

# Realising Knowledge

Science and Research in the South Australian  
Department for Environment and Heritage

2009



Department  
for Environment  
and Heritage



Government  
of South Australia

# Understanding nature through science



*We are confronting environmental challenges with real solutions and creating innovative scientific responses to ensure the survival of our natural environment.*

The challenges facing nature are vast and complex. The challenge facing environmental agencies is that, despite the enormous advances already made, we still know too little about this vastness and complexity, and how to restore balance to systems under threat.

At the Department for Environment and Heritage (DEH) we are proud of our record of scientific endeavour and its contribution to the current knowledge. We are also acutely aware that we cannot reach our potential alone.

Science and research is steeped in collaborative efforts that found solutions where singular efforts failed. It is based on sharing ideas and results for further discovery, refinement and confirmation. On the ground, a task shared is a task delivered more effectively.

As South Australia's largest and most active agency dedicated to conservation and ecosystem management, DEH is ideally positioned to translate knowledge gained into knowledge realised on the ground. Our central role makes us the perfect partner for collaboration with pure and applied researchers, and on-ground agents delivering projects that effect sustainable development, climate change mitigation and adaptation, and water resource management.

Our databases, collections and our people hold a wealth of useful information.

We have a history of collaborative partnerships and we now want to engage more and more widely with research institutions and delivery agencies. Together we can realise our potential, develop innovative conservation solutions and integrate this knowledge within a social and economic context.

This prospectus celebrates DEH's scientific achievements and research activity, and invites you to join us. We are keen to work with other scientists and delivery agents to realise the best outcomes, not only for the State's plants and animals but for all South Australians.

If you would like to work with us please contact us at [ScienceDEH@sa.gov.au](mailto:ScienceDEH@sa.gov.au)

A stylized, handwritten signature in black ink, appearing to read 'Allan Holmes'.

**Allan Holmes**  
Chief Executive  
Department for Environment and Heritage  
Government of South Australia



# Our science in focus

The Department's scientific work spans five key directions across terrestrial, freshwater and marine environments:

## 1. Discovering biodiversity

Plants, their identification and classification, and their evolutionary relationships, are a major focus for DEH.

*Read more about this key direction on page 1*

## 2. Evaluating the status of species and populations

DEH actively surveys the distribution of plants and animals across South Australia, from the common to the critically endangered, the local to the invasive.

*Read more about this key direction on page 3*

## 3. Understanding ecological processes

DEH scientists assess the ecological processes that influence the distribution and survival of plants and animals and the health of ecosystems.

*Read more about this key direction on page 5*

## 4. Restoring degraded landscapes, seascapes and habitats

DEH is working with others to restore large areas of degraded habitats in programs underpinned by sound scientific knowledge of ecosystems combined with social and economic considerations.

*Read more about this key direction on page 7*

## 5. Adapting to climate change

With key partners, including non-government scientists and managers, DEH is using innovative modelling and research to understand more about the impacts of climate change on species and ecosystems, and consequently develop landscape-scale management strategies.

*Read more about this key direction on page 9*

Visit [www.environment.sa.gov.au/science](http://www.environment.sa.gov.au/science)

# Discovering biodiversity

*Biological diversity is vitally important to South Australia's social, cultural and economic well being.*

The State Herbarium of South Australia is the centre for knowledge and information on the State's native and naturalised plants, algae and fungi. Our taxonomists and botanists are improving knowledge of the natural boundaries between species. As the picture of variation becomes clearer, they identify the physical characteristics that maintain species as separate genetic units.

The almost one million botanical specimens at the herbarium are being made accessible through unique interactive and online identification and information tools for key plant groups ([www.flora.sa.gov.au](http://www.flora.sa.gov.au)) that are continually updated. The first of the five-volume update of South Australia's Flora is scheduled for release in 2010.

The DEH Biological Survey of South Australia, begun in 1971, is systematically documenting the distribution of South Australia's vascular plants and vertebrate animals. Biological Survey specimens are deposited with the State Herbarium or the South Australian Museum to ensure correct identification. With over 25,000 plot-based samples, it is the most systematically sampled biological survey in Australia.

Survey efforts, particularly in remote areas of the State, have uncovered new species and rediscovered species thought to have gone extinct.

Our less well known marine systems are being opened to scientific understanding as we develop South Australia's system of Marine Protected Areas.



A library of micrographs is essential for many aspects of scientific research and is being constructed by the State Herbarium's Algal Unit. These images are also incorporated into information sheets being developed for university students and community diver groups to improve the accuracy of surveys of South Australian reef habitats

## CASE STUDY: Barcodes of life

*We now have unique insights. We are able to see how plant communities have evolved so we can plan for the future.*

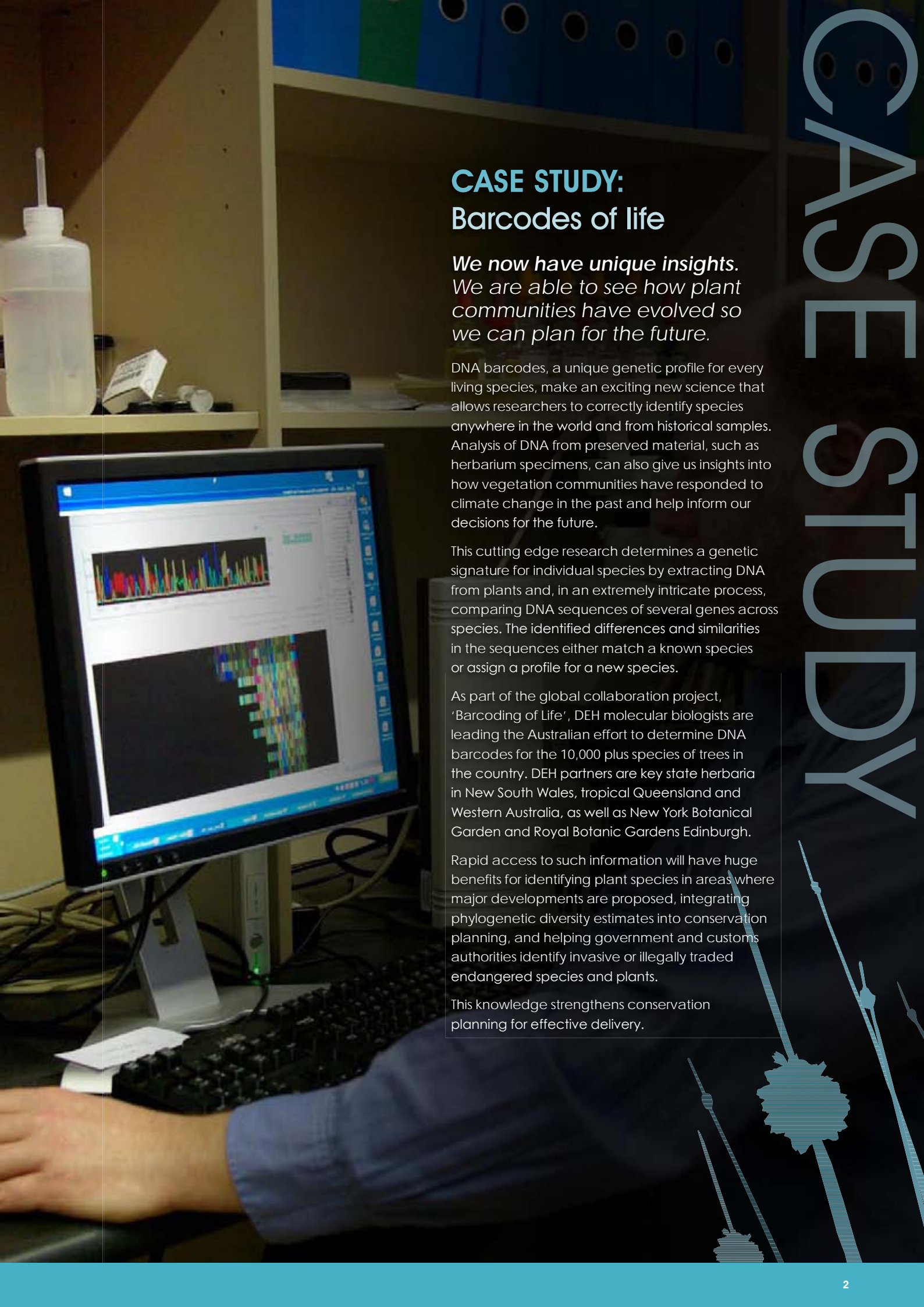
DNA barcodes, a unique genetic profile for every living species, make an exciting new science that allows researchers to correctly identify species anywhere in the world and from historical samples. Analysis of DNA from preserved material, such as herbarium specimens, can also give us insights into how vegetation communities have responded to climate change in the past and help inform our decisions for the future.

This cutting edge research determines a genetic signature for individual species by extracting DNA from plants and, in an extremely intricate process, comparing DNA sequences of several genes across species. The identified differences and similarities in the sequences either match a known species or assign a profile for a new species.

As part of the global collaboration project, 'Barcoding of Life', DEH molecular biologists are leading the Australian effort to determine DNA barcodes for the 10,000 plus species of trees in the country. DEH partners are key state herbaria in New South Wales, tropical Queensland and Western Australia, as well as New York Botanical Garden and Royal Botanic Gardens Edinburgh.

Rapid access to such information will have huge benefits for identifying plant species in areas where major developments are proposed, integrating phylogenetic diversity estimates into conservation planning, and helping government and customs authorities identify invasive or illegally traded endangered species and plants.

This knowledge strengthens conservation planning for effective delivery.



# Evaluating species and populations

*Keeping a close eye on the condition of plant and animal communities allows us to detect changes and trends and to take action to address imbalances*

Collections, surveys and monitoring programs keep track of the distribution and condition of key plant and animal communities across the state, and inform planning and management strategies.

In each South Australian biogeographical region, all native plants and animals are being assigned a conservation status based on quantitative data and expert knowledge. Having detailed regional information on species or populations that are threatened, declining or invasive enables more rigorous priorities for recovery action and development of options and solutions for restoration and recovery.

Successful science-based programs include:

**Bird conservation:** Through the Mallee Bird Recovery Program, DEH is working with the Riverland West Local Action Planning Group to protect a colony of threatened Regent Parrots from further decline.

**Abundant species and sustainable use:** DEH has collaborated on a number of projects to increase our understanding of the impacts of particular native species, techniques to mitigate these impacts and, for some species, their sustainable use. Management policy is developed from this solid foundation of knowledge.

## **Freshwater fish conservation:**

A collaboratively developed action plan for all threatened species of freshwater fish in South Australia now enables far greater and more targeted stakeholder engagement on freshwater fish conservation across the state.

**Habitat protection:** Knowledge of species ecological requirements, occurrence and land type can be used to identify areas for legally protecting relatively intact habitats, on protected areas under the *National Parks and Wildlife Act 1972* and *Wilderness Protection Act 1992*, and on private landholdings. More than 1200 landholders play a significant role in habitat conservation through the Heritage Agreement Scheme.

**Ecosystem restoration:** In agricultural landscapes that are largely cleared and pastoral lands affected by overgrazing, many populations of plants and animals are prone to isolation and conflicts with predators and competitors. DEH is restoring ecosystems to give plant and animal populations the best chance of survival on both public and private land. The scientifically based, integrated management approach of the Flinders Ranges Operation Bounceback program, spanning reserves, private landholdings and pastoral leases, is helping the threatened Yellow-footed Rock-wallaby to recover.

## CASE STUDY: Scientific expertise to the rescue

*The future of the Warru is looking more secure. Our recovery efforts continue to build on past experiences and address the present day dangers.*

Once common across the rocky ranges of Central Australia, the Warru (or Black flanked Rock wallaby, *Petrogale lateralis* – Macdonnell Ranges race) is now found in just two localities in the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands and possibly fewer than 100 animals remain. Fox and cat predation is thought to be the main cause of their decline.

The Warru Recovery Team, initiated by DEH, is merging innovative science, practical on ground action against threats and Anangu ecological knowledge to bring the Warru back from the brink of extinction.

With no adult Warru held in captivity, a priority was to establish a captive breeding program at South Australia's Monarto Zoo. Previous work informed the decision to cross foster Warru pouch young to surrogate Yellow footed Rock wallaby mothers. This conserved the mammal's unique genetic lines while minimising impacts on the wild population, as Warru mothers can produce more young within 30 days.

The Recovery Team also baits predators, collects data on Warru population dynamics and health, and searches for unknown populations.

This team is a partnership of the traditional owners of the APY Lands, DEH, APY Land Management, the Royal Zoological Society of South Australia, the University of Adelaide, and independent ecologists, with funding from the Commonwealth Department of the Environment, Water, Heritage and the Arts, the Alinytjara Wilurara Natural Resources Management Board and the Indigenous Land Corporation.

# Understanding ecological processes

*Every species plays a role in the ecosystem.*

*To safeguard biodiversity we must have a better understanding of the way that plants and animals interact with their physical and chemical environments.*

Natural systems must be resilient if they are to adapt to today's many environmental stresses, including climate change, and unsustainable use and development. Management strategies that increase the resilience of natural systems must be based on a better understanding than we have at present of the physical, chemical and environmental processes that shape ecosystems, and the impact we humans have on these processes.

Major DEH projects are investigating ecological processes:

**Seed ecology:** The *Millennium Seed Bank Project* is a global effort to safeguard plants against extinction. The South Australian program led by DEH aims to collect and store seed from at least 60% of our State's threatened plant species. Researchers at the Adelaide Botanic Garden's Seed Conservation Centre are investigating the germination requirements of seeds of native plant species.

**Wetland ecology:** DEH is taking a leadership role in developing science-based management strategies, such as ecological and hydrological modelling and environmental impact assessment, to deal with the ecological crisis in the Coorong and Lower Lakes.

CSIRO and the University of Western Australia are collaborating with DEH to trial a bioremediation technique to offset the impacts of exposure of acid sulphate soils that threaten the lakes' ecology.

**Disturbance ecology and fire:** The DEH fire research program explores beneficial fire regimes and impacts of fire in the landscape, and how to manage fire-prone systems to maximise public safety, and ecosystem health and regeneration. Significant projects include modelling optimal fire mosaics for plants, birds and reptiles in mallee reserves of the Eyre Peninsula, Murray Mallee and Kangaroo Island.

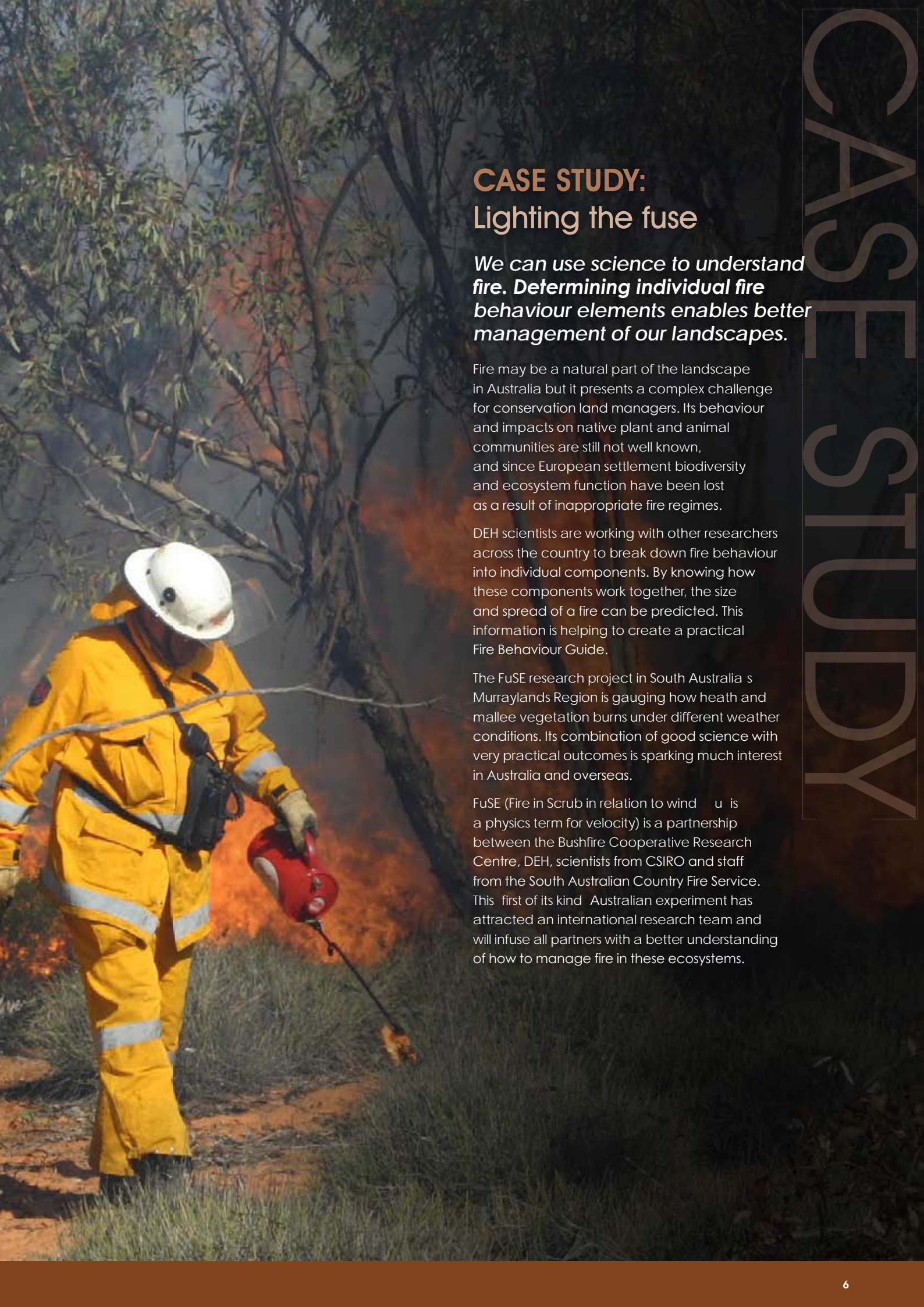
**Marine ecology and systems:** South Australia's coastal and marine waters are some of the most biodiverse in the world. They are being examined and mapped at a regional scale to help prioritise conservation efforts. In our global biodiversity hotspot for marine algae and seagrasses, DEH scientists are working to understand the species we have, their ecology and reproductive biology, and to develop rapid processes for assessing community diversity and health.



To unlock the mystery surrounding the propagation of our native plant species, Seed Conservation Centre researchers undertake both laboratory and field-based experiments. Research is also undertaken to determine the impact of threatening processes including:

- climate change and altered fire regimes on seed germination,
- controlled seed ageing to predict the longevity of seeds when stored within an environmentally controlled seed bank, and
- the use of tissue-culture based technologies as alternative methods for propagating and conserving native plant species.





## CASE STUDY: Lighting the fuse

*We can use science to understand fire. Determining individual fire behaviour elements enables better management of our landscapes.*

Fire may be a natural part of the landscape in Australia but it presents a complex challenge for conservation land managers. Its behaviour and impacts on native plant and animal communities are still not well known, and since European settlement biodiversity and ecosystem function have been lost as a result of inappropriate fire regimes.

DEH scientists are working with other researchers across the country to break down fire behaviour into individual components. By knowing how these components work together, the size and spread of a fire can be predicted. This information is helping to create a practical Fire Behaviour Guide.

The FuSE research project in South Australia's Murraylands Region is gauging how heath and mallee vegetation burns under different weather conditions. Its combination of good science with very practical outcomes is sparking much interest in Australia and overseas.

FuSE (Fire in Scrub in relation to wind  $u$  is a physics term for velocity) is a partnership between the Bushfire Cooperative Research Centre, DEH, scientists from CSIRO and staff from the South Australian Country Fire Service. This first of its kind Australian experiment has attracted an international research team and will infuse all partners with a better understanding of how to manage fire in these ecosystems.

# Restoring degraded landscapes, seascapes and habitats

*We want to know more so we can do more and be more effective. We are conserving natural areas and restoring degraded ecosystems for the benefit of people and the environment.*

Restoring degraded landscapes and habitats in a State where only around 30% of native vegetation remains in the agricultural zone is a major challenge. Pre-European vegetation mapping by DEH scientists attempts to reconstruct the communities that existed 200 years ago. They interpret historical accounts and images, map communities from current ecological data, link them back to geomorphological and climate data – and inform restoration programs.

DEH scientists and their partners are investigating the best ways to restore large areas of habitat across the landscape, so that plants and animals have the best chance to survive and adapt to environmental change, including climate change. Private landholders are a vital part of these efforts so that areas larger than conservation parks can be restored.

South Australia's *NatureLinks* program aims to connect habitats across South Australia in a partnership of government, landholders, community groups, conservation organisations, local councils, Aboriginal communities,

research institutions and industry bodies. Its conceptual framework addresses some of South Australia's most pressing biodiversity conservation concerns, including climate change and habitat fragmentation.

**Restoring the landscape:** As the interaction between restoration efforts and native species becomes better understood, some locally extinct species can be reintroduced. Successful large-scale terrestrial restoration projects include the Northern Murray Mallee Landscape Trial, Operation Bounceback, the Urban Forest – Million Trees project, the River Murray Forest and Habitat 141.

**Restoring coastal and marine habitats:** DEH has made significant progress in restoring the 5200 ha of seagrass meadows lost off the Adelaide coast since the 1950s in collaboration with Flinders University and the South Australian Research and Development Institute.



Seagrass restoration has inherent challenges: vegetative growth is slow, seedling survivorship is very low, and the reasons for the original losses may still be occurring.

## CASE STUDY: Revegetation for biodiversity benefit

*Our evidence-based planning is achieving biodiversity milestones. Our delivery and evaluation is clearly defined with specific goals.*

Market-based mechanisms are becoming an increasingly popular approach to encouraging participation in large-scale habitat recovery. But how do we get the best biodiversity outcome possible using such mechanisms? DEH's science-based approach is delivering biodiversity metrics based on data, expert knowledge, ecology, spatial modelling, logic, calculation and decision making. This work is setting priorities for one of the State's biggest revegetation programs, the River Murray Forest, which is establishing 2.5 million native plants for habitat and carbon sequestration benefits through partnerships between government and private landholders.

Successful biodiversity conservation planning, delivery and evaluation needs clearly defined and specific goals. Here, a goal-based approach is targeting investment in the landscape for the highest biodiversity conservation worth. Spatial modelling places revegetation efforts where they would contribute most to declining faunal species; expert knowledge determines the minimum patch size needed for viable habitat; and vegetation templates guide which species should be planted and what the planting structure should look like.

Scientifically sound biodiversity planning to determine appropriate locations for on-ground conservation works can be used for other biodiversity conservation objectives across South Australia.

Research into the ecological relationships between landscape types, declining bird species and vegetation communities in the River Murray Forest corridor and wider region has been essential for determining key biodiversity assets and native vegetation templates for revegetation. Further research into the ecology and distribution of flora and fauna species and their habitats within a landscape is needed for more effective biodiversity conservation planning and on-ground works.

Future work will incorporate climate change predictions to help plan more resilient ecosystem restorations.



# Adapting to climate change

*Climate Change affects all of us. The rapid changes are affecting all natural and man-made systems.*

Climate change and its impacts will become increasingly important for all areas of natural resource management as human activities continue to emit greenhouse gases.

Environmental concern is growing as the world searches for solutions and faces the realities and implications of climate change.

Rising temperatures, sea levels, seawater acidification and increasingly variable rainfall are but a few of the symptoms expected as a result, affecting biodiversity, agricultural productivity and water supplies.

DEH scientists are working on managing the impacts on land-based ecosystems. They use state-wide data and partner with a range of research institutes to highlight key ecological assets at risk, develop improved predictive models, understand vulnerabilities, and recommend appropriate mitigation and adaptation strategies for species, habitats and landscapes.

Climate change also threatens our coastal and marine environments. Long-term monitoring sites from Fowlers Bay to the Victorian border enable DEH coastal geomorphologists, engineers and other scientists to investigate the impact of climate change and rising sea levels on beaches, coastal lakes and wetlands. Monitoring sites are also being established within the marine environment as part of South Australia's Representative System of Marine Protected Areas to determine those areas most vulnerable, resilient or adaptive to changes.

This knowledge of a changing climate system improves our ability to anticipate the actions needed to adapt and mitigate impacts, and help South Australians cope with emerging environmental effects.



Closer examination of existing herbarium specimen data and biological survey data is already being used to identify changes in the flowering and fruiting of many species. In addition, predictive science and modelling can give further early warning of potential future catastrophic impacts, including sea level rise, species range shifts and changes to the ecology and interdependencies of species due to environmental shifts.

## CASE STUDY: Preparing for rising sea levels

***Scientific research is increasing our knowledge on sea level rise. In only a few decades the extreme predictions may be realised.***

Forecasts made by climate models show that sea levels are rising faster than originally thought, due mainly to ice sheet melting in Antarctica and Greenland. DEH is staying abreast of current projections to develop adequate and appropriate sea level rise adaptation strategies.

The Coast Protection Board, a statutory body supported by DEH, advises on coastal hazards, such as sea level rise, coastal erosion and flooding and drifting sand dunes, many of which are exacerbated significantly by climate change. Policies on these hazards are applied to new coastal development to limit exposure to the impacts of sea level rise and enhanced storm surge events, and to plan adaptation of at-risk existing coastal development.

The Board assesses the impacts of hazards on coastal ecosystems such as mangroves, saltmarshes and sand dunes and how to allow these to adapt to climate change.

DEH is helping the Board underpin sound planning and innovative solutions with the best science available.

Understanding coast and marine ecosystems is essential for managing our marine environment. DEH is working with its partners to create informed responses to the maritime impacts of climate change. Marine mapping and biological surveys for baseline information in several marine bioregions of South Australia are actioned through the support of regional natural resources management boards and the Australian Government, and in collaboration with four Australian universities.

# Partnering in innovation and discovery

*Partnerships are important. Prosperity and sustainability can be better achieved by working together.*

Over many years, DEH has collaborated with the community, natural resources management boards, cooperative research centres, universities, CSIRO, and government and non-government agencies, in South Australia, interstate and internationally.

Leveraging our high-quality, credible data, information and knowledge through active partnering with a range of research institutes has allowed DEH to highlight key ecological assets at risk, improve predictive models and establish appropriate mitigation and adaptation management strategies for species, habitats and landscapes.

DEH's research co-funding program and Wildlife Conservation Fund grants scheme support our commitment to innovative science-based policy and conservation management options for South Australia.

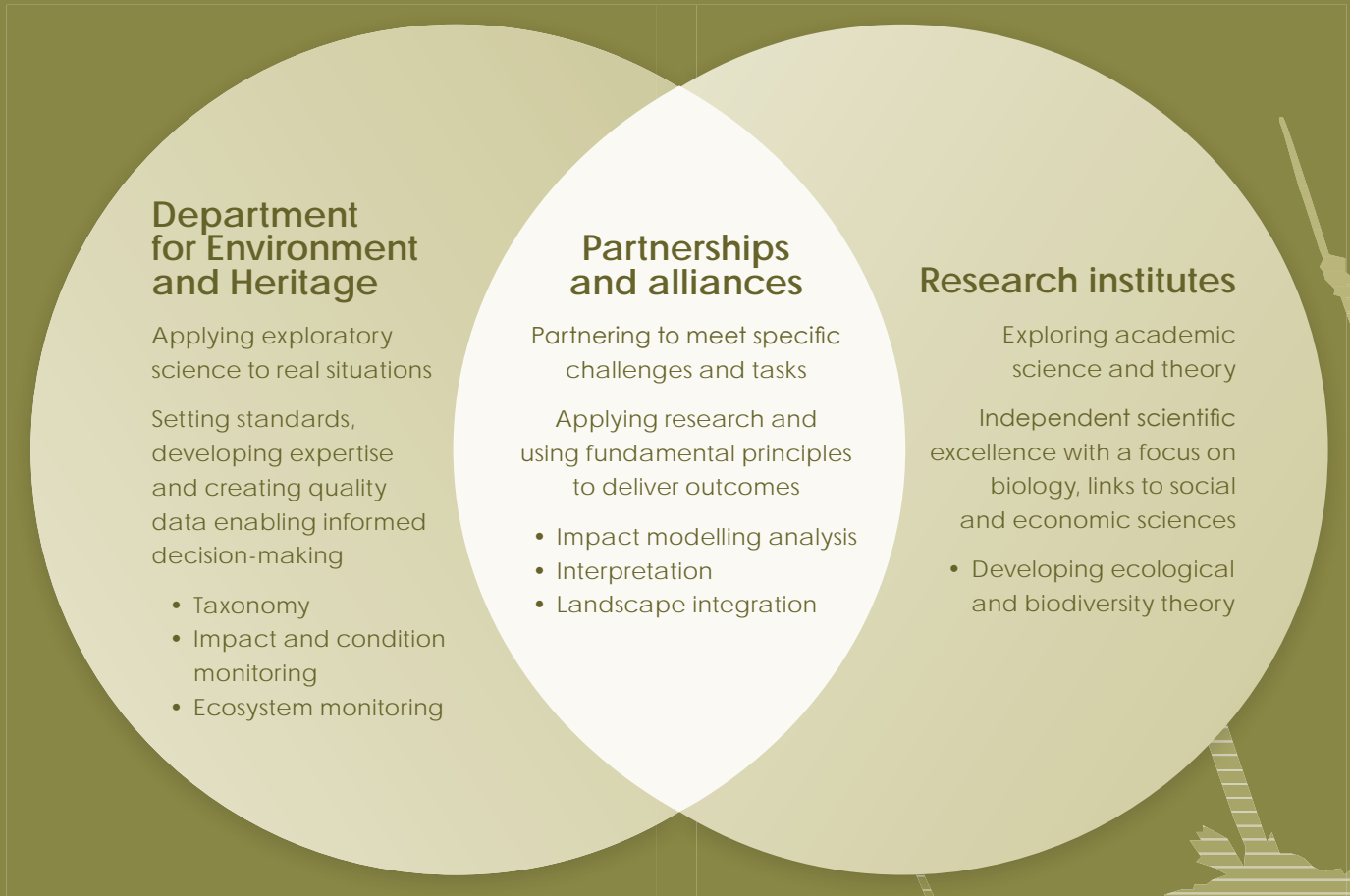
DEH is constantly seeking new partnerships that increase the diversity of expertise and extent to which environmental science can improve our capacity for effective conservation management. The fate of South Australia's unique native plants and animals is in the balance. At DEH, we still need your help in partnership.

**To discuss partnership, sponsorship or research project opportunities, contact us at [ScienceDEH@sa.gov.au](mailto:ScienceDEH@sa.gov.au) or visit [www.environment.sa.gov.au/science](http://www.environment.sa.gov.au/science)**



Photo: Warru Recovery Team

*Credible, interpreted knowledge and applied scientific skills maintain the Department's leading role in nature conservation at local and national levels.*



*Everyday the environment is conserved and enhanced through the policies, processes, practices and partnerships of which we are part.*

# Join the Science of Discovery

## *Combining Conservation Activities with Prosperity Outcomes*

DEH's more than 1000 regional and metropolitan employees are the best in their fields. They are enthusiastic about biodiversity conservation in South Australia and, with the support of thousands of volunteers and friends' groups, are actively conserving our natural heritage – on land, along our coasts and in our marine waters.

***Our people are passionate about making a difference to conservation.*** If you'd like to make a difference, check on vacancies and how to be a volunteer at [www.environment.sa.gov.au](http://www.environment.sa.gov.au)



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