Government of South Australia
Adelaide and Mount Lofty Ranges
Natural Resources Management Board

Adelaide and Mount Lofty Ranges Natural Resources Management Plan

Volume 1 — Part 1

Strategic Plan

2014-15 to 2023-24

Thriving communities caring for our hills, plains and seas

November 2013

Natural Resource Management Act 2004

Natural Resources Management Plan

Volume 1: Strategic Plan for the region

for the

Adelaide and Mount Lofty Ranges Region

prepared by the

Adelaide and Mount Lofty Ranges Natural Resources Management Board

I, Ian Hunter, Minister for Sustainability, Environment and Conservation, hereby adopt this Natural Resource Management Plan, Volume 1: Board business and operational plan pursuant to section 80(3)(a) of the *Natural Resources Management Act 2004*.

Ian Hunter Date: 2/12/13

Minister for Sustainability, Environment and Conservation

CONTENTS

TABLES

PART 1

PART 2 (PLEASE REFER TO VOLUME 1 PART 2)

FIGURES

PART 1

FOREWORD

A message from Presiding Member
Professor Chris Daniels

As the Presiding Member of the Adelaide and Mount Lofty Ranges Natural Resources Management (NRM) Board, I am delighted to present this Regional NRM Plan.

Why a Regional NRM Plan?

A Regional Plan is a clear, defensible and transparent statement of what needs to be done in NRM, why action is needed, and how the best possible actions are determined and delivered.

The plan is based on the best science and methodological approaches currently available. The actions proposed in the plan are tested, and the outcomes continually analysed through state of the art monitoring and evaluation techniques. The benefits of the Regional Plan's approach, methods and targets, are continually reviewed by the board and through active discussion in the NRM groups and committees. This continual review is fed into the Regional Plan through the three-year review process and helps to shape changes to the strategic plan (10-yearly plan review). Life is learning and the plan is a living document that encourages learning as well as action.

One of the great strengths of the regional NRM planning system is that the community participates at every step. The board asks its community directly and through its community-based structures: what needs to be conserved, preserved and used? Natural resources management is not possible without active community involvement. The development of this Regional Plan would not have been possible without the significant input received over the last two years from the community and key stakeholders, and the board thanks you for your involvement.

The Regional Plan also sets boundaries. There are simply not sufficient financial and practical resources for the community to repair everything. We must set priorities. Where do we best direct our limited resources for greatest effect? The Regional Plan determines these priorities and defends our choices. We must continue to challenge ourselves and our Regional Plan, and improve it with future versions. We respond to what we have learned by following the plan, to make a better plan for next time.

Why this NRM Plan?

This new Regional Plan for the Adelaide and Mount Lofty Ranges, the second plan for the region, takes a landscape view and approach. The first plan, released in 2008, set specific targets, many of which have been achieved (see achievement reports and report cards at www.amlrnrm.sa.gov.au).

Since that first plan was developed, ecological knowledge has grown and matured. We now know that we must treat ecosystems as a whole and take a landscape approach to be effective. We can have the greatest effect on resource management not by identifying a species or particular creek that needs conserving, or by simply replanting degraded grassland. We conserve more species, repair degraded

land and polluted water, and reinvigorate agricultural services by identifying the ecosystems that best service the region. If we conserve those ecosystems, at a landscape level, then many other beneficial actions will follow.

It is with this greater understanding of the need for an integrated and holistic approach to managing the environment that the AMLR NRM Board acknowledges the perspective of Traditional Owners that the land, waters and all living things are connected. Working together we will support cooperative approaches to the protection and maintenance of culture, cultural sites and the natural resources of the lands and waters through the involvement of all Aboriginal people.

Our region and our country are full of dynamic natural systems. When these ecosystems are resilient, supported by a complex natural biodiversity, and able to use and reuse their resources internally and sustainably, they can cope with stress. Resilient ecosystems can cope with drought and flooding rains, with plagues of rabbits and locusts, with freezing nights and scorching hot days. Landscape denuded of its strength in diversity and resource vitality cannot cope with such stresses. Hence this new Regional Plan is taking a more complex route to identifying resilient landscapes, a stronger environment that can defend itself and us against change. This change from targets to landscape is a big step, but it is appropriately based on the successes of the previous plan. It is at the forefront of our ecological knowledge about how to best manage natural resources in a complex environment with multiple stakeholders and competing interests.

We will continue to use the targets established in the first five year plan – they set the trajectory towards the long term regional targets and still guide our day-to-day actions. Now, however, we place how we will achieve these targets in a bigger, more realistic landscape picture that instills a capacity for resilience, for coping, for responding and surviving in good times and bad.

What is your role in the plan?

The Adelaide and Mount Lofty Ranges region is home to 1.3 million people, most of them in metropolitan Adelaide. You might live in the urban landscapes of Adelaide but the natural resources that sustain you, physically and mentally, are all around you.

Our ‘backyard’ is more than just resources. It is home. In it we find our rest and recreation, and a sense of place. We are Adelaideans because we holiday on the Fleurieu Peninsula, eat paté from the Barossa Valley, drink milk from Parawa, relish seafood from Gulf St Vincent, sip wine from McLaren Vale, celebrate Christmas with cherries from the Adelaide Hills, nourish our children with veggies from Virginia, go surfing at Middleton, and watch the whales at Victor Harbor. We are among the most fortunate communities in the world. We both want to, and have a responsibility to, keep it that way.

We can all exercise our responsibility towards NRM in many ways. It may be in just willingly paying your levy because you see the benefits that the board and its Regional Plan bring to the region; it may be in volunteering for an environmental project; it may be in managing your land to protect and enhance the natural resources that support ecosystems and your primary production businesses.

Encourage your children to engage in environmental education through schools and through outdoor educational activities. Recognise the importance of home grown produce and our native biodiversity. Most of all, engage with NRM. These are your assets. If you don’t care for them, who will?

ABOUT THIS PLAN

The Regional Natural Resources Management Plan for the Adelaide and Mount Lofty Ranges has been prepared under the *Natural Resources Management Act 2004* (the Act) and is presented in two volumes:

- Strategic Plan for the Adelaide and Mount Lofty Ranges Region 2014-15 to 2023-24:

  a 10-year strategic plan for the region, which the Act intends to apply to all stakeholders managing natural resources in the Adelaide and Mount Lofty Ranges (AMLR) region (this document)

- Adelaide and Mount Lofty Ranges Natural Resources Management Board Business and Operational Plan 2014–15 to 2016-17:

  outlines how the Board will invest the money that it raises through levies and other funding sources.

Under the Act, the Strategic Plan for the region is required to be reviewed at least once in every 10-year period. The Board intends for the Strategic Plan to be an adaptive plan and therefore intends to review and amend it frequently to ensure that it remains an up to date and usable document (see Chapter 5). The Business and Operational Plan must be reviewed, at least, every three years.

The Strategic Plan for the Adelaide and Mount Lofty Ranges region

The Strategic Plan for the Adelaide and Mount Lofty Ranges region sets the direction for all stakeholders to work together to improve the natural resources of the region.

This Strategic Plan is the first attempt by the AMLR Natural Resources Management (NRM) Board to adopt a systems approach to developing an NRM plan.

A systems (resilience) approach to NRM is about:

- thinking about the region as linked systems, rather than individual natural resources assets (e.g. water, pests, biodiversity)
- recognising complexity, uncertainty and natural variability
- identifying the drivers that may cause a system to shift to a more undesirable state
- identifying the way in which those drivers may act on a system and the thresholds that may exist between states
- targeting effort towards where it can make the greatest difference to prevent systems approaching or crossing thresholds.

The Strategic Plan outlines the long term vision for the region and identifies the strategic directions necessary to maintain systems in healthy states. A number of additional documents support the implementation of the Regional Plan, although they are not formally a part of it. Key elements of the Regional Plan and key supporting documents are summarised in Figure 1.

The Regional Plan is presented in a different way, with our understanding of the region described using systems. Figure 2 is a quick guide to where to find information.

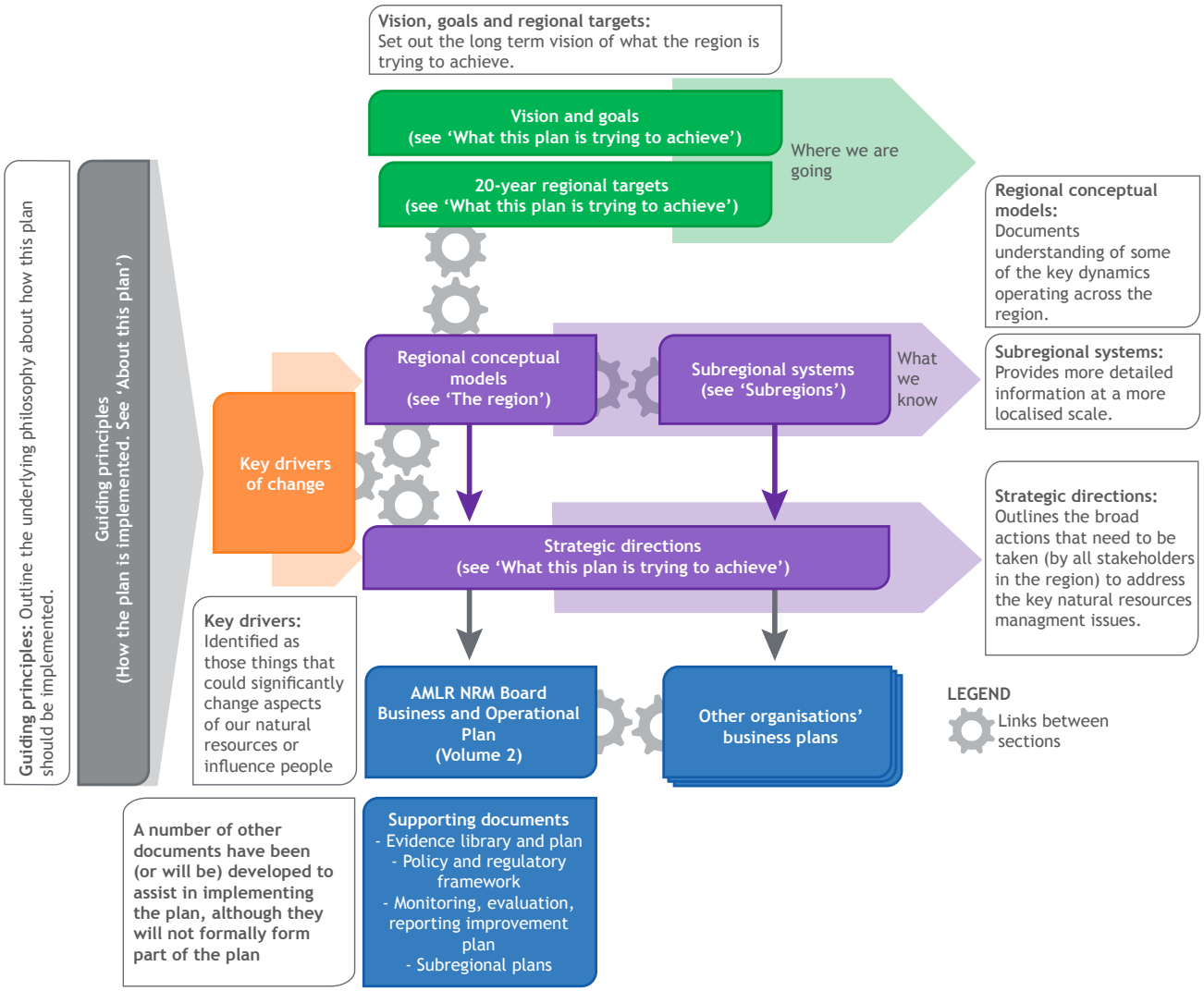


Figure 1: Key elements of the Regional Plan

Guiding principles for the Regional Plan

A set of guiding principles outlines the underlying philosophy for implementing the Regional Plan:

- Achieve results through government, communities, research institutions and businesses working together
- Plan for uncertainty and take action using an adaptive management approach
- Consult with stakeholders to balance competing social and economic demands to ensure healthy natural resources that underpin healthy communities
- Decisions are based on the best available information
- Allow for innovation
- Protect and enhance core natural resource assets and processes
- Allow for the intergenerational timeframes required to manage ecological systems

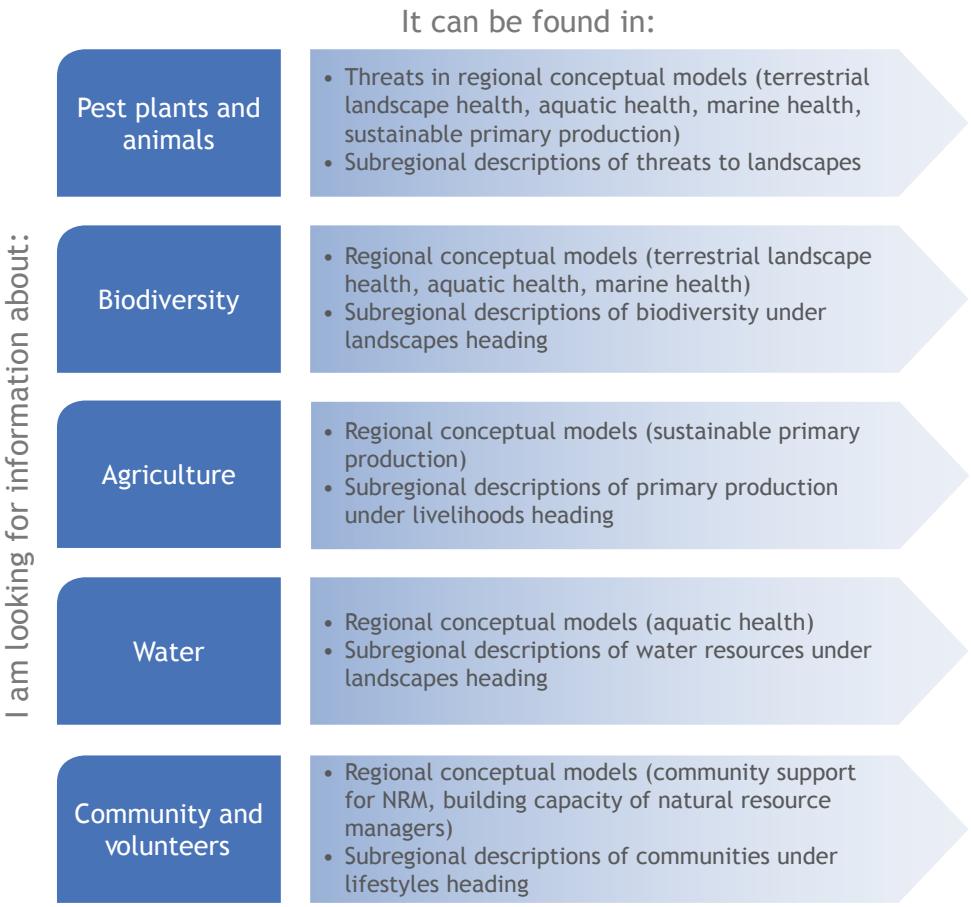


Figure 2: Quick guide to finding information in the Regional Plan

Context of the Regional Plan

This Regional Plan is part of an extensive framework of national, state and regional policies and plans (see Appendix A).

WHAT THE PLAN IS TRYING TO ACHIEVE

Vision, goals and targets

The Regional Plan is based on a long-term vision for the future of the region, which was developed following extensive consultation for the first Regional Plan in 2008.

The vision, ***Thriving communities caring for our hills, plains and seas***, is supported by four goals that outline what the stakeholders in the region are aiming to achieve by 2028 (20 years from the adoption of the first Regional Plan). The desired future described in the goals forms the basis to guide action by stakeholders in managing and improving the natural resources of the region. The goals are:

1. Ecological processes for life and livelihood
   - healthy seas, rivers and landscapes
   - well functioning ecological processes that support life and livelihoods.

2. Communities engaged and active
   - communities living within resource limits
   - informed and engaged communities actively protecting and restoring our natural resources.

3. Amenity, culture and environment valued
   - use and reuse of natural resources based upon environmental, economic, social and cultural values
   - iconic sites protected and new ones created.

4. Knowledgeable decisions and action partners
   - uncertainty is acknowledged and actions anticipate change
   - partners committed to working together to achieve natural resources outcomes.

The regional targets were developed in 2008 to support the vision and goals. They describe the desired condition of natural resources in 2028. The 20-year regional targets (Table 1) will assist with evaluating the region's collective performance towards achieving the shared vision and goals over the long term.

The regional targets considered the targets set out in *South Australia's Strategic Plan* (Government of South Australia 2011) and the *Our Place. Our Future. State Natural Resources Management Plan South Australia 2012 - 2017 (*Government of South Australia 2012). To be achieved, the regional targets require

action from all stakeholders and individuals investing in NRM in the region. An evaluation of the regional targets late in 2012 considered the rate of progress of their implementation and any refinements that might be necessary. Minor changes were made to targets 1, 2, 5, 9 and 13, and target 4 was removed. Further information on the evaluation of targets can be found at www.naturalresources.sa.gov.au/adelaidemtloftyranges. Most of the changes improved alignment with *South Australia's Strategic Plan* and *State NRM Plan* targets. The regional targets are ambitious but are considered to be achievable with appropriate investment.

Measuring success against the regional targets is an important part of measuring the success of implementing the Regional Plan. A set of core indicators is used to monitor progress and report cards are produced to report on progress against the targets. Further information on these indicators and report cards can be found at www.naturalresources.sa.gov.au/adelaidemtloftyranges.

Table 1: Regional targets

Target*	by 2028	Link to regional conceptual models**
T1	The region will have the system capacity to harvest up to 35 GL of stormwater and 50 GL of wastewater per annum	marine health, aquatic health
T2	Aquatic ecosystems and groundwater condition is maintained or improved	aquatic health
T3	All water resources used within sustainable yield (allowing for variability)	aquatic health, adapting to a changing climate
T5	Maintain or increase the productive capacity of agriculture	sustainable primary production
T6	Land condition for primary production improved by 15%	building capacity of natural resources managers, sustainable primary production
T7	Condition and function of ecosystems (terrestrial, riparian) recovered from current levels	terrestrial landscape health, aquatic health
T8	Extent of functional ecosystems (coastal, estuarine, terrestrial, riparian) increased to 30% of the region (excluding urban areas)	terrestrial landscape health, marine health, aquatic health
T9	Improvement in conservation prospects of native species (terrestrial, aquatic, marine) from current levels	terrestrial landscape health, marine health, aquatic health
T10	Land based impacts on coastal, estuarine and marine processes reduced from current levels	building capacity of natural resources managers, marine health, aquatic health
T11	Halt the decline of seagrass, reef and other coast, estuarine and marine habitats, and a trend towards restoration	building capacity of natural resources managers, marine health, aquatic health, terrestrial landscape health
T12	All coast, estuarine and marine water resources meet water quality guidelines to protect defined environmental values	marine health, aquatic health
T13	Increase participation in natural resources management activities by 20%	community support for NRM, building capacity of natural resources managers

***T4 (Average annual cost of flood damage reduced) removed after review and evaluation of targets**

**** See Chapter 3 for regional conceptual models**

Strategic directions

The strategic directions guide the region, and all stakeholders involved in NRM in the region, on the work required to:

- achieve the regional targets
- address priority issues in each subregion
- maintain or shift systems towards the desired states as defined in the regional conceptual models (see Chapter 3).

The strategic directions are likely to be delivered by a range of organisations and individuals taking a range of roles. Potential partners in any aspect of the work proposed are highlighted in each table (Table 2–5). They are intended to be indicative only, and may not necessarily include all organisations and individuals that will undertake NRM work in the region.

Partnerships and collaboration are vital to the successful implementation of the Regional Plan, which is about encouraging and supporting a collaborative approach, as well as getting commitment from key players to collectively make a difference. This partnership approach has been an important part of developing the Regional Plan and will become even more important as we move towards implementation.

Understanding the regional dynamics and subregional systems in this Regional Plan has seen four key drivers of change identified for the Adelaide and Mount Lofty Ranges (AMLR) region. These drivers could push terrestrial, aquatic or marine health as well as a range of social systems across thresholds to a different state or undesirable condition. They are:

- climate change
- land management and change
- economic impacts
- knowledge and capacity.

The strategic directions have been grouped to address each of these key drivers because of their potential impact on the overall resilience of the AMLR region (Table 2–5). The strategic directions are intended to assist the region to adapt to the impact of each driver. Each strategic direction links to relevant regional conceptual models (which provide evidence on why the action is required) and relevant subregions (see Appendix B for links).

Photo: Bill Doyle

Climate change

The future climate in the AMLR region is predicted to:

- be warmer and drier with longer hotter hot spells
- have less reliable rainfall and later breaks in season
- have sea level rise and storm surges impact on coastal infrastructure and ecosystems (including internationally significant migratory bird species).

These predicted changes are likely to drive a wide range of changes to natural resources in the region, and changes to the industries that rely on those natural resources. Further information on the predicted changes and potential impacts of climate change can be found in the 'Adapting to a changing climate' regional conceptual model. Strategic directions to address this key driver are shown in Table 2.

Table 2: Strategic directions - climate change

	Strategic direction	Potential partners
C-A	Participate in opportunities for low carbon futures	Australian Government, AMLR NRMB, land managers, NGOs, industry
C-B	Build the adaptive capacity of communities	DEWNR, AMLR NRMB, local government, community, industry
C-C	Build the understanding and knowledge of future climate change impacts	research organisations, state government, community, local government, industry
C-D	Provide opportunities for landscapes to adapt to climate change	DPTI, DEWNR, AMLR NRMB, land managers, industry
C-E	Provide opportunities for production systems to adapt to climate change	PIRSA, AMLR NRMB, land managers, industry

Land management and change

Land use in the AMLR region is changing. In particular, urban areas are expanding, rural living is increasing and primary production uses are intensifying. These changes, along with the way land is managed, can result in a wide range of impacts on, and threats to, natural resources, such as:

- impacts:
  - clearance of vegetation and fragmentation of vegetation
  - increased use of water resources and decreasing water quality
  - fragmentation of primary production land and reduction in farm size leading to less ability to run a profitable primary production business
  - intensification of land use leading to soil impacts
  - conflicts between adjoining land uses
- strategic threats such as invasive species or altered fire regimes (pre-existing and new/emerging threats).

In addition the competing demands for land, particularly for urban development and rural lifestyle development, are increasing property prices across traditionally primary production areas.

The strategic directions to address this key driver (Table 3) can be broadly considered in terms of either land management or land use change. Land use change in particular links closely with the land use planning system, and the controls in place through development plans. Section 75(3)(f) of the *Natural Resources Management Act 2004*, indicates that a regional NRM plan can identify policies in a development plan that the board believes should be reviewed to improve the relationship between the development plan and the regional NRM plan. A number of issues of importance that can best be managed through development plan controls are highlighted throughout this Regional Plan, in particular in the subregional descriptions. Strategic direction L-A is intended to focus on improvements that can be made to the development planning system to ensure better natural resources outcomes.

Table 3: Strategic directions - land management and change

	Strategic direction	Potential partners
L-A	Identify and resolve land use planning conflicts to minimise impacts on natural resources	DPTI, DEWNR, AMLR NRMB, local government, Renewal SA, industry, PIRSA, DMITRE, EPA
L-B	Reinstate ecosystems in priority locations to stem biodiversity declines	DEWNR, AMLR NRMB, land managers, local government, NGOs
L-C	Improve the condition of priority biodiversity areas	DEWNR, AMLR NRMB, land managers, local government, NGOs
L-D	Improve the long-term prospects of threatened* and declining species and communities	DEWNR, AMLR NRMB, land managers, local government, NGOs
L-E	Maintain high value primary production areas for primary production	DPTI, PIRSA, AMLR NRMB, industry groups, land managers
L-F	Reduce land based impacts on aquatic and marine health through appropriate land management and management of runoff	land managers, local government, AMLR NRMB, DEWNR, EPA, industry
L-G	Provide suitable water regimes to maintain and improve the condition of aquatic (freshwater) and marine ecosystems	DEWNR, AMLR NRMB, land managers, SA Water, local government, EPA

*** Threatened includes non-listed species**

Economic impacts

Areas within 100 kilometres of the Adelaide GPO consistently generate around 25% of South Australia's total farm-gate value of production, much of it from high value horticulture, winegrape and livestock industries. This distinctive pattern of production is due to a combination of favourable natural resources and climate, major investments in infrastructure, and good access to labour, transport and support industries. Very few parts of the state enjoy this combination of factors. These same areas also present important opportunities for adapting to the impacts and uncertainties of climate change, water scarcity, and a carbon-constrained economy. Within this region SA's farm-sector and food system are buffered from external shocks by the high rainfall, cool climate conditions of the Mount Lofty Ranges, by access to multiple water resource options, including recycled water, and by proximity to a major market and national freight network.

Commercial fisheries contribute $7.6 million (gross regional product) and important social benefits to the region. Main fisheries include the Gulf St Vincent Prawn Trawl fishery for Western King Prawn (as well as by-product catches of Slipper Lobster and Calamari) and the mixed species Marine Scalefish Fishery. A number of invertebrate species such as Calamari, Cuttlefish, Sand Crab, Blue Crab, and Goolwa and Mud Cockles are managed under the multi-species Marine Scalefish Fishery. The Australian Sardine fishery takes a range of small pelagic fish, including Sardine (Pilchard), Anchovy, Sprat and Round Herring in Gulf St Vincent waters. The coast and marine environment also supports a range of recreational industries, for example, recreational fishing and charter boat activities. The main species of fish sought by charter boats in the Gulf St Vincent–Kangaroo Island region are Bight Redfish, King George Whiting and Snapper.

The ability of natural resources managers to implement works for improvement is in part dependent on profitability of the enterprise. Strategic directions to address this key driver are shown in Table 4.

Table 4: Strategic directions - economic impacts

	Strategic direction	Potential partners
E-A	Support and encourage sustainable primary production	PIRSA, industry groups, land managers, AMLR NRMB, EPA
E-B	Support and encourage sustainable marine industries	PIRSA, industry groups, AMLR NRMB, Renewal SA
E-C	Support and encourage sustainability in other industries reliant on natural resources	Regional Development Australia, industry groups, local government
E-D	Maximise the use of stormwater and treated wastewater	local government, DEWNR, SA Water, AMLR NRNB, EPA
E-E	Recognise the intrinsic economic value of biodiversity	NGOs, land managers, AMLR NRMB

Knowledge and capacity

People are an integral part of the environment, particularly in the AMLR region, which has a significant population for its geographic area. Most land in the region is in private ownership and therefore to achieve improved natural resources outcomes it is critical to work with the people of the region.

People also provide a significant opportunity for NRM, contributing through both physical action on ground and advocating to policy makers and the broader community about the value of natural resources to the community – both in the intrinsic value offered by the natural resources and the value of the industries those natural resources support. Strategic directions to address this key driver are shown in Table 5.

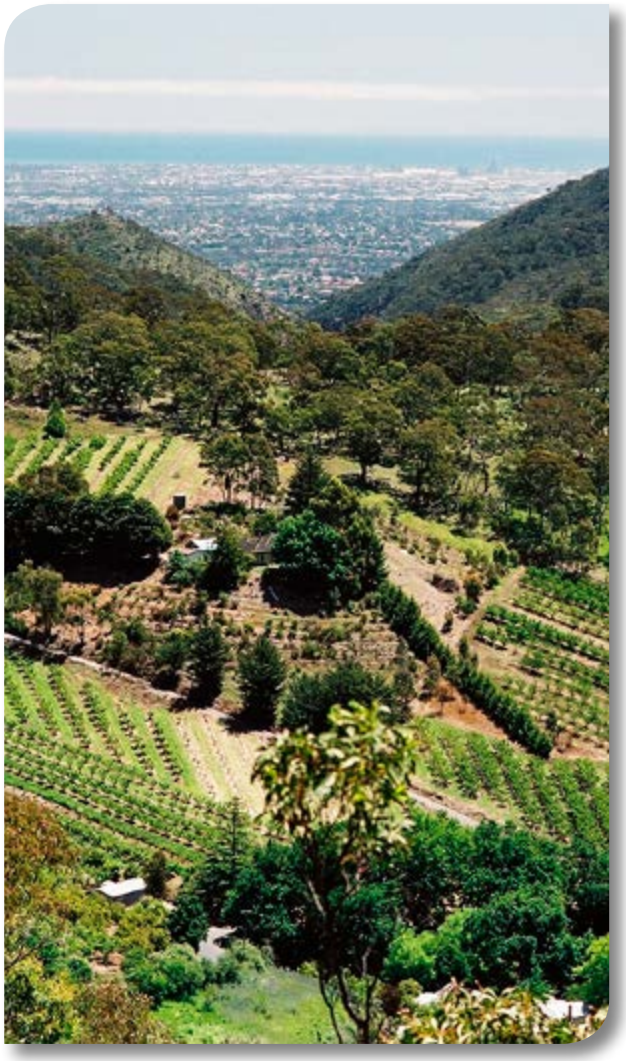
Table 5: Strategic directions - knowledge and capacity

	Strategic direction	Potential partners
K-A	Build capacity of Aboriginal and non-Aboriginal communities in Aboriginal culture	Aboriginal nation groups, DEWNR, AMLR NRMB, community, local government
K-B	Increase the connection that people have with the environment and food production and the link to natural resources	PIRSA, NGOs, schools, community groups, AMLR NRMB, local government
K-C	Encourage sustainable living and engagement with nature	NGOs, schools, community groups, local government
K-D	Increase and diversify the participation in natural resources management activities	AMLR NRMB, industry groups, community groups, NGOs, local government, EPA
K-E	Support all land managers to achieve good natural resources outcomes	AMLR NRMB, land managers, PIRSA, DEWNR, local government
K-F	Support land managers to increase areas under environmental stewardship	DEWNR, land managers, AMLR NRMB, Australian government
K-G	Support innovation and knowledge sharing	research organisations, AMLR NRMB, NGOs, DEWNR
K-H	Encourage urban planning to consider the inclusion of nature in an urban context (link to place making, community health and wellbeing, amenity and urban cooling)	local government, DPTI, DEWNR, AMLR NRMB, NGOs

THE REGION

The Adelaide and Mount Lofty Ranges (AMLR) region is one of eight natural resources management (NRM) regions established in South Australia under the *Natural Resources Management Act 2004*. It includes metropolitan Adelaide and the western side of the Mount Lofty Ranges, extending from Mallala and the Barossa in the north, to the Fleurieu Peninsula in the south (Figure 3). The region also extends up to 30 km into the marine environment. Of its total area of approximately 11,200 square kilometres, 59% is land and 41% marine waters.

The region supports a diverse mosaic of landscape types, including remnant bushland, agriculture and horticulture, urban areas, beaches, spectacular coastal scenery and marine environments. It is the most complex landscape in the state. The population and landscapes in the region support diverse industries which make a significant contribution to the state's economy.



This most biologically diverse region in South Australia is home to half of the state's species of native plants and three-quarters of its native birds. It also contains some of the state's most productive primary industries supplying local and international markets and contributing to South Australia's economic and social wellbeing.

The region is under continual pressure as metropolitan Adelaide grows, and land use changes. In the last 10 years urban development has increased at the northern and southern edges of metropolitan Adelaide and agricultural land use has changed to rural residential land, particularly in the north of the region and in the Fleurieu. Primary production land has also been changing from agricultural to horticultural uses, particularly adjacent to existing horticultural areas. These changes reflect intensification of land uses which may impact on the natural resources of the region.

With approximately 1.3 million people, the region contains almost 80% of the state's population. The extremely diverse population lives and works in rural landholdings and primary industries, rural townships and peri-urban areas, and metropolitan Adelaide.

In general the region's population is ageing; population growth is slowing and household sizes are decreasing while the number of households is increasing. These and other socio-demographic characteristics such as education levels, degree of home ownership, language spoken at home, income levels and family status all influence the ability of people to be involved and actively take part in natural resources management.

Figure 3: The Adelaide and Mount Lofty Ranges region

Aboriginal Nations in the region

The AMLR NRM region intersects the traditional lands of the following Traditional Owner groups:

- Kaurna
- Ngadjuri
- Ngarrindjeri
- Peramangk.

The AMLR NRM Board acknowledges and respects their Traditional Ownership, and their rights, interests and obligations to speak and care for their traditional lands in accordance with their customary laws, customs, beliefs and traditions. The board also acknowledges the perspective of Traditional Owners that the land, waters and all living things are connected, are part of a cultural landscape formed during the creation, and have been continually managed by Traditional Owners since time immemorial.

The Regional Plan seeks to enable partnerships between Traditional Owners, other Aboriginal people living in the region, and the board (and other stakeholders) based upon mutual respect and trust. Traditional Owners seek these partnerships to support cooperative approaches to the protection and maintenance of culture, cultural sites and the natural resources of the lands and waters through the involvement of all Aboriginal people.

The board acknowledges Australian Government reforms focusing on supporting the economic development and employment of Aboriginal people, and Traditional Owner and other Aboriginal people's interests in gaining economic benefits as part of the implementation of the Regional Plan. The board also acknowledges Aboriginal people's interests in being involved in natural resources planning and implementation processes.

The board acknowledges there are differences between Traditional Owner groups and other Aboriginal peoples in the region, and their preferred approaches to engaging in natural resources management.

The board acknowledges that the majority of the region aligns with the traditional lands of the Kaurna Nation and seeks to engage the Kaurna people through the Kaurna Nation Cultural Heritage Association.

Ngarrindjeri, represented by the Ngarrindjeri Regional Authority, have entered into the whole-of-government Kungun Ngarrindjeri Yunnan Agreement (listen to Ngarrindjeri speaking) with the South Australian Government. The authority's preferred engagement with the government is through the Kungun Ngarrindjeri Yunnan Agreement Taskforce meetings and the establishment of working groups with its partners, including the AMLR NRM Board, to implement partnership opportunities.

The region will work in accordance with the South Australian *Aboriginal Heritage Act 1988* and work with the Nation Groups to advance their strategic directions in relation to their heritage links with natural values. The Aboriginal Heritage Act covers all areas of South Australia and provides for the protection for Aboriginal remains, and Aboriginal sites and objects of significance to Aboriginal archaeology, anthropology, history and tradition. Any projects with on-ground works can potentially impact on Aboriginal Heritage.

Regional conceptual models

A suite of high level regional conceptual models has been developed to document our understanding of key dynamics in the region. The models focus on identifying potential states that can occur, key threats and drivers that may be shifting systems from one state to another, and the management actions that can shift a system in the opposite direction.

The models are intended to broadly address both biophysical and socio-economic factors in an integrated manner. However, at this stage, the models are either primarily biophysically or primarily socially based. Over time, as more information becomes available, these models will further integrate biophysical and socio-economic factors, and will be scaled down to be more locally relevant at a subregional scale.

The primarily biophysical models focus on the 'health' of a system. They should be considered in association with the socially based conceptual models and the subregional systems to get a full picture of the key dynamics of the AMLR region. The three models with a primarily biophysical focus are:

- terrestrial landscape health
- marine health
- aquatic health.

People are an integral part of the environment, particularly in the AMLR region, which has a significant population for the geographic area. Most land in the region is in private ownership and to achieve natural resources management outcomes it is critical to work with the people of the region. The four socially based conceptual models developed describe the dynamics between people and natural resources management. These models are intended to work together and should not be considered in isolation. They should also be considered along with the biophysical conceptual models and the subregional systems to get a full picture of the key dynamics in the AMLR region. The four socially based models, and their focus, are:

- **community support for natural resources management** – all people in the region, whether or not they manage land
- **building capacity of natural resources managers** – land managers in the region, regardless of whether or not they are commercial properties
- **sustainable primary production** – primary producers in the region, that is, land managers who derive an income and run a primary production business from their property
- **adapting to a changing climate** – adaptation needs for a changing climate.

Terrestrial landscape health

The terrestrial landscapes of the region support a diverse range of uses that underpin environmental health, economic productivity and social wellbeing in the region. The value of services provided by the soils, flora and fauna are incalculable – they generate oxygen and remove carbon dioxide from the atmosphere, filter water for drinking, recycle nutrients, maintain habitat, provide recreational spaces and support tourism. Maintaining and protecting strong, healthy, functioning landscapes are fundamental to social and economic wellbeing (Adelaide and Mount Lofty Ranges NRM Board 2008).

The region is unique, with woodland and forest landscapes flanking the Mount Lofty Ranges, ocean to the south and west, and more arid habitats to the north and east. Figure 4 identifies the remaining vegetation communities in the region. The Mount Lofty Ranges are a nationally recognised biodiversity 'hotspot' and support a very high diversity of native species and vegetation communities. The region hosts a diverse mosaic of landscapes containing a number of species of state, national and global significance. The region is particularly significant for orchids, with numerous species unique to the area. It is also home to many relict fauna and flora species which usually occur in the temperate forests and alpine areas in Victoria, New South Wales and Tasmania. The Mount Lofty Ranges, with their topographic variability, also support the most western occurrence of Messmate Stringybark in Australia (Department for Environment and Heritage 2010). The region is projected to be a very important biodiversity refuge under climate change scenarios.

Four ecological communities in the region are listed as threatened under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Fleurieu Swamps, Grey Box grassy woodland, Peppermint Box grassy woodland, Irongrass grassland (Wilson and Bignall 2009)). Approximately 19% of the native plant species of the region have a conservation rating (EPBC Act or South Australian *National Parks and Wildlife Act 1972*) meaning they are threatened or in decline.

The region has a very diverse bird fauna and supports over half of all bird species in South Australia (Department for Environment and Heritage 2010). It also has a significant number of declining bird species, with the Mount Lofty Ranges recognised as a hotspot for declining woodland birds. The region has one of the highest concentrations of threatened bird species on mainland Australia (Department for Environment and Heritage 2010); 104 species have a conservation status (EPBC or NPW Act listing). A significant number of declining bird species in the region are at the very western end of their range, with losses from the region often equating to a significant range contraction to eastern and south eastern Australia.

Approximately 13% of pre-European settlement native vegetation cover remains in the region, of which approximately 22% is protected under dedicated conservation tenures. Historic land use changes have caused hydrological impacts such as reduced water availability, which in turn has impacted on some of the broad vegetation groups that require higher rainfall (e.g. Red Gums both in creek lines and on flats) and reduced the area suitable for these vegetation groups (Adelaide and Mount Lofty Ranges NRM Board 2008).

The coastal ecosystems in the region range from samphire flats and mangrove forests in the north through broad sandy beaches and dunes in the metropolitan area to cliff top and sandy beach communities in the south. These diverse ecosystems give enormous value to our society. The mangrove/samphire flat system in the north is economically important as it is suitable habitat for breeding of a number of commercial fish and crustacean species. The samphire flats are also the final destination for a number of migratory birds which travel annually from Siberia to escape the northern winter. The sandy beaches of the coast not only make a popular recreational landscape they are also a valuable protection barrier from coastal inundation and damage of private homes and public infrastructure. The steep cliff system in the south has magnificent viewscapes and provides important habitat for rare and endangered species including the Yellow-tailed Black-cockatoo. Each of these ecosystems is under increasing pressure from the high number of diverse recreational users, pest plant and animal invasion, recreational and commercial developments, and changing climatic conditions.

Biodiversity in the region continues to decline and faces substantial challenges and continual pressure as metropolitan Adelaide grows. Action is required if this decline is to be halted. Key regional issues include the fragmentation and degradation of native vegetation and landscapes, inappropriate fire regimes, unsustainable land management and resource use.

The control and management of invasive species in the AMLR region is pivotal. The use of appropriate weed control techniques particularly along road sides is extremely important for conservation of species in this region: inappropriate weed control can have a greater impact on native species than on the weeds themselves (Wilson and Bignall 2009).

Biosecurity (pest plants, animals and fungi) is still important to protect both biodiversity and primary production in this region, despite the large number of invasive species that have already become established. Invasive species can have larger impacts than just competing with individual species. For example, the root rust fungus *Phytophthora cinnamomi* kills a set of species found in the heathy communities of the AMLR (such as *Banksia* sp. stringybarks and Myrtle Wattle (*Acacia myrtifolia*)) but their loss from this system can have much wider reaching impacts – potentially total collapse of the system (Department for Environment and Heritage 2010).

The conceptual model for terrestrial landscape health (Figure 5) describes the states, transitions and thresholds controlled by the increasing loss and modification of native habitat (Hobbs and Harris 2001; McIntyre and Hobbs 1999). The model incorporates thresholds associated with the loss of ecological connectivity (below ~60% habitat cover) and loss of physical landscape function (below ~10% habitat cover). As landscapes cross a threshold, they undergo a period of transition (which may take decades) as they move from one state to another (Hobbs 1998; Walker and del Moral 2009). Changes in state result in different possible outcomes and associated management needs (Fischer and Lindenmayer 2007).

This model is a generic description of landscape change, outlining broad impact types and implications. As native species occur across a very wide range of spatial of temporal scales (from tens of metres for some insects to hundreds of kilometres for some birds (Wiens et al. 2002), the scale of the 'landscape' varies between species. A range of other issues directly impact on species (such as predation, disease, competition). As a result, species will respond to landscape change on an individual basis, rather than strictly reflecting generic models (although there will be a dramatic loss of native species as landscapes become heavily developed (Lindenmayer and Fischer 2007).

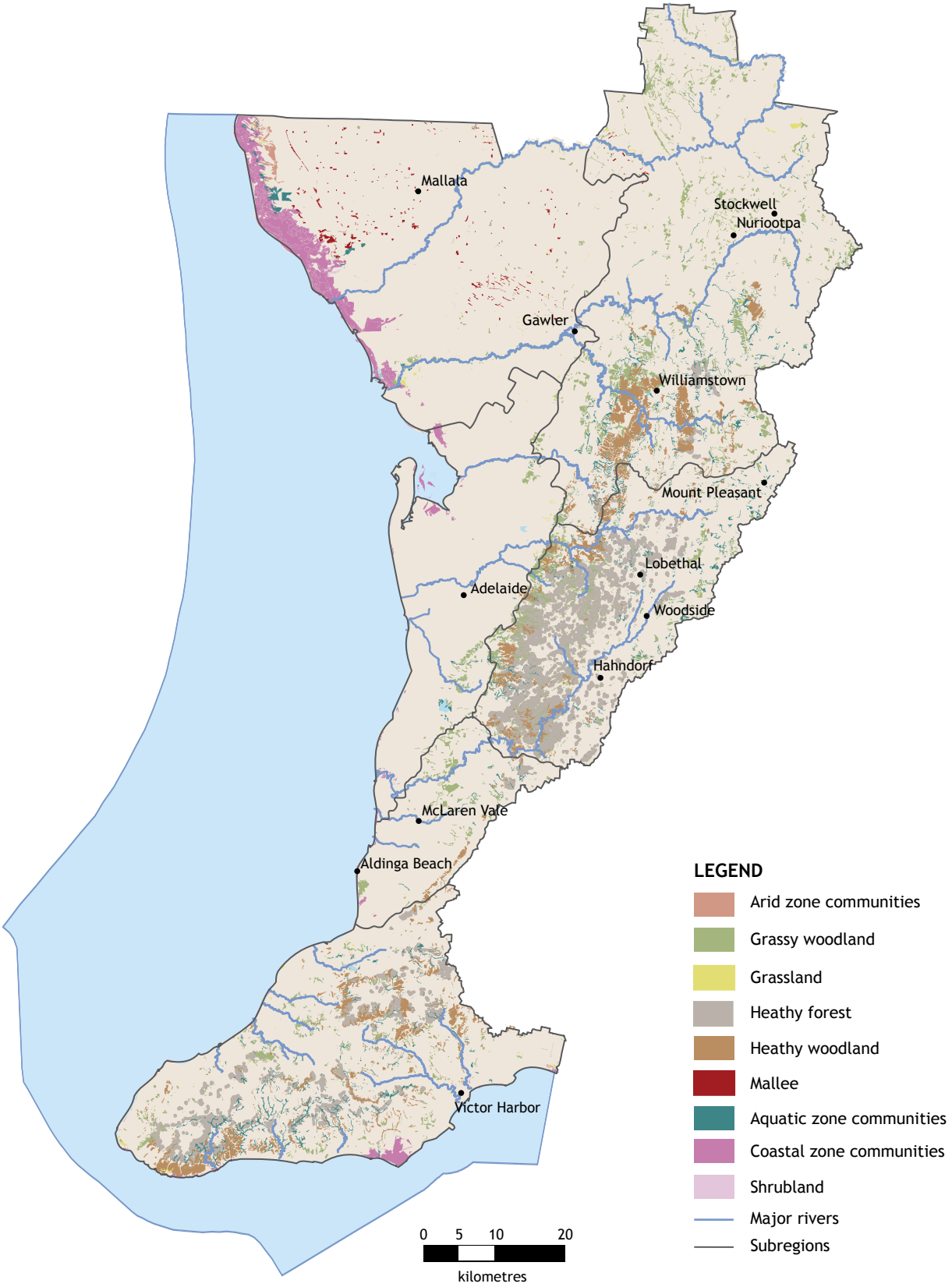


Figure 4: Remaining areas of terrestrial vegetation communities in the AMLR region

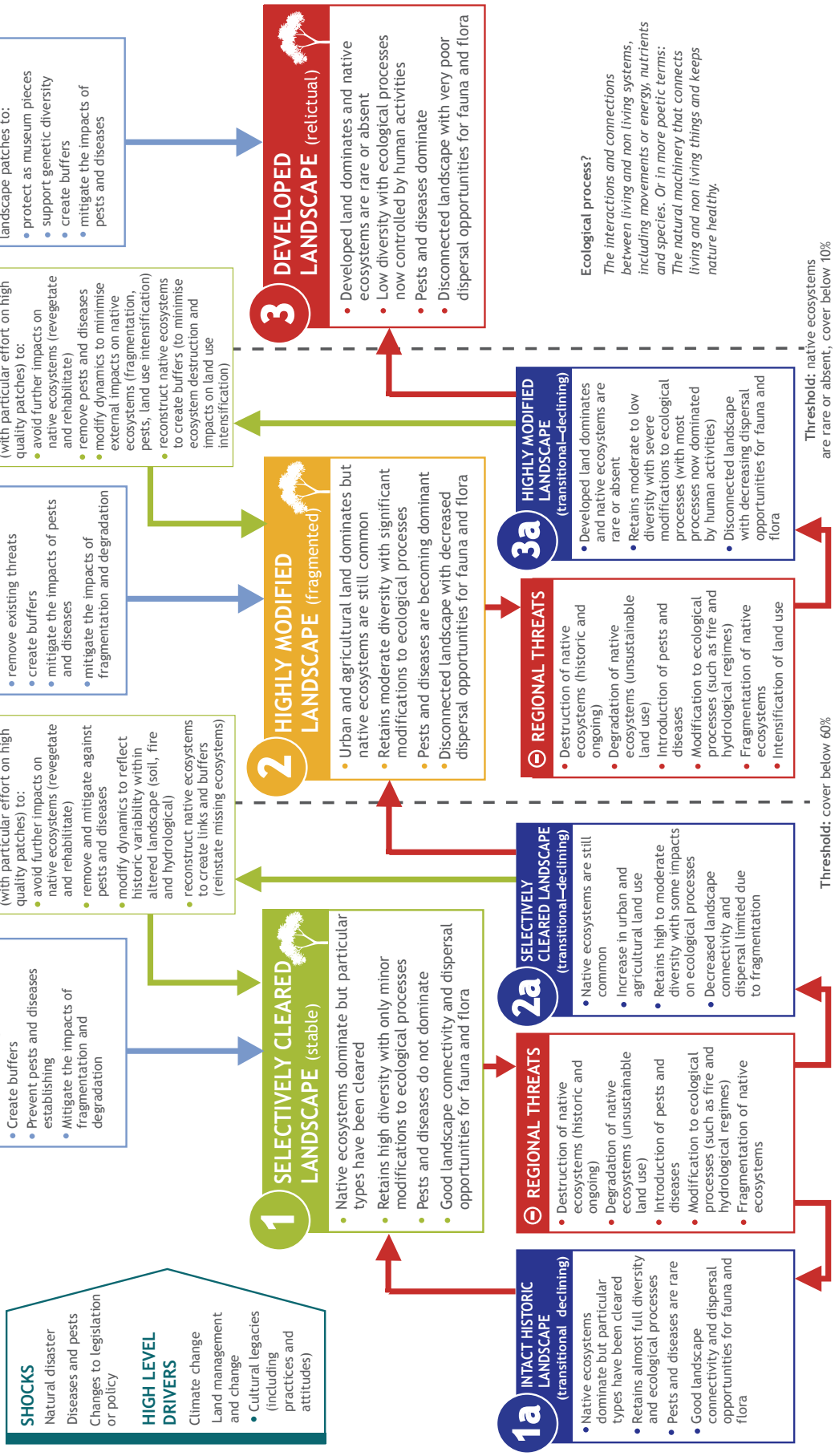


Figure 5: Terrestrial landscape health regional conceptual model

Terrestrial landscape health – A case study: Community action conserving biodiversity in the South Para

The terrestrial landscape health model case study (Figure 6) identifies the different states of natural landscape of the AMLR. Due to the populated nature of the region, areas of highly modified landscapes that are fragmented or transitioning to fragmented are uncommon. Work that focuses on protecting and restoring these landscapes is a priority.

One of the largest areas of intact vegetation in the region occurs in the South Para catchment. The South Para case study details the significant input into protecting and increasing the connectedness of the landscape and halting the decline in habitat in the area. In some areas habitat condition has been reversed and restored by changes in practice (Bentz and Milne 2007). The South Para case study shows how implementing management and maintenance responses from the conceptual model contribute to achieving desired outcomes for terrestrial landscape health.

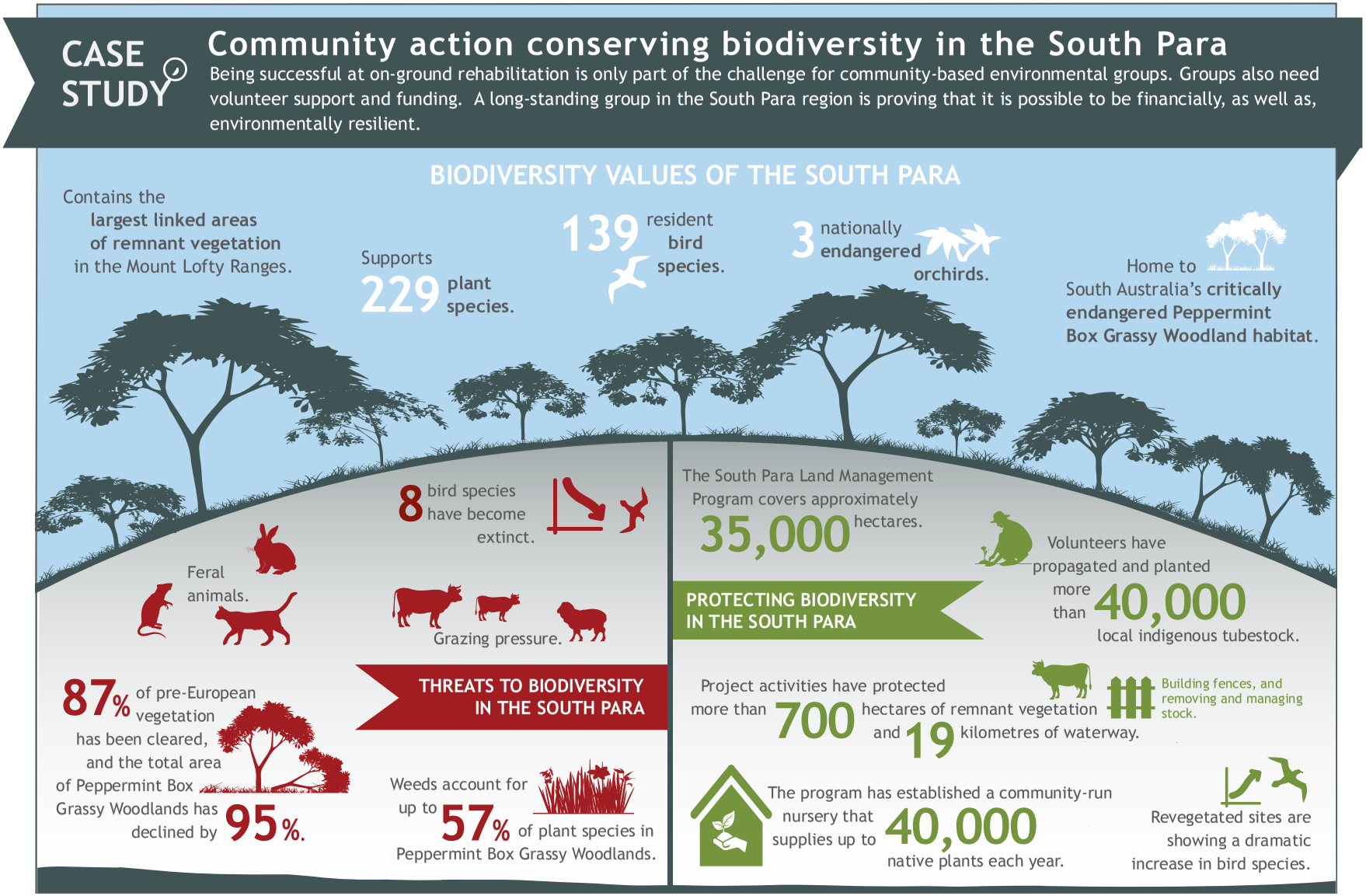


Figure 6: South Para case study - putting the terrestrial landscape health regional conceptual model into local action

Marine health

Marine waters are a significant component of the region, making up approximately 41% of its total area. Most of the region's marine waters are in Gulf St Vincent, with the boundary extending to the south into Backstairs Passage and the more exposed waters of the eastern Fleurieu Peninsula. The marine waters are shared with three other NRM regions, Northern and Yorke, Kangaroo Island and South Australian Murray–Darling Basin, and management of the marine area needs to be considered jointly with these regions. The marine waters of the region are covered in part by the Encounter Marine Park and the Upper Gulf St Vincent Marine Park. Management plans have been developed for both of these marine parks.

Marine biodiversity in Gulf St Vincent is typical of cool temperate biota but with significant levels of species uniqueness or endemism for many algae, fish and marine invertebrates. The gulf (Figure 7) has extensive seagrass meadows, mangroves, and samphire or saltmarsh, as well as significant sandy and soft bottomed habitats and reef areas (Adelaide and Mount Lofty Ranges NRM Board 2008).

Dominant habitats in near shore subtidal waters (<15 m) include seagrass, rocky reefs and unvegetated soft sediment (Edyvane 1999a).

The seagrass meadows along the metropolitan coast are mostly *Posidonia* and *Amphibolis* communities. The mixed *Posidonia* and *Amphibolis* communities of the past are now being dominated by *Posidonia*. Outside the metropolitan areas, coastal seagrass meadows appear to be relatively healthy with continuous and extensive dense seagrass still in Encounter Bay. Recent mapping of the southern Fleurieu found eight species of seagrass (Adelaide and Mount Lofty Ranges NRM 2008).

The region's subtidal temperate reefs are dominated by large seaweeds or macroalgae and invertebrates such as sponges, bryozoans, ascidians, hydroids, echinoderms, molluscs and crustaceans. Structure and species composition is related to wave action and other physical influences. Below the brown algal canopy are a number of understoreys, comprising smaller green, brown or red algae. The species composition of these understoreys appears to be variable at different sites (Adelaide and Mount Lofty Ranges NRM Board 2008).

In addition to its intrinsic value, a healthy marine aquatic environment supports a substantial commercial and recreational fishing industry, nursery habitat for resident and migratory species, protection against storms, sediment trapping and stabilisation, beach protection and the tourism industry. Marine aquatic health has been assessed (Gaylard et al. 2013) based on the habitat status of:

- seagrass cover and condition
- reef condition.

Near-shore waters are exposed to a range of external pressures which can adversely affect their condition. These wide and varied pressures include short-term pulsed inputs such as stormwater, through to constant discharges such as those from sewage treatment plants. The impacts on marine aquatic health can be temporary and localised or can be permanent and wide ranging. The major impact of stormwater is long term as it is a source of elevated nutrients (into a naturally low nutrient system), contaminants and erosion sediments. Both near-shore and off-shore habitats can also be impacted by a range of marine based activities such as dredging (Gaylard et al. 2013).

Studies have shown that for South Australian marine waters even small increases in nutrient concentrations can have disproportionate degenerative effects. These include increasing epiphyte loading on seagrass, potentially leading to seagrass loss, and shifting from canopy macroalgal reef systems to turf dominated reef systems. When habitats shift to less productive, less diverse systems

they are generally seen as being in poor condition. A system in poor condition can lead to not only loss of ecological value but economic losses as well. Consistent with the findings of other similar large-scale studies, the Adelaide Coastal Waters Study (Fox et al. 2007) identified modification and degradation of Adelaide's coastal marine environment as a result of many years of near-continuous inputs of nutrient rich, turbid and coloured water and wastewater. All the evidence points to the key role of nitrogen loads causing nutrient enrichment of coastal waters, growth of epiphytes, and (perhaps) direct effects on the seagrasses. There is no evidence from the study to show that toxicants or other nutrients play a key role in the ecosystem dynamics (Fox et al. 2007).

The Adelaide Coastal Waters Study generated a unique historical record of nitrogen (and other pollutant) loads to coastal waters, coupled with a long series of observations of seagrass cover in Adelaide coastal waters. Analysis of this historical loading trend (coupled with the realisation of long time lags in this system between loading increases and seagrass losses) shows that seagrass losses were widespread after the loads increased to about half the present levels.

Sediment movement inshore of the seagrass beds is presently sufficient to prevent regrowth of seagrasses. *Amphibolis* has been shown to recruit to patches of sacking and other rough materials anchored to the bottom (Wear 2006) – a possible technique to support future recovery if conditions are conducive to recruitment and subsequent growth. Recovery is expected to be slow. In other parts of the world it has taken up to 20 years for seagrasses to regrow once suitable conditions were re-established, and for both *Posidonia* and *Amphibolis*-dominated systems, this timeframe may exceed 100 years. Large-scale recovery of seagrass meadows should not be expected unless dramatic and lasting reductions in coastal inputs are made. Even then, sediment instability and nutrient recycling may inhibit progress (Fox et al. 2007).

The marine health regional conceptual model (Figure 8) identifies the indicators of various states of the marine environment based on monitoring multiple lines of evidence. The model combines historical knowledge and monitoring results to identify key pressures and appropriate management responses to maintain or improve marine system health. While the model is particularly technical in its content at this stage, ongoing work with stakeholders in the marine environment will aim to build improved social and economic indicators to add to the descriptions of the state of marine health and to the threats and management response information.

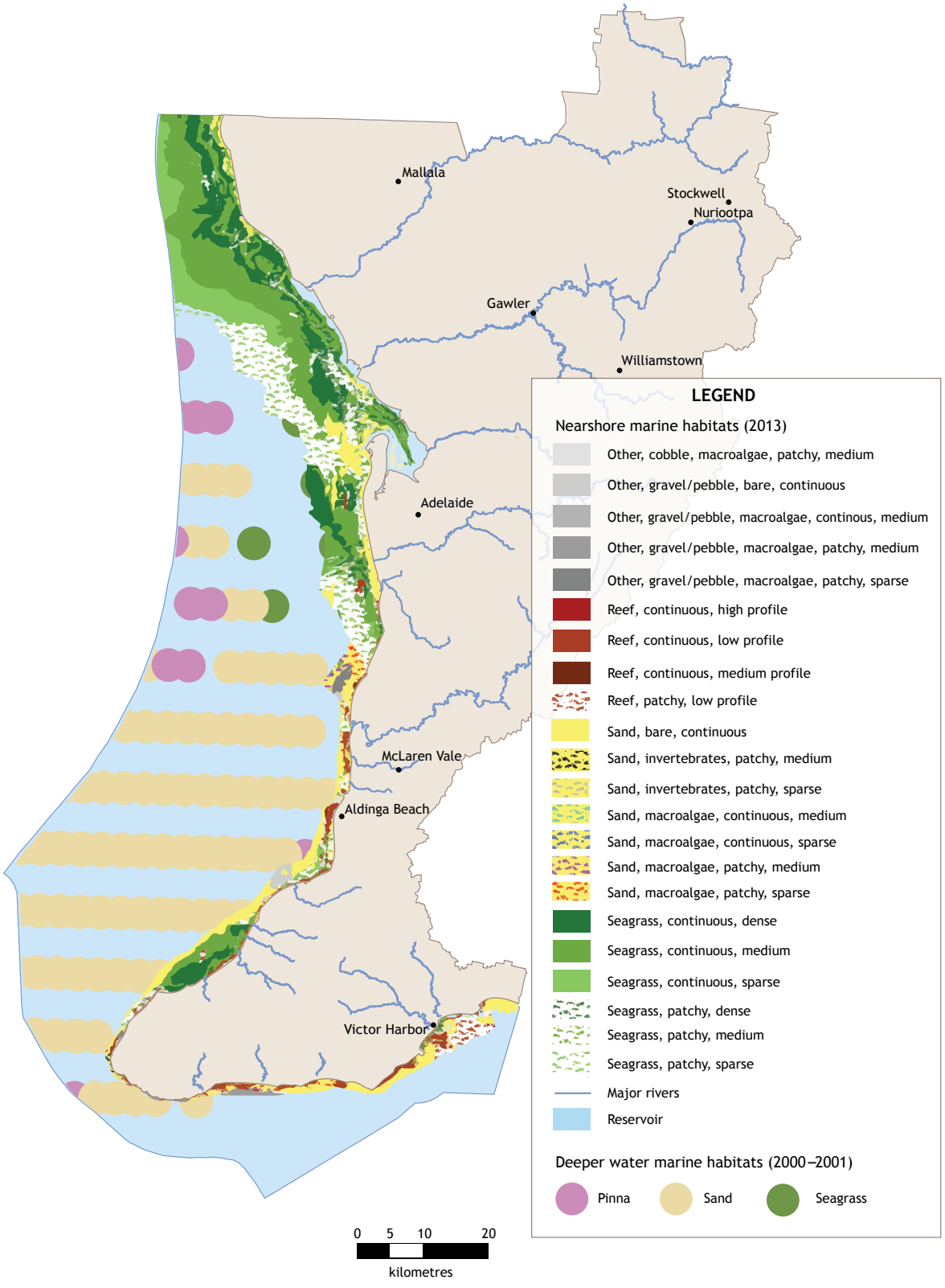


Figure 7: Marine habitats of the Adelaide and Mount Lofty Ranges region

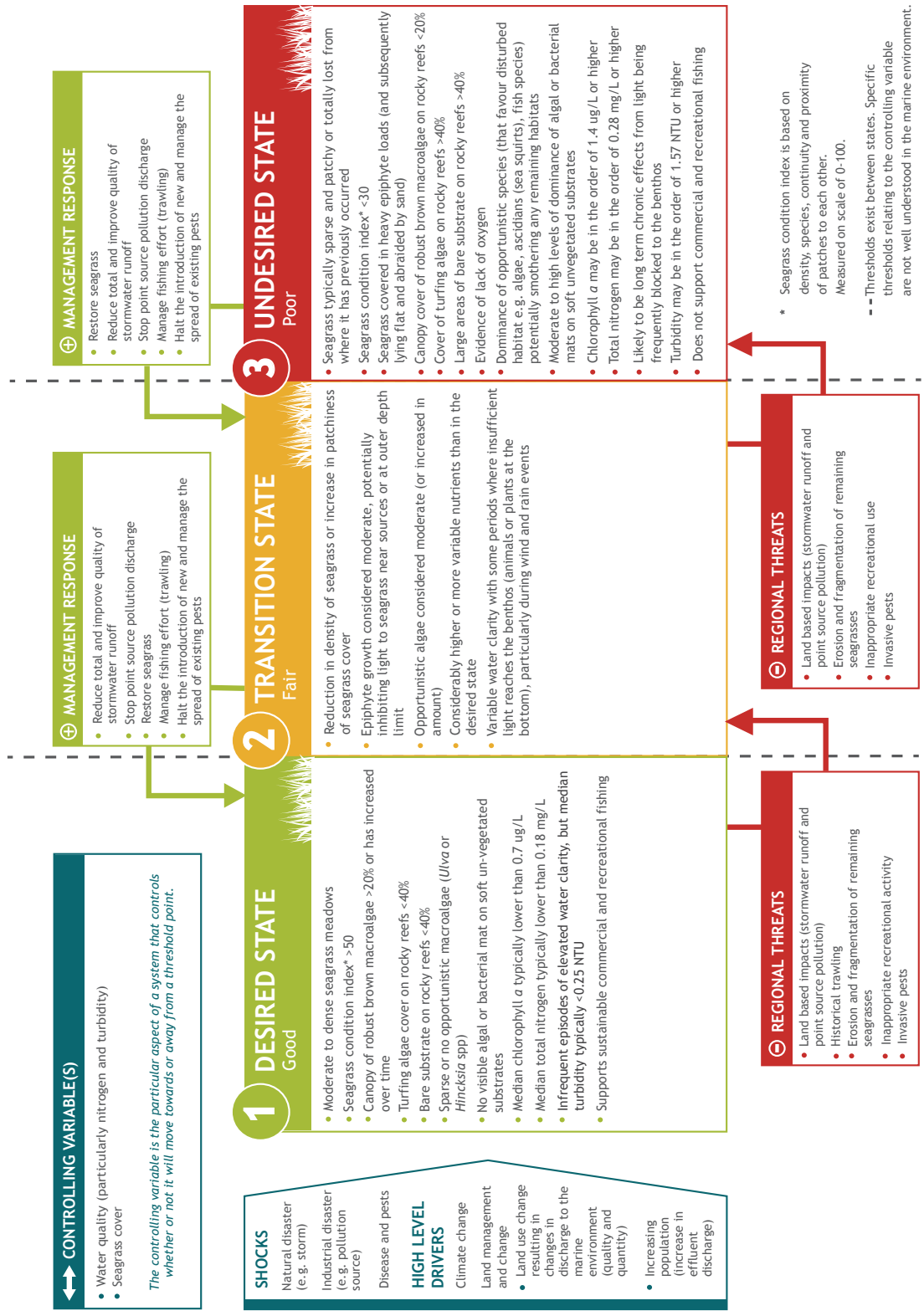


Figure 8: Marine health regional conceptual model

Marine health – A case study: Protecting South Australia's valuable seagrass communities

Seagrass communities are only one component of the marine ecosystem but their extent and condition contributes to assessing the health of marine systems.

The marine health case study (Figure 9) identifies the value of seagrass to the environment and to the community including economic impacts of seagrass loss and economic value of its presence. Seagrass condition varies across the AMLR depending on the site; it is a strong example of a component of the marine health system in poor and good states in different parts of the region (see also Chapter 4, Figure 53: State and transition model of seagrass condition for Gulf St Vincent waters).

Metropolitan Adelaide seagrass bears the results of many years of impacts from the urban environment (Westphalen et al. 2004), in sharp comparison to the good condition of seagrass on the Fleurieu Peninsula (Tanner et al. 2012). The causes of seagrass loss along the metropolitan coast are well known and this knowledge should be used to ensure the same impacts do not occur along the Fleurieu Peninsula.

Management actions for protecting the Fleurieu and encouraging recovery of seagrass beds along the metropolitan coast are well documented and identified (Fox et al. 2007).

Photo: Alison Eaton

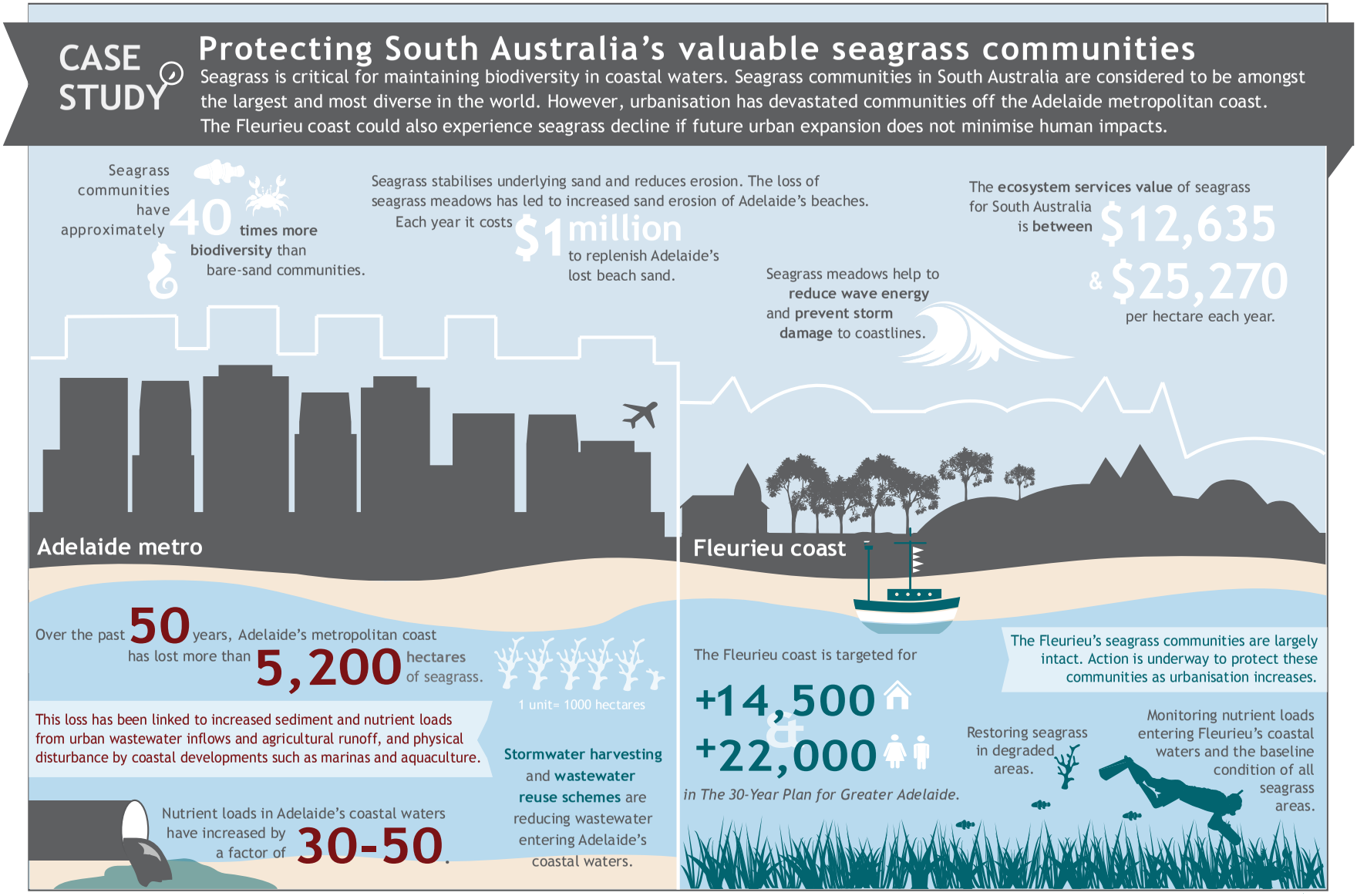


Figure 9: Seagrass protection - putting the marine health regional conceptual model into action

Aquatic health

The inland waters of the AMLR region include surface water (rivers and streams) and wetlands. The major catchments in the region include the Light and Gawler rivers (including the North and South Para) in the north, the Torrens and Onkaparinga rivers in the centre, and a number of smaller catchments on the Fleurieu peninsula, the largest being the Hindmarsh and Inman rivers.

Benefits from aquatic systems are many and varied but they can broadly be thought of in two groups: consumptive benefits and non-consumptive (or intrinsic) benefits.

Consumptive benefits occur when water is taken from an aquatic system and used for production purposes. This often generates private benefits, for example, extracting water for irrigated agriculture with private benefits arising from commercial farming. The wide range of consumptive users of water resources in the region includes agriculture (irrigation and stock watering), industry and public water supply.

Non-consumptive benefits arise without extracting water from the system. They can include protection from floods, reduction of pest species, links to cultural heritage, and opportunities for recreation and tourism. Non-consumptive benefits are often of a public nature – they contribute to societal wellbeing and are obtained free of any direct monetary charge (Plant et al. 2012).

For these reasons, as well as maintaining the intrinsic value of aquatic ecosystems, it is important to better understand the dynamics of maintaining aquatic health.

Aquatic health (Figure 10, 11 and 12) indicates how well surface water and groundwater systems are functioning and interacting, and how well catchments are functioning. The health of groundwater-dependent ecosystems is particularly influenced by the use of, and recharge to, groundwater systems. The aquatic health of streams in the AMLR region is shown in Figure 12.

A wide range of indicators (Figure 10) need to be considered when determining the health of any aquatic habitat (Goonan et al. 2012), such as:

- macroinvertebrates – generally assessed in terms of both diversity and abundance (number), easy to sample and identify, and respond predictably to changes in their environment
- water quality parameters (e.g. nitrogen, phosphorus, oxygen)
- vegetation, including the amount and type of both in-stream and riparian vegetation
- surface water levels and flows (hydrology)
- groundwater levels and movement (hydrogeology).

Many factors can influence the health of an aquatic ecosystem, for example:

- water regime (including volume and timing of water availability) – influenced by the flow of surface water resources and interactions of surface and groundwater resources
- water quality – influenced by runoff and activities in the catchment.

The extraction and use of surface water resources (rivers) can clearly impact on the health of an aquatic ecosystem; the use of groundwater can also impact on aquatic health in a surface water resource, because of interactions between surface and groundwater resources. The nature and degree of connection between groundwater and surface water (Figure 11) can vary significantly and manifest as:

- gaining water from inflow of groundwater through the streambed
- losing water to groundwater by outflow through the streambed
- gaining in some parts and losing in others, or alternating between gaining and losing depending on changes in relative stream and groundwater levels.

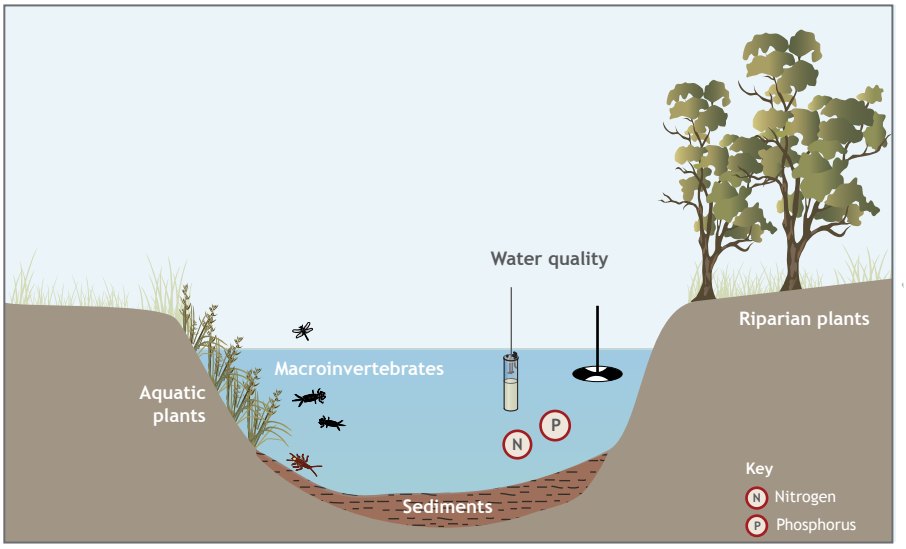


Figure 10: Components of aquatic health (Environmental Protection Authority 2012)

Some streams can be gaining and losing in different parts of their catchment; others can be gaining and losing at different times in the same reach (area) depending on the physical conditions (rainfall, runoff) and the volume of groundwater use from the aquifer.

In areas where there is a strong connection between groundwater and surface water, the effects of groundwater pumping can lead to significant impacts on the connected surface water resource and associated aquatic systems health.

Generally, in the AMLR region, the headwaters (hills area, incised valleys) are gaining streams, and plains watercourses are losing streams. Streams can then become gaining again near the coast where saline groundwater may enter the streams to make them saline streams.

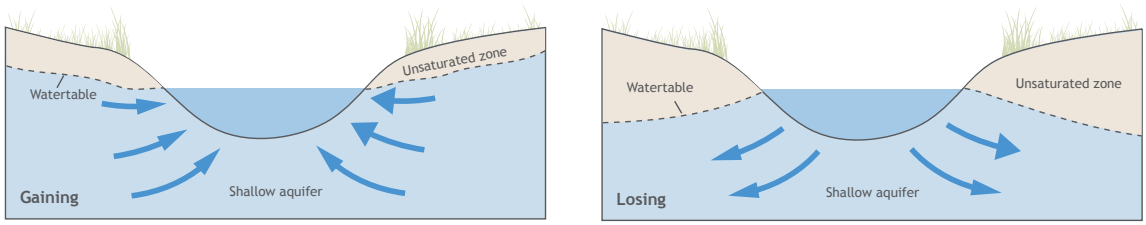
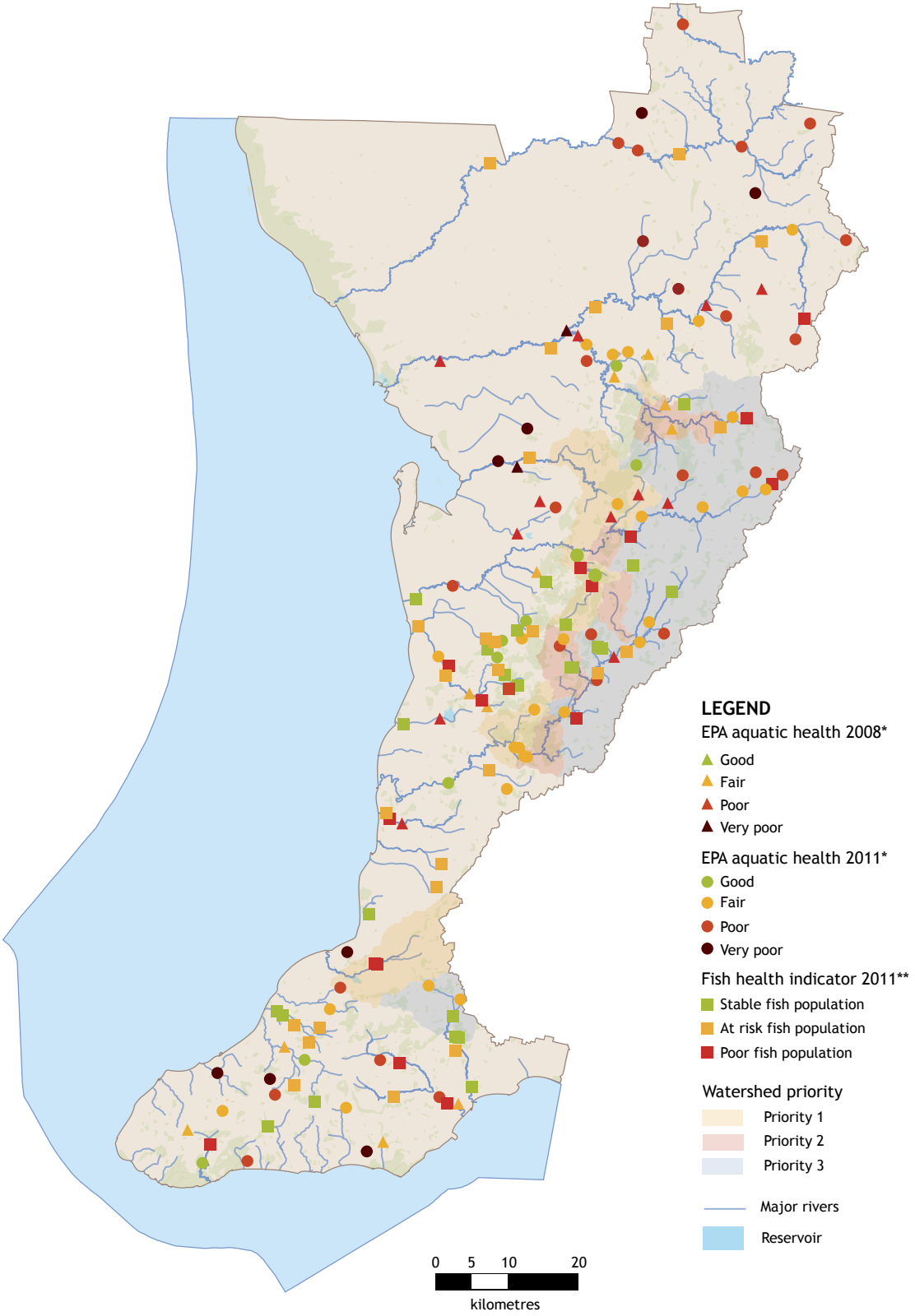


Figure 11: Gaining and losing streams

The regional conceptual model for aquatic health (Figure 13) uses the criteria developed to assess aquatic health to identify desired, transition and undesired states for aquatic systems. Controlling variables that contribute to moving aquatic systems from one state to the next have been identified as have the management actions that can be implemented to move to or maintain an aquatic system in a desired state.

The aquatic health regional conceptual model currently focuses on mainly biophysical descriptions of states; however, over time it is envisaged that social and economic indicators and drivers of aquatic health state will be developed and included into the model to improve the understanding of the socio-ecological system.



* Source: http://www.epa.sa.gov.au/environmental_info/water_quality/aquatic_ecosystem_monitoring_evaluation_and_reporting

** Source: McNeil et al. 2011

Figure 12: Aquatic health condition of streams in the AMLR region, assessed in 2008 and 2011

Figure 13: Aquatic health regional conceptual model

Aquatic health – A case study: Using environmental flows to increase the Onkaparinga River's resilience

Healthy aquatic ecosystems are integral to the maintenance of good natural resources condition. In the region, rivers also often form part of the system to collect and distribute water for human consumption. This has resulted in significant modification of aquatic systems and their consequent poor health.

The Mount Bold reservoir is part of the Onkaparinga River aquatic system and is an important source of water for human consumption. However, the reduced flow in the Onkaparinga River had significant environmental impacts including on the health of the Onkaparinga estuary (Cook and Coleman 2010).

Implementing environmental flows (a management response in the aquatic health model) in the Onkaparinga River, and monitoring the response of the system to those flows has shown improvements in the condition of the aquatic ecosystem to the point that it is now fair to good (Coleman 2013). Ongoing work is required to ensure that the system can be maintained in a good state while still retaining its ability to deliver the required water for human consumption.

This case study is a good example of how the environment, economic and social needs of a system need to be balanced to achieve the desired outcome (Figure 14).

Onkaparinga River - before and after environmental flow release

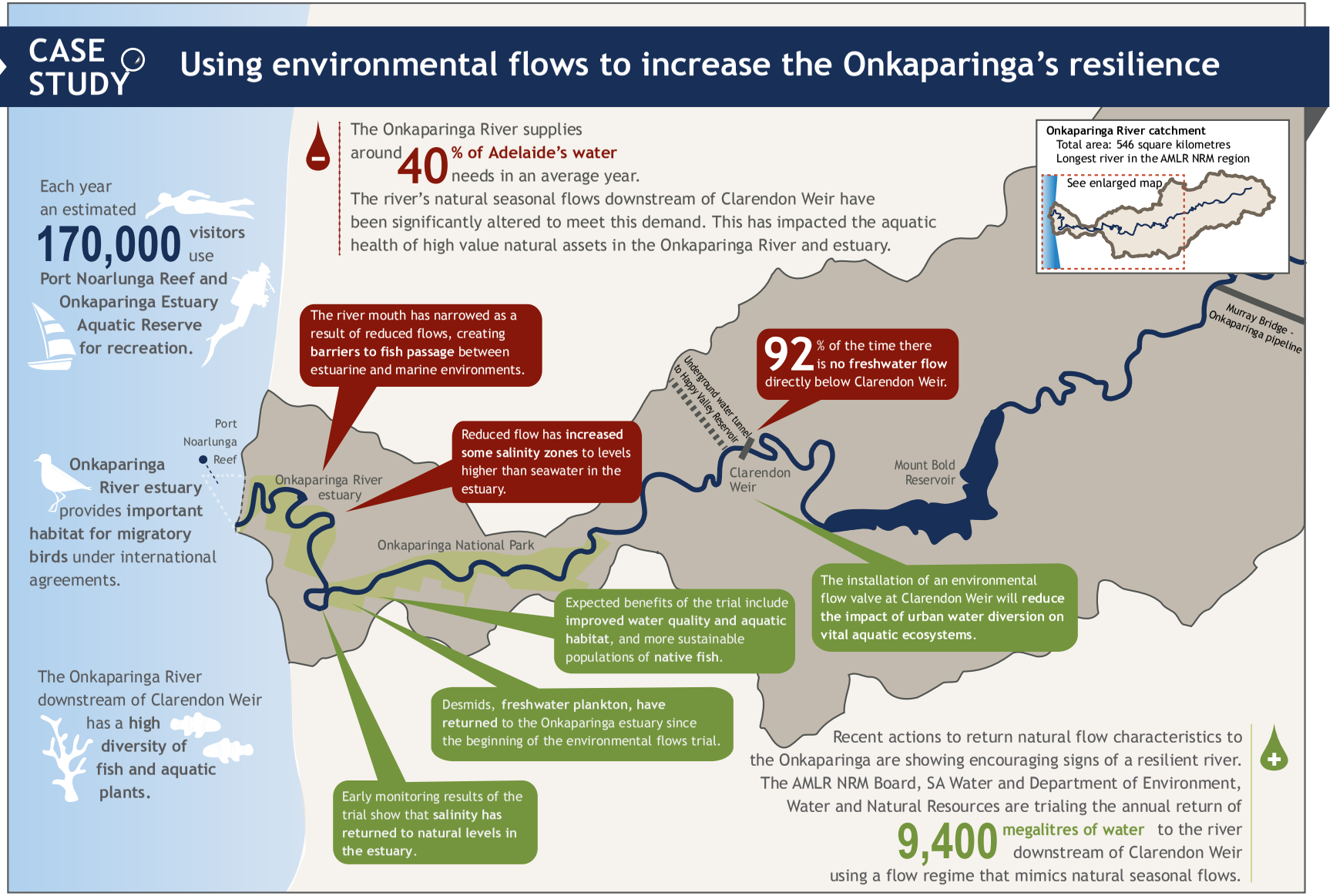


Figure 14: Environmental flows in the Onkaparinga River - putting the aquatic health regional conceptual model into action

Community support for natural resources management

The AMLR region is characterised by the significant urban population based in metropolitan Adelaide (1.1 million (Australian Bureau of Statistics 2011)) and surrounding townships.

This population contributes to NRM through physical action on ground and by advocating to policy makers and the broader community about the value of natural resources. The community also contributes financial resources through the NRM levy.

Government and the board have a significant role in recognising the value of a community that is actively engaged and participating in managing natural resources and actively seeking to work in partnership with them (Department of Agriculture, Forestry and Fisheries 2011). They also have a critical role in removing barriers to community action and involvement, and can help people recognise their relationship with natural resources. Adams et al. (2005) note a strong link between participation in the community and a positive influence on physical wellbeing.

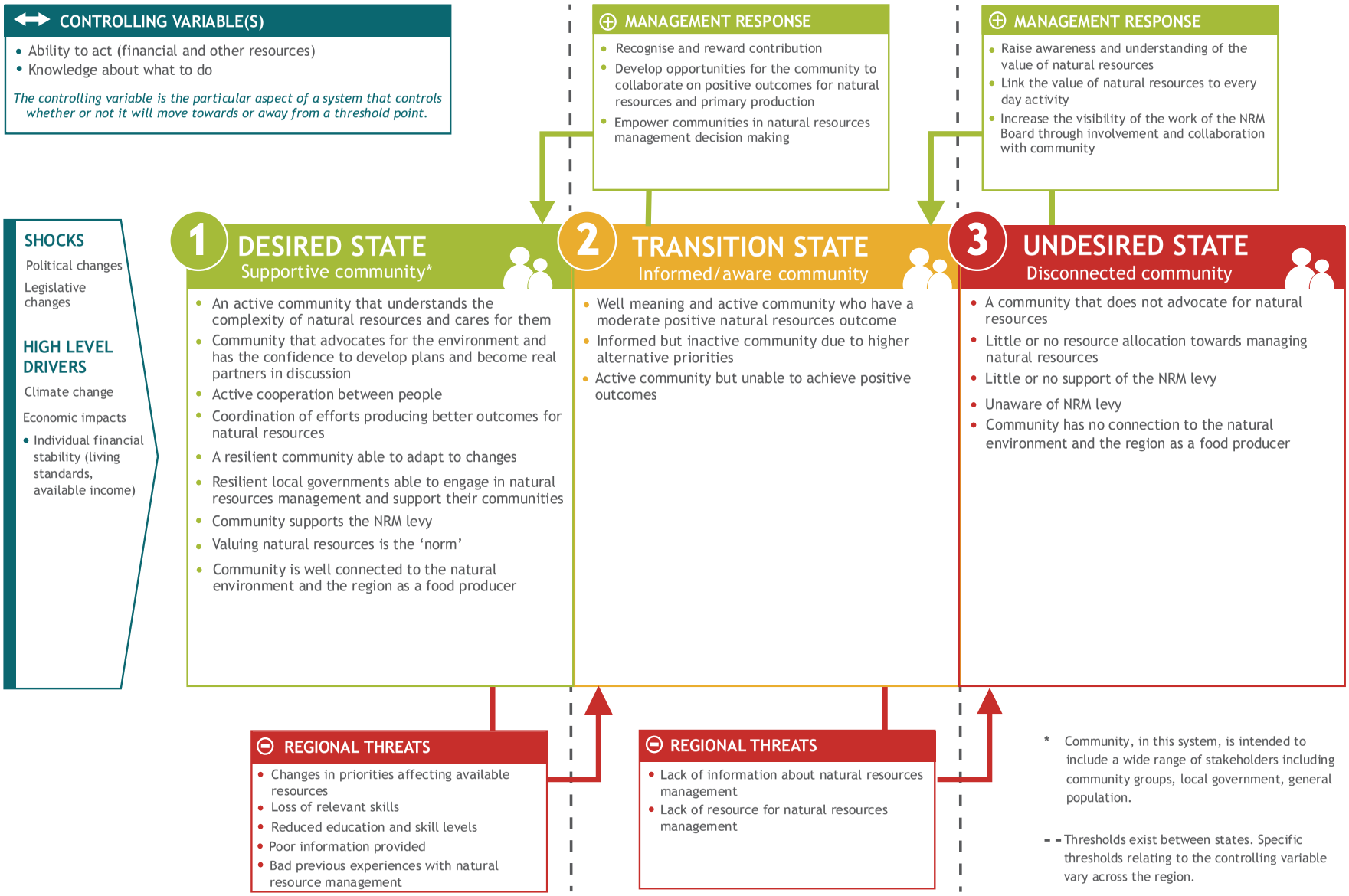
People (the community) have had, and continue to have, impacts on natural resources (Sexton Marketing Group 2007). For example, the size and proximity of the urban population has forced land clearing, an ongoing demand for land for urban development, conflicts between adjoining land uses and impacts on natural resources from recreation use.

The region is important for primary production, and has productive landscapes that integrate agriculture and biodiversity. However, there is often a disconnect between much of the urban community and the growth of food (Hillman and Buckley 2011). Many consider that the urban population should be reconnected with primary production and food growth (Charles and Low 2009; Jordan 2009).

There is significant evidence (see References) that a community engaged with NRM works to modify and reduce its impacts, and support the actions required to truly make significant improvements in the state of the region's natural resources. However, community engagement is not a 'one-size-fits-all' process and individual community groups require specific approaches to maintain and increase engagement (Adams et al. 2005).

The regional conceptual model for community support for NRM (Figure 15) identifies the attributes of the community in various states of NRM awareness and support. This model identifies controlling variables and management actions that support the change of the community from one state to another. It is a qualitatively derived model that identifies social characteristics. Future investigations will work at identifying relevant quantitative measures that could be used to support the indicators of each state in the model.

Figure 15: Community support for natural resources management regional conceptual model



Community support for natural resources management – A case study: Greener schools and healthier kids

Increasing community support for, and knowledge about, natural resources is a complex problem requiring a range of approaches depending on the demographic or group of interest.

One successful program is building support and knowledge for NRM among school communities by developing a 'living sustainably' culture that can be spread beyond the school, to all in the community (Figure 16). School children can discuss and discover a range of ways to implement sustainable living outcomes, which all link to using and protecting natural resources.

Schools build sustainable living education activities into the whole curriculum so that it becomes a way of life rather than a subject studied at school. The program supports teachers in developing curriculum and provides training and development opportunities.

These school children will become the NRM supporters of the future as well as in the present. It is more likely that they will choose NRM careers or become natural resources volunteers. Increased knowledge and participation leads to a more resilient community.

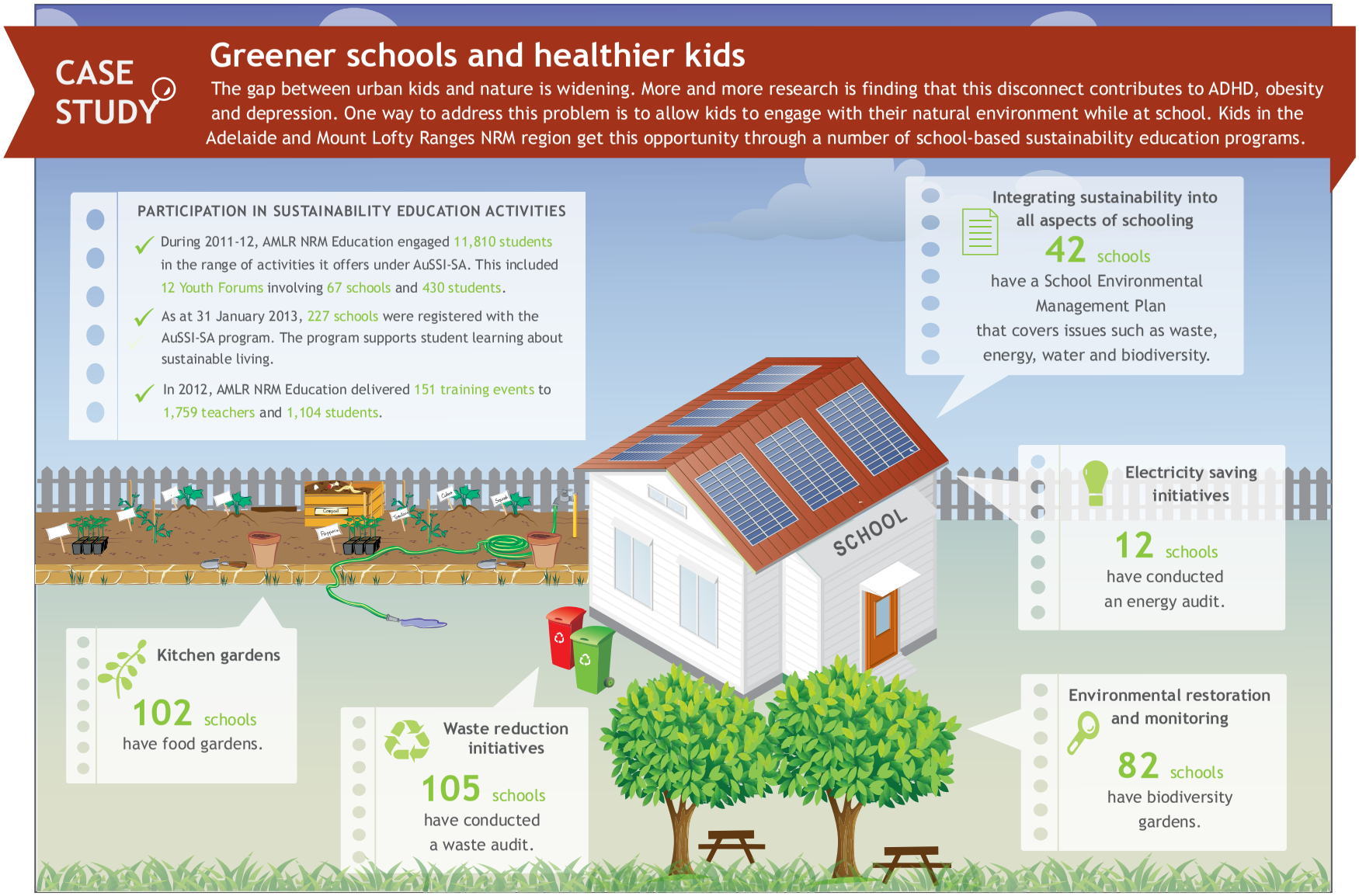


Figure 16: Greener schools and healthier kids - putting the community support for natural resources management regional model into action

Building capacity of natural resources managers

The capacity to achieve sustainable NRM can be built by a range of activities. Capacity in this context includes awareness, skills, knowledge, motivation, commitment and confidence (Department of Agriculture, Forestry and Fisheries 2011).

Natural resources management problems are complex and occur on a broad spatial and temporal scale. They often involve difficult tradeoffs between alternative land uses (and users). People need the capacity to respond to new challenges as they arise, and be able to be proactive in their response to change.

Adaptive capacity describes the capacity of people to deal with change and disturbance, and reflects learning through knowledge sharing. Communities that are able to enhance their adaptive capacity can deal with conflicts, make difficult tradeoffs between short and long term wellbeing, and implement rules for ecosystem management. This in turn improves the capacity of the ecosystem to continue to provide services (Fabricius et al. 2007).

To obtain on-ground improvement in the environment, those who live and work directly with it have a major role to play along with government and industry. Investment in people as well as on-ground works is needed to achieve long-term environmental outcomes (Department of Agriculture, Forestry and Fisheries 2011).

The National Natural Resource Management Capacity Building Framework (Department of Agriculture, Forestry and Fisheries 2011) identifies four key conceptual areas of importance to capacity building:

- **Awareness** – individuals in the community become conscious of regional NRM issues and understand the link between them and the long-term viability of their community.
- **Knowledge and information** – natural resources managers and users are able and willing to access the necessary information, data and science (biophysical, social and economic) to make sound NRM decisions.
- **Skills and training** – natural resources managers and users are equipped with, or have access to, the necessary technical, people management, project management and planning skills to participate in the development and implementation of sustainable NRM at property, local and regional scales.
- **Facilitation and support** – support systems are in place to ensure the engagement and motivation of the community, build social capital, and enable skilled natural resources managers and users to exercise ownership over regional NRM decision-making processes and effectively implement actions arising from these processes.

Capacity building is not just a focus on transferring technical information and capability to land managers; it also looks at building human and social capital — the capability of individuals and the social networks and relationships they develop.

The majority of land in the region is held in private ownership. Therefore, the capacity of people to manage their natural resources is critical for meaningful NRM outcomes.

The diverse property types in the region can broadly be considered to be properties where the major source of income is derived:

- on farm (economically productive or commercial properties)
- off farm/property (rural lifestyle).

This split is not marked; in reality there is likely to be a continuum for landholder reliance on off-farm income. Many factors influence how much any given property may rely on off-farm income, and it may vary from year to year. The ability of landholders to manage the natural resources of their property may depend on the type of landholder they are, that is, where they derive their income from (Moon and Cocklin 2011).

This regional conceptual model (Figure 17) is intended to apply to all land managers regardless of whether they manage commercial properties or not.

Building capacity of natural resource managers – A case study: Small landholders helping each other learn

All land managers in the AMLR region have responsibilities for maintaining the natural resources of the region. This case study (Figure 18) focuses on a sector of the community often referred to as lifestyle or 'hobby' farmers. They make up a significant proportion of the land manager population in the Central Hills and Fleurieu subregions, and that proportion is rising. Identifying the characteristics of this sector, which makes them different from more commercial land managers, is critical to identifying the best ways to support them and build their NRM capacity (Moon and Cocklin 2011).

Key for this group is building their understanding of land management impacts on the whole environment. Improving their stock management practices, knowledge of soil issues and understanding of how improvements to land management lead to improved natural resources, is a goal for this sector.

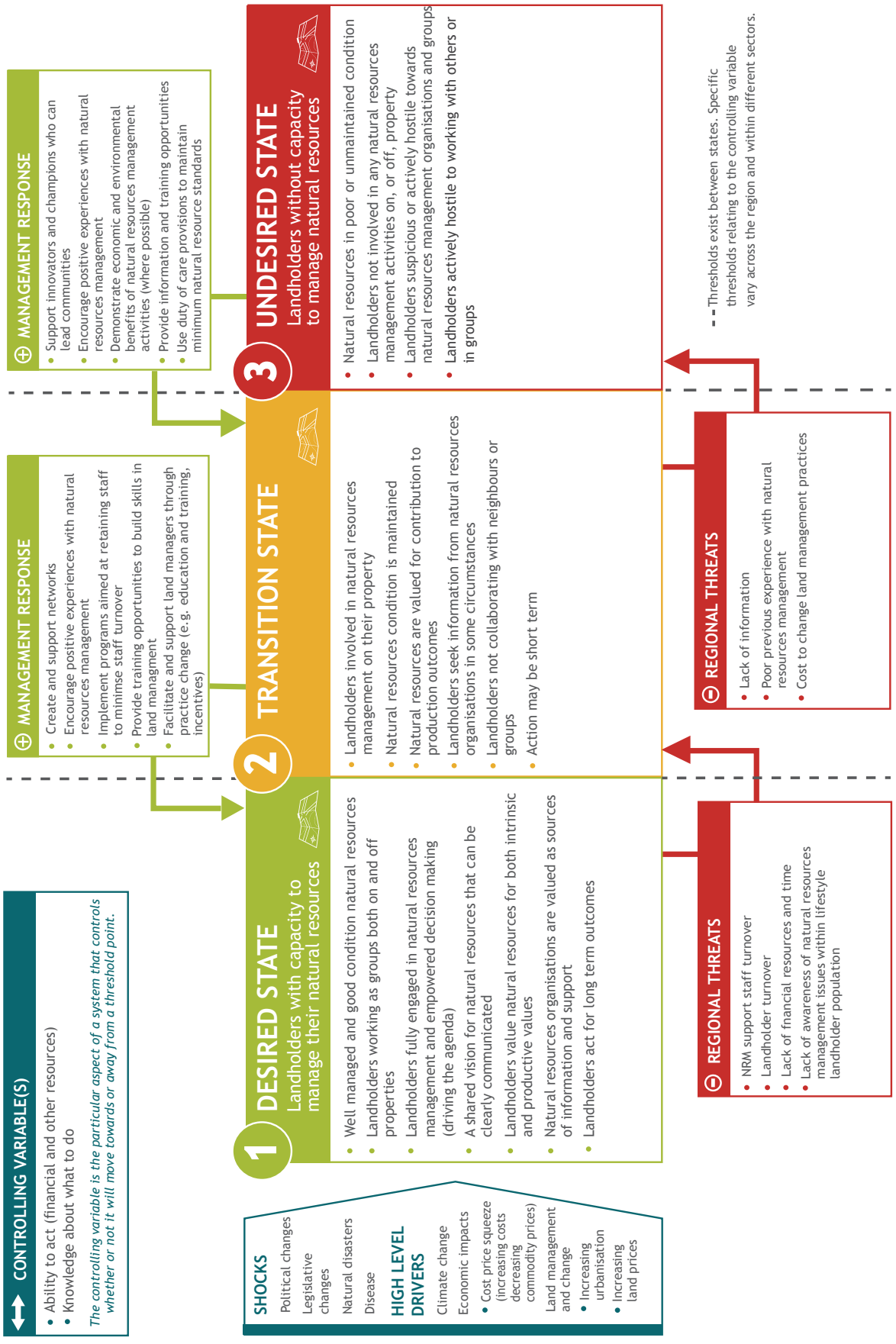


Figure 17: Building capacity of natural resources managers regional conceptual model

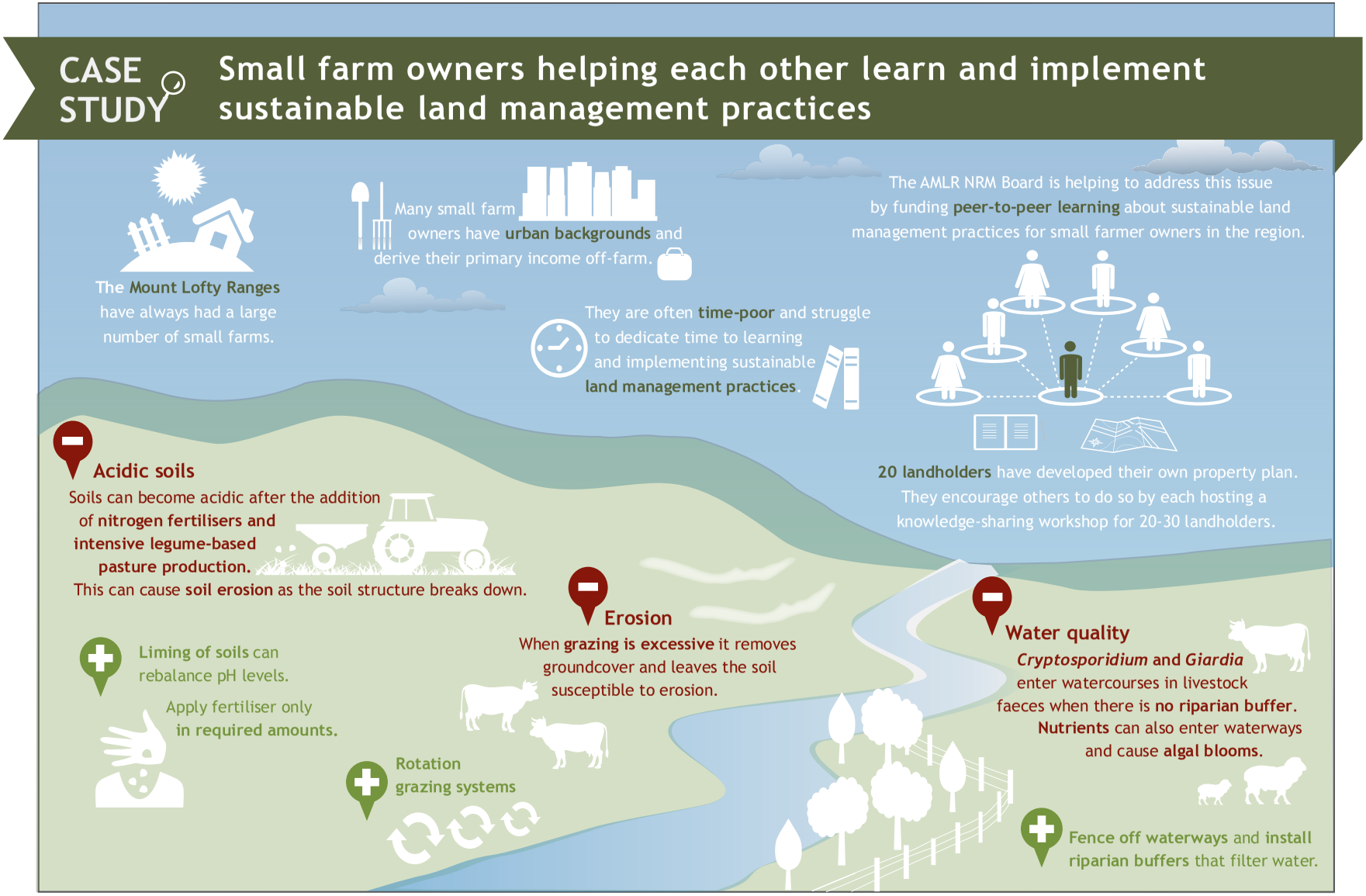


Figure 18: Small landholders helping each other learn - putting the building capacity of natural resources managers regional conceptual model into practice

Sustainable primary production

The objects of the *Natural Resources Management Act 2004* promote ecologically sustainable development by, among other things:

- recognising and protecting the intrinsic value of natural resources
- providing for the protection and management of catchments, and the sustainable use of land and water resources
- supporting sustainable primary production systems.

The region supports a diverse range of land uses and primary industries (Table 6), in particular cropping (cereal), perennial and annual horticulture, viticulture, forestry, grazing and dairy (Figure 19). Pressures on sustainable and profitable primary production have seen supporting industries and value-adding industries becoming increasingly important to the sector.

Some of the major NRM issues in the region are:

- land degradation and soil fertility management
- pest and weed control
- watercourse management
- remnant vegetation management.

Natural resources underpin productivity. It is critical that the natural resources base is protected to maintain and increase the primary production (and food production) sector in the region. Undesirable consequences of some agricultural activities include erosion, salinity, and loss of soil structure; these can limit farm productivity. There are also off-site impacts of farm practices such as herbicide or nutrient discharge into watercourses (Kokic et al. 2006). The links between environmental degradation and farm productivity in many instances are not clear; however, sustainable primary production relies in part on the natural resources base that supports it, and in turn profitable primary production businesses are able to invest in good NRM.

Social and economic influences can often be more immediately critical to maintaining profitable primary production businesses, and are therefore often given a higher priority, as they impact on day to day business. This focus has the potential to lead to poor NRM outcomes with consequences for individual properties and the wider landscape.

It is therefore critical to understand the links between profitable and sustainable primary production. The natural resources of the region must be improved to better support a sector that has significant ability to influence NRM outcomes for the region. This regional conceptual model (Figure 20) identifies attributes of sustainable and profitable primary production and the controlling variables that move sustainable primary production industries from one state to the another. The model includes mainly qualitative information on the attributes of each state and those controlling variables. Identifying and collecting further information for specific industries and areas of primary production will add value to the information in this regional conceptual model.

Table 6: Agricultural statistics for the Adelaide and Mount Lofty Ranges region

	AMLR region	% of state total	Number of businesses in the AMLR*	AMLR total production (t)	% of state production
Hay and silage (ha)	18,776		600	94,822	8.6%
Wheat (ha)	26,449		183	94,516	1.6%
Oats (ha)	772		32	1,918	1.5%
Barley (ha)	13,307		150	43,093	34.6%
Triticale (ha)	565		23	1,669	1.9%
All other cereals (ha)	2,299		15	4,402	4.1%
Canola (ha)	5,035		56	9,617	2.7%
Chickpeas (ha)	325		5	440	3.1%
Field beans (ha)	4,440		60	10,739	6.7%
Field peas for grain (ha)	6,357		85	12,287	6.3%
Nurseries, cut flowers or cultivated turf (ha)	384	39.4%	136		
Vegetables (ha)	2,347	16.4%	403	118,916	12.7%
Fruit and nut trees (trees under 6 yrs) (number of trees)	448,500	24.5%	134		
Fruit and nut trees (trees over 6 yrs) (number of trees))	1,407,312	21.9%			
Grapevines for wine production (area not yet bearing) (ha)	1,273	42.0%	210		
Grapevines for wine production (area of bearing age) (ha)	21,798	29.7%	1,159	168,002	21.7%
Dairy cattle (number)	25,823	18.1%	114		
Meat cattle (number)	65,049	5.9%	804		
Sheep (number)	298,952	2.7%	583		
Pigs (number)	84,736	22.7%	36		
Horses (stud and other) (number)	2,753	28.9%	325		

*Note: number of business totals includes business that produce multiple products, therefore totals could include businesses counted multiple times.

Source: Australian Bureau of Statistics (2012a,b,c)

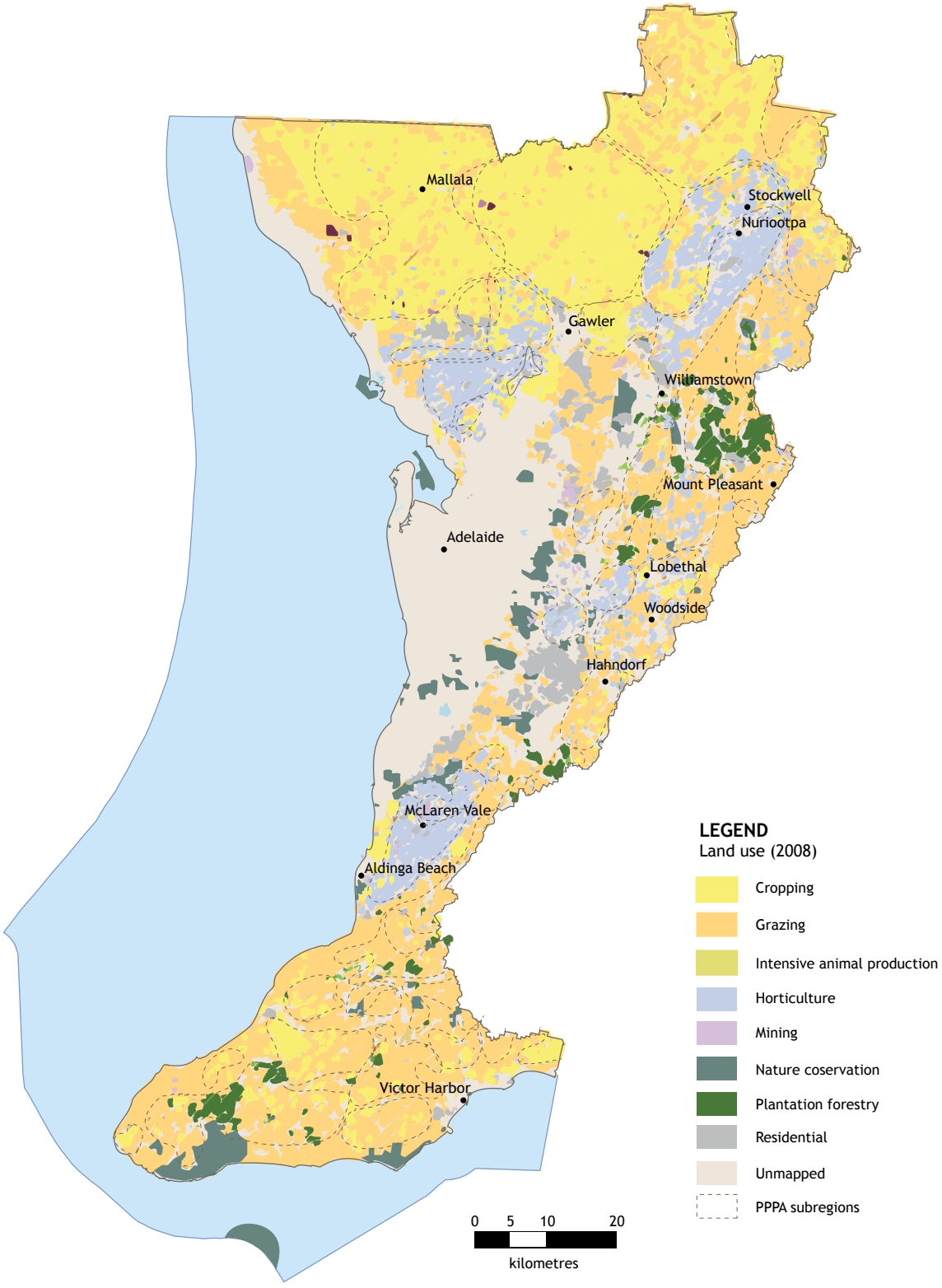
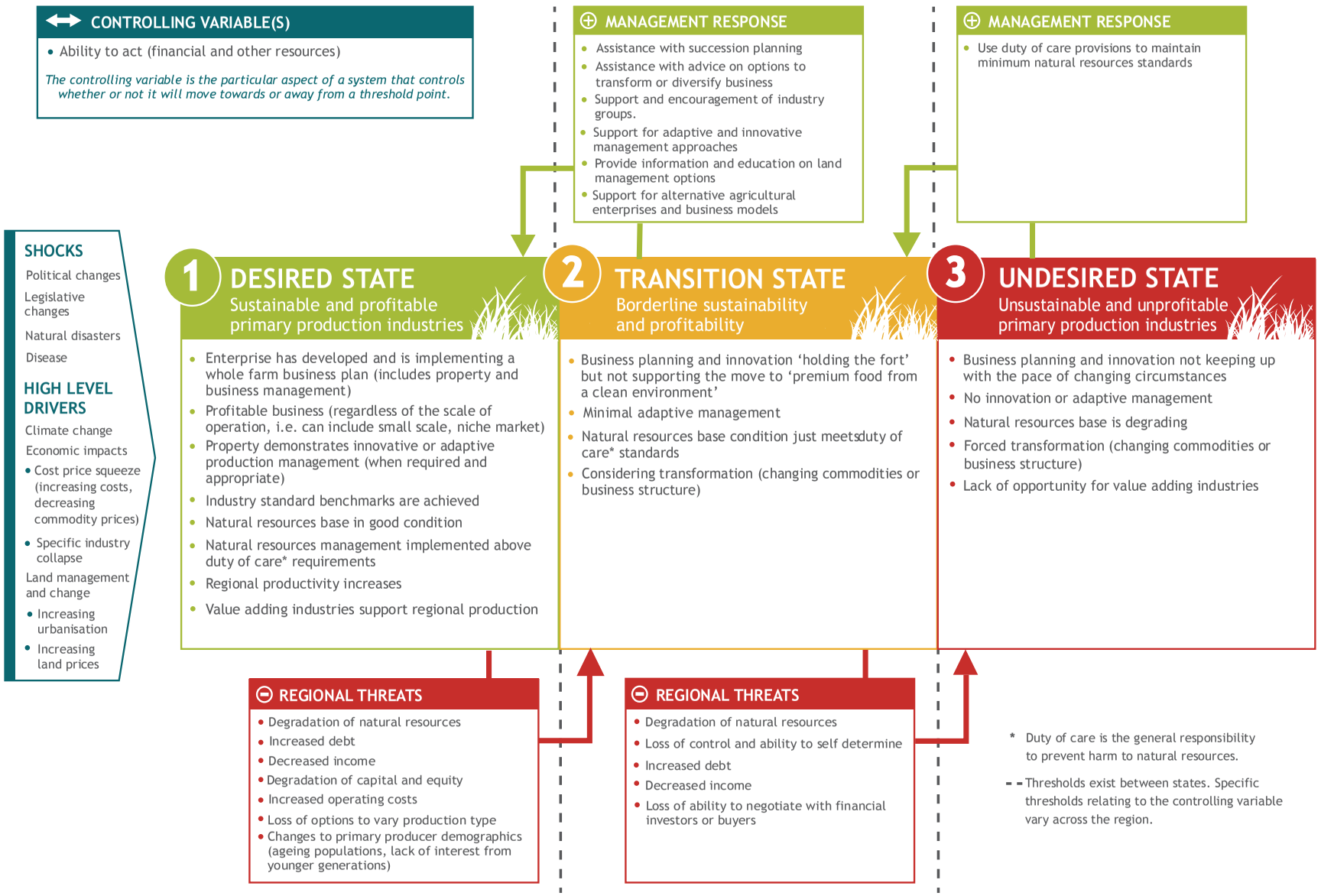


Figure 19: Primary production in the Adelaide and Mount Lofty Ranges

Figure 20: Sustainable primary production regional conceptual model



Sustainable primary production – A case study: Increasing farm resilience through sustainable land management

Agriculture is a significant contributor to the state's economy (PIRSA 2012) and the sustainability of individual farm businesses and industries as a whole is improved with good NRM. Sustainable primary production is supported by an understanding of the links between financial viability and sustainable management of resources, and the pressures outside an individual's sphere of influence (Fiebig and Sherriff 2011).

This case study focused on identifying good resource management practices that contribute positively to the economic viability of farm businesses in the Barossa Valley (Figure 21).

The project received seed funding from the board; its purpose was to change management practices to improve not only the condition of natural resources but also farm profitability.

The project identified aspects of land management that impacted negatively on business performance and NRM condition, and then identified management responses to address those threats. It is trialing new and innovative practices and communicating the results throughout the community.

The management responses implemented so far have improved natural resources condition and had positive impacts on farm profitability.

Figure 21: Sustainable farm management in the Barossa Valley - putting the sustainable primary production regional conceptual model into practice

CASE STUDY Increasing farm resilience through sustainable land management

Agricultural production in the AMLR NRM region during 2009-10 totalled $788 million. This represented 17% of South Australia's total agricultural production.

The Barossa contributed $231 million towards this total.

Livestock was the highest contributor at 39% followed by winegrapes at 37%.

A group of Barossa farmers is implementing best practice grazing systems, as they recognise some existing land management practices limit their profitability and sustainability. The group is trialling different pasture systems and rotational grazing, which is improving the productivity and health of groundcover.

The AMLR NRM Board provided the group's initial funding grant. The group chose to employ a Project Coordinator to organise the pasture trials and secure extra funding.

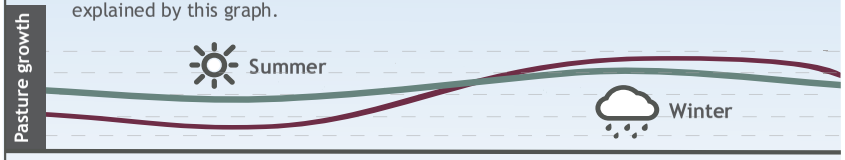
The Project Coordinator helped the group attract additional Commonwealth Government funding, enabling the trials to be expanded to consider soil health issues. This example shows how a small amount of financial support to groups can result in significant improvements in sustainable farming practices as well as small farm business profitability.

Examples of land management issues that affect farm sustainability

Acidic soils cause economic and land management impacts in the Barossa. In the AMLR region, a minimum application of **32,000 tonnes of lime per year** is required to overcome the annual acidification rate.

Bare soil leads to erosion, compaction and loss of nutrients.

Pastures dominated by annual species can **pose an erosion risk** because the ground becomes bare in dry summer months, as explained by this graph.



Annual pasture (e.g. annual rye, brassicas, annual medics) cannot survive dry summer conditions. Once they stop growing and are grazed down, bare ground results and erosion risk increases. With autumn rainfall, dormant seed takes a while to germinate. It takes a long time before the plants are capable of holding the soil together.

Perennial pasture (e.g. perennial rye, cocksfoot, phalaris, fescue, lucerne, clovers) can survive year-round and when grazed down they remain as clumps of roots that continue to hold the soil together. They can spring into life with minimal rainfall and quickly provide good groundcover.

Benefits of rotation grazing and perennial pastures

Improved soil carbon levels, which improves soil health characteristics:

+ water holding capacity
+ nutrient retention
+ soil structural stability.

+ Reduced risk of soil erosion
+ Improved weed supression
+ Reduced need for chemical pesticides

$ Increased yields of quality pasture, reducing the need for supplementary feeding.

$ Increased farm profit via increased carrying capacity and liveweight gain of livestock.

Adapting to a changing climate

In the AMLR region, climate change has the potential to significantly compromise the sustainability of NRM for current and future generations. Natural resources managers already deal well with climate variability but ongoing climate change will bring significant challenges.

The wide range of climate changes predicted for the region are summarised in Table 7.

Table 7: Projected climate change in the Adelaide and Mount Lofty Ranges region by 2030

Greenhouse gas emissions	• Carbon dioxide increase to 420–480 ppm (currently approximately 390 ppm)
Temperature	• Increase in annual range of warming of 0.4–1.2°C • Increase in annual number of hot days over 35°C in Adelaide to 15–20 days (currently 14) • Increase in annual number of hot spells (3–5 days over 35°C) to 2 spells (currently 1 spell) • Increase in the annual number of hot days over 40°C in Adelaide to 2–3 days (currently 1 day)
Rainfall	• Likely decrease in average annual rainfall of 1–10% • Possible increase in extreme rainfall events
Environmental change (changes in climate could lead to important environmental change in the region)	• More intense storm events • Changes in timing of flowering and breeding cycles • More variable breaks in the winter growing season • Sea level rise • Higher coastal storm surges • Increased fire frequency and intensity • More frequent erosive events • Changes in the impact of weeds and animal pests • Reductions in groundwater recharge • Reductions in average stream flows

Source: Bardsley (2006)

The response to climate change can be guided by an assessment of the vulnerability of the system, based on the projected impacts of climate change and capacity to adapt to change. An initial assessment of vulnerability has been made for the AMLR (Bardsley 2006), which can help to focus where significant effort is needed to help develop the adaptive capacity of the region.

Vulnerability can be defined as the extent to which a human society or system is unable to cope with the negative impacts of climate change, variability and extremes. Vulnerability is assessed by two key criteria: potential impact and adaptive capacity.

The potential impacts of climate change come from both:

- exposure – the weather events, weather patterns and background climate conditions that affect the system
- sensitivity – the responsiveness of systems to climatic influences and the degree to which changes in climate might affect them.

A number of NRM sectors are vulnerable to projected climate change (Table 8). This severity rating is not designed to undervalue other NRM issues; rather, the issues mentioned could be considered priority areas for investigation and action in the short term.

Table 8: Summary of vulnerability analyses for natural resources management in the Adelaide and Mount Lofty Ranges

	Sector	Potential impact	Adaptive capacity	Vulnerability
Water	Riparian flood management	medium	limited	medium-high
	Surface water	medium-high	significant	medium
	Groundwater	medium-high	significant	medium
Land	Agriculture: annual crops	medium-high	significant	medium
	Agriculture: horticulture	medium-high	medium	medium-high
	Land management	medium	significant	low-medium
	Parks and gardens	low-medium	significant	low
Biodiversity	Terrestrial biodiversity	medium-high	medium	medium-high
	Freshwater biodiversity	high	limited	high
	Revegetation	medium	significant	medium
	Invasive species	medium	medium	medium
	Bushfire	high	medium	medium-high
Coast	Coastal flooding	high	medium	high
	Beach management	high	medium	medium-high

Source: Bardsley (2006)

The regional conceptual model for adapting to climate change (Figure 22) is considerably different to the other models presented. This is because climate change influences all social-ecological systems. This model identifies a conceptual understanding of the current activities and potential future activities that may be required to support the region (and the state) in adapting to the impacts of climate change now and in the future.

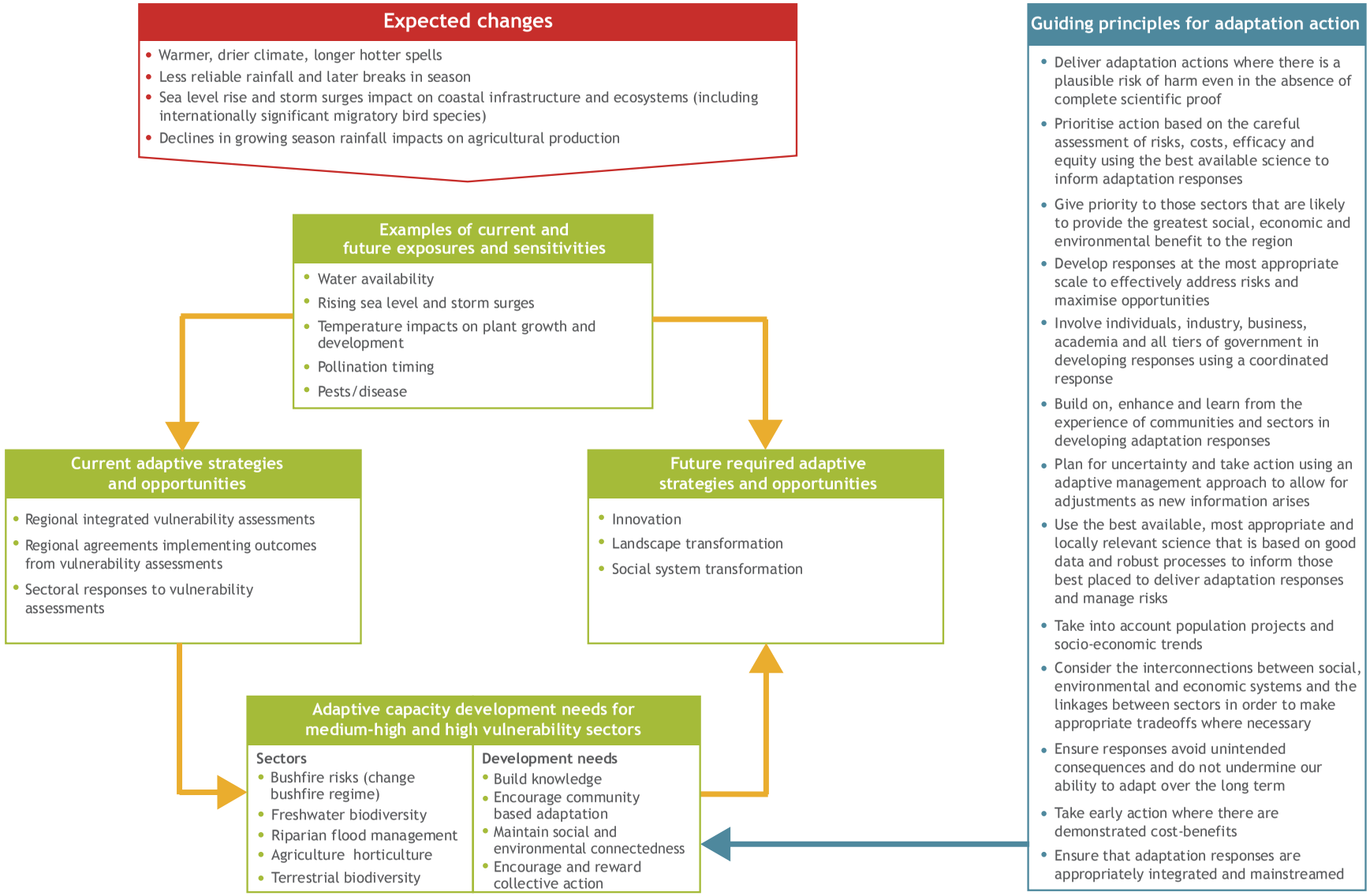
Adapting to a changing climate – A case study: Climate change and the resilience of inter-tidal coastal ecosystems

The potential consequences of climate change to the region are difficult to determine with a high degree of accuracy as current models operate on global scales. However, predictions of potential impacts are still relevant, useful and important when planning natural resources management activities to ensure potential changes in the future are accounted for (Abuodha and Woodroffe 2007).

This case study (Figure 23) identifies one system where the impacts of climate change are reasonably well predicted and the actions required cover, a wide range of partners and stakeholders. It is a good example of managing adaptation to climate change in a complex social and ecological environment.

Sea level rise particularly along the northern coast of the region has the potential to significantly impact on both natural and built habitats. Planning for the future of the area needs to take into account the requirements of both the natural and built environment in the event of the worst case scenario (Gurran et al. 2011). The challenge is working through the conflicts between the land use needs of both to ensure the system as a whole retains its resilience.

Figure 22: Adapting to climate change regional conceptual model



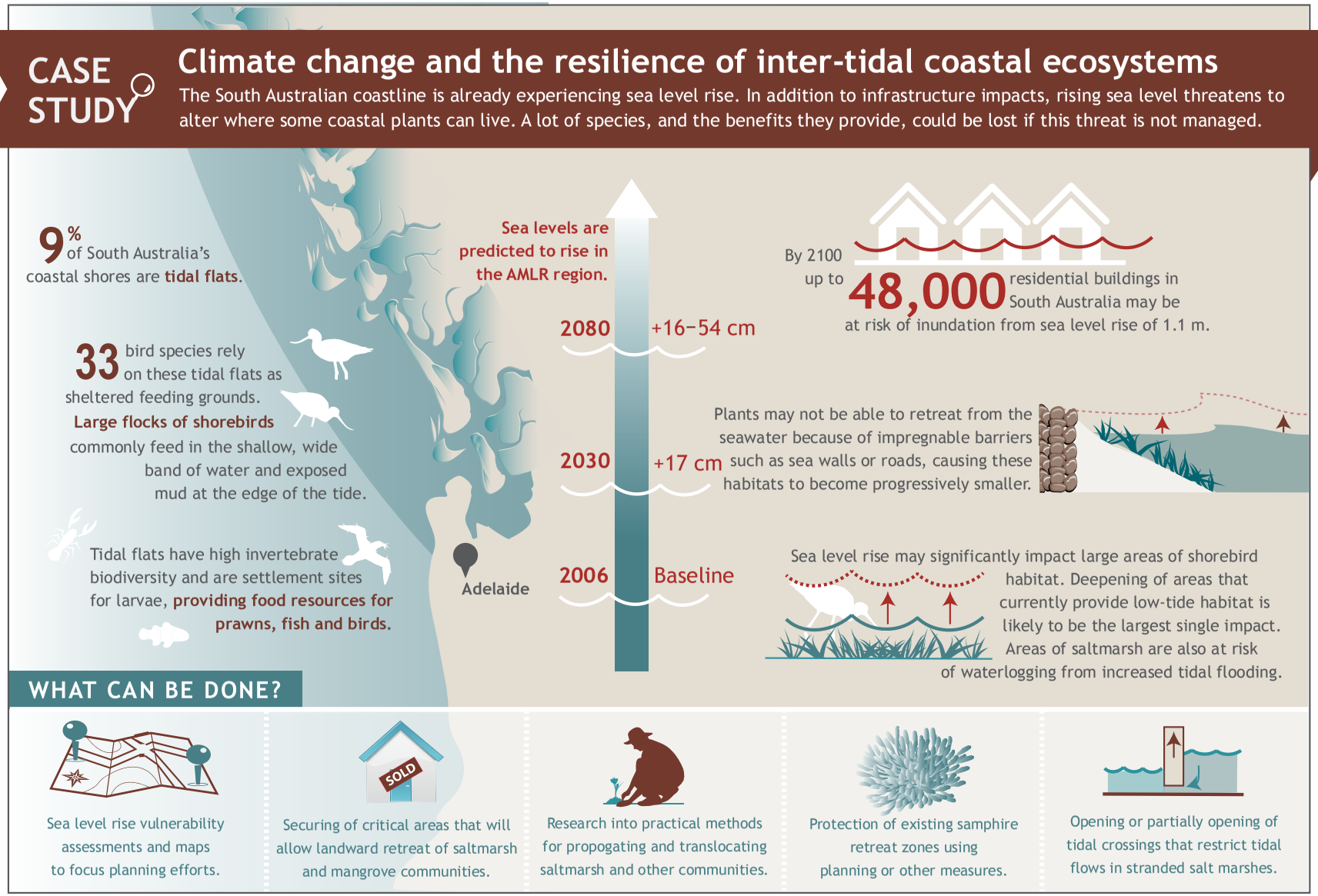


Figure 23: Climate change impacts on the inter-tidal coastal ecosystems - putting the adapting to climate change regional conceptual model into action

Natural resources centres

www.naturalresources.sa.gov.au/adelaidemtloftyranges

Eastwood
205 Greenhill Road
Eastwood SA 5063
(08) 8273 9100

Gawler
8 Adelaide Road
Gawler South SA 5118
(08) 8523 7700

Lobethal
1 Adelaide Lobethal Road
Lobethal SA 5241
(08) 8389 5900

Willunga
5 Aldinga Road
Willunga SA 5172
(08) 8550 3400

Printed on recycled paper