank biodiversity security for knowledge and resilience | Natural systems |
| Adaptation planning for HCC – lead indicators | Development of lead indicators for climate change adaptation in water and resource security | Settlements |
| Social Transition Planning for HCC – 20-year project | Social transition planning | Circular economy / community resilience |

## 5.2 Actions underway

In parallel with the inception of the HCC ERA project, a number of actions to enhance regional adaptation planning are also underway including:

- **Upper Hunter Economic Diversification Action Plan** – The Hunter Joint Organisation is working with the NSW Government, University of Newcastle and its member councils to develop an integrated suite of policies to help the Upper Hunter's unique communities prosper over the long term. The Upper Hunter Economic Diversification Action Plan articulates the region's priorities for delivering a sustainable and secure economic future – levering existing regional advantages and expanding into new growth areas of agribusiness, renewable energy and the export of expertise in mining, advanced manufacturing and professional services to global markets.
- **Economic Diversification and Transformation – The Hunter 2050 Foundation** – In November 2019, the board of the Hunter JO, guided by its Sub-Committee on Economic Transition, agreed to invest in a project to explore the establishment of a foundation to provide local leadership on economic diversification and transformation in the region. The Hunter JO has been consulting on the foundation project with key players in Hunter industry and across the state and federal governments.

- **Circular Economy Facilitators Group** – Work completed to date on the CE eco-system in the region has confirmed a network of committed, knowledgeable and capable people with the potential to drive the CE program forward. As a first step in harnessing this capacity, an informal 'Hunter Circular Facilitators' group has been established.
- **Hunter BioCircular** – By demonstrating a circular economy approach, Hunter BioCircular seeks to move the region towards zero waste to landfill, and in doing so provide long-term economic, social and environmental benefits from processing waste locally, which will help transition our regional economy, delivering new local jobs, greenhouse gas reductions and improvements to our soils.
- **Regional Disaster Resilience Program** – A project officer has been funded by Resilience NSW as part of a statewide pilot to build capacity and regional resilience with local governments in the HCC. The position will be located with the Hunter JO and will work with DPIE and local councils on a range of core and focus projects such as business continuity and disaster recovery plans.
- **Cultural Fire Management of Land – Firesticks Alliance** – The Firesticks Alliance is an Indigenous led organisation that works with communities, land and fire agencies and organisations across Australia to raise awareness of Indigenous knowledge of culture and Country, skills and experience in both cultural burns and contemporary fire management practices.

## 5.3 Supporting processes

### Increasing Resilience to Climate Change program

This partnership program between Local Government NSW and DPIE provides funding to address identified climate change risks and vulnerabilities facing NSW councils.

#### Objectives

The Increasing Resilience to Climate Change (IRCC) program has been established to encourage:

- implementation of actions to address identified climate risks
- regional consideration of climate change impacts in decision-making
- implementation of climate change adaptation actions beyond business-as-usual projects and programs, and
- enhanced adaptive capacity.

The Climate Change Fund is providing $2.8 million of funding over three rounds. Grants of between $30,000 and $300,000 are available to coordinate adaptation projects to individual councils or across a number of councils. Collaboration with one or more councils, regional organisations, private sector or government agencies, community groups and other organisations is encouraged.

Current IRCC projects in the HCC region include:

- **Central Coast Council** – Climate Change Adaptive Landform Case Study: Woy Woy will develop a landform and drainage study for four areas of coastal and flood inundation on the Woy Woy Peninsula foreshore.
- **Lake Macquarie City Council** – The Swansea Tidal Gate Trial is designed to protect the Swansea CBD from increasingly frequent tidal inundation and storm surge through the stormwater system.

- **Newcastle City Council and University of Newcastle** – Adaptive community place-making in an urban local centre identifies, implements and monitors design solutions to reduce urban heat stress in a public outdoor space in the suburb of Beresfield.
- **Beyond Zero Emissions** – Seeking to adapt households for climate change, the 'Cooling our Homes' booklet will lead to a safer, healthier and more comfortable community using less energy in the region.
- **MidCoast 2 Tops** – Landcare 'Recovery Action Planning' workshops offer increased safety, productivity and biodiversity connectivity across the catchments in the region, focused on recovery.

## Community Resilience Innovation Program

The Community Resilience Innovation Program (CRIP) supports a broad range of community-led projects designed to increase all-hazard disaster preparedness and build community capacity and resilience. CRIP projects are based on collaboration and partnership between local community organisations and emergency services agencies. CRIP aims to:

- encourage local communities to engage in creative, community focused activities that will enhance disaster resilience
- develop effective partnerships and build networks between local community organisations, councils, businesses and emergency services agencies
- foster ways to effectively engage the local community in emergency management and resilience building
- share knowledge and lessons learnt about new approaches and models through project evaluation
- support initiatives that can be integrated into current business and maintained in the longer term.

Two CRIP projects are currently underway in the Hunter and Central Coast regions:

- **Hunter Councils Inc – Everyone's Talking About It… Let's Get Disaster Ready** – $162,000 to develop a coordinated, all-hazards approach to frontline engagement with the community on emergency preparedness and response. This will increase community resilience to natural hazards across all participating councils in the region.
- **SES Newcastle – When Roads Become Rivers** – to build preparedness and resilience for urban flood risk in Newcastle, $32,250 for a pilot investigating new ways to build the capacity of SES volunteers to have effective conversations about local urban flash flood risk and facilitate conversations to build resilience with the local community.

# 6. Measuring progress

## 6.1 Adaptation process

The ability to detect change is a critical component of any monitoring program because it facilitates adaptive management (Allan & Curtis 2005); however, issues associated with monitoring and evaluating climate adaptation are well documented and include (Bours et al. 2013):

- measuring adaptation against a moving climate baseline
- consideration of avoided impacts through counterfactual arguments that are difficult to prove, such as 'if we hadn't undertaken this adaptation action the outcomes might have been much worse'
- the difficulty with attempting to attribute an adaptation outcome to a particular course of action, as often multiple actions have contributed to improved climate resilience
- local adaptation actions can have outcomes that span multiple scales, sectors and responses, and
- the lack of a universal set of indicators against which adaptation can be measured.

Despite these difficulties, organisations (private and public) are moving from *awareness* about the need to manage climate change risks to *implementing actions* to manage them. This has led to the emergence of a common set of practices considered necessary to deliver effective adaptation to climate change: the adaptation process cycle (Figure 20). All of the processes in the cycle commonly occur as part of the climate adaptation in New South Wales.

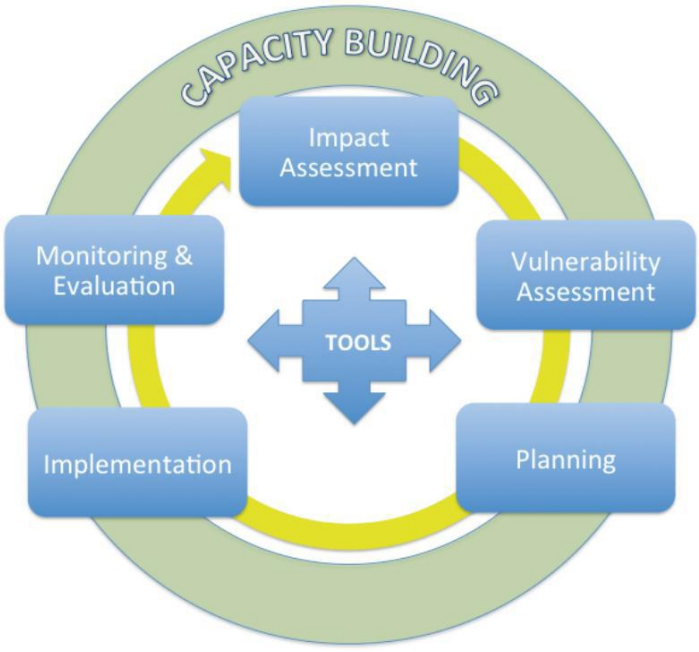


**Figure 20** **The adaptation process cycle**
Source: Hansen et al. (2013)

A well-defined process cycle is central to effective benchmarking. Benchmarking can be used to evaluate an organisation, business or process against external criteria. The objectives of benchmarking are to determine what and where improvements may be made,

to analyse the ways in which other groups achieve high performance, and to use this information to drive improvements in performance. Benchmarking represents a ‘soft policy’ that encourages flexible planning, local consultation and incorporation of local context coupled with institutional support at higher scales of governance. Soft policy instruments can create a ‘stickiness’ that works towards achieving normative outcomes that are embedded and accepted in everyday practices.

For climate change, benchmarking adaptation process at regional scale circumvents many of the problems with attempting to assess and aggregate local-scale adaptation actions. The HCC ERA process focuses on assessing the degree to which organisations are employing effective adaptation processes rather than the effectiveness of government adaptation processes or interventions, the underlying assumption being that good process leads to good adaptation decisions. This type of approach was used by Hansen et al. (2013) in a national climate adaptation benchmarking exercise conducted across a number of sectors in the United States of America.

## 6.2 Adaptive capacity

One way to promote adaptation action is to build regional capacity to adapt (Jacobs et al. 2015). Targeted capacity building requires an understanding of where the barriers to action lie in the region, which is generally related to the resources available for adaptation and the ability to use them. These resources commonly include awareness, knowledge and skills, and staff resources (human capital), engagement and networking with the community and other organisations (social capital), the formulation of strategic plans, and the financial resources to implement adaptation actions. Monitoring adaptive capacity over time can provide an additional measure of regional change.

## 6.3 Regional online survey

An initial qualitative survey was conducted to benchmark regional adaption actions at the start of the project, to provide a baseline assessment. A follow-up survey was conducted following completion of the HCC ERA workshop process as a preliminary assessment of change. The surveys were available online for a period of four weeks from June to July 2019 (initial) and again in February 2020 (post-workshops).

In total, 68 people completed the initial or baseline survey from across all levels of government in the region. The majority of respondents represented local government (47%) and state government agencies (45%), with further representation from regional (4%) and national (1%) organisations, and a further (3%) from non-government organisations. In total, 55 respondents completed the follow-up survey. The representation of respondents was spread across local (46%), state (40%) and regional (5%) government agencies and non-government organisations (9%). The majority (82%) of respondents had attended at least one of the HCC ERA workshops in 2019. One respondent identified themselves as being of Aboriginal or Torres Strait Islander heritage in the baseline survey and five respondents in the follow-up survey.

### Perceived key climate change risks

The respondents identified a number of climate related risks facing the HCC (Figure 21). The top four risks were perceived to be flooding, intense storm events with high winds, sea level rise and heatwaves. The four most important event types were incorporated in the workshop discussions to develop the region’s vulnerability snapshot (see Section 3.4).

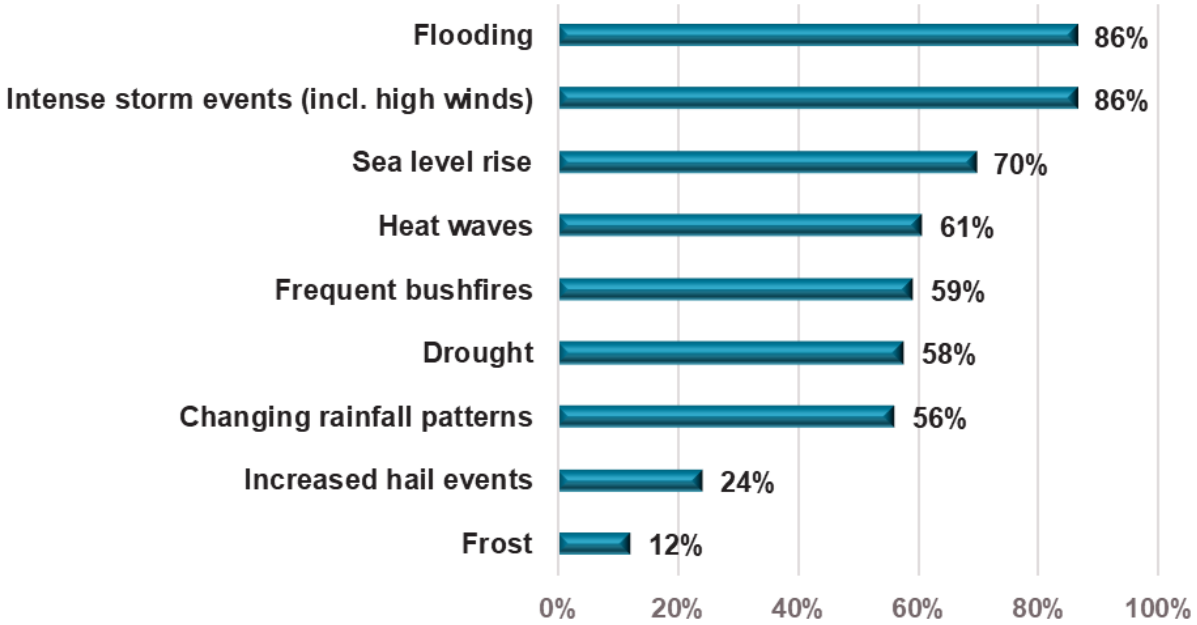


**Figure 21** **Climate risks identified for the Hunter and Central Coast regions**

## Importance of climate change adaptation

A series of questions was asked to ascertain the importance of climate change adaptation from an individual and organisational perspective. The majority of the respondents (87%) agreed that climate change adaptation is a moderate to strong priority both personally and in their professional roles. A further 11% considered it a slight priority and only 4% said it was not a priority. Similarly, the majority (71%) of respondents noted that climate change adaptation was a moderate to strong priority for their organisation and a further 20% considered it a slight priority. About 4% said it was not a priority for their organisation and a further 5% did not know.

## Adaptation action

The surveys explored the wide range of adaptation actions that organisations or individuals had been involved with in the past, actions they are currently engaged in and adaptation actions that are likely to occur in the future (Figure 22).

The top three adaptation actions that have occurred in the past include:

- assessing the risks posed by climate change
- awareness raising or education of staff and local communities, and
- conducting vulnerability assessments.

These same adaptation actions are currently continuing in addition to changing policies and strategies to account for climate change impacts.

Important adaptation actions to undertake in the future included awareness raising and education for government staff and regional communities, mapping the physical impacts of climate change such as heat mapping, continuing to monitor and assess the risks posed by climate change, and building trust and networks and partnerships to mobilise adaptation action. Collectively, these actions are critical to providing the evidence base for policy decisions and build cross-linkages in the region. In terms of what's happening now, securing adaptation funding, conducting training in adaptation for staff and communities, and capitalising on the benefits of climate change were the least pursued adaptation actions in both surveys.

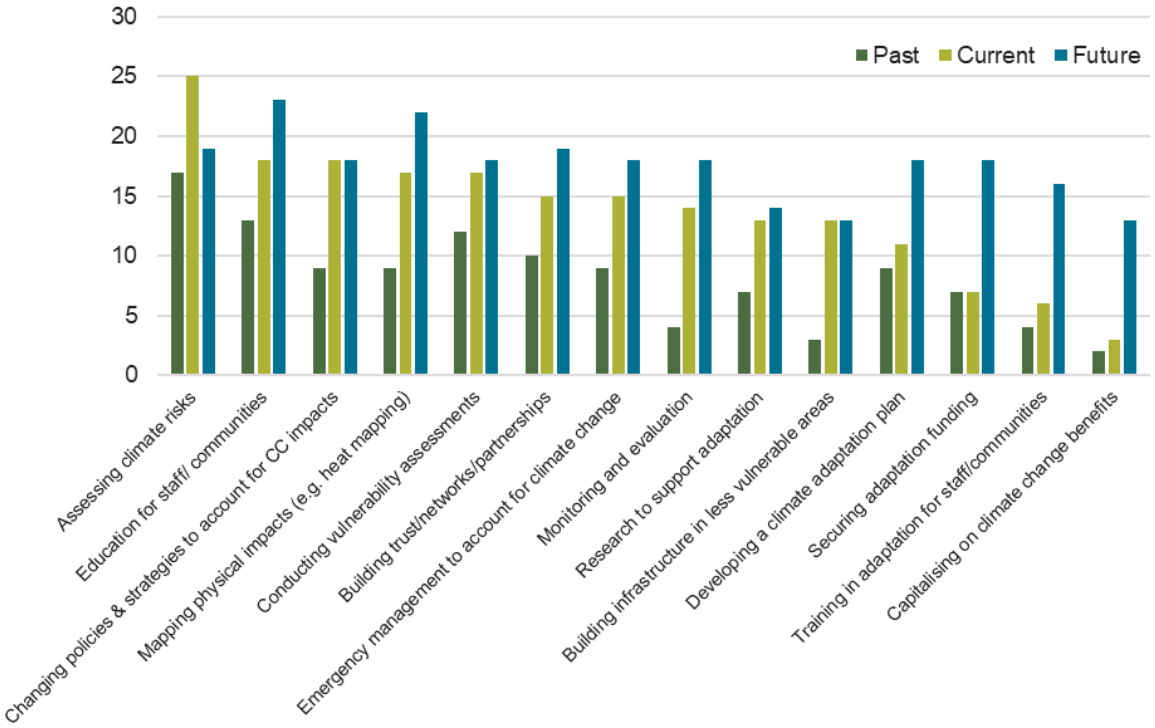


**Figure 22** **Adaptation actions across temporal scales**

Note: CC refers to climate change.

Adaptation actions can span multiple scales, sectors and responses as shown in (Figure 23). Adaptation actions such as assessing climate risks and undertaking vulnerability assessments were conducted both at the local scale and regional scale. Awareness raising and education for staff or communities and developing a climate adaptation plan were conducted primarily at the local scale, while building trust, networks and partnerships was reported as more likely to occur at the regional scale.

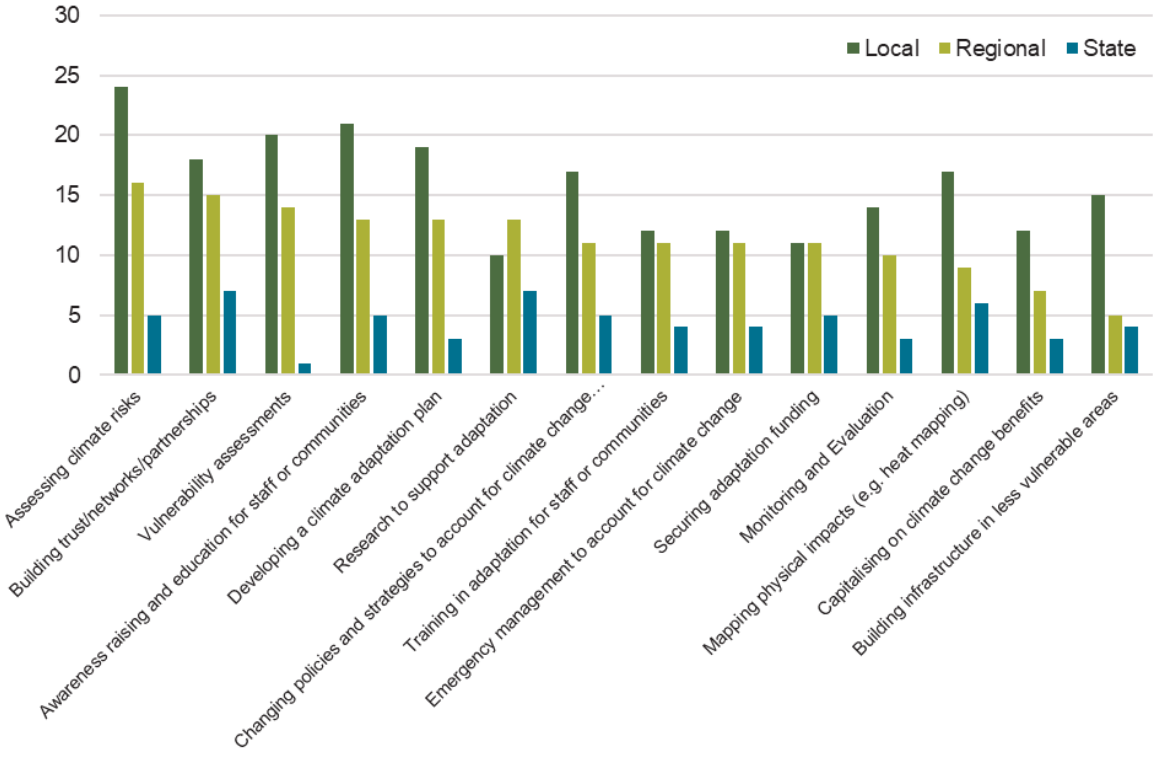


**Figure 23** **Adaptation actions across geographical scales**

## Organisational capacity to undertake climate change adaptation

The survey also explored organisational capacity to undertake regional adaptation actions. Organisational capacity can be broken down into seven key areas:

1. raising awareness of the impacts of climate change
2. knowledge and skills to adapt to a changing climate
3. resources
4. engagement with the community and organisations within the region
5. strategic planning
6. funding for adaptation
7. implementing regional adaptation.

Median responses to the capacity assessment statements (Figure 24) suggest the region is generally constrained in its capacity to adapt. Respondents believed they were less constrained in awareness of climate change, regional engagement and strategic planning than other key areas of capacity.

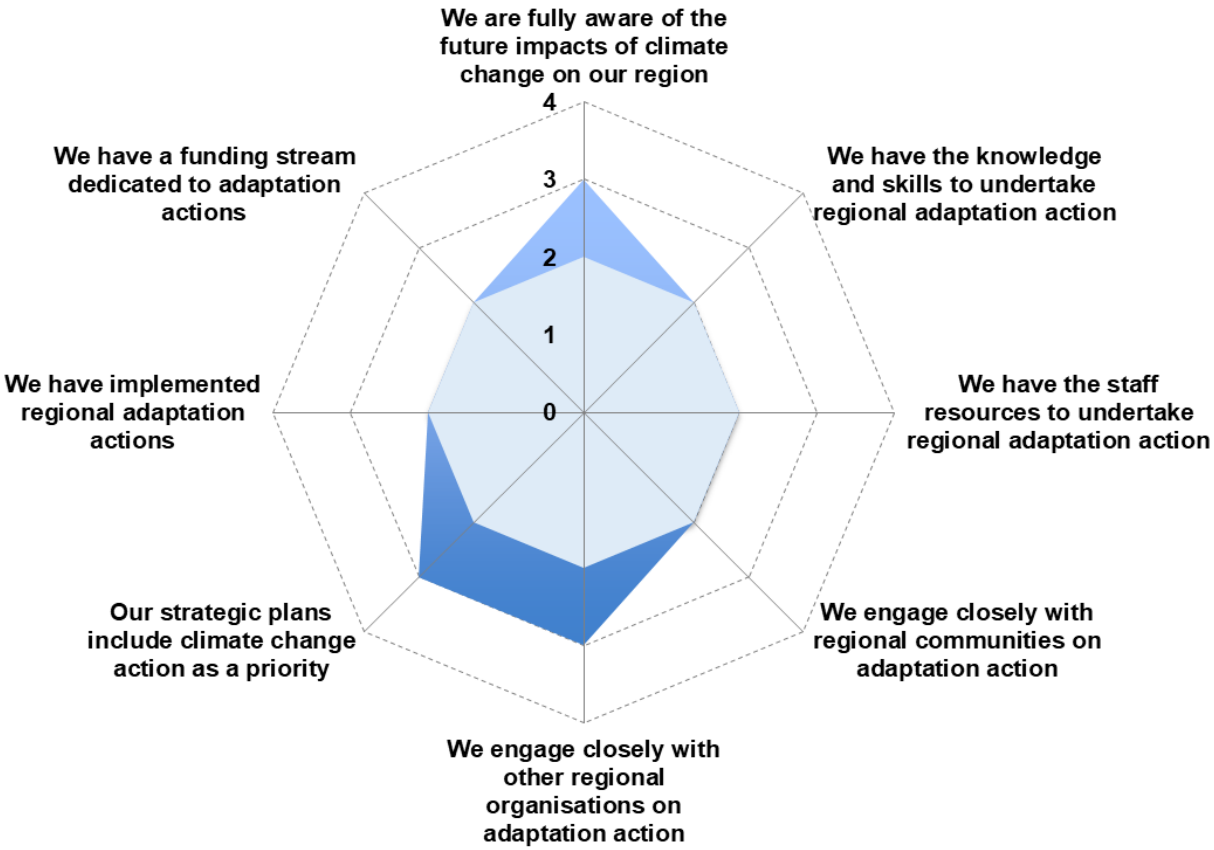


**Figure 24** **Adaptive capacity plot for the Hunter and Central Coast regions**

Note: Before (light blue) and after (dark blue) the workshops. Ratings are median level of agreement with each statement where 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree. N = 40.

## Regional adaptation initiatives

The surveys aimed to gain a deeper understanding of the specific types of adaptation actions that had taken place or were planned for the region. Some of the adaptation actions identified include coastal and floodplain risk management, climate smart cities, integration of Aboriginal cultural heritage into adaptation planning, and natural resource management.

### Coastal and flood risk management and natural resource management

Under NSW planning policy, councils are required to consider coastal process risks for the 2050 and 2100 planning periods. Some local councils are in the process of conducting coastal and floodplain risk management studies. For floodplains this includes flood studies and mapping to understand the potential climate impacts on their future flood risk profile and improvements to stormwater infrastructure. Coastal risk management and adaptation actions focus on protecting assets from current and future coastal recession due to sea level rise with action plans developed with the support of the community. For example, Lake Macquarie Council has been proactive in this space and has leveraged support and funding from DPIE Coast and Estuaries and Floodplain management contestable grants. Furthermore, a coastal erosion hotspots project was undertaken in 2019 to understand coastal recession in Stockton and a similar project is planned for Belmont in 2020. Coastal recession is the loss of land, or long-term removal of sediment and rocks along the coastline due to the action of waves, currents, tides and impacts from storms. Furthermore, landform studies and landform modification projects are being undertaken to protect low-lying areas; however, challenges included lack of funding to undertake detailed risk assessment due to the length of the region's coastline.

There has been research and reporting on the vulnerability to climate change of threatened species and ecological communities in the region.

### Integration of Aboriginal cultural heritage into adaptation planning

The incorporation of Aboriginal traditional knowledge to adapt to a changing climate includes the use of cultural fire management such as firestick farming to build healthy, functional and resilient landscapes and communities. Aboriginal land holdings (namely Land Council assets) will play a significant role, as will Crown lands, regarding carbon sinks, fire management and carbon markets. The increasing local Aboriginal leadership has been successful due to the number of stakeholders involved and the number of Aboriginal community representatives who participated in the events over the years, with the support of local government agencies and local communities.

### Factors that constrain adaptation action in the region

Some local councils in the region are taking a proactive approach to climate adaptation by adopting a climate change policy, undertaking risk assessments, and consulting with local communities. However, resourcing climate action is the biggest challenge when local government has multiple competing priorities and a lack of strong state directions to prioritise climate action at the local level. It is difficult to maintain momentum and focus on the long-term actions when day-to-day priorities take precedence. The Hunter JO identified a number of adaptation actions as environment strategic priorities; however, action is constrained by significant budget challenges. The regional delivery program has relied heavily on availability of grant funding, which has fluctuated over the years, making it challenging to maintain capacity and continuity.

The lack of political agreement and commitment at senior levels is also inhibiting action. Some also noted political interference at the state level as a major constraint. There has also been community resistance to supporting actions that involve significant trade-offs, have high upfront costs or impinge on property rights. For example, the planned retreat model originally chosen for a coastal erosion hotspot worked in practice and had wide community acceptance but faced local resistance. The local resistance resulted from no compensation and hence landowners were losing their primary asset and not having funds available to relocate elsewhere. There is also uncertainty regarding land ownership as the beach in this location is now technically private property due to fixed property boundaries. Local resistance can be overcome through intensive engagement and education with state experts in the room.

### Future actions

A key action is a move towards climate smart cities. Newcastle City Council is embarking on development of a smart city strategy, which will factor in actions and techniques to address adaptation. Other initiatives include urban heat island mapping, which is strongly influencing capital works projects in commercial centres. Furthermore, the Greater Newcastle Metropolitan Plan includes a target for carbon neutral certification by 2050.

## Monitoring and evaluation of adaptation actions

Programs, research and recommendations require continual monitoring, evaluation and adjustment to ensure they meet the needs of the regional communities in a dynamically changing environment. The final survey question asked if monitoring and evaluation (M&E) of adaptation initiatives are undertaken on a regular basis. Only 21% of respondents confirmed that adaption actions are being regularly monitored with a further 26% noting that M&E occurs infrequently. Approximately 28% of respondents indicated that actions are not being monitored and 26% were unsure.

# Appendix A: Expected physical responses to climate change for the Hunter and Central Coast

**Table 7 Expected physical response, trend, projection and implications for climate change in HCC**

| Physical response | Trend | Projection | Implications |
|---|---|---|---|
| Heat | Increase | Heatwaves are projected to occur more often, be more intense and last longer.<br>Across most of New South Wales there will be more days over 40°C.<br>For further information refer to Minimising the impacts of extreme heat: A guide for local government on the AdaptNSW website. | • Human health<br>• Urbanisation<br>• Biodiversity<br>• Fire weather<br>• Agricultural productivity |
| Hillslope erosion | Increase | Areas which already experience high erosion rates are projected to see increases in erosion. For this region, soil erosion is projected to increase by 11.4% in the near future and 20.3% in the far future.<br>For further information refer to Soil Erosion Climate Change Impact Snapshot on the AdaptNSW website. | • Water quality<br>• Agricultural productivity<br>• Biodiversity |
| Soil properties (SOC, pH and sum of bases) | Increase – decrease | Hunter & Central Coast regions are projected to experience increase in the frequency of saline incursions into coastal plain subsoils. There may be significant loss of organic matter in coastal swamps that die because of saline incursions and higher water tables.<br>For further information refer to Soil Properties Climate Change Impact Snapshot on the AdaptNSW website. | • Agricultural productivity (+ and –)<br>• Natural ecosystems |
| Rainfall erosivity | Increase | In the region rainfall erosivity is projected to increase for both the near and far futures. In the far future rainfall erosivity will slightly decrease in summer; however, increases are projected for autumn, winter and spring.<br>For further information refer to Rainfall erosivity in the Soil Erosion Climate Change Impact Snapshot on the AdaptNSW website. | • Water quality<br>• Agricultural productivity<br>• Biodiversity |
| Rainfall extremes | Increase | Rainfall extremes are projected to increase in the near future and far future.<br>For further information visit the Floods and storms page on the Adapt NSW website. | • Flooding<br>• Agricultural productivity<br>• Emergency services<br>• Local government |

| Physical response | Trend | Projection | Implications |
|---|---|---|---|
| Flood | | For further information visit the Floods and storms page on the Adapt NSW website or ask your local council. | • Urban and rural properties<br>• Agricultural productivity<br>• Emergency services<br>• Local government |
| Hydrology (surface flow/ runoff and recharge) | Increase – decrease | The projections of future runoff are spatially variable across the Hunter & Central Coast. In the near future there is a mix of projected increases and decreases in runoff, with summer runoff decreasing in the elevated mountainous tops. In the far future for the whole region, summer, spring and autumn are projected to increase in runoff and winter runoff is projected to be slightly lower.<br>In the near future, recharge during summer is likely to be lower in the region. In autumn and spring months there is a general trend for a small increase in recharge for the near and far futures. Projections are spatially variable in the far future, with some higher and some lower recharge in different parts of the region.<br>For further information refer to Hydrology Climate Change Impact Snapshot on the AdaptNSW website. | • Councils' stormwater infrastructure<br>• Town water supplies<br>• Agricultural productivity |
| Drought | Increase | For this region, time spent in drought is projected, with medium confidence, to increase over the course of the century.<br>For further information see the CSIRO and BoM Technical Report (2015). | • Human health<br>• Town water supplies<br>• Agricultural productivity<br>• Biodiversity |
| East coast lows (ECLs) | Seasonality changes/ increasing intensity | Climate modelling projects a decrease in the number of small to moderate ECLs in the cool season with little change in these storms during the warm season. However extreme ECLs in the warmer months may increase in number but extreme ECLs in cool seasons may not change.<br>For further information visit the East Coast Lows page on the Adapt NSW website. | • Emergency services<br>• Water security<br>• Local government |
| Fire weather | Increase | The Hunter & Central Coast is expected to experience an increase in severe and average Forest Fire Danger Index values in the near future and the far future.<br>For further information visit the Bushfires page on the Adapt NSW website. | • Fire regimes<br>• Emergency services<br>• Hazard reduction |

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