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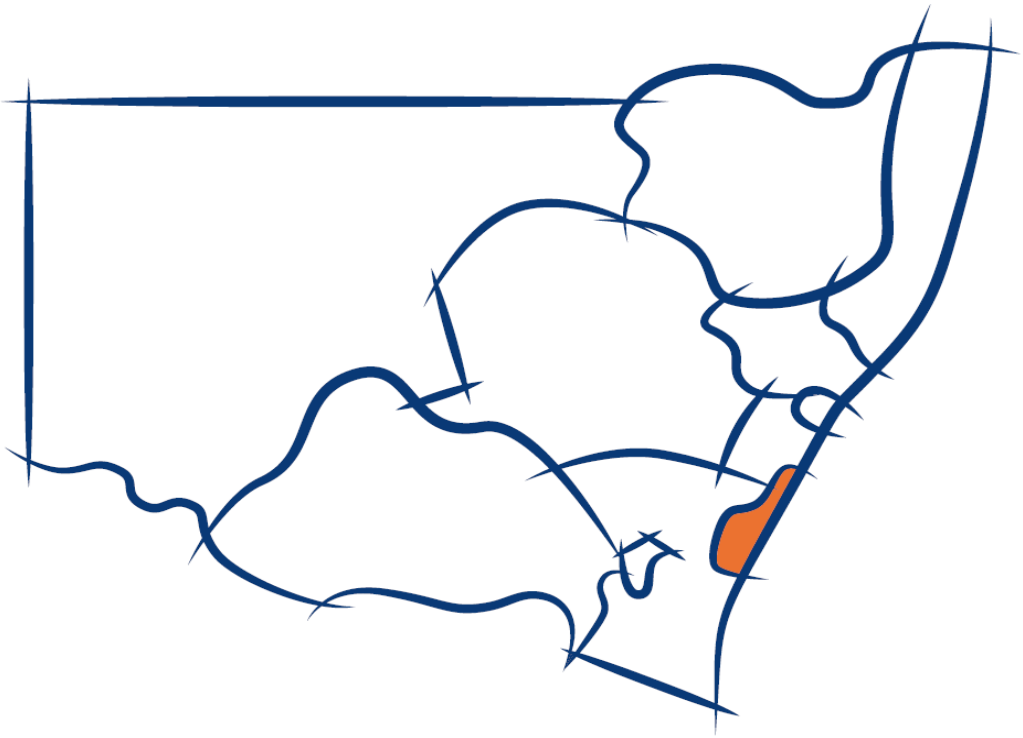
Shoalhaven and Illawarra Enabling Regional Adaptation



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Report overview

This report contains a collective understanding of the likely vulnerability to climate change of the Shoalhaven Illawarra region 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 seven systems identified in this report.

To address the region's vulnerability to climate change, regional administrators, businesses and communities can begin by pursuing the following opportunities to:

- **Understand regional vulnerability** – Table 3 in Chapter 3 of the report outlines the exposure and sensitivity of the region to climate and other regional drivers of change. It provides a lens through which the specific attributes of the region can be viewed as a means of addressing threats (adaptive capacity). It can also help to identify what attributes are absent or negative, highlighting which adaptive responses will be constrained, leaving the region vulnerable.
- **Understand the flow-on impacts of climate shocks and stressors across the community** – The impact chains in Figure 12 in Chapter 4 show how climate variability and extreme events will affect food and agriculture in the region and illustrate the complexity of consequences from the four main climate drivers that were identified.
- **Assess the progress of climate change adaptation in the region** – The survey results in Chapter 6 outline the key climate 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 seven 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 2 and Appendix A summarise the changes to climate variables that can be expected in the future and also 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 Shoalhaven Illawarra region and are a valuable resource to help build momentum.
- **High priority pilot projects** –Table 5 in Chapter 5 lists seven 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 Shoalhaven Illawarra region. This report is designed to facilitate that action and enable transition for the region.

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, 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 Office of Environment and Heritage (OEH) has developed and delivered processes that enable regional scale consideration of climate projections and investigation of related impacts.

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

The SIERA 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 SIERA project has sought to:

- provide a credible evidence base for Government adaptation planning by developing a regional understanding of the impacts of projected climate change and vulnerability to the expected impacts for the Shoalhaven Illawarra region
- 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 Shoalhaven Illawarra region, with a view to capturing opportunities for regional climate change adaptation action.

This report presents the output from a series of workshops held in the Shoalhaven Illawarra region during 2017. Workshop participants developed transition pathways for key regional systems, to build resilience to climate extremes and minimise impacts on their local communities.

The report also outlines the workshop process, and potential projects to activate the transition pathways and strengthen key regional systems in the Shoalhaven Illawarra, 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 needs to change in the Shoalhaven Illawarra region?

2.1 Vulnerable regional systems

The state's regions are subject to a broad range of drivers of change (economic, technological, social, and environmental). The Shoalhaven Illawarra region comprises 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), 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 Shoalhaven Illawarra region, seven regional systems were identified as particularly vulnerable and in need of change to ensure effective ongoing government service planning and delivery:

- Satellite settlements
- Transport
- Emergency management
- Energy
- Food
- Industrial transformation
- Water.

2.2 Transition models for key regional systems

For each system a change model has been developed that describes:

1. the regional system or sets the 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.

Satellite settlements

The region supports a range of human settlements from regional cities such as Wollongong and Nowra to large commercial hubs such as Kiama, and smaller more dispersed and isolated settlements (or satellites) such as Jamberoo, Hyams Beach and Calderwood. Many of these smaller villages along the coast have limited road access; for example, Sussex Inlet, which can affect safety and evacuations during an emergency event. Satellite settlements were defined as small settlements where residents source services outside of the locality (Figure 1).

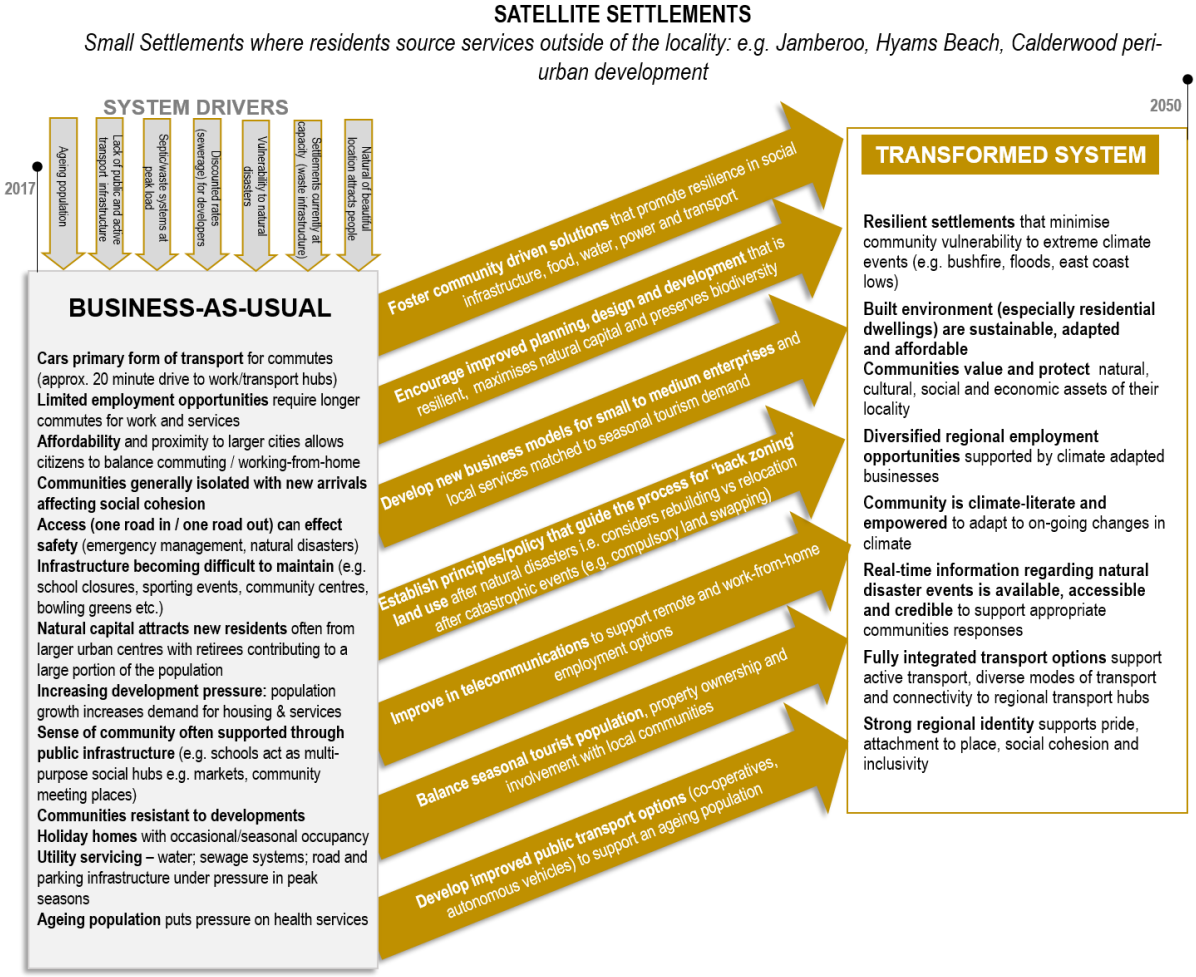

Figure 1 Change model for satellite settlements

Delivery of services to satellite settlements is influenced by their amenity value (beaches, coastal hinterland) which attracts tourists and new residents; however, many settlements are considered to be at capacity with sewerage/waste infrastructure at peak load, a lack of transport infrastructure and vulnerability to natural disasters (especially bushfires and storms). This exposes their communities to high levels of climate risk, particularly where retirees add to the already ageing population.

The region's satellite settlements were characterised as having limited employment opportunities with residents commuting for work and services, using private cars as the primary form of transport. The region's natural capital and housing affordability attract new residents, often from larger urban centres, with retirees making up a large portion of the population, and providing a large volunteer workforce. Public infrastructure, such as schools, act as multi-purpose social hubs; however, infrastructure supporting local health, water and sewage services is increasingly difficult to maintain and under pressure from population growth and demographic change. While communities are becoming resistant to further development, many settlements support holiday rental properties that are seasonally occupied, placing utilities under further pressure in peak seasons.

Pathways that could facilitate change in satellite settlements include engaging communities to develop solutions for challenges in social infrastructure, food, water, power and transport provision that improve local resilience, support an ageing population and balance the needs of tourism seasonality with those of local communities. These solutions will likely require new business models for local small–medium enterprises to support regional service delivery. Improvements to the planning, design and development of infrastructure are critical to

conserve the region's unique natural environment. In particular, the region's telecommunications require upgrading to support remote and work-from-home employment options. Protection of the community from the impacts of extreme climate events and sea level rise may require 'back-zoning' following natural disasters.

Transformed satellite settlements were envisioned as inclusive, cohesive and climate-literate communities supported by a sustainable built environment, integrated transport options and diversified employment in settlements that minimise vulnerability to extreme climate events. Communities are highly responsive and resilient to natural disasters supported by available, credible and accessible real time emergency service information. Communities value and actively protect their environmental, social and economic assets as fundamental to a strong regional identity.

Transport

The transport system for the region was defined as the management of journeys for business, freight and commuters, and of the region's road networks (Figure 2). The concept of 'journey management' is based on efficiency and safety rather than service frequency.

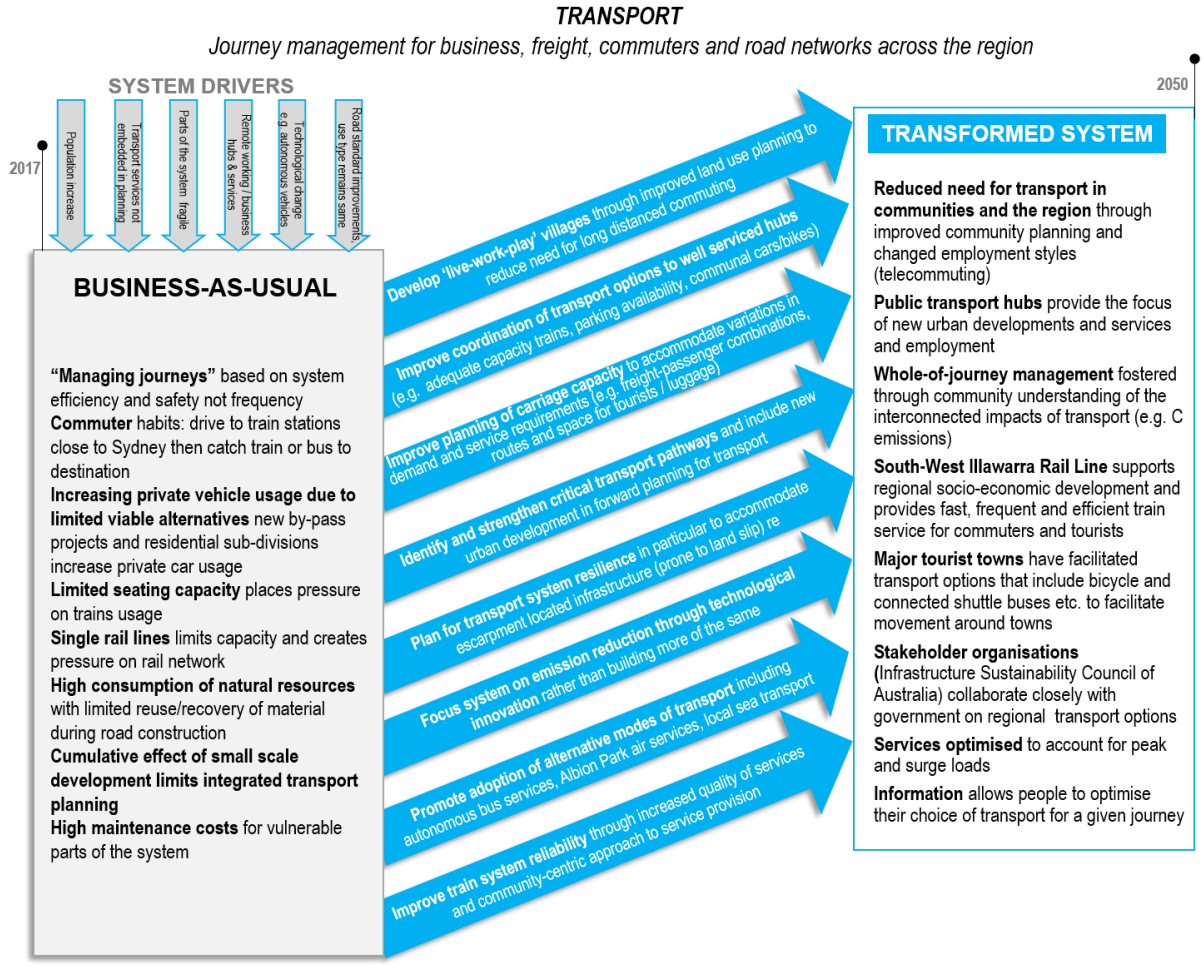

Figure 2 Change model for transport

The transport system is under pressure from a growing regional population. The system is fragile owing to the region's geographical features (coastal strip with a narrow hinterland and a steep escarpment), leading to a focus on north–south connectivity. The cumulative effect of small-scale development limits the integration of transport infrastructure, but this infrastructure is increasingly required to support remote employment and access to commuter and service hubs. Technological change, in particular electric and autonomous vehicles, is anticipated to become an increasingly strong driver of transport system change.

The current system is built around a combination of road transport (primarily private cars) to commuter hubs then heavy rail to final destinations, most often in the Sydney metropolitan area. There is growing pressure for more passenger services due to limited seating capacity (too few carriages per set) and large sections of single line south of Unanderra. While there is sufficient rail capacity in the short to medium term, freight rail access to Port Kembla is expected to grow, placing further pressure on the line. A lack of integration of transport in planning for new residential subdivisions, limited investment in public transport and the high cost of maintaining rail services that are already vulnerable to extreme weather events, entrenches car dependence in the region. Other potential, alternative transport links, such as the port and airport, are currently considered underutilised.

Transition pathways for regional transport are focused on expanding the range of transport options to reduce dependence on private vehicles. This includes the development of 'live–work–play' villages through improved land-use planning for new and existing developments, and improving train service reliability and linkages to critical transport hubs. Access to and from transport hubs requires improved availability of parking, communal cars/bikes, on demand and autonomous bus services and ride sharing, combined with adequate capacity trains that can accommodate variations in demand and service requirements (e.g. freight, passengers, routes and space for tourists/luggage). Adoption of technological innovation is needed to reduce the transport system's carbon emissions.

A transformed regional transport system encompasses a reduced need to travel for work and a reduced commuting distance, rail-centric public transport hubs serviced by a rail network that is fast, frequent, and efficient and provides easy access to alternative transport modes and intermodal facilities. The system is safe and provides regional connectivity at a range of scales that supports socioeconomic development, in particular for major tourist destinations. The system has evolved with improvements in community planning and new styles of employment. Transport users appreciate the contribution of journey management to reduced carbon emissions.

Emergency management

Emergency management was defined as a Prevent–Prepare–Respond–Recover approach to all hazards (Figure 3). Regional emergency management is influenced by heightened community risk, increasing commitment, resources and planning required for hazard reduction and mitigation (in particular bushfires), and an increasing need for better community awareness and acceptance of personal responsibility for risk under the impact of a changing climate. The system is constrained by emergency management legislative requirements and inconsistent terminology across the sector.

Currently, emergency management is defined under the *State Emergency and Rescue Management Act 1989*; however, varying interpretations of this legislation causes conflict in its implementation. The region currently has strong volunteer networks and is well coordinated across the services during disaster events; however, the demands placed on emergency services and an ageing population can lead to volunteer burnout and a declining volunteer base. Limited perception of risk in the community often leads to unsafe behaviour.

The generation of waste following floods and storms causes concerns for public health where compliance with mandated clean-up intervals following an event raises disposal costs for local government.

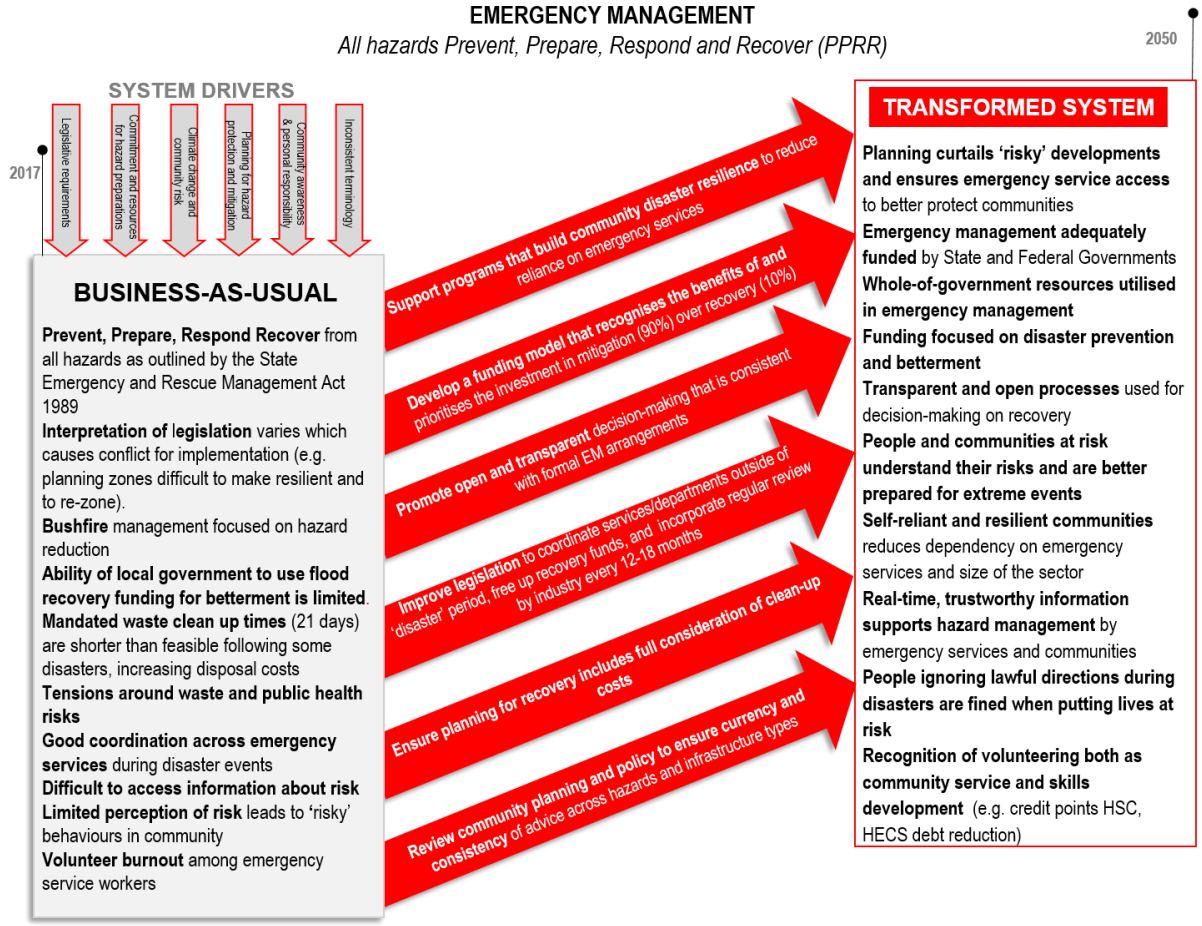

Figure 3 Change model for emergency management

Transition pathways in emergency management focused mainly on changing community behaviour and government policy. For the community, change requires programs that build community disaster resilience and reduce reliance on emergency services. For policy, a change in focus from recovery to mitigation matched by re-prioritisation of funding (that includes clean-up costs), better whole-of-government coordination outside of disaster response, and greater consistency in planning across hazards and infrastructure types, were considered essential. In addition, system transition would be aided by improving the transparency of decision-making during emergencies and the subsequent recovery period.

A transformed emergency management system protects communities through planning processes that curtail development in 'risky' areas and ensure emergency service access during extreme events. Communities are prepared for and self-reliant during extreme events supported by real time, trustworthy information to enable better decision-making. The critical role of volunteers in emergency management is recognised and formally incentivised through the education sector (such as credit points in the HSC or HECS debt reduction). In addition, emergency management is adequately funded by state and federal governments and that funding is focused toward disaster prevention and infrastructure betterment following disaster events.

Energy

The Shoalhaven–Illawarra energy system was defined as encompassing generation, distribution, pricing, infrastructure (poles and wires) and consumption (behavioural demand management) of energy (Figure 4).

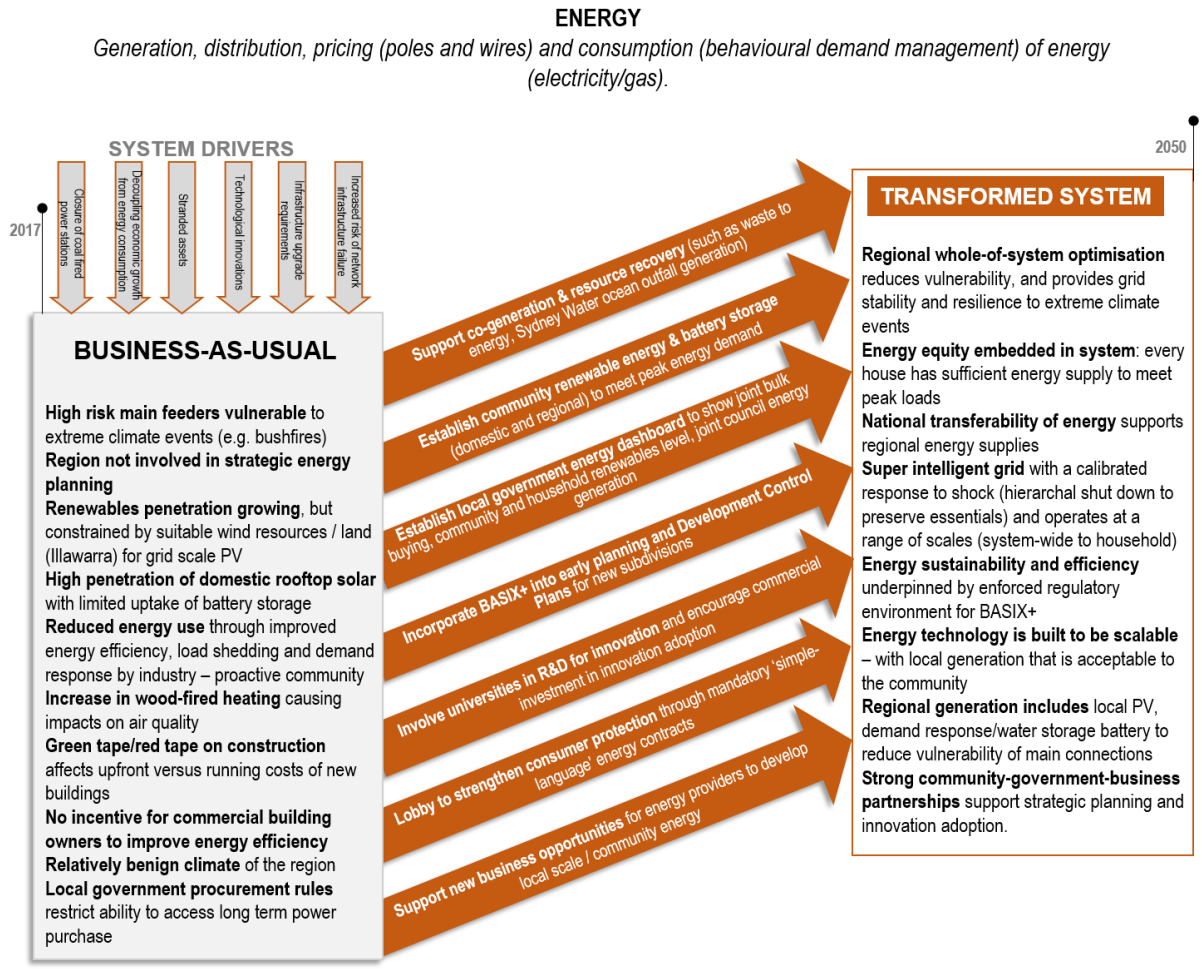

Figure 4 Change model for energy

The system is viewed as already in transition, with change being driven by the closure of coal fired power stations, the risk of asset stranding and network infrastructure failure, and the need for infrastructure upgrades. The pace of technological innovation is rapid and its adoption is assisting the decoupling of economic growth from energy consumption.

The region's energy system is characterised as a centralised system that is vulnerable to network infrastructure failure from extreme climate events; however, the penetration of renewable energy is growing due to community renewable initiatives such as Repower Shoalhaven. However, further penetration of domestic rooftop solar is limited by a lack of storage, and other forms of renewable energy are sourced from outside the region due to insufficient wind resources. The relatively benign climate of the region combined with a proactive community is seeing reductions in energy use through technological innovations that improve energy efficiency and facilitate load shedding as a peak demand response. Local and state government policies on procurement and building standards restrict change.

Transition pathways call for the establishment of a policy environment to support community-based ownership of energy generation and storage combined with legislative reform that incentivises energy efficiency. These initiatives would be strengthened by new business

opportunities for energy providers to develop more local- and community-scale energy projects to meet peak energy demand. Information provision in the form of a local government 'energy dashboard' to show joint bulk buying, community and household renewables levels, and joint council energy generation, would help to promote system change. Technological innovation would be enhanced by greater collaboration with universities in energy research and development, and by encouraging commercial investment in innovation adoption such as resource recovery and waste to energy. Energy efficiency could be boosted through the incorporation of BASIX+ into early planning and Development Control Plans for new subdivisions. Consumer protection and renewable adoption by households would be strengthened through mandatory 'simple-language' energy contracts.

Transformation in the region's energy system envisages energy supplied via a super intelligent grid that is optimised for reliability, sustainability and resilience to extreme climate events, and that embodies ethical production and equity of access for communities. The system is supported by strong community–government–business partnerships for strategic planning that foster innovation, and the adoption of localised clean energy generation and energy efficiency that are scalable.

Food

The Shoalhaven–Illawarra food system encompasses the total value chain including: food production, consumption, distribution, and waste and resource recovery for production (Figure 5). The production of food is influenced by the region's changing rainfall and temperature patterns, increasing urbanisation, which is fragmenting agricultural land, and risks to biosecurity. Cheap imports are undermining the viability of local production and changes in consumer food habits, dietary choices and views on waste are changing food marketing and distribution.

Land-use planning decisions, often under the influence of property developers, are failing to protect prime agricultural land over alternative uses resulting in productive lands, biodiversity and essential ecosystem services being lost to increasing urbanisation. These development patterns are leading to conflict between residents adjacent to agricultural land and farmers, and are also placing pressure on water resources for agriculture. Consequently, food production and processing is being relocated to areas that are more vulnerable to extreme climate events, increasing the vulnerability of local food producers. The purchasing power of supermarket chains is placing pressure on farmer livelihoods, food affordability and waste volumes. Consumers have an expectation of year-round availability of seasonal produce, which increases resource use and food miles. Growth in demand for 'clean, green' produce is driving expansion of food exports, particularly milk/milk-derived products to Asian markets.

Food system transition focuses on implementing land-use planning mechanisms to protect food security, ecosystem services, productive agricultural land and livelihoods, by better matching changing production practices with land capability and climate adapted food production. Local production and food businesses would be supported through grants for education, pilot programs, partnerships and promotion of the Shoalhaven Illawarra regional brand and food tourism. The local food industry should forge stronger collaborations with the research and tertiary education institutions to foster technological innovation and training. The sustainability of the food system would be enhanced by policies and incentives to facilitate resource efficiency in water, energy, nutrients and waste (e.g. recycled organics). The case for retention of a viable regional food sector would be bolstered by better articulation of the links between healthy food and health system cost savings.

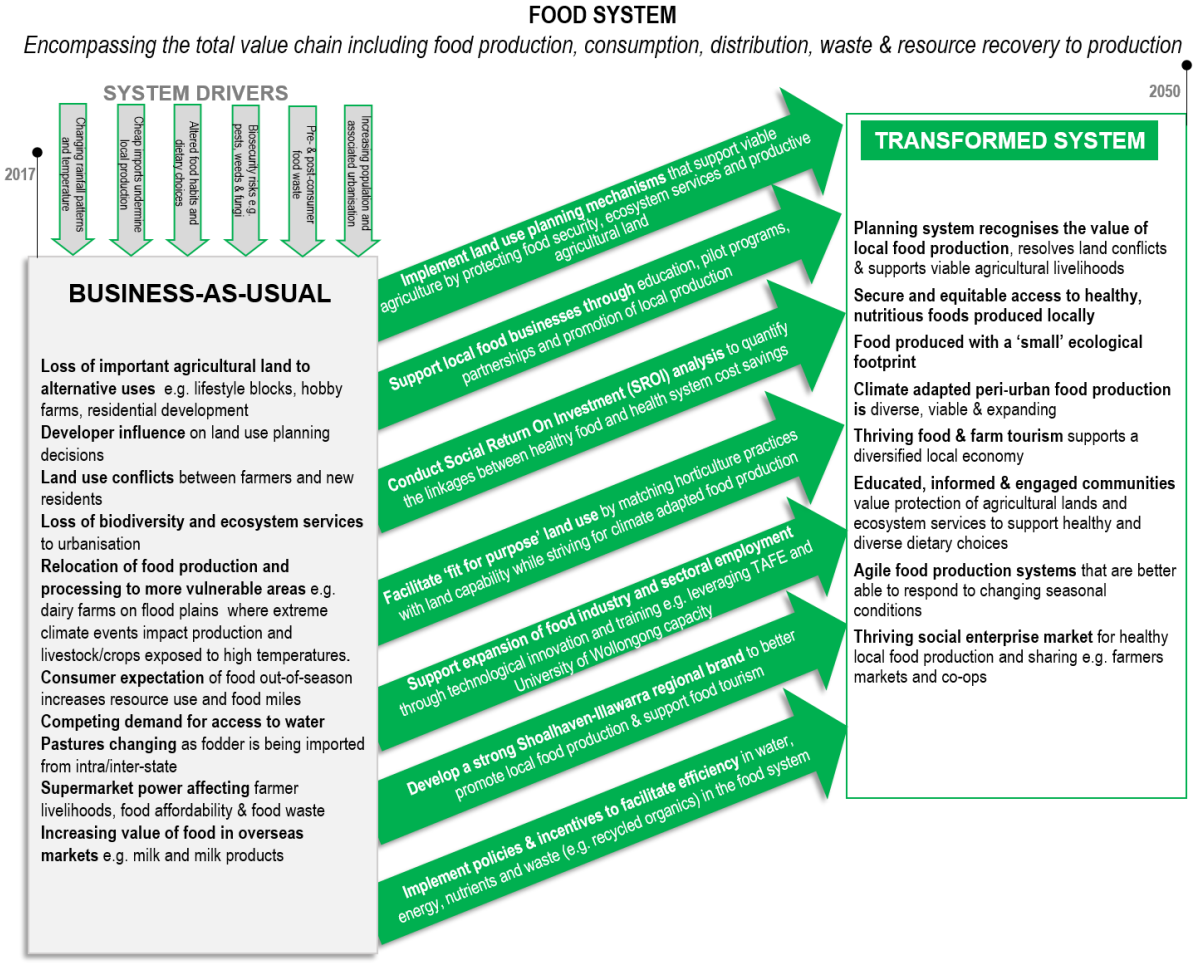

Figure 5 Change model for food

A transformed food system emphasises secure and equitable access to healthy, nutritious foods that are produced locally with a 'small' ecological footprint. Peri-urban food production is agile, expanding and climate adapted. Communities value the protection of agricultural lands and ecosystem services that support healthy and diverse dietary choices. Local food production and sharing (e.g. farmers markets and co-ops) thrive through an active social enterprise market that is supported by government. Expanding food- and farm-tourism enterprises contribute to a diversified local economy and create varied employment opportunities, especially for the region's youth. The system is underpinned by an enabling policy environment and planning system that recognises the value of local food production, resolves land conflicts and supports viable agricultural livelihoods.

Industrial transformation

The industrial transformation of the Shoalhaven Illawarra region is defined as long-term viable manufacturing infrastructure and port facilities (Figure 6). This is underpinned by ongoing change in the Australian coal and steel industries, supported in the Illawarra by the long-term viability of the region's manufacturing infrastructure and port facilities. Change in these industries is being driven by rising energy costs, international competition and exchange rates, pressure to reduce environmental externalities (CO_2 emissions and impacts on water catchments), and the need for investment in infrastructure renewal and replacement.

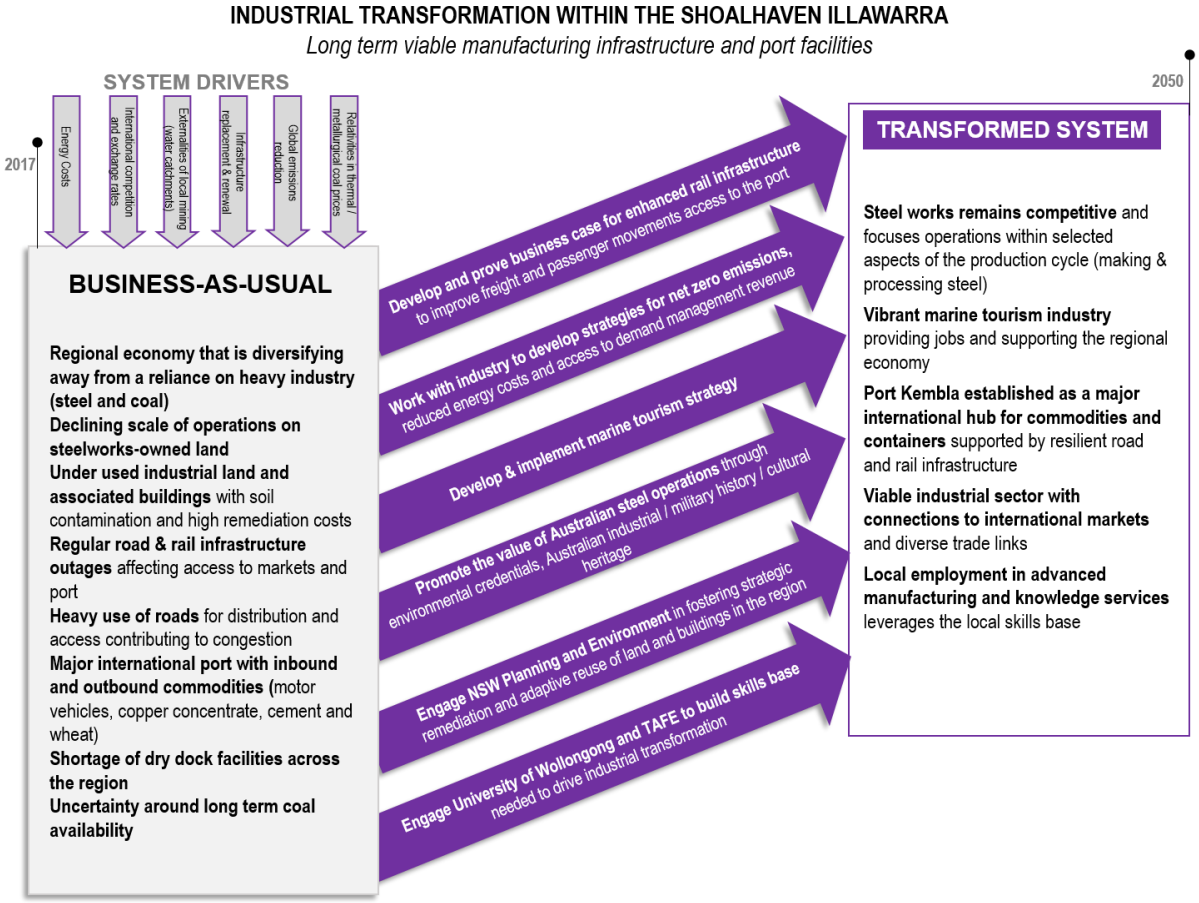

Figure 6 Change model for industrial transformation of the Shoalhaven Illawarra region

Currently the region is adapting to a decline in the importance of the steel and coal industries in the regional economy and uncertainty over the viability of coal going forward. The scale of steelworks operations is declining, resulting in unused land and buildings that have limited opportunities to be repurposed due to site contamination and high remediation costs. Infrastructure outages and congestion on roads and rail lines affect access to the port and its operations. The region has a shortage of dry dock facilities. Main imports through the port include motor vehicles, copper and cement with wheat the major export commodity.

Transition pathways for industrial transformation include more effective promotion of the value of Australian steel operations through enhanced environmental credentials such as use of renewable carbon sources for steel making, and strategies for net zero emissions from steel production through carbon offsets, capture and reuse. Engagement with strategic stakeholders, including the University of Wollongong and TAFE, would build the regional skills base needed to drive industrial transformation. In addition, strategic remediation and adaptive reuse of industrial land and buildings should be a priority in collaboration with NSW

Planning and Environment. A proven business case for enhanced rail infrastructure would improve freight and passenger movements and access to the port. Implementation of the marine tourism strategy would enhance port infrastructure (dry dock/slipway and terminals) and facilitate establishment of a vibrant marine tourism sector that expands port and harbour utilisation.

A transformed industrial system sees a competitive steel industry that concentrates on selected aspects of the production cycle, underpinned by advanced manufacturing and knowledge services in the region, which employs a local skilled workforce. Port Kembla is established as the centre of a vibrant marine tourism sector and is a major international hub for commodities and containers supported by resilient road and rail infrastructure.

Water

The Shoalhaven–Illawarra water system includes all aspects of water supply including potable, waste and storm water, and the region's natural systems and catchments (Figure 7). The system is under pressure from a changing climate, population growth, new residential developments and variations in seasonal demand. Declining health of natural catchments, biodiversity loss and the need to protect public health are also drivers of system change.

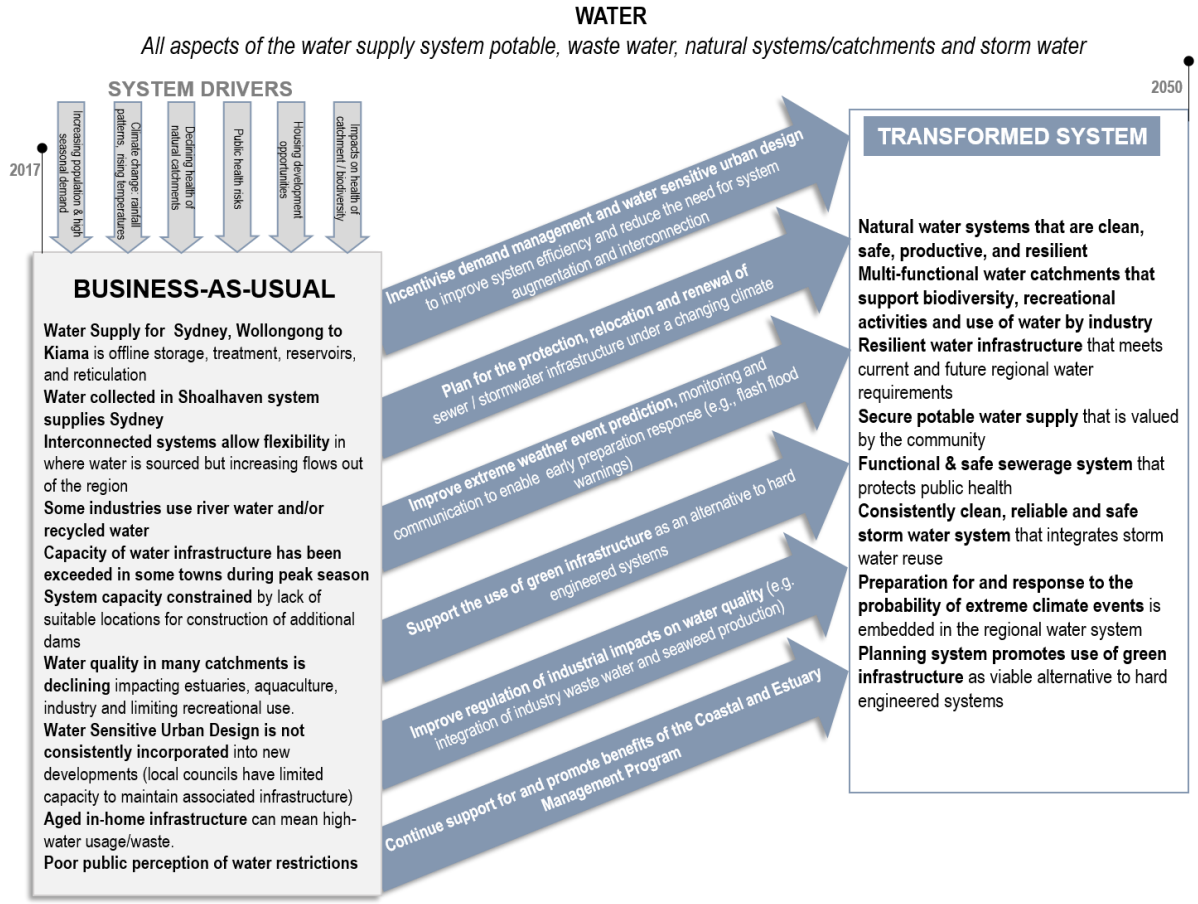

Figure 7 Change model for water

The regional water system consists of offline storage, treatment, reservoirs, and reticulation, interconnected to allow for flexibility of sourcing. The Shoalhaven is an important part of the water supply for Sydney. The capacity of sewerage infrastructure has been exceeded in some towns during peak tourist season. Expansion of potable water storage capacity is constrained by a lack of suitable locations for construction of new dams. Local government capacity for maintenance constrains incorporation of Water Sensitive Urban Design (WSUD) into new or existing developments. Declining water quality and biodiversity of natural catchments causes downstream impacts for estuaries, aquaculture, recreation and some industrial water users. Attempts to manage demand through water restrictions are unpopular with the public.

Transition pathways for the water system include implementation of economic instruments to encourage demand management and water efficiency, and to reduce the need for system augmentation. Promotion and use of eco-sensitive water infrastructure through the planning system coupled with climate resilient WSUD would provide a viable alternative to hard engineered systems. Greater enforcement of regulation of industrial impacts on water quality coupled to continued support for the Coastal and Estuary Management Program would ensure high water quality in the landscape and support biodiversity, recreational users and businesses. Monitoring and early warning of extreme climate events (e.g. early flash flood warnings) would enable appropriate management responses to ensure system resilience under a changing climate, and allow improved planning for the protection, relocation and renewal of sewer and stormwater infrastructure.

A transformed water system envisions multifunctional water catchments that are safe, secure, productive and resilient, and that support potable consumption, biodiversity, recreational activities and use of water by industry. Water is appropriately valued to drive efficiency and highest value use. Resilient water infrastructure meets current and future regional water requirements. A clean, reliable and safe stormwater system integrates water reuse by industry to reduce pressure on potable supplies and the environment. Adaptive responses to extreme climate events are embedded in the regional water system.

3. Why does Shoalhaven/Illawarra need to change?

3.1 Social and economic

People

The region's total population in 2016 was 393,201 (ABS 2016a) and grew by 7% between 2011 and 2016. It is projected to grow 17% by 2036 (Department of Planning and Environment 2016). The rate of growth varies across the age profiles with the number of young people (less than 15 years old) growing by 9%, people of working age (15–64), growing by 8% and people 65 or older growing by 56%. This will see the proportion of people aged 65 years or older grow from 20% to 26% of the total population by 2036 (Department of Planning and Environment 2016).

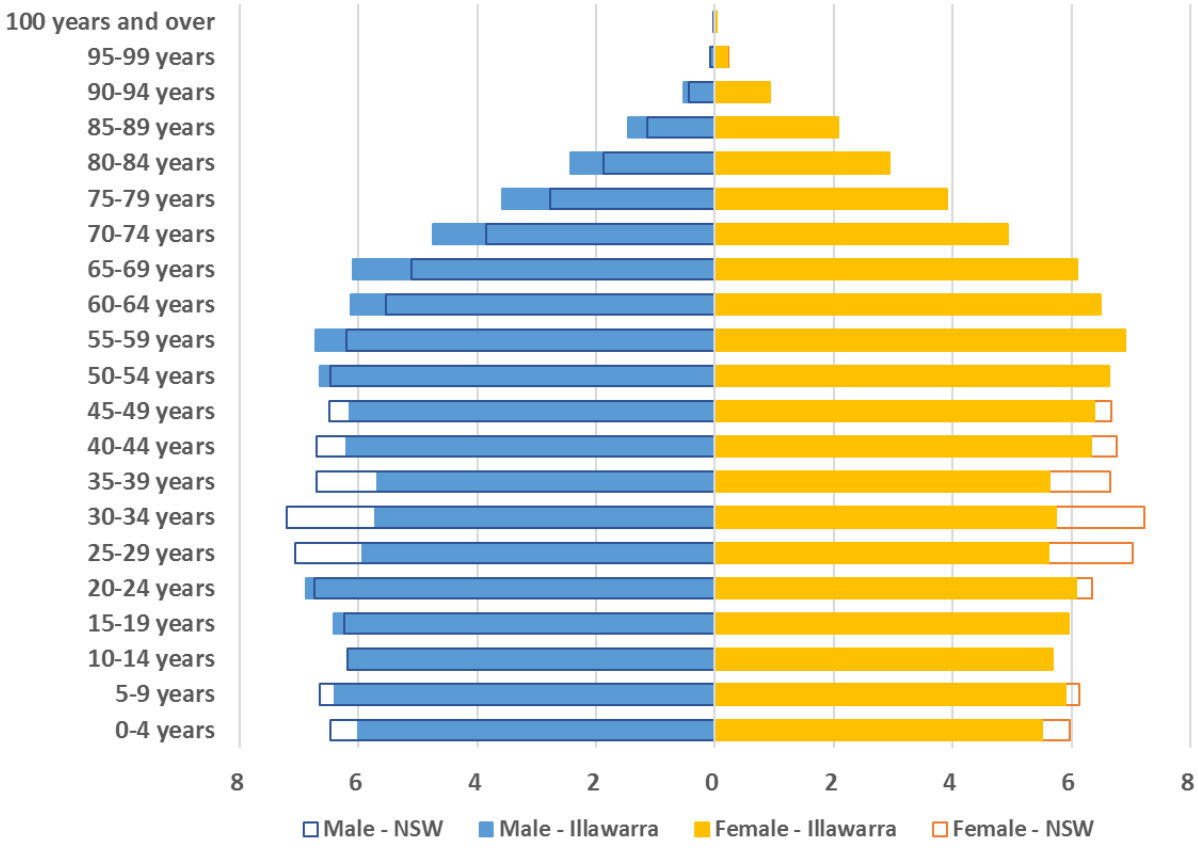

Figure 8 **Age profile of the NSW and Illawarra populations (ABS 2016a)**

The labour force participation rate for the region in 2016 was 54.4% (NSW 59.2%) and the working age population (i.e. those aged 15–64 years) of the region comprised 62% (NSW 65%) of the total population, although it is acknowledged that many workers continue past their 65th birthday (Department of Jobs and Small Business 2017).

Stakeholders from the region expressed the greater importance of social relationships and bonds, family links, groups, support networks and influences over political decisions. Some key points when assessing social capital for the region include:

- 93% of the region has a well-developed proficiency in English speaking compared to 2% not well or not at all, among non-English speaking background people (ABS 2016a)
- 65% of the region is families, with the highest proportion of families classed as coupled families with no children (26%), followed by coupled families with children under 15 years (17%) (ABS 2016a)
- 18.6% of the population in 2016 was involved in volunteer activity (ABS 2016a)
- being able to contact family and friends not living in the same household can enhance a person's feelings of connectedness to the wider community and can build social resilience. Based on the 2014 General social survey (ABS 2015), most households (75%) have face-to-face contact with family or friends living outside of the household at least once a week or every day.

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 are:

- compared to the whole of NSW (62.4%), people living in the region had slightly lower educational attainment and were less likely to have completed Year 12 (57%) and more likely to have left school before or directly after Year 10 (29%); people were less likely to have a post-secondary schooling qualification above certificate level (ABS 2016b)
- 82.5% of people living in the region spoke English at home (ABS 2016b)
- compared to the whole of NSW, the workforce had an under-representation of professionals and managers and an over-representation of community and personal service, and technical and trades (ABS 2016b)
- the incidence of obesity is higher than for NSW as a whole (NSW Health 2018)
- one local government area was ranked in the top 50 for socioeconomic disadvantage based on the ABS Socio-Economic Indexes for Areas (SEIFA; ABS 2016c).

Economy

The Illawarra–Shoalhaven is the third-largest regional economy in New South Wales with a Gross Regional Product (GRP) of $22.8 billion and 143,610 local jobs. The region's industry is a mix of traditional and emerging industries with construction and manufacturing the largest contributor to regional economic output, while healthcare and social assistance and retail trade are the region's largest employers (Table 1).

Table 1 Top five industries by contribution to economic output and top five employers by industry

Industry contribution to output	Employers by industry (2016)
1. Construction (16.1%)	1. Health care and social assistance (14.7%)
2. Manufacturing (14.2%)	2. Retail trade (10.4%)
3. Rental, hiring and real estate services (11.5%)	3. Education and training (10.2%)
4. Health care and social assistance (6.9%)	4. Construction (9.8%)
5. Financial services (6.3%)	5. Accommodation and food services (7.9%)

Source: REMPLAN data incorporating Australian Bureau of Statistics' (ABS) 2016

The region's visitor economy contributes around $1.5 billion (Tourism Research Australia 2017), supporting a range of industries including the accommodation and food services and allied retail trade sectors. Health care and social assistance is one of the largest sectors, with increased demand from a growing and ageing population likely to drive continued growth in this sector.

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). Based on 2016 Census data key attributes of physical capital for the region are:

- Separate occupied houses (77%) are the dominant dwelling type, followed by semidetached (11.2%) dwellings and flats or units (10.5%). A relatively large proportion of dwellings are unoccupied (13.4%), with the majority of these located in the Shoalhaven LGA (ABS 2016b).
- The internet is accessed from most dwellings in the region (80%), compared to no internet access (17.4%) (ABS 2016b).
- There are a total of 37 private schools, 118 public schools, 16 hospitals and 17 libraries (Education NSW 2016; NSW Health 2016; Private Schools Directory 2016).

3.2 Biophysical

The Shoalhaven Illawarra region on the NSW coast south of Sydney covers over 7000 square kilometres and has about 200 kilometres of coastline. It stretches from Garie Beach in the Royal National Park in the north to Durras Lake in the south. The coastline is characterised by long sandy beaches, rivers, large protected estuaries and small coastal embayments protected by large sandstone headlands – much of which is Hawkesbury sandstone.

The coastal plain is clearly delineated from the rolling hills of the Southern Tablelands in the west, by the sharp rise of the Illawarra Escarpment, which stretches 120 kilometres from the sea cliffs of the Royal National Park in the north to the junction of the Shoalhaven and Kangaroo rivers in the south. The escarpment rises from 300 metres above sea level in the north to 700 metres in the south around Albion Park.

In the north of the region, the natural ecosystems tend to be concentrated along the escarpment and sandstone plateau. Rainforests and tall eucalypt forest occur along the Illawarra Escarpment and in sheltered gorges. The sandstone plateau is largely covered in dry sclerophyll forest, interspersed with smaller patches of heath and upland swamps. Major reserves in these parts include Budderoo National Park, Barren Grounds Nature Reserve and the Illawarra Escarpment State Conservation Area.

In the southern half of the region, the escarpment and plateau forests and heaths are complemented by the diverse tall open forests of the coastal plain. Major reserves in this part include Morton, Budawang, Murramarang, Conjola and Jervis Bay national parks. The Shoalhaven River is the largest river in the region. Jervis Bay is well known for its spectacular scenery and rich coastal waters. There are numerous smaller estuaries and coastal lakes, varying in size from the large Lake Illawarra to the small Meroo Lake, and numerous creeks, many of which rise on the steep escarpment. Saline wetlands are found in all of the major estuaries, particularly the Crookhaven River. Freshwater wetlands occur around the margins of coastal lakes, on coastal sand plains and on the floodplains of the major rivers such as the Shoalhaven.

3.3 Expected regional climate change

Information on projected climate for the region can be found in the Illawarra Climate Change Snapshot report on the AdaptNSW website (OEH 2014). The snapshot provides near future (2030) and far future (2070) scenarios. The climate projections for 2020–2039 are described in the snapshots as near future, or as 2030, the latter representing the average for the 20-year period. The climate projections for 2060–2079 are described in the snapshots as far future, or as 2070, the latter representing the average of the 20-year period.

In summary:

- The region is expected to experience an increase in all temperature variables (average, maximum and minimum), more hot days, and fewer cold nights for the near and far futures. Heatwaves are also projected to increase, be hotter and last longer.
- Seasonality of rainfall will change. Autumn rainfall will increase in the near future and the far future. The majority of models agree that winter rainfall will decrease in the near future and far future. Spring rainfall is projected to decrease in the near future; however, summer rainfall is projected to increase in the near future.
- Fire risk will increase, with projected increases in average and severe Forest Fire Danger Index values in the near future and the far future.

Table 2 Climate change projections for the Shoalhaven Illawarra region

Climate variables (average across the region)	Trend	Projections	
		Near future (2030)	Far future (2070)
Atmospheric CO_2	Increase	A2 IPCC emissions scenario	
Max temperature	Increase	0.7°C	1.9°C
Min temperature	Increase	0.6°C	2.0°C
Hot days	Increase	0 to +3 days	+2 to 7 days
Cold nights	Decrease	–3 to –6 days	–10 to –13 days
Heatwaves	Increase (frequency) Increase (intensity) Increase (duration)	1 to 1.5 events 1.5 to 7°C 1.5 to 2.5 days	2.5 to 3.5 events 1.5 to 7°C 1.5 to 2.5 days
Rainfall	Wetter and drier	–13% to +12%	–9% to +30%
Change in rainfall by season	Wetter and drier	Summer (–20 to +21%) Autumn (–24 to +33%) Winter (–21 to +14% Spring (–25% to +13%)	Summer (–12% to +40%) Autumn (–13% to +50%) Winter (–39% to +35%) Spring (–18% to +19%)

*Negative values represent drying and positive values represent wetting under projections for annual rainfall and seasonality rainfall. Source: Office of Environment and Heritage (2014)

Appendix A provides more detailed information about the physical responses to climate change expected for the Shoalhaven Illawarra region in the near future and far future, and their implications for the region.

3.4 Vulnerability affecting government services

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

1. **Healthy population** – population growth and demographic change (ageing) will increase demands on the health system under a changing climate.
2. **Employment diversity** – a heavy reliance on nature-based tourism and a declining industrial sector in the Illawarra drive the need for diversified employment.
3. **Connected transport system** – regional settlement patterns, predominantly north–south connectivity, commuting to out-of-region jobs and heavy private vehicle dependence require improved public transport connectivity.
4. **Strong volunteer base/mentoring** – currently strong, volunteerism is influenced by regional demographic change and the potential for volunteer fatigue under heightened impacts of climate change.
5. **Regional knowledge base** – strengths in local environmental management and industry need ongoing support to maintain regional capacity for climate adaptation and innovation.
6. **Community disaster preparedness** – the region's geography leads to heightened community exposure to climate impacts and a need for community self-reliance to reduce demands on the emergency management sector.
7. **Cultural diversity** – a community strength that requires investment to maintain community cohesion under rapid population change. Community building events support social connectivity and regional identity to foster community self-reliance.
8. **Natural capital** – under climate change will require increasing resources to maintain ecosystem health, preserve its contribution to the regional economy, and conserve unique biodiversity values.

Vulnerability

Regions across New South Wales vary in their vulnerability to climate change. Figure 9 provides a snapshot of vulnerability for the Shoalhaven Illawarra region. The snapshot draws on workshop activities, the adaptation survey, discussions and supporting literature and data to illustrate 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.
- **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, adaptive responses will be constrained.

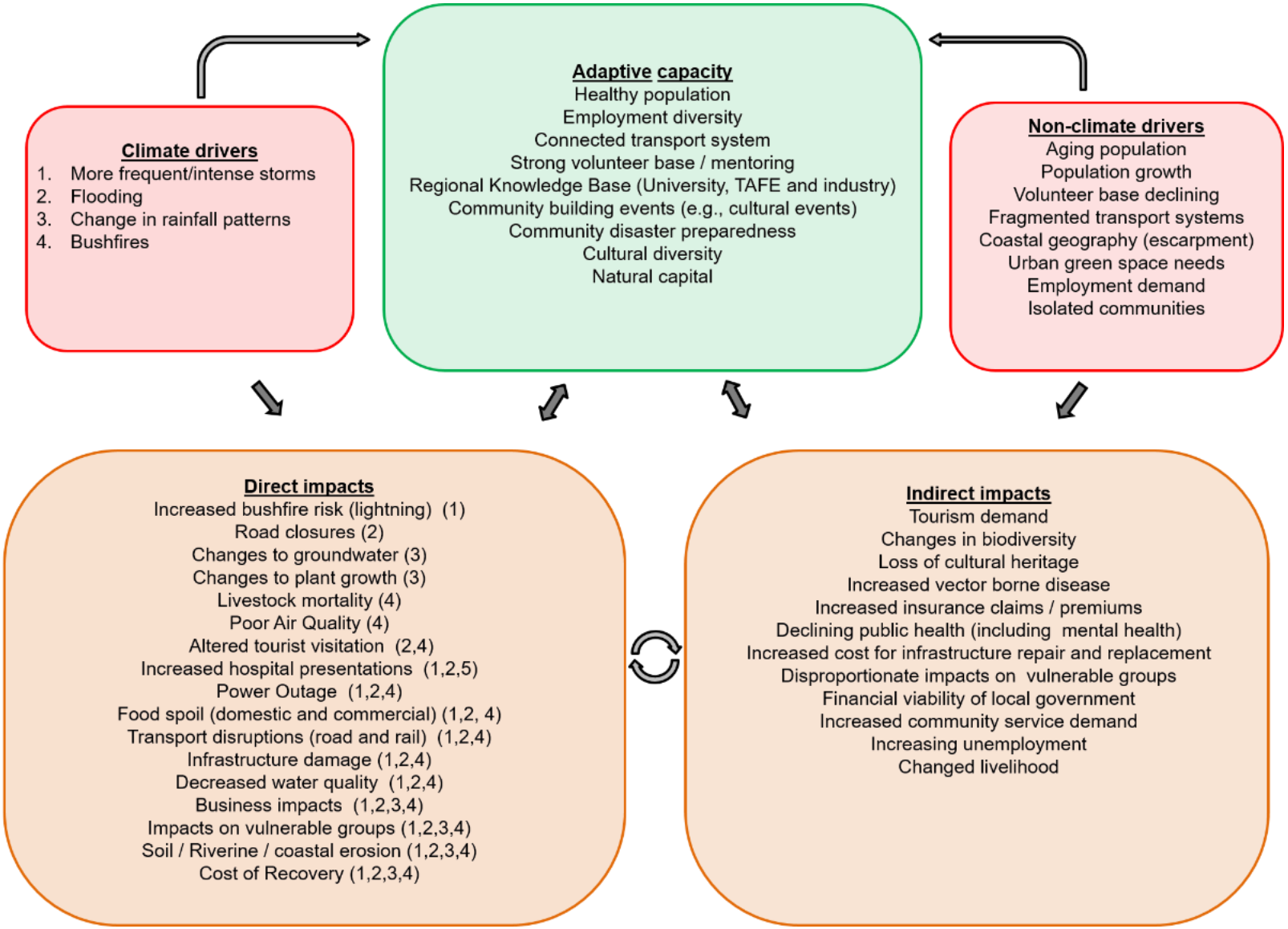

Figure 9 **A snapshot of vulnerability in the Shoalhaven Illawarra region**

Exposure

Climate drivers

The main climate drivers of the Shoalhaven Illawarra region are more frequent and intense storms, flooding, changes in rainfall patterns and increasing frequency of bushfires. Of these drivers, changes in rainfall patterns and average fire weather 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 Shoalhaven Illawarra region. They operate at a range of scales from national (population growth and ageing) to regional (coastal geography, employment demand) and local (volunteer base declining, isolated communities). While they act independently of climate drivers, they may interact with climate impacts within the region. For example, population growth is in part influenced by capital city house prices, proximity to Sydney for employment, and the natural environment of the region. However, in combination with climate drivers, population growth can, for instance, increase local exposure of the community to impacts of climate change (such as flooding and bushfires) and increase demands on emergency management and other government services.

Sensitivity

Direct impacts

The impact of climate change in the Shoalhaven Illawarra region manifests, most immediately, through the effects of extreme events. These direct impacts, shown in Figure 9, summarise the initial interconnected effects that ripple through the region's systems (see impact chain diagram in Figure 12). For example, a flood event can cause damage to critical infrastructure including roads, bridges and water treatment plants. Smoke from bushfires can result in poor air quality with subsequent impacts on human health, such as breathing difficulties, and an increase in hospital admissions. Changing rainfall patterns directly impact the growth rate of plants, surface water quality and groundwater recharge. Multiple impacts from individual climate drivers often converge at critical points. For example, more intense storm events can increase flood risk and can also increase bushfire risk via lightning strikes, especially during periods of lower than average rainfall. All four climate drivers intersect to cause infrastructure, transport and business disruptions; soil, riverine and coastal erosion; and, disproportionate impacts on vulnerable groups.

Indirect impacts

These are the concluding impacts, which have 'snowballed' along the impact chains in Figure 12. They represent further socioeconomic and biophysical drivers of change that affect the region, culminating from climate drivers, and are heavily influenced by non-climate drivers in complex ways. For example, non-climate drivers including the loss of biodiversity or cultural heritage (e.g. sea level rise effects on Indigenous heritage sites) may have a negative impact on tourism, which in turn may affect local employment. Increased frequency or intensity of storms may place pressure on regional financial resources through rising costs for insurance, repairs and maintenance of infrastructure, which in turn places pressure on local council budgets.

Sectoral impact priorities

Participants identified both the direct and indirect impacts of concern to the five major sectors of the region (Table 3). In general, the impacts of concern aligned closely with the service delivery responsibilities of the sector. For example, human services, and settlements and infrastructure were most concerned with the direct effects of climate on critical infrastructure, underlining the importance of communications, transport, water and energy assets to the regional economy and communities. The focus of infrastructure damage for human services was the flow-on effects to vulnerable members of regional communities, in particular effects on public health. The industry sector was most concerned about the broad ranging impacts of power outages on local businesses and the increased costs of infrastructure repairs and maintenance under climate change. Landscapes and ecosystems identified erosion and changes to plant growth as areas of critical concern, with flow-on effects to biodiversity and the financial viability of local government.

Table 3 Climate impacts of most concern to sectors

Sector	Direct climate impacts	Indirect climate impacts	Adaptive capacity
Economy, industry and agriculture	• Power outage	• Increased infrastructure costs • Increasing unemployment	• Regional knowledge base
Human services	• Infrastructure damage • Impacts on vulnerable groups	• Declining public health • Disproportionate impacts on vulnerable groups	• Community building events • Regional knowledge base
Settlements and infrastructure	• Infrastructure damage	• Increased infrastructure costs	• Community disaster preparedness • Regional knowledge base • Connected transport system
Landscapes and ecosystems	• Erosion of soil/riverine/coastal • Changes to plant growth	• Changes in biodiversity • Financial viability of local government	• Natural capital • Community disaster preparedness
Emergency management	• Increased bushfire risk	• Increased community service demand	• Community disaster preparedness • Strong volunteer base/ mentoring • Connected transport system

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 future uncertainty.

For example, a healthy regional population supports community self-reliance, and reduces demand on government services under the influence of climate and demographic changes. While the volunteer base in the region is currently considered strong, with an influx of new residents and an ageing population the volunteer base will need to be refreshed through

engagement, training and youth outreach to meet future demands. The Shoalhaven Illawarra region has a strong regional knowledge base through the University of Wollongong and TAFE, augmented by high-tech skills and industrial knowledge in the region, which contributes to the regional economy. However, this knowledge base should be closely engaged in development of strategic approaches to climate adaptation. The transition pathways identified in the system transformation models (Chapter 2) and the 'first steps' projects outlined in Chapter 5 provide a mechanism to support and enhance regional adaptive capacity.

While sectors of the regional economy may prioritise differently the various aspects of vulnerability that affect their service delivery, there is considerable overlap among them. Table 3 above lists the sectoral priorities for the adaptive capacity indicators. For example, community disaster preparedness was identified as a priority for the settlements and infrastructure, landscapes and ecosystems, and emergency management sectors. In contrast, a strong volunteer base was a priority for the emergency management sector only and related closely to that sector's service provision.

4. How do we know?

4.1 Description of the ERA process

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

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 the regional scale, the SIERA approach used both qualitative and quantitative techniques to integrate multiple lines of evidence gathered throughout the assessment. Evidence was gathered by the following means:

- two participatory workshops with regional decision-makers – one regional workshop and one integration workshop
- an online survey focused mainly on local government administrations and state government agencies in the region.

ERA 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 14). An online survey was also undertaken before and after the workshops (see Chapter 6).

ERA 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.

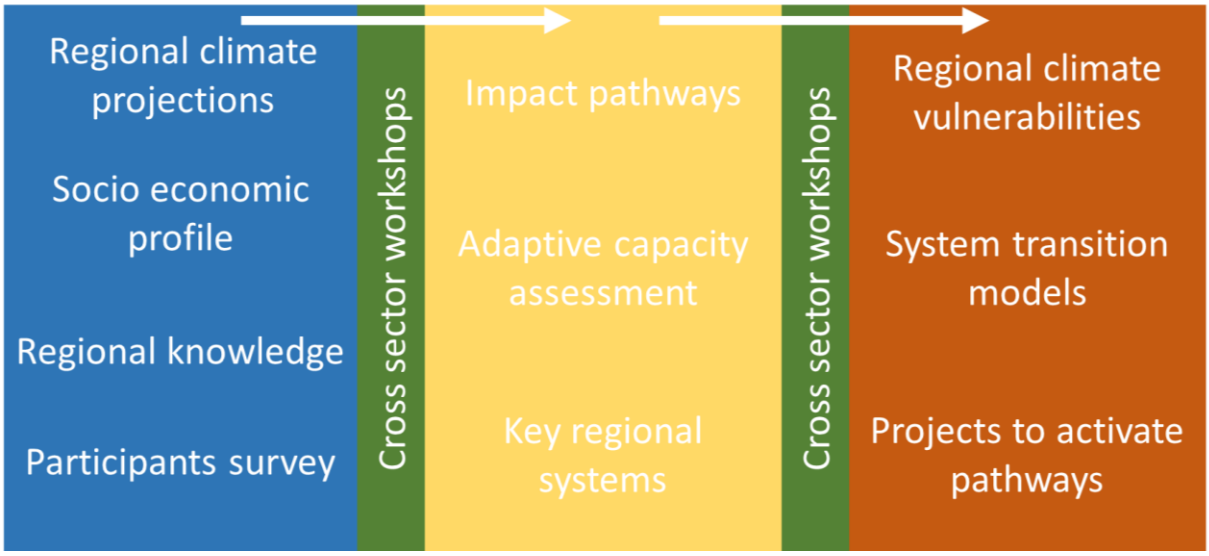

Figure 10 Enabling Regional Adaptation process

4.2 Participatory workshops

In 2017, two workshops were held in the Shoalhaven Illawarra region with 60 government stakeholders representing 26 government organisations (state – 37, local – 22 and federal – 1). The workshops provided an opportunity to discuss, explore and gather information and data on the impact of climate change on the region, and identify important systems that would be impacted and opportunities to respond.

An initial regional workshop was held on 4 August 2017 in Kiama with 43 stakeholders. The workshop was designed to:

- conduct an Integrated Regional Vulnerability Assessment (IRVA) to understand the climate impacts for the region and assess adaptive capacity to respond
- present the latest climate projections for the Shoalhaven Illawarra region
- identify key regional systems that need to change.

An integration workshop was held on 13 October with 33 participants. This workshop built on the outcomes of the first regional workshop to:

- construct a climate impact timeline to encourage consideration of climate projections in light of extreme climate events, regional socioeconomic trends and policy processes
- 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
- continue to build the regional capacity to deliver best practice adaptation.

The workshop process acknowledged that the understanding of the current vulnerability of government service delivery in the region relies on collection of the tacit knowledge that resides in the collective store of experience of NSW public sector decision-makers. The information gathered from the consultations aims to inform regional planning to enable regional adaptation to climate change.

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 12 overleaf). 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.

Nine major impacts points (highlighted in bold) were identified through this process. These include impacts on:

- **public health** from increased hospital presentations due to poor air quality from bushfires and rising strain on mental health from increased frequency and severity of extreme events
- the regional economy from **impacts on businesses, tourism and livelihoods as well as costs of recovery** from climate events
- **failure of infrastructure** as a result of damage from climate impacts including storms, floods, bushfires and sea level rise
- **declining water quality** from changes in rainfall patterns and flooding
- **loss of biodiversity** including the **loss of natural areas**, impacts on soils, changes in plant growth and loss of flora and fauna.

Climate timeline

A climate timeline (Figure 11) 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 up until 2050. The timeline showed NSW Department of 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 11 Climate timeline

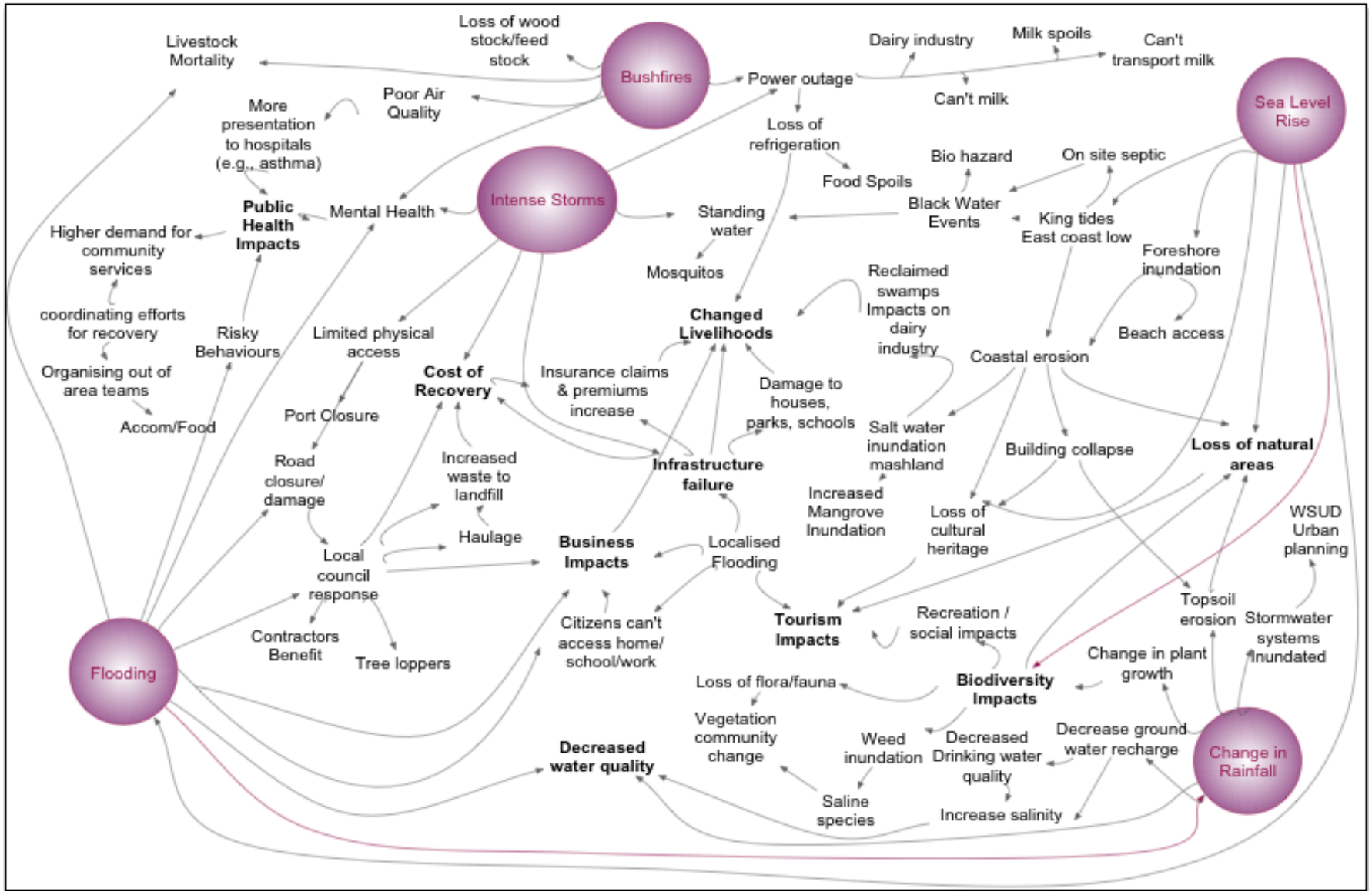

Figure 12 Shoalhaven Illawarra impact map

Key regional systems

The sub-regional workshops identified seven 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 the 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, such as:

- Satellite settlements
- Transport
- Emergency management
- Energy
- Food systems
- Industrial transformation
- Water.

System change models

Thinking 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 because of new drivers of change (Figure 13).

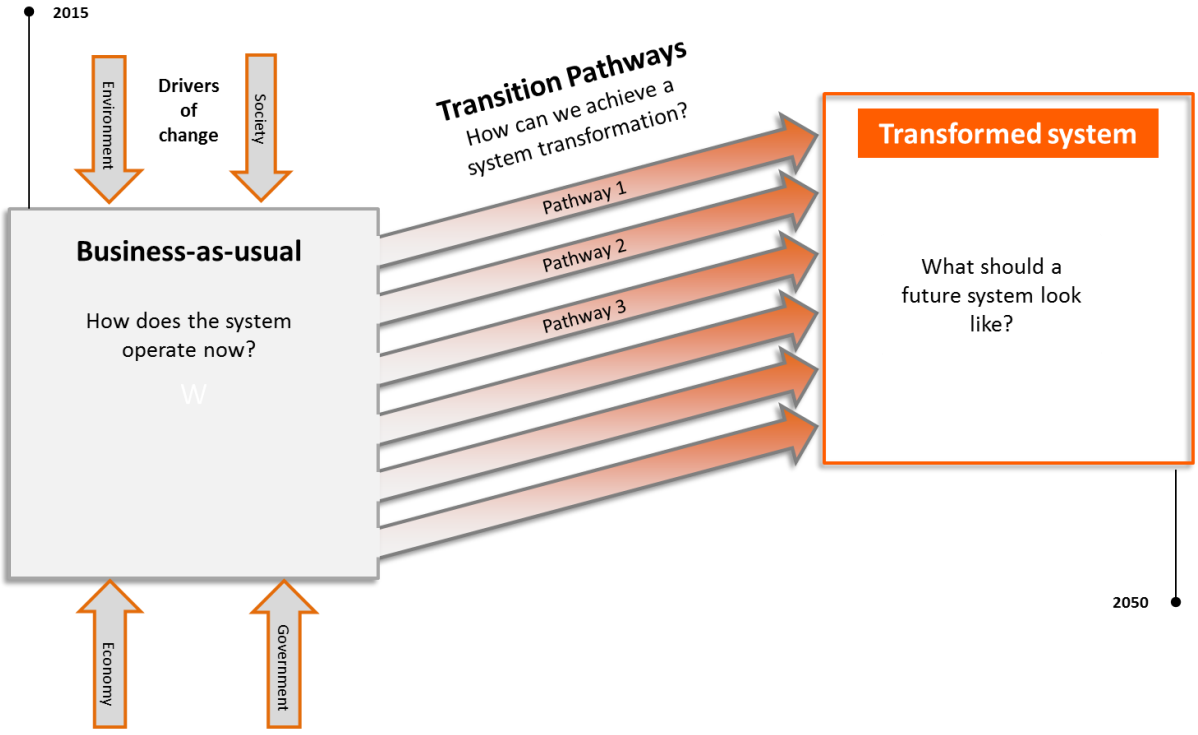

Figure 13 Conceptual model of transformative change (adapted from Jacobs et al. 2016)

For each of the selected systems the workshop participants discussed:

- **business-as-usual (BAU)** – what constitutes 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 BAU that are emerging now or may in the near future. These pathways could emerge from changes in the economy, society, the environment, technological development or politics
- **barriers and enablers** – for selected transition pathways participants identified the barriers to and enablers of change, who they need to work with to effect change, and any aligned processes or policies
- **transformed system** – participants were asked to identify their vision of service delivery in 2050 and articulate what the features of the transformed system would be.

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 (see Table 4). Two clear priority pathways were identified for each system.

Table 4 Priority pathways for government in the Shoalhaven Illawarra region

System	Key pathways
Settlements	• Foster community driven solutions that promote resilience in social infrastructure, food, water, power and transport • Encourage improved planning, design and development that is resilient, maximises natural capital and preserves biodiversity
Transport	• Develop 'live–work–play' villages through improved land-use planning to reduce the need for long distanced commuting • Improve coordination of transport options to well serviced hubs (e.g. adequate capacity trains, parking availability, communal cars/bikes
Emergency management	• Support programs that build community disaster resilience to reduce reliance on emergency services • Develop a new funding model supported by economic analysis that prioritises investment in mitigation (90%) over recovery (10%)
Energy	• Establish community renewable energy and battery storage (domestic and regional) to meet peak energy demand • Incorporate BASIX+ into early planning and Development Control Plans for new subdivisions
Food	• Implement land-use planning mechanisms to protect food security, ecosystem services, productive agricultural land and livelihoods • Support local food businesses through grants for education, pilot programs, partnerships and promotion of local production
Industrial transformation	• Develop and prove a business case for enhanced rail infrastructure to improve freight and passenger access to the port • Work with industry to develop strategies for net zero emissions from steel production such as CO_2 offsets, carbon for steel sourced from renewables, CO_2 capture and reuse
Water	• Incentivise demand management and water sensitive urban design to improve system efficiency and reduce the need for system augmentation and interconnection • Plan for the protection, relocation and renewal of sewer / stormwater infrastructure under a changing climate

The settlements change model has strong interlinkages to other regional systems, most notably food, transport, water, energy, and emergency management; for example, integrated approaches to planning of infrastructure (water, communications and transport) and land use that better service the community and protect the region's unique natural capital were a feature of the settlements, food, water, energy, and transport transition pathways.

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 5 below.

Table 5 Pilot projects to activate pathways

Pilot project	Description	System
Vulnerable Infrastructure Betterment and Enhancement	Build the business case for investing in the betterment and enhancement of regionally important infrastructure to ensure it is resilient to extreme weather now and into the future	Emergency management
SI Regional Energy Resilience Initiative	Intra region cooperation and collaboration on energy efficiency and renewable energy, investigate bulk buy opportunities and identify renewable energy potential to help reduce costs to council and community, spend energy $ locally and build regional resilience	Energy
Good food destination	Develop the good food destination business case to demonstrate the health and tourism benefits associated with food grown locally. This would help prioritise the retention of important agricultural land, and associated services, within the region	Food
Transforming Industry in the Shoalhaven Illawarra	Identify the opportunities to provide incentives for low carbon innovation across the industrial process, products, materials and research and development	Industry transformation
Beginners guide to resilient communities	Develop a beginner's guide to community resilience that helps guide communities through a process of developing a community resilience plan. Work with satellite settlements in the region to apply the guide	Satellite settlements
Shoal-share cars	Investigate opportunities to attract share car operators to larger regional hubs within the Shoalhaven	Transport
Water management planning for resilience	Take a holistic and strategic approach to building resilience into water management planning across the region	Water

5.2 Actions underway

Since the inception of the SIERA project in the Shoalhaven Illawarra region, a number of actions to enhance regional adaptation planning have commenced including:

- OEH is sponsoring the Environment Institute of Australia and New Zealand to run a Learning to Adapt professional development program in the region. OEH will award 10 regional scholarships for ERA participants to attend
- establishment of a working group under the Illawarra South Coast Regional Emergency Management Committee
- working with local industry groups to raise awareness of local manufacturers to the availability of funding to reduce energy costs through the Manufacturing Energy Efficiency Grants program.

5.3 Supporting processes

Increasing Resilience to Climate Change grants program

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

Objectives

The Increasing Resilience to Climate Change 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
- enhanced adaptive capacity.

The Climate Change Fund is providing $1,100,000 of funding in Round 1 for projects delivered within two years. Grants of between $30,000 and $120,000 are available to individual councils. Grants of between $50,000 and $300,000 are available for regional projects to coordinate adaptation projects 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.

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 partnerships 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.

Shoalhaven Council were successful and awarded a grant for 2013–14 to develop a Strategic Action Plan for the Sussex Inlet Community.

Illawarra Multicultural Services Inc. were successful and awarded a grant in 2014–15 to run information sessions on prevention, preparation and response to floods and fires, for refugees, newly arrived people and emerging communities.

The University of Wollongong was successful and awarded a grant during the 2015–17 funding round to develop a participatory research methodology to engage, facilitate and map the culturally diverse narratives, beliefs, knowledge, experiences and capacities for disaster resilience among refugee communities in the Illawarra.

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
- 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 14). All the processes in the cycle commonly occur as part of climate adaptation in New South Wales.

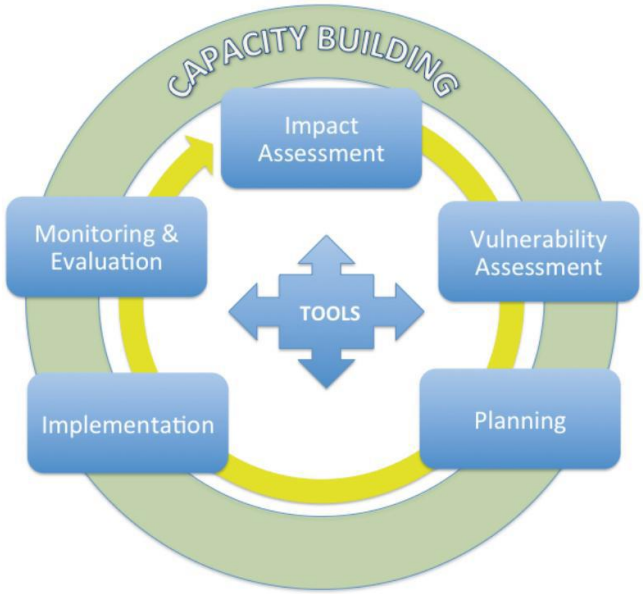

Figure 14 The adaptation process cycle (Hansen et al. 2013)

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 the adaptation process at the regional scale circumvents many of the problems with attempting to assess and aggregate local-scale adaptation actions. The SIERA process focuses on assessing the degree to which organisations are employing an effective adaptation process 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 USA.

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.

6.2 Regional online survey

A qualitative survey was conducted to benchmark regional adaption actions at the start of the project, to provide a baseline, and following completion of the SIERA workshop process as a preliminary assessment of change. The survey was available online for a period of three weeks from June to July 2017 (initial) and again in March to April 2018 for three weeks (post-workshops).

In total, 31 people from across all levels government in the region completed the baseline survey. About half (51%) of respondents represented state government agencies, 39% were from local government, 10% from regional agencies, and local non-government organisations 3%.

In total, 32 respondents completed the follow-up survey. The representation of respondents was spread across state government agencies (56%), local government (43%) and non-government organisations (1%). Well over half (69%) of respondents had attended at least one of the SIERA workshops in 2017. In both surveys, none of the respondents identified themselves as being of Aboriginal or Torres Strait Islander heritage.

Perceived key climate change risks

In both surveys the respondents identified a number of climate related risks facing the Shoalhaven Illawarra region. The top four risks were perceived to be intense storm events with high winds, flooding, changing rainfall patterns, and bushfires. The four most important event types were incorporated in the workshop discussions to develop the region's vulnerability snapshot. In the follow-up survey sea level rise was also identified as an emerging climate issue for the region (Figure 15).

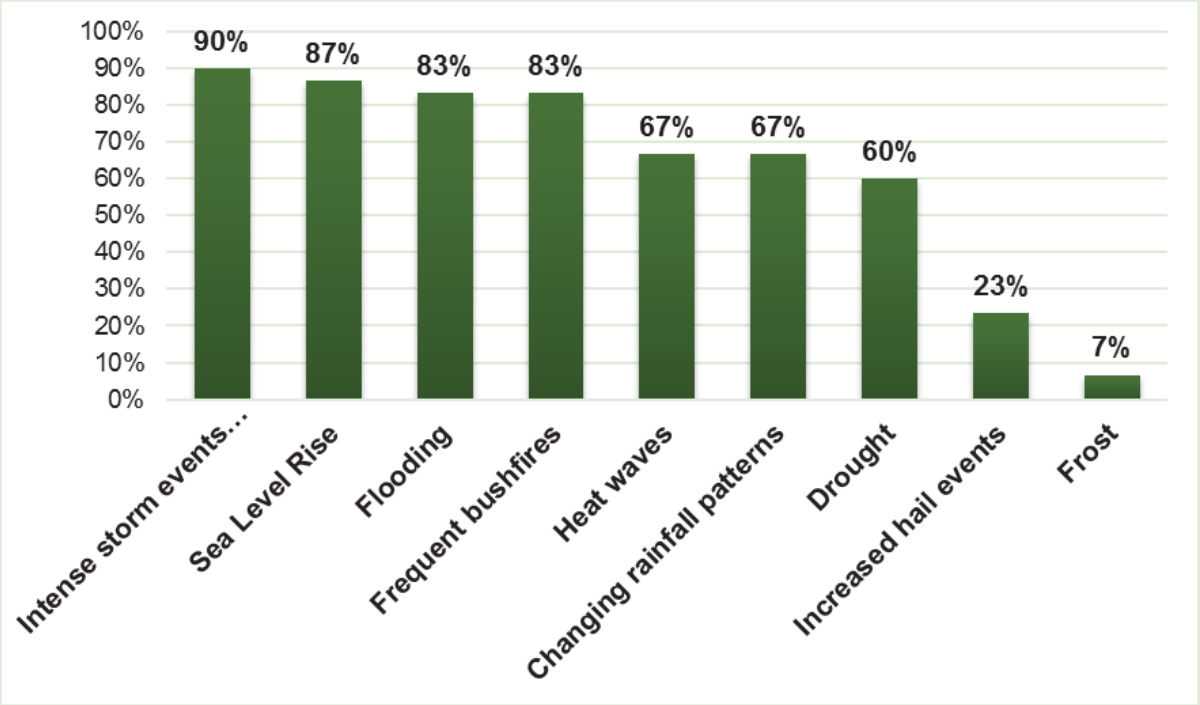

Figure 15 Climate risks identified for the Shoalhaven Illawarra region

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 (80%) agreed that climate change adaptation is a moderate to strong priority both personally and in their professional roles. Only 3% said it was not a priority. Over half (55%) of respondents noted that climate change adaptation was a moderate to strong priority for their organisation and a further 26% considered it a slight priority. About 19% said it was not a priority for their organisation.

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 16).

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

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

The top adaptation actions **currently underway** include:

- monitoring and evaluation of adaptation actions
- assessing climate change risks
- building trust, networks and partnerships
- changing policies and strategies to account for climate change impacts.

All of these actions are important to provide the evidence base for policy decisions and build cross-linkages. The **future** actions most often identified were changing policies and strategies to account for climate change impacts and encouraging the emergency management sector to account for climate change.

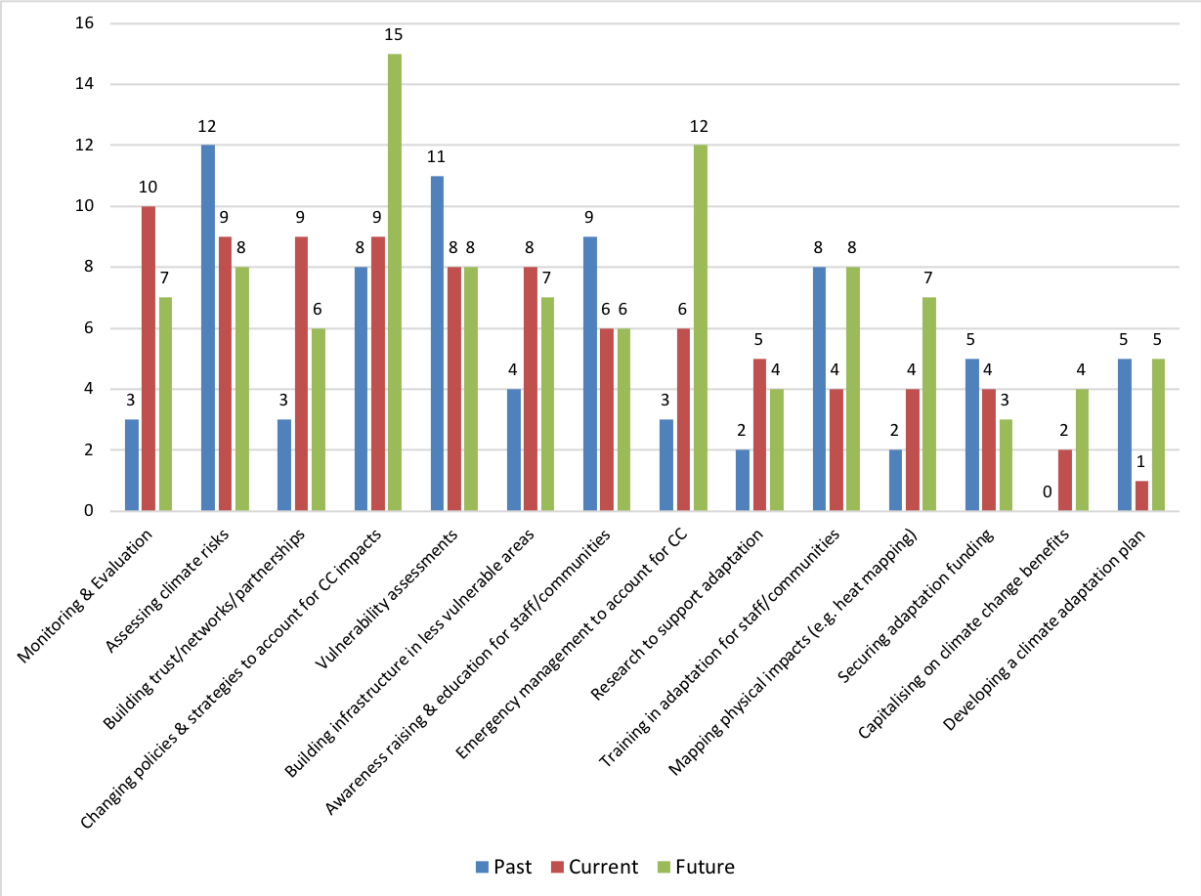

Figure 16 Adaptation actions across temporal scales

Developing a climate adaptation plan and capitalising on climate change benefits were the least pursued current adaptation actions in both surveys.

Adaptation actions can span multiple scales, sectors and responses as shown in Figure 17. Adaptation actions such as assessing climate risks, awareness raising and education of staff or the community, and adaptation training were generally conducted at the local or regional scale. Building infrastructure in less vulnerable areas was an activity more often at the local and state scale, while building trust networks and partnerships occurred slightly more often at the regional scale than at local or state scales.

Organisational capacity to undertake climate change adaptation

The survey also explored organisational capacity to undertake regional adaptation actions (Figure 18). Organisational capacity can be broken down into seven key areas:

1. Awareness of the impacts of climate change
2. Knowledge and skills to adapt to a changing climate
3. Resources to undertake regional adaptation action
4. Engagement with the community and organisations within the region
5. Strategic planning
6. Funding for adaptation
7. Implementation of regional adaptation.

Median responses to the capacity assessment statements suggested that the region is generally constrained in its capacity to adapt. Respondents believed they were particularly constrained by staff resources in undertaking regional adaptation actions.

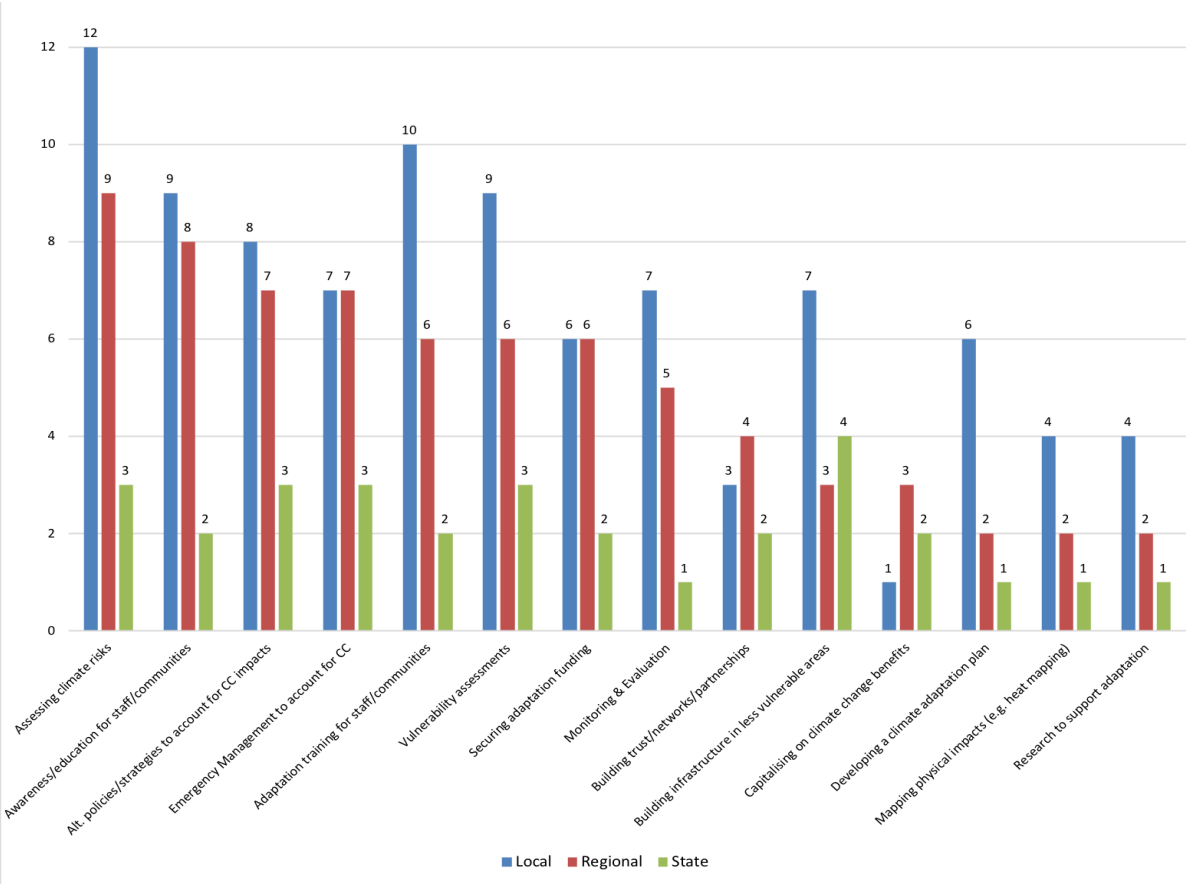

Figure 17 Adaptation actions across geographical scales

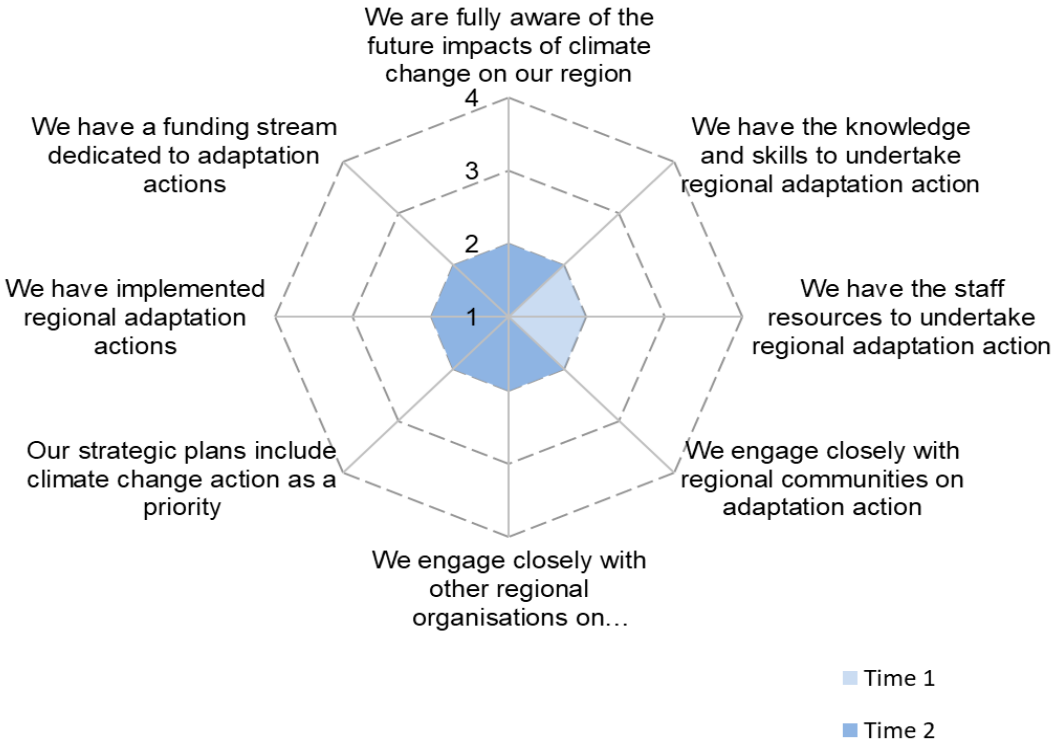

Figure 18 Adaptive capacity plot for the Shoalhaven Illawarra region

Ratings are the median level of agreement with each statement where 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree; N = 27.

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 flood risk management, energy security, and mitigation of impacts on infrastructure and biodiversity.

Coastal and flood risk management

Some local councils have partnered with OEH to develop a floodplain risk management (FRM) plan which takes account of potential climate impacts on future flood risk profiles and outlines measures to manage risks. However, a key challenge to the adoption and implementation of climate resilient FRM measures is community and councillor reticence to embrace early action in the face of uncertainty. This issue is slowly being overcome by studies that are providing an evidence base to inform planning as well as the maintenance of an ongoing dialogue to build acceptance within local government and the wider community.

Both Wollongong and Shellharbour councils have implemented Coastal Zone Management Plans (CZMPs) to mitigate the potential climate change risks associated with changes in rainfall intensity and sea level rise. For example, Wollongong Council used a risk management approach to identify adaptation options to manage assets and properties in light of a changing climate. This has been detailed in the CZMP.

Energy

The Illawarra-Shoalhaven Regional Plan was released in November 2015. This plan documents the regional vision and direction for land-use planning priorities and decisions addressing future needs for housing, jobs, infrastructure, energy and a healthy environment. Specifically, it includes an action to collaborate with partners to explore opportunities to support community and member council renewable energy uptake.

Infrastructure

Local government recognises the need to assess the likely impacts of climate change on coastal infrastructure to inform future development and maintenance, such as monitoring and recording weather events that cause port disruption to establish long-term trends.

Biodiversity

The impacts of climate change on individual species are often difficult to predict. The *Saving our Species* program is currently assessing the threat and impact of climate change on certain species in the region, such as the *Saving Our Species* Scarlet Robin project in the Braidwood area.

Factors that constrain adaptation action in the region

Despite some local councils taking a proactive approach to climate adaptation, others are constrained by a lack of priority given to climate change by executive management. Action is further hampered by a general lack of resources in the local government sector; however, this inertia is slowly being overcome through consultation and collaboration to support early adopters and champions, and demonstrate the need for change and the path forward.

Future actions

Planned actions are focused on land-use planning and transport; for example, one NSW Government initiative is focused on mapping important agricultural lands and understanding barriers to agriculture, which may include climate change impacts. In transport, action includes the re-ballasting of the railway line between Berry and Bomaderry (subject to funding approval under Fixing Country Rail) to add security to freight movements in and out of the region.

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 20% of respondents confirmed that adaption actions are being regularly monitored with a further 15% noting that M&E occurs infrequently. Approximately 40% of respondents indicated that actions are not being monitored and 25% were unsure.

Appendix A: Expected physical responses to climate change for the Shoalhaven Illawarra region

Physical response	Trend	Projection	Implications
Heat	Increase	Heatwaves are projected to occur more often, be more intense and last longer. Across most of New South Wales there will be more days over 40°C. For further information refer to *Minimising the impacts of extreme heat: A guide for local government*: climatechange.environment.nsw.gov.au/Adapting-to-climate-change/Local-government	• Human health • Urbanisation • Biodiversity • Fire weather • 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 3.6% in the near future and 11.8% in the far future. For further information refer to *Soil Erosion Climate Change Impact Snapshot*: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Soil/Soil-Erosion	• Water quality • Agricultural productivity • Biodiversity
Soil properties (SOC, pH and sum of bases)	Increase – decrease	Shoalhaven Illawarra region is projected to experience an overall decline in soil organic carbon (SOC) stocks in both the near and far futures. The region is projected to experience a slight alkalisation of soils in the near and far futures. It is projected to experience an overall increase in the sum of bases (macro-nutrients) in the near and far futures. For further information refer to *Soil Properties Climate Change Impact Snapshot*: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Soil/Soil-Properties	• Agricultural productivity (+ and –) • Natural ecosystems
Rainfall erosivity	Increase	In the region rainfall erosivity is projected to decrease in autumn and increase in winter in the near future; however, in the far future rainfall erosivity will increase in summer, autumn and winter. For further information refer to *Rainfall erosivity* in the *Soil Erosion Climate Change Impact Snapshot*: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Soil/Soil-Erosion	• Water quality • Agricultural productivity • Biodiversity
Rainfall extremes	Increase	Rainfall extremes are projected to increase in the near future and far future. For further information visit the Adapt NSW website: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Floods-and-storms	• Flooding • Agricultural productivity • Emergency services • Local government

Physical response	Trend	Projection	Implications
Flood		For further information visit the Adapt NSW website: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Floods-and-storms or your local council.	• Urban and rural properties • Agricultural productivity • Emergency services • Local government
Hydrology (surface flow/ runoff and recharge)	Increase – decrease	The projections of future runoff are spatially variable across the Shoalhaven Illawarra. In the near future there is a mix of projected increases and decreases across the region. 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 lower. In the near future, projections for recharge are spatially variable. Projections are spatially variable in the far future, with higher recharge consistent across the region in autumn. For further information refer to *Hydrology Climate Change Impact Snapshot*: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Water-resources/Groundwater-recharge-and-surface-runoff	• Councils' stormwater infrastructure • Town water supplies • Agricultural productivity
Drought	Increase	For this region, time spent in drought is projected, with medium confidence, to increase over the course of the century. For further information see the CSIRO and BoM Technical Report (2015): www.climatechangeinaustralia.gov.au/en/publications-library/technical-report/	• Human health • Town water supplies • Agricultural productivity • 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. For further information visit Adapt NSW website: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/East-Coast-Lows	• Emergency services • Water security • Local government
Fire weather	Increase	The Shoalhaven Illawarra is expected to experience an increase in average FFDI values in the near future and an increase in summer and spring severe fire weather in the far future. For further information visit the Adapt NSW website: climatechange.environment.nsw.gov.au/Impacts-of-climate-change/Bushfires	• Fire regimes • Emergency services • Hazard reduction

Appendix B: List of SIERA workshop participating organisations

Department of Education

Department of Family and Community Services

Department of Finance, Services and Innovation

Department of Industry

Department of Planning and Environment

Department of Premier and Cabinet

Department of Primary Industries

Illawarra Joint Pilot Organisation

Illawarra Shoalhaven Local Health District

Kiama Council

National Parks and Wildlife Service

NSW Ambulance

NSW Fire and Rescue

NSW Police

NSW Ports Authority

Office of Environment and Heritage

Office of Regional Development

Regional Development Australia – Far South Coast

Roads and Maritime Services

South East Local Land Services

Shellharbour Council

Shoalhaven Council

State Emergency Service

TafeNSW

WaterNSW

Wollongong Council

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