

Prospering in a Changing Climate

A Draft Climate Change Adaptation Framework for South Australia

Draft for Community Consultation
December 2010



Government of
South Australia

In partnership with the Premier's Climate Change Council and the Natural Resources Management Council

Foreword

This draft Climate Change Adaptation Framework provides the foundation for South Australians to develop well-informed and timely actions to increase their preparedness for the impacts of climate change. It is intended to guide action by government agencies, local government, non-government organisations, business and the community.

While governments can provide leadership and coordination, the majority of effort will need to occur at an individual, regional and local level. Those affected by climate change will be in the best position to decide how to deal with its impacts. Building the capacity of communities, businesses, species and ecosystems to adapt to the impacts of climate change will be fundamental to success.

This draft Climate Change Adaptation Framework is a first step towards formalising adaptation action that is coherent and integrated in existing institutions. The final Framework will deliver improved coordination between the public and private sectors and the community and will enable decision-makers to identify climate change risks and to plan responses that deliver comprehensive adaptation plans for all South Australians.

The impacts of climate change will affect us all. The nature and extent of these impacts will vary across the state depending upon the industries that contribute to regional economies, socioeconomic factors and the surrounding natural environment. The Framework therefore calls for a bottom-up approach in developing adaptation responses, with an emphasis on the regional community level which inform sectoral and statewide approaches.

Many communities around South Australia have already begun to prepare for the changes in our weather patterns and rising sea levels. For example communities on the Eyre Peninsula have undertaken several projects to better understand and deal with climate change. This includes a pilot climate change vulnerability assessment for the areas of Kimba, Cowell and Greenpatch to assess climate change impacts and sensitivity, as well as existing adaptive capacity.

Adaptation is not an isolated stand-alone agenda. It will need to be incorporated into all our policy and planning processes and embedded into public and private risk management frameworks. Adaptation will play a complementary and equally important role to mitigation in our efforts to respond effectively to climate change.

Adaptation will create many opportunities for innovation across all sectors, and it provides us with an unprecedented opportunity to incorporate sustainable development principles into everything we do.

Building adaptive capacity will assist South Australians to effectively deal with gradual changes to our climate. Adaptive capacity will also assist us to respond to the potentially abrupt climate change that has been observed in the past but is more difficult to accurately predict.

So far, South Australia's approach to adaptation has been to take full advantage of our scientific knowledge base and unique natural environment. Skills in forestry, dryland farming and spatial mapping have been applied to factor climate change into evaluating future options for cropping and forestry industries. Land in strategic locations has been used for extensive tree plantings to provide salinity and biodiversity benefits in addition to carbon sequestration.

There are many ways in which we are already responding to the challenges of climate change. For example the State Government has developed Water for Good – A plan to ensure our water future to 2050, a plan for sustainable water supply and use in South Australia for at least the next 40 years.



The 30-Year Plan for Greater Adelaide provides important policy measures to ensure an effective long-term approach to dealing with the impacts of climate change particularly in relation to the urban form, including energy efficient building design, a reduction in the vulnerability of critical infrastructure and continued protection of coastal development from seawater inundation.

The Living Coast Strategy (2004) is a plan to protect the South Australian coast for the future. Many of its actions assist in maintaining South Australia’s leadership in planning for and implementing climate change adaptation on our coast. The Coast Protection Board will continue to play a key role in implementing many of these actions, including identifying development, infrastructure and ecosystems at risk, and developing and implementing strategies to inform adaptation planning.

The 2008 State of the Environment Report made a number of recommendations about adapting to climate change and in its response the Government announced a “planned and strategic approach to climate change adaptation, which involves all levels of government, the private sector and the community, and that cuts across all sectors.” The Government also committed to conducting research on the health impacts of climate change, including through its effects on air quality, and to programs for generating community awareness and behaviour change.

This draft Adaptation Framework will build on the good work that has already started in South Australia to build resilience to climate change. Its guiding nature will ensure efforts by all sectors and levels of government are strategic and coordinated.

Climate change will bring many challenges, but it will also create significant opportunities for innovation, diversification and leadership associated with both mitigation and adaptation activities. Applied well, adaptation can improve the market position of existing goods and services produced in South Australia, and help develop new markets and businesses.

While governments can take on a leadership role and ensure that public services and assets can withstand and respond to the impacts of climate change, climate change risks to private interests will ultimately need to be addressed by business and the community. The Government will need to provide information and planning frameworks to facilitate such actions by private parties. We will also be establishing regional agreements with key organisations to drive the development of community-based adaptation action plans that will enable South Australians to capture opportunities and continue to thrive and prosper into the future.

We encourage you to review this document and provide your comments so that together we can prepare to adapt to our changing climate.

Mike Rann
The Hon Mike Rann MP
Premier of South Australia

David Kingberg AO
CHAIR Premier’s
Climate Change Council

Sharon Starick
CHAIR Natural Resources
Management Council





People, regions, industries and communities across South Australia are resilient to the impacts of climate change and are able to capture new opportunities

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Summary

There will be inevitable impacts from climate change despite global efforts to reduce greenhouse gas emissions. Projections for South Australia indicate warmer and drier conditions across much of the state with an increased risk of severe weather events, including storms, flooding, heatwaves, drought and bushfires. These changes will affect our health and wellbeing, key industries that underpin the state's economy particularly primary production, businesses and the natural environment.

When finalised, this draft Climate Change Adaptation Framework for South Australia ('the Framework'), will guide action by State Government agencies, local governments, non-government organisations, the research sector, business and the community to develop well-informed and timely adaptation responses. Indeed, appropriate investment in research, innovation, skills and workforce development has the potential to improve our adaptive capacity, enabling us to not only minimise the negative impacts of climate change but also to create new opportunities for our community and the economy.

The Framework will inform and align with South Australia's policy on climate change. It will also inform the development of forthcoming strategies and plans, such as the revised State Natural Resources Management Plan, and be consistent with national adaptation policies.

Progress on implementing the Framework will be reported once every two years as part of the formal requirements to report on climate change activities in the state under the Climate Change and Greenhouse Emissions Reduction Act 2007. The Premier's Climate Council and the Natural Resources Management Council will review the Framework after five years.

The implementation of the Framework will be guided by a set of principles that describe how adaptation responses will be prioritised, developed and delivered.

The implementation of the Framework is intended to deliver responses based on a cohesive and coordinated approach, which will be mainstreamed in established planning, decision-making and risk management frameworks, and help to build recognition of the interconnections between social, environmental and economic systems.

It is intended that adaptation actions will be prioritised through assessment of risks, costs and equity using the best available science, and taking into account the uncertainty associated with climate change projections.

The full range of guiding principles required to ensure a successful and consistent approach to adaptation in South Australia is outlined in Section 1.5 of the Framework.

A three-tiered integrated approach

This Adaptation Framework is based on a three-tiered integrated approach:

1. Statewide priorities

Four overarching statewide objectives are provided to guide the adaptation responses we will need to make at the state level, along with the strategies to achieve them and the lead agencies and entities that will have primary responsibility.

In the short term, the Framework provides the leadership necessary to coordinate actions by the parties affected by climate change including governments, businesses and communities. The Framework also allows for the preparation and development of the science and research agenda that will inform adaptation responses into the future.

Objective 1

Leadership and strategic direction for building a more resilient state

Lead SA's adaptation efforts by building partnerships, incorporating adaptation in all decision-making and actively participating in national and international activities

Objective 3

Resilient, well-functioning natural systems and sustainable, productive landscapes

Increase the resilience of terrestrial, aquatic, marine ecosystems and primary production systems and link adaptation, biodiversity conservation and sustainable landscape use

Objective 2

Policy responses that are founded on the best scientific knowledge

Establish processes that deliver science of high quality and relevance to inform an adaptive management approach to building resilience and adaptive capacity

Objective 4

Resilient, healthy and prosperous communities

Build resilience and adaptive capacity by empowering communities and businesses with relevant information and decision-making tools and by helping the most vulnerable

2. A regional approach

The Framework recognises that climate change and its economic, social and environmental impacts will vary across South Australia and therefore proposes that locally relevant adaptation responses are developed across the 12 existing State Government regions. This approach ensures that future adaptation strategies take into account the knowledge of local communities and the differing circumstance and impacts within each region.

Preparing for climate change will require local organisations and State Government agencies to work with communities to assess climate change risks and opportunities, to determine priorities and to develop adaptation action plans. In the first instance, this work will include the development of regional integrated vulnerability assessments in each region to understand the sectors and systems that are most at risk. The Framework proposes that these assessments and regional adaptation work that follows will be managed under regional agreements between the Minister for Sustainability and Climate Change and local organisations under the *Climate Change and Greenhouse Emissions Reduction Act 2007*.

3. A sectoral approach

Climate change adaptation will also require understanding of the impacts of climate change on specific sectors of the South Australian economy, including understanding of the sensitivities and the level of adaptive capacity within each sector. The Framework identifies the following sectors:

- Community health and individual wellbeing
- Forestry
- Manufacturing
- Water resources
- Coastal regions
- Biodiversity
- Infrastructure and the built environment
- Agriculture
- Emergency management
- Fisheries and aquaculture
- Tourism
- Minerals and energy

Sector specific adaptation action will be required in the future at statewide, regional and individual enterprise level. This action will be in part informed by the outcomes of the regional integrated vulnerability assessments and in part by risk assessments carried out by private parties.

Together these three components provide a comprehensive framework to guide action.

Consultation

This draft Climate Change Adaptation Framework is a first step to developing a coordinated and integrated response to climate change in South Australia. Action to address climate change will allow communities, businesses and individuals to minimise any negative impacts but also to identify and benefit from opportunities presented by climate change.

It is intended that the final Framework will facilitate the development of more detailed strategies at regional, sectoral and government levels.

This draft Framework is presented for community consultation with comments sought from individuals, community organisations, governments and business. The consultation process will involve regional workshops conducted in early 2011. Written comments can also be provided to the Sustainability and Climate Change Division of the Department of the Premier and Cabinet by 31 March 2011 at climatechange@sa.gov.au or GPO Box 2343, Adelaide SA 5001.

1 Adaptation in SA

1.1 Why we need to adapt

Even if global greenhouse emissions are reduced today, some changes in the global climate are inevitable. Although there is still a degree of uncertainty around the precise impacts, their timing and the adaptive capacity of human and natural systems, it is imperative that we begin planning now for how we will adapt to the impacts of our changing climate.

Climate change will create conditions that we have not experienced before. This means we will need to do things differently. We will need to work together in new ways and form partnerships across jurisdictional boundaries and between different groups of stakeholders who may in the past not have worked together.

To date, national and international efforts to address climate change have concentrated on mitigating or reducing greenhouse gas emissions. To effectively address the many complex challenges of climate change however, mitigation and adaptation must be recognised as complementary and equally necessary approaches – not alternatives.

Failure to adapt will expose us to possibly severe and long-term consequences including reduced productivity, property and financial losses, threats to biosecurity, higher costs for goods and services, serious health issues, reductions in social and human capital, and the loss of unique and essential natural systems and species.

Early action is likely to see us benefit from this change and avoid or minimise long-term negative impacts.

Strengthening the adaptive capacity of the South Australian community by expanding our options

for dealing with climate change will be critical to delivering effective responses in the future. This preparedness is especially important given that the precise timing and magnitude of climate change impacts are uncertain. Better integration of risk management approaches and flexible decision-making processes will improve our adaptive capacity. Building the climate resilience of natural systems will be equally important. Appendix 1 provides more information on building resilience and adaptive capacity.

Climate change projections¹ for South Australia indicate warmer and drier conditions across most of the state, with an increased risk of extreme events such as flooding, drought and bushfires (see Appendix 2). These events will have variable impacts on the lives of all South Australians and on the natural environment across the state.

Likewise, climate change will have direct and indirect impacts on our health and wellbeing, particularly for vulnerable members of the community, such as the elderly, those who live in remote settlements, the sick and people on low incomes. Health and community services will be affected across the state.

Some of South Australia's key industries worth billions of dollars to the economy, such as the wine, grain and seafood industries, are likely to be affected. The natural resources management sector will be challenged, risks to biosecurity will increase and our already fragile natural systems will be under increasing pressure. The state's water supplies will be severely threatened as rainfall decreases and temperatures rise. Indeed, maintaining sustainable water supplies into the future will be one of South Australia's biggest challenges.

Homes, businesses and infrastructure will be threatened by the increased risk of extreme events, such as bushfires and floods, and coastal settlements and ecosystems will be exposed to the rise in sea levels, floods and storm surges. There is a range of research, planning and policy activity occurring across State and Local Government and the private sector. However this needs to be better coordinated and have a clearer strategic direction or we will be vulnerable to gaps in our adaptation response, with increased chances of maladaptation or over-adapting and potentially wasted resources.



¹CSIRO (2006) *Climate change under enhanced greenhouse conditions in South Australia* http://www.climatechange.sa.gov.au/uploads/pdf/SA_CMAR_report_High_resolution.

1.2 Opportunities

While climate change will bring many challenges, it will also create significant opportunities for innovation, diversification and leadership associated with both mitigation and adaptation activity. The opportunities arising from effective adaptation to climate change include:

- improvement of the market position of our existing goods and services
- development of new markets arising from more effective adaptation to climatic changes and carbon constrained markets
- development of new markets for climate change adaptation related goods and services, and
- reduction of climate change related costs to government and the community.

The pressures of living in an already dry climate have taught us to adapt and develop knowledge critical to our survival. This ability to adapt will assist us in dealing with climate change and, as we develop methods for dealing with the impacts of global warming, we can uniquely position South Australia to help others by exporting our newly developed skills and expertise.

We will utilise our existing institutions that have in the past developed world-class dryland agricultural

practices, and our expertise in delivering and managing infrastructure and water resources in a harsh environment, to position our state's industries on a more competitive footing. We can further build on the strength of the technological innovations and intellectual property that support South Australia's minerals and defence industries.

The challenges associated with climate change will provide the state with commercial opportunities for exporting our adaptation skills and technologies into developing and developed countries. There will also be opportunities for the mutual transfer of skills and technologies between countries that are likely to experience similar climatic changes.

Some of the opportunities for South Australia associated with adaptation are summarised in Table 1.



Table 1 South Australia's climate change adaptation opportunities

Sector	Opportunity
Infrastructure and urban areas	Improving building standards and design guidelines to create more thermally and energy efficient buildings.
	Creating a more liveable urban environment through the establishment of a network of greenways, tree-lined streets and open spaces, which have a cooling effect on nearby neighbourhoods and new buildings.
Agriculture	Leading internationally on the development of sustainable food and farming systems, including the development of bio-fuels, soil carbon capture technologies, bio-char-type soil conditioners and drought tolerant crops.
	Developing and promoting the adoption of new farming options that are better suited to climate variability (e.g. farming systems based on perennial plants) particularly in lower rainfall zones where few options exist.
Biodiversity	Rehabilitating previously cleared or degraded natural systems if current land uses become unviable.
	Biosequestration.
	Managing and restoring key ecological assets.
	Creating greater connectivity between fragmented habitats to enable species to adapt to changing conditions.
	Strategically using environmental water to build resilience.
Emergency management	Developing ecosystem services through market-based instruments such as combining biosequestration with other ecomarkets to make environmental plantings financially viable.
	Building on the state's expertise in hazard prevention, mitigation, response and recovery, and disaster preparedness.
Bio-technology	Informing people about emergency risks and how to reduce their exposure and vulnerability.
	Increasing South Australia's leadership in biotechnology, including products and services that will reduce the impacts of climate change and assist in building resilience, such as drought-tolerant crops, soil remediation technologies and biofuels.
Water management	Building on our expertise in sustainable water management technologies, including sustainable irrigation, water recycling, stormwater capture, storage and use, water trading and infrastructure.
	Improving water allocation and water resource management to provide water to the environment.
	Increasing use of environmental regulations to use limited water resources more efficiently and to appropriately regulate desalination.
Food supply	Investing in sustainable, climate change-adapted local food industries, which could provide employment and a vigorous and innovative food market.
Financial and consulting services	Climate information and adaptation-related consulting services.
	Providing appropriate insurance services.
Forestry	Diversifying forest products by developing climate change tolerant species and processing technologies.
	Greater industry involvement in connecting remnant vegetation.

1.3 South Australia's early adaptation responses

There is a range of adaptation activity already happening across State and Local Government, academia and the private sector.

South Australia was the first jurisdiction to introduce a sea-level rise policy into its planning regulations. Allowances for sea-level rise over the 21st century were a key component of the Coast Protection Board's 1991 Policy on Coast Protection and New Coastal Development, which was incorporated into the land use planning system in 1994.

The Premier's Climate Change Council is a high-level independent council that was established to advise the Premier on reducing greenhouse gas emissions and adapting to climate change. The Council has placed a high priority on adaptation and has played a major role in the development of this Framework, in partnership with the Natural Resources Management Council.

Under Section 16 of the *Climate Change and Greenhouse Emissions Reduction Act 2007*, the Government is entering into a range of sector agreements with key sectors and businesses. The agreements will provide the basis for the sectors and the Government to work cooperatively to reduce greenhouse gas emissions and develop adaptation responses. An agreement with the Eyre Peninsula region has already been signed and will provide for the development of the state's first regional adaptation action plan, which will be based on a regional integrated vulnerability assessment (IVA).

The Premier's Science and Research Council has actively supported adaptation-related activities, including the identification of skill needs and support for research projects and infrastructure that contribute to South Australia's adaptive capacity. The Council has further supported adaptation projects through the Premier's Science and Research Fund, including a significant project with the University of Adelaide to build research capability to identify climate change vulnerability and adaptation options for South Australian landscapes.

*Water for Good – A plan to ensure our water future to 2050*² is the Government's plan for sustainable water supply and use in South Australia for at least the next 40 years. *Water for Good* will largely underpin adaptation in the water sector.

Sustainability and climate change resilience is one of the three interlocking objectives of the 30-year Plan for Greater Adelaide³.

The plan includes several policies to improve the capacity of urban communities to adapt, including:

- setting improved building standards and design guidelines to create more thermally and energy efficient buildings
- creating a more liveable urban environment through the establishment of a network of greenways, tree-lined streets and open spaces
- encouraging commercial and industrial developers to include green buffers and shady areas in their developments.

Target 3.2 of South Australia's Strategic Plan, provides for "five well-established biodiversity corridors to maximise ecological outcomes particularly in the face of climate change." The program that will deliver this target for terrestrial areas is NatureLinks. Tracts of land that are managed for conservation outcomes will be linked with the parks and reserves system to provide wildlife corridors to assist movement and migration in response to climate change.

South Australia's Representative System of Marine Protected Areas will assist in increasing the resilience of marine ecosystems to climate change.

No Species Loss: A nature conservation strategy for South Australia 2007-2017 includes as one of its five major goals "Adjustment to the impacts of climate change".

Landscape scale management that maintains healthy natural systems and is adaptive to climate change is one of the four major goals of the *State Natural Resources Management Plan 2006*.⁴

Initiatives such as Bushfire Awareness Week and the community-based FloodSafe program are current examples of initiatives to improve community resilience to emergencies.

Local governments across South Australia are implementing a range of actions to address adaptation. These include the development of comprehensive climate change strategies and adaptation plans and a range of sustainable water initiatives, such as the Water Proofing the South project and the Water Proofing Northern Adelaide project.

¹ <http://www.waterforgood.sa.gov.au/>

² <http://www.dplg.sa.gov.au/plan4adelaide/html/plan.cfm>

³ http://www.dwlbc.sa.gov.au/assets/files/NRM_StateNRMPPlan2006.pdf

Flinders University and the University of South Australia are also conducting a wide range of research projects that will inform adaptation responses for both natural and human systems.

The South Australian Government and the Adelaide and Mount Lofty Ranges Natural Resources Management Board have worked in partnership to implement a broad framework to assist climate change adaptation decision-making within and across natural resource management (NRM) sectors.

1.4 Who is responsible?

There are many options available to address climate change impacts, not all of them efficient or desirable. Equally, there are many parties who could deliver adaptation responses, some of them not necessarily best placed to do so. It is therefore essential to be explicit about the roles and responsibilities of individuals, communities and institutions in delivering adaptation action. This issue has been at the forefront of the climate change policy agenda in Australia in 2010 and includes work of the Council of Australian Governments, the Council of Australian Federation and the Heads of Treasuries. Wherever possible, the content of the Framework reflects the deliberations and agreements achieved in these fora.

Adaptation to climate change is a shared responsibility and involves a joint effort by all levels of government, business, communities and individuals. Given that most assets and activities at risk of climate change are owned or managed by businesses or the community, it is reasonable to expect businesses and the community to manage their exposures. Given this and the scale and range of predicted impacts it is not feasible for governments to bear all the costs of adapting to the impacts of climate change.

1.4.1 Government

Much of the action to adapt to the inevitable consequences of climate change will need to be driven by State and Territory governments.

The major role for all levels of government in adaptation will be to create the right conditions for businesses, communities and individuals to make timely and well informed decisions. Ultimately businesses and individuals will need to make decisions about how to protect their own personal situation, but governments will need to

make sure that they are adequately informed and that government plays its own part by factoring climate change into legislative frameworks within which these decisions are made. This requires governments to:

- facilitate climate change research and provide information regarding climate change risks and adaptation strategies, which have a broad public benefit to motivate businesses, communities and individuals to develop specific information necessary to manage their climate change risks
- provide leadership and encourage forward-looking behaviour and private initiative
- ensure that regulation of markets, such as development rules and building codes and essential service provision and planning, facilitates adaptation to changing climate risks
- ensure that climate change risks to public infrastructure are effectively managed, and the delivery of public services such as health care and emergency management are responsive to demands arising from a changing climate
- protect valued environmental assets at risk from climate change.

Governments may also need to intervene in areas where individuals or the community are unable to deliver adaptation responses and if there is a broader public benefit to do so. This may include identifying and implementing priorities to improve adaptive capacity and strengthen climate resilience in vulnerable communities or in areas that do not have sufficient resources to respond. It is also envisaged that the existing social welfare system will be used to support these communities.

In fulfilling the above responsibilities governments across all tiers will require appropriate resourcing and funding in the future. Work undertaken as part of this Framework will ensure that adaptation actions are delivered efficiently, with less duplication and at the most appropriate level. Where appropriate, government support may need to be provided to regional organisations to deliver targeted and location specific programs.

National, state and local governments will have differing but complementary roles in leading climate change adaptation efforts. Ultimately, however, adaptation to climate change involves a joint effort by all levels of government, business, research organisations, communities and individuals.

Commonwealth Government

The Commonwealth Government has an important role in setting national directions and priorities for adaptation. Major national adaptation initiatives are summarised in Appendix 2.

Key roles for the Commonwealth Government include:

- maintaining a strong, flexible economy and a well-targeted social safety net
- providing leadership on national adaptation reform including working with other levels of government to establish national adaptation priorities to protect the national economy, security and interests including natural systems of national significance, and set implementation activities in relation to these priorities
- working with governments to develop a consistent approach to adaptation responses and to implement monitoring and evaluation for nationally coordinated policies, programs and research to ensure adaptation responses are effective and well-targeted
- providing national science and information including managing climate change science and national adaptation research to ensure a consistent approach to regional climate projections, climate change impact modelling and reporting
- facilitating national adaptation forums to share adaptation experiences across jurisdictions
- working with governments in the development and verification of nationally consistent assessment tools including risk assessment and modelling tools
- working with governments in managing climate change risks to public assets that are identified as being of national significance and for which the Commonwealth has some responsibility.

State Government

Adaptation to climate change is a major priority for the South Australian Government. All agencies will play an important role in working with business, non-government organisations and local communities to develop statewide and regional responses.

There are four broad roles for the State Government in adaptation:

- encouraging climate resilience and adaptive capacity including by utilising regulatory and policy instruments
- providing or disseminating relevant local and regional science and information
- managing public assets (including natural assets), infrastructure, service delivery and programs
- cooperating with other governments to implement the national adaptation reform.

Some of the specific roles for the State Government may include:

- raising community awareness and promoting a risk management response to climate change adaptation by government and private parties
- ensuring that regulatory and market frameworks including state planning, property and environmental legislation promote effective adaptation by private parties
- partnering with the business sector and providing support for adaptation responses by business
- working with other governments to identify and implement priorities to improve adaptive capacity and strengthen climate resilience in vulnerable communities
- supporting local governments to facilitate building resilience and adaptive capacity in the local community and to ensure that policies and regulations are consistent with the State Government adaptation approaches
- managing risks and impacts to public assets (including natural assets) and infrastructure owned and managed by the Government
- managing risks from climate change impacts to services provided by the Government in such areas as emergency management, transport, land use planning, environment, health services and public housing
- undertaking actions where these will not be initiated by the private or community sectors because of market failure, for example by strengthening the resilience and adaptive capacity of natural systems

- establishing science and research priorities and conducting research in key areas of specific interest to South Australia not addressed in national research priorities and outcomes
- providing information and decision-making tools that are relevant to local communities, including educating communities about how to adapt to a highly variable climate
- facilitating institutional arrangements that provide for an integrated approach to adaptation among sectors
- collaborating with other jurisdictions to develop national standards, codes and approaches and implementing them through state regulatory instruments.

The statewide objectives and strategies outlined in Part 2 reflect these roles.

Local Government

Local governments will play a vital role in adaptation, as it is the closest to local communities where the effects of climate change will be felt the most. The key roles for local government include:

- administering relevant legislation to promote adaptation responses
- partnering with other regional organisations to develop regional IVAs and completing and reviewing local government risk assessment and adaptation pilot projects
- working with communities and sectors to develop regional adaptation plans
- building resilience and adaptive capacity in the local community including through providing locally relevant information and decision-making tools to individuals and businesses
- advocating on behalf of the community for resources to assist in adaptation
- incorporating climate change adaptation into the management of infrastructure, assets, ecosystems and natural resources, including completing comprehensive climate change risk assessment and adaptation plans
- undertaking capital works and other projects to minimise the impacts of climate change
- managing risk and climate change impacts on local government service delivery.

1.4.2 Private parties

Individuals, communities and businesses will primarily be responsible for managing the risks to private assets and incomes and the benefits they receive from doing so are a strong incentive to act. These private parties will have a particular interest in maintaining the vibrancy and longevity of regional economies and will therefore play an important role in developing local adaptation responses. Businesses such as the insurance, finance and banking industries will also play a critical role in developing adaptation responses by providing appropriate financial mechanisms to help manage risks. Key roles for private parties include:

- mainstreaming adaptation into what they do
- undertaking risk assessments
- investing in strategies to reduce risk
- developing and supplying new products that assist with adaptation
- working with policy makers
- making the business adjustments to support regional adaptation to climate change
- undertaking necessary in-house research to understand the implications that climate change is projected to have for each regional industry
- participating in regional vulnerability assessments and the development of adaptation responses
- contributing financial support or in-kind support as far as possible to the regional process.

1.4.3 Research institutions

South Australia's research institutions, including the major universities, the CSIRO, the South Australian Research and Development Institute, the Premier's Science and Research Council, the Museum and the State Herbarium, and Zoos SA have a clear role in undertaking the science and research that will underpin successful adaptation responses. Key roles for the research sector include:

- providing the relevant science to underpin policy development, including understanding of social and human capital aspects of adaptive capacity
- working with the Commonwealth to improve regional climate change projections, particularly in relation to the effects of rainfall on runoff and recharge, sea level rise and extreme events
- working with research institutions in other jurisdictions
- lobbying for national research funding
- ensuring South Australia's science and research priorities align with national priorities as outlined in the National Climate Change Adaptation Research Plans
- contributing to national and international research initiatives
- identifying gaps in knowledge and skills.

Adaptation involves taking action to minimise the negative impacts of climate change and to maximise the opportunities that may arise as a consequence of this change.

Adaptation responses need to occur at a range of scales across all sectors and levels of government. The development of successful responses requires consideration of the potential impacts and risks, and the assessment of community and sectoral vulnerabilities and adaptive capacity. Responses that successfully build resilience also need to take into account the complex interconnections between human and natural systems. It will also be important to understand the body of knowledge about individual and community resilience and the level of social and human capital as important precursors of successful adaptation processes. Research institutions have an important role in building this body of knowledge.

Adaptation is not an isolated, stand-alone agenda. It will need to be integrated into national, state, regional, sectoral and local planning processes, as well as at the operational level. With many adaptation actions needing to be undertaken by the private sector, it will be important to ensure

we have the right public policy settings to enable action. This will include creating regulations, market mechanisms and non-fiscal incentives to encourage businesses to incorporate climate change risk assessment into their systems and practices. Research will need to underpin the policy responses by Government.

The South Australian Government will take a leadership role in building the state's resilience and adaptive capacity to ensure that all South Australians are able to make timely and accurate decisions as they adjust to living in a changed climate. However, successful adaptation will ultimately require a collaborative approach across all sectors to ensure our long-term sustainability and ongoing prosperity.

1.5 Guiding principles for adaptation action

The implementation of the Adaptation Framework will be guided by the following set of principles that describe how adaptation responses will be prioritised, developed and delivered. These principles will guide responses at all levels to ensure a successful and consistent approach to adaptation in South Australia:

- Deliver adaptation actions where there is a plausible risk of harm even in the absence of complete scientific proof.
- Prioritise actions based on the careful assessment of risks, costs, efficacy and equity using the best available science to inform adaptation responses.
- Give priority to those sectors that are likely to provide the greatest social, economic and environmental benefit for the state.
- Develop responses at the most appropriate scale to effectively address risks and maximise opportunities.
- Involve individuals, industry, business, academia and all tiers of government in developing responses using a coordinated approach.
- Build on, enhance and learn from the experience of communities, sectors and regions in developing responses adaptation.
- Plan for uncertainty and take action using an adaptive management approach to allow for re-adjustments as new information arises.
- Use the best available, most appropriate and locally relevant science that is based on good data and robust processes to inform those best placed to deliver adaptation responses and manage risks.
- Take into account population projections and socioeconomic trends recognising uncertainty and need for flexibility to respond to emerging trends.
- Consider the interconnections between social, environmental and economic systems and the linkages between sectors in order to make appropriate tradeoffs where necessary.
- Ensure responses avoid unintended consequences and do not undermine our ability to adapt over the long-term.
- Take early action where there are demonstrated cost-benefits.
- Ensure that adaptation responses are appropriately integrated and mainstreamed.



2 Statewide objectives

This Adaptation Framework outlines four overarching statewide objectives for increasing South Australia's resilience to the impacts of climate change. This recognises that while the effects of climate change will be different across regions and sectors, there are overarching issues that are common across the state.

The following objectives largely focus on building the capacity of the business sector, industry, communities, individuals and natural systems to adapt to climate change through coordinating effort, providing strategic direction, understanding existing adaptation practices, making information and decision-making tools easily accessible, engaging with local communities, improving the responsiveness of government policy, and setting science and research priorities.

The four objectives are:

1. Leadership and strategic direction for building a more resilient state.
2. Policy responses that are founded on the best scientific knowledge.
3. Resilient, well-functioning natural systems and sustainable, productive landscapes.
4. Resilient, healthy and prosperous communities.

Objectives one and two focus on enabling action through providing leadership, strategic direction and high quality, relevant science and information. Objectives three and four reflect our societal and environmental goals for building resilient communities, businesses and natural environments. The latter two objectives are closely and inextricably interlinked.

State Government, local government, business, non-government organisations, the research sector and communities will all need to work together to achieve these objectives.

Objectives and strategies

The following section outlines the four statewide objectives and their underlying strategies. It describes the rationale for each of the objectives and the major partners required to work together at a range of levels to achieve them. The development and identification of specific government actions to deliver the objectives and strategies will be undertaken together with the regions in a process that will deliver locally specific actions with a state perspective.

Objective 1

Leadership and strategic direction for building a more resilient state

- Strategy 1.1** Lead South Australia's adaptation efforts
- Strategy 1.2** Build partnerships with the business community and non-government organisations
- Strategy 1.3** Incorporate adaptation into all decision-making
- Strategy 1.4** Actively participate in national and international initiatives

While action will need to occur at a range of levels, it is important for some responses to be coordinated at the whole-of-state level to reduce duplication, minimise costs, maximise opportunities for sharing information and ensure that adaptation responses are effective and build trust within the community.

Mechanisms and processes that will build resilience and adaptive capacity must be embedded into public and private sector decision-making and risk assessment. This will require the right policy settings and the creation of incentives to encourage action. The majority of adaptation responses will need to occur in the private sector, therefore it will be crucial for government to form strong partnerships with business and the scientific community.

It is also important for South Australia to continue to show leadership on climate change by actively participating in and seeking to influence national adaptation policy and programs, keeping up to date with international developments and making the most of commercial opportunities to export skills and knowledge.

Partners

State Government, Local Government, key business and industry groups, regional natural resources management boards, regional development boards, Bureau of Meteorology, and national policy fora such as Ministerial Councils.



Objective 2

Policy responses that are founded on the best scientific knowledge

Strategy 2.1 Establish a comprehensive science and research agenda for South Australia

Strategy 2.2 Identify and create the datasets and knowledge to underpin successful responses

Strategy 2.3 Use up-to-date, high quality and relevant science to inform an adaptive management approach to building resilience and adaptive capacity

Accurate, relevant and up-to-date science should underpin successful responses to build resilience. South Australia has excellent adaptation research and climate science capacity. It is vital that our efforts are coordinated, prioritised, and informed by the latest national and international developments. It is also important to acknowledge that there will always be uncertainties about the extent and impacts of climate change. To this end we will need to take an adaptive management approach that will allow sufficient flexibility to change our responses as new information arises. This will rely on continuously improving our knowledge and monitoring our responses. Community science programs, such as Climate Watch⁵, will also have an important role to play.

It is also vital that we have the right datasets to inform our responses. As yet, we do not have some of the underlying datasets that are essential to create the knowledge required to take action. Finally, we will need to make sure that local communities and businesses have access to, and understand, the science that they need to make effective decisions.

Partners

State Government agencies, Premier's Science and Research Council, the research sector and the science and technology industry



⁵ www.climatewatch.org.au

Objective 3

Resilient, well-functioning natural systems and sustainable, productive landscapes

Strategy 3.1 Increase the resilience of South Australia's terrestrial, aquatic and marine biodiversity

Strategy 3.2 Increase the resilience of primary production systems

Strategy 3.3 Strengthen policy links to achieve mutual benefits for climate change, biodiversity conservation and the sustainable use of landscapes and water

Our health, wellbeing and economic prosperity depend upon healthy, natural systems and the services they provide, such as clean water, climate regulation, healthy soils, pollination and nutrient recycling. Many natural systems in South Australia are already degraded. To increase natural system resilience we will need to reform our management objectives for biodiversity conservation to deal with the complexities created by climate change. We will need to increase ecosystem resilience and connectivity across the landscape through restoration and rehabilitation; manage major threats to biodiversity, many of which are likely to worsen under climate change; and ensure that protected areas conserve as many different ecosystems and habitats as possible.

Pests, weeds, soil erosion, water scarcity, loss of biodiversity, and extreme weather events threaten productive landscapes and primary industries that underpin the state's prosperity. Primary producers need support to identify opportunities for diversification, and the uptake of new technologies and management regimes. Farm management systems will need to incorporate measures that will increase resilience, and integrated approaches will be needed to address the impacts of fire, pests, weeds and diseases, all of which are expected to increase under climate change.

With flexible and integrated approaches to both mitigation and adaptation, there will be many opportunities to develop solutions that deliver positive mitigation and adaptation outcomes and enhance the sustainable use of natural resources and biodiversity values. We must ensure that we make the most of these opportunities.

Partners

The State Government, including the SA Research and Development Institute, Local Government, Regional Development Australia including regional natural resources management boards, South Australian Farmers Federation, Conservation Council of South Australia, Agricultural Excellence Alliance.



Objective 4

Resilient, healthy and prosperous communities

- Strategy 4.1** Build the resilience and adaptive capacity of businesses and communities at the regional and local levels
- Strategy 4.2** Create climate resilient urban areas
- Strategy 4.3** Address the needs of the most vulnerable members of the community
- Strategy 4.4** Empower people to take action by making relevant information and decision-making tools easily accessible
- Strategy 4.5** Increase community awareness and understanding of the opportunities for adaptation
- Strategy 4.6** Increase community resilience during times of crisis

The impacts of climate change affect the economy and the way that people lead their everyday lives. Building resilient, healthy and prosperous communities will involve spreading risk and maintaining economic and social diversity. It involves seizing opportunities, and promoting and recognising successes. It requires the ‘mainstreaming’ of climate change considerations into planning and policy (see Strategy 1.3), creating flexible decision-making frameworks, assessing the vulnerability of sectors and communities, and empowering people to take action by providing accessible information and decision-making tools. It will also require us to pay attention to the needs of the most vulnerable members of society, including the elderly, young children, and those who live in remote or highly vulnerable coastal communities.

Attention also needs to be given to businesses and sectors that have the potential to prosper through effective adaptation. Planning for training and workforce development is required to equip communities with the skills needed to take advantage of climate change opportunities – allowing them to make use of innovative solutions and technologies.

Creating resilient and adaptive human systems will also mean paying attention to increasing the resilience of natural systems, as healthy, diverse ecosystems underpin successful and prosperous communities (see Statewide Objective 3).

Partners

State Government, Local Government, industry, business, communities and individuals.



3 A regional approach to objectives

3.1 Introduction

Part 2 discusses the objectives we will need to pursue at the whole-of-state level, recognising that building resilience and adaptive capacity at the regional level is one of the key strategies to achieving Objective 4 – Resilient, healthy and prosperous communities. These objectives are primarily concerned with providing the policy settings and institutional arrangements that will build the adaptive capacity of businesses, communities and natural systems.

As already discussed, climatic change and its consequent economic, social and environmental impacts vary across South Australia's regions. As such, the different regions, including metropolitan regions, will need to develop their own approaches and actions based on the nature of their local economies, population structures, social cohesion and the surrounding natural environment.

The benefits of a regional approach include:

- developing regionally specific adaptation strategies that take into account differing circumstances and impacts
- strengthening the capacity and knowledge of organisations already familiar with their lands, waters, communities and climatic conditions
- forging relationships between regional organisations and authorities, across regions and with State Government agencies
- directly engaging local communities in the development of adaptive measures
- developing capacity so that those who bear the risks associated with climate change can adequately respond to those risks
- building a comprehensive, statewide picture of climate change vulnerability.

It will be important for regions to work together when developing adaptation responses, particularly to address issues that cut across more than one region, such as ensuring sustainable and productive landscapes, healthy water supplies and viable public infrastructure such as roads and pipelines.

The involvement of regional and local communities in the development of responses will be fundamental to success. Close involvement of the community will help to increase awareness and understanding about the possible impacts. This greater understanding will assist in building the capacity of communities and sectors to take action that will enable them to reduce risks, make knowledgeable decisions and maximise opportunities.

Local communities will be encouraged to work with regional organisations and State Government agencies to undertake climate change risk assessments, determine priorities and develop action plans to prepare for the likely local impacts of climate change.

3.2 Regional integrated vulnerability assessments

Understanding the sectors and systems that are most at risk and the interconnections between them will assist in successfully planning for adaptation. It will require consideration of the interconnections between sectors and the potential impacts on regional economies, communities and natural environments. This will be achieved, in part, through regional integrated vulnerability assessments (IVAs), which will allow regions to identify the most vulnerable sectors and systems so that appropriate adaptive responses can be planned, prioritised and programmed into investment strategies.

Understanding the interconnections is critical because:

- the increased occurrence of extreme events in South Australia such as bushfires, heatwaves and floods will have implications for human health; challenge disaster management, emergency and public health services; affect natural systems; and potentially reduce opportunities for tourism
- The extent of the impacts will vary across the regions
- the reduction in rainfall in areas reliant on primary production systems such as agriculture and forestry will affect local economies and challenge water supplies. This will, in turn, have implications for people's health, the social cohesion of local communities and the health of the surrounding natural environment.

The regional approach will be based largely on the following State Government regions (Table 2, Figure 3). There may need to be some adjustments to take into account the needs of particular areas.

Table 2 South Australian Government Regions

Eastern Adelaide	Fleurieu and Kangaroo Island
Northern Adelaide	Eyre and Western
Southern Adelaide	Far North
Western Adelaide	Limestone Coast
Adelaide Hills	Murray and Mallee
Barossa	Yorke and Mid North

The assessment of regional vulnerability will require consideration of the likely exposure of a sector or system to climatic changes, the extent to which the sector or system will be sensitive to those changes and the level of adaptive capacity within the sector or system (Figure 1).

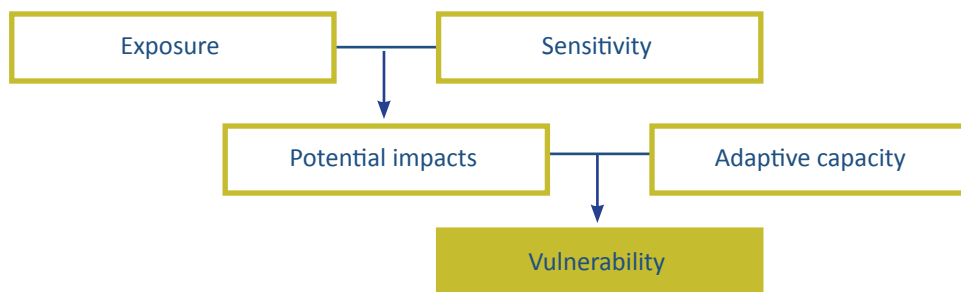
The Intergovernmental Panel on Climate Change (IPCC) has identified a list of criteria for assessing key vulnerabilities:⁶

- **Magnitude**—impacts are of a large scale (e.g. high number of people or species affected) or a high intensity (e.g. catastrophic degree of damage such as loss of life or extinction).
- **Timing**—impacts are expected in the short-term and/or are unavoidable in the long-term if not addressed.
- **Persistence/reversibility**—impacts result in persistent (e.g. water shortages) or irreversible (e.g. species extinction, melting of ice sheets) damage.
- **Likelihood/certainty**—projected impacts or outcomes are highly likely.
- **Importance**—sectors or systems at risk are of high value to society.
- **Equity**—the poor and vulnerable will be likely to be the most affected and are the least able to adapt.

Ultimately the findings of the IVAs and the identified responses will be incorporated into action plans for each region. They will also inform state strategies and plans, regional natural resources management plans, development planning and planning application regulations, industry plans and other relevant local level regulations. Although this will be a challenge for many regional communities, it will be fundamental to achieving successful adaptation.

⁶ Pew Centre on Global Climate Change. *Climate Change 101 – Adaptation*. http://www.pewclimate.org/docUploads/Adaptation_0.pdf

Figure 1 The process used for assessing regional vulnerability⁷



Exposure

What type of climate changes and impacts can we expect, and which systems will be exposed? What is the plausible range of severity of exposure, including the duration, frequency, and magnitude of changes in average climate and extremes?

Sensitivity

To what extent is the system (or systems) likely to be affected as a result of projected climate changes? For example, will the impacts be irreversible (e.g. death, species extinction or ecosystem loss)? What other substantial impacts can be expected (e.g. extensive property damage or food or water shortages)?

Adaptive capacity

To what extent can the system adapt to plausible scenarios of climate change and/or cope with projected impacts? What is feasible in terms of repair, relocation or restoration of the system? Can the system be made less vulnerable or more resilient?⁸

Source: Allen Consulting Group 2005, adapted from Schröter et al. 2004.

⁷The Allen Consulting Group (2005). *Climate change risk and vulnerability: promoting an efficient adaptation response in Australia*. Australian Government, Canberra

⁸ *Climate Change 101: Adaptation*. The Pew Centre on Global Climate Change. www.pewclimate.org

3.3 Regional agreements

To ensure that regional IVAs are coordinated, it is proposed to establish a series of regional agreements under Section 16 of the *Climate Change and Greenhouse Emissions Reduction Act 2007*⁹. The agreements will be between the Minister for Sustainability and Climate Change and key regional organisations such as natural resources management boards, Local Government, regional development boards and key private sector organisations.

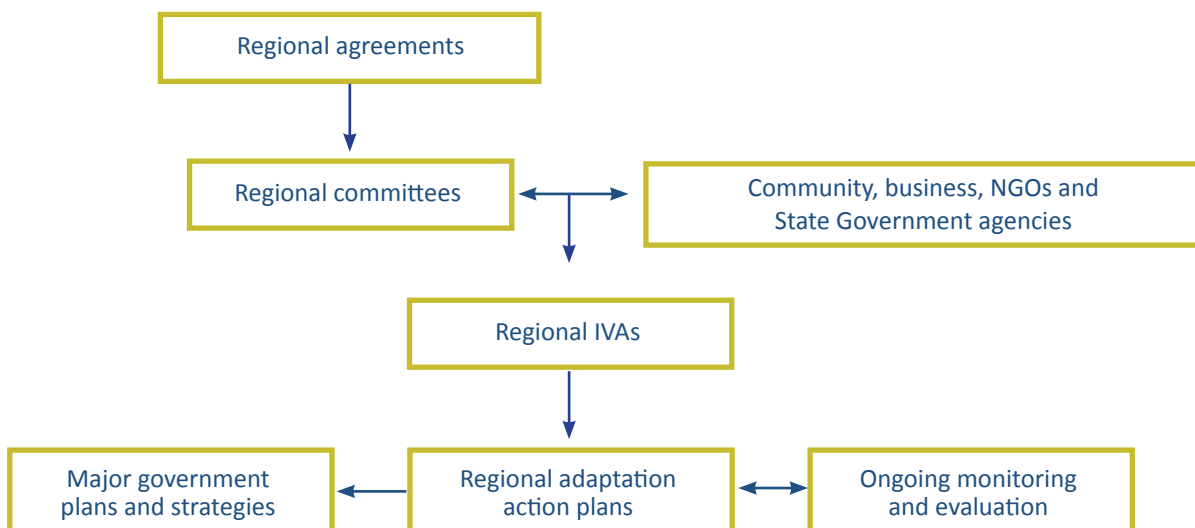
The regional approach will begin in the Eyre Peninsula region through the Eyre Peninsula Regional Sector Agreement between the Minister and the Eyre Peninsula Natural Resources Management Board, the Eyre Regional Development Board, the Whyalla Economic Development Board and the Eyre Peninsula Local Government Association. A major outcome will be the state's first regional climate change adaptation plan.

Signatories to the agreements will form regional committees that will take responsibility for planning and managing the IVAs and prioritising, planning and managing adaptation responses in close consultation with business and the wider community (see Figure 2). Specific roles of the regional committees will include:

While the Eyre Peninsula Sector Agreement will guide the regional approach to adaptation, responses will need to be developed that take into account the specific regional conditions and circumstances.

- overall coordination of vulnerability assessments and adaptation planning
- facilitating and directing vulnerability assessments across the relevant sectors in each of the regions
- engaging local communities to ensure the results of vulnerability assessments are understood
- engaging local communities in the development of adaptation strategies and actions
- ongoing monitoring and evaluation of the process
- developing and enhancing adaptation methodologies promoting opportunities and best practice in other regions.

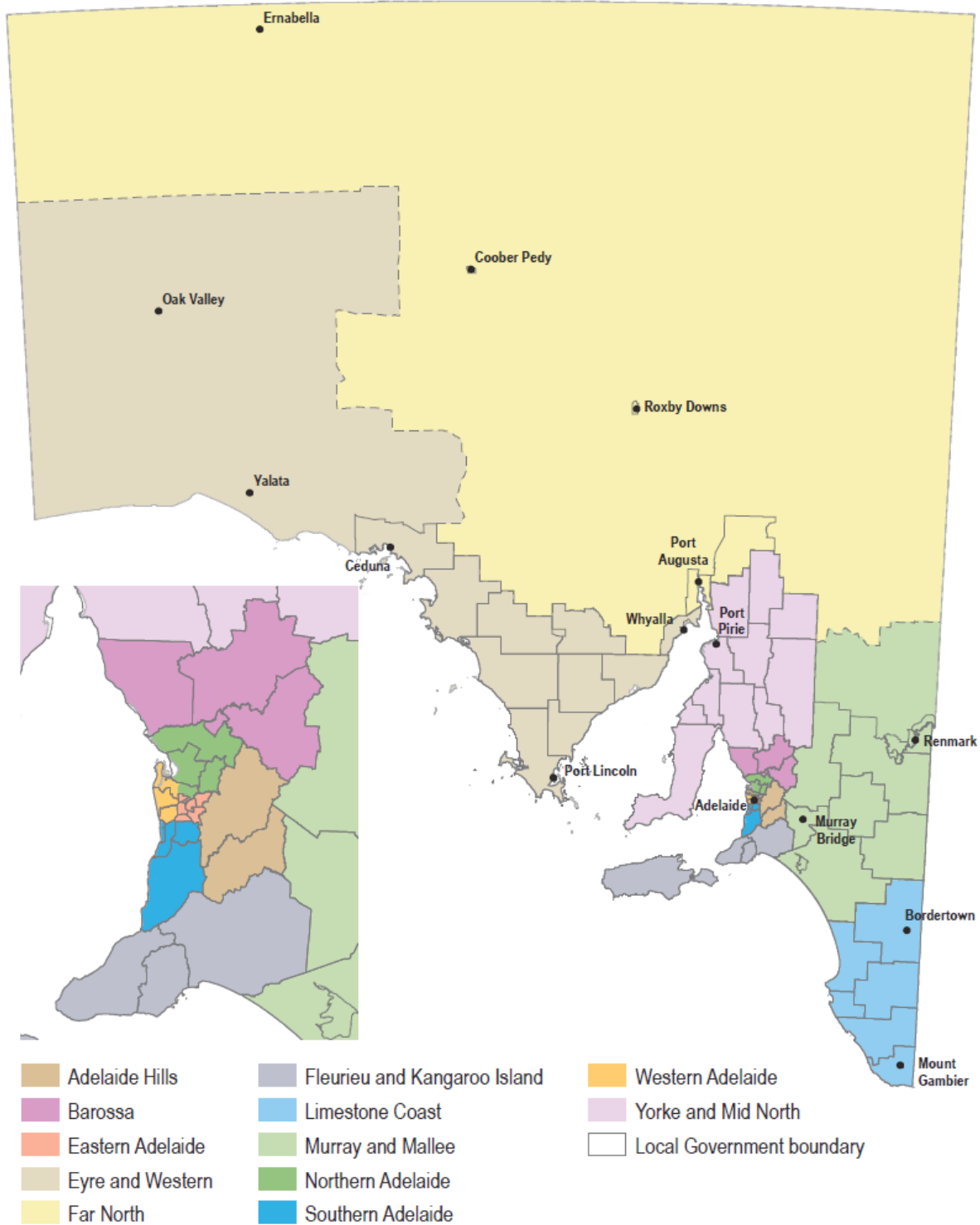
Figure 2 The regional model for developing adaptation responses



⁹ Section 16 provides that the Minister may enter into agreements (sector agreements) with a particular person or entity or industry or business group on a voluntary basis and may provide for such matters as developing strategies to adapt to climate change.

Figure 3 State Government Regions

South Australian Government Regions



0 100 200 300 km

Map prepared by Planning SA, December 2007.


 Government of South Australia
 SPAR ID: 2600

4 Sectoral Impacts, Challenges and Responses

4.1 Introduction

When potential regional effects are understood key sectors will need to develop adaptation responses that build resilience to climate change, with action required at the statewide, regional and individual enterprise levels. Sectoral responses will need to take into account the economic, social and environmental implications of climate change, and the complex interactions between sectors.

The sectors below have been identified at a national level as key adaptation sectors. The manufacturing and minerals and energy sectors have also been included to ensure relevance to South Australia.

Key sectors

- Community health and individual wellbeing
- Forestry
- Water resources
- Coastal regions
- Biodiversity
- Infrastructure and the built environment
- Agriculture
- Emergency management
- Fisheries and aquaculture
- Tourism
- Minerals and energy
- Manufacturing

All sectors will be vulnerable, but the risks will vary depending upon the sensitivities to climatic changes and the level of adaptive capacity within each sector. For example, primary production that is heavily influenced by climate and dependent upon natural resources will be particularly vulnerable. A risk-based approach, combined with flexible decision-making processes, will underpin successful responses.

Adaptation responses for the sectors are likely to fall into four broad categories¹⁰:

- **Accepting the impacts and bearing the losses**—this reflects a decision that no specific action is required to deal with the identified level of risk as existing systems and procedures are sufficient or the costs of adaptive strategies outweigh the benefits.
- **Preventing effects or reducing risks**—this involves introducing measures to provide some degree of protection such as relocating, changing use, improving preparedness and building resilience.
- **Offsetting losses by spreading or sharing risks or losses**—this involves reducing losses by using insurance or establishing partnerships or cooperatives to share risks or losses.
- **Exploiting positive opportunities**—this involves introducing new activities, behaviours, technologies, practices or species to take advantage of changed climatic conditions.

The following sections summarise the likely impacts of climate change on each of the key sectors and outline the critical considerations that should be taken into account when developing adaptation responses. Specific actions will depend upon the outcome of the regional IVAs.

It is envisaged that statewide sectoral responses will be primarily informed by the regional IVAs, which will identify those issues that cut across regions and therefore will be addressed most effectively at the state level.

¹⁰ UK Climate Impacts Programme. *Identifying adaptation options*. http://www.ukcip.org.uk/images/stories/Tools_pdfs/ID_Adapt_options.pdf



4.2 Community health and individual wellbeing

Climate change will have direct and indirect impacts on communities and the individuals within them. Some regions and socioeconomic groups are likely to be more affected than others. Those South Australians who are least economically equipped to move or adapt their living conditions are likely to be the hardest hit, such as elderly people, Aboriginal communities, those with a disability, young children and those on low incomes. However, all South Australians will experience some level of impact on their health and wellbeing as a consequence of climate change.

Human and social capital is a key determinant of adaptive capacity and is as important to climate change adaptation as levels of income and technological capacity. Community organisation is an important factor in adaptive strategies to build resilience; therefore communities with low social capital are likely to be more vulnerable to the impacts of climate change both in terms of poor community function, and individual physical and mental health consequences.

The diversity of health risks presents a significant challenge to South Australia's health and community services. As such, understanding the risks, identifying vulnerable members of the community and devising appropriate adaptation strategies will need to take into account current and future demographic trends, including population growth and socioeconomic factors.

Possible impacts

Changes to our climate such as lower rainfall, higher temperatures and extreme weather events are likely to have significant impacts on community and individual wellbeing. While adaptation aims to capture new opportunities and reduce the adverse climate change impacts, climate change remains a threat to our current way of life and the viability of some communities. Some of the direct and indirect impacts could include:

- loss of quality of life and wellbeing
- disruption of social networks, and forced migration
- lack of information, knowledge and skills
- sense of hopelessness and abandonment, stress, confusion, agitation and fear
- heat stress, especially during heat waves
- increased risks to life and property as a consequence of greater and more frequent extreme events such as bushfires and flood

- an increase in the frequency of vector-borne infectious diseases such as Ross River Virus
- an increase in air pollution (e.g. from dust and bushfire smoke) that may increase respiratory diseases and allergies
- an increase in the frequency of water and food-borne infectious diseases
- a reduction in food production, crop yields and nutritional quality
- the physical and mental health consequences that occur when communities are dislocated or displaced.

In South Australia it is heat-related deaths that are likely to take the highest toll, particularly with an ageing population, which is generally less tolerant to heat.

In March 2008, Adelaide experienced 15 consecutive days of 35°C or higher and 13 consecutive days of 37.8°C or higher – almost doubling previous records and setting new records for any Australian capital city.

In January/February 2009 a maximum temperature of 45.7°C with a minimum temperature reaching 33.9°C was recorded. Police reported increased sudden mortality during this event.

Possible opportunities

- The cross-sector focus on climate change adaptation has the potential to deliver community health and individual wellbeing through proactive measures by, for example, delivering healthier lifestyles such as walker-friendly urban design.
- Fostering greater community cohesion.
- More effective emergency and surveillance responses arising from better decision-making that is based on improved information.
- Reduced exposure to poor air quality, especially of the more vulnerable sectors of the population.

Adaptation responses:
Critical considerations for community health and individual wellbeing

A wide range of issues will need to be taken into consideration when developing adaptation responses for community health and individual wellbeing, including:

- building of social and human capital as a means of creating more resilient communities and increasing their adaptive capacity
- the linkages between the health sector and other sectors, particularly emergency management, water resources, primary industries, and infrastructure and urban planning
- the human health risks faced by vulnerable groups in the community, including the elderly, people with a disability or illness, remote and indigenous communities, children and the poor
- the impacts on both mental and physical health

- the consequences of both direct (e.g. heat-waves) and indirect (e.g. spread of infectious diseases) impacts on health
- the capacity of local health and community services to respond in emergency situations (e.g. bushfire or extreme heat wave).

Key partners

The following organisations will play a major role in developing adaptation responses for the community health and individual wellbeing sector:

- Department of Health
- Department for Families and Communities
- Country Health Services
- Department of Planning and Local Government
- Health advisory councils
- Local councils
- Local Government associations
- NGOs involved in community care



4.3 Water resources

Low and highly variable rainfall has always been a challenge in South Australia. Higher temperatures, lower average rainfall and higher evaporation rates will pose additional and much more serious challenges for the state's future water supplies; protecting them will be a top priority.

Adapting to drier conditions will mean thinking about completely new ways of managing our rural and urban water supplies. This will involve using a mix of traditional water sources in combination with water re-use and the use of water sources that do not rely on rainfall, such as desalinated water.

Uncertainty about the exact impacts of climate change and what this means for future water supplies in South Australia means that sustainable water management measures must be incorporated into all planning and infrastructure decisions at both the statewide and regional levels.

Possible impacts

Adelaide has been flagged as one of the most likely of Australian cities (alongside Perth) to suffer water shortages as the consequence of climate change¹¹, with associated extreme effects on productivity, and operational, maintenance and capital expenditure.

Over the last few years, South Australia experienced unprecedented dry conditions; flows into the River Murray are at the lowest since records began 118 years ago.

This has reduced flow and quality of water into water storages, prompted widespread water restrictions and placed constraints on rural water supplies. Rivers and wetlands, and the communities they support, have also suffered from reduced flows and the over-allocation of water resources. Estuaries and inlets, which support highly productive ecosystems, have degraded and groundwater systems have declined.

Threatened water security has serious economic, social and environmental implications for South Australia. It puts at risk our primary industries, and the quantity and quality of urban and rural water supplies; this will have serious implications for regional economies and the health and wellbeing of local communities.

Additionally, the population and economic growth expected over the next few decades could pose additional challenges.

Possible opportunities

- Building on our expertise in sustainable water management technologies, including sustainable irrigation, water recycling, stormwater capture, storage and use, desalination, water trading and infrastructure.
- Improving water allocation and water resource management to provide water to the environment.
- Increasing use of environmental regulators to use limited water resources more efficiently and to effectively regulate new sources such as desalination.
- Fast-track water quality improvement plans for key catchments.

Adaptation responses:

Critical considerations for water resources

A wide range of issues will need to be taken into consideration when developing adaptation responses for water resources, including:

- the linkages with other sectors, particularly community health and individual wellbeing, agriculture, biodiversity, infrastructure and mining
- Commonwealth/state agreements and regulatory arrangements
- vulnerable communities and ecosystems
- current water allocations and land use change resulting in higher water use
- environmental water needs
- the capacity of current surface and ground water storages to deal with flood events
- the sustainability of current and new sources of water
- the impact of a decrease in rainfall on runoff and recharge
- the impact of increase in temperature and heat stress on water demand
- reduced recharge to coastal groundwater aquifers through seawater intrusion
- the impact on stream flow
- the capacity of current surface and ground water storages to deal with flood and low flow, and recharge events.

¹¹ http://www.garnautreview.org.au/pdf/Garnaut_Chapter6.pdf

Key partners

The following organisations will play a major role in developing adaptation responses for the water resources sector:

- SA Water
- Department for Water
- Department of Environment and Natural Resources
- Environment Protection Authority
- Local councils
- Local Government associations
- Primary Industries and Resources South Australia
- Department of Planning and Local Government
- Stormwater Industry Association of South Australia
- Water Industry Alliance
- Australian Water Association (SA Branch)
- Regional natural resources management boards
- Resources and Energy Sector Infrastructure Committee
- South Australian Chamber of Mines and Energy
- Centre for Water Management and Reuse



4.4 Coastal management

The state's vulnerability to sea level rise has long been recognised. As a consequence, South Australia has led nationally in developing strategic responses to sea level rise and coastal flooding and erosion; the Coast Protection Board's 1991 sea level rise policy¹² was incorporated into state coastal development plans in 1994¹³.

This policy is currently being reviewed in light of 2007 projections by the IPCC in its Fourth Assessment Report, which indicates rises of between 0.19m and 0.78m by 2100¹⁴. Research conducted since then, which has improved knowledge and quantification around the uncertainties in the IPCC report, has also been considered in this review. This more recent research indicates potentially higher sea level rises than quantified by the IPCC¹⁵. Modelling based on 2002 IPCC projections indicate that 0.5 metre of sea level rise would flood the centre of Port Adelaide and a current one in 100-year flood would occur annually. This modelling is being updated to reflect the 2007 scenarios.

Monitoring conducted by the Bureau of Meteorology shows that sea levels have been rising at Port Stanvac at an average rate of 5.1mm per year since 1992. The average sea level rise in South Australia over the previous century (as calculated from tidal records) was 1.5mm per year.

Regional areas such as the Yorke Peninsula are particularly vulnerable. Increasing development in the region, which is popular for retirees and people seeking a sea change, exacerbates the risks. In a first for Australia, and possibly the world, the South Australian Supreme Court rejected a developer's appeal for an 80-lot subdivision at Marion Bay in March 2008 on the grounds of the risk posed by future sea level rise.

Possible impacts

Sea level rise, increased coastal flooding, storm surges, coastline erosion, reduced sediment production through ocean acidification and aridification pose a significant and immediate threat to coastal communities and natural environments along South Australia's coastline. It has been estimated that more than 60,000 buildings along South Australia's coast are likely to be at risk in the absence of any adequate protection measures¹⁶.

An increased dependence on desalination will result in intensified impacts from brine discharges, which would require appropriate regulation and management into the future.

There will be potential impacts on all sectors, including tourism, emergency management, and the insurance and finance sectors. It may also lead to the disruption of local communities and increasing levels of stress and tension, which will have implications for the health sector.

Across the state, there is the potential for billions of dollars worth of losses associated with damage to critical infrastructure, property, agricultural land and natural environments. Coastal landowners and lenders in the banking and finance sector face significant losses associated with the inundation or erosion of land by rising sea levels.

Coastal ecosystems, including estuaries, coastal vegetation, wetlands and reefs will also be vulnerable, as will land adjacent to the coast that is used for primary production, industry and residential purposes. Increases in coastal erosion will pose a risk for seagrass, an important source of carbon sequestration and nursery for many fish stocks.¹⁷

The effects of sea level rise in the Northern Adelaide metropolitan region will be exacerbated by a subsiding coastline.

¹² Policy on Coast Protection and New Coastal Development 1991, consolidated in 2002 into the Coast Protection Board Policy Document (http://www.environment.sa.gov.au/coasts/pdfs/cpb_policy_document_2002.pdf)

¹³ 30cm by 2050 and 1 metre by 2100

¹⁴ Note these do not take into account the melting of major ice sheets

¹⁵ The Copenhagen Diagnosis, 2009: Updating the world on the Latest Climate Science. I. Allison, N. L. Bindoff, R.A. Bindaschadler, P.M. Cox, N. de Noblet, M.H. England, J.E. Francis, N. Gruber, A.M. Haywood, D.J. Karoly, G. Kaser, C. Le Quéré, T.M. Lenton, M.E. Mann, B.I. McNeil, A.J. Pitman, S. Rahmstorf, E. Rignot, H.J. Schellnhuber, S.H. Schneider, S.C. Sherwood, R.C.J. Somerville, K. Steffen, E.J. Steig, M. Visbeck, A.J. Weaver. The University of New South Wales Climate Change Research Centre (CCRC), Sydney, Australia, 60pp. <http://www.copenhagendiagnosis.org/>

¹⁶ <http://www.climatechange.gov.au/en/climate-change/impacts/national-impacts/sa-impacts.aspx>

¹⁷ Adelaide Coastal Waters Study and Improvement Plan

¹⁸ Living Coast Strategy for South Australia (2004), Action 4.3: Establish Effective Development Controls

¹⁹ Living Coast Strategy for South Australia (2004), Action 4.2: Protect Coastal Assets

Possible opportunities

- Maintaining SA's leading role in coastal policy development and application, further developing the state's expertise in climate change adaptation.
- Integration of coastal adaptation policy and measures across sectors, particularly with emergency management and the state's planning system. This will ensure the security of new settlements from the foreseeable impact of sea level rise and other coastal impacts of climate change. It will also guide the adaptation of existing communities to the impacts of climate change.
- Strategic allocation of land adjacent to the coast to allow sea level rise-induced retreat of tide-dependent ecosystems (e.g. mangroves and saltmarsh).
- Regulation of coastal dredging and discharges.

Adaptation responses:

Critical considerations for coastal management

Consistent with the Living Coast Strategy (2004) the Government is pursuing improved coastal zoning in development plans and increased powers of direction for the Coast Protection Board over applications for development subject to unaddressed coastal hazards.¹⁸

However, while these are necessary actions to ensure that new development and infrastructure is not placed at risk from climate change impacts, planning for adaptation in coastal regions must be extended beyond the current development plan-based instruments. This needs to include strategic IVAs (see Part 2) to identify the sectors, assets, infrastructure and communities that are at risk, and the capacity of businesses and the community to respond. This will form the basis for developing regionally and locally tailored adaptation responses via a coast protection strategy for the whole of the South Australian coast.¹⁹

Key partners

Major partners in developing coastal strategies include:

- Coast Protection Board
- Department of Environment and Natural Resources
- Local Government associations
- Department of Planning and Local Government
- Local councils
- Regional development boards
- Regional natural resources management boards
- Department for Water
- Environment Protection Authority.

4.5 Biodiversity

Healthy and diverse natural systems are essential to support vibrant economies and healthy, prosperous communities. Natural systems provide us with a wide range of benefits, including carbon storage, nutrient recycling, water purification, pollination of crops, climate regulation and support for fisheries and aquaculture. A healthy environment also supports South Australia's multi-million dollar tourism industry and provides areas of natural beauty for recreation and relaxation.

It is highly probable that climatic changes will affect the ability of natural systems to deliver these vital services. This will affect our way of life and compromise the state and regional economies.

Human activities over the last two centuries have placed South Australia's native plants, animals and ecosystems under significant pressure as a result of many factors including habitat fragmentation, the introduction of invasive species, altered fire regimes, pollution and urban development. Climate change is likely to exacerbate many of these pressures, which may stretch the limits previously encountered by many ecosystems.

The impact of climate change on natural systems extends beyond changes to rainfall and temperature, and includes changes in ecological processes influenced by hydrological and fire regimes. More intense and frequent bushfires and changed water availability will threaten recruitment and regeneration opportunities for many species. More intensive management of fire risk through prescribed burning may further exacerbate this.

Some species will be advantaged by climate change and are likely to become more abundant or have an increased distribution as their available habitat expands.

Possible impacts

Plants, animals and microorganisms will be especially affected by climate change as they will have more difficulty than humans in adapting to large-scale, rapid changes in climate and the climate change induced increases to other stressors such as pest species. Native species would have little ability to move to more suitable environments within the predicted timeframes for climate change.

While there is reasonable agreement among scientists that climate change is already starting to affect some species and ecosystems, there is still uncertainty about the specific impacts, however, these are likely to include:

- changes in the distribution and abundance of species (including invasive species)
- changes in reproduction timing and duration, fecundity and growth rates
- species and ecosystem migrations
- changed interactions between species
- changes in coastal, estuarine and aquatic habitat
- warmer and more acidic marine environments
- fragmentation and changes of habitats
- loss of species.

Research by the South Australian Government indicates that land-based species and ecosystems restricted to Kangaroo Island and the Mount Lofty Ranges are likely to be among the most vulnerable. Coastal ecosystems, including bird species that are internationally significant, will also be vulnerable to sea level rise, storm surges and reduced rainfall.

There is insufficient information about the impacts of climate change on ecosystems and species in many regions of the state, particularly for marine ecosystems. As such, this information is needed as a matter of priority.

Possible opportunities

- Rehabilitating previously cleared or degraded natural systems if current land uses become unviable.
- Biosequestration.
- Managing and restoring key ecological assets.
- Creating greater connectivity between fragmented habitats to enable species to adapt to changing conditions.
- Strategic use of environmental water to build resilience.

Adaptation responses:

Critical considerations for biodiversity

Building the resilience of natural systems is a key objective of this Adaptation Framework. (See Strategy 3.1 for further information.)

A wide range of issues will need to be taken into consideration when developing adaptation responses for biodiversity, including:

- acknowledging the vital role that healthy natural systems play in supporting prosperous communities and vibrant economies
- developing new approaches to manage the impacts of climate change, existing threats and the complex interactions between them
- developing bio-physical monitoring programs to inform modelling and other research to better understand ecosystem trajectory
- accepting that change is inevitable but also ensuring that action is taken so that ecosystems continue to function properly
- giving priority to conducting risk assessments for species, ecosystems and processes
- allowing buffers and corridors for tide-dependent ecosystems to migrate to higher ground in response to rising sea levels, and along the coast in response to climatic changes
- ensuring buffers near sand dunes allow for large-scale sand movement in the event that stabilising vegetation dies off as a result of aridification
- ensuring management strategies are flexible to allow for readjustment as new information arises
- developing regional partnerships to support on-ground activity
- considering and assessing the full range of biosequestration possibilities inherent in biodiversity conservation, including the carbon capture potential in restoration of coastal seagrass meadows

- improving biosecurity measures for the prevention of the establishment or spread of high-risk invasive plants and animals
- long term monitoring of ongoing changes in the distribution and abundance of invasive species
- promoting buffers for inland aquatic ecosystems affected by changing climate-driven flow regimes
- developing an adaptive monitoring framework to enable tracking of population and distribution trends in species and communities.

Key partners

The following organisations will play a major role in developing adaptation responses for the biodiversity sector:

- Department of Environment and Natural Resources
- Department for Water
- Local Government associations
- Local councils
- Primary Industries and Resources SA
- Department of Planning and Local Government
- Environment Protection Authority
- Conservation Council of South Australia
- Nature Conservation Society
- Environment Institute, University of Adelaide
- NRM Council
- Regional natural resources management boards
- Coast Protection Board



4.6 Agriculture

Agriculture in Australia has evolved to cope with risk and uncertainty, not only in relation to an extremely variable climate but also in response to issues such as market supply and demand cycles and legislative arrangements. Farmers have subsequently developed highly adaptive land management practices. However, long-term climate change may result in changed farming systems and could push some systems beyond their viable limits. This may drive the need to identify opportunities for diversification, economic restructuring and development of new systems.

Agriculture is a significant contributor to South Australia's economy. In 2008/09 the State Gross Food Revenue was \$12.3 billion. However, the industry faces significant challenges, which will vary across regions. As such, adaptive management strategies that allow producers to increase their resilience and adjust or diversify their management regimes to take into account current or future changes in climate will be vital.

To ensure that South Australian agricultural businesses remain viable and continue to be competitive, producers will need to take into account potentially changing consumer demands for agricultural produce and implications for the entire value chain.

Possible impacts

While the predicted drying and warming trends for South Australia are expected to cause a range of impacts on agricultural systems, the precise effects are uncertain. However, they are likely to include:

- fundamental shifts in agricultural practices and capability, including changes in crop type
- changes to crop yields and produce quality
- changes to the quality of some crops
- impacts on livestock (e.g. drinking water, pasture quality and heat stress)
- changes to soil carbon levels
- impacts on flowering, pollination and fruit set
- increased susceptibility of some soils to erosion
- a reduction in the potential for expansion of irrigated agriculture
- greater exposure to pests and diseases
- loss or damage from extreme events
- reduced volume and quality of water resources, including a potential reduction in the current irrigated area
- changes to dryland salinity in response to decreased rainfall and increased temperatures, bushfires and extreme rainfall events

- changes in abundance and distribution of invasive species
- reduced reliability and availability of water supplies for livestock
- loss of sustainable landscapes.

Possible opportunities

- Leading internationally on the development of sustainable food and farming systems, including the development of bio-fuels, soil carbon capture technologies, bio-char-type soil conditioners and drought tolerant crops.
- More efficient use of energy and water, including in-situ desalination.

Adaptation responses:

Critical considerations for agriculture

A wide range of issues will need to be taken into consideration when developing adaptation responses for agriculture, including:

- the linkages with other sectors, particularly water, urban development, biodiversity and human health
- biosecurity risks associated with fire, water availability, pests, diseases and weeds
- regulatory impacts of changing land use demands
- structural change in the industry and within regional areas
- the impacts of climate change on soil carbon levels and soil structure
- ensuring flexible planning and investments to allow for adjustment as conditions change
- the need to build resilience into the whole supply chain – from the farm-gate to the market
- potentially changing demands from consumers for agricultural products and the need for the entire value chain to understand the implications of these demands
- increasing demand for agricultural crops as world population rises
- conflicts of demand for pasture and grain feed for livestock with rising demands for human consumption and biofuels
- appropriate training and skill development for producers to manage production, environmental and market-based risks
- reducing cost structure of farm business through efficiencies of scale.

Key partners

The following organisations will play a major role in developing adaptation responses for the agriculture sector:

- Primary Industries and Resources SA
- South Australian Research and Development Institute
- Local councils
- Local Government associations
- Department for Water
- NRM Council
- Regional natural resources management boards
- Department of Environment and Natural Resources
- Regional development boards
- South Australian Farmers Federation
- Industry associations
- Future Farm Industries Cooperative Research Centre
- Agriculture Excellence Alliance
- Advisory Board of Agriculture
- Agriculture Bureau
- Regional development boards
- Department of Planning and Local Government
- Environment Protection Authority



4.7 Fisheries and aquaculture

The effect of climate change on fisheries and aquaculture, including the interaction between the two sectors, will have a range of social, economic and environmental impacts, many of which require further research. For example, impacts on the recreational fishing industry will flow through to communities and other industries that rely on the fisheries sector, such as tourism.

A key challenge for fisheries, not only for South Australia but also nationally, is greater precision in estimating the vulnerability of wild fish stocks to inform the development of sustainable management strategies. It will also be important to take into account the risks posed by non-climate change related threats on fish populations, such as over-fishing.

Possible impacts²⁰

Fisheries

Marine fisheries are a significant industry in South Australia, contributing around 22% of Australia's total fisheries production. While there remains considerable uncertainty about the precise impacts of climate change on fisheries, increasing ocean temperatures, acidification, changes to ocean currents and rainfall patterns, altered coastal processes and extreme weather events are all likely to affect commercial and recreational fisheries. Some of the likely impacts include:

- changes to distribution patterns, breeding and growth rates, physiology and migration patterns
- risks to marine biosecurity through the spread of pests and diseases
- a decrease in the productivity and diversity of zooplankton, which underpin marine food chains
- degradation of samphire and mangrove communities, which provide shelter and food for a range of commercially and recreationally important fish in South Australia, including King George whiting and prawns.

The combination of ocean warming around Australia and strengthening of boundary currents like the East Australia Current is already changing the distribution, growth, recruitment and wild catch of some fisheries. Southern-ranged species, including those in South Australian waters, are the most likely to be affected. Initial estimates suggest that prawn, western rock lobster, salmon and estuarine species could be particularly vulnerable.

Aquaculture

Aquaculture production represents almost 56% of the state's total seafood production. In 2007/08 the total value of South Australian aquaculture was estimated at over \$657 million.

Increased flood events are likely to result in larger than usual volumes of stormwater being discharged into the sea. This will affect nutrient levels and water quality around aquaculture developments potentially causing death and an increased risk of disease. It may also cause the more regular closure of shellfish sites through quarantine regulations.

Ocean warming and increased sea levels are beginning to influence the location of some aquaculture sectors and the species that can be farmed successfully in some locations. Repositioning sites may be difficult due to possible increased risk to infrastructure damage due to more frequent storm events. A decline in rainfall and therefore water availability could affect land-based aquaculture industries that rely on a freshwater supply. The supply of feed ingredients, such as soybean meal and plant protein, for aquaculture operations may be compromised by climate change.

Possible opportunities

- Investing in sustainable, climate change-adapted local food industries could provide employment and a vigorous and innovative food market.

Adaptation responses:

Critical considerations for fisheries and aquaculture

A wide range of issues will need to be taken into consideration when developing adaptation responses for fisheries and aquaculture, including:

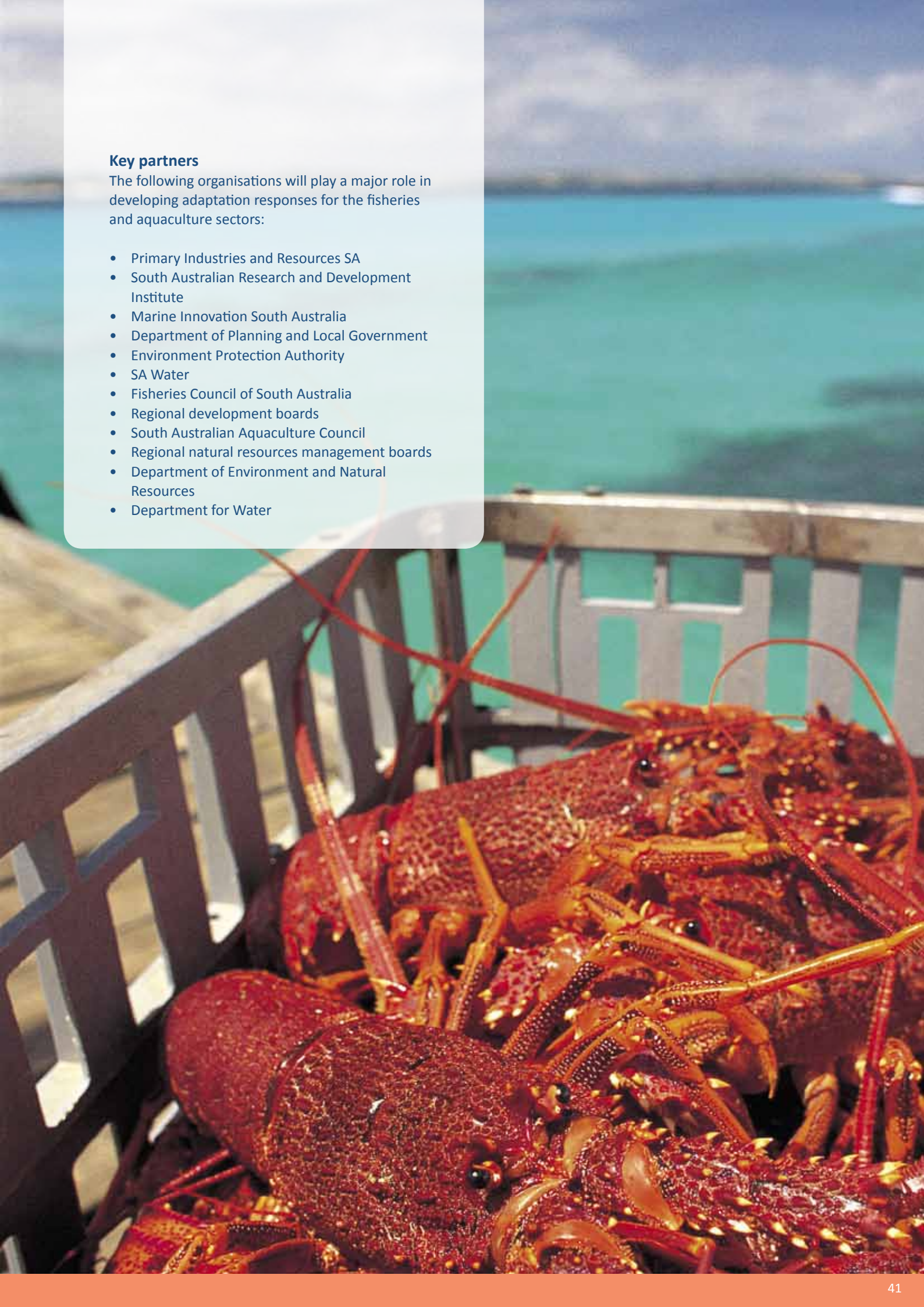
- the linkages with other sectors, particularly water, tourism, biodiversity and emergency management (storm surges and impacts on fishing and aquaculture)
- the risks posed by non-climate change related impacts, such as over-fishing or land-use decisions
- the potential impacts on critical fishing infrastructure, such as jetties and wharves.

²⁰ The majority of information in this section is summarised from *The implications of climate change for Australian fisheries and aquaculture – a preliminary assessment* <http://www.climatechange.gov.au/~media/publications/fisheries/fisheries.ashx>

Key partners

The following organisations will play a major role in developing adaptation responses for the fisheries and aquaculture sectors:

- Primary Industries and Resources SA
- South Australian Research and Development Institute
- Marine Innovation South Australia
- Department of Planning and Local Government
- Environment Protection Authority
- SA Water
- Fisheries Council of South Australia
- Regional development boards
- South Australian Aquaculture Council
- Regional natural resources management boards
- Department of Environment and Natural Resources
- Department for Water



4.8 Forestry

The impact of climate change on plantation forests is likely to have long-term economic, social and environmental consequences. A large proportion of the land that is used for forestry has multiple purposes, including providing recreation opportunities and habitat for native plants and animals – all of which would also be affected with any reduction in the health of forests.

A reduction in forest productivity would have significant economic impacts on industries that rely on round wood, with flow-on effects to local communities.

Managing for climatic variability is particularly important for forestry as it can take many years for trees to produce a commercial product, for example it takes around 35 to 40 years to produce a final crop in Radiata Pine and about 12 years for hardwood.

The ability of forests to provide carbon sinks whether or not they are recognised under the Kyoto Protocol provides a strong incentive to ensure that the industry adapts and remains viable.

Possible impacts

Forestry and forest industries are a significant contributor to South Australia's economy, particularly in regional areas. The sector generated approximately 30% of the gross regional product of the South East Region and 25% of the employment²¹. The wood processing industry produced around 10% of the state's manufacturing production.

As with many other primary industries, it is expected that drier conditions and increased temperatures will affect the state's forestry industry, although the degree to which it will be affected is uncertain. Reduced rainfall and higher average temperatures may affect growth rates, the frequency and intensity of bushfires and attack by pests, diseases and weeds. Forest ecosystems that are already under pressure from salinity, fragmentation and competing demands for its inputs will be less resilient to climatic change.

South Australia's commercial tree plantings are concentrated in the South East, and to a lesser degree in the Mount Lofty Ranges, Mid North and Kangaroo Island. These plantations may be vulnerable, particularly to reduced rainfall. The areas considered commercially viable for forestry may shift geographically, shrink or expand.

Increased atmospheric levels of carbon dioxide are expected to cause physiological changes that may benefit forest growth. However the precise effects will depend upon the balance between the benefits of increased carbon dioxide concentrations and the extent of changes in rainfall and temperature²².

Possible opportunities

- Biosequestration and biofuels from forest products and residue.
- Shade and shelter for native fauna and productive livestock.

Adaptation responses:

Critical considerations for forestry

A wide range of issues will need to be taken into consideration when developing adaptation responses for forestry, including:

- the linkages with other sectors, particularly emergency management, manufacturing and tourism
- emergency management and biosecurity risks associated with fire, rainfall, pests, changing weather patterns, diseases and weeds
- ensuring management and manufacturing strategies are flexible to allow for readjustment as new information arises
- increasing demand for plantation products as logging of native and rainforests decreases nationally and globally
- education and training to maximise production and the capacity of the workforce to adapt to changing climatic conditions.

Key partners

The following organisations will play a major role in developing adaptation responses for the forestry sector:

- Primary Industries and Resources SA
- Forestry Industry Development Board
- South Australian Forestry Corporation
- Department for Water
- Department of Environment and Natural Resources
- South Australian Research and Development Institute
- Regional natural resources management boards
- Green Triangle Regional Plantation Committee
- Local councils
- Local Government associations
- Regional development boards
- Industry associations
- South Australian Fire and Emergency Services Commission.

²¹ http://www.pir.sa.gov.au/forestry/programs/forest_policy

²² <http://www.csiro.au/files/files/plhg.pdf>



4.9 Infrastructure and urban areas

The costs associated with the adaptation of infrastructure to climate change will be high, but it is likely to be more expensive in the long-term if responses are delayed. However, the long lifespan of most infrastructures can make early responses problematic, because most, such as roads, pipelines, bridges, railways and ports, are designed for a life of 50 to 100 years. It will be a major challenge to adapt existing infrastructure so that it can cope with expected climatic changes.

The planning and development sector faces a major challenge in facilitating adaptation responses for settlements and infrastructure. This will require incorporation of the impacts of climate change into policy and regulatory instruments for land use and urban planning, infrastructure planning and design, and building design and performance standards. For example, planning policy will need to be reviewed to check risk management criteria such as the one in 100-year flood level allowance.

Possible impacts

Almost all types of major infrastructure in South Australia, including roads, bridges, rail networks, airports, ports and pipelines are likely to be at risk from storms, coastal inundation, flooding and higher temperatures, including heat stress. Water, sewer and stormwater infrastructure is also likely to be affected, as will homes, commercial and industrial buildings and community facilities, such as schools and hospitals.

While climate change models forecast consistent trends in relation to increasing number and intensity of extreme weather events, rising sea levels and warmer drier conditions for South Australia, there is some uncertainty about the exact magnitude and timing of these impacts. These will vary from region to region depending upon local economies, population structures and geographic considerations, such as elevation and proximity to the coast.

Settlements and infrastructure along the coast are particularly vulnerable (see section 4.4).

Roads and rail networks will be threatened by higher temperatures, which may melt bitumen or buckle railway lines, with areas in the north of the state particularly vulnerable. Higher temperatures and prolonged heatwaves will lead to greater energy demand for cooling, increasing stress on energy generation, transmission and distribution systems.

Making cities more climate-resilient may assist in making South Australia's urban areas more comfortable while reducing climate change-related infrastructure stress. For example, increasing the energy and water efficiency of buildings will not only make them less expensive and more comfortable to live in but will remove some of the climate change pressures on existing electricity and water infrastructure.

Changing the form of urban areas, including the way that buildings and suburbs are designed, provides opportunities to reduce water consumption and improve thermal comfort during heat waves. This is achieved by minimising surfaces that trap heat and replacing those with natural elements such as open spaces, greenways and parklands.

Possible opportunities

- Improving building standards and design guidelines to create more thermal- and energy-efficient buildings.
- Creating a more liveable urban environment through the establishment of a network of greenways, tree-lined streets and open spaces, which have a cooling effect on nearby neighbourhoods and new buildings.

Adaptation responses:

Critical considerations for infrastructure and urban areas

A wide range of issues will need to be taken into consideration when developing adaptation responses for infrastructure and urban areas, including:

- the linkages with other sectors particularly emergency management, water supply, coastal regions, primary industries and human health
- the impact of higher temperatures and heat stress on roads, railways, energy infrastructure, pipelines, airport runways and the associated impacts on safety
- the impact of flood events on reservoirs, pipelines, bridges and wastewater treatment facilities and the associated impacts on human health
- vulnerable coastal infrastructure
- the need for infrastructure planning and design to take into account the long-term impacts of climate change
- incorporating measures to reduce heat impacts and increase water-use efficiency into urban design principles

- considering how a changed climate will affect the way people use infrastructure, such as roads and railways
- ensuring building standards and design guidelines improve the liveability of housing, including exposure to noise and air pollution
- ensuring new and modified infrastructure and development considers adaptation needs in other sectors (e.g. biodiversity).

Key partners

The following organisations will play a major role in developing adaptation responses for the infrastructure and urban areas sector:

- Department of Planning and Local Government
- Department for Transport, Energy and Infrastructure
- Local Government associations
- Coast Protection Board
- Resources and Energy Sector Infrastructure Committee
- Regional development boards
- Property Council of Australia (SA Division)
- Industry associations (e.g. Housing Industry Association, Master Builders Association)
- Insurance industry



4.10 Emergency management

Emergency management organisations will have a significant role to play in assisting South Australians to cope with the more severe and extreme impacts of climate change. Emergency management will require additional coordination across all services.

The expected increase in extreme events may have resource implications. For example, South Australia's 2009 heatwave saw:

- a threefold increase in ambulance call-outs for cardiac arrests, each requiring a paramedic team of up to five crew members
- around 1200 people worked for over 10 days to bring the 2007 Kangaroo Island fires under control, which eventually burnt 19% of the island.

Possible impacts

Under the South Australian emergency management arrangements, there are 10 'hazards' with assigned hazard leaders. Seven²³ of these are likely to be affected by climate change, as indicated in Table 3.

The impacts on the community, economy and the environment as a consequence of extreme events can be devastating. They include:

- loss of life
- social dislocation
- destruction of communities
- damage to, or destruction of, infrastructure
- disruption to industries and economic activity
- effects on physical and mental health
- widespread damage to the environment.

The unprecedented catastrophic fires in Victoria in February 2009 demonstrate the scale of the impacts and the challenges faced by the emergency management.

Communities living near the coast will be exposed to flooding and storm damage, and communities in the Mount Lofty Ranges and rural areas are highly vulnerable to bushfire. Population growth in these areas exacerbates the risks associated with these hazards. Remote communities are also particularly vulnerable to natural disasters, particularly fires, floods and extreme weather.

Possible opportunities

- Building on the state's expertise in hazard prevention, mitigation, response and recovery, and disaster preparedness.

Adaptation responses: *Critical considerations for emergency management organisations*

A wide range of issues will need to be taken into consideration when developing adaptation responses for emergency management, including:

- focusing on preparedness and crisis avoidance as a method of minimising emergencies
- promoting community resilience as a shared responsibility requiring a cooperative effort at individual, local, regional, state and national levels
- using different methods to engage individuals and communities to ensure disaster risks are understood, management of those risks is owned and shared, and appropriate actions are taken
- ensuring an integrated approach is maintained through collaborative engagement with cross-sectoral and non-government stakeholders
- focusing on those self-reliant individuals, community members and business owners who are prepared to take responsibility for risk and are ready to assist when the impact of disasters is beyond their capacity
- engaging with and influencing organisations responsible for urban and regional planning recognising that land-use planning policies, building codes and development standards represent an effective method of reducing disaster risk and, therefore, form part of the emergency management intervention in the medium-to-longer term
- ensuring greater flexibility and adaptability of emergency management organisations to future risks and enhanced levels of interoperability.

²³ *Earthquake, Terrorism and Escape of Hazards are unlikely to be affected by climate change*

Key partners

The following organisations will play a major role in developing emergency management adaptation responses:

- State Emergency Management Committee and advisory groups (mitigation, response and recovery)
- State hazard leaders
- Zone Emergency Management Committees
- South Australian Forestry Corporation
- Bureau of Meteorology
- Department of Environment and Natural Resources
- Local Government associations
- Local councils
- South Australian Fire and Emergency Services Commission
- Department of Planning and Local Government
- Primary Industries and Resources South Australia



Table 3 South Australian Emergency Management Hazards affected by climate change

Hazard	Hazard leader	Likely effects of climate change
Animal and Plant Disease	Primary Industries and Resources SA (PIRSA)	Warmer temperatures will change terrestrial and marine conditions, making them more favourable for some invasive species and diseases that adversely affect primary industries and ecosystems.
Bushfire	SA Country Fire Service (SA CFS)	Longer, drier conditions are likely to increase the frequency and intensity of bushfires.
Extreme Weather	SA State Emergency Service (SA SES)	Stronger wind and storm events are likely to increase the frequency and intensity of storm damage and coastal storm surge flooding. More frequent and longer heatwaves are likely to increase risks to human health and infrastructure.
Flood	Department for Water (DFW)	Less frequent but more intense rainfall events are likely to change the intensity, frequency and duration of inland flood events. Sea level rise is likely to increase the frequency and severity of coastal inundation from tidal and storm surge events.
Human Health	Department of Health (DOH)	Changing climatic conditions will increase some vectors of disease, and increase the occurrence of some diseases. Changing climatic conditions will increase the severity of some medical conditions, posing a greater risk to human health.
River Murray River Bank Collapse	Department for Water (DFW)	<p>Longer dry periods and prolonged droughts will affect flows and river levels in the River Murray, adversely increasing the risk of further instability and collapse.</p> <p>Increased dry periods will cause more drying of the riverbank, adversely affecting the likelihood of further collapses.</p>
Urban Fire	SA Metropolitan Fire Service (SA MFS)	Prolonged hot, dry conditions will increase electricity usage, in turn increasing the likelihood of urban electrical fires.

4.11 Tourism

Climate change is likely to lead to a loss of tourist attractions, a loss in the quality of attractions, increased costs for repair, maintenance and replacement of tourism infrastructure and increased costs for developing alternative attractions²⁴.

The precise impacts of climate change on tourism in South Australia, however, are uncertain.

Possible impacts

Some of the state's premier tourist destinations may be affected:

- A hotter and dryer climate may affect our iconic wine-growing regions such as the Barossa Valley and the Coonawarra.
- Reduced river flows affect the River Murray and the Coorong and Lower Lakes.
- Higher temperatures and extreme events, such as flood and fire, may affect tourism in the north of the state, including the Flinders Ranges, and on Kangaroo Island.
- Sea level rise, coastal instability and storm events are likely to affect tourism in coastal regions.

This will have potentially significant social and economic impacts on the tourism industry, which in 2007 contributed \$4.2 billion to the state's economy, and indirectly on the regional communities that provide goods and services to tourists.

The Barossa Valley was included in a recent study by the Sustainable Tourism Cooperative Research Centre²⁵ on the impacts of climate change on five iconic tourism destinations in Australia. The final report concluded that achieving sustainable tourism in the Barossa Valley is inherently tied to the sustainability of local communities and industries, particularly the wine industry.

South Australia is a popular destination for ecotourism, and while there may be significant opportunities for the ecotourism industry to demonstrate sustainable practices, it may also be challenged by the greater risk of flooding, storm surges, fires and heatwaves. This could have implications for major tourist destinations such as Kangaroo Island and the Flinders Ranges.

The tourism industry will be challenged with maintaining market enthusiasm for South Australia as a tourist destination, and will require innovative and creative marketing approaches.

Adaptation responses: *Critical considerations for tourism*

A wide range of issues will need to be taken into consideration when developing adaptation responses for tourism, including:

- linkages with other sectors, particularly biodiversity
- impacts on tourism infrastructure, activities and operational costs
- indirect social and economic impacts on regional communities
- destinations that are likely to be the most vulnerable
- opportunities for ecotourism.

Key partners

The following organisations will play a major role in developing adaptation responses for the tourism sector:

- Tourism SA
- Department of Environment and Natural Resources
- South Australian Tourism Commission
- SA Tourism Alliance
- South Australian Tourism Industry Council
- Department of Planning and Local Government

²⁴ Sustainable Tourism Cooperative Research Centre 2007, *Climate Change and Australian Tourism*, Sustainable Tourism CRC, Southport, Queensland

²⁵ Sustainable Tourism Cooperative Research Centre 2009. *The impacts of climate change on Australian Tourism Destinations*. <http://www.crctourism.com.au/BookShop/BookDetail.aspx?d=671>



4.12 Manufacturing and services

The trend for dryer, warmer conditions and more extreme weather events is likely to affect many aspects of manufacturing and service sectors in South Australia – and pose both challenges and opportunities for the state’s business community. Due to the relatively high vulnerability of South Australia to the impacts of climate change, local businesses are more likely to be exposed sooner than other economies. Hence, climate change adaptation is an important issue for local manufacturers and service providers.

Risks associated with natural resource security are key for some manufacturing sectors. Climate change may adversely impact on the costs, reliability and quality of water and energy supplies, and would introduce competitiveness pressures on some manufacturers. This could have a negative effect on investment attraction.

Climate change is likely to influence consumer preferences, which may result in the shrinkage of some markets and the growth of others. Demand for products and services that will assist the community in responding to climate change will increase (e.g. air conditioners and insulation) and opportunities for new and innovative products would stimulate business growth.

New opportunities will also eventuate through the Knowledge Intensive Services sector, which specialises in climate change adaptation services, such as engineering, design, planning, and environmental science. Building the services sector and the associated intellectual property in climate change adaptation is likely to result in new export opportunities (e.g. tradeable services).

Possible impacts

The precise effect of climate change on the state’s manufacturing and services sectors is not well known and further work is required to identify vulnerabilities.

It will be essential for some individual businesses to conduct risk assessments to determine their level of vulnerability and adaptive capacity. Forward planning for climate change, and embedding adaptation into risk management frameworks, will help to mitigate business risk and identify opportunities.

Some of the possible effects on manufacturing and services businesses in South Australia include:

- increased business costs associated with energy and water supplies as the costs of adaptation measures are passed down through the supply chain
- increased costs associated with rising insurance premiums due to exposure to extreme weather events
- extreme weather events may reduce manufacturing production through disruptions in energy and water supplies, and also adversely influence supply chain reliability (e.g. transport)
- loss of production for firms that primarily rely on agricultural produce (e.g. food and wine)
- access to investment and capital may be inhibited if manufacturers do not implement measures to identify and reduce risks.

Possible opportunities

There are likely to be positive impacts associated with climate change in relation to some manufacturing sectors and service providers, including:

- growth of the knowledge intensive service sector
- changes in consumer preferences, which will provide opportunities for increased market share and assist local industry make the transition to a carbon-constrained economy.

Adaptation responses:

Critical considerations for manufacturing

A wide range of issues will need to be taken into consideration when developing adaptation responses for the manufacturing and services sectors, including:

- assessing the availability of markets and suppliers
- ensuring that adaptation strategies avoid increasing greenhouse gas emissions
- the vulnerability of the supply chain, utilities and transport infrastructure
- implications for investment, insurance and stakeholder reputation
- changing consumer demands for goods and services
- impacts on production processes and service delivery
- implications for the workforce and customers
- impacts on building design, construction, maintenance and facilities management
- innovative use of incentives, instruments and programs such as sector agreement, sustainability licences and eco-efficiency training
- support and effective regulation of emerging industries such as aquaculture and desalination.



Key partners

The following organisations will play a major role in developing adaptation responses for the manufacturing and services sector:

- Department of Trade and Economic Development
- Economic Development Board
- Regional development boards
- Department of Planning and Local Government
- Manufacturing Consultative Council
- Business Council
- Innovate SA
- Business SA
- Environment Protection Authority

4.13 Minerals and energy

The increasing international demand for non-renewable resources has resulted in the mineral sector experiencing significant growth over the last decade. This growth has been primarily driven by the significant increases in the prices of minerals making exploration, development of mines and extraction of minerals more profitable and therefore a lower-risk proposition.

However mining operations around Australia are not immune to the impacts of climate change. The location of mines often requires operators to provide the necessary infrastructure for the workforce and secure the transport networks to bring in consumables and ship out product, to overseas markets.

The mining operations are often carried out in harsh environments where climate change may produce even more severe extremes of weather than is already occurring, threatening not only the welfare of the workforce but the mine's infrastructure.

The combination of weather instability combined with high water demand for mining and processing operations has already forced miners to secure additional water sources including consideration of desalinated water.

Mining operations are already high users of energy and the impacts of climate change may result in further increases in energy use in response to hotter and drier climatic conditions.

Minerals exploration and extraction provides significant opportunities related to the use of renewable energy. This is particularly relevant to South Australia where a significant resource of wind energy and wind generation infrastructure is already available. There are potential opportunities for use of solar thermal and geothermal energy in South Australia's north especially in light of existing and planned mining operations in that area. Deployment of other energy-saving technologies may also use geothermal energy, for example, to boil minerals processing waste water and to yield recycled water for processing and incremental product as precipitate.

Possible impacts

The specific impacts of climate change on mining operations in South Australia will depend on the location of the operation, the transport corridors utilised in the business and the proximity of communities providing mine staff and supporting services.

Some of the possible climate change impacts on the minerals sector include:

- decreasing use of available water and the necessity to source water from alternative processes including desalination and recycling
- adverse impacts on the health of mine staff and supporting communities related to more extreme weather conditions
- deterioration of mine's infrastructure due to extreme weather events such as flooding
- increased use of energy to address more extreme weather conditions, limited water resources and infrastructure improvements
- increased cost in mine's operation due to weather-related operational delays and higher energy and infrastructure use
- damage to external transport infrastructure used to bring in consumables and export product including sea level rise threat to port operations
- threats to vulnerable ecosystems in areas within mining operations.

Possible opportunities

- Given its high and predictable energy demand the minerals sector is uniquely positioned to enable it to partner with energy companies to source renewable energy for its operations.
- Establishment of industries around new technologies such as carbon capture and storage (CCS) and geothermal plants.

Adaptation responses:

Critical considerations for the minerals and energy sector

A wide range of issues will need to be taken into consideration when developing adaptation responses for the minerals and energy sector, including:

- linkages with other sectors, particularly infrastructure
- social and economic impacts on regional communities
- impact of competition for scarce water resources between existing water users and mining activities.



Key partners

The following organisations will play a major role in developing adaptation responses for the minerals and energy sector:

- Primary Industries and Resources South Australia
- Department for Transport, Energy & Infrastructure
- Department of Environment and Natural Resources
- Department of the Premier and Cabinet
- Environmental Protection Authority
- Department of Treasury and Finance
- Resources and Energy Sector Infrastructure Committee
- Australian Energy Market
- Mining Act 1971 Licence holders
- Petroleum and Geothermal Energy Act 2000 Licence holders
- Economic Development Board
- Natural resources management boards
- Resource Industry Development Board
- South Australian Minerals and Petroleum Experts Group
- South Australian Chamber of Mines & Energy
- Australian Petroleum Production and Exploration Association
- Minerals Council of Australia
- Australian Geothermal Energy Association
- Australian Pipeline Industry Association
- Australian School of Petroleum, University of Adelaide

5 Implementation

5.1. Plans

The implementation of this Adaptation Framework is intended to result in adaptation responses which will be mainstreamed in established planning, decision-making and risk management frameworks, and help to build recognition of the interconnections between social, environmental and economic systems.

It will be important to ensure that adaptation action is relevant to local communities and business. Undertaking integrated regional vulnerability assessments in each of the 12 government regions to gain an understanding of the vulnerability of sectors and systems at the regional level will assist considerably in the implementation of the Framework.

While the Framework identifies key stakeholders and statewide priorities this is only a first step in highlighting the need to prepare for more comprehensive climate change adaptation action in South Australia. It is intended that the Framework will facilitate the development of more detailed strategies at regional, sectoral and statewide levels. Future government strategies will also be informed by these regional and sectoral plans. Figure 4 shows the key actions and interconnections for implementing the Framework.

5.2. Roles in implementation

State Government agencies, relevant advisory boards, Local Government, business, the research sector and non-government organisations will need to work together to implement the statewide, regional and sectoral components of this Framework. Major roles are summarised in Table 3.

5.3 Tracking progress

Reporting on implementation of the Adaptation Framework will be achieved through the reporting requirements under the *Climate Change and Greenhouse Emissions Reduction Act 2007*. The Premier's Climate Change Council and the Natural Resources Management Council will review the Framework in five years.

Figure 4 Implementation model

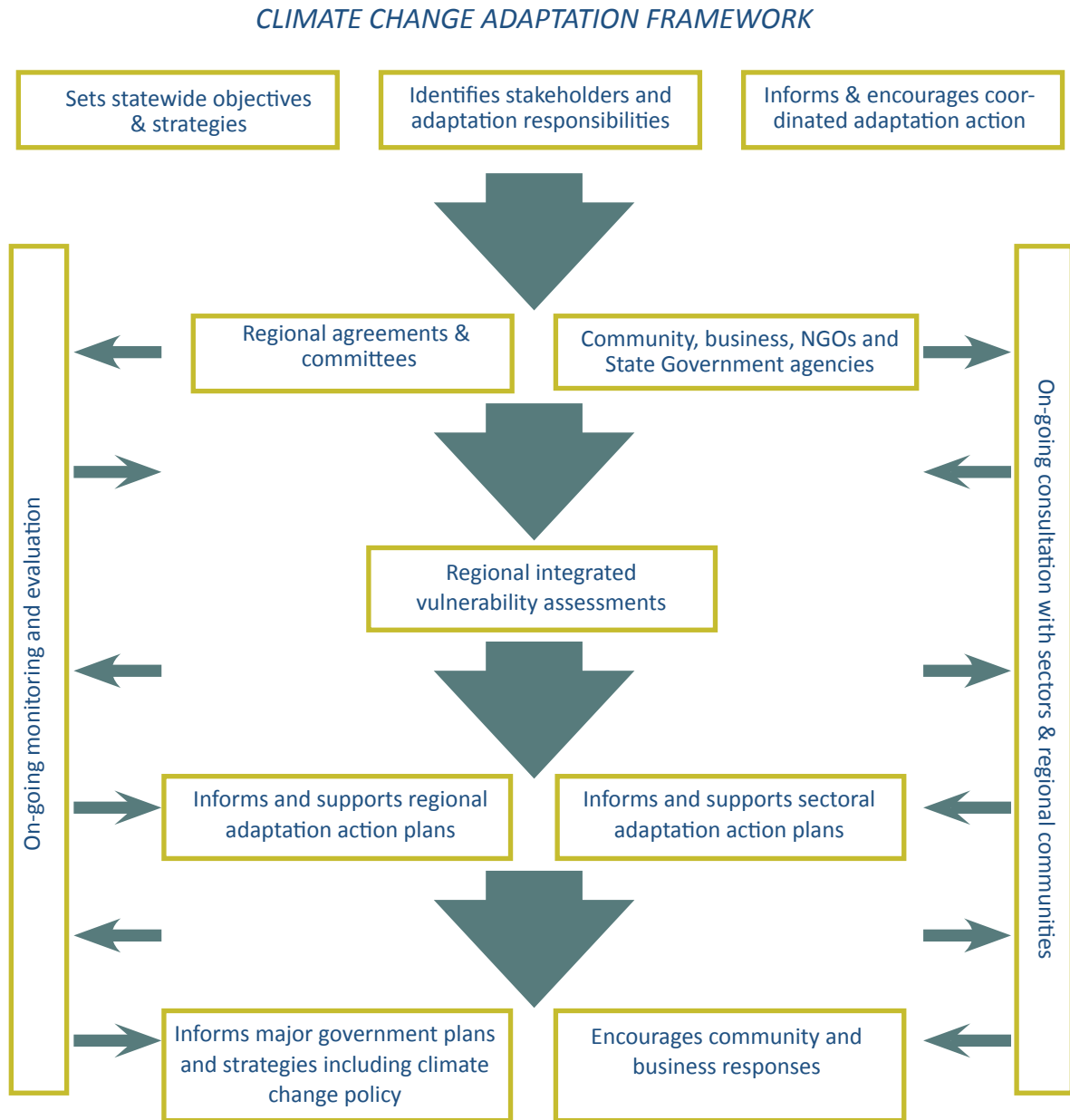


Table 4 Major roles for implementing the Adaptation Framework

Organisation	Major Role
Department of the Premier and Cabinet – Sustainability and Climate Change Division	Working with the Premier’s Climate Change Council and the Natural Resources Management Council to oversee implementation of the Framework. Coordinating adaptation responses across State Government. Coordinating implementation of the Framework, preparing budget submissions, overseeing regional governance arrangements and the development of regional strategies and plans.
Other State Government agencies	Either leading or partnering in the implementation of statewide actions. Working with regional partners and sectors to develop and implement regional IVAs. Working with regional partners and sectors to develop regional adaptation plans. Working with regional partners and sectors to develop sectoral adaptation plans. Developing Chief Executive-level agreements on implementation actions.
Premier’s Climate Change Council	Endorsement of the draft Framework. Consultation on the draft Framework. Annual review on progress. Coordinating five-yearly review of the Framework.
Natural Resources Management Council	Endorsement of the draft Framework. Consultation on the draft Framework. Annual review on progress. Coordinating five-yearly review of the Framework.
Coast Protection Board	Maintaining and updating policies to guide sustainable development and biodiversity conservation on the coast. Providing guidance to planning authorities and other organisations on coastal development and land use. Working with regional partners and sectors to develop regional IVAs. Working with regional partners and sectors to develop and implement regional adaptation plans.
Premier’s Science and Research Council	Leading on the implementation of Statewide Objective 2. Working with the Premier’s Climate Change Council on adaptation science and research issues.
Regional natural resources management boards	Partnering with other regional organisations to develop regional IVAs – see Part 3. Working with local communities and sectors to develop regional adaptation plans. Working with other key partners on the implementation of Objective 3.
Regional development boards	Partnering with other regional organisations to develop regional IVAs – see Part 3. Working with local communities and sectors to develop regional adaptation plans.
Local Government (including local councils and Local Government associations)	Partnering with other regional organisations to develop regional IVAs – see Part 3. Working with local communities and sectors to develop regional adaptation plans.
Universities	Working with the Premier’s Science and Research Council and other key partners on the implementation of Objective 2.
Non-government organisations and business	Working with other key partners to deliver relevant statewide actions. Working with regional partners to develop regional IVAs – see Part 3. Working with regional partners, and local communities and sectors to develop regional adaptation plans.



APPENDIX 1 Building resilience and adaptive capacity

Building the resilience of social, economic and natural systems so that they can withstand climatic change without collapsing will be essential to successful adaptation. The alternative to a resilient system is a vulnerable or fragile system, where even small changes can have disastrous outcomes.

We are part of the natural world and depend on the services provided by nature for survival. The intricate connections between people and the environment mean that we will need to build resilience into both human and natural systems at the same time.

Resilience has three defining features²⁶:

- The amount of change a system can undergo and still retain the same controls on function and structure.
- The degree to which the system is capable of self-organisation.
- The ability to build and increase the capacity for learning and adaptation.

In the context of climate change, a more resilient system has the ability to withstand higher threshold limits associated with such events as droughts, heat waves and floods.

Some of the factors that can decrease the resilience of our natural, social and economic systems include:

- loss of biodiversity
- toxic pollution
- inflexible, closed institutions

- perverse subsidies that encourage the unsustainable use of resources
- a focus on production and increased efficiencies that lead to a loss of redundancy.

The key to building resilience in both human and natural systems is maintaining diversity and spreading risk. Adaptive management processes can also increase resilience.

Some of the actions that will increase the resilience of human and natural systems include:

- stopping practices that put people at high risk
- incorporating climate change information into planning, practice, and decision-making
- implementing measures that proactively reduce climate impacts
- developing informed risk-spreading practices.

Improving adaptive capacity creates and expands our options for dealing with climate change, and allows us to respond quickly and effectively to climate change impacts that go beyond what existing systems can reasonably withstand.

Adaptive capacity is about building our understanding of the interrelationships and feedbacks between the social, economic and ecological systems across the time and space scales that are appropriate to climate change impacts. Understanding these interrelationships will allow us to prepare for any necessary changes in our behaviours in the face of significant changes to our climate.

The six stages of adaptive management

Assess the problem: determine management objectives, indicators of success, options for action, assumptions, key uncertainties and alternative hypotheses.

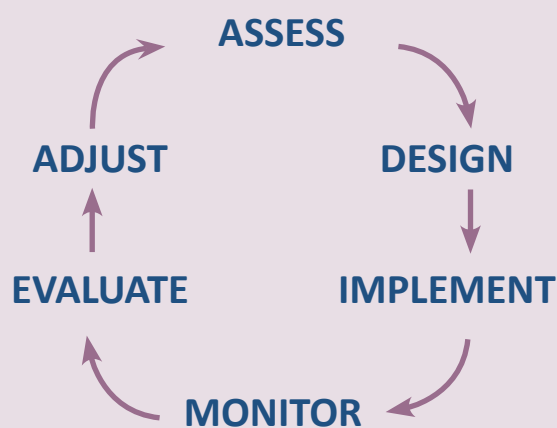
Design actions to test hypotheses; predict outcomes based on current knowledge.

Implement the actions as designed.

Monitor implementation and effectiveness: are there any deviations from the design, and were the objectives achieved.

Evaluate the results: which actions were most effective, and which hypotheses should be accepted or rejected.

Adjust and revise uncertainties and hypotheses and repeat; share what has been learned.



Source: ESSA Technologies Limited <http://www.essa.com/services/am/index.htm>

²⁶ <http://www.resalliance.org>

APPENDIX 2 Relevant sectoral plans and strategies

The following resources may be useful in the development of adaptation responses.

Health

- National Adaptation Research Plan for Human Health and Climate Change – December 2008
www.nccarf.edu.au/national-adaptation-research-plan-human-health
- National Adaptation Research Network for Human Health
www.nccarf.edu.au/humanhealth/

Water

- Water for Good – A Plan to Ensure our Water Future to 2050
www.waterforgood.sa.gov.au/
- The National Water Initiative
www.nwc.gov.au/www/html/117-nationalwater-initiative.asp
- National Adaptation Research Plan – Water Resources and Freshwater Biodiversity - currently awaiting Ministerial approval
Consultation draft at <http://www.nccarf.edu.au/node/531>
- National Water Resources and Freshwater Biodiversity Adaptation Research Network
www.nccarf.edu.au/water/
- Water Sensitive Urban Design Technical Manual for the Greater Adelaide Region (July 2009)
www.planning.sa.gov.au/go/wsud
- State of the Environment Report 2008
www.epa.sa.gov.au/soe
- Government response to State of the Environment Report 2008
www.environment.sa.gov.au/deh/pdfs/soe-2008-response.pdf

Biodiversity

- Securing the Future: A Long-Term Plan for the Coorong, Lower Lakes and Murray Mouth Region
www.environment.sa.gov.au/cllmm/pdfs/ltp-full-document.pdf
- Australian Weed Strategy
www.weeds.gov.au/publications/strategies/pubs/weed-strategy.pdf
- Australian Pest Animal Strategy
www.environment.gov.au/biodiversity/invasive/publications/pubs/pest-animal-strategy.pdf
- Australia's Biodiversity Strategy 2010 – 2020 (consultation draft)
www.environment.gov.au/biodiversity/strategy/pubs/biodiversity-conservation-strategy2010-2020.pdf

- Australia's Biodiversity and Climate Change – A strategic assessment of the vulnerability of Australia's biodiversity to climate change (a report to the NRM Ministerial Council)
- National Adaptation Research Plan – Terrestrial Biodiversity
www.nccarf.edu.au/national-adaptation-research-plan-terrestrial-biodiversity
- National Adaptation Research Network for Terrestrial Biodiversity
<http://hosting2.arcs.org.au/terrestrialbiodiversity/>
- NatureLinks - South Australia's major program to increase biodiversity resilience
www.environment.sa.gov.au/naturelinks/
- No Species Loss – A Nature Conservation Strategy for SA 2007-2017
- State Natural Resources Management Plan 2006
<http://www.nrm.sa.gov.au/LinkClick.aspx?fileticket=Zn5hT2e0Qr4%3d&tabid=1356>
- SARSMPA – South Australian Representative System of Marine Protected Areas
- State of the Environment Report 2008
www.epa.sa.gov.au/soe
- Government response to State of the Environment Report 2008
www.environment.sa.gov.au/deh/pdfs/soe-2008-response.pdf

Agriculture

- The Changing Climate: Impacts and adaptation options for South Australian primary producers – PIRSA 2009 Primary Industries and Resources SA and PIRSA Rural Solutions SA 2009
www.pir.sa.gov.au/__data/assets/pdf_file/0020/119117/PIRSA_Climate_Change_-_FINAL_low_resolution.pdf
- A Guide to Climate Change Adaptation in Agriculture in South Australia – SARDI PIRSA 2007
www.pir.sa.gov.au/__data/assets/pdf_file/0003/43464/Guide_to_Climate_Change.pdf
- National Adaptation Research Plan – Primary Industries – awaiting approval
www.nccarf.edu.au/national-adaptation-research-plan-primary-industries
- National Adaptation Research Network for Primary Industries
www.nccarf.edu.au/adaptation-research-network-primary-industries
- Farming Futures – a national program to support farmers adapt to climate change
www.daff.gov.au/climatechange/australias-farming-future

- A regional climate change decision framework for natural resource management – DWLBC 2008
<http://www.amlrnm.sa.gov.au/LinkClick.aspx?fileticket=UHeNVhg9O6k%3d&tabid=3064&mid=4258>
- An overview of climate change adaptation in Australian primary industries – impacts, options and priorities (CSIRO, February 2008)
<http://www.csiro.au/files/files/plhg.pdf>

Fisheries and aquaculture

- The implications of climate change for Australian fisheries and aquaculture – a preliminary assessment. Department of Climate Change, August 2008
<http://www.climatechange.gov.au/publications/fisheries/fisheries.aspx>
- National Adaptation Research Plan for Marine Biodiversity and Resources
<http://www.nccarf.edu.au/sites/default/files/NARP%20marine%20biodiversity%20FORWEB.pdf>
- National Adaptation Research Network for Marine Biodiversity and Resources
<http://arnmbr.org/content/index.php/site/aboutus/>
- State of the Environment Report 2008
www.epa.sa.gov.au/soe
- Government response to State of the Environment Report 2008
www.environment.sa.gov.au/deh/pdfs/soe-2008-response.pdf

Forestry

- National Climate Change and Commercial Forestry Action Plan 2009-2012²⁷
www.daff.gov.au/forestry/national/national_climate_change_and_commercial_forestry_action_plan
- National Climate Research Plan for Primary Industries – awaiting approval
<http://www.nccarf.edu.au/national-adaptation-research-plan-primary-industries>
- National Adaptation Research Network for Primary Industries
www.nccarf.edu.au/adaptation-research-network-primary-industries

Coastal management

- Climate Change Risks to Australia's Coasts
<http://www.climatechange.gov.au/publications/coastline/climate-change-risks-to-australias-coasts.aspx>

- Port Adelaide seawater and stormwater flood risk assessment
- National Adaptation Research Plan – Settlements and Infrastructure
<http://www.nccarf.edu.au/national-adaptation-research-plan-settlements-and-infrastructure>
- State of the Environment Report 2008
www.epa.sa.gov.au/soe
- Government response to State of the Environment Report 2008
www.environment.sa.gov.au/deh/pdfs/soe-2008-response.pdf

Infrastructure and the built environment

- South Australian Planning Strategy – 30-Year Plan for Greater Adelaide and Regional Plans
<http://www.dplg.sa.gov.au/plan4adelaide/index.cfm>
- National Adaptation Research Plan for Settlements and Infrastructure
<http://www.nccarf.edu.au/national-adaptation-research-plan-settlements-and-infrastructure>
- National Adaptation Research Network for Settlements and Infrastructure
www.nccarf.edu.au/settlements-infrastructure/
- Water Sensitive Urban Design Technical Manual for the Greater Adelaide Region (July 2009)
www.planning.sa.gov.au/go/wsud
- State of the Environment Report 2008
www.epa.sa.gov.au/soe
- Government response to State of the Environment Report 2008
www.environment.sa.gov.au/deh/pdfs/soe-2008-response.pdf

Tourism

- Sustainable Tourism Cooperative Research Centre 2009. The impacts of climate change on Australian Tourism Destinations
www.crctourism.com.au/BookShop/BookDetail.aspx?d=671

Emergency management

- The Natural Disaster Resilience Program
http://www.ag.gov.au/www/emaweb/emaweb.nsf/Page/FundingandGrants_FundedPrograms_NaturalDisasterResilienceProgram
- The National Adaptation Research Plan - Emergency Management and Climate Change 2009
<http://www.nccarf.edu.au/national-adaptation-research-plan-emergency-management>
- State Bushfire Management Plan (Bushfire Hazard Plan).

²⁷ Endorsed by Primary Industries Ministerial Council and on behalf of Natural Resource Management Ministerial Council on 6th November 2009

Glossary

Adaptation

Actions by individuals or systems to avoid, withstand or take advantage of current and projected climate changes and impacts. Adaptation decreases a system's vulnerability, or increases its resilience to impacts. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation – Adaptation that takes place before the impacts of climate change are observed. It is also referred to as proactive adaptation.

Autonomous adaptation – Adaptation that does not constitute a conscious response to the impacts of climatic change, but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.

Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain or achieve a desired state.

Adaptive capacity

In relation to climate change impacts, it is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Climate change

Any change in climate over time, whether due to natural variability or because of human activity.

Impact

An effect of climate change on the structure or function of a system.

Maladaptation

Occurs when adaptive responses have unintended, adverse consequences that outweigh the benefits of undertaking them. An adaptive response that is made without consideration for interdependent systems may, inadvertently, increase risks to other systems that are sensitive to climate change. To avoid maladaptation, the social, environmental and economic consequences of a response must be

taken into account. For example:

Primary producers may pipe water to increase efficiencies and reduce water losses, but this could have significant negative effects on biodiversity and native vegetation, and could potentially increase the water demand of other crops. Increased nitrogen fertilizer on crops to offset reductions in protein as a consequence of higher CO₂ levels could lead to significant greenhouse gas emissions.

Mitigation

Actions to reduce greenhouse gas emissions.

Resilience

The ability of a system to withstand negative impacts without losing its basic functions.

Risk

The result of the interaction of physically defined hazards with the properties of the exposed systems – i.e., their sensitivity or social vulnerability. Risk can also be considered as the combination of an event, its likelihood, and its consequences – i.e. risk equals the probability of climate hazard multiplied by a given system's vulnerability.

Sector

A part or division, as of the economy (e.g. the manufacturing sector, the services sector) or the environment (e.g. water resources, forestry).

System

A population or ecosystem; or a grouping of natural resources, species, infrastructure or other assets.

Vulnerability

The potential for a system to be harmed by climate change, considering the impacts of climate change on the system as well as its capacity to adapt.

Sources:

- <http://www.pewclimate.org/docUploads/Climate101-Adaptation-Jan09.pdf>
- <http://www.undp.org/climatechange/adapt/definitions.html#6>

