2010

# Western Australian resource condition monitoring projects 2007-2009

Ceidwen Pengelly

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Department of Agriculture and Food

GOVERNMENT OF WESTERN AUSTRALIA

Australian Government

# Western Australian Resource Condition Monitoring Projects 2007–2009


## Acknowledgments

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- The four lead state agencies managing the RCM projects and their enthusiastic and dedicated officers including: Keith Claymore, Neil Coles, Will De Milliano, Jim Dixon, Steve Fisher, Vanessa Forbes, Judith Harvey, Brett Human, Leah Martin, Roy Melville-Smith, Sophie Moller, Malcolm Robb and Richard Wheater.
- The WA M&E Advisory Committee, and the State M&E Team who were responsible for overseeing the RCM program.
- The state agency and Regional NRM Group staff that supported these projects.

Photos by Peter Maloney and Simon Eyres, Department of Agriculture and Food, Western Australia and Peter Maloney's personal collection. Project specific photos provided by individual RCM Project Managers.


## Disclaimer




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RCM lead agencies responsible for managing these projects:

GOVERNMENT OF WESTERN AUSTRALIA
Department of Agriculture and Food

Department of Environment and Conservation

Government of Western Australia
Department of Fisheries
Fish for the future

Government of Western Australia
Department of Water

Department of Agriculture and Food

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# Western Australian Resource Condition Monitoring Projects 2007–2009

*Author: Ceidwen Pengelly, Manager, State Monitoring and Evaluation Coordination Team*

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# Foreword

Monitoring the status and trends of our natural resources is the only way we can assess whether the actions that have been implemented are making a difference. The impetus for this resource condition monitoring program (RCM) was the recognition that our monitoring networks, baseline data and data management systems were inadequate to enable quantitative reporting to government, and the community, on the difference their investments in natural resource management were making. It was considered that making a significant investment in raising our ability to report would be a long-lasting legacy of value to the state.

Collaboration has been the key to the success of the program. Funded jointly by the state and federal governments, four state government agencies worked closely with the six Regional natural resource management (NRM) Groups to achieve the results of the program. While the government funding was over $10 million, this was matched by the in-kind contribution from agencies and Regional NRM Groups.

The Western Australian Monitoring and Evaluation Advisory Committee (WAMEAC) accepted responsibility for guiding the program from initiation to final report. WAMEAC had representation from all relevant state agencies, the regional catchment councils and the federal government.

While this program has been successful in improving our capacity to report on the status and trends of our natural resources, the challenge is to maintain the momentum. Resource condition change is a slow process and hence monitoring needs to be a long-term commitment by governments and the community.

It has been a pleasure to chair WAMEAC and work with so many people dedicated to achieving sustainable natural resource management in the state.

Bob Nulsen
Chair, Western Australian Monitoring and
Evaluation Advisory Committee

# Introduction

… our natural resources face considerable threats …

## Western Australia has beautiful and varied landscapes …

Western Australia has beautiful and varied landscapes including the South-Western Australia international biodiversity hotspot, unique plants and animals and unspoilt natural environments. It is these natural resources (including land, water and forests) that provide Western Australians with economic, environmental and social opportunities.

However, the *2007 State of the Environment Report* showed that our natural resources face considerable threats including climate change, population pressure and degradation of soil and water.

Two NRM programs—the National Action Plan for Salinity and Water Quality (NAP) and Natural Heritage Trust 2 (NHT2)—provided cash funding of $440 million for community and government actions to manage natural resources.

Resource Condition Monitoring (RCM) was an important part of this investment. State and trend monitoring is essential to provide the information required to manage these natural assets for the future.

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This information must be collected in the right way and at the right time. Scientists require coordinated and standardised data to understand what is happening in the natural environment.

RCM is the joint responsibility of four state agencies involved in natural resource management.

In addition to agency core spending in RCM, eight projects were funded under the NAP and NHT2 programs to fill gaps in the state RCM network. These projects aimed to develop and set protocols for RCM and to install infrastructure. These projects were identified in the *2005 Resource Condition Monitoring – Requirements for NRM in Western Australia* report and finalised in December 2009.

The goal of these projects was to make progress towards an integrated, effective and efficient monitoring system.

The Department of Agriculture and Food, Western Australia (DAFWA) has the lead role in state NRM. Two groups—the State Monitoring and Evaluation (M&E) Team and the WA Monitoring and Evaluation Advisory Committee—have overseen the development and implementation of the eight RCM projects.

The projects address gaps in monitoring including:

- infrastructure installation
- protocol development
- quality assurance and training
- data collection, management and interpretation
- development of baselines and benchmarks
- evaluation and reporting.

A lead state agency was nominated to manage each project.

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Ultimately, sound RCM programs will provide the information needed to sustain the state's natural resources for future generations.

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# The resource condition monitoring projects

The following sections summarise the progress of the eight RCM projects. Table 1 provides an overview of the funded projects and lead agencies. More detail on each project can be found by contacting the key agency officers listed on the last page of this document.

Table 1 The resource condition monitoring projects

| RCM project | Project dates | Lead agency | NAP/NHT2 Funding allocated |
|---|---|---|---|
| 053017<br>Land salinity component | Jan. 2007–Sep. 2009 | Department of Agriculture and Food, Western Australia | 3 640 000 |
| 063009<br>Significant native species and ecological communities | Oct. 2007–Dec. 2009 | Department of Environment and Conservation | 1 916 600 |
| 063010<br>Soil condition monitoring | Oct 2007–Dec. 2009 | Department of Agriculture and Food, Western Australia | 688 200 |
| 063011<br>Estuarine monitoring | Oct. 2007–Sep. 2009 | Department of Water | 814 000 |
| 063012<br>Native vegetation monitoring | Sep. 2007–Dec. 2009 | Department of Environment and Conservation | 976 800 |
| 063013<br>Ecologically significant invasive species monitoring | Aug. 2007–Nov. 2009 | Department of Agriculture and Food, Western Australia | 296 000 |
| 073003<br>Inland aquatic resource condition indicators | May. 2008–Sep. 2009 | Department of Water | 2 000 000 |
| 073007<br>Coastal and marine monitoring scoping project | Jul. 2008–Sep. 2009 | Department of Fisheries | 232 900 |
| **Total funding provided** | | | **$10 564 500** |

Note: This is the funding provided to each RCM project. As the projects have not yet been finalised unspent funds may be returned to the State and Australian Governments.

# Land salinity component

## Department of Agriculture and Food

The RCM Land Salinity Project enabled the investment of $3.64 million to enhance the existing state land salinity monitoring network.

Monitoring the impacts of land-use change is important for its capacity to reveal unexpected side effects on the resource condition and therefore the sustainability of that activity. The development of dryland salinity following widespread land clearing in much of the past century is one of the consequences of land-use change from natural deep-rooted perennial vegetation to shallow-rooted annual cropping systems.

A significant investment has been made in groundwater and surface water monitoring in the past three decades to assess the impacts of changes in run-off (flows) and groundwater recharge. In addition, water quality and the impacts of rising saline groundwater is also monitored to determine the risk of salinisation and waterlogging on agricultural production and remnant biodiversity values.

The RCM Land Salinity Project enabled the investment of $3.64 million to enhance the existing state land salinity monitoring network.

### Surface water monitoring

Surface water monitoring equipment was installed in five key sub-catchments with electronic probes to monitor water depth and salinity at preset intervals, and data loggers to store and send this information back to base. The primary objective was to gain a better understanding of the impact of rainfall and run-off at both landscape scale and a more localised farm scale.

Surface water monitoring data has been collected since 2007. Due to low rainfall, some sites have had no significant surface flow in that time, providing limited data for analysis.

### Groundwater monitoring

A network of 424 groundwater monitoring bores was installed to fill gaps in the landscape monitoring network based on the existing SALTWATCH program.

Key ‘sentinel’ sites were chosen in representative landscapes to ensure wider coverage of the dryland agricultural area of the south-west of Western Australia, in particular in those landscape zones and catchments not (or inadequately) represented in the program.

The drilling and installation program was conducted according to industry best practice and was completed on time and on budget. Each bore site was GPS recorded and regular monitoring commenced after the bores were established.

All data was entered into the AGBORES and HYDSTRA databases maintained by the Department of Agriculture and Food. This data was automatically passed to the Bureau of Meteorology, for inclusion in the national database as part of the National Water Initiative Program.

## Standardising monitoring procedures

Operational protocols for ground and surface water monitoring (based on national standard requirements) were developed to ensure a standardised approach to monitoring, data collection and verification. These included:

- preparing for a monitoring trip
- visiting a surface water monitoring site
- visiting a rainfall monitoring site
- visiting a manually monitored groundwater monitoring site
- taking a water sample for testing
- water sampling methods
- data logging and verification protocols.

Protocols were also developed for measuring depth to groundwater, sampling, and measurement of groundwater salinity. These were endorsed in draft form by the Audit Advisory Council before it was disbanded.

The installation and monitoring of additional surface water and groundwater infrastructure will eventually provide established baseline datasets for resource condition assessment and provide the basis for assessing salinity risks. The use of telemetry was evaluated as part of an ongoing study into developing effective remote-sensing techniques for data collection and resource condition monitoring.

The enhanced data available for analysis will assist regional, state and national assessment of land salinity status and trends, enabling a strategic approach to investment in land-use change to minimise salinity risk due to changed land use. The data will provide input into an evaluation process to determine the risk to threatened ecological communities (TECs) in biodiversity recovery catchments and will enable long-term trend analysis in the future. This will also have significant value in determining the likely outcomes and risk from climate variability to sustainable agricultural production.

The enhanced data available for analysis will assist regional, state and national assessment of land salinity status and trends, enabling a strategic approach to investment in land-use change to minimise salinity risk due to changed land use.

# Significant native species and ecological communities

Department of Environment and Conservation

*Threatened species the chuditch with ear tags for monitoring at Bindoon. Photo: C Groom, Department of Environment and Conservation*

The RCM project has provided a more effective framework for monitoring to occur and it is expected that the outcomes of the RCM project will result in more effective monitoring of threatened species in this state.

*Attendees at the Fauna Management Course 2009 at Dryandra Woodland learn how to use radio-tracking equipment. Photo: Christine Groom*

*Bird surveying at the Fauna Management Course 2009 at Dryandra Woodland. Photo: Amrit Kendrick*

… develop a strategic approach to coordinating and integrating statewide RCM of significant native species and ecological communities.

A total of $1 916 600 was allocated to develop a strategic approach to coordinating and integrating statewide RCM of significant native species and ecological communities.

The approach focused on the development of standardised operating procedures and monitoring protocols, redeveloping and standardising databases, establishment of monitoring sites and preparing training materials. Twenty-two 'standard operating procedures' have been reviewed and finalised. These are available from the website: http://www.dec.wa.gov.au/content/view/5389/2239/. So far there has been excellent feedback on the website from users.

Baseline monitoring sites for Threatened Ecological Communities (TECs) were selected to provide dedicated sites to answer specific monitoring questions and to deliver training opportunities. Additional sites monitored are part of the Western Shield long-term monitoring program.

The project developed and ran three 'Introduction to monitoring' courses for DEC and NRM staff using videoconferences. These were well received by the participants.

A web-based resource centre has been established and is available at: http://www.dec.wa.gov.au/content/category/31/930/2237/. It contains the standard operating procedures, monitoring protocols, and a range of other related materials to be used in developing and implementing monitoring projects.

## Threatened and Priority Flora

The Threatened and Priority Flora database is being redeveloped to better manage the data. The project has also focused on adding records for priority flora and additional records for the threatened and priority fauna database. More records were added to the database at the WA Museum.

Native species listed as threatened or priority are currently being monitored in a number of ways, depending on their conservation status.

The RCM project has provided a more effective framework for monitoring to occur and it is expected that the outcomes of the RCM project will result in more effective monitoring of threatened species in this state. In addition to the current and ongoing monitoring projects, it is anticipated that this framework will also provide the impetus for increased monitoring activities should funding become available.

*Participants at the TEC course. Photo: AW Kendrick, Department of Environment and Conservation*

*Participants at the TEC course set up a monitoring quadrat. Photo: AW Kendrick, Department of Environment and Conservation*

# Soil condition monitoring

## Department of Agriculture and Food

The effective management of our soil resource requires that quality information at the appropriate scale is available to enable decision making about soil condition.

Wind erosion, water erosion, soil pH change and soil carbon change were the four main indicators of soil condition nominated by the National Monitoring and Evaluation Working Group.

A sum of $688 200 was allocated to develop monitoring methods for the four nominated indicators and, where possible, to establish baseline conditions for these indicators.

The project focuses on the cereal-growing regions of Western Australia where the threat of soil condition change is highest—between Binnu in the north-west to Condingup in the south-east.

Substantial progress has been made but the monitoring protocols and implementation still require ongoing development, especially for soil carbon.

*Inappropriate management leads to soil erosion. Photo: J Laycock*

... develop monitoring methods for the four nominated indicators and, where possible, to establish baseline conditions for these indicators.

{ Broad-scale soil condition monitoring will provide regional, state and national-level NRM decision makers with the necessary information on which to base their decisions. }

## Wind and water erosion monitoring

The project investigated techniques to monitor wind and water erosion at 2500 GPS-located sites—3000 km of roadways in 13 transects. The roadside survey technique was adapted from the Andrew McCord (South Australian Department of Conservation, Biodiversity and Water) technique. It was trialled with the development of standard operating procedures, monitoring protocols and databases linked to the WA soils database.

Since 2008 the roadside surveys have assessed the wind-erosion hazard throughout the wheatbelt. Based on observations of groundcover, surface material detachment and topography at each site, the wind-erosion hazard is rated from safe to very high in six steps. The assessments are then summarised and reported to stakeholders.

The 13 transects cover all the main landscape zones of the wheatbelt. Each site is monitored twice yearly—in late autumn (April–July) when groundcover is at a minimum and in spring (October–December) when cover is at its highest.

To complement the roadside surveys, two PM 10 DustTrak atmospheric dust samplers were installed at Mullewa and Merredin. The DustTrak samples air particulates every 15 minutes (or every minute if the particulate concentration exceeds the minimum threshold) to give a precise measurement of dust in each wind erosion event. Monthly reports, over the summer/autumn period are prepared and circulated to Department of Agriculture and Food district offices.

In the future a combination of roadside surveys, DustTrak samplers and satellite imagery should present an accurate picture of wind erosion across the state. In the short term, the information generated will help target investment to areas with water and wind erosion and in the long term it will show whether management actions are changing and mitigating the loss of soil resources.

## Soil acidification monitoring

An internationally recognised method for designing a soil monitoring network was adapted for application to soil acidification and Soil Organic Carbon (SOC) in WA.

As soils are so variable, the statistical analysis of soils data and fieldwork results showed that at least 400 sites are needed to get an accurate estimate of change in pH and SOC. Each site involves intensive sampling to follow the protocols for accurate measurement. Samples were analysed by the Chemistry Centre WA.

This project has played an important role in standardising the measurement of pH and SOC in WA. Progress has been made towards establishing a baseline and setting scientifically defensible protocols for sampling. In the future the results from these monitoring programs could be used to strategically direct funding to manage pH and SOC issues.

## National monitoring standards

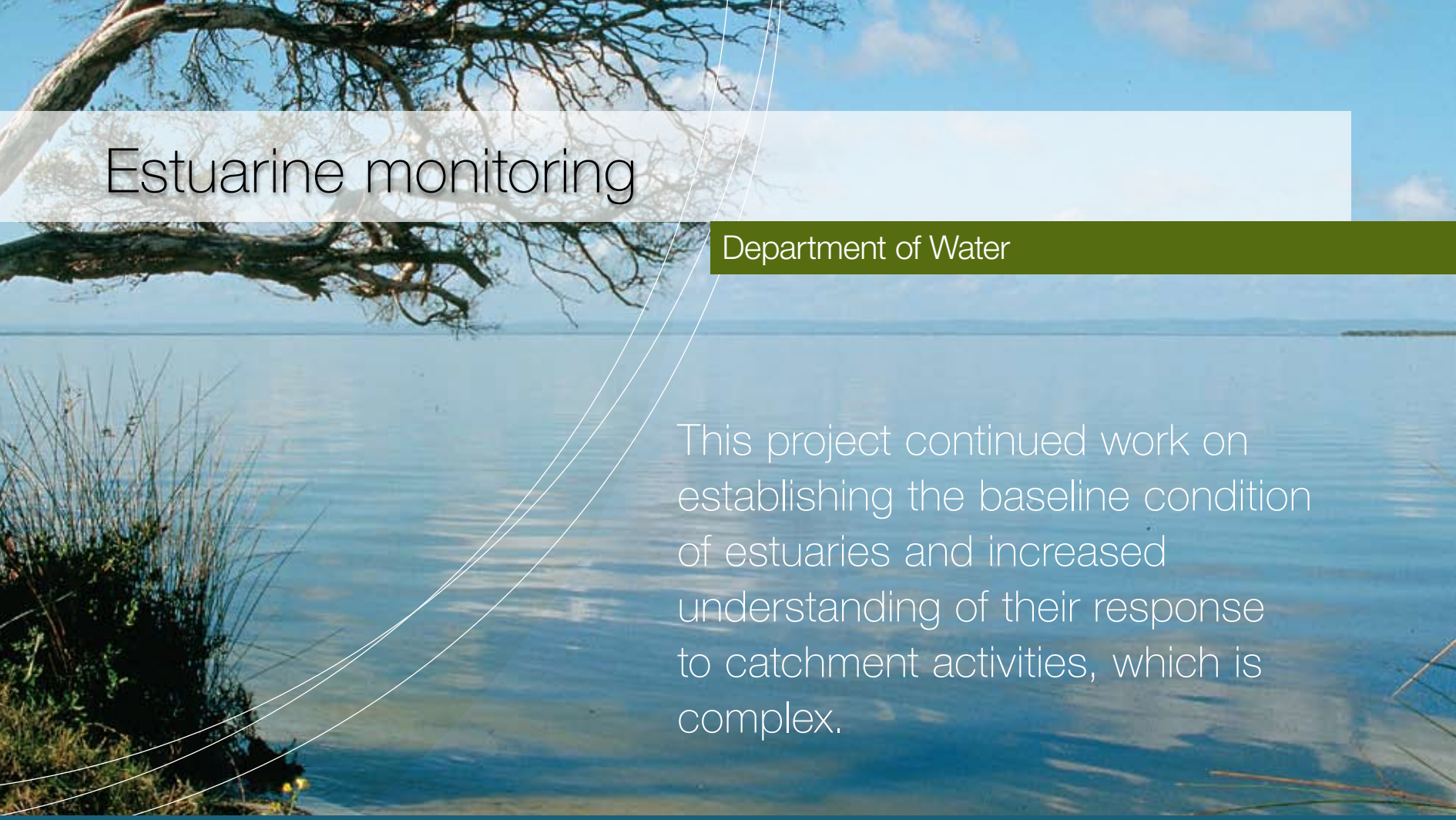
The project has taken a collaborative approach and is contributing to two national projects sponsored by the Department of Agriculture, Fisheries and Forestry (DAFF) to develop national standards for roadside survey methods and a national approach to monitoring pH and SOC.

Databases have been developed to store and analyse the field and laboratory data and generate reports based on the four indicators. These are under constant review and improvement and will be the prototype for the national equivalents.

Broad-scale soil condition monitoring will provide regional, state and national-level NRM decision makers with the necessary information on which to base their decisions. It will help to assess current soil condition and determine whether on-ground investments are effective.

# Estuarine monitoring

## Department of Water



This project continued work on establishing the baseline condition of estuaries and increased understanding of their response to catchment activities, which is complex.

Estuaries are heavily impacted by the nutrients and sediment received from agricultural and urban activities in catchments. Considerable state and Commonwealth funding has been invested to manage these threats, and more work is still required to address the significant issues facing estuaries.

This project continued work on establishing the baseline condition of estuaries and increased understanding of their response to catchment activities, which is complex. In extreme cases the response is visible—algal blooms and fish kills—but this project aimed to understand some of the earlier symptoms of stress on estuaries.

A more difficult task is to understand the vulnerability of estuaries and the rate at which they respond to both improvements and deteriorations in catchment pressures. These are the measures that tell us how well and whether our investments make a difference.

Because every estuary is different, estuaries may respond quite differently under similar nutrient loading conditions—some grow phytoplankton and others grow macroalgae and macrophytes.

> Routine assessment of estuaries using these measures shows the community how an estuary changes as a result of their efforts and with time.

This makes it difficult to choose the right indicators for monitoring. For example, traditional water-quality data are important indicators of eutrophication but on their own do not describe the overall estuarine condition especially when nutrients are stored in sediments or plant biomass.

Therefore, a combination of indicators is required to establish condition and should be incorporated into any long-term monitoring program. This project focused on biotic and non-biotic indicators other than water quality (covered by the Inland Aquatic RCM project). Resource condition targets can be derived from these indicators, which are measurable in routine and systematic monitoring programs.

The project also aimed to provide condition assessments of priority estuaries using the recommended indicators and to report back to communities on the condition of their estuaries.

To do this, a number of activities were undertaken.

Experience so far in WA estuaries shows that sediments and submerged aquatic vegetation are important measures of estuarine condition and reflective of changes in both catchment loading and estuarine dynamics.

Sediment quality and submerged aquatic vegetation surveys were completed in Stokes, Wellstead, Beaufort, Gordon, Oyster Harbour, Wilson Inlet, Torbay, Parry, Irwin, Walpole Nornalup, Hardy, Vasse Wonnerup, Leschenault and Swan Canning. This work complemented previous work in developing sediment indicators.

It resulted in the development of a set of indicators that are meaningful at both the community and manager level and that can be used over the long term.

Seven estuary condition summary reports and 'report cards' or assessment indices were developed that can be used to report locally, statewide and nationally. These reports provide clear, concise information that supports estuary management by community groups.

Knowledge gaps were filled in 15 estuaries to allow comprehensive estuary condition assessment and reporting. This project has established a core list of measures and indicators for estuaries and an understanding of frequency of measurement required for measuring response to catchment pressures, climate change and our management actions.

Presentations were made on the Hardy Inlet to community and agency audiences in Augusta, on the Leschenault Estuary in Bunbury, and recently on the Wilson Inlet in Denmark. It is essential that information be returned to the community in ways relevant to them.

The benefits of this work are that we now understand the key condition measures for WA estuaries and can synthesise water quality, biotic and sediment measures in a way that is understandable to concerned communities and management agencies.

Routine assessment of estuaries using these measures shows the community how an estuary changes as a result of their efforts and with time. The same assessments provide feedback to government on the effectiveness of their policies and provide early warning of problems so a management response can be implemented before serious loss of amenity occurs.

Estuaries are still where the majority of West Australians live and the condition of the estuary is of vital interest to all.

The Department of Water's systematic and coherent river and estuary monitoring established and coordinated through this project will cease at the end of this RCM project. All non-water-quality estuary condition work will also cease. We will, however, process and develop reports and condition statements on estuaries with Department of Water funds until the end of the 2009–10 financial year.

# Native vegetation monitoring

Department of Environment and Conservation

The native vegetation integrity RCM project was allocated $976 800 to assist in providing foundation data from which regional, state and national NRM decision makers can assess the current condition of native vegetation resources and determine if on-ground investments are producing improvements on a scale sufficient to make a difference.

The project has already furthered knowledge about native vegetation monitoring techniques, enabling the provision of information on the condition of native vegetation.

The native vegetation integrity RCM project was allocated $976 800 to assist in providing foundation data from which regional, state and national NRM decision makers can assess the current condition of native vegetation resources and determine if on-ground investments are producing improvements on a scale sufficient to make a difference.

The development of protocols and benchmarks based on current science and the investigation of remote-sensing techniques has begun. Quadrat-based protocols have been field tested. A number of case study assessments of vegetation condition and threats across WA using remote-sensing tools are being evaluated and concluded.

Work has begun in comparing information gathered on the ground with Landsat imagery of the Swan Coastal Plain and the Fitzgerald River National Park on the south coast.
A review of regional condition targets has been completed, a sample of fixed reference sites for assessment of changes in native vegetation was established, and a set of draft protocols was developed and field-tested for both areas.

A workshop with regional M&E staff was held, data analysis undertaken and a review of the current mapped vegetation types is currently underway.

Gnangara—fenced and burnt site, July 2009. Photo: N Casson, Department of Environment and Conservation

A literature review of native vegetation condition monitoring has been undertaken.

The project has already furthered knowledge about native vegetation monitoring techniques, enabling the provision of information on the condition of native vegetation.

# Ecologically significant invasive species monitoring

Department of Agriculture and Food

… improve WA's monitoring capacity by developing a long-term and strategic monitoring framework for ecologically significant invasive species in the state.

*European wild rabbit grazing (*Oryctolagus cuniculus*)*

It will detail how NRM groups can collect invasive species data strategically and in a standardised manner.

*Fox (*Vulpes vulpes*) and bandicoot*

Invasive species have long been recognised by land managers in WA as a major threat to natural resources, biodiversity and primary production. It is not surprising then that considerable time and money is spent each year on combating these threats. The task is not easy and is further complicated by WA's limited capacity to monitor the threat posed by invasive species in a strategic manner.

In 2007 this project received funding to improve WA's monitoring capacity by developing a long-term and strategic monitoring framework for ecologically significant invasive species in the state. The approach focused on aligning national, state and regional monitoring requirements, improving data management and data provision, and enhancing the capacity of regional NRM groups to monitor and report on Resource Condition Targets (RCTs) for ecologically significant invasive species.

The project ran six full-day workshops for each NRM region with participants from NRM groups, the Department of Agriculture and Food, the Department of Environment and Conservation, local governments and non-government organisations. The workshops obtained input into the design of a state monitoring framework for invasive species and to align national, state and regional requirements. Potential monitoring sites were also identified.

The Invasive Species Monitoring framework (ISM framework) that was subsequently developed will be published in 2010. It will detail how NRM groups can collect invasive species data strategically and in a standardised manner. It will also explain how the Shared Land Information Platform (SLIP) can be used to manage, store and share these data and other information products with stakeholders.

The ISM framework will have two parts. The first part will explain key concepts and approaches that are used nationally and internationally to manage invasive species. It will also describe national frameworks for monitoring natural resources and invasive species. The second part brings these concepts, approaches and national framework together into a framework for monitoring invasive species in WA.

Twelve rabbit-monitoring sites were set up and two monitoring protocols—one for monitoring the abundance of rabbits and one for tissue sampling—were developed to trial the ISM framework. One year's worth of data has been collected and will be shared with the regional NRM groups through SLIP. The data also contributes to national initiatives, such as RabbitScan, and the Rabbit Management Advisory Committee and Invasive Animal Cooperative Research Centre projects.

The Department of Agriculture and Food will continue to carry out its legislative requirements for monitoring and reporting on invasive species.

*Cane toad (*Bufo marinus*)*

# Inland aquatic resource condition indicators

## Department of Water
## Department of Environment and Conservation

… develop a long-term, strategic approach to river and estuary water-quality monitoring using standardised protocols.

The project was developed to assess and consolidate a range of monitoring approaches so that RCTs could be set and measured against.

Extensive consultation identified the needs of the regional strategies for monitoring of indicators and development of targets. This included agency components and activities funded through the regional investments. The project funding was then allocated with a focus on sites with likely long-term benefits.

The project had two themes—rivers and estuaries, and wetlands.

### Rivers and estuaries

The primary objective of the *Water Quality* theme managed by the Department of Water was to develop a long-term, strategic approach to river and estuary water-quality monitoring using standardised protocols. This strategy avoids duplication of effort and maximises the benefits of investment in data collection by building on existing state and national initiatives.

## An efficient framework meeting national standards has been established …

From June 2008 the monitoring program involved sampling 230 sites across the state—catchments and estuaries on the Swan (16 sites), Peel (34), Leschenault (22), Geographe (20) and Scott (11); south coast estuaries and catchments between Broke Inlet and Esperance (90); and Northern Agricultural Region estuaries and catchments (37) from Moore River north to the Murchison River. This involved sampling for nutrients, turbidity and physical measurements such as salinity.

Monitoring was guided by concise sampling and analysis plans that aimed at achieving uniformity of sampling and analytical chemistry protocols across the regions.

The data is being used to:

- assess status and condition
- measure change in condition over time of rivers and estuaries
- calibrate and validate decision support models relating land use to nutrient and sediment export
- set resource condition targets.

Water Quality data are reported via the web at http://www.water.wa.gov.au/idelve/srwqa/ and will be incorporated into catchment report cards in the future.

The River Health Assessment Scheme (RHAS) was carried out by the Department of Water for 20 sites in the Swan-Canning catchment during October 2008 and October 2009 based on riparian vegetation, physical form, macroinvertebrate communities, fish communities and water quality.

The results from these studies will be compared with the 2007 assessments to show changes over time and to assess the suitability of the methodology for uptake by the Framework for the Assessment of River and Wetland Health (FARWH). Individual report cards for each of the sites assessed, a summary report and an RHAS Users Manual have been published.

An efficient framework meeting national standards has been established to provide the information needed to assess status and condition of waterways, track trends and changes over time, measure the impact from government and community investments, and to report to communities on progress.

### Wetlands of Significance

The objective of the wetlands component *Inland Aquatic Habitat Integrity* theme was to identify gaps in our understanding of wetlands at risk, especially in the Rangelands and Northern Agricultural regions. This forms the basis for establishing RCM. This theme also included rivers—with the main objective to integrate river health protocols with FARWH.

Rapid condition assessments of significant wetlands were undertaken by the Wetlands Section of DEC, with monitoring protocols developed using indicators recommended by the *Draft national guidelines on assessment of wetland condition* and the *Wetlands Monitoring Protocol.*

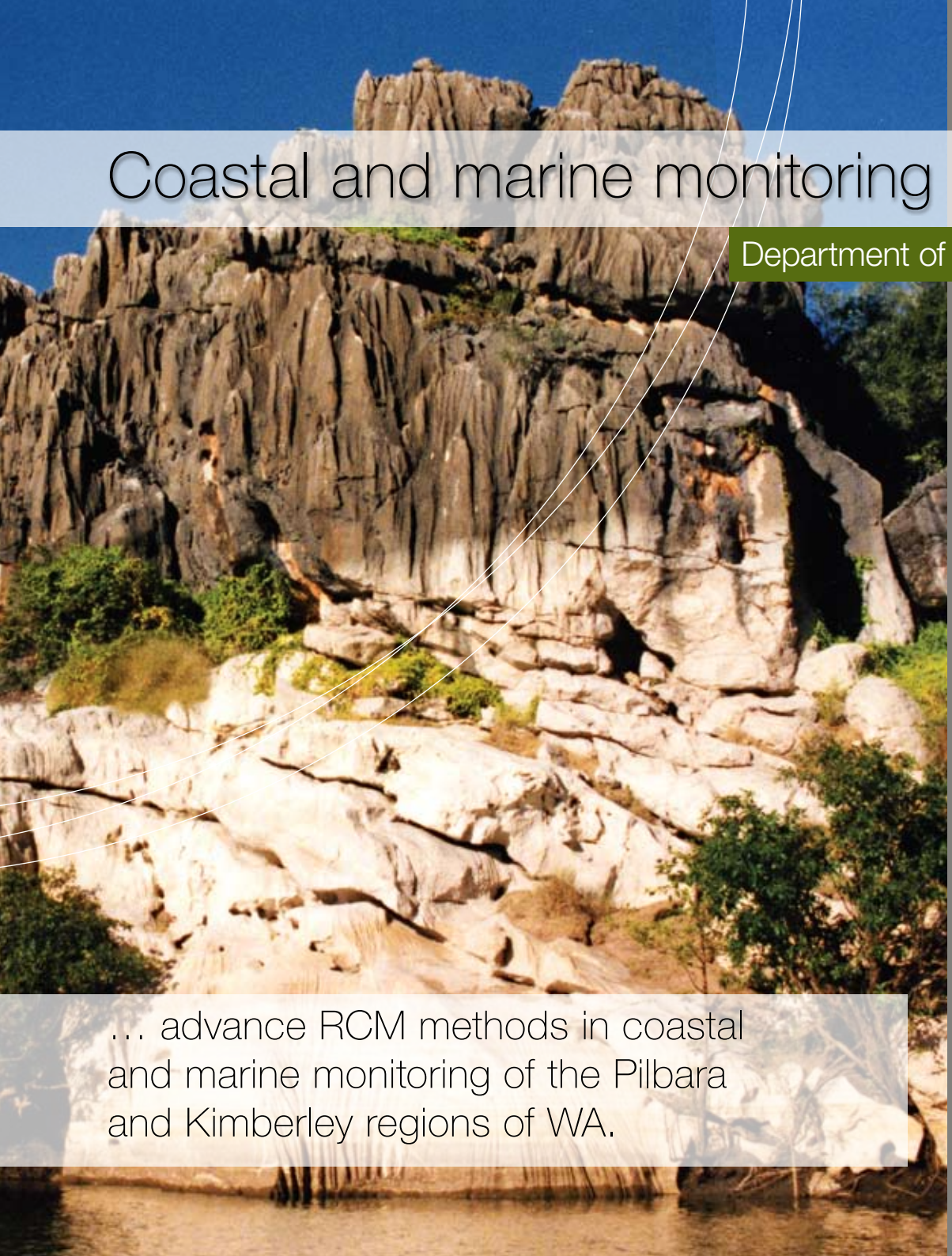
Thirty surveys of wetlands in the Rangelands, Northern Agricultural, South West, Avon and South Coast NRM regions were conducted and resource condition reports were completed for each region.

The protocol for monitoring wetlands was endorsed by the Wetlands Coordinating Committee and was incorporated into *The guide to monitoring and restoring Western Australian wetlands*.

Wetland education and training workshops were held in Perth, Carnarvon and Gingin, where wetland monitoring and the results of surveys were presented to stakeholders and other interested parties.

# Coastal and marine monitoring scoping project

## Department of Fisheries



… advance RCM methods in coastal and marine monitoring of the Pilbara and Kimberley regions of WA.

This scoping project received $232 900 to advance RCM methods in coastal and marine monitoring of the Pilbara and Kimberley regions of WA. The project was run through the Biodiversity and Biosecurity Branch of the Department of Fisheries.

The project aims to provide criteria for selecting indicators that can be used to assess the condition of intertidal and sub-tidal systems and their response to stressors. This needs to be usable within the logistical constraints of a long-term monitoring regime, at different spatial and temporal scales. A Strategic Assessment Report will also be produced, with recommendations and a suggested approach to inform and guide future coastal and marine policy and to direct and prioritise management actions.

A desktop study of current coastal and marine research and RCM programs in the Pilbara and Kimberley was completed to determine what monitoring had taken place. Over 2000 references were sourced, of which about 10 per cent were relevant to the study. A significant finding of the monitoring review was that the majority of marine and coastal monitoring conducted in the region is through private industries and consultancies.

A standardised monitoring protocol was developed in consultation with the Marine Monitoring and Remote Sensing units of the Department of Environment and Conservation.

As a result, nearly 80 per cent of the literature relating to monitoring of the marine and coastal environments was inaccessible.

A list of 45 knowledge gaps was drawn up as a result of this process, and these gaps were discussed at stakeholder meetings co-hosted by the Department of Fisheries, the University of Western Australia (UWA) and the Rangelands NRM Coordinating Group in Kununurra, Broome and Karratha. Through an informed voting process, 71 stakeholders voted for large-scale oceanographic and long-term monitoring programs as a priority for future research.

A standardised monitoring protocol was developed in consultation with the Marine Monitoring and Remote Sensing units of the Department of Environment and Conservation. In collaboration with DEC staff, a field assessment of potential resource condition indicators, and remote-sensing tools, were tested for monitoring mangroves and mudflats in the long term. Potential resource condition indicators trialled included tree numbers per transect, tree height, leaf health, soil quality and water quality. Indicators that showed promise are being developed in collaboration with DEC for use in long-term monitoring projects.

Remote sensing was evaluated as a monitoring tool. The physical difficulties of on-ground monitoring of mudflats and mangrove swamps make remote sensing an attractive, cost and resource-effective alternative, so long as the quality of the data can be assured. Geographical Information Systems (GIS) specialists at the Remote Sensing Unit of DEC, in consultation with the Department of Fisheries, selected areas for on-ground monitoring to test different remote-sensing methods. Additional study is required, but remote sensing looks to be a strong possibility.

The project has developed strong working relationships with DEC and the UWA/NRM Rangelands team, dovetailing as it does with their project 'Human Uses of the Rangelands Coast'.

It is anticipated that the field trial components of this project will be the subject of a co-authored publication with DEC on field-trialled indicators for the monitoring of mangroves.

The literature review and gap analysis were presented as a paper to the 5th Western Australian State Coastal Conference 2009. The literature review, and outcomes from the stakeholder meetings, will be submitted as multiple publications in peer-reviewed literature.

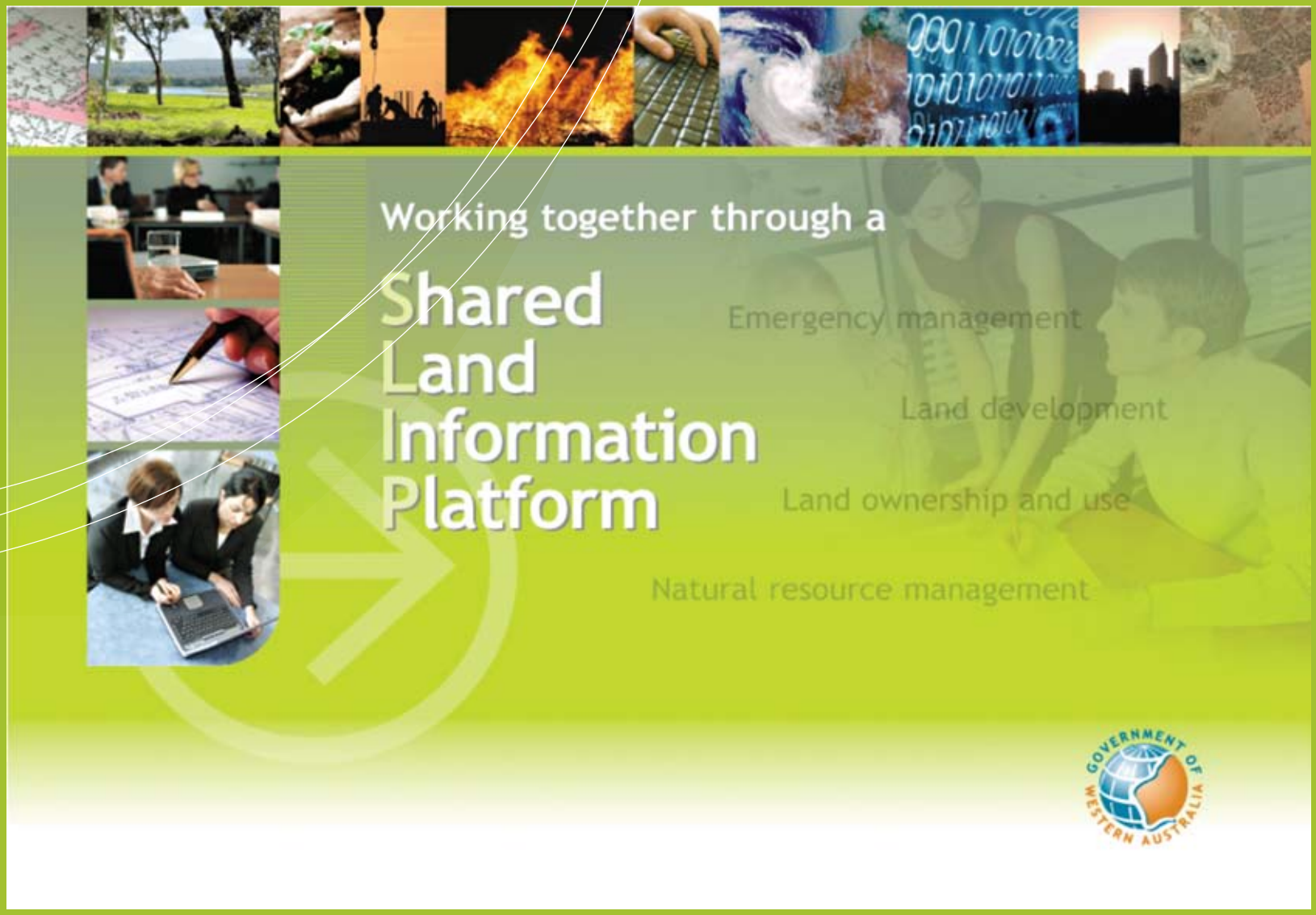
The Coastal and Marine RCM Project was a *scoping project* to inform and guide the development of a future surveillance-level RCM program for the Pilbara and Kimberley regions. The project was only funded for one year and by its end, will have achieved its objective.

The Department of Fisheries has both core funding and industry cost-recovered funding to monitor exploited marine stocks. This project was guiding the expansion of RCM to non-consumptive aspects. Unfortunately, in the short term, there is no funding available to expand the results of this scoping project into a full-blown program.

… 71 stakeholders voted for large-scale oceanographic and long-term monitoring programs as a priority …

# Delivery of data and information products from RCM projects through the Shared Land Information Platform

Department of Agriculture and Food



These data, and derived information products, are being made available to stakeholders via a range of new, more user-friendly facilities.

Each of the RCM projects has generated, or has established, infrastructure that will generate large volumes of data and information on the status of natural resource assets—or indicators of changes in their condition—over time. These data, and derived information products, are being made available to stakeholders via a range of new, more user-friendly facilities.

A Shared Land Information Platform (SLIP) has been established in WA to provide access to a wide range of spatial (or mapped) data and information—including that produced by RCM projects.

Guidelines for using the SLIP, and for publishing data through this facility and other web portals available from state NRM agencies, have been published in the Regional Spatial Data Management Toolkit published in 2008 through the SLIP NRM program. The toolkit is available online at http://spatial.agric.wa.gov.au/slip/toolkit.asp, or on CD-ROM and in hard-copy format from the Department of Agriculture and Food. Contact Geographic Information Services at gis@agric.wa.gov.au.

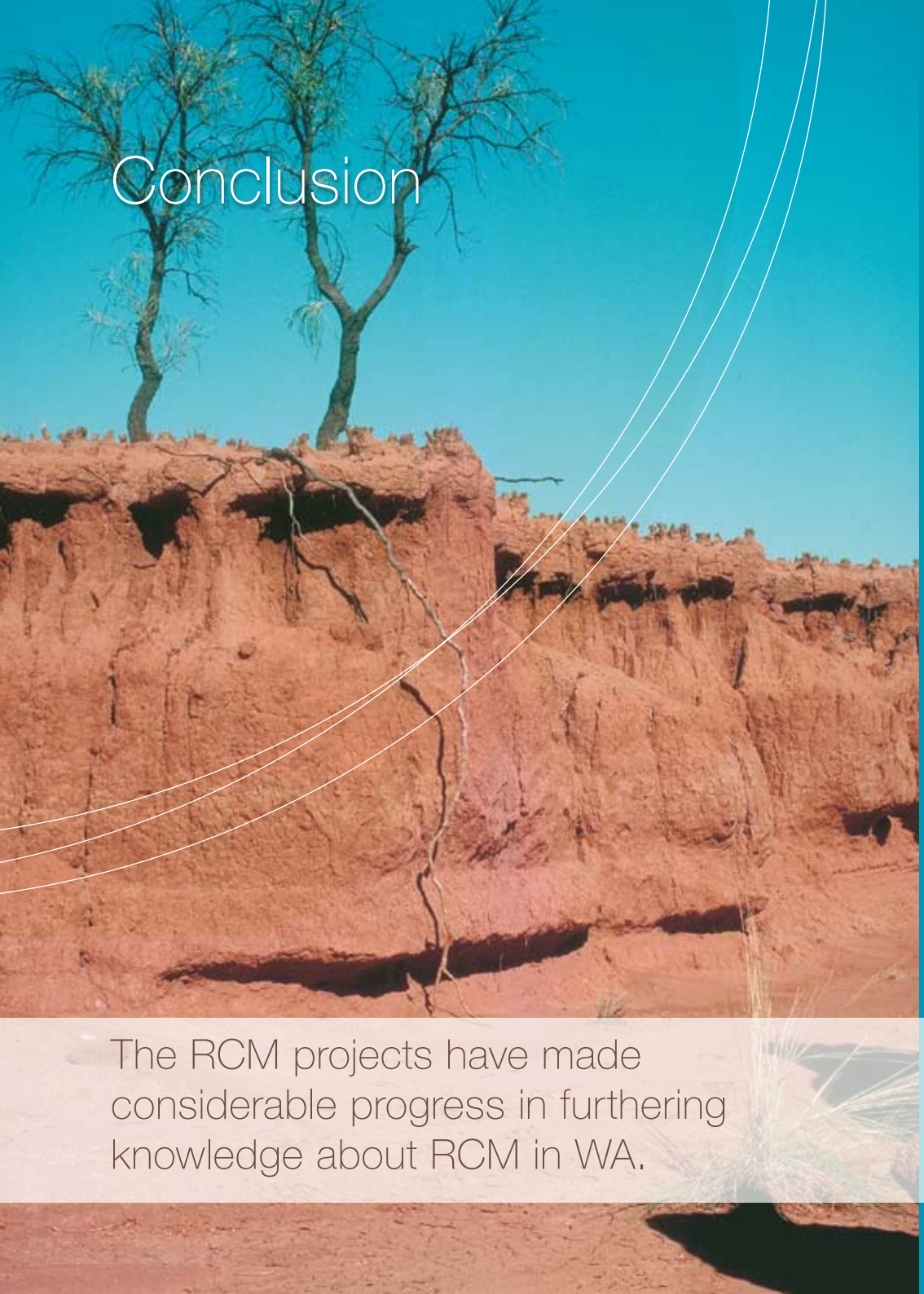
For further information visit the following websites:

- SLIP NRM webpage @ http://spatial.agric.wa.gov.au/slip
- WA Land Information System (WALIS) website @ http://www.walis.wa.gov.au/.

Although the SLIP toolkit focuses on the collection of spatial data, the principles discussed can be applied to data management more broadly. The toolkit includes advice on how to find existing data using a range of freely available tools, and how to go about setting up a database to capture new data. The NRM groups in WA have adopted the common set of spatial data management policies documented in this toolkit. They are based on those developed and used by the Western Australian Land Information System community over the past two decades.

The WA NRM toolkit is also consistent with the national guidelines for data management published through the National Land and Water Resources Audit. See http://www.nlwra.gov.au.

# Conclusion



The RCM projects have made considerable progress in furthering knowledge about RCM in WA.

## While much has been achieved, more remains to be done.

The RCM projects have made considerable progress in furthering knowledge about RCM in WA.

They have succeeded in developing and setting standardised monitoring methods and protocols, installed infrastructure and conducted trials of these methods in a relatively short period.

These achievements would not have been possible without the dedication and engagement of the state agency officers involved, many of whom worked under pressure to deliver these projects in the required time frame.

While much has been achieved, more remains to be done. Although these projects have developed methods and protocols for gathering data, the long-term collection of data was outside the scope of these funded projects. To date, limited data has been collected against the new protocols.

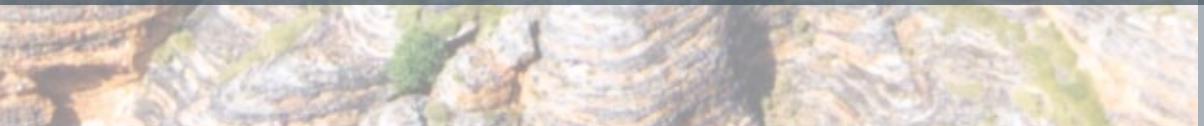
Monitoring is a long-term venture—with changes in the environment difficult to detect—and can be costly. However, the information is required to tell us whether our current activities are making a difference. Future investment in RCM projects is required to capitalise on the progress made to date.

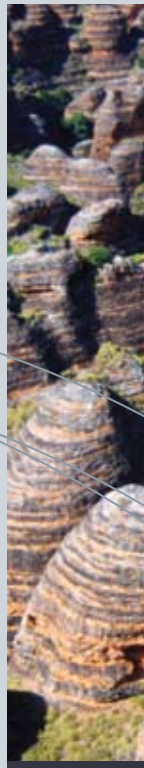
# Contact details

To learn more about each of the RCM projects, contact:

| RCM projects | Lead agency | Contact person | Contact details |
|---|---|---|---|
| 053017<br>Land salinity component | DAFWA | Neil Coles | 08 6488 1668 |
| 063009<br>Significant native species and ecological communities | DEC | Sophie Moller | 08 9334 0390 |
| 063010<br>Soil condition monitoring | DAFWA | Jim Dixon | 08 9368 3368 |
| 063011<br>Estuarine monitoring | DoW | Malcolm Robb | 08 6364 7852 |
| 063012<br>Native vegetation monitoring | DEC | Keith Claymore | 08 9442 0342 |
| 063013<br>Ecologically significant invasive species monitoring | DAFWA | Will De Milliano | 08 9368 3476 |
| 073003<br>Inland aquatic resource condition indicators | DoW | Malcolm Robb | 08 6364 7852 |
| 073007<br>Coastal and marine monitoring scoping project | DOF | Roy Melville-Smith | 08 9203 0173 |

**For general information about the RCM Program contact Ceidwen Pengelly, Department of Agriculture and Food, Western Australia on (08) 9368 3467.**





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