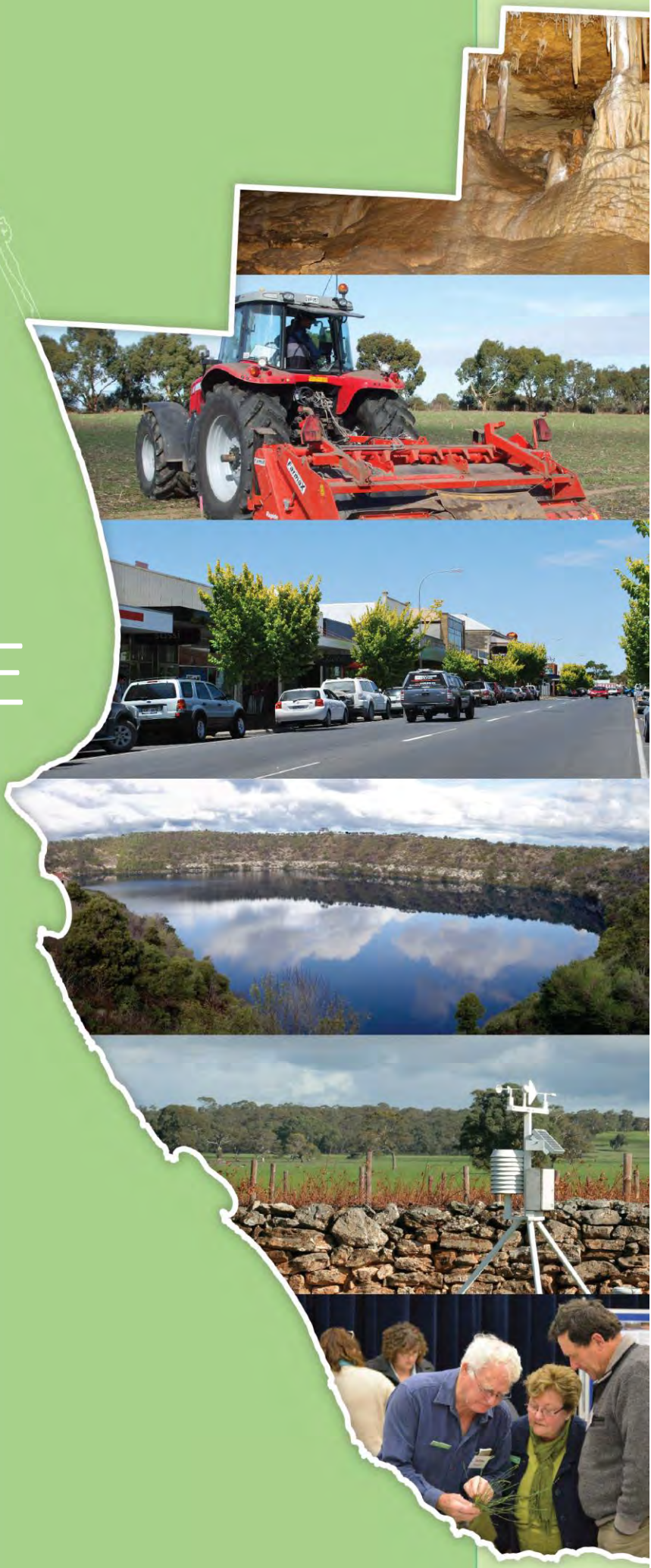
URPS

LIMESTONE COAST

REGIONAL CLIMATE CHANGE ADAPTATION PLAN



April 2016

Regional Climate Change Adaptation Plan

Limestone Coast

Lead Consultant URPS

Sub-Consultants Seed Consulting Services

Prepared for Regional Development Australia Limestone Coast, Limestone Coast Local Government Association and the South East Natural Resources Management Board

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There are at least 21 stories recorded around Australia of the sea rising and not returning to its former level. If these stories are an account of when sea levels rose following the last Ice Age and resulted in the current coastline of Australia, they are an example of trans-generational transmission of oral history for over 7000 years[1]

This story comes from *The Booandik Tribe of South Australian Aborigines: A sketch of their Habits, Customs, Legends and Language* written by Mrs James (Christina) Smith. Christina Smith (1809-1893) was a teacher and Christian missionary who documented the lives, customs, legends, and language of the Buandig (Booandik) Indigenous Australians from the Mount Gambier region in western Victoria and south-eastern South Australia, including the story of the origin of MacDonnell Bay.

Origin of MacDonnell Bay[2]

At one time, it is said, the land extended southward as far as the eye could carry from the spot on which the township of Port MacDonnell now stands. A splendid forest of evergreen trees, including a wattle out of which oozed a profusion of delicious gum, and a rich carpet of beautiful flowers and grass, grew upon it. A man of great height, fearful in his anger and a terror to trespassers on this favoured ground, was the owner. One hot summer's day, whilst taking a walk through his land, he saw at the foot of the wattle-tree a basket full of gum. His anger rose, and in his rage, with a voice like thunder, he cried, "Who is robbing me of my food?" Looking up he saw a woman concealed among the boughs, and in a loud voice commanded the thief to come down. Trembling, she obeyed, and pleaded for her life. He was relentless, and told her he would drown her for robbing him. Filled with rage, he seated himself on the grass, extended his right leg towards Cape Northumberland (Kinneang) and his left towards Green Point, raised his arms above his head, and in a giant voice called upon the sea to come and drown the woman. The sea advanced, covered his beautiful land, and destroyed the offending woman. It returned no more to its former bed, and formed the present coast of Port MacDonnell Bay.

[1] Nunn, P. D. and Reid, N. J. (2016) *Aboriginal Memories of Inundation of the Australian Coast Dating from More than 7000 Years Ago*, Australian Geographer, Vol 47:1, 11-47 (http://dx.doi.org/10.1080/00049182.2015.1077539)

[2] Smith, C. (1880) *The Booandik Tribe of South Australian Aborigines: A sketch of their Habits, Customs, Legends and Language*, Government Printer North-Terrace

Acknowledgements

The Limestone Coast Regional Adaptation Plan is the product of collaboration between Regional Development Australia Limestone Coast, the Limestone Coast Local Government Association, the South East Natural Resources Management Board and the stakeholders and communities that live, work and visit the Limestone Coast Region.

The Regional Adaptation Plan also received funding from the South Australia government.

Particular acknowledgment is made of the many individuals representing a diversity of organisations, sectors and interests from across the Limestone Coast who gave up their time to actively participate in workshop processes and directly influence the development of this Regional Adaptation Plan.

The preparation of the Regional Adaptation Plan was overseen by a project steering group comprising representation from Regional Development Australia Limestone Coast, the Limestone Coast Local Government Association, the South East Natural Resources Management Board and Wattle Range Council.

The development of the Regional Adaptation Plan was undertaken by a consultant team led by URPS in association with Seed Consulting Services.

EXECUTIVE SUMMARY

Executive Summary

As our climate changes, impacts will be experienced by our communities, natural ecosystems, business and industries.

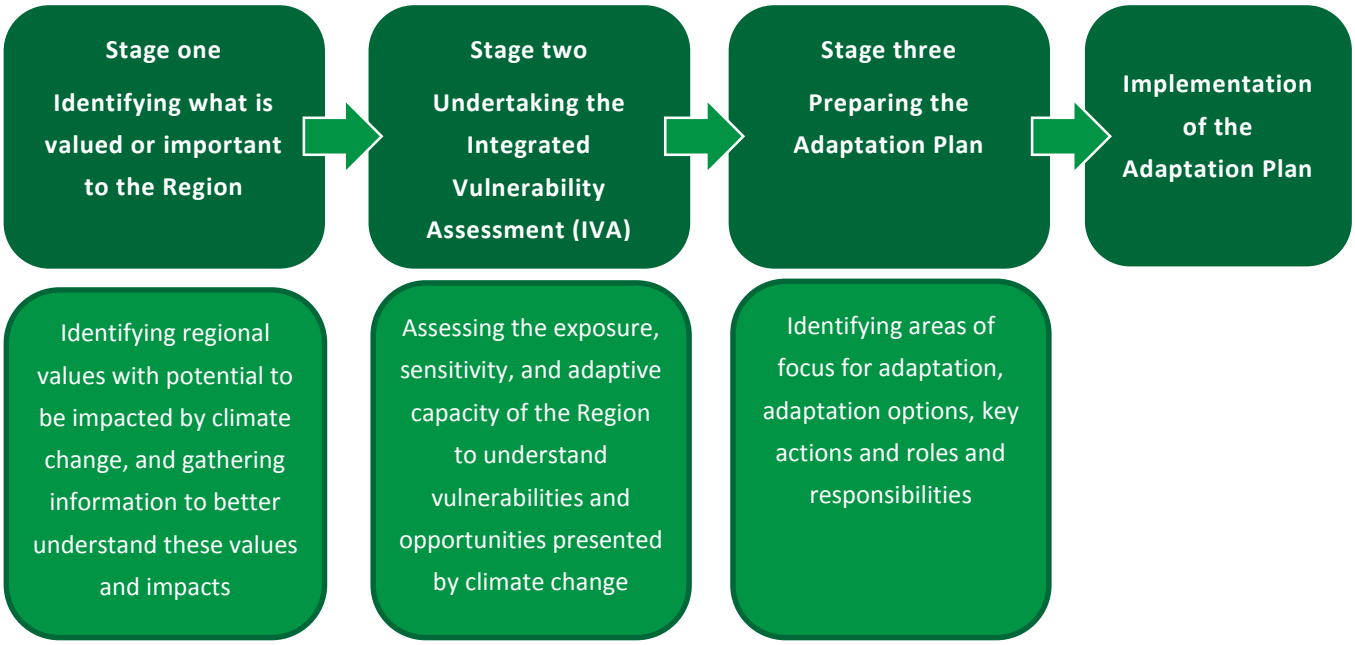
Despite increased global action to manage and reduce greenhouse gas emissions, we know that we are already on a trajectory which means that some form of adaptation will still be required if the Limestone Coast is to remain a desirable, vibrant, productive and prosperous place to live, work and visit.

These impacts will present challenges for our Region as well as opportunities. To ensure we are well positioned to meet these challenges and take advantage of any opportunities that may be presented we want to be proactive and work together. This Limestone Coast Regional Climate Change Adaptation Plan (the Regional Adaptation Plan) provides the foundation for this collaboration and identifies priorities for adaptation action across our Region.

The Limestone Coast Regional Climate Change Adaptation Plan project is a collaboration between Regional Development Australia (RDA) Limestone Coast, the Limestone Coast Local Government Association (LCLGA) and the South East Natural Resources Management (SENRM) Board and the stakeholders and communities that live, work and visit the Limestone Coast Region to actively plan for changes in climate.

The preparation of the Regional Adaptation Plan was undertaken over the following three key stages as summarised below:

Limestone Coast Regional Climate Change Adaptation Plan Project Stages



Active participation of the Region's stakeholders

Integral to the preparation of the Regional Adaptation Plan was the active participation of stakeholders and members of the community representing a diversity of organisations, sectors or groups that play a role in the Region. The knowledge and expertise of these people has directly influenced each stage of the preparation of the Regional Adaptation Plan (refer Figure 1 in section 1.2), and has resulted in the identification of adaptation options that are based on local information and tailored to the local context of the Limestone Coast.

Identifying options for adaptation

The Regional Adaptation Plan identifies adaptation options for the Limestone Coast to address key vulnerabilities or opportunities presented by a changing climate.

Climate projections prepared to inform this adaptation planning process (refer section 2) indicate that the Limestone Coast will face warmer and drier conditions in the future, changed seasonality of rainfall (drier spring and summer) as well as changes in relation to sea level rise and ocean conditions.

Using these climate projections, an Integrated Vulnerability Assessment (IVA) was undertaken to determine how aspects or features that are valued across the Limestone Coast may be impacted by climate change (refer section 3). A total of 46 indicators were assessed using the IVA, the analysis of which revealed those valued aspects or features of the Limestone Coast that have a higher vulnerability to climate change than others.

Based on the analysis of the IVA, areas of focus were derived for adaptation planning known as 'key decision areas'. For the Limestone Coast ten key decision areas were identified and adaptation pathways analysis was used to gather and assess a range of information in order to identify adaptation options for the Region (refer section 4).

For three out of the ten key decision areas, pathway maps were also generated meaning that a number of preferred adaptation options have been identified for implementation for the Limestone Coast.

The remaining seven key decision areas have a series of key adaptation options identified which may require further consideration to determine priority or preference for implementation.

Tables A and B and Figure A summarise these adaptation options and provide an indication of timing for implementation. Those options identified as 'now' are those where action needs to commence immediately, whether that be acceleration of current activities, implementation of new responses or planning for future action. Those options identified as 'later' are those that are not considered to be required in the near future (e.g. within 10 years), but are considered to be options that may be needed at some point in time as the climate changes.

Table A Summary of preferred adaptation options for the Limestone Coast based on pathway maps

Key decision area	Timing	Preferred adaptation options
Coastal landscapes How do we manage coastal assets and landscapes as the sea level rises?	Now	Identify areas for future development that are not likely to be at risk
		Education and awareness raising about the impacts of sea level rise and storm surge
		Monitoring of beaches and cliffs in high risk areas
		Modelling and mapping of high risk areas
		Soft structural options (e.g. beach replenishment, dune restoration)
		Small scale, hard infrastructure
	Later	Implement coastal management design guidelines
		Development Plan Amendments to restrict development
		Acquire land in high risk areas
		Hard protection infrastructure (large scale)
		Innovative infrastructure (small and large scale)
		Relocate (built and natural assets)
		Abandon assets (built and natural)
Vulnerable members of the community How do we improve the health, safety and wellbeing of vulnerable members of the community as the sea level rises and the frequency and intensity of heat waves and bushfires increase?	Now	Communicate and raise awareness of climate hazards and opportunities to respond
		Develop a heat clinic model based on the flu clinic model for emergency departments
		Emergency management planning
		Inter-agency networking and information sharing
		Build community connections
		Residential energy management program
		Improve telecommunications infrastructure
	Later	Mandatory implementation of climate sensitive building design
Water security How do we maintain water security in the region for community, business and environment, as our climate becomes warmer and drier?	Now	Educate and raise awareness about climate change
		Improve water use efficiency
		Undertake research and monitoring
		Continue water allocation planning
		Complete South East Drainage and Wetland Strategy
	Later	Investigation of the feasibility of recharging the aquifer with drainage water

Table B Summary of proposed key adaptation options for 7 key decision areas

Key decision area	Timing	Key adaptation options
Irrigated agriculture, horticulture and viticulture How do we maintain and increase the contribution irrigated agriculture, horticulture and viticulture make to the region's economy as the climate becomes warmer and drier?	Now	Information sharing and collaboration to build capacity
	Later	Greater use of the drainage network for localised groundwater recharge
Marine habitats and fisheries How do we protect and enhance the marine ecosystems that support our fisheries as the climate becomes drier and ocean conditions change?	Now	Undertake land management activities that improve surface water quality and quantity
		Monitor marine species and habitats
		Awareness raising and education regarding catch limits
		Periodic closure of fishing for selected species to maximise reproduction
	Later	Target alternative species
Natural ecosystems How do we protect and enhance the condition and extent of natural ecosystems (heathlands, shrublands, and woodlands) and scattered trees as our climate becomes warmer and drier and bushfire risk?	Now	Pest plant and animal management
		Improved fire management
		Demonstrate the social and economic value of functional native ecosystems
		Paddock tree replacement
		Landholder management of native vegetation
		Establish environmental water allocations
		Landscape-scale habitat restoration
	Later	Planned retreat of coastal ecosystems
Recreation, open space and public realm How do we provide, protect and enhance the amenity and recreation opportunities provided by open space and public realm as our climate becomes warmer and drier and there is an increased risk of damage from bushfires and sea level rise?	Now	Modelling and mapping to assist with risk management and planning
		Education and awareness raising regarding bushfire risk, sea level rise and storm surge
		Improved soil and irrigation management practices
		Improved stormwater management
		Rationalisation of irrigated open space to maintain a smaller amount to a higher standard
		Prepare open space and public realm guidelines
	Later	Relocate facilities
		Abandon assets in high risk areas
		Construct large indoor multi-sport facilities
Road infrastructure How do we maintain the effective operation of our road network as the sea level rises and more frequent and intense heat waves and flooding occurs?	Now	Update design standards, maintenance regimes and asset management plans to accommodate projected climate change
		Educate and raise awareness of organisational staff regarding impacts of climate change on assets
	Later	Upgrade or relocate roads in high risk areas
Tourism How do we maintain and grow the contribution tourism makes to the region's economy as our climate becomes warmer?	Now	Market the Limestone Coast's milder climate as a point of difference
		Coordinate planning for tourism at a regional scale
		Provide mobile phone coverage across entire Region
	Later	Improve accessibility to/from coastal towns/localities

Key decision area	Timing	Key adaptation options
Wetlands How do we protect and enhance the condition and extent of wetlands as our climate becomes warmer and drier and the sea level rises?	Now	Prioritise wetlands for future investment
	Later	Develop a new approach to the management of the drainage network and the allocation of water

Dryland cropping, extensive grazing and forestry are key economic contributors to the Limestone Coast and their productivity is interlinked with seasonal and climatic conditions. As such, it was anticipated that these activities would be an area of focus for the Regional Adaptation Plan. However, the IVA found that these activities had lower vulnerability as a result of either higher adaptive capacity or presenting opportunities associated with a warming climate. Subsequently they are not directly reflected in the key decision areas. Related water and infrastructure aspects however, which are relevant to dryland cropping, extensive grazing and forestry activities, are considered in other key decision areas.

Cross sectoral adaptation options

As described above this Regional Adaptation Plan identifies a range of adaptation options in relation to ten key areas of decision making. Many of these options (particularly those that do not have pathway maps) will require further work by the relevant sectors to determine the preferred combination of adaptation options for implementation.

A review of the adaptation options identified a number that are relevant to multiple key decision areas and therefore multiple sectors and would benefit from a coordinated and regional response (refer section 5.2). These adaptation options relate to:

- Investigation of the feasibility of recharging the aquifer with drainage water and options for retaining water in the landscape
- Education and awareness raising about climate change and its impacts, particularly in relation to extreme events such as heatwave, flooding (from storm surge and sea level rise) and bushfire. In particular, education and awareness raising needs to focus on activities that increase the resilience of individuals, organisations and communities throughout the Region so that they can adapt to climate change through their own actions where possible.
- Managing impacts along the coast through various options including soft and hard infrastructure, relocation and abandonment of assets and assisting ecosystems' adaptation or retreat.

Implementing the Regional Adaptation Plan

To assist with implementation, an Action Plan (refer Appendix B) has been prepared which identifies actions to assist with progressing the implementation of more immediate adaptation options. This Action Plan can be used by organisations and individuals across the Limestone Coast to guide adaptation action and where required be further developed and refined as new information becomes available, as monitoring and review occurs and as climatic conditions change.

For more immediate adaptation options the Action Plan identifies:

- potential actions to progress implementation of the option (including preparatory work required for future options that may need to start now),
- timing for implementation (ie now versus later),
- lead responsibility for initiating and/or driving implementation of the option, and
- others to be involved in implementation.

Governance arrangements to support implementation

Recognising that the transition from planning to implementation can be challenging, and that ongoing discussion and collaboration is required by stakeholders of the Limestone Coast to action this Regional Adaptation Plan, a workshop was held representing a range of interests and sectors from the Region including Local Government, regional development, natural resources management, health, emergency management, primary production and fisheries.

In particular this workshop sought to discuss and reach broad agreement regarding governance arrangements for the implementation of this Regional Adaptation Plan and discuss in detail the actions required to initiate three key cross sectoral, regional adaptation options identified by the Plan. The summary of this workshop (refer Appendix C) can be used to progress discussions regarding the governance arrangements to facilitate implementation.

THE LIMESTONE COAST OPTIONS TO ADAPT TO A CHANGING CLIMATE

The Limestone Coast Regional Climate Change Adaptation Plan identifies what we can do across the region to make sure our businesses, communities and environments respond positively to the challenges and opportunities of a changing climate

In developing the Climate Change Adaptation Plan, an Integrated Vulnerability Assessment (IVA) was undertaken to understand how climate change might impact what we value in our region (eg health and well being, our rural lifestyle, primary production, biodiversity, water availability).

The IVA helped identify what is more vulnerable to climate change, and where to focus actions to help us adapt.

For some aspects of the region, one or two key things can be done to reduce our vulnerability to climate change. For others, there are many options, and implementing some or all of these can contribute to building our resilience and enable the region to adapt. Some options should start now. Others can happen later, but preparation and planning may need to commence soon.

OPTIONS FOR OUR REGION TO ADAPT TO CLIMATE CHANGE...

CHALLENGE
*Adverse impacts on health, habitat and regeneration of **trees and scrub***

OPTIONS NOW
- Pest and animal management
- Fire and native vegetation management
- Paddock tree replacement
- Environmental water allocations
- Habitat restoration
- Value ecosystems

OPTIONS LATER
- Planned retreat of coastal ecosystems

OPPORTUNITY
*Opportunity for **tourism** growth in the region*

OPTIONS NOW
- Market a milder climate
- Regional tourism planning
- Mobile phone coverage across the region

OPTIONS LATER
- Improve accessibility to coastal locations

CHALLENGE
*Adverse impacts on the health, safety and wellbeing of **vulnerable members of the community***

OPTIONS NOW
- Education and awareness raising
- Establish heat clinics
- Emergency management planning
- Information sharing
- Build community connections
- Residential energy use program
- Improve telecommunications infrastructure

OPTIONS LATER
- Mandatory climate-sensitive building design

CHALLENGE
*Reduced quality, use and amenity of **public spaces and places***

OPTIONS NOW
- Risk management planning
- Education and awareness raising of climate hazards
- Improve soil, stormwater and irrigation management
- Increase the quality of open space
- Design guidelines for open space

OPTIONS LATER
- Relocate or abandon facilities
- Indoor multi-sport facilities

CHALLENGE
*Inundation of development along the **coast***
Erosion of rocky cliffs and sand dunes

OPTIONS NOW
- Promote development in safe areas
- Education and awareness raising
- Monitor beaches and cliffs
- Map high risk areas
- Establish both soft and small-scale hard infrastructure

OPTIONS LATER
- Coastal design guidelines
- Development control
- Land acquisition in high risk areas
- Establish large scale hard infrastructure,
- Establish innovative infrastructure
- Relocate or abandon assets

CHALLENGE
*Impacts on growing seasons and quality of **agriculture** products, increased risk of pests and disease*

OPTIONS NOW
- Information sharing
- Capacity building

OPTIONS LATER
- Greater use of drainage for localised groundwater recharge

CHALLENGE
*Increased disruption to **road networks***

OPTIONS NOW
- Improve road design standards, maintenance and asset maintenance
- Education and awareness

OPTIONS LATER
- Upgrade or relocate roads in high risk areas

CHALLENGE
*Risks to **water** security due to reliance on groundwater resources*

OPTIONS NOW
- Education and awareness
- Improve water use efficiency
- Research and monitoring
- Water allocation planning

OPTIONS LATER
- Investigate feasibility to recharge aquifer with drainage water
- New approach to water management

CHALLENGE
*Impacts on biodiversity and quality and quantity of water in **wetlands***

OPTIONS NOW
- Prioritise future investment

OPTIONS LATER
- New approach to drainage network management and allocation of water

CHALLENGE
*Impacts on diversity and distribution of **marine** habitats and fisheries*

OPTIONS NOW
- Improve surface water quality through land management
- Monitor species & habitats
- Education and awareness of catch limits
- Periodic closure of fisheries

OPTIONS LATER
- Target alternative species

CHANGES IN OUR CLIMATE BY 2070

AVERAGE ANNUAL RAINFALL
Average annual rainfall is projected to decrease by 6.8%, spring rainfall is projected to reduce by 21% and winter rainfall is projected to reduce by less than 1%

RAINFALL INTENSITY/ STORMS
The intensity of heavy rainfall events is projected to increase by 5%

EXTREME TEMPERATURES
The number of days over 35°C is projected to increase by about 50%

AVERAGE TEMPERATURE
Average maximum temperatures are projected to increase by 1.4°C

BUSH FIRE RISK
The number of severe bush fire risk days is projected to increase by 36%

SEA LEVEL RISE
Sea levels are projected to rise 30-40cm

OCEAN ACIDITY
Ocean acidity is projected to increase with a 0.15 to 0.30 decline in pH projected by 2090*

SEA SURFACE TEMPERATURE
Sea surface temperature is projected to increase by 1-2°C by 2090*

**Data available for 2090*

For more information and to view the Plan visit www.naturalresources.sa.gov.au/southeast

Government of South Australia
South East Natural Resources Management Board

Regional Development Australia
LIMESTONE COAST

LCLGA
Limestone Coast Local Government Association

1 INTRODUCTION

1 Introduction

As our climate changes, impacts will be experienced by our communities, natural ecosystems, business and industries.

Despite increased global action to manage and reduce greenhouse gas emissions, we know that we are already on a trajectory which means that some form of adaptation will still be required if the Limestone Coast is to remain a desirable, vibrant, productive and prosperous place to live, work and visit.

These impacts will present challenges for our Region as well as opportunities. To ensure we are well positioned to meet these challenges and take advantage of any opportunities that may be presented we want to be proactive and work together. This Limestone Coast Regional Climate Change Adaptation Plan (the Regional Adaptation Plan) provides the foundation for this collaboration and identifies priorities for adaptation action across the Region.

1.1 Whose Plan is this?

The Regional Adaptation Plan is for the Limestone Coast Region which comprises the seven Local Government Areas of Grant, Kingston, Mount Gambier, Naracoorte Lucindale, Robe, Tatiara and Wattle Range (refer Figure 1).

The preparation of the Regional Adaptation Plan has been a collaboration between Regional Development Australia (RDA) Limestone Coast, the Limestone Coast Local Government Association (LCLGA) and the South East Natural Resources Management (SENRM) Board, and the stakeholders and communities that live, work and visit the Limestone Coast Region.

Adaptation to climate change is everyone's business and we can all play a role in taking actions that build our resilience and reduce or ameliorate the impacts of climate change. The Regional Adaptation Plan is therefore a plan for the Region and its implementation resides with individuals and organisations across the Limestone Coast including land managers, primary producers, tourist operators, service providers, government agencies, not-for profit organisations, Local Government, business and industry, infrastructure owners and managers and community groups.

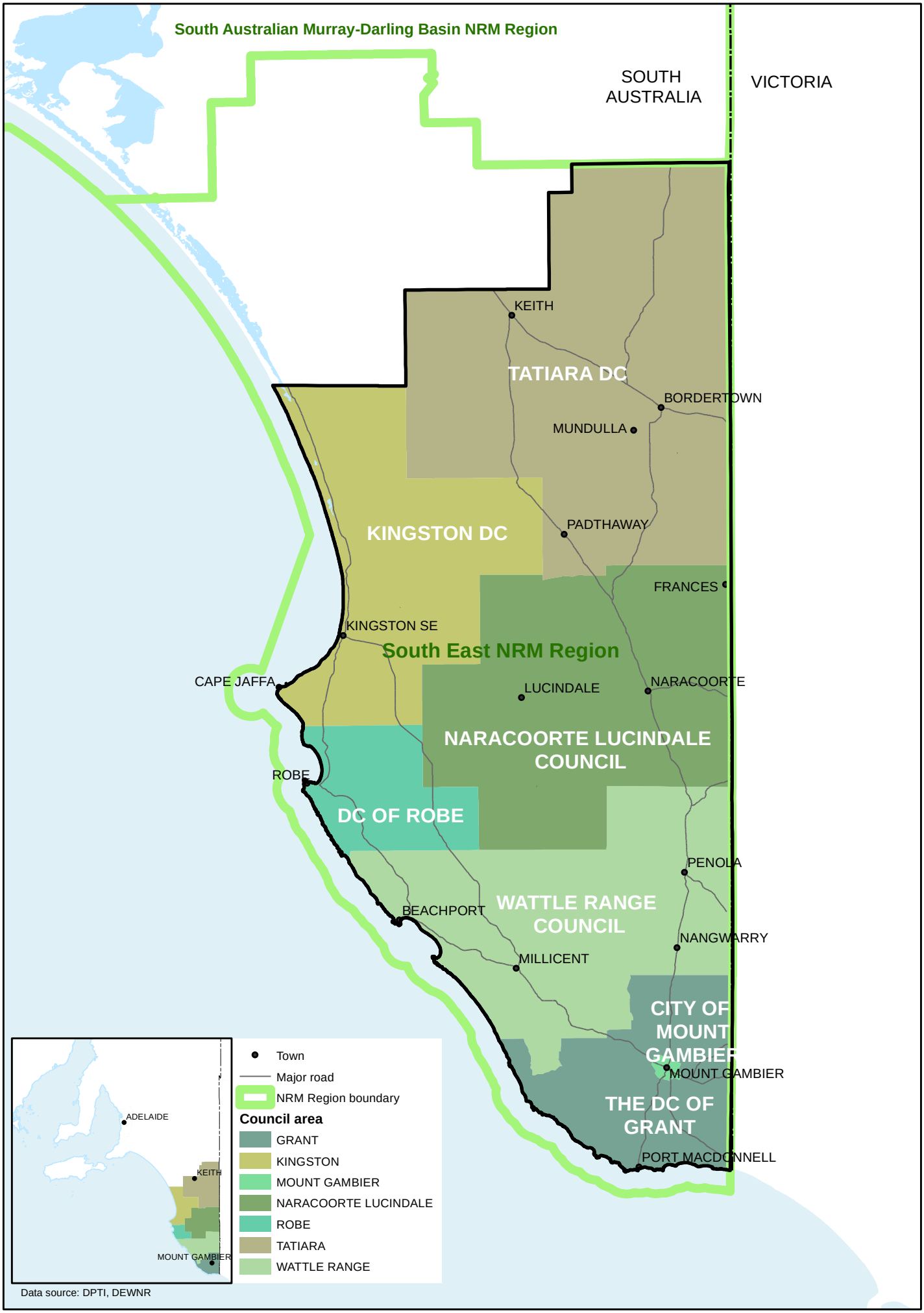


Figure 1 The Limestone Coast Region

1.2 How has this Plan been developed?

The Regional Adaptation Plan was developed over three key stages with the active participation of stakeholders and community members representing a diversity of organisations, sectors or groups that play a role in the Region's:

- assets and infrastructure
- emergency management
- local economic development and sustainability
- natural environment, open space and water
- social and community resilience and health.

Figure 2 summarises this approach and identifies how stakeholders have contributed to and influenced the preparation of the Regional Adaptation Plan and Appendix A lists those who participated.

Figure 2 Approach to preparing the Regional Adaptation Plan and contribution of stakeholders

Delivery of these three stages has generated the following key reports which can be found on the Natural Resources South East website (http://www.naturalresources.sa.gov.au/southeast/about-us/our-regions-plan/Planning-for-climate-change):

- *Climate Projections Report*-this report describes the current and projected future climate of the Limestone Coast Region
- *Regional Values and Climate Change Report*-this report summarises what is valued in the Region and how climate change may impact important and valued aspects or features
- *Integrated Vulnerability Assessment Report*-this report documents the assessment of valued aspects and features to determine their vulnerability to the impacts of climate change
- *Regional Adaptation Plan*-this report identifies adaptation options for the Region to build resilience and adapt to the impacts of climate change in relation to key areas of vulnerability and take advantage of any opportunities.

1.3 How to read this Regional Adaptation Plan

Table 1 provides an overview of the content of each section of this Regional Adaptation Plan.

Table 1 Guide to reading the Regional Adaptation Plan

Section		Purpose
1	Introduction	Describes the Limestone Coast Regional Adaptation Plan project partners, who the Plan belongs to, what it hopes to achieve and how it has been prepared
2	How will climate change be experienced across the Limestone Coast?	Summarises the current and projected climate for the Limestone Coast Region. This information was used to understand risks and opportunities presented by climate change
3	Understanding vulnerability and identifying areas for focussing adaptation action	Provides an overview of how areas for focussing adaptation action were identified based on: • Understanding what is valued in the region • Implementation and analysis of the Integrated Vulnerability Assessment • Identification of key decision areas for adaptation action • Identification and assessment of adaptation options utilising adaptation pathways analysis
4	Adaptation options for the Limestone Coast	Provides further detail regarding adaptation pathways analysis Describes the pathway maps and how to interpret them Describes the adaptation options identified for each key decision area
5	Implementing the Regional Adaptation Plan	Summarises the adaptation options with reference to the Adaptation Action Plan, discusses cross sectoral adaptation options, identifies enabling conditions to support the implementation of the Regional Adaptation Plan as well as governance arrangements
6	References	Lists documents referred to in the Plan
	Appendix A	List of organisations/sectors that participated in the preparation of the Regional Adaptation Plan
	Appendix B	Adaptation Action Plan which proposes actions for adaptation options for more immediate implementation as well as suggested leaders and partner for actions
	Appendix C	Summary of workshop held with regional stakeholders to discuss governance arrangements to support implementation of the Regional Adaptation Plan and detailed actions to initiate cross sectoral adaptation options

2

HOW WILL CLIMATE CHANGE BE EXPERIENCED ACROSS THE LIMESTONE COAST?

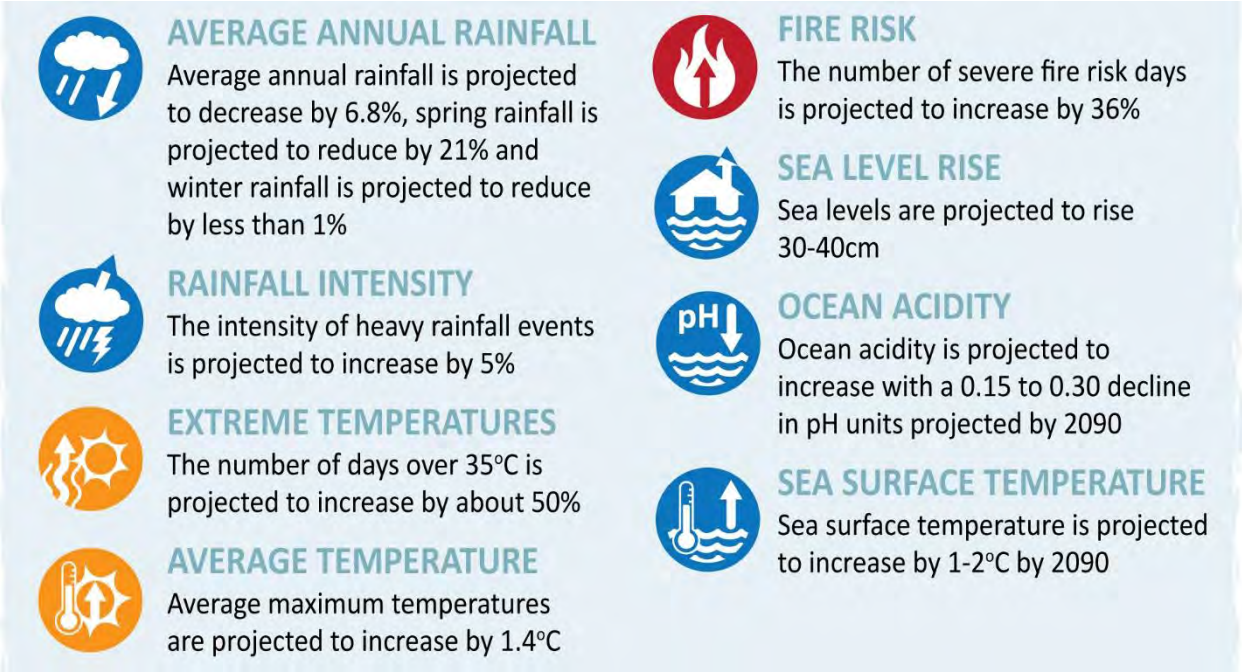
2 How will climate change be experienced across the Limestone Coast?

To assist with preparing the Regional Adaptation Plan, climate projections were prepared and documented in the Climate Projections Report[3]. Climate projections differ depending on a range of factors including which climate model, concentration pathway (previously referred to as emissions scenario) and timeframe for the concentration pathway are selected. The Project Steering Group that has overseen the preparation of the Regional Adaptation Plan considered the range of projections that could be used and chose to use data from the median model outputs to 2070 under an intermediate (emissions) concentration pathway (RCP4.5). This data was used to identify climate variables which describe various aspects of future climate such as:

- average annual maximum and minimum temperatures
- temperature at different times of the year e.g. summer versus winter
- frequency and intensity of heatwaves
- quantity and seasonality of rainfall
- intensity of extreme rainfall events
- frequency and intensity of extreme fire danger days
- sea level rise.

The changes in climate projected for the Limestone Coast are summarised by Figure 3 and in Table 2 and Table 3.

Figure 3 Summary of 2070 climate projections for the Limestone Coast



[3] Limestone Coast (2015) *Climate Projections Report*, prepared by URPS and Seed Consulting Services as part of the consultancy led by URPS for the Limestone Coast Regional Climate Change Adaptation Plan Project

Table 2 Climate projections for Mount Gambier (2070, intermediate emissions)

Climate variable	Type of change projected	Current	Projected (2070)
Extreme heat[4]	Increased frequency and intensity	6 days >35ºC 1 days >40ºC	10.5 days >35ºC 2 days >40ºC
Bushfires	Increased frequency and intensity (Fire danger rating "severe")	1.6	2.6
Annual temperature[5]	Warmer annual (1.4ºC increase)	19ºC	20.4ºC
Summer temperature	Warmer summer (1.3ºC increase)	24.5ºC	25.8ºC
Autumn temperature	Warmer autumn (1.3ºC increase)	19.6ºC	20.9ºC
Winter temperature	Warmer winter (1.2ºC increase)	13.7ºC	14.9ºC
Spring temperature	Warmer spring (1.6ºC increase)	18.1ºC	19.7ºC
Annual rainfall[2]	Drier (6.8% reduction)	711 mm	662 mm
Rainfall summer	Drier summer (9.5% reduction)	91 mm	83 mm
Rainfall autumn	Drier summer (3.8% reduction)	161 mm	155 mm
Rainfall spring	Drier spring (20.5% reduction)	180 mm	143 mm
Rainfall winter	Wetter winter (0.7% increase)	278 mm	280 mm
Rainfall intensity	Increased intensity (7% increase)	-	-

Table 3 Climate projections for Keith (2070, intermediate emissions)

Climate variable	Type of change projected	Current	Projected (2070)
Extreme heat[6]	Increased frequency and intensity	21 days >35ºC 4 days >40ºC	31 days >35ºC 8.5 days >40ºC
Bushfires[7]	Increased frequency and intensity	1.7	2.8
Annual temperature[8]	Warmer annual (1.4ºC increase)	22.3ºC	23.7ºC
Summer temperature	Warmer summer (1.3ºC increase)	29.2ºC	30.5ºC
Autumn temperature	Warmer autumn (1.3ºC increase)	22.6ºC	23.9ºC
Winter temperature	Warmer winter (1.2ºC increase)	15.6ºC	16.8ºC
Spring temperature	Warmer spring (1.6ºC increase)	21.7ºC	23.3ºC
Annual rainfall[9]	Drier (6.8% reduction)	460 mm	429 mm
Rainfall summer	Drier summer (9.5% reduction)	66 mm	60 mm
Rainfall autumn	Drier summer (3.8% reduction)	106 mm	102 mm
Rainfall winter	Wetter winter (0.7% increase)	166 mm	167 mm
Rainfall spring	Drier spring (20.5% reduction)	123 mm	98 mm
Rainfall intensity	Increased intensity (7% increase)	-	-

It should be noted that future projected change relates to "median" conditions. Some seasons or years will experience conditions more or less severe than this.

[4] Baseline based on average days per year between 1981-2010
[5] Baseline temperature and rainfall data are for the period 1942-present for Mount Gambier Aero weather station
[6] Baseline based on average days per year between 1981-2010
[7] Fire danger data is presented for Adelaide because projections data for Keith are not available. Other locations for which fire danger projections are available in SA are Mt Gambier, Ceduna and Woomera.
[8] Baseline temperature data are for the period 1962-present for Keith weather station
[9] Baseline rainfall data are for the period 1906-present for Keith weather station

3

UNDERSTANDING VULNERABILITY AND FOCUSING ADAPTATION ACTION

3 Understanding vulnerability and focusing adaptation action

The key objective of the Regional Adaptation Plan is to identify adaptation actions that reduce or address key vulnerabilities that are presented by climate change or build on areas of resilience and take advantage of opportunities.

The Integrated Vulnerability Assessment (IVA)[10] undertaken in stage two of the project assessed 46 indicators that related to aspects or features valued by the Limestone Coast Region[11] to understand how they might be vulnerable to climate change. These indicators related to aspects or features of the Limestone Coast Region which were considered to contribute to the following values identified during stage one of the project:

- caring for the natural environment
- looking after our land
- management of water resources
- community participation
- quality of life, wellbeing and availability of quality services across the region
- a diverse, modern and productive regional economy
- regional identity, collaboration, good governance and financial sustainability.

3.1 What is an IVA?

The IVA is a tool that enables consideration of both the potential impact of climate change (exposure and sensitivity) and adaptive capacity (refer Table 4). Once implemented, analysis of the IVA enables aspects or features of the Region that may be more vulnerable than others to the impacts of climate change to be determined. This then allows areas of focus to be identified for focussing adaptation planning.

[10] Limestone Coast (2015) *Integrated Vulnerability Assessment Report*, prepared by URPS as part of the consultancy led by URPS for the Limestone Coast Regional Climate Change Adaptation Plan Project

[11] Limestone Coast (2015) *Regional Values and Climate Change Report*, prepared by URPS as part of the consultancy led by URPS for the Limestone Coast Regional Climate Change Adaptation Plan Project

Table 4 Definition of key terms

Term	Definition
Exposure	Exposure considers the likelihood of a feature or its function being subjected to change in a particular climate variable. For example low lying land is more exposed to inundation from flooding, the entire Limestone Coast Region is exposed to heatwaves and the coastal area is exposed to sea level rise. For this Adaptation Plan, exposure relates to predicted changes in the climate at 2070
Sensitivity	Sensitivity considers the degree to which a feature or its functions are affected by change to a particular climate variable For example, older people are more sensitive to heatwaves, the condition of wetland ecosystems is sensitive to reduced rainfall and native vegetation is sensitive to increased bushfire risk
Adaptive capacity	Adaptive capacity is the ability or potential of a feature or function to adjust to climate change impacts (including climate variability and extremes). It enables systems to moderate potential damages, take advantage of opportunities, or cope with consequences and maintain the valued characteristics of that feature or function Consideration is given to what extent a feature or its function in its current form, with current management practices or funding, is able to continue to function, cope or adjust to the expected climate conditions at 2070

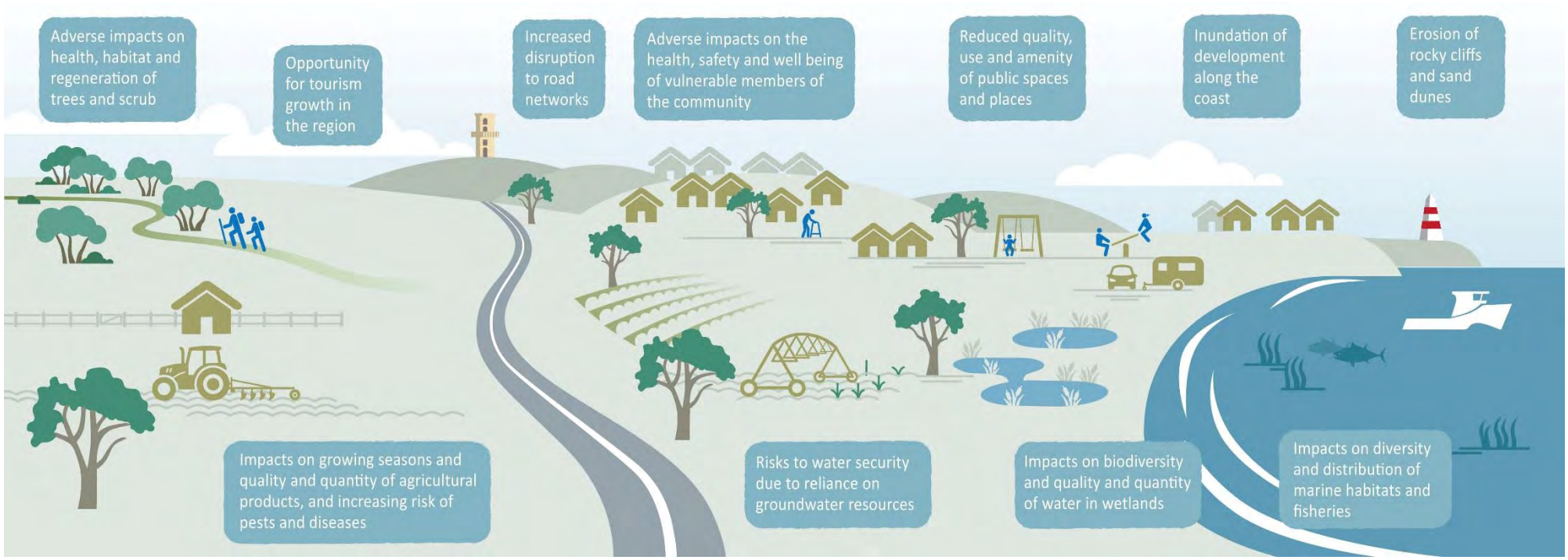
3.2 What did the IVA tell us?

Table 5 and Figure 4 show those valued aspects or features of the Limestone Coast that were identified via analysis of the IVA as having a higher vulnerability to climate change than others.

Table 5 Indicators that were assessed by the IVA as having a higher vulnerability to climate change

Indicators that were identified by the IVA as having higher vulnerability to climate change
Amenity and character provided by open space and public realm in townships
Condition and extent of heathlands and shrublands
Condition and extent of marine habitats - kelp
Condition and extent of wetland ecosystems
Condition and extent of woodlands ecosystems
Condition of marine habitats - reef areas (off shore and intertidal)
Condition and (natural) recruitment of scattered trees
Condition of rocky coasts
Condition of sandy coasts
Condition of State and local heritage items (built items)
Effective operation of 2,500km of drainage network in the SE
Effective operation of road network
Health, safety and wellbeing of low income households
Health, safety and wellbeing of people with disability (e.g. people needing assistance with core activities, physical disabilities, mental health issues)
Health, safety and wellbeing of vulnerable members of the community (those aged over 75)
Productivity of cropping activities - irrigated (e.g. Lucerne seeds)
Productivity of horticultural and viticultural land uses
Productivity of summer annual cropping activities - irrigated (potatoes and onions)
Regional economic contribution of tourism sector
Sustainability and productivity of fisheries (recreational)

Figure 4 Valued aspects and features that are vulnerable to climate change or present opportunities



3.3 Transitioning from the IVA to adaptation planning

Adaptation pathways analysis was used to prepare the Regional Adaptation Plan. An important step in undertaking this approach is to frame the areas of focus that have been identified by the analysis of the IVA as 'key areas of decision making'.

Key areas of decision making comprise questions that the Regional Adaptation Plan is looking to respond to and are made up of the following elements:

- the objective that the Limestone Coast Region is looking to achieve in relation to an aspect or feature that is valued (e.g. to provide, protect and manage [the aspect or feature])
- the valued feature or aspect that the Region is focussed on (e.g. the health, safety and wellbeing of vulnerable members of the community)
- The reason why the Region needs to take action, i.e. in response to a particular climate impact such as increased frequency and intensity of heat waves.

For the Limestone Coast Regional Adaptation Plan, 10 key areas of decision making were developed as summarised in Table 6 and their development is directly linked back to the IVA analysis (refer Integrated Vulnerability Assessment Report).

Table 6 Key areas of decision making

Theme	Key area of decision making
Wetlands	How do we protect and enhance the condition and extent of wetlands as our climate becomes warmer and drier and the sea level rises?
Natural ecosystems (heathlands shrublands, and woodlands) and scattered trees	How do we protect and enhance the condition and extent of natural ecosystems (heathlands, shrublands, and woodlands) and scattered trees as our climate becomes warmer and drier and bushfire risk increases?
Irrigated agriculture, horticulture and viticulture	How do we maintain and increase the contribution that irrigated agriculture, horticulture and viticulture make to the region's economy as the climate becomes warmer and drier?
Marine habitats and fisheries	How do we protect and enhance the marine ecosystems that support our fisheries as the climate becomes drier and ocean conditions change?
Coastal landscapes	How do we manage coastal assets and landscapes as the sea level rises?
Water security	How do we maintain water security in the region for community, business and environment, as our climate becomes warmer and drier?
Infrastructure (roads)	How do we maintain the effective operation of our road network as the sea level rises and more frequent and intense heat waves and flooding occurs?
Recreation, open space and public realm	How do we provide, protect and enhance the amenity and recreation opportunities provided by open space and public realm as our climate becomes warmer and drier and there is an increased risk of damage from bushfires and sea level rise?
Tourism	How do we maintain and grow the contribution tourism makes to the region's economy as our climate becomes warmer?
Vulnerable members of the community	How do we improve the health, safety and wellbeing of vulnerable members of the community as the sea level rises and the frequency and intensity of heat waves and bushfires increase?

Dryland cropping, extensive grazing and forestry are key economic contributors to the Limestone Coast and their productivity is interlinked with seasonal and climatic conditions. As such, it was anticipated that these activities would be an area of focus for the Regional Adaptation Plan. However, the IVA found that these activities had lower vulnerability as a result of either higher adaptive capacity or presenting opportunities associated with a warming climate. Subsequently they are not directly reflected in the key decision areas. Related water and infrastructure aspects however are considered in other key decision areas which are relevant to dryland cropping, extensive grazing and forestry activities.

3.4 What is adaptation pathways analysis?

As referred to above, adaptation pathways analysis has been used to prepare this Regional Adaptation Plan.

Adaptation pathways analysis is an emerging approach to developing adaptation plans. Some of the current research into adaptation pathways thinking is summarised in work by Hasnoot[12] and Wise[13].

Adaptation pathways provide a way of considering and visualising adaptation options. Rather than being limited to identifying the best single set of adaptation options for a limited set of climate change scenarios, it enables decision makers and communities to consider a range of possible actions, how they will be impacted by climate change through time, and whether any options have an 'expiry date' (i.e. a point in time at which they are no longer viable or useful for addressing the impact being experienced). It also enables the exploration of what combination of options are most suitable for adapting to future climate change and how these could be sequenced over time (ie what should be done now, versus what can be delayed). This type of analysis can break down the disempowering sense that 'everything' will be affected by climate change, or that everything needs to be done at once.

[12] Hasnoot, M., Kwakkel, J. H., Walker, W. E., and ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. Global Environmental Change. Volume 23: 485–498. (http://dx.doi.org/10.1016/j.gloenvcha.2012.12.006)

[13] Wise, R. M., Fazey, I., Stafford Smith, M., Park, S. E., Eakin, H. C., Archer Van Garderen, E. R. M., and Campbell, B. (2014). Reconceptualising adaptation to climate change as part of pathways of change and response. Global Environmental Change (on-line). (http://www.sciencedirect.com/science/article/pii/S095937801300232X.)

4

ADAPTATION OPTIONS FOR THE LIMESTONE COAST REGION

4 Adaptation options for the Limestone Coast Region

Adaptation options have been identified and assessed in relation to the ten key areas of decision making. For three of the key areas of decision making, a pathways map has also been developed (refer sections 4.2 to 4.3).

To develop adaptation options for each of the key areas of decision making a range of information generated by the project was drawn upon including the project reports described at Section 1.2.

For each key area of decision making the following aspects are discussed:

- why the area of focus is important to the region
- how projected climate change may impact that area of focus
- how the region can respond through adaptation.

Critical to the identification and assessment of adaptation options for each key area of decision making was the consideration of the aspects summarised by Table 7. The majority of information documented in response to these aspects was generated by stakeholders from the Region at the adaptation options workshops and was used to generate the content, including adaptation options, of sections 4.2 to 4.11 of this Regional Adaptation Plan.

Table 7 Key considerations for identifying and assessing adaptation options

Consideration	Questions we asked our Region	Why is it important to consider this?
Current practice	What are we currently doing in relation to the key area of decision making?	By understanding what we are doing now, we can think about what else we might need to do in the future as the climate changes
Thresholds for changing our approach	What are our levels of tolerance, or thresholds, for changing what we are doing as we experience changes in climate?	By understanding thresholds, we can identify when we might need to change our approaches so we can adapt to changes in climate
When what we are doing will no longer be enough to cope	Given what we understand about projected climate change, when might what we are doing no longer be enough to cope with changes in climate?	By understanding what we are doing now and how the climate might change, we can consider when our current approaches may not be enough to cope
Identifying adaptation options	What options are there to respond to the challenge posed by the key decision area?	By identifying options we can take action to adapt
Now or later	What adaptation options should be progressed now or later?	By understanding when options might be needed we can consider how to sequence actions over time as we don't need to do everything all at once

Pathway maps have been prepared for the following key decision areas:

- coastal landscapes
- vulnerable members of the community
- water security.

These key decision areas were chosen by the project Steering Group to focus the development of pathway maps in the first instance, with the opportunity to use the information gathered and documented in this Regional Adaptation Plan to develop pathway maps for the remaining seven key decision areas in the future.

For the remaining seven key decision areas that pathway maps were not prepared for, similar information has been collected and documented, but the additional filtering process to determine the preferred combination of adaptation options for each key decision area has not been undertaken. This means that further work is likely to be required by the sectors relevant to those seven key decision areas to determine the preferred combination of adaptation options for implementation.

4.1 Interpreting the pathways maps

The pathway maps set out both the range of adaptation options considered for each key decision area, and the preferred adaptation pathway made up of the preferred options. The timing for each option and the relationship with other preferred options are also shown on the pathways.

Each pathway should be read in conjunction with the description of the relevant key decision area.

The horizontal axis of the pathway shows both a timescale, and expected changes to the climate that are relevant to the key decision area.

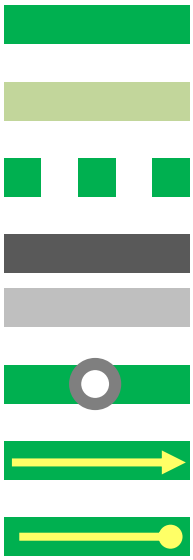
The range of adaptation options considered for the decision area are listed along the left hand side of the pathway.

Against each option is a combination of dots and lines that indicate:

- the contribution of the option to the relevant key decision – whether it fully or partly addresses the decision
- the favourability of the option
- the time period over which the option is effective
- the time period before an option is implemented during which preparatory work is required
- decision points where decision makers need to choose between options
- the preferred pathway through the options listed.

Figure 5 describes the symbology used in the pathway maps.

Figure 5 Pathway map symbology



A solid, dark green line indicates the time period over which an option could usefully address the relevant key area of decision making

A lighter green line indicates time before an option is implemented during which preparatory work is required

A dashed, thick dark green line indicates that the option contributes to the adaptation solution but only in part

A solid dark grey line indicates an option that is not favoured

A lighter grey line indicates an option that is not preferred but that requires time during which preparatory work would be required if such an option was to be pursued

Circles indicate a decision point, such as when decision makers may need to choose between different options

Yellow line indicates the preferred pathway through the options (as identified by stakeholders)

Indicates a preferred pathway that has reached an expiry date, that is, the point at which the option no longer usefully addresses the key area of decision making

A vertical line through 'decision point' circles identifies a point in time at which a decision needs to be made between different options. The timing of the decision is indicative relative to the x-axis. This is based on the premise that as climate changes some options will become less suitable as adaptation measures and so new ones may be required.

For each pathway, 'current practice' is the first listed option. This relates to all aspects of the current approach being taken to the decision area, for example current funding, management, and maintenance regimes. The length of the adjacent line shows how long the current approach with no changes can be expected to effectively address the key area of decision making.

4.1.1 Understanding the preferred pathway

The preferred pathway (yellow line/s) identifies which options should be progressed now and into the future based on currently available information, including information provided by stakeholders at the adaptation workshops.

The preferred pathway does not preclude current actions that contribute to future adaptation from continuing. The pathways should be reviewed at least every 5 years, at which time new information may suggest that the preferred pathway should take a different course through potential options.

It should be noted that although there was significant stakeholder involvement in the preparation of the pathways, further assessment of options by relevant individual sectors may still be required.

4.2 Coastal landscapes and assets

Why are coastal landscapes and assets important to the Region?

The diverse coastal landscapes of the Limestone Coast are valued for their amenity, contribution to regional character, provision of recreational opportunities and as tourist attractions. Coastal landscapes including sandy bays, dune systems, cliffs and coastal wetlands also provide a range of habitats for native species. They are highly valued by the Region's indigenous people, providing food, shelter, medicines and cultural items. Built coastal assets such as houses, caravan parks, boat ramps, playgrounds and pathways are valued for accommodation, shelter and recreation.

How will climate change impact coastal landscapes?

The IVA found that coastal landscapes are highly vulnerable to sea level rise, with cliffs, dunes and coastal vegetation likely to be damaged and eroded. Where development restricts natural landward migration, natural assets are more vulnerable and less able to retreat inland. Similarly, the IVA found that built coastal assets such as houses, caravan parks, boat ramps, playgrounds and pathways are also vulnerable as a consequence of flooding caused by the combined effects of sea level rise and storm surge. This will result in temporary or permanent inundation and reduce the effective operation of some assets, physical damage to others, and in some locations, the need to relocate or abandon.

How do we manage coastal assets and landscapes as the sea level rises?

Current action to protect coastal landscapes includes beach erosion management such as fencing and revegetation, dune and erosion monitoring and investigations, off-road vehicle access restrictions, pest plant and animal control, protection of migratory shorebird habitat and coastal wetland restoration. The Limestone Coast and Coorong Coastal Action Plan also recommends a number of actions to address impacts of climate change on coastal resources as well as actions to protect habitat, conservation and heritage values. Stakeholders identified that within 10 years, current action alone will no longer be adequate to protect coastal landscapes from the impacts of sea level rise.

Responding to the impacts of sea level rise along the coast involves a combination of defence, retreat and potentially, abandonment options. The combination of adaptation options implemented will vary depending on whether the assets being protected are built or natural, and the extent to which a site is already being impacted by sea level rise.

An immediate priority in managing coastal assets and landscapes is to identify areas for future development to prevent continued development of known areas of risk and raise awareness about the potential impacts of climate change in the coastal zone (refer Figure 6). These options should be implemented over the coming 10 and 20 years respectively, to ensure the necessary planning has been undertaken in advance of major impacts being

experienced. Education and awareness raising can also be used as an opportunity to discuss with communities and industry the prospect of reduced beach maintenance in the future and discuss options to relocate infrastructure before major impacts are experienced.

A series of other adaptation options are also required for immediate implementation. Complementing one another are mapping and monitoring high risk areas using a technique such as LIDAR. The resulting data can then be used for modelling coastal processes and understanding current and emerging areas of risk. On-ground works required immediately include soft structural options (e.g. beach replenishment and dune restoration) and small scale, hard protection infrastructure.

Within 5 years adaptation for the coastal zone should focus on implementing coastal management design guidelines and techniques (e.g. material selection, vegetation management) and making amendments to relevant Development Plans to restrict development in high risk areas. Amendments to Development Plans require a lead time of 5-10 years in order to allow for the requisite mapping of high risk areas to occur and consultation on proposed amendments.

Within 20 years, it is anticipated that adaptation will involve acquiring land in high risk areas, constructing hard protection infrastructure on a large scale to protect major coastal assets and towns, and use of innovative infrastructure on both a small and large scale. Once a combination of soft and hard structural options have been deployed across the Region, the focus of adaptation will move to relocating or abandoning built and natural assets. This is expected to occur within 30 years.

The timing of adaptation options identified above will depend on the location of built and natural coastal assets. In some instances, assets in low lying areas may already require major protection works and decisions regarding relocation or abandonment will occur in the coming 5-10 years. The recent cessation of sand replenishment in parts of the coastal zone near Beachport is an early example whereby some built assets have already been identified for relocation.

While the transition from one set of adaptation options to another may be informed by periodic review of coastal zone planning strategies, other thresholds are also likely to be important including:

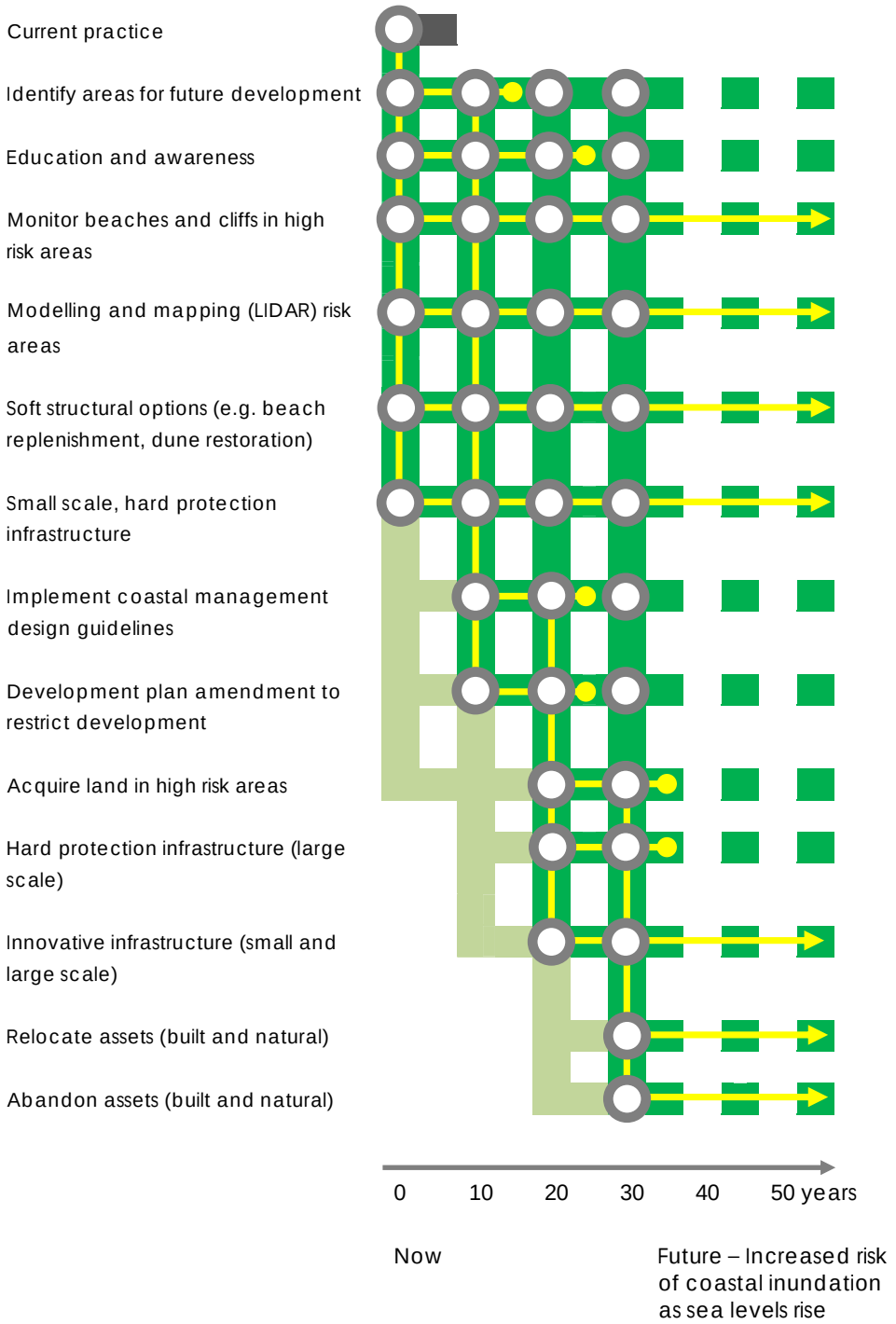
- over floor flooding of residential buildings (e.g. if this were to occur more than twice per year)
- sea level rise resulting in permanent inundation of buildings or facilities
- increased costs and frequency of requirements for repairs to Council assets
- flooding results in increased frequency of local road closures (e.g. four times per year)
- flooding results in increased frequency of major transport route closures (e.g. once per year)
- soil salinity levels rising to a point where agriculture near the coast is impacted
- wetlands experience hypersaline conditions
- seawater intrusion occurs into the drainage network
- measurable loss of beach nesting bird eggs and chicks or loss of migratory bird pre-departure body weight.

Summary of key findings

An immediate priority for managing coastal assets and landscapes in the coming decades is to identify areas for future development and raise awareness about the potential impacts of sea level rise. These will be complemented by mapping and monitoring of high risk areas and on-ground works such as soft structural options and small scale, hard protection infrastructure. Within 20 years a broader array of protection infrastructure will be required before key decisions about relocating or abandoning assets are made within 30 years.

Figure 6 Coastal landscapes pathway map

How do we manage coastal assets and landscapes as the sea level rises?



4.3 Vulnerable members of the community

Why is improving the health, safety and wellbeing of vulnerable members of the community important to the Region?

Health, safety and wellbeing is desired for all residents of the Limestone Coast Region. Members of the community who are already vulnerable due to poor mental or physical health, are isolated by distance or a lack of mobility or transport options and/or are highly dependent on particular facilities or support services will be more vulnerable to the impacts of climate change, particularly during extreme events.

How will climate change impact the health, safety and wellbeing of vulnerable members of the community?

The IVA found that the health, safety and wellbeing of vulnerable members of the community, including older people, those living with a disability, mental health issues or needing assistance with core activities, and low income households will be adversely impacted by climate change. In particular, climate hazards such as heatwaves, bushfire and inundation from sea level rise will further exacerbate existing vulnerability as vulnerable members of the community are likely to have a lower ability to respond and recover from such events.

How do we improve the health, safety and wellbeing of vulnerable members of the community as the sea level rises and the frequency and intensity of heat waves and bushfires increase?

Current actions to improve the health, safety and wellbeing of vulnerable members of the community during heatwaves include the Red Cross telecross REDi program that makes phone calls to registered members of the community, policies relating to hot weather activities (e.g. children's services and sport and community service provision) and use of air-conditioned facilities on extreme heat days. Many services that look after vulnerable members of the community include training for staff relating to heatwaves and bushfire. Stakeholders identified that current services are already capacity and would be unable to cope with an increase in demand expected as the climate becomes hotter and drier. Stakeholders identified that within 10 years, current action alone will no longer be adequate to support vulnerable members of the community from the impacts of climate change.

Improving the health, safety and wellbeing of vulnerable members of the community in response to climate change will require implementation of a range of adaptation options, many of which form part of current practice in this sector but require acceleration or renewed focus. An immediate priority for ongoing implementation is to communicate, educate and raise awareness of the risks of climate hazards such as extreme heat, bushfire and sea level rise to all sectors of the community (refer Figure 7). This should be followed by the preparation of emergency response and recovery plans and the use of social media to build community networks. The information provided through these networks needs to be targeted at different demographics and people living in high risk or non-protection areas.

An innovative adaptation option that has been identified and is not part of current practice is the establishment of heat clinics in emergency departments. These would be based on the model of flu clinics currently provided in the Region and provide specialised support for people suffering from heat stroke, dehydration and other heat related illness.

Investing in homes and infrastructure will also form a vital part of the response in improving the health, safety and wellbeing of vulnerable members of the community. Residential energy management programs should include provision of advice, subsidies for power bills, promotion of energy-efficient appliances and assistance to install solar panels and insulation. Improving telecommunications infrastructure across the Region will improve access to the internet and mobile phone coverage. Both options should be implemented over the coming two decades, by which time the necessary changes to homes and telecommunications infrastructure should be completed.

The only preferred option that requires a delay in its introduction is the mandatory implementation of climate sensitive building design. The five year lead time for this option is designed to enable the policy and planning work to be completed that is necessary to support implementation of this option.

While identified as an adaptation option, restricting development in high hazard areas is not preferred as a way to improve the health, safety and wellbeing of vulnerable members of the community. Furthermore, relocating people and communities was not supported at all.

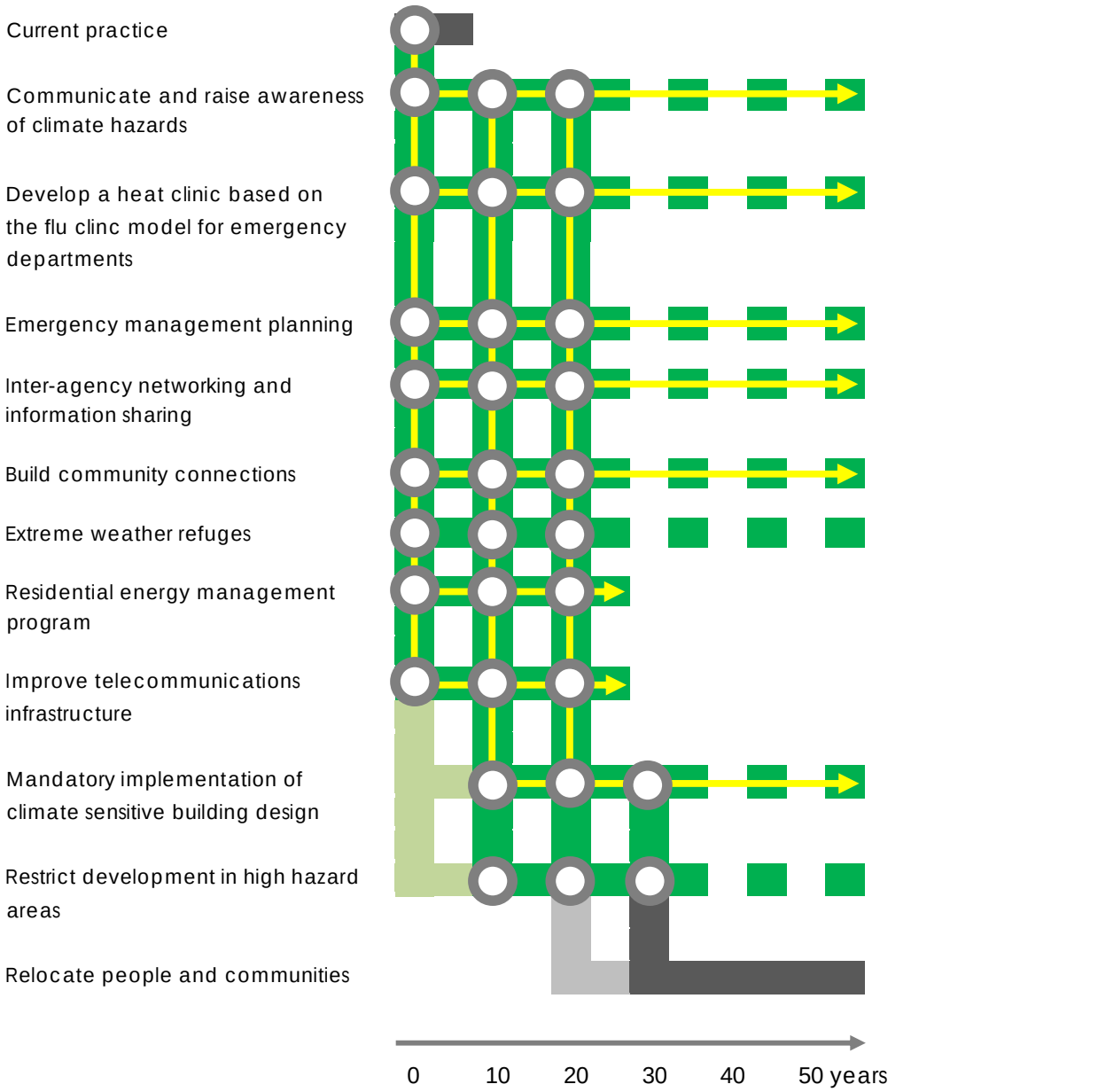
A review or change to the combination of adaptation options may be triggered if certain thresholds are exceeded. For this sector, the most important threshold would be an increase in the number of deaths as a result of extreme heatwaves. Other relevant thresholds will be in relation to the number of hospital admissions as result of extreme events, increases in evacuations, rises in insurance premiums, frequency of home floor level inundation, cost of repairs required as a result of flood or storm damage, the number of homes damaged or destroyed by bushfire and an increase in the number of deaths as a result of extreme events.

Summary of key findings

Immediate priorities for improving the health, safety and wellbeing of vulnerable members of the community as the climate changes are to communicate, educate and raise awareness of the risks of climate hazards; prepare emergency response and recovery plans; build community networks; develop heat clinics in emergency departments; deliver residential energy management programs; and improve telecommunications infrastructure. Within five years there should be mandatory implementation of climate sensitive building design.

Figure 7 Vulnerable members of the community pathway map

How do we improve the health, safety and wellbeing of vulnerable members of the community as the sea level rises and the frequency and intensity of heat waves and bushfires increase?



inundation as sea levels rise.

4.4 Water security

Why is water security important to the Region?

Water resources, predominantly groundwater, sustain the Region's community, economy and natural environment. Agricultural, forestry, industrial and manufacturing industries are reliant on groundwater for production and creation of products for export. Much of the Region's potable water supply comes from groundwater, and many wetlands and biodiversity are sustained by shallow groundwater.

How will climate change impact water security?

There is a heavy reliance on groundwater resources as the main source of water in the Region as well as dependence on Water Allocation Plans for the management of these resources. Climate change is likely to result in reduced rainfall and runoff to recharge groundwater sources which will be coupled with increased demand for this water as the reduced rainfall occurs. In other words there will be increased demand for water from a declining resource. To ensure that the Region continues to prosper, there is a need to improve water management and explore alternative and secure water sources such as retaining water in the landscape to increase recharge and reduce losses to the sea

How do we maintain water security in the region for community, business and environment, as our climate becomes warmer and drier?

Current action to maintain water security is driven by the Water Allocation Plans for the Region's groundwater resources that require monitoring of groundwater levels and salinity, rainfall and volume of extraction and allocate water considering the sustainable yield of the relevant aquifers and environmental water requirements. Stakeholders identified that within 10 years, current action alone will no longer be adequate to maintain water security as recharge reduces and temperatures increase.

Water security has amongst the largest number of potential adaptation options of any sector (refer Figure 8). Immediate priorities for water security in the region, most of which form part of current practice but require acceleration, are:

- educating and raising awareness amongst the community, industry and government about the impacts of climate change on water resources across the Limestone Coast
- continuing to support measures to improve water use efficiency that have been identified in the region's Water Allocation Plans
- undertaking research and monitoring into groundwater resources, focussing on better understanding recharge, sea water intrusion and salinity hotspots

- completing the South East Drainage and Wetlands Strategy (a project of the SE NRM Board and the SE Water Conservation and Drainage Board)
- continuing to undertake water allocation planning, including investigating alternative options for prescribing environmental water and developing triggers in Water Allocation Plans to assist with managed declines in groundwater availability.

Within 5 years, work should commence on the investigation of the feasibility of recharging the aquifer with drainage water and options for retaining water in the landscape. This adaptation option has also been identified for irrigated agriculture and wetlands and needs to be progressed in a coordinated manner, considering integrated management of surface water and groundwater resources. This strategy would represent a significant change in focus for management of the drainage network, which was originally designed to de-water the landscape to make it more suitable for agriculture.

Implementation of the adaptation options identified above should be monitored and reviewed on at least a five yearly basis to determine the most appropriate combination of actions to address the key area of decision making as the climate changes.

Other adaptation options that should be considered for implementation in the coming five years, but are currently not preferred, are managing sea water intrusion, diffusing salinity hotspots, shandying saline ground water and increased construction of small scale desalination plants. Longer term options for which the planning phase is still at least two decades away are to develop deep aquifers for water supply, constructing large scale desalination plants and increasing the reticulation of alternate water sources such as from the River Murray.

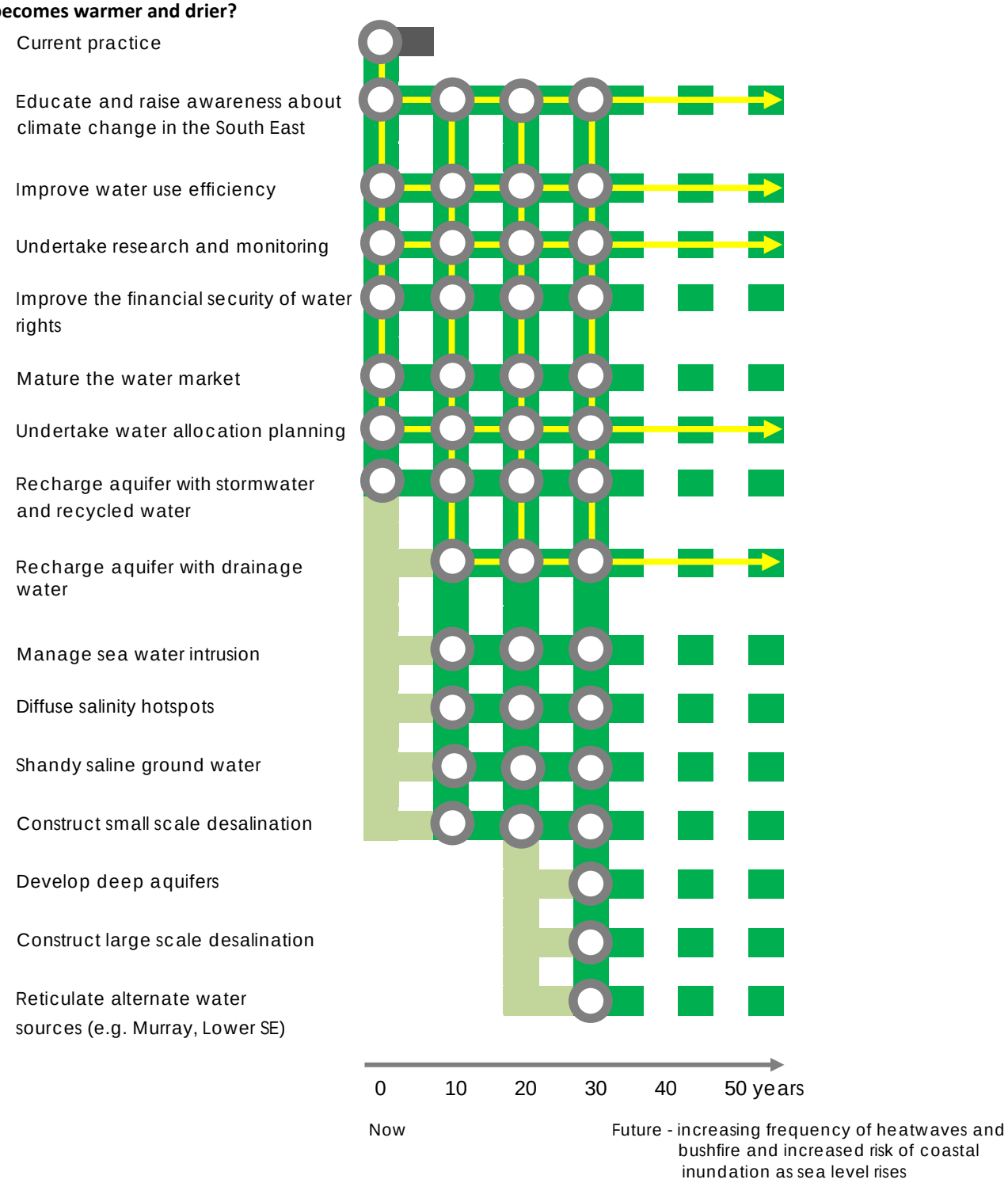
As the climate changes there are several thresholds that if met, should be a trigger for a review of the combination of adaptation options being implemented. These thresholds would relate to groundwater salinity levels, height of the groundwater table and reduced drainage flows.

Summary of key findings

Immediate priorities for maintaining water security in the region are educating and raising awareness about the impacts of climate change on water resources; continuing to support measures to improve water use efficiency; undertaking research and monitoring into groundwater resources; continuing to undertake water allocation planning; and within five years, commence investigating options to recharge aquifers with drainage water.

Figure 8 Water security pathway map

How do we maintain water security in the region for community, business and environment, as our climate becomes warmer and drier?



4.5 Irrigated agriculture, horticulture and viticulture

Why is irrigated agriculture, horticulture and viticulture important to the Region?

Irrigated agriculture, horticulture and viticulture are valued by the Region for their contribution to the regional economy and as significant employment sectors and generators of household income. The Region's grape growing and wine production areas are also valued tourist attractions and agriculture, horticulture and viticulture landuses are inextricably linked to the Region's character and identity. The Region generates 12% of the State's winegrape production and 40% of the State's dairy production[14].

How will climate change impact irrigated agriculture, horticulture and viticulture?

The agriculture, horticulture and viticulture sectors rely heavily on the availability of groundwater for irrigation and the IVA found that projected reduction in rainfall and runoff as a result of climate change may lead to reductions in groundwater allocations as the associated Water Allocation Plans are implemented. The IVA also found that projected changes in the climate may affect the quality of outputs, increase the risk of pests and disease and the suitable growing season for some crops.

How do we maintain and increase the contribution irrigated agriculture, horticulture and viticulture make to the region's economy as the climate becomes warmer and drier?

Current action to support irrigated horticulture, agriculture and viticulture includes pasture management to improve yield and control pests and disease, increasing the efficiency of water use, livestock breeding, varietal selection, reduced stocking rates, targeted branding and marketing. Stakeholders considered that practice change is driven by their economic viability and the impacts of a drier and warmer climate will require producers to consider how they can sustain output and productivity.

The Limestone Coast has amongst the highest rainfall levels in South Australia, meaning that even with projections of a warmer and drier climate, it will continue to be a major focus for agriculture in the State.

A key adaptation option identified for immediate implementation for the irrigated agriculture, horticulture and viticulture sector is to continue to collaborate across the industry and to share information. It is recognised that there are well established industry associations and South East agriculture, horticulture and viticulture groups and that these require continued support to conduct research and development and build capacity amongst growers with respect to responding to changing climatic conditions.

[14] Department of Premier and Cabinet (2015) *Regional profile South Australia 2012-13* (http://data.sa.gov.au/data/dataset/regional-profile-south-australia-2011-12), *Regional profile Limestone Coast 2012-13* (http://data.sa.gov.au/data/dataset/regional-profile-limestone-coast-2011-12).

As the climate changes, a further key action that is not a major part of current management practice is making greater use of the drainage network for localised groundwater recharge. If this is implemented, it would mark a significant change in operational focus for management of the drains, which were originally constructed to dewater land considered too swampy for grazing and cropping. A coordinated, region wide strategy for managed aquifer recharge would likely take at least 5-10 years to develop and so preparatory work should commence immediately.

Other adaptation actions identified for implementation now which form part of current agricultural management practices but require acceleration to further build adaptive capacity in the Region's irrigated agriculture sector include:

- improving water use efficiency, for example through better irrigation systems and new crop varieties better suited to changes in climate
- changing land management and production techniques, such as increased use of cover crops between rows, changes to the direction of vine rows, mulching, increased use of organic matter in the soil, alerted spray practices and growing bigger canopies
- changing crops or varieties to better suit conditions, including considering choice of perennials versus annuals
- monitoring pests and disease to enable early detection of damage.

There are several adaptation options which are not favoured for the Region due to their potential negative economic impact, such as relocating some forms of agricultural to more suitable climates. While this might occur if some industries were to leave the Region, it is recognised that industries are already moving within the Limestone Coast, for example, leasing and buying of land further south for irrigated pasture production while land in the north is being used for cropping.

There are a variety of thresholds, which if exceeded, could drive the transition between adaptation options. These thresholds relate to irrigation demand versus groundwater availability and water cost. If groundwater allocations were reduced to all license holders, groundwater allocations were suspended or there were more than 3 years of catastrophic production, major change in management approaches – and hence adoption of adaptation options – may occur. The ability for agriculture to manage this change process and maintain and increase its contribution to the Region's economy, will be influenced by the rules contained in the various Water Allocation Plans for the Region.

Summary of key findings

A key adaptation option for immediate action is to support information sharing and continued collaboration across the irrigated agriculture, horticulture and viticulture industries with a view to further building the capacity amongst growers to respond to changing climatic conditions. A further key option is greater use of the drainage network for localised groundwater recharge, recognising that a coordinated, region wide strategy for achieving this will take at least 5-10 years to develop and commence implementation.

4.6 Marine habitats and fisheries

Why are marine habitats and fisheries important to the Region?

Marine biodiversity and fisheries including rock lobster and abalone are valued for their contribution to the Region's economy and identity. Recreational fishing is also highly valued, enjoyed by locals and visitors alike. The marine biodiversity of the Region is influenced by the cold-water upwelling of the Bonney Upwelling, where highly productive waters support species including endangered Blue Whales and giant kelp.

How will climate change impact marine habitats and fisheries?

The IVA found projected changes in ocean water temperature and acidity were likely to impact species populations and distribution. Changes in rainfall and runoff to marine environments may impact reproductive success particularly for those species sensitive to changes in water quality such as cockles and seagrass.

How do we protect and enhance the marine ecosystems that support our fisheries as the climate becomes drier and ocean conditions change?

Current action to protect and enhance marine habitats and fisheries include protection of key habitats and breeding areas through Marine Park sanctuary zones, Fishery Management Plans that require licensee reporting of fishing effort and catch and describe quotas and catch limits. The uncertainty regarding how marine habitats and fisheries might respond to increasing ocean temperatures and acidity led stakeholders to suggest that current action needs to be reviewed immediately to enable adaptive management approaches that can commence as soon as required.

There are a wide range of adaptation options for marine habitats and fisheries identified for immediate implementation. This reflects an extensive history in managing these systems but also suggests further analysis may be required as to the most effective adaptation options as conditions in the marine environment change.

In general, there is a need to maintain flexibility in fishing approaches and marine habitat management techniques, recognising that there remains uncertainty in how regional marine ecosystems will respond to changing sea surface temperatures, ocean pH and cold-water upwelling. Furthermore, there are few practical changes that can be made to ocean conditions such as temperature and ocean pH, compared to the management options available to land based farmers with respect to warmer and drier conditions.

Options for immediate implementation include:

- supporting land management activities that improve surface water quality and quantity

- monitoring marine species and habitats to enable identification of new pests and disease, and changes in the abundance and distribution of existing pests and disease in order to have the information needed to respond to climate change
- awareness raising and education for recreational and commercial fishers, particularly regarding catch limits with a focus on understanding the impacts if changes do not occur
- additional periodic closure of fishing for selected species to maximise reproduction
- use of alternative fishing technologies, especially where target species may change
- reducing catch levels of selected species when declines in recruitment are observed.

Adaptation options for implementation in the future include restricting outflows from drains to marine areas by diverting water into wetlands. This would require assessment on a case by case basis, and given the lead time in preparing for this option it is expected to require at least 5 years of planning. Another option requiring up to 5 years planning is the introduction of artificial habitats, which has the potential to increase habitat for fish stocks.

In the longer term, targeting alternative species may also be required to maintain the viability of fisheries and marine habitats. This will occur when the opportunities arise and would be subject to appropriate monitoring and evaluation and the development of the requisite fishery management plans.

While supporting the development of aquaculture is an adaptation option, there are limited opportunities for the Limestone Coast region because of the small number of suitable deployment sites in the Southern Ocean and because of environmental impact concerns.

The trigger for revising and implementing new adaptation options is likely to be the periodic review of fisheries management strategies, such as fishery management plans and harvest strategies. The latter are prepared in line with the Commonwealth Fisheries Harvest Strategy Policy and Guidelines and allow for a strategic, science–based approach to setting catch limits in Commonwealth fisheries.

The primary impact in the region that could lead to a change in management of marine habitats and fisheries in response to climate change would be declining fish populations and recruitment causing fisheries to be closed more frequently. Other changes that could lead to different management responses include declines in the condition and extent of kelp forest, fish stocks becoming commercially unviable or new species colonising marine habitats.

Summary of key findings

There is a need to maintain flexibility in fishing approaches and marine habitat management techniques, recognising that there remains uncertainty in how regional marine ecosystems will respond to changing sea surface temperatures, ocean pH and cold-water upwelling. Key immediate adaptation options include land management activities that improve surface water quality and quantity, monitoring marine species and habitats, awareness raising and education regarding catch limits, and periodic closure of fishing for selected species to maximise reproduction.

4.7 Natural ecosystems (heathlands, shrublands and woodlands and paddock trees)

Why are natural ecosystems important to the Region?

The diverse natural ecosystems of the Limestone Coast include heathlands, shrublands and woodlands that support a diverse range of plants and animals including many of State and National conservation significance. The high biodiversity of the Region is valued and recognised as a National 'Biodiversity Hotspot'. Scattered paddock or isolated trees, in particular large Red Gums, are key contributors to the Region's amenity and character in agricultural areas and provide shade and shelter to grazing animals.

How will climate change impact natural ecosystems?

The IVA found that projected changes in seasonal rainfall could have an adverse impact on vegetation health making species more prone to disease and pests. A reduction in spring rainfall and increased fire frequency could have adverse impacts on germination success and natural recruitment of many vegetation types and in particular, scattered trees.

How do we protect and enhance the condition and extent of natural ecosystems (heathlands, shrublands, and woodlands) and scattered trees as our climate becomes warmer and drier and bushfire risk?

Current action to protect and enhance the condition and extent of natural ecosystems and scattered trees include pest plant and animal control, bushfire and fuel load monitoring and management, Regional Action Plans for threatened species and ecological communities, education and awareness raising and grants for landholders to undertake revegetation and Bushcare. Stakeholders considered that whilst there is a lot of knowledge about how to manage natural ecosystems, there are also gaps, particularly relating to ecological burns. Stakeholders identified that current management practices are not adequate to meet current challenges and would be unable to adequately protect and enhance natural ecosystems as the climate becomes hotter and drier.

There are a large number of adaptation options for immediate implementation in order to protect and enhance the condition and extent of natural ecosystems across the Region. This breadth of options reflects the high vulnerability of many of these systems to climate change.

Adaptation will need to continue to support the management of threats, the impacts of which will be exacerbated by warmer and drier conditions and the increased risk of fire. This will require the adequate control of pest animals (e.g. deer, goats, foxes, rabbits) and plants (e.g. boneseed) through an adaptive and predictive management approach. The focus of such a program needs to be on current and emerging risks, that is more than just weeds of national significance. Implementation of this option will deliver benefits to other sectors as well, such as agriculture and tourism, by preventing degradation of natural and farmed landscapes.

Another important aspect of threat control is fire management. This requires continued improvements to fire management of native vegetation (e.g. prescribed burns) and land management (e.g. harvest codes of practice, fire permits for stubble burning). Underpinning this is the need for continued research into the positive and negative impacts of ecological burn regimes.

Other key adaptation options for immediate implementation include:

- demonstrating the social and economic value of functional native ecosystems to landholders and other key stakeholders
- developing a paddock tree replacement program
- encouraging landholders to use Heritage Agreements and other mechanisms for managing native vegetation and encouraging revegetation
- establishment of environmental water allocations
- undertaking landscape-scale habitat restoration in areas of strategic importance and ensuring that this utilises a species and genetic mix appropriate for future climates.

As the climate changes, other adaptation options will start to become important. For example, within 5-10 years work needs to commence on the identification and planned retreat of coastal ecosystems and the identification and rehabilitation of land that is no longer suitable for agriculture but that could be used for enhancing the condition and extent of natural ecosystems. Within 10 years work will also need to commence to identify ecosystems at risk of irreversible change and to identify other suitable locations for these ecosystems. Taking action following this initial planning will be required within 20 years.

The transition between adaptation options in the future will be influenced by biophysical thresholds being exceeded. The most important threshold for the Region will be the loss of the condition and extent of habitat required to sustain regionally significant native flora and fauna. Other thresholds that will inform decision making will include:

- regional species loss and changed distribution of species
- increased frequency of bushfires to levels that limit regeneration
- increased pest plant or animal populations and changed distribution
- increased occurrence of disease
- changes in ecological community composition and structure
- changes in dry periods impacting on flowering events
- changes in the depth to groundwater
- reduced water availability
- pressure from land use change, leading to change from grazing to cropping resulting in loss of paddock trees
- more intense irrigation, increasing pressure on water-dependent ecosystems.

Summary of key findings

Key immediate adaptation options to protect and enhance the condition and extent of natural ecosystems include adequate control of pest plants and animals; improved fire management and understanding of ecological burn regimes; demonstrating the social and economic value of native ecosystems; paddock tree replacement; encouraging landholders to use Heritage Agreements and other mechanisms to manage native vegetation and encourage revegetation; establishment of environmental water allocations; and undertaking landscape-scale habitat restoration.

4.8 Recreation, open space and public realm

Why is recreation, open space and public realm important to the Region?

Parks, reserves, recreation facilities and the public realm are valued for their contribution to the character and amenity of the Limestone Coast. They provide opportunities for active and passive recreation, vital to maintaining the community's quality of life and health and wellbeing. These places also provide spaces for events, celebrations and activities that contribute to community connectedness and tourism. Street trees and landscaped public realm areas also assist in reducing the urban heat island effect.

How will climate change impact recreation, open space and public realm?

The IVA found that the condition of grassed areas and trees is vulnerable to increasing temperatures and reduced rainfall which will have flow on effects for amenity and useability. The IVA also found that recreation, open space and public realm assets in coastal areas are particularly vulnerable to sea level rise, as salt water inundation can damage or destroy grassed areas, result in temporary or permanent inundation and reduce the effective operation of some assets and physical damage to others.

How do we provide, protect and enhance the amenity and recreation opportunities provided by open space and public realm as our climate becomes warmer and drier and there is an increased risk of damage from bushfires and sea level rise?

Current action to provide, protect and enhance open space and public realm include increasing irrigation efficiency through subsurface irrigation and use of moisture sensors, developing species planting guidelines, provision of shade infrastructure, installation of artificial turf in selected areas, installing water sensitive urban design features including permeable paving and installing rainwater tanks. Stakeholders identified that increasing irrigation may be limited in the future if the cost of water increases. Opportunities to change the timing of events or sporting activities may also be limited if there are too many activities occurring at the same time.

Providing, protecting and enhancing the amenity and recreation opportunities provided by open space and public realm will require acceleration of a number of existing actions already being implemented by Local Government across the Limestone Coast. Key immediate adaptation options to continue with are:

- modelling and mapping to assist with risk management and planning
- educating and raising the awareness of community groups and council staff in order to build their capacity to understand and plan for climate change
- improving soil and irrigation management practices including use of recycled water, optimisation of available water, irrigation timing and monitoring

- improving stormwater management and adopting water sensitive urban design approaches, including the capture and reuse of stormwater for irrigation.

In addition to adaptation options that protect existing areas, new work is required to rationalise irrigated open space to maintain a smaller amount to a higher standard. This will require identifying opportunities to share facilities and the potential for artificial (grass or other) surfaces. Such a review would also consider the need to provide shade cover for existing facilities. Complementing the rationalisation of irrigated open space will be the preparation of guidelines regarding open space management to ensure that new facilities use appropriate materials and plant species and potentially decrease grassed areas.

As the climate continues to change into the future, more significant adaptation responses will be required. This could involve relocating facilities within 10 years, abandoning assets in high risk areas within 20-25 years or constructing large indoor facilities that service multiple sports toward the latter half of the century.

Decisions about the combination of adaptation options implemented as the climate changes will be influenced by when a range of thresholds are exceeded. Key thresholds for open space and public realm include:

- grass and vegetation mortality from heat, sea water inundation and bushfire, making areas unusable for recreation and leading to an increase in demand for indoor facilities
- increasing irrigation demand and a decrease in rainfall, especially during the summer
- increasing costs for maintaining recreation areas
- increasing frequency of coastal inundation (resulting from sea level rise and/or storm surge) (e.g. twice per year) leading to decreased use of some areas
- cancellation of events
- increasing demand for indoor facilities and the centralisation of sporting activities
- repeat years with extreme weather events leading to the closure of facilities or cancellation of events (e.g. three consecutive years).

Summary of key findings

Key immediate adaptation options to provide, protect and enhance the amenity and recreation opportunities provided by open space and public realm are modelling and mapping to assist with risk management and planning; educating and raising the awareness of community groups and council staff; improving soil and irrigation management practices; and improving stormwater management and adopting water sensitive urban design approaches. This should be complemented by work to rationalise irrigated open space and the development of guidelines regarding open space management to ensure that new facilities use appropriate materials and plant species. In the future options may include relocating facilities, abandoning assets in high risk areas or constructing large indoor facilities that service multiple sports.

4.9 Road infrastructure

Why is road infrastructure important to the Region?

The Limestone Coast's road network is critical to supporting the Region's economy and community, enabling transport of products for internal and export markets, connections between residents and services, access and egress to enable emergency response and access to visitor destinations.

How will climate change impact road infrastructure?

The IVA found the road network to be particularly vulnerable to projected increases in heatwave frequency and intensity, with road surface damage experienced during recent heat events. Sea level rise may also damage road assets sensitive to inundation by salt water and result in temporary or permanent inundation. Increasing intensity of rainfall events could increase erosion of roads or verges or damage bridges or culverts. Disruption to the road network could have flow on effects to the export and supply chains.

How do we maintain the effective operation of our road network as the sea level rises and more frequent and intense heat waves and flooding occurs?

Current action to maintain the effective operation of the Regions' road network include the implementation of asset management plans and road design standards. Stakeholders noted that road design standards are based upon historic rainfall and runoff rates, sea water inundation and historic temperature ranges which may mean the road network is at risk of increased inundation and increased rates of deterioration. Road maintenance works may also be affected if water availability is reduced. Reduced opportunities to undertake maintenance as the frequency of hot days and inundation from sea water and/or flood waters increases.

Key immediate adaptation options for maintaining the effective operation of the road network are:

- Updating design standards, maintenance regimes and asset management plans to accommodate projected climate change. This will require a better understanding of the service level expectations of the community and more standardised construction approaches such as in relation to bridges and culverts.
- Educating and raising awareness of organisational staff regarding impacts of climate change on assets. This will require cultural change and more collaboration across relevant agencies.
- Building capacity of organisational staff regarding their understanding of the impacts of climate change on assets and the potential implications for procurement policy. This will require collaboration and partnerships between councils, the Department Planning, Transport and Infrastructure and the South Eastern Water Conservation and Drainage Board, all of whom play a role in road infrastructure in the region.

Other adaptation options that will assist with maintaining the effective operation of the road network include changing work practices (e.g. different work hours), use of innovative materials, developing modelling and mapping to assist with risk management and planning, and investigating and supporting alternate methods of transport. Additional modelling and mapping would need to be done in conjunction with asset management planning and involve development of long term strategies for coastal towns across the Region and consideration of social and economic drivers (e.g. intensification of urban growth in regional areas and decentralisation of services from Adelaide).

Future adaptation will need to consider upgrading and/or relocating some roads through high risk areas (e.g. Princess Highway, Ports Highway, Riddoch Highway). The timing of such works remains uncertain and should be informed by the proposed modelling and mapping work.

The choice of adaptation options will be influenced by periodic planning reviews but also may be triggered by thresholds being exceeded on-ground, such as

- flooding resulting in an increased frequency of local road closures (e.g. 4 times per year)
- flooding results in increased frequency of major transport route closures (e.g. once per year)
- increased maintenance costs of local roads
- decline in asset life.

Summary of key findings

Key immediate adaptation options for maintaining the effective operation of the road network are to update design standards, maintenance regimes and asset management plans; educate, raise awareness and build capacity of organisational staff and encourage greater collaboration and partnerships between councils, the Department Planning, Transport and Infrastructure and the South Eastern Water Conservation and Drainage Board.

4.10 Tourism

Why is tourism important to the Region?

Tourism is valued by the Limestone Coast Region for its important contribution to the economy. The tourist sector is diverse, with visitors attracted to natural features (caves, wetlands, lakes and parks), recreation opportunities (fishing, diving and walking), premium food and wine and cultural experiences. Many heritage places are valued and are popular tourist attractions in themselves (e.g. Mary MackIllop Penola Centre).

How will climate change impact the contribution tourism makes to the Region's economy?

The IVA found that the tourism sector is vulnerable to climate change particularly projected changes associated with heatwaves and bushfire. Transport infrastructure vital for tourist access (see section 4.9) and many popular tourist destinations are located in vulnerable coastal areas (see section 4.2). The IVA also found however, that climate change may present an opportunity for tourism in the Region as the overall cooler temperatures of the Limestone Coast compared with the rest of the State could provide an opportunity for increased tourism as it becomes a more attractive place to visit and spend time.

How do we maintain and grow the contribution tourism makes to the region's economy as our climate becomes warmer?

Current action to maintain and grow tourism in the Region include marketing and promotion of iconic locations such as the Blue Lake and Naracoorte Caves, enhancement of visitor precincts through infrastructure and accommodation upgrades, development of touring and holiday itineraries, development of nature-based tourist opportunities and the promotion of the Region's food and wine.

A key adaptation option identified for immediate implementation for the tourism sector of the Limestone Coast is to use the milder climate, beautiful environment and unique experiences on offer as a selling point. While much of the Region's tourism focuses on these features already (e.g. promotion of icons like the Blue Lake and Naracoorte Caves), the emphasis on the Region's climate can further differentiate the Limestone Coast from other parts of the State.

Adaptation should also focus on tourism planning. This needs to consider how to coordinate tourism at a regional scale and integrate its development with broader regional economic diversification activities. Ensuring the Region is ready to embrace tourism opportunities requires ensuring there are no remaining areas without mobile phone reception. During heatwaves, beaches and coastal areas may experience increases in visitor numbers as people try to stay cool. Future facility planning will need to consider how to take advantage of such opportunities for increases in visitation as well as alternative attractions for visitors displaced as a result of park or facility closures on high fire danger days.

In the future, investment will be required to improve and adapt accessibility for tourists to coastal towns and coastal regions. This reflects that many of the Region's tourism attractions and experiences will be impacted by climate change, such as rising sea levels in the coastal zone or increased periods of extreme heat. Maintaining accessibility will benefit tourists as well as people who live and work in the Region.

Noting that climate change impacts will increase by mid-century, adaptation options for implementation in the future but for which planning should commence now are:

- further promoting and creating opportunities for ecotourism (planning lead time of 5 years)
- transforming transport options to reduce reliance on fossil fuels, such as providing electric car recharging facilities at all visitor information centres (planning lead time of 15 years)
- investigating, developing and promoting new experiences and destinations in the region (planning lead time of 20 years).

The transition between adaptation responses as the climate changes will be influenced most by changing numbers of tourists. Other factors that will influence the response of the tourism sector, but to a lesser degree, will be the loss of iconic sites and tourism routes, declining visitor spend, declining quality of visitor experience and loss of infrastructure in coastal regions.

Summary of key findings

Key immediate adaptation options for the tourism sector are to use the milder climate as a selling point in addition to the environment and unique experiences; ensure planning for tourism is coordinated at a regional scale and is integrated with broader regional economic diversification activities; and ensure there are no remaining areas without mobile reception. In the future, investment will be required to improve and adapt accessibility for tourists to coastal towns and coastal regions.

4.11 Wetlands

Why are wetlands important to the Region?

The wetlands of the Limestone Coast are highly valued features of the natural environment and appreciated for their intrinsic value and their contribution to the Region's identity, amenity and character. Many wetlands are sustained by surface water inflows whilst others are fed by shallow groundwater or both. Wetlands provide habitat for numerous species of conservation significance and many are of national and international significance.

How will climate change impact wetlands?

The IVA found that wetlands will be impacted by climate change as water availability changes as a result of reduced runoff and recharge (which could reduce by as much as 50%), warmer conditions, rising sea levels and climate extremes such as heatwaves. 96% of wetlands (by area) in the South East has been identified as being groundwater dependent to some extent [15] and these changes in climate and impacts on groundwater level could result in changes in vegetation communities, changes in the distribution and abundance of pest plant and animals, permanent wetlands becoming ephemeral or ephemeral wetlands becoming terrestrialised. Increasing bushfire risk has the potential to impact the condition and extent of fringing and aquatic vegetation, with peat wetlands extremely sensitive to fire.

How do we protect and enhance the condition and extent of wetlands as our climate becomes warmer and drier and the sea level rises?

Current action to protect and enhance the condition and extent of wetlands includes using existing drainage infrastructure to manage water, individual wetland condition monitoring and management plans, works undertaken as part of the South East Drainage and Wetland Management Program and grant programs that assist landholders to manage wetlands on private properties. Stakeholders identified that current management practices are not adequate to meet current challenges and would be unable to adequately protect and enhance wetlands as the climate becomes warmer and drier.

Protecting and enhancing wetlands as the climate becomes warmer and drier and the sea level rises will largely focus on water regime management strategies. An immediate adaptation response is to prioritise wetlands for future investment, recognising that the resilience of wetland systems will depend on water availability. This prioritisation process needs to consider the risk of wetland terrestrialisation (drying out). For example, recent modelling by the Goyder Institute for Water Research highlights that by 2030, declining rainfall and falling

[15] SKM 2009. *Classification of groundwater – surface water interactions for water dependent ecosystems in the South East, South Australia.* Unpublished report to the Department of Water, Land and Biodiversity Conservation. Sinclair Knight Merz, Hobart, Australia.

groundwater levels could lead to the terrestrialisation of some wetlands[16]. Prioritising wetlands for future investment will require monitoring of wetland condition (including water quality, flora and fauna) to enable identification of climate induced changes. Furthermore, the hydrology of coastal wetlands will need to be reviewed, focusing on drainage and sea water inflows.

Other key immediate adaptation options include:

- complete South East Drainage and Wetland Strategy to prioritise actions
- consider findings of the Department for Water's 2010 South East Water Science Review
- continuing to implement the South East Flows Restoration Project using the drainage network to reinstate hydrological function
- supporting private landholders to undertake good land and wetland management such as fencing, grazing management and weed control
- awareness raising and education for the community, local government and other stakeholders regarding wetland management.

In the future there will be a greater need for water manipulation capabilities to achieve the desired water regime for given wetlands. This may require additional structures and artificial watering of wetlands drawing on confined aquifers. Importantly, the need and viability of such an approach will depend on regional groundwater levels and may not be effective if levels fall below thresholds.

The potential impact of falling groundwater levels has led to suggestion that certain parts of the drainage network will need to be filled or outlets closed off to retain water in the landscape. It is recognised that this would require significant planning and may proceed in the first instance with site specific decommissioning of some drains. It is estimated that planning and implementation of this option would occur over a period of three or more decades.

Related to a strategy for changing the management of the drainage network would be the development now of an integrated surface and groundwater management strategy, which would then allow for the prescription of surface water to enable environmental water allocations to be developed in the future. A related adaptation option is the development of water policy at a landscape scale, including an integrated cross-border approach, for example inclusion of surface water in the Border Groundwaters Agreement. This would establish variable allocations based on recharge and an annual consumptive pool. While this may require short term adjustments to water allocation planning, it is likely to deliver long term benefits.

Incentives to encourage landholders to allow inundation of their properties is considered a last resort option, requiring legislative tools to support them and effective collaboration.

There are various potential thresholds that could drive change in management approaches, including species loss, loss of habitat, salinisation of wetlands, extended dry periods between inflows, reduced productivity of wetlands,

[16] Harding et al (2015) *Water Resources in South Australia, Phase 4, Volume 2 – Predicting the impacts of climate change to groundwater dependent ecosystems,* DEWNR Technical Report 2015/01, (https://www.waterconnect.sa.gov.au/Content/Publications/DEWNR/DEWNR-TR-2015-01.pdf) .

increased pest plant or animal populations and increased occurrence of disease. However, the primary driver is likely to be change in vegetation communities, where permanent wetlands become ephemeral or ephemeral wetlands are at risk of becoming terrestrialised.

Summary of key findings

The key adaptation option for immediate action is to prioritise wetlands for future investment, recognising that the resilience of wetland systems will depend on ongoing water availability. Such a prioritisation process needs to consider the risk of future wetland terrestrialisation. Prioritising wetlands for future investment will require monitoring of wetland condition.

Falling groundwater levels will likely require development of a new approach to the management of the drainage network and allocation of water. Such a strategy could be implemented over a period three or more decades, potentially involving site specific decommissioning of some drains and closing off outlets to retain water in the landscape.

5

IMPLEMENTING THE REGIONAL ADAPTATION PLAN

5 Implementing the Regional Adaptation Plan

Section 4 of this Regional Adaptation Plan identifies a range of adaptation options in relation to the 10 key areas of decision making for the Limestone Coast to build resilience and adapt to the impacts of climate change. These adaptation options are summarised by Table 8 and Table 9.

Those adaptation options identified by Table 8 are termed 'preferred adaption options'. These preferred options were identified based on further discussion and assessment by stakeholders to determine the preferred combination of options or pathway through the full set of adaptation options identified for the relevant key decision area as identified by the pathway maps (refer sections 4.2 to 4.4).

This contrasts with those adaptation options identified by Table 9 which are termed 'key adaptation options'. These key options were identified based on discussion and assessment by stakeholders but were not subject to a further process to determine the preferred combination of options for implementation. Further consideration and assessment of these options may still be required to determine priorities for implementation.

Table 8 Summary of preferred adaptation options for the Limestone Coast based on pathway maps

Key decision area	Timing	Preferred adaptation options
Coastal landscapes How do we manage coastal assets and landscapes as the sea level rises?	Now	Identify areas for future development that are not likely to be at risk
		Education and awareness raising about the impacts of sea level rise and storm surge
		Monitoring of beaches and cliffs in high risk areas
		Modelling and mapping of high risk areas
		Soft structural options (e.g. beach replenishment, dune restoration)
		Small scale, hard infrastructure
	Later	Implement coastal management design guidelines
		Development Plan Amendments to restrict development
		Acquire land in high risk areas
		Hard protection infrastructure (large scale)
		Innovative infrastructure (small and large scale)
		Relocate (built and natural assets)
		Abandon assets (built and natural)
Vulnerable members of the community How do we improve the health, safety and wellbeing of vulnerable members of the community as the sea level rises and the frequency and intensity of heat waves and bushfires increase?	Now	Communicate and raise awareness of climate hazards and opportunities to respond
		Develop a heat clinic model based on the flu clinic model for emergency departments
		Emergency management planning
		Inter-agency networking and information sharing
		Build community connections
		Residential energy management program
		Improve telecommunications infrastructure

	Later	Mandatory implementation of climate sensitive building design
Water security How do we maintain water security in the region for community, business and environment, as our climate becomes warmer and drier?	Now	Educate and raise awareness about climate change
		Improve water use efficiency
		Undertake research and monitoring
		Complete South East Drainage and Wetland Strategy
		Continue water allocation planning
	Later	Investigation of the feasibility of recharging the aquifer with drainage water

Table 9 Summary of proposed key adaptation options for 7 key decision areas

Key decision area		Key adaptation options
Irrigated agriculture, horticulture and viticulture How do we maintain and increase the contribution irrigated agriculture, horticulture and viticulture make to the region's economy as the climate becomes warmer and drier?	Now	Information sharing and collaboration to build capacity
	Later	Greater use of the drainage network for localised groundwater recharge
Marine habitats and fisheries How do we protect and enhance the marine ecosystems that support our fisheries as the climate becomes drier and ocean conditions change?	Now	Undertake land management activities that improve surface water quality and quantity
		Monitor marine species and habitats
		Awareness raising and education regarding catch limits
		Periodic closure of fishing for selected species to maximise reproduction
Natural ecosystems How do we protect and enhance the condition and extent of natural ecosystems (heathlands, shrublands, and woodlands) and scattered trees as our climate becomes warmer and drier and bushfire risk?	Now	Pest plant and animal management
		Improved fire management
		Demonstrate the social and economic value of functional native ecosystems
		Paddock tree replacement
		Landholder management of native vegetation
		Establish environmental water allocations
		Landscape-scale habitat restoration
	Later	Planned retreat of coastal ecosystems
Recreation, open space and public realm How do we provide, protect and enhance the amenity and recreation opportunities provided by open space and public realm as our climate becomes warmer and drier and there is an increased risk of damage from bushfires and sea level rise?	Now	Modelling and mapping to assist with risk management and planning
		Education and awareness raising regarding bushfire risk, sea level rise and storm surge
		Improved soil and irrigation management practices
		Improved stormwater management
		Rationalisation of irrigated open space to maintain a smaller amount to a higher standard
		Prepare open space and public realm guidelines
	Later	Relocate facilities
		Abandon assets in high risk areas
		Construct large indoor multi-sport facilities

Key decision area		Key adaptation options
Road infrastructure How do we maintain the effective operation of our road network as the sea level rises and more frequent and intense heat waves and flooding occurs?	Now	Update design standards, maintenance regimes and asset management plans to accommodate projected climate change
		Educate and raise awareness of organisational staff regarding impacts of climate change on assets
Tourism How do we maintain and grow the contribution tourism makes to the region's economy as our climate becomes warmer?	Now	Market the Limestone Coast's milder climate as a point of difference
		Coordinate planning for tourism at a regional scale
		Provide mobile phone coverage across entire Region
	Later	Improve accessibility to/from coastal towns/localities
Wetlands How do we protect and enhance the condition and extent of wetlands as our climate becomes warmer and drier and the sea level rises?	Now	Prioritise wetlands for future investment (to be guided by Drainage and Wetlands Strategy when completed)
	Later	Develop a new approach to the management of the drainage network and the allocation of water

5.1 Adaptation Action Plan

To assist with progressing adaptation across the Limestone Coast, the more immediate adaptation options have been brought together in the Adaptation Action Plan contained in Appendix B.

It should be noted that the Adaptation Action Plan is divided into two parts which reflects the following:

- the three key decision areas for which adaptation pathway maps were developed and have therefore been subject to a detailed process to identify preferred adaptation options
- the seven key decision areas where pathway maps were not developed and therefore key adaptation options have been identified and assessed, however have not been through a process to determine preferred options for implementation. This means that further work may be required to determine preferred options for these key decision areas.

For each adaptation option, the Action Plan summarises:

- potential actions to progress implementation of the option (including preparatory work required for future options)
- timing for implementation (ie now versus later)
- lead responsibility for initiating and/or driving implementation of the option
- others to be involved in implementation.

It is intended that this Action Plan be used by organisations and individuals across the Limestone Coast to guide adaptation action, and where required be further developed and refined as new information becomes available, as monitoring and review occurs or as climatic conditions change. Local governments can use this Regional Adaptation Plan to develop climate change plans for the Local Government Areas.

The SE NRM Board has received Australian Government funding to make the Regional NRM Plan climate change-ready. The SE NRM Board intends to use this funding to inform the Regional NRM Plan that is currently being revised and due for public consultation in 2017.

5.2 Cross sectoral adaptation options

This Regional Adaptation Plan has identified a range of adaptation options in relation to ten key areas of decision making. Many of these options (particularly those that do not have pathway maps) will require further work by the relevant sectors to determine the preferred combination of adaptation options for implementation.

As a regional plan, consideration also needs to be given to adaptation options which are relevant to multiple key decision areas and therefore multiple sectors. A review of the range of adaptation options identified by this Regional Adaptation Plan identified a number of adaptation options that are relevant to multiple sectors as summarised by Table 10.

Table 10 Cross sectoral adaptation options

Adaptation option	Key decision areas this relates to	Discussion
Investigate the feasibility of recharging the aquifer with drainage water and options for retaining water in the landscape	Water security Wetlands Irrigated agriculture, horticulture and viticulture	Given projected changes in rainfall and the potential for this to impact on runoff and aquifer recharge and therefore availability of groundwater, stakeholders recognised the need to consider alternative ways to retain water within the landscape. This approach could provide benefit for water users such as irrigators as well as natural ecosystems including wetlands. It was recognised that using the drainage network for aquifer recharge represents a significant change in focus for management of the drainage network, which was originally designed to de-water the landscape to make it more suitable for agriculture. The SENRM Board and the SE Water Conservation and Drainage Board are currently developing a SE Drainage and Wetland Strategy to guide the use of drainage water for aquifer recharge. Given this adaptation option has been identified for three key decision areas, it needs to be progressed in a coordinated manner, considering integrated management of surface water and groundwater resources. Different timeframes for implementing this adaptation option were identified across the three key decision areas, with 'water security' identifying the need to commence preparatory work now in order to develop an integrated regional approach to be enable implementation within the next 5 to 10 years.
Education and awareness raising	Coastal landscapes Vulnerable members of the community Water security Marine habitats and fisheries Recreation, open space and public realm	Education and awareness raising was a common adaptation option identified across six out of ten key decision areas. It was considered that education and awareness raising needs to occur about climate change and its impacts, particularly in relation to extreme events such as heatwave, flooding (from storm surge and sea level rise) and bushfire. In particular education and awareness raising needs to focus on activities that increase the resilience of individuals, organisations and communities throughout the Region so that

Adaptation option	Key decision areas this relates to	Discussion
	Road infrastructure	they can adapt to climate change through their own actions where possible, for example, through adopting new farming practices, ensuring they have prepared their own emergency response plan to implement during extreme events such as a bushfire or build community connections so they are part of a strong network of support. For those people less able to respond on their own and requiring more support, there may be a need to identify new ways of communicating information and building capacity so that they are more able to cope as the climate changes. There is unlikely to be 'one size fits all' approach to education and awareness raising and messaging and techniques will differ depending on the target audience. There will however, be opportunity for consistency of information across the Region, for example, in terms of the changes projected and the desire to increase resilience so that the Region can thrive and prosper in the face of change. There will also be opportunities to share information and learnings between sectors and leverage of each other's activities to deepen the reach of education and awareness raising activities.
Soft and hard infrastructure options Abandon assets in high risk areas Relocate (built and natural assets) Planned retreat of coastal ecosystems Improve accessibility to/from coastal towns/localities	Coastal landscapes Vulnerable members of the community Natural ecosystems Recreation, open space and public realm Tourism	There is a clear multi-sectoral adaptation priority for the Region in relation to the coast and the impacts of sea level rise and storm surge. Already some coastal Councils are taking action to adapt to the impacts of sea level rise and relocating coastal assets such as the caravan park in Wattle Range Council. Stakeholders recognised the need to not exacerbate future issues and manage how and where development occurs to reduce the risk of inundation in the future. At the same time, stakeholders recognised the complexity of issues at play and the important social, economic and environmental values of the coast. For example, there is a strong desire to live along the coast, there are many public assets located along the coast that facilitate its visitation and enjoyment, coastal towns are key tourist attractions in the Region and provide recreation opportunities for people living in the Region, there is recognition that community members should be safe and not at risk from climate hazards such as flooding and important ecosystems are located along the coast and hold be able to retreat as they experience the impacts of sea level rise. Given the many issues and aspects associated with adaptation along the coast, particularly where built and natural assets converge, a coordinated approach will be required and could involve the development of an 'Integrated Coastal Response Strategy' for the Region or more site specific and targeted strategies that consider the wide range of responses including coastal defence and retreat option for particular locations at risk.

5.3 Enabling adaptation action

Any decision making process sits within a broader context. Understanding this context and ensuring appropriate conditions are in place to enable adaptation action is as important as identifying the adaptation options themselves.

New thinking is emerging from work by the CSIRO Adaptation Flagship[17] which suggests that there are three factors that influence whether a decision (to take action and implement an adaptation response) is made. These factors are values, knowledge and rules and it is considered that where there is overlap or alignment between all three of these factors, adaptation responses are more likely to occur.

Decisions to take adaptation action occur where there is understanding and intersection of:

- How adaptation action will impact what is **valued** by the Region
- **Knowledge** of how systems operate (ie interactions between social, economic and natural features) and how they will respond to adaptation actions
- **Rules** which support the adaptation action to be implemented. Rules can include policies, legislation and governance arrangements

At the final adaptation workshop, stakeholders from the Limestone Coast Region were asked to reflect on these three factors and consider what enabling conditions are needed to facilitate implementation of the Regional Adaptation Plan. The following enabling conditions were identified as being critical to the successful implementation of this Regional Adaptation Plan:

- **Regional commitment to implementation**-it was identified that the successful implementation of a Regional Plan such as this one requires commitment by the Region particularly by organisations that have regional roles and responsibilities such as Limestone Coast Local Government Association, Limestone Coast RDA and the South East Natural Resources Management Board. This commitment can be bolstered by formalising agreement to support implementation of the Regional Adaptation Plan by these regional bodies in addition to other key organisations/influencers from the Region. Once this formalised agreement is reached, for example via a Climate Change Sector Agreement or Memorandum of Understanding, the partners can take the Regional Adaptation Plan to other organisations and sectors across the Region to raise awareness and seek involvement and support to coordinate and implement adaptation options.
- **Leadership and appropriate management structures to enable cultural change**-it was identified that cultural change is needed in order for climate change considerations to be embedded in organisations and what they do so that it becomes 'standard operating procedure' to consider what climate change may mean for everyday practices, activities and programs and respond accordingly through adaptation. Cultural change can be difficult and requires leadership and appropriate management structures to help facilitate change. The Regional Adaptation Plan itself provides a strong basis from which to provide leadership and can be used to

[17] The "VRK" framework has been developed primarily by Dr Russell Gorddard and Dr Russell Wise from the CSIRO Adaptation Flagship. It is described in more detail in Gorddard, R., Wise, R.M., Ware, D., and Dunlop, M. under review. Values rules and knowledge: Adaptation as change in the decision context, submitted to Ecology and Society

build the case for change as well as the foundation for driving action. An important first step to assist with embedding climate change considerations in organisations across the Region is to link the Regional Adaptation Plan with other key plans and strategies which influence decision making and action such as Council Strategic Management Plans, Development Plans, asset management plans and the Regional Natural Resources Management Plan.

- **Whole of community reach to increase understanding about climate change impacts**-the need to reach the whole community and raise awareness and build capacity regarding the potential impacts of climate change, and opportunities to respond and adapt was considered critical. This 'reach' was considered particularly important for those members of the community who are isolated or disconnected from networks, support and services. This awareness and capacity building is necessary so that individuals and communities can increase their resilience to the impacts of climate change through their own actions where possible, for example, through adopting new farming practices, ensuring they have prepared their own emergency response plan to implement during extreme events such as a bushfire or build community connections so they are part of a strong network of support. For those people less able to respond on their own and requiring more support, there may be a need to identify new ways of communicating information and building capacity so that they are more able to cope as the climate changes.
- **Funding**-it was recognised that adaptation to climate change, particularly for adaptation options that require capital works, will require additional funding and it will be critical to find new sources or reallocate existing resources. In addition, not only will resources be needed to fund capital works, but also ongoing monitoring and evaluation that will support the implementation of the Regional Adaptation Plan and assist with understanding when new decisions need to be made to enable transition between adaptation options over time as climate conditions change. This funding also extends to resourcing the ongoing coordination/implementation of the Regional Adaptation Plan, for example, via a designated person who's charged with driving implementation across the Region. This 'coordinator' role has proven to be a key contributing factor to the successful progression of Regional Adaptation Plans in other regions, for example, Resilient South and Northern and Yorke.
- **Research and development**-for some sectors, undertaking research and development is important in order to better understand the adaptation options that may be required and which ones are preferred for implementation. For example, in relation to water security, it was considered that more information is needed to understand the groundwater resource to assist with determining an acceptable level of resource condition and recharge rates.
- **Monitoring and review**- This Regional Adaptation Plan presents adaptation options based on information available at the time of its preparation and local knowledge and preferences of those stakeholders who were involved in its development. It is recommended that the Regional Adaptation Plan be periodically reviewed, consistent with an adaptive management approach that allows for continual improvement. This will enable new information to be considered, including changes in climate or as adaptive capacity of sectors grows as adaptation responses are implemented. To support this, a monitoring and evaluation framework is recommended. This framework should include indicators that seek to understand what success looks like in the context of adaptation responses, as well indicators that seek to monitor thresholds and therefore when changes in adaptation action may be required.

5.4 Current action that supports adaptation

There are already a number of initiatives or actions underway in the Region that contribute to or support adaptation options identified by this Regional Adaptation Plan. These include[18]:

- The preparation of the Limestone Coast Emergency Response Plan
- The development of the South East Drainage and Wetland Strategy and 'climate ready' Regional NRM Plan by the South East NRM Board
- Local Government Association Climate Change Action Plan
- Limestone Coast Councils' Development Plans
- The Limestone Coast Regional Roadmap prepared by Regional Development Australia Limestone Coast.

5.5 Monitoring and review

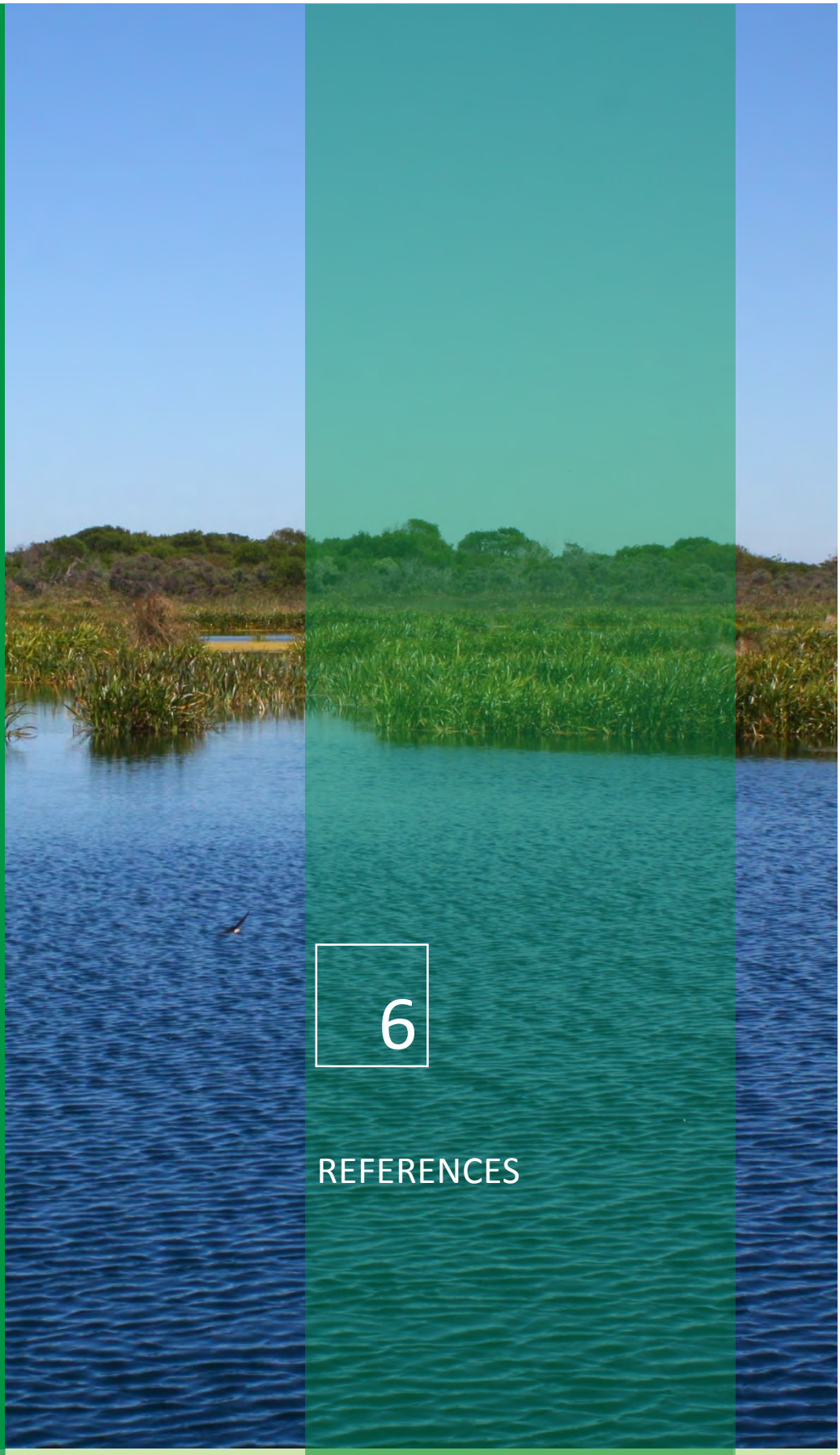
This Regional Adaptation Plan presents adaptation options based on information available at the time of its preparation and local knowledge and preferences of those stakeholders who were involved in its development.

It is recommended that the Regional Adaptation Plan be periodically reviewed, and that this review process be consistent with an adaptive management approach. This will enable new information to be considered, including changes in climatic conditions or as adaptive capacity of sectors increases as adaptation responses are implemented. To support this review process, the establishment of a monitoring and evaluation framework is recommended. This framework should include indicators that seek to understand what success looks like in the context of adaptation responses, as well indicators that seek to monitor thresholds and therefore when changes in adaptation action might need to occur (refer section 4 for potential thresholds).

5.6 Establishing governance arrangements for implementation

Recognising that the transition from planning to implementation can be challenging, and that ongoing discussion and collaboration is required by stakeholders of the Limestone Coast to action this Regional Adaptation Plan, a workshop was held representing a range of interests and sectors from the Region including Local Government, regional development, natural resources management, health, emergency management, primary production and fisheries. In particular this workshop sought to discuss and reach broad agreement regarding governance arrangements for the implementation of this Regional Adaptation Plan and discuss in detail the actions required to initiate three key cross sectoral, regional adaptation options identified by the Plan. A summary of this workshop is provided in Appendix C and can be used to progress discussions regarding the governance arrangements and initiating action on the 3 key cross sectoral adaptation options.

[18] For more information about existing initiatives and actions refer to Limestone Coast (2015) *Regional Values and Climate Change Report*, prepared by URPS as part of the consultancy led by URPS for the Limestone Coast Regional Climate Change Adaptation Plan Project



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APPENDICES

Appendix A

Organisations/sectors that participated in the process to prepare the Regional Adaptation Plan

City of Mount Gambier
Coorong-Tatiara Local Action Planning Committee
Country Fire Servicer
Dairy SA
Department of Education and Child Development
Department of Environment, Water and Natural Resources, Natural Resources South East
District Council of Robe
District Council of Tatiara
Environment Protection Authority
Friends of Butchers Gap
Forestry SA
Green Triangle Forestry Plantations
Limestone Coast Grape and Wine Council
Lochabar Agricultural Bureau
Lower South East Natural Resources Management Group
Naracoorte-Lucindale Council
Nature Glenelg Trust
Primary Industries and Regions SA
Regional Development Australia Limestone Coast
SA Water
South East Cave Exploration Group
South East Local Government Association
South East Natural Resources Management Board
South East Potato Growers
State Emergency Service
Upper South East Natural Resources Management Group
Viticulture and Oenology Committee
Wattle Range Council

Appendix B

Action Plan

Adaptation Action Plan-Part A

Ref	Preferred adaptation option	Timing	Potential actions to progress implementation of immediate adaptation options including preparatory work that may be required to commence now for longer term options	Suggested lead	Suggested partners
Coastal landscapes (CL)					
CL1	Identify areas for future development that are not likely to be at risk	Now	Review and assess land for future development that is unlikely to be at risk from sea level rise and storm surge or is located inland and provides new development opportunities not likely to be at risk of sea level rise or storm surge Assessment criteria to identify land that is: - of low environmental value - low productivity and therefore not required for agriculture activities	Coastal Councils	Department of Planning, Transport and Infrastructure (DPTI)
CL2	Education and awareness raising	Now	Develop and implement education initiatives which focus on raising awareness and understanding of hazards such as flooding from storm surge and how to prepare for and recover from extreme events This education and awareness raising should include general information about changes in climate and opportunities to respond	Coastal Councils	South East NRM Board Natural Resources, South East Department of Environment, Water and Natural Resources (DEWNR) RDA Limestone Coast Limestone Coast LGA Bureau of Meteorology Zone Emergency Management Committee (ZEMC) State Emergency Service (SES)
CL3	Monitoring beaches and cliffs in high risk areas	Now	Develop and implement a monitoring strategy to inform decision making regarding the timing for adaptation options that may be required in relation to beaches and cliffs in high risk areas	Coastal Councils Coast Protection Board	South East NRM Board Natural Resources, South East DEWNR
CL4	Modelling and mapping of high risk areas	Now	Undertake a modelling and mapping project which focuses on known high risk areas Modelling and mapping to be undertaken to a level of detail that will assist with determining appropriate adaptation responses and the likely timing of when they may be required	Coastal Councils Coast Protection Board	South East NRM Board Natural Resources, South East DEWNR
CL5	Soft structural options (e.g. beach replenishment, dune restoration)	Now	Enhance existing dune care and beach replenishment programs through the provision of additional resources (e.g. support for volunteers or community groups, financial)	Coastal Councils Coast Protection Board	South East NRM Board Natural Resources, South East Community groups
CL6	Small scale, hard infrastructure	Now	Utilise outputs of modelling and mapping to identify locations for small scale, hard infrastructure	Coastal Councils Coast Protection Board	South East NRM Board Natural Resources, South East DEWNR
CL7	Implement coastal management design guidelines	Later 10 years	Preparatory work to commence now includes: Develop guidelines for coastal management which includes information and techniques that assist with managing the impacts associated with sea level rise and storm surge including: - shoreline protection - offshore protection - construction materials - new and innovative approaches - case studies showing examples of approaches used elsewhere	Coastal Councils	South East NRM Board Coast Protection Board Natural Resources, South East DEWNR DPTI
CL8	Development Plan Amendments to restrict development	Later 10 years	Preparatory work to commence now includes: Develop a Statement of Intent which sets out the scope for to undertake a regional Development Plan review and amendment to address climate change considerations relating to coastal areas across the Limestone Coast Region. Areas of focus to include: - revising existing policy based on an assessment of hazards and promoting development in appropriate locations and conversely restricting/preventing development occurring in high risk areas; and	Coastal Councils	Coast Protection Board DPTI Natural Resources, South East DEWNR

Ref	Preferred adaptation option	Timing	Potential actions to progress implementation of immediate adaptation options including preparatory work that may be required to commence now for longer term options	Suggested lead	Suggested partners
			- policy that responds to anticipated climate impacts (e.g. sea level rise, storm surge/coastal inundation)		
CL9	Acquire land in high risk areas	Later 20 years	Preparatory work to commence now includes: - use mapping and modelling to identify land in high risk areas for possible acquisition - develop a strategy for acquisition. Given the anticipated difficulties in implementing this adaptation option consideration will need to be given to community and landholder engagement, potential funding mechanisms etc	Coastal Councils	Coast Protection Board DPTI
Vulnerable members of the community					
VMC1	Communicate and raise awareness of climate hazards	Now	Develop and implement initiatives which raise awareness and understanding of hazards such as bushfire, heatwaves and flooding from sea level rise and storm surge and how to respond and recover from extreme events Utilise a range of methods/techniques for educating/communicating/raising awareness including social media, engagement with special interest groups and region-wide advertising campaigns	Limestone Coast Councils	Country Fire Service (CFS) ZEMC Not-for Profit Organisations (NGOs) Natural Resources, South East DEWNR SA Health Country Health SA SES
VMC2	Develop a heat clinic model based on the flu clinic model for emergency departments	Now	Develop a heat clinic model based on the flu clinic model for emergency departments to provide specialised support for people suffering from heat stroke, dehydration and other heat related illness	Country Health SA	SA Health Hospitals Health care professionals
VMC3	Emergency management planning	Now	Undertake emergency management planning focusing on those facilities caring for vulnerable members of the community (e.g. aged care homes, hospitals) and members of the community living in hazard prone (e.g. bushfire or sea level rise/storm surge) and/or isolated locations.	Country Health SA	ZEMC SES SA Health Hospitals Health care professionals Department of Education and Child Development (DECD)
VMC4	Inter-agency networking and information sharing	Now	Encourage partnerships and collaboration to enhance formal and informal support networks	Country Health SA	Allied agencies and organisations throughout the Region
VMC5	Build community connections	Now	Undertake/support initiatives which contribute to building social connectivity including: - develop a culture of civic leadership and community action - increase and broadening general participation in social/community activities and civic processes - encourage partnerships and collaboration to enhance formal and informal support networks - use social media to build community networks	Limestone Coast councils	
VMC6	Residential energy management program	Now	Develop a Residential Energy Management Program addresses aspects such as: - provision of advice regarding opportunities to reduce household energy consumption - subsidies for electricity bills - promotion of energy-efficient appliances - assistance to install solar panels	State government	Electricity providers
VMC&	Improve telecommunications infrastructure	Now	Identify and redress 'black spots' in mobile phone coverage, particularly those along key transport routes, high risk areas (e.g. bushfire, flooding prone) and isolated parts of the Region	Telecommunications carriers	Limestone Coast councils RDA Limestone Coast Limestone Coast LGA
VMC8	Mandatory implementation of climate sensitive building design	Later (5 years)	Preparatory work to commence now includes Progress climate sensitive building design through ensuring appropriate polices are contained within Council Development Plans and the Building Code of Australia An initial step is to review existing Development Plan policies and the Building Code of Australia to determine opportunities to improve building design given projected climate change	State government	DPTI Limestone Coast councils Development industry

Ref	Preferred adaptation option	Timing	Potential actions to progress implementation of immediate adaptation options including preparatory work that may be required to commence now for longer term options	Suggested lead	Suggested partners
			The five year lead time for this option is designed to enable the policy and planning work to be completed that is necessary to support implementation of this option		
Water security					
WS1	Educate and raise awareness about climate change	Now	Develop and implement education initiatives which focus on raising awareness and understanding amongst the community, industry and government regarding the impacts of climate change on water resources across the Limestone Coast and opportunities to adapt Utilise a range of methods/techniques for educating/communicating/raising awareness including social media, engagement with special interest groups and region-wide advertising campaigns	South East NRM Board	Natural Resources, South East Bureau of Meteorology Goyder Institute
WS2	Improve water use efficiency	Now	Implement measures for water use efficiency identified by the Region's Water Allocation Plans	South East NRM Board Natural Resources, South East	DEWNR License holders Industry groups
WS3	Undertake research and monitoring	Now	Undertake research and monitoring of groundwater resources, focusing on better understanding recharge, sea water intrusion and salinity hotspots	Natural Resources, South East South East NRM Board	Landholders DEWNR Research Institutes and Universities
WS4	Continue water allocation planning	Now	Continue to implement, review and monitor Water Allocation Plans Investigate alternative options for prescribing environmental water and developing triggers in Water Allocation Plans to assist with managed declines in groundwater availability	Natural Resources, South East South East NRM Board	License holders
WS5	Complete the South East Drainage and Wetland Strategy	Now	Complete the South East Drainage and Wetland Strategy	Natural Resources, South East South East NRM Board	
WS6	Investigate options to recharge aquifer with drainage water and options for retaining water in the landscape	Later (but preparatory work now)	Preparatory work to commence now includes determining the hydrogeological feasibility of this option Once feasibility determined, develop a region wide strategy for managed aquifer recharge and/or other options for retaining water in the landscape and an approach for implementation across the region	Drainage Board South East NRM Board	Landholders License holders

Adaptation Action Plan-Part B

Ref	Key adaptation options NB these options may need to be further considered and assessed to determine preference for implementation	Timing	Potential actions to progress implementation of immediate adaptation options including preparatory work that may be required to commence now for longer term options	Suggested lead	Suggested partners
Irrigated agriculture, horticulture and viticulture (IAHV)					
IAHV1	Share information and collaborate to build capacity	Now	Utilise existing and well established industry associations and Limestone Coast agriculture groups to: - conduct research and development to identify opportunities to adapt to changing climatic conditions - share information including opportunities to adapt to changing climatic conditions - identify opportunities for collaboration across sectors	Natural Resources, South East RDA Limestone Coast	Industry groups
IAHV2	Greater use of the drainage network for localised groundwater recharge	Later (5 to 10 years)	Preparatory work to commence now includes developing a region wide strategy for managed aquifer recharge and an approach for implementation across the region	Drainage Board South East NRM Board	DEWNR Natural Resources, South East Landholders Industry groups/bodies
Marine habitats and fisheries (MBF)					
MBF	Undertake land management activities that improve surface water quality and quantity	Now	Reduce stormwater and wastewater discharges to the marine environment Consider marine biodiversity in the preparation of Water Quality Improvement Plans and Stormwater Management Plans Catchment management including fencing of watercourses, revegetation and grazing management to maintain soli cover and minimise erosion End of catchment monitoring to help identify priority catchments for action Ensure compliance with water affecting activities policies	South East NRM Board Limestone Coast Councils	Landholders Industry groups
MBF2	Monitor marine species and habitats	Now	Monitor condition and extent of marine habitats (e.g. sea grass, kelp forest, rocky reefs) Monitor to allow early identification of emerging marine pests	Primary Industries and Regions SA (PIRSA)	Fishing Industry
MBF3	Awareness raising and education regarding catch limits	Now	Develop and implement education initiatives which focus on raising awareness and understanding of catch limits, why they are important to the Region and the consequences if they are not adhered to	PIRSA	Fishing Industry
MBF4	Periodic closure of fishing for selected species to maximise reproduction	Now	Continued implementation, review and monitoring of Fisheries Management Plans Ongoing monitoring of species to determine if periodic closures are required	PIRSA	Fishing Industry
MBF5	Target alternative species	Later	Ongoing monitoring and evaluation to determine appropriateness, desirability and market demand for alternative species to be targeted Subject to the development of the requisite fishery management plans	PIRSA	Fishing industry
Natural ecosystems (NE)					
NE1	Pest plant and animal management	Now	Ongoing implementation of pest plant and animal management programs and activities Approaches need to deploy an adaptive and predictive management approach and focus on current and emerging risks e.g. more than just weeds of national significance	South East NRM Board	Landholders Friends of Parks groups Community groups
NE2	Improved fire management	Now	Review and improve approaches to fire management taking into account projected climate change in relation to bushfire risk. This could include prescribed burns practices of native vegetation and land management practices such as harvest codes of practice and fire permits for stubble burning, and developing a better understanding of ecological burn regimes	South East NRM Board Natural Resources SA	CFS SES ZEMC DEWNR
NE3	Demonstrate the social and economic value of functional native ecosystems	Now	Use new and existing activities and programs to raise awareness of landholders and other key stakeholders regarding the social and economic value of functional native ecosystems These could include: - field days - engagement processes relating to the preparation of plans and strategies - extension activities - information materials included with existing mailouts e.g. water license information	South East NRM Board Natural Resources SA	DEWNR

Ref	Key adaptation options NB these options may need to be further considered and assessed to determine preference for implementation	Timing	Potential actions to progress implementation of immediate adaptation options including preparatory work that may be required to commence now for longer term options	Suggested lead	Suggested partners
			- social media Key messaging to focus on how natural ecosystems support social and economic outcomes for the Region		
NE4	Replace paddock trees	Now	Develop and implement a Paddock Tree Replacement Program	South East NRM Board Natural Resources SA	Landholders
NE5	Landholder management of native vegetation	Now	Encourage landholders to use Heritage Agreements and other mechanisms to manage native vegetation and undertake revegetation works	South East NRM Board Natural Resources SA	
NE6	Establish environmental water allocations	Now	Establish environmental water allocations by determining process for progressing this and the investigations required	South East NRM Board Natural Resources SA	DEWNR Landholders Water license holders
NE7	Undertake landscape-scale habitat restoration	Now	Identify areas of strategic importance for landscape scale habitat restoration Ensure rehabilitation works utilise a species and genetic mix appropriate for future climates	South East NRM Board Natural Resources SA	Landholders Research institutions and universities
NE8	Planned retreat of coastal ecosystems	Later (5 to 10 years)	Preparatory work that should commence now includes: - identifying coastal ecosystems for planned retreat - identifying and rehabilitating land that is no longer suitable for agriculture but that could be used for coastal habitat retreat - identifying ecosystems at risk of irreversible change and to identify other suitable locations for these ecosystems	South East NRM Board Natural Resources SA	Coastal councils Landholders Coast Protection Board Research institutions and universities
Open space and public realm (OSPR)					
OSPR1	Undertake modelling and mapping to assist with risk management and planning	Now	Undertake a modelling and mapping project to identify assets likely to be at risk from bushfire and sea level rise Modelling and mapping to be undertaken to a level of detail that will assist with determining appropriate adaptation responses and the likely timing of when they may be required	Limestone Coast Councils	Coast Protection Board
OSPR2	Educate and raise awareness	Now	Develop and implement initiatives which focus on raising awareness and understanding of users of open space and public realm areas regarding periodic hazards such as bushfire and flooding (from sea level rise and storm surge)	Limestone Coast Councils	SES CFS ZEMC
OSPR3	Improve soil and irrigation management practices	Now	Increase the use of recycled water for irrigation of open space and public realm areas, optimisation of available water and irrigation timing and monitoring	Coastal Councils	South East NRM Board
OSPR4	Improve stormwater management	Now	Develop and implement Stormwater Management Plans Increase the implementation of water sensitive urban design approaches, including the capture and reuse of stormwater for irrigation of open space and public realm areas	Limestone Coast Councils	Water Sensitive SA
OSPR5	Rationalise irrigated open space to maintain a smaller amount to a higher standard	Now	Review existing open space to determine opportunities for rationalisation to enable maintenance of high standard areas This review should consider opportunities to share facilities and the potential for artificial (grass or other) surfaces and the need to provide shade cover (natural and constructed) for existing facilities.	Limestone Coast Councils	Limestone Coast LGA
OSPR6	Prepare open space and public realm guidelines	Now	Develop and implement guidelines for the design and construction of climate sensitive open space and public realm. Climate sensitive design includes spaces and infrastructure that are designed and constructed to take into account anticipated climate impacts, and could involve: - utilising materials that are more resilient to extreme weather such as extreme heat, wind and rainfall - designing and constructing footpaths and trails that can cope with extreme rainfall, flooding from storm surge events and heat - providing shade via vegetation or built structures for playspaces and playgrounds and adjacent to walking and cycling paths	Limestone Coast Councils State government	Limestone Coast LGA

Ref	Key adaptation options NB these options may need to be further considered and assessed to determine preference for implementation	Timing	Potential actions to progress implementation of immediate adaptation options including preparatory work that may be required to commence now for longer term options	Suggested lead	Suggested partners
			Incorporate the development and maintenance of climate sensitive spaces and outdoor infrastructure into relevant Council plans and policies such as Asset Management Plans, Playground Strategies, Open Space and Public Realm Strategies, Procurement Policies etc. Identify priorities for implementing climate sensitive infrastructure across the region (e.g. playgrounds for installation of shade)		
Road infrastructure (RI)					
RI1	Update design standards, maintenance regimes and asset management plans to accommodate projected climate change	Now	Review and update design standards, maintenance regimes and asset management plans to accommodate projected climate change This review should extend to the review and update of procurement policies and procedures in relation to maintenance and construction of roads	Limestone Coast councils	DPTI
RI2	Educate and raise awareness of organisational staff regarding impacts of climate change on assets	Now	Design and implement education and awareness raising initiatives which increase the capacity of organisational staff in relation to climate change impacts on road assets An initial activity could include holding a regional forum to: - present information about projected changes in climate - discuss potential impacts of climate change on the Region's roads - showcase techniques used by road infrastructure mangers elsewhere in the State, Australia and overseas to increase the resilience of roads to climate impacts - identify opportunities to work together across the Region to share information and implement adaptation actions	Limestone Coast councils	DPTI Limestone Coast RDA Limestone Coast LGA
RI3	Upgrade or relocate roads in high risk areas	Later	Identify those roads that traverse areas at risk of flooding (e.g. Princess Highway, Ports Highway, Riddoch Highway Develop responses to ensure access is maintained/improved. Options may include upgrade works or relocation of roads	DPTI	Limestone Coast councils Limestone Coast RDA Limestone Coast LGA
Tourism (T)					
T1	Market the Limestone Coast's milder climate as a point of difference	Now	Develop messaging that can be incorporated into the Region's marketing initiatives that differentiate the Limestone Coast from other regions because of its more amenable climate. This messaging should be integrated with existing approaches to marketing the Limestone Coast so that the climate is seen as another reason to visit the Region and enhances the experiences that are provided by the natural environment and iconic sites	South Australian Tourism Commission (SATC)	Tourism operators Limestone Coast RDA Limestone Coast LGA
T2	Planning for tourism to be coordinated at a regional scale	Now	Develop and implement an approach for tourism planning across the region that takes a long term, coordinated, regional view rather than short term, site specific approach. This coordinated regional approach includes consistent messaging and marketing and identifying opportunities for the tourism sector to contribute to regional economic diversification. For example, create and promote ecotourism facilities that integrate renewable technologies into new and existing tourism facilities	South Australian Tourism Commission (SATC)	Tourism operators Limestone Coast RDA Limestone Coast LGA
T3	Provide mobile phone coverage across entire Region	Now	Identify and redress 'black spots' in mobile phone coverage, particularly those along key tourist routes and at key sites/locations	Telecommunications providers	Tourism operators Limestone Coast RDA Limestone Coast LGA
T4	Improve accessibility to/from coastal towns/localities	Later	Identify those coastal town/localities that are likely to be at risk due to sea level rise and storm surge. Review these towns/localities in terms of tourist assets/experiences likely to be at risk of inundation including key access routes in/out Develop responses to ensure access is maintained/improved. Options may include development of alternative access routes where there are only single points of access currently	Coastal Councils	Tourism operators Coast Protection Board

Ref	Key adaptation options NB these options may need to be further considered and assessed to determine preference for implementation	Timing	Potential actions to progress implementation of immediate adaptation options including preparatory work that may be required to commence now for longer term options	Suggested lead	Suggested partners
Wetlands (W)					
W1	Prioritise wetlands for future investment	Now	Undertake a process to prioritise wetlands for future investment: Prioritisation process to consider aspects such as water availability and therefore risk of wetland terrestrialisation (drying out) Monitor wetland condition (including water quality, flora and fauna) to enable identification of climate induced changes For coastal wetlands, monitoring to also include the review of the hydrology, focusing on drainage and sea water inflows	South East NRM Board Natural Resources, South East	Landholders DEWNR Research Institutes and Universities
W2	Develop a new approach to the management of the drainage network and the allocation of water	Later (over 30 years)	Develop a strategy that seeks to implement a new approach to managing the drainage network. This approach to be focused on ways to retain water in the landscape through filling in drains or closing them off. This strategy to identify site specific drains for: - decommissioning - closing off outlets to retain water in the landscape	Drainage Board South East NRM Board	Natural Resources, South East DEWNR

Appendix C

Workshop Summary

Implementing the Limestone Coast Regional Adaptation Plan-Workshop Summary

A workshop was held on Monday 4 April 2016 with stakeholders from the Limestone Coast region. The objectives of the workshop were to:

- Provide an overview of the Limestone Coast Regional Climate Change Adaptation Plan
- Discuss and reach broad agreement regarding governance arrangements for the implementation of the Regional Adaptation Plan
- Discuss in detail the actions required to initiate three key cross sectoral, regional adaptation options identified by the Plan.

These workshop objectives reflect the understanding that the transition from planning to implementation can be challenging, and that ongoing discussion and collaboration is required by stakeholders of the region to action the Regional Adaptation Plan.

A series of activities was undertaken in small groups to explore:

- Characteristics of 'good governance'
- Challenges to implementation of the Regional Adaptation Plan
- Initiating commitment and identifying who needs to be involved
- Detailed actions required to initiate three cross sectoral priority adaptation options.

More than 50 stakeholders attended the workshop, representing a range of interests and sectors from the Limestone Coast including Local Government, regional development, natural resources management, health, emergency management, primary production and fisheries.

A summary of discussions is provided below under key headings.

1.1 Characteristics of 'good governance'

Characteristics of good governance identified by workshop participants included:

- The need for agreed and clearly articulated vision, purpose and objectives
- Commitment to follow through
- Clear, robust and accountable decision making processes, drawing on best available information
- Reporting mechanisms that include performance indicators that enable ongoing evaluation and monitoring
- Authority to make decisions
- Clearly defined roles and responsibilities
- Transparency (open, honest, fair, respectful, credible)

- Collaborative, in partnership
- Good communication (with each other and the broader community)
- Energy
- Patience.

1.2 Challenges to implementation

The following challenges to implementation of the Regional Adaptation Plan were identified:

- Ongoing community scepticism (regarding climate change and the need to act)
- Sentiment that climate change is yet to come, when in reality it is already here and we are experiencing impacts now
- The need to maintain community confidence in a positive future, which could include identifying opportunities to profit from climate change as a way to activate community support (ie what's in it for me?) as well as adaptation doesn't necessarily mean increased costs
- Decision makers not taking the issue seriously; "decision makers need to be on the same page"
- Transitioning high level ideas (in the Regional Adaptation Plan) to on-ground action both at the regional and local scale
- Multi-generational nature of the issue
- Inconsistent direction on climate change action (ie at the National level), the need for bipartisan support and unified message
- Investor confidence (need to maintain grower and industry responses)
- Resourcing, who pays, short term versus long term budget planning
- Uncertainty regarding how quickly climate change will occur
- Vested interests blocking action
- Messaging in the media (there is a need to simplify messages so easier to digest and remember)

1.3 Commitment to implementation

Obtaining commitment to implementation of the Regional Adaptation Plan was considered a critical factor to the Plan's successful implementation.

Opportunities identified to initiate this commitment included:

- Recognise there is an issue (communicate, provide evidence, stimulate debate)
- Assign responsibility for actions
- Define achievable goals

- Educate key stakeholders (including the costs of doing nothing)
- Build community support
- Further develop adaptation pathways maps and invest in small pilot projects to “thrash out” detail of adaptation options
- Appoint a coordinator/project officer to drive implementation
- Embed adaptation actions into regional plans of regional bodies (eg South East Natural Resources Management Board, Regional Development Australia Limestone Coast and Limestone Coast Local Government Association)
- Work with leaders and community champions (ie there are people in the region already undertaking adaptation action which can be showcased, leveraged, built on, promoted etc)
- Utilise cloud/crowd funding to obtain resources for implementation
- Insert a signatory page in the Plan

There was strong agreement within the group that a coordinator or project officer responsible for driving the implementation of the Regional Adaptation Plan was key to initiating and maintaining commitment and achieving ‘action on the ground’.

1.4 Governance arrangements for implementation of the Regional Adaptation Plan

Reflecting on the previous discussions including the characteristics of good governance, challenges to implementation and the need for commitment, stakeholders were asked to identify their preferred approach to the governance arrangements to support implementation of the Regional Adaptation Plan.

A number of models were proposed as follows:

- Project steering committee or core group of lead stakeholders comprising representation from SENRM, RDALC and LCLGA. This committee would oversee the implementation of the Regional Adaptation Plan through a project coordinator that would work with different sectors to implement actions and new ideas for adaptation (eg industry groups, Zone Emergency Management Committee , Health SA, Education sector, primary producers, State Government Agencies, Environmental Youth Network etc)
- As above, but with a Reference Group comprised of community representatives
- Enter into a sector agreement or memorandum of understanding that essentially identifies “we will implement this Regional Adaptation Plan”. Key signatories to this agreement to comprise South East Natural Resources Management Board, Regional Development Australia Limestone Coast and Limestone Coast Local Government Association and Minister for Climate Change and Minister for Regional Development.

It was also suggested that the Local Government Association’s economic diversification group structure may provide insight regarding an appropriate governance structure.

As discussion progressed, **there was general agreement regarding the following in relation to obtaining commitment and progressing the implementation of the Regional Adaptation Plan**:

- Formalised commitment is particularly desired from the South East Natural Resources Management Board, Regional Development Australia Limestone Coast and Limestone Coast Local Government Association as the core group/primary leaders
- This commitment to the implementation of the Regional Adaptation Plan be discussed and determined at the upcoming Board meetings of each body/organisation in April/May 2016
- Once agreement is obtained regarding commitment to the Regional Adaptation Plan, work together to finalise the approach to governance by June 2016.

Attachment A provides a visual representation of a possible approach to governance arrangements based on discussion with workshop participants.

1.5 Detailed actions to progress cross sectoral adaptation options

Recognising that it is challenging to initiate action, participants were asked to discuss in small groups the detail of the key steps involved with implementation of the following three key cross sectoral adaptation options identified by the Regional Adaptation Plan:

1. Education and awareness raising
2. Investigation of the feasibility of recharging the aquifer with drainage water and options for retaining water in the landscape
3. Preparation of an 'Integrated Coastal Response Strategy' for the Region.

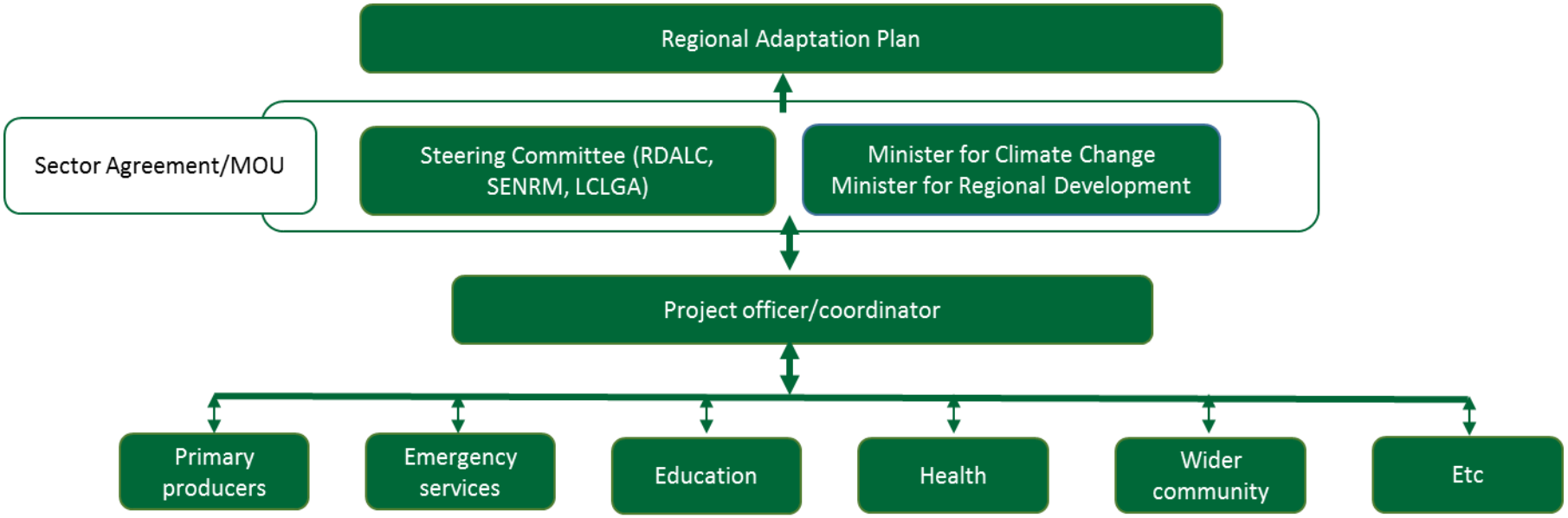
To assist with this discussion, participants completed a pro forma which considered the following aspects:

- The key steps required to initiate action
- Who does what for each step (ie roles and responsibilities)
- Barriers to progressing each step or opportunities/existing initiatives that can be used/leveraged to progress the step
- How the barriers could be overcome or opportunities realised
- Timeframes involved with each step
- Likely costs involved.

Through considering the above, the small groups were then asked to synthesise their discussion to identify the 'bones' of a project brief, in particular a project title, key objectives and key outputs/deliverables.

A summary of discussions is provided in Attachment B. It should be noted that the information contained within the table is a summary of workshop discussion and provides preliminary consideration of the actions. Actions to progress the three cross sectoral adaptation options still require further exploration and development. Where table cells are blank, this means no comment was recorded by the group.

Attachment A Possible governance arrangements



Attachment B Summary of possible actions to progress 3 cross sectoral adaptation options

	Project title	Objectives of the project	Key outputs/deliverables	Describe the key steps required to initiate action	Who should be involved?	Describe any barriers to progressing each step OR any opportunities/existing initiatives that can be used/leveraged to progress the step	How could the barriers be overcome or opportunities realised?	What timeframe is involved for each step?	What cost is likely to be involved (dollars, in kind resourcing, allocation of FTE)
Investigation of the feasibility of recharging the aquifer with drainage water and options for retaining water in the landscape (3 groups considered this option)									
Group 1	Landscape and Water Management Improvement	Define 'preferred" recharge locations Engage with community and stakeholders Broaden our science on recharging the aquifer with drainage water and retain water in the landscape	Develop an assessment tool to identify suitable locations	Step 1 Define preferred recharge locations	DEWNR Drainage Board	NRM and Drainage Board are currently preparing Drainage and Wetlands Strategy Local landholder loss No areas identified as yet	Investigate engineering solutions Who to involve in identification of sites	Strategy is due in June 2018	
				Step 2 'Science' prior to making decisions regarding recharge locations	DEWNR	Drains are intended for 1 in 10 year event Need to look forward Dismal Swamp and Tatiara Creek are good locations for case studies	Quantify risks to wetlands Be well informed and understand trade-offs (ie wetland versus aquifer recharge) What is Victoria doing regarding water management?		
				Step 3 Develop an assessment tool to identify suitable locations		Understanding run off from towns/urban areas			
				Step 4 Community discussion regarding possible recharge locations	RDA, PIRSA, Local Government, industry groups, primary producers, Victoria	Legal issues involved in flooding land Is it a majority win situation? All industries have a different perspective	Tourism opportunities regarding wetlands		
				Step 5 Rename the Drainage and Wetland Strategy to Water Management Strategy					
Group 2	Capturing surface water runoff/drainage water in the aquifer	Define suitable areas for recharge Identify ways to retain water in the landscape (eg weirs, large basins, wet flats, recycling waste water from Finger Point) Determine the potential for the landscape to maintain/manage recharge	Increased recharge of aquifer	Step 1 Define suitable areas for recharge	DEWNR	If water is retained some properties will be flooded Adaptive management-flexible regime depending on whether it is wet or dry	Financial incentives for flooded land to compensate for loss of production' Wetland Strategy-directing water for best use (retained on surface, recharge aquifer or sent to Coorong)	Feasibility study-6months to 1 year Wetland Strategy-3 years	Tens of millions
				Step 2 Recycle water from Finger Point	SA Water	Install pumps to pump back to Mount Gambier Analysis of water	Provide funding	2 years	Tens of thousands
				Step 3 Control water going down the drains • Install more weirs • Drill recharge wells • Start small and enlarge scheme as time progresses	Drainage Board	Funding Climate change means there is less water available	Implement a market based approach to pricing of water Fixed 15% of water allocated to the environment	Ongoing project Need to identify milestones	
Group 3	Water for Life	Understand how the system works Expand and develop the decision support system Encourage most productive use of water (ie highest return to economy)	Increased recharge of aquifer Increased retention of water in the landscape	Step 1 Understand how the system works • Surface water/groundwater interactions • Gaining/losing • Water quantity • Climate impact • Future demand and supply	NRM Drainage Board Local Government	Cross border issues (no surface water agreement, no forest management) Lack of knowledge Goyder Water Modell Decision Support System Productivity Report	Expand Goyder ground water model climate change scenarios Expand Border Agreement to include surface water and forestry Fund further research and data collect Recommission gauging system	6 months 3-5 years 1-4 years Obswells now 2 years	$500,000 In kind $400-$500,000 In kind Components $200,000 Resources $300,000 pa
				Step 2 Expand and develop the decision support system • Manage drains in high flows/low flows • Drainage bores • Stormwater • Holding water higher in the landscape					
				Step 3 Encourage most productive use of water					

	Project title	Objectives of the project	Key outputs/deliverables	Describe the key steps required to initiate action	Who should be involved?	Describe any barriers to progressing each step OR any opportunities/existing initiatives that can be used/leveraged to progress the step	How could the barriers be overcome or opportunities realised?	What timeframe is involved for each step?	What cost is likely to be involved (dollars, in kind resourcing, allocation of FTE)
Investigation of the feasibility of recharging the aquifer with drainage water and options for retaining water in the landscape (3 groups considered this option)									
Preparation of an 'Integrated Coastal Response Strategy' for the Region (1 group considered this option)									
Group 4	Coast for the Future or Coast of the Future or Limestone Coastal Response Strategy	Develop an Integrated Coastal Response Strategy with/by key stakeholders (Limestone Coast Local Government Association, Councils, Fisheries, Department of Environment, Water and Natural Resources, South East Natural Resources Management Board and Department of Planning, Transport and Infrastructure) that: • Feeds into/provides information for Council Development Plan policy • Involves the community, landholders and land managers in a conversation about risk • Identifies priorities for action.	Finer scale LIDAR modelling of land inundation from sea level rise and storm events Communication products (for Council planning and awareness raising) Response Strategy document	Step 1 Form a Steering Committee Build on structure of LCLGA Coastal Management Create governance and gain commitment from stakeholders sub-committee	Steering Committee comprised of Coastal Protection Branch, local Councils, DPTI, DEWNR, PIRSA, fisheries representatives	Build on structure of LCLGA Coastal Management sub-committee Difficult to define the scope with such a broad group/range of issues Regional scale of the strategy could be a challenge		Within first 6 months	
				Step 2 Define the biggest issues, scope of the strategy and method	Steering Committee			Within first 6 months	
				Step 3 Get updated LIDAR Fill data gaps and undertake modelling		Funding Data will never be perfect	Look for State/National funding opportunities	To obtain funding and undertake modelling could take 1 to 2 years	$500,000
				Step 4 Identify assets that are threatened (social, cultural, built, environmental) Place dollar value on threatened built assets		Collaborate on weirs/retention of water in the landscape projects to mitigate flooding of coastal zone and sea grass impacts in storm surges			
				Step 5 Community conversation about risk					
				Step 6 Develop a priority response matrix addressing each asset (eg protect, augment, retreat, abandon etc)		Political and legal issues relating to increased planning requirements (eg higher floor levels))			

	Project title	Objectives of the project	Key outputs/deliverables	Describe the key steps required to initiate action	Who should be involved?	Describe any barriers to progressing each step OR any opportunities/existing initiatives that can be used/leveraged to progress the step	How could the barriers be overcome or opportunities realised?	What timeframe is involved for each step?	What cost is likely to be involved (dollars, in kind resourcing, allocation of FTE)
Education and awareness raising (2 groups considered this option)									
Group 5	Climate of Opportunity	Positive and consistent messaging about climate change including economic opportunities that it presents for the region	Appointment of a coordinator/project office to deliver program Consistent messaging and communications materials Community feels empowered, resilient and secure in that they can take action to adapt to and mitigate climate change People remain in region	Step 1 Identify champions to help communicate the messaging (eg RDA, LCLGA, NRM Board, high profile community members etc)					
				Step 2 Appoint a project officer				12 month trail	One full time equivalent position and funds for communication materials
				Step 3 Prepare communications materials to support key messages: • We can adapt to climate change • We can mitigate climate change • We are resilient • We'll still be here in 200 years plus • There are economic opportunities • There is no need to leave the region Target communications to a range of audiences (eg young people, older people, primary producers, schools etc)		Link with regional NRM planning, Council Development Plans and RDA's Regional Road Map			
Group 6	Climate Forecast and Me-supporting a viable and resilient Limestone Coast in a changing climate	Scan of the programs and activities that could be leveraged to educate and raise awareness across the region Identify gaps that may need to be addressed	List of what is being done Identification opportunities to leverage existing actions Identify opportunities for collaboration Identification of gaps that need to be addressed	Step 1 Establish a collaborative working group (eg RDA, DEWNR, LCLGA, Health, DECD, Red Cross etc) Define parameters of the scan Appoint a project manager Undertake a scan to review existing education and awareness raising programs with a climate change 'filter' (ag adaptation, mitigation, extreme events, resilience etc) Identify relevant current initiatives and gaps		Time and resources Electoral cycle timeframes Media/social media and communications tactics			
				Step 2 Find resources and funding Recruit project manager		Aligns with organisational goals			
				Step 3 Start the project and gain buy in Allocate resources to start the work					
				Step 4 Collaborate with PERMA and Resilience and Wellbeing Present adaptation plan actions Provide case studies showing best practice examples of adaptation		Information not being available Starting point			