

PRACTICAL INDEX OF SALINITY MODELS – USER'S GUIDE

National Action Plan for Salinity
and Water Quality - Tools,
models and frameworks for
planning



Australian Government

Department of Agriculture, Fisheries and Forestry

Department of the Environment and Heritage



Australian Government

Land & Water Australia

National
**DRYLAND
SALINITY**
Program | Know-how
to tackle salinity

URS

Prepared by the National Dryland Salinity Program and URS for the Australian Government Department of Agriculture, Fisheries and Forestry and the Department of the Environment and Heritage.

Published by Land & Water Australia and the National Dryland Salinity Program on behalf of the Australian Government Department of Agriculture, Fisheries and Forestry, and the Department of the Environment and Heritage.

Land & Water Australia

Postal address: GPO Box 2182,
Canberra ACT 2601

Office location: Level 1, The Phoenix
86 Northbourne Avenue
Braddon ACT 2612

Telephone: 02 6263 6000

Facsimile: 02 6263 6099

Email: Land&WaterAustralia@lwa.gov.au

Internet: www.lwa.gov.au

© Commonwealth of Australia 2003

Disclaimer:

The information contained in this publication is intended for general use, to assist public knowledge and discussion and to help improve the sustainable management of land, water and vegetation. The information should not be relied upon for the purpose of a particular matter. Legal advice should be obtained before any action or decision is taken on the basis of any material in this document. The Commonwealth of Australia, the Australian Government Department of Agriculture, Fisheries and Forestry, the Department of the Environment and Heritage, Land & Water Australia, the authors, and the National Dryland Salinity Program and its partners do not assume liability of any kind whatsoever resulting from any person's use or reliance upon the content of this document.

Publication data: Practical Index of Salinity Models, User's Guide

Product code: ER030779

September 2003

CONTENTS

1	Introduction	4
1.1	About <i>PRISM</i>	4
1.2	Natural resource management planning in Australia.....	5
1.3	The value of tools, models and frameworks in planning.....	6
1.4	About the <i>User's Guide</i>	7
2	The planning process in Natural Resource Management	7
2.1	What is a Natural Resource Management Plan?	7
2.2	Why plan?	8
2.3	How to plan?	8
2.4	Skills and expertise for regional planning	10
2.5	What are 'tools, models and frameworks'?.....	10
2.6	The role of tools, models and frameworks in NRM.....	11
3	<i>PRISM</i>	12
3.1	The <i>PRISM</i> Database	12
3.2	Using <i>PRISM</i> for regional planning	13
3.3	Other uses for <i>PRISM</i>	15
4	Sources of expertise	15
4.1	National focus	15
4.2	Multi-jurisdictional.....	18
4.3	Universities.....	18
4.4	State/Territory agencies	20
4.5	Private sector	21
5	Maintaining <i>PRISM</i>	22
6	Acknowledgments	23

TABLES

Table 1: Key sources of expertise	16
---	----

FIGURES

Figure 1: Matrix for categorising items and expertise.....	8
--	---

1 Introduction

This *User's Guide* introduces people to regional planning for natural resource management and the role of *PRISM* (Practical Index of Salinity Models) in this process. The *PRISM* database and *User's Guide* are products of the National Action Plan for Salinity and Water Quality Initiative. This initiative will involve \$1.4 billion invested in natural resource management over the next five years.

Expert planning to get the maximum return from this investment includes using a range of planning tools, models and decision-making frameworks that can show the relationship between the money invested and the environmental improvements generated.

To help people become acquainted with these planning processes, the Australian Government has developed *PRISM*, a guide to the available tools, models and frameworks for regional natural resource planning. *PRISM* also presents the array of planning expertise available around Australia.

1.1 About *PRISM* online

1.1.1 What is it?

PRISM consists of two items – a database of models, tools and expertise, and this *User's Guide*.

This *User's Guide* describes:

- the National Action Plan for Salinity and Water Quality (the 'NAP') and the Natural Heritage Trust II, which will be important sources of investment for regional natural resource management planning;
- the planning process used in the NAP;
- the types of tools, models and frameworks used in planning, and how they can be assessed for different purposes;
- the expertise available for planning; and
- current activities in natural resource management planning in the States and Territories.

As well as the online database, an MS Access database or Excel spreadsheet is available on CD-ROM (order from Canprint 1800 776 616 - quote product code EC030615).

The database contains more than 90 different tools, models and frameworks being used by community groups, R&D organisations, State agencies and universities in devising solutions to natural resource management problems. Each entry describes the tool, model or framework, and provides information about where and how it can help in the planning process.

1.1.2 Who should use *PRISM*?

PRISM is designed to inform people interested in regional natural resource management planning. Likely users will be people in:

- regional organisations carrying out NAP and other forms of NRM planning;
- State agencies that are providing technical expertise;
- private organisations providing planning services;
- research organisations that want to keep track of developments in modelling and planning technologies; and
- Australian Government and State agencies that are responsible for ensuring that the right planning tools, models or frameworks have been used.

1.1.3 How should *PRISM* be used?

Essentially, *PRISM* will be able to identify people working on planning across the different disciplines; and, through interrogation of the database, provide information on what tools, models and frameworks are available, what they can be used for, and who knows about them.

1.2 Natural resource management planning in Australia

Natural resource management planning is occurring at all scales of decision-making - from national to neighbourhood; and across all disciplines – from social risk management to airborne geophysical analysis. Over the next five years, activity will be dominated by three major national-scale initiatives. *PRISM* is able to support planning activities in all three.

1.2.1 The National Action Plan

The **National Action Plan for Salinity and Water Quality (NAP)** is promoting the development of Integrated Natural Resource Management (INRM) plans to underpin future investment by governments and other stakeholders in NRM. These plans will build on existing regional NRM, salinity and water quality plans and strategies to target action to stabilise and reverse trends in dryland salinity and improve water quality while achieving broader NRM outcomes. The Australian Government, and State and Territory Governments will invest \$1.4 billion into natural resource management through these plans over the next five years.

1.2.2 The Natural Heritage Trust

The Australian Government's **Natural Heritage Trust** invested over \$1 billion in natural resource management projects from 1996/97 to 2001/02. The trust invested through 17 programs and provided funds directly to agencies and community groups. The Australian Government, and State and Territory Governments will continue to build on the outcomes of the earlier programs through the Natural Heritage Trust.

1.2.3 Murray-Darling Basin Commission programs

The Murray-Darling Basin contributes hugely to agricultural and industrial production, provides water and power to millions of Australians, and has priceless environmental values. To ensure that it can continue to contribute to Australia's welfare, the Australian Government and the four States that include the Basin within their boundaries have, through a specific Act of Parliament, formed the **Murray-Darling Basin Commission** to manage the waterways and their uses. The Commission invests funds in natural resource management planning and action through the States and community bodies.

1.3 The value of tools, models and frameworks in planning

Natural resource management planning is a difficult business. Actions taken in one place and at one time may cause a response many kilometres away and at a (very) much later date. Changing how land and water are used will affect not only the resources themselves, but the industries and human welfare that depend on their productivity. To try and make sense of the complexity, people use real data in 'tools and models' to mimic and predict the actual behaviour of the system being managed. Because a model of a simple or complex system can generate a range of options, each with different actions and outcomes; planning or decision-making 'frameworks' can be used to help people decide the option that best meets the desired bio-physical, economic and/or social requirements.

An immense amount of effort has been and is being put into developing tools, models and frameworks that can define whole-system function and predict the outcomes from actions taken to address NRM needs at regional and catchment scales, and help decide which management strategies and options to adopt. This is not easy work – researchers and modellers are forced to cope with imperfect data, long lags between action and effect (up to 50 years in some environments), enormous spatial variability, and models that can be at best only an approximation of the real world. However, this is vital work. Imperfect though this approach is, it is the best we have. Without a commitment to improving an understanding of the 'action-impact' relationships for specific situations, regional NRM strategies are likely to deliver uneven and unpredictable outcomes which do not address the relevant issues comprehensively. Without an assurance of the value of the actions, there will be little incentive for public investment and even less for private investment.

The NAP Board of Management has recognised the diversity of models and tools that already exist and the need for regional organisations and NRM investors to be better informed about what is available, and the expertise to assist in their applications. *PRISM* has been designed to address these needs.

1.4 About the *User's Guide*

- Section 1:** provides the background to the National Action Plan for Salinity and Water Quality, and outlines the purpose of the *User's Guide*.
- Section 2:** defines regional integrated natural resource management planning and discusses how 'tools, models and frameworks' are used in the planning.
- Section 3:** presents the structure and content of *PRISM*, with suggestions for its use to support the planning process.
- Section 4:** summarises the available planning expertise and its location.
- Section 5:** describes briefly the processes for updating *PRISM*.
- Section 6:** acknowledges those people who helped with the *User's Guide* and lists the references.

2 The planning process in Natural Resource Management

Effective integrated natural resource management is a complex process that requires an understanding of biophysical and socio-economic dynamics at the regional scale. It also requires a capacity for making substantial trade-offs between competing interests and outcomes. Through an iterative process of considering different action-outcome scenarios, the stakeholders involved in regional planning can work towards a plan that best meets their needs, which will have defined actions, outcomes and targets.

2.1 What is a Natural Resource Management Plan?

A plan for natural resource management for a local area, catchment, or region needs to address the broad issues of how the land, vegetation and water resources are used and managed and the implications for bio-physical, economic and social outcomes. There is no fixed 'recipe' for an NRM plan - the scope and content of plans will vary according to situation. At its most basic, an NRM plan must show how the available natural and human resources are used to progress towards desired goals for bio-physical, economic and social well-being.

An NRM plan cannot be static. Our knowledge of natural resources behaviour is increasing all the time, and the socio-economic desires and imperatives in our communities will change over time. Plans need regular review and modification to address changing circumstances.

2.2 Why plan?

There are three fundamental reasons for planning in natural resource management:

1. Natural resources are shared between users to generate multiple benefits. A logical approach to planning is required so that the process of sharing is equitable and the benefits distributed fairly.
2. Natural resources are basic and interactive components of natural ecosystems that occur at different spatial scales. Their management requires an appreciation of how these systems work and how an action in one part of a system causes a reaction in another part.
3. The management of natural resources must be integrated rather than fragmented, with decisions based on the best possible information and involving all those who use, manage and benefit from natural resources.

2.3 How to plan?

Planning needs to consider outcome areas or 'domains', stages in the planning process, and the scale at which planning needs to occur.

The conceptual framework for the planning process in the National Action Plan is shown in Figure 1. This provides the logic for organising the tools, models and frameworks for regional NRM planning.

Figure 1: Matrix for categorising items and expertise

Monitoring and review		Tools, models and frameworks allocated to the matrix, and analysed against evaluation criteria							
Implementation	Economic/social consequences								
Planning	Technical feasibility								
	Economic assessment – cost effectiveness								
	Prioritisation								
Baseline info	Biophysical process								
	Risk, awareness and aspirational goals								
	Socio-economic environment								
						Scale			
						Paddock-farm scale	Sub-catchment, medium catchment	Major catchment, region	Inter-region, national

2.3.1 Outcome areas or ‘planning domains’

The matrix in Figure 1 is ‘layered’ to account for six outcome areas relevant to the National Action Plan. These outcome areas are:

- land resource condition and trends;
- infrastructure condition and trends;
- surface water quantity and quality and trends;
- groundwater status and trends;
- biodiversity condition and trends; and
- socio-economic status and trends.

2.3.2 Stages of planning

The model in Figure 1 presents four over-arching planning stages.

Baseline information on the existing situation and the desired goals

- Understanding and describing the socio-economic environment, its opportunities and challenges for NRM;
- Assessing the level of NRM awareness and risks, and defining the aspirational goals for the region/locality;
- Understanding and describing the bio-physical processes that are at work.

Planning to identify and prioritise options

- Assessing the impact and technical feasibility of a range of options for the use and management of natural resources that will affect the condition of the natural resources;
- Assessing the economic impact of these options and their relative cost-effectiveness in achieving improvement in the condition of the natural resources;
- Developing a transparent basis for applying community values and desires to the process of choosing preferred options from all those available.

Identifying the economic and social consequences from implementing the plan

- Processes for ensuring that the consequences of actions taken to improve the condition of the natural resources are understood, and managed properly.

Monitoring progress and reviewing the plan

- Monitoring the inputs, outputs and outcomes in plan implementation to answer the question: ‘Has the plan been implemented properly?’
- Using this information to develop measures of efficiency and effectiveness to answer the questions: ‘Have we developed the best plan?’ ‘Is change needed?’

2.3.3 Spatial scales of planning

In Figure 1, the spatial scale is presented as varying between paddock and national scale. The point of departure for a planning/evaluation exercise will vary among the people involved. For some it may be appropriate to commence planning at the paddock scale and work 'upwards'; other approaches describe the catchment as a whole and disaggregate this to determine the response of component parts. For others involved in assessing socio-economic outcomes, it may be sensible to commence at the medium catchment scale and work 'outwards' in both spatial directions.

2.4 Skills and expertise for regional planning

A wide array of expertise will be required for regional strategic planning. This process, which under the NAP will be core business for government investment, will require the following skills:

- **strategic planning;**
- **scenario development and assessment;**
- **trade-off negotiation;**
- communication;
- **technical expertise – bio-physical, social, institutional;**
- **economics, particularly resource economics;**
- knowledge broking; and
- community-based championing and promotion.

The items highlighted in **bold** are those addressed in *PRISM*.

2.5 What are 'tools, models and frameworks'?

PRISM has been developed by the Australian Government Department of Agriculture, Fisheries and Forestry ([DAFF](#)) and the Department of the Environment and Heritage ([DEH](#)) as a source of information about the array of tools, models and frameworks to assist regional natural resource management planning, both in the NAP and to meet other needs.

These separate terms, and their role in NRM planning require explanation.

2.5.1 A 'tool'

A tool is a means of interpreting the system being managed and an aid to routine analysis. There are two types of tools:

1. A tool may not seek to link inputs and outputs in a rigorous way, but instead provides some clarity about how the system functions or where the pressure points for potential action are located. An example of a tool for this purpose is

Benefit-Cost Analysis, which enables an evaluation of the net present value of different options for management.

2. Datasets are another type of tool that can help with understanding what the resources are, and where they occur in the landscape. Significant advances have been made in our ability to capture the richness and diversity of our natural resources in maps and plans that can be interrogated with the aid of Geographic Information Systems. Examples include the information assembled through the [National Land and Water Resources Audit](#) and the data being collected through intensive biological surveys across Australia.

2.5.2 A 'model'

A model is a simplified representation or abstraction of reality. Simplification is needed because reality is too complex to copy exactly and because much of the complexity is irrelevant to the specific problem. Model construction needs to consider the trade-off between representation and simplification, which are contradictory concepts. An example of a model is MODFLOW, which represents groundwater behaviour at a localised scale as affected by different management regimes.

2.5.3 A 'framework'

Frameworks to help the planning process are less easily defined. Essentially a planning framework provides a logical and transparent structure that allows all of the stakeholders to be engaged, the options to be developed and choices to be made between the options. This latter stage is critical – at the end of the day, an NRM plan needs to specify outcomes, targets and actions that have general support or at least acceptance among the stakeholders. To this end, all of the States and Territories are developing 'decision-making frameworks' that assist stakeholders to assess the options against goals and decide which will deliver the best outcomes.

2.6 The role of tools, models and frameworks in NRM

The process of adaptive management, which is at the heart of regional INRM planning, requires understanding of system function (in economic, bio-physical and social terms) that are able to relate deliberate management actions to outcomes. Models of system behaviour allow this understanding to be developed. Tools are required to allow interpretation of the systems being managed and also to encourage engagement in their management and the generation of aspirational goals. Investment decision-making frameworks are required to allow stakeholders to choose between a range of options that will take the region towards the goals. Having used these frameworks to decide on the management action to be taken, models of the system will then predict the outcomes that can be re-framed as targets. *PRISM* has been designed so that it can be updated to capture the adaptive learning that occurs through the use of the tools, models and frameworks described.

An ability to evaluate the impact of management actions is critical. Prior evaluation of the program requires using the models to determine the anticipated outcomes (targets) from a range of actions. Having decided on the action to be taken, post-action evaluation of the program will reveal whether the actions undertaken actually delivered the planned outcomes, or whether the targets were achieved. Failure to achieve the target will be caused either by a failure to implement the action properly, or because the assumptions about the system being modelled are wrong. In the latter case, adaptation is required to the description of the system.

3 PRISM

PRISM currently has over 100 tools, models and frameworks available for scrutiny. Its core is an MS Access database with evaluation criteria as fields for interrogating the information (see Section 3.2). The MS Access database was created to store the information obtained from the interviews and to enable efficient and specific retrieval.

This section of the document should be read as a 'how to' guide to access the information in *PRISM*.

3.1 The *PRISM* Database

The main approach to operating *PRISM* will be via the search capability in the MS Access database. The main search fields are:

- **Model/tool summary** – provides summary data for all discrete items (tools/models/frameworks) entered.
- **Finding Model/tool** – has a cascading set of criteria that can be used to locate items with particular specifications
 - *Acronym and full name*
 - *Key word search*
 - *Category search* – as per major criteria only
- Availability of temporal and spatial datasets
- Level of confidence – that the model/tool/framework reflects key and relevant processes. Level of verification/validation through peer review etc.
- Empirical and scientific testing – of the model/tool/framework
- Evidence of application – in environments that are relevant to region/community needs for NAP-scale planning
- Logical flows – from the output from the model/tool/framework into the next step in the planning process
- Transparency and credibility – of the output ('the answer')

- Commitment to its use – for NAP planning as part of government policy and action
- Availability of skills and time – for application to NAP planning.
- *Locating a specific item* – as per the matrices presented in the previous tables
 - By domain (land resource, infrastructure, surface water, groundwater, biodiversity, socio-economic)
 - By stage in planning process (baseline information (three choices), planning (three choices), implementation, monitoring and evaluation)
 - By spatial scale (paddock to farm to townsite, sub-catchment to medium catchment, major catchment to region, inter-region to national).
- **Reports** – It is possible to search the raw database via the MA Access 'Reports' function for the occurrence of any text. This is very useful.

3.2 Using *PRISM* for regional planning

PRISM will be most useful to four key client groups in assisting in answering questions related to NAP or any other regional natural resource management planning (e.g. NHT). The questions will differ according to the client group's interest in tools, models and frameworks and the availability of expertise. Examples of questions and answers that will occur through the planning process are shown below for the key client groups.

3.2.1 Australian Government NRM agencies

The Australian Government's interest is ensuring that proper processes have been used in a rigorous manner in developing the investment plan. Suggested questions and answers follow:

- *Have the 'right' items been used in developing realistic plans?* Answered by querying domain, planning stage and spatial scale fields and major criteria.
- *Have they been properly used, with sufficient support from data and expertise?* Answered by querying data availability and matching expertise listed to expertise used.
- *How much confidence can we (the Australian Government as investor) have in the planned outcomes given planned inputs?* Answered by scrutiny of the items and expertise used against their listed capabilities and data availability.
- *What can we (the Australian Government) use independently to validate the submitted investment plans?* Answered by determining an appropriate suite of models and expertise for plan evaluation.

3.2.2 Other NRM agencies/ institutions

The interests of other NRM agencies and institutions are likely to be tracking developments and experiences in the use of items and expertise, in maintaining communication across areas of expertise and in identifying opportunities for inter-

agency collaboration in R&D and application. Suggested questions and answers follow:

- *What is happening in other jurisdictions and environments?* Answered by querying major criteria, domain, stage of planning and spatial scale.
- *Where is there the most action in item development?* Answered by querying contacts with required expertise.
- *What is being applied in similar situations and across the stages in the planning process?* Answered by querying, domain, stage of planning and spatial scale.
- *What opportunities are here for collaboration in further item development?* Answered by querying items and expertise used in situations where expertise is required.

3.2.3 NRM (including NAP) regional governance

NRM regional governance and their communities are the ultimate beneficiaries of the planning and implementation for salinity and water quality management. They are *the* key stakeholders. In many regions, logistical and procedural arrangements for planning are well advanced. It is important that NRM regional governance is able to track developments both in their own and other regions. Suggested questions and answers follow.

- *What has worked in similar environments?* Answered by querying major criteria, domain, stage of planning and spatial scale.
- *Who outside our normal range of providers may be able to assist us?* Answered by querying expertise and items similar to those being used.
- *Are we using suitable items for our planning purposes?* Answered by querying major criteria, domain, stage of planning and spatial scale.
- *What else do we need to do?* Answered by querying domain, stage of planning and spatial scale.

3.2.4 Planning expertise and service providers

The interests of planning expertise and service providers are likely to be in marketing opportunities for R&D and service provision, and in identifying items for use and expertise for collaboration in service delivery.

Suggested questions and answers follow:

- *What items and expertise are available to assist us in given situations?* Answered by querying the database and direct contact with sources of expertise.
- *Who else is working in this field?* Answered by querying the database and direct contact with sources of expertise.
- *Where are regional groups 'at' in the planning process?* Answered by querying the regional summaries database and direct contact with sources of expertise.
- *What is state-of-the art NAP planning?* Answered by querying major criteria, domain, stage of planning and spatial scale, and sources of expertise to build a quick picture of the state-of-the-art.

- *What sort of models that are not data hungry can be run on a personal computer?* Answered by querying the database for items in respect of their data availability and hardware requirements.

3.3 Other uses for *PRISM*

PRISM will be useful for two other purposes.

3.3.1 Education and training

People can access the database and expertise to assist in developing training/education programs in NRM planning and system behaviour under different types of land use and management. Individuals with a personal interest in the use of tools, models and frameworks to address NRM problems can use *PRISM* to pursue different lines of inquiry.

3.3.2 Tool, model and framework R&D

Model development is a dynamic science. *PRISM* can assist in providing an up-to-date view of what is happening and where different tools, models and frameworks are being used. This will assist in setting research priorities for new model development, for building linkages between existing models, or in making datasets available.

4 Sources of expertise

The sources of institutional expertise for NAP planning are listed in Table 1. This matrix disaggregates the sources of expertise by type and location of agency/organisation and by disciplinary focus. The sections below provide points of contact for the agencies/institutions. In some cases, these are first points of contact only (electronic addresses); in others specific individuals are listed.

This information is not fully comprehensive and inevitably the details will change over time. It should be seen as a snapshot and point of natural resource management planning in mid-2002.

4.1 National focus

4.1.1 Multi-disciplinary

National Dryland Salinity Program (<http://www.ndsp.gov.au>); Phone: (02) 6263 6000

Australian Government Department of Agriculture, Fisheries and Forestry
(formerly Agriculture, Fisheries and Forestry – Australia) (<http://www.daff.gov.au>);
Phone: (02) 6272 3933

Australian Bureau of Agricultural and Resource Economics

(<http://www.abare.gov.au>); Phone: (02) 6272 2027; (Contact: Colin Mues)

Australian Greenhouse Office (<http://www.greenhouse.gov.au>); Phone: (02) 6274 1888; (Contact: Gary Richards)

Bureau of Rural Sciences (<http://www.brs.gov.au>); Phone: (02) 6272 4282; (Contact: Allan Curtis, Heather Aslin)

CSIRO (<http://www.csiro.au>); Phone: 1300 363 400; Land and Water (Contact: Mike Young); Plant Industry; Sustainable Ecosystems (Contact: Doug Cocks)

Table 1: Key sources of expertise

Disciplinary focus	Types of agencies/institutions containing the expertise				
	National	Multi-jurisdictional	Universities	State/Territory agencies ¹	Private sector
Multi-disciplinary	CSIRO Sustainable Ecosystems; Bureau of Rural Sciences; Land & Water Australia; DAFF; Research and Development Corporations	CRC for Plant-based Management of Dryland Salinity; MDBC	ICAM group, CRES, ANU	NSW – DIPNR, NSW Ag, NPWS; NT – DPI; Qld – DNRM, DPI; SA – PIRSA, DEH, Vic – DPI, DSE; WA – DAWA, CALM, DEWCP	Environment Institute of Australia
Social	CSIRO Land and Water – Australian Research Centre for Water in Society; CSIRO Sustainable Ecosystems; Bureau of Rural Sciences; Land & Water Australia		Charles Sturt University; University of Queensland; James Cook University; University of Tasmania; Murdoch University	NSW – DIPNR, NSW Ag, NPWS; NT – DPI; Qld – DNRM, DPI; SA – PIRSA, DEH; Vic – DPI, DSE; WA – DAWA, CALM, DEWCP	Environment Institute of Australia
Economic	ABARE; CSIRO Sustainable Ecosystems; Bureau of Rural Sciences; CSIRO Land and Water		University of WA	NSW – DIPNR, NSW Ag, NPWS; NT – DPI; Qld – DNRM, DPI; SA – PIRSA, DEH, Vic – DPI, DSE; WA – DAWA, CALM, DEWCP	Environment Institute of Australia
Bio-physical	CSIRO Land and Water; CSIRO Plant Industry; CSIRO Sustainable Ecosystems; Land & Water Australia; DEH; AGO, Geoscience Australia	CRC for Catchment Hydrology; CRC for Landscape Environments and Mineral Exploration	Centre for Water Research, UWA; ICAM group, CRES, ANU	NSW – DIPNR, NSW Ag, NPWS; NT – DPI; Qld – DNRM, DPI; SA – PIRSA, DEH, SA Water; Vic – DPI, DSE; WA – DAWA, CALM, DEWCP	Environment Institute of Australia

¹ The key State and Territory agencies that have a primary responsibility for NRM are listed. Others that may have NRM as part of their responsibilities are not listed.

Australian Government Department of the Environment and Heritage
(formerly Environment Australia) (<http://www.deh.gov.au>); Phone: (02) 6274 1111;
Environment Resource Information Network

Land & Water Australia (<http://www.lwa.gov.au>); Phone: (02) 6263 6000 National
Dryland Salinity Program (NDSP); Redesigning Australian Agricultural Landscapes
(RAAL)

Grains Research and Development Corporation (<http://www.grdc.com.au>);
Phone: (02) 6272 5525

4.1.2 Social

Bureau of Rural Sciences (<http://www.brs.gov.au>); Phone: (02) 6272 4282;
(Contacts: Allan Curtis, Heather Aslin)

CSIRO (<http://www.csiro.au>); Phone: 1300 363 400; Land and Water - Australian
Research Centre for Water in Society; (Contact: Geoff Syme); Sustainable
Ecosystems (Contact: Nick Abel)

4.1.3 Economic

Australian Bureau of Agricultural and Resource Economics;
(<http://www.abare.gov.au>); Phone: (02) 6272 2027; (Contact: Colin Mues)

Bureau of Rural Sciences (<http://www.brs.gov.au>); Phone: (02) 6272 4282;
(Contact: Michele Barson)

CSIRO (<http://www.csiro.au>); Phone: 1300 363 400; Land and Water (Contact:
Mike Young); Sustainable Ecosystems (Contact: Nick Abel, Mark Howden)

4.1.4 Bio-physical

Australian Greenhouse Office (<http://www.greenhouse.gov.au>); Phone: (02)
6274 1888; (Contact: Gary Richards)

CSIRO (<http://www.csiro.au>); Phone: 1300 363 400; Land and Water (Contact:
Glen Walker, Tom Hatton); Sustainable Ecosystems (Contact: Barney Foran)

Australian Government Department of the Environment and Heritage
(formerly Environment Australia) (<http://www.deh.gov.au>); Phone: (02) 6274 1111;
Environment Resource Information Network; Biodiversity Unit; (Contact: Andrew
Taplin)

Geoscience Australia (<http://www.geoscience.gov.au>); Phone: (02) 6249 9111;

4.2 Multi-jurisdictional

4.2.1 Multi-disciplinary

Cooperative Research Centre for Plant-based Management of Dryland Salinity; (<http://www.crcsalinity.com>); Phone: (08) 9380 8559; (Contact: Phil Cocks)

Murray-Darling Basin Commission (<http://www.mdbc.gov.au>); Phone: (02) 6279 0100; (Contact: Sharon Davis)

4.2.2 Social

Greening Australia (<http://www.greeningaustralia.org.au>); (Contact: Trish Gowdie, Greening Australia (WA))

4.2.3 Economic

Cooperative Research Centre for Plant-based Management of Dryland Salinity; (<http://www.crcsalinity.com>); Phone: (08) 9380 8559; (Contact: David Pannell)

4.2.4 Bio-physical

Cooperative Research Centre for Plant-based Management of Dryland Salinity; (<http://www.crcsalinity.com/>); Phone: (08) 9380 8559; (Contact: Keith Smettem)

Cooperative Research Centre for Catchment Hydrology; (<http://www.crc.gov.au/centres/environ/catchment.htm>); Phone: (03) 9905 2704; (Contact: Rob Vertessy)

Cooperative Research Centre for Landscape Environments and Mineral Exploration; (<http://leme.anu.edu.au>); Phone: (08) 6436 8695; (Contact: Ray Smith)

Greening Australia (<http://www.greeningaustralia.org.au>); Phone: (02) 6281 8585; (Contact: Rob Lambeck, WA)

4.3 Universities

4.3.1 Multi-disciplinary

Integrated Catchment Assessment and Management Centre; (<http://incres.anu.edu.au/icam/>); Phone: (02) 6125 4742; (Contact: Tony Jakeman)

Centre for Resource and Environmental Studies (<http://cres.anu.edu.au>);
Phone: (02) 6125 4742; (Contact: Tony Jakeman)

Australian National University (<http://www.anu.edu.au>); Phone: (02) 6125 0666;
(Contact: Barry Croke)

4.3.2 Social

Charles Sturt University (<http://www.csu.edu.au>); Phone: (02) 6051 9945;
(Contact: Allan Curtis)

Murdoch University (<http://www.murdoch.edu.au>); Department of Environmental
Science; Institute for Sustainable Technology Policy; Phone: (08) 360 6000;
(Contact: Sue Moore)

University of Queensland (<http://www.uq.edu.au>); Phone: (07) 3365 1111;
(Contact: Helen Ross, Gatton Campus)

James Cook University (<http://www.jcu.edu.au>); Phone: (07) 4781 4111;
(Contact: Keith Fenton)

University of Tasmania (<http://www.utas.edu.au>); Phone: (03) 6226 2999;
(Contact: Frank Vanclay, Ph 03 6226 2618)

4.3.3 Economic

The University of Western Australia (<http://www.uwa.edu.au>); Phone: (08) 9844
8659; (Contact: David Pannell)

4.3.4 Bio-physical

Centre for Water Research, The University of Western Australia;
(<http://www.cwr.uwa.edu.au>); Phone: (08) 9380 3085; (Contacts: Murugesu 'Siva'
Sivapalan, Keith Smettem)

Centre for Resource and Environmental Studies, ANU (<http://cres.anu.edu.au>);
Phone: (02) 6125 4742; (Contacts: Tony Jakeman, Barry Croke)

Integrated Catchment Assessment and Management Centre, ANU;
(<http://incres.anu.edu.au/icam/>); Phone: (02) 6125 4742; (Contact: Tony Jakeman)

4.4 State/Territory agencies

Because many of the State and Territory agencies contain the full suite of expertise shown in Table 1, for ease of presentation the listings here are given by State and not discipline.

4.4.1 New South Wales

Department of Infrastructure, Planning and Natural Resources (formerly Department of Land and Water Conservation) (<http://www.dlwc.nsw.gov.au>); Phone: (02) 9228 6111; (Contacts: David Eyre, Mark Littleboy, Geoff Podger)

NSW Agriculture (<http://www.agric.nsw.gov.au>); Phone: (02) 6391 3100; (Contact: Harley Smith)

National Parks and Wildlife Service (<http://www.npws.nsw.gov.au>); Phone: (02) 9895 7440; (Contact: Julianne Smart)

4.4.2 Northern Territory

Department of Infrastructure, Planning and Environment (<http://www.lpe.nt.gov.au>); Phone: (08) 8999 3630; (Contact: Ian Smith)

4.4.3 Queensland

Department of Natural Resources and Mines (<http://www.nrm.qld.gov.au>); Phone: (07) 3896 3111; (Contacts: Tim Danaher, David Freebairn, Ian Gordon, Mike Grundy)

Department of Primary Industries (<http://www.dpi.qld.gov.au/home/default.html>); Phone: (07) 3404 6999; (Contacts: Y Abawi, Graeme Hammer and H Meinke)

Agricultural Production Systems Research Unit (APSRU) (<http://www.apsru.gov.au>); Phone: (07) 4688 1394; (Contacts: David Freebairn, Graeme Hammer)

4.4.4 South Australia

Primary Industries and Resources, South Australia; Department of Environment and Heritage (<http://www.pir.sa.gov.au>); Phone: (08) 8303 7722; (Contact: Kym Nicholson)

4.4.5 Tasmania

Department of Primary Industries, Water and Environment (<http://www.dpiwe.tas.gov.au>); Phone: 1300 368 550; (Contacts: Mike Temple-Smith, Greg Pinkard)

4.4.6 Victoria

Department of Sustainability and Environment (formerly Department of Natural Resources and Environment) (<http://www.dse.vic.gov.au>); Phone: (03) 9637 8000; (Contacts: Craig Beverly, Toni Harper, Carl Smith, Mark Eigenraam)

Department of Primary Industries (formerly Agriculture Victoria) (<http://www.dpi.vic.gov.au>); Phone: (03) 9637 8000; (Contact: David Nash)

4.4.7 Western Australia

Department of Agriculture (<http://www.agric.wa.gov.au>); Phone: (08) 9368 3333; (Contacts: Bob Nulsen, Richard George (bio-physical), Ross Kingwell (economics), Noel Schoknecht (data sources))

Department of Conservation and Land Management (<http://www.calm.wa.gov.au>); Phone: (08) 9334 0333; (Contacts: Ken Wallace, Keith Claymore (management), Greg Keighery (bio-physical data))

Department of Environmental Protection (formerly Department of Environment, Water and Catchment Protection; Waters and Rivers Commission, and Department of Environmental Protection); (<http://www.wrc.wa.gov.au> and <http://www.environ.wa.gov.au>); Phone (WRC): (08) 9278 0300; Phone (DEP): (08) 9222 7000; (Contacts: Don McFarlane, Tim Sparks (management), Robin Smith (bio-physical))

Department of Planning and Infrastructure (<http://www.dpi.wa.gov.au>); Phone: (08) 9216 8000;

Main Roads Western Australia (<http://www.mrwa.wa.gov.au>); Phone: (08) 9323 4111

4.5 Private sector

Rather than list the large array of private consultants and organisations available to assist with natural resource management planning, readers are directed to the professional organisation as a first point of entry in locating private service deliverers.

Environment Institute of Australian (<http://www.eia.asn.au>)

The Professional Association for Environmental Practitioners

GPO Box 211D, Melbourne, Victoria 3001

Phone: (03) 9654 7473

5 Maintaining *PRISM*

The Australian Government Department of Agriculture, Fisheries and Forestry and the Department of the Environment and Heritage want to see *PRISM* develop as a source of planning assistance beyond the immediate needs of the National Action Plan. To do this, the database of tools, models and frameworks, and the list of planning expertise will be allowed to grow.

Organisations or individuals with tools, models, frameworks and expertise that could benefit regional NRM planning can apply to have the applicable details added to *PRISM* and to this *User's Guide*.

Contact should be made with:

Land & Water Australia

Postal address: GPO Box 2182,
Canberra ACT 2601

Office location: Level 1, The Phoenix
86 Northbourne Avenue
Braddon ACT 2612

Telephone: 02 6263 6000
Facsimile: 02 6263 6099
Email: Land&WaterAustralia@lwa.gov.au
Internet: www.lwa.gov.au

6 Acknowledgments

The Consultant Team acknowledges with gratitude the assistance provided by:

- The Australian Government Department of Agriculture, Fisheries and Forestry; (formerly Agriculture, Fisheries and Forestry Australia);
- Australian Bureau of Agricultural and Resource Economics;
- Australian Greenhouse Office;
- Australian National University;
- Bureau of Rural Sciences;
- Charles Sturt University, Albury;
- The Australian Government Department of Transport and Regional Services;
- Cooperative Research Centre for Catchment Hydrology;
- Cooperative Research Centre for Plant-based Management of Dryland Salinity;
- CSIRO Land and Water;
- CSIRO Sustainable Ecosystems;
- Department of Agriculture, WA;
- Department of Environmental Protection; (formerly Department of Environment, Water and Catchment Protection, WA);
- Department of Land Administration, WA;
- Department of Infrastructure, Planning and Natural Resources (formerly Department of Land and Water Conservation, NSW);
- Department of Sustainability and Environment (formerly Department of Natural Resources and Environment, Victoria);
- Department of Natural Resources and Mines, Queensland;
- The Australian Government Department of the Environment and Heritage (formerly Environment Australia);
- Land & Water Australia;
- Murdoch University;
- Murray-Darling Basin Commission;
- NSW Agriculture;
- Phil Dyson and Associates;
- Primary Industries and Resources, South Australia;
- Townley and Associates Ltd;
- University of Melbourne;
- University of Western Australia;
- Water and Environmental Consultants Pty Ltd