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Principles for riparian lands management

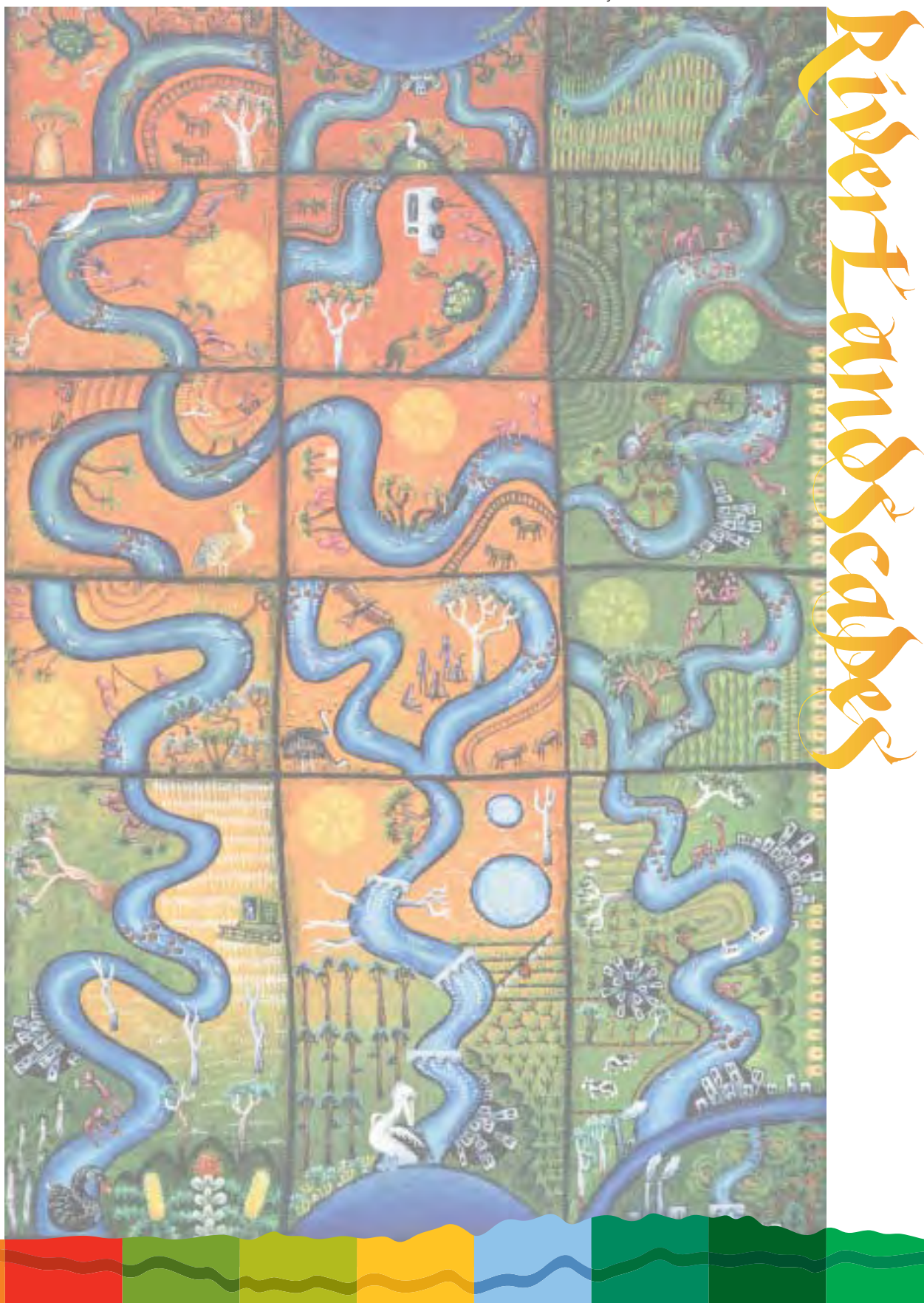


River and cox

*Together...
we can restore, protect
and enhance our river
landscapes for present
and future generations.*

Principles for riparian lands management

Edited by Siwan Lovett and Phil Price





Principles for riparian lands management

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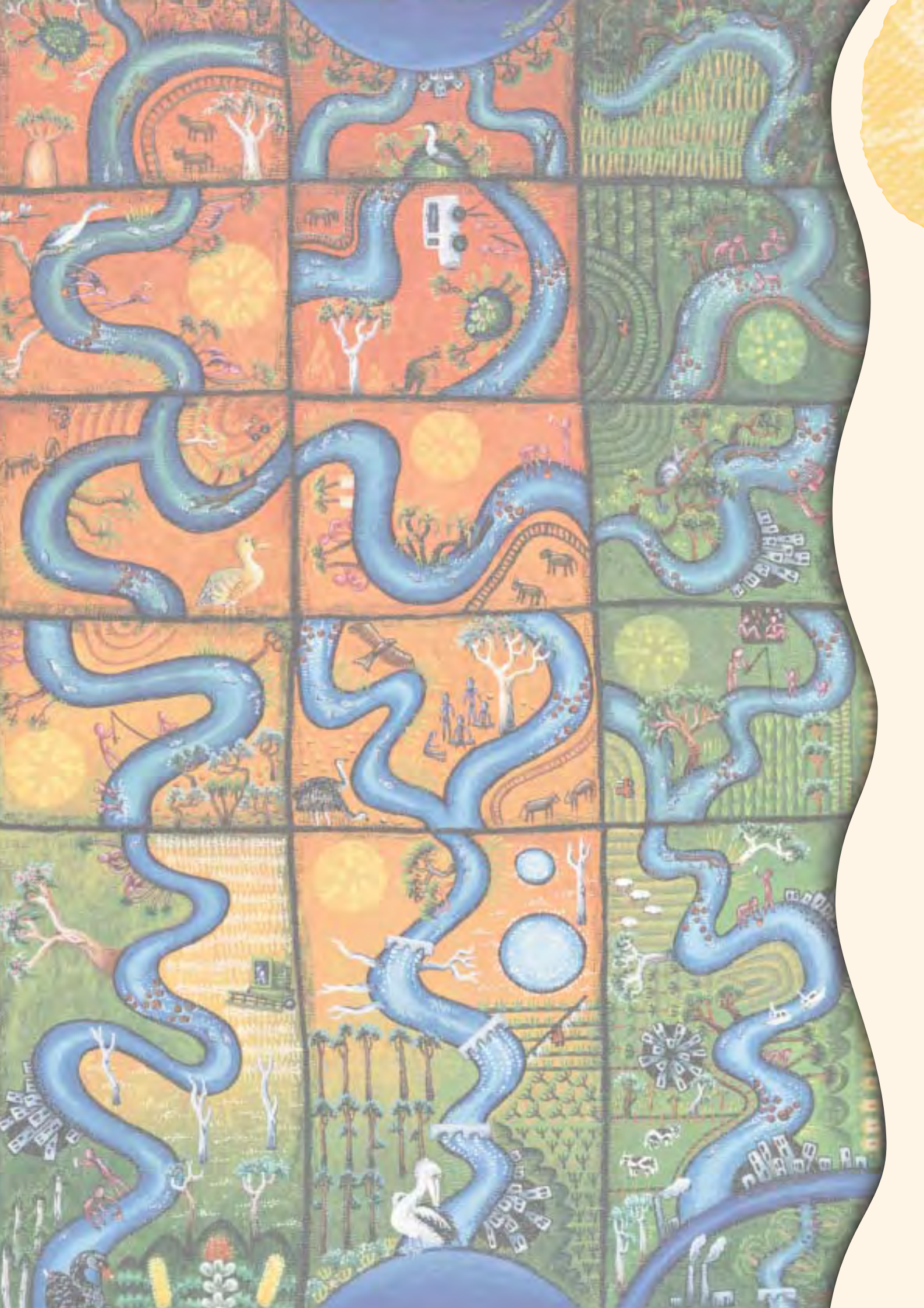
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FOREWORD



In 1993, the Land & Water Australia Board (then the Land & Water Resources Research & Development Corporation) agreed to fund the National Riparian Lands R&D Program. This followed a study that showed although riparian zone processes were thought to be crucial for healthy rivers, there was very little published Australian data about these processes, or about how riparian land should be managed to maintain its key functions. Phase 1 of the Program ran for nearly seven years in total. It had three sub-programs, two based on scientific experimentation and one on practical application through a series of demonstration projects. Phase 1 had funding of \$4.6 million from Land & Water Australia, \$0.7 million from third parties (mainly state agencies) and \$2.3 million from research organisations. It was guided by an advisory committee with representation from Commonwealth, state and territory agencies. This group played an important role in making sure the R&D responded to issues faced by river managers, and also in taking research results back into agency policy and programs. Phase 1 also started the strong communications effort that has characterised the entire Program, with a series of *River and Riparian Management Fact Sheets*, *River and Riparian Management Technical Guides*, and the *Riparian Land Management Technical Guidelines* (1999) which summarised both the scientific knowledge at the time and provided practical guidance in riparian management, as well as a summary of relevant legislation. These were complemented by the *RipRap* newsletter and establishment of the www.rivers.gov.au website.

Phase 1 provided for the first time a sound, scientific underpinning on which to base good riparian management. Land & Water Australia decided to fund a second phase of the Program to translate this research into management practices that could be used by agencies, rural industries, land holders and community groups. A series of workshops with agencies and industry bodies identified 11 management issues that have been the focus of work within Phase 2, which ran from 2000 until 2005, with a harvest year in 2006 to complete the synthesis and communication of new information. Funding for Phase 2 was \$3.5 million from Land & Water Australia, \$1.1 million from third parties, and \$1.3 million from research organisations. The range of communication materials has been expanded and earlier editions updated, and several industry-specific guides on sound riparian management have been published through collaboration with the Sugar and Cotton R&D Corporations and Australian Wool Innovation.

This large, national investment, equivalent to \$1 million per year over 13 years, has greatly increased the understanding and measurement of important riparian processes, enabling sound management practices to be developed and used with confidence. It has also been instrumental through its communication effort in lifting the profile of riparian and river management within rural communities and industries.

Principles for Riparian Lands Management reviews the science underpinning recommended management practices, and updates the *Riparian Land Management Technical Guidelines* published in 1999. The chapters are based on the main aspects of riparian land management, and summarise Australian R&D from within and beyond the National Riparian Lands R&D Program, as well as related findings from overseas. *Principles* has been developed to provide advisers and facilitators, state and territory agency, and local government staff, with information that will help them in working with groups and individual landholders to design and implement best-practice riparian management. The document is intended to have a national scope, but as Australia has a huge diversity of environments, it is not possible to be prescriptive about what to do in every region. The aim is to provide the science that will empower those with local knowledge to make appropriate local decisions.

The authors of the chapters are mainly the researchers who conducted the work, and we would like to acknowledge the immense contribution these people have made to the success of the National Riparian Lands R&D Program. We would also like to thank all those people across Australia who have been involved with our demonstration projects, used our products, contributed to our research and worked to protect and restore our riparian environments. It has been a pleasure and a privilege to work on the National Riparian Lands R&D Program and we hope *Principles for Riparian Lands Management* reflects the effort, insights and progress we have made together in better understanding and managing riparian lands across Australia.

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Structure and characteristics of riparian lands

Phil Price and Wendy Tubman¹

Summary

- ~ Riparian land is defined here as 'any land which adjoins, directly influences, or is influenced by a body of water'. The body of water could be a creek or stream (even if it flows only occasionally), a river, a lake, or a wetland. There is no rule of nature that defines the 'width' of riparian land: the width of interest or concern is largely determined by the particular landscape and by management objectives.
- ~ Riparian land is important because it is ecologically and economically productive.
- ~ Riparian land is vulnerable and is the 'last line of defence' for aquatic ecosystems against the impacts of land use elsewhere in the catchment.
- ~ Since European settlement, riparian land in Australia has been subjected to considerable degradation, much of which is associated with the clearing of native vegetation for agricultural or urban development, or with un-managed grazing by domestic stock or feral/native animals.
- ~ Fortunately, the importance of managing riparian land well is increasingly being recognised, and protection, rehabilitation and restoration work is being undertaken at local, regional, state and territory, and national levels.

¹ Wendy Tubman was co-author of this chapter in the previous edition.

1.1 What is riparian land?

Riparian land can be defined in a number of ways — how it is defined in particular situations largely depends on why it is being defined. For example, for administrative or legal purposes riparian land has sometimes been defined as a fixed width alongside designated rivers and streams. For management purposes this definition is not very useful: in places, the band identified may be too narrow to include all the land influencing the stream; in other places, it may be wider than is necessary. It would clearly not be helpful to have the same riparian width designated for a small upland tributary as for the large, main stem of a river in its floodplain. Definitions based on land use are similarly of limited use for management purposes. This is because what the land is used for often pays little attention to protecting the natural processes fundamental to riparian land.

This publication aims to help people improve and protect the health of riparian land (including associated waterbodies). As a result, the definition used here is in terms of the roles — or functions — of such land.

Using the functional approach, riparian land is defined as:

‘any land which adjoins,
directly influences, or
is influenced by a body
of water’.

With this definition, riparian land includes:

- ~ land immediately alongside small creeks and streams (even if they flow only occasionally), including the bank itself,
- ~ land alongside major rivers including the bank,
- ~ gullies and dips which sometimes run with surface water that finds its way into a nearby watercourse,
- ~ areas surrounding lakes, reservoirs, and large farm dams, and
- ~ wetlands on river floodplains which interact with the river in times of flood.

It is important to remember that there is no single law of nature that defines the width of riparian land or of buffer strips within riparian land, as the width is determined largely by the particular landscape and by management objectives. For example, the riparian width required to trap sediment from upslope may be a fraction of that required for wildlife habitat, yet both are legitimate objectives for riparian management. One of the aims of

Photo courtesy North Central
Catchment Management Authority.

Photo Michael Douglas.



Photo Siwan Lovett.



Photo Alex Meehan.

Photo courtesy NSW Murray
Wetlands Working Group.

For more information about managing riparian land to achieve different management objectives

'Managing riparian widths', *River and Riparian Management Fact Sheet*, no. 13, Price, P., Lovett, S. & Lovett, J. 2005.

'Managing riparian land to achieve multiple objectives', *RipRap*, edition 23, Lovett, S. (ed.) 2003.

Managing riparian land for multiple uses — Robins, L. (ed.) 2002.

As well as specific industry guidelines on managing riparian lands to achieve multiple objectives in the cotton, sugar and wool industries. All these publications are available on the www.rivers.gov.au website.

this publication is to help people make informed choices about the riparian widths appropriate to their particular situation and management objectives.

Because of the complex interactions between land and water in riparian areas, this publication deals with both the land around water bodies (riparian land) and the water itself.

1.2 The importance of riparian land

Productivity and vulnerability

Riparian land is important because it is often the most fertile and productive part of the landscape, in terms of both agricultural production and natural ecosystems. It often has deeper and better quality soils than the surrounding hill slopes due to past erosion and river deposition and, because of its position lower in the landscape, often retains moisture over a longer period.

Riparian land generally supports a higher diversity of plants and animals than the surrounding hillslopes. This is a result of its wide range of habitats and food types, its proximity to water, its less extreme microclimate and its ability to provide refuge. Many native plants are found only, or primarily, in riparian areas, and these areas are also essential to many animals for all or part of their lifecycle. Riparian land provides a refuge for native plants and animals in times of stress, such as drought or fire.

The photos at left show different types of riparian land.



Intact riparian area with natural processes functioning to provide terrestrial and in-stream habitat for a range of organisms. Photo Mike Wagg.

From an aquatic perspective, vegetation on riparian land regulates in-stream primary production through shading (reduced light and water temperature); supplies energy and nutrients (in the form of litter, fruits, terrestrial arthropods and other organic matter) essential to aquatic organisms; and provides essential aquatic habitat by way of large pieces of wood that fall into the stream and through root-protection of undercut banks.

In addition to being productive, riparian land is often a vulnerable part of the landscape — being at risk of damage from cultivation or over-grazing and from natural events such as floods. The combination of productivity and vulnerability means that careful management of riparian lands is vital for the conservation of Australia's unique biodiversity, as well as for sustainable agricultural productivity.

The interaction between land and water

There are many types of interaction between riparian land and adjacent waterways. For instance, a tree on riparian land may fall into a stream, creating new aquatic habitat; riparian land can 'buffer' streams against sediment and nutrients washing off agricultural land; and riparian land can be a source of leaf litter and insects that fall into a stream and become food for aquatic organisms. Operating in the other direction, insects which spend much of their life in the stream may become food for land-based animals when they emerge. The interactions between land and water are depicted in Figure 1.1.

The use and management of riparian land

The important linkages between land and water in riparian areas were not well recognised in the past by Australian land users or governments. There was a widespread belief that streams and rivers could be used as drains — removing problems from the adjacent land. However, it is now understood that rather than being seen as drains, waterways should be likened to arteries supporting the land around them. Similarly, because of its position, riparian land can be seen as a 'last line of defence' for aquatic ecosystems against potential negative effects from surrounding land use.

In recent years, in recognition of the significant benefits that can be achieved, many landholders, community groups and government agencies have become actively involved in improving the management of riparian lands. They have recognised the capacity of riparian land to:

- ~ trap sediment, nutrients and other contaminants before they reach the waterway and reduce water quality for downstream users,
- ~ lower water tables,
- ~ reduce rates of bank erosion and loss of valuable land,
- ~ control nuisance aquatic plants through shading,
- ~ help ensure healthy stream ecosystems,
- ~ provide a source of food and habitat for stream animals,
- ~ provide an important location for conservation and movement of wildlife,



Figure 1.1. The benefits of native vegetation in riparian areas. **Below:** Significant effort is now going into rehabilitating riparian land. Illustration Paul Lennon. Photo Greening Australia.

- ~ help to maintain agricultural productivity and support mixed enterprises,
- ~ provide recreation and maintain aesthetically pleasing landscapes, and
- ~ provide cultural and spiritual enrichment for people.

The range of benefits provided by riparian land can be referred to as 'ecosystem services'. Ecosystem services are the benefits to humans that come from plants, animals and micro-organisms in nature interacting together as an ecological system, or 'ecosystem'. The functioning of natural ecosystems provides 'services' that are essential for human health and survival. Examples of the kinds of services we receive from nature are those listed above, as well as water filtration, maintenance of soil fertility, pollination and pest control. Despite providing these benefits, however, many of the ecosystems that deliver them in Australia are in decline. Riparian areas are particularly important because they are where land and water meet in the landscape and, as a result, support a diversity of terrestrial and in-stream ecological processes.

For more information on ecosystem services

'Riparian ecosystem services', *River and Riparian Management Fact Sheet*, no. 12, Lovett, S., Price, P. & Cork, S. 2004.

'What are ecosystem services', *RipRap*, edition 21, Lovett, S. (ed.) 2002.

Both publications are available at www.rivers.gov.au





Flood and fire are natural disturbances to riparian land, although their frequency may have changed since European settlement in Australia. Photos: (left) Angus Emmott, (right) Tim Le Roy.

1.3 Degradation of riparian land

Because riparian land is a particularly dynamic part of the landscape, it can change markedly — even under natural conditions. Fires, unusually severe frosts, cyclones, and major floods, can all have huge impacts on riparian land and result in major changes to channel position, shape and associated riparian vegetation. Although relatively infrequent, these events can cause large changes to riparian land.

In contrast, human impact since European settlement has been at a lower intensity than these extreme natural events, but it has been continuous over time and has resulted in widespread and large-scale degradation of riparian areas. In southern Australia, the degradation has been largely as a result of the wide-scale removal or non-regeneration of riparian vegetation due to clearing and un-managed grazing of domestic stock. In northern Australia, feral animals and plants have also had a major impact on riparian areas.

The nature of the problem

The degradation of riparian land, especially in southern Australia, is often associated with the removal of vegetation for agricultural or urban development within a catchment. The major impacts of this are summarised below.

- ~ Removing riparian trees increases the amount of light and heat reaching waterways. This favours the growth of nuisance algae and weeds.

- ~ Clearing native riparian plants removes the natural source of leaves, twigs, fruit and insects that underpins the aquatic food web.
- ~ Under natural conditions, trees would occasionally fall into the river, and the large woody pieces provide important habitat for aquatic organisms. Removing riparian vegetation takes away the source of large branches and trunks and disrupts aquatic ecosystems.
- ~ Continuing agriculture to the top of stream banks by cropping or unrestricted stock access increases the delivery of sediments and nutrients to streams. Large volumes of fine-grained sediment smother aquatic habitat, while increased nutrients stimulate weed and algal growth. Increased nutrient load also affects estuaries and marine life beyond the river mouth.
- ~ Removing riparian vegetation destabilises stream banks, often resulting in massive increases in channel width, channel incision and gully erosion. This erosion of the channels often delivers more sediment to streams than does human activity on the surrounding land.
- ~ Removing vegetation along channels, and of large wood in channels, can allow water to travel downstream at a faster rate, sometimes contributing to increased flooding and erosion of lowlands.
- ~ Removing vegetation throughout the catchment can lead to raised water tables and salinisation of land which, as salt-saturated water drains into rivers and streams, ultimately results in saline waterways.



Examples of factors other than clearing that also degrade riparian land. Photos: (top left) Siwan Lovett, (top right) Jenny O'Sullivan, (bottom left) Gary Caitcheon, (bottom right) Lizzie Pope.

However, removal of native vegetation is not the only human impact that adversely affects riparian land, other impacts include:

- ~ altering water regimes (through the construction of dams and weirs, and from pumping) that can severely affect aquatic populations and the capacity of the waterways to carry flow,
- ~ removing sand and gravel and straightening channels can result in channel incision and head cutting, which in turn influence bank height and shape and lead to increased erosion rates,
- ~ uncontrolled access of stock can lead to over-grazing and trampling of vegetation, breakdown of soil structure and contamination of the water with nutrient-rich urine and faeces,
- ~ altering fire regimes and invasion by exotic weeds can further degrade riparian land.

It is important to recognise that the impacts of these disturbances are not just cumulative; they often exacerbate each other. For example, clearing riparian vegetation from upland streams multiplies, many times, the impact of increased nutrients from surrounding land

use. This is because clearing also results in extra light and higher water temperatures, conditions needed to enable nuisance weeds and algae to flourish and dominate the aquatic ecosystem.

The National Land and Water Resources Audit publication *Catchment, River and Estuary Condition in Australia* (2002) lists the following as key management actions required to improve the condition of rivers and wetlands:

- ~ protective management of good condition riparian lands and wetlands,
- ~ revegetation of disturbed riparian lands,
- ~ reduction in the barriers to fish passage,
- ~ rehabilitation and re-establishment of wetlands, and
- ~ provision of environmental flows.

Publication available at www.nlwra.gov.au

These images show the changes that have occurred along the riverbank as a result of stock exclusion. In the photo at right, the bank is now stable, water quality has improved, and the riparian vegetation is regenerating. Photos Bruce Mundy.



The extent of the problem

The following statistics, drawn from the National Land and Water Resources Audit 1997–2002 and earlier State of the Environment reports, give some indication of the magnitude of the land and water degradation problem in Australia. As riparian land is often the ‘last line of defence’ in protecting waterways and water quality, problems arising elsewhere in a region or catchment usually affect riparian land.

- ~ It is estimated that since European settlement, about 40% of all native tree cover (an area over one and a half times the size of Tasmania) has been completely removed, and a further 35% of all native tree cover has been subjected to harvesting — this includes past clearing and harvesting adjacent to waterways, (there are now regulations and codes of practice in most states to govern such activity).
- ~ Out of the 14,500 river reaches assessed for the Audit, about one quarter were found to be extensively modified and extremely impaired in comparison with reference (natural) reaches, a further 50% were either severely or moderately affected, and only around 25% were largely

unmodified and found to be in natural condition. In the Northern Territory, around two thirds of total river length assessed was largely unmodified, while in all other states and the Australian Capital Territory, except for Tasmania, 80% of the total river length assessed was substantially or moderately modified from natural condition. The Audit identified loss of native riparian vegetation as a major driver of river degradation.

- ~ The Audit found that there was a strong relationship between loss of natural condition and ecological impairment, and the intensity of catchment development — catchments and waterways in poorer condition form a crescent running from Western Australia through the southern states and into Queensland, all areas with a history of high intensity land uses. The catchments in better condition lie in Tasmania, the Northern Territory and northern Queensland.
- ~ The Audit showed that rivers with the most degraded reaches are located in the Murray-Darling Basin, the Western Australian wheatbelt, western Victoria, and South Australian agricultural regions. These

Examples of severely degraded riparian lands and waterways. Photos: (top left) Samantha Burt, (top right) Nicky Taws, (bottom left) Gary Caitcheon, (bottom right) Peter Davies.



reaches generally have highly modified (developed) catchments, are subject to high loads of suspended sediment and nutrients, have lost much of their riparian vegetation, and have dams and levees that disrupt natural water flow and the movement of material and biota into and from the river.

- ~ Drainage in South Australia has reduced that state's wetlands to 11% of their former area.
- ~ Estuaries have generally fared better than fresh-water bodies. Of the 980 estuaries and coastal waterways assessed by the Audit, three quarters were either in near pristine condition or largely unmodified, while about 20% were in modified condition and 10% extensively modified.

The State of Environment reports provides numerous examples of research which has shown the extent of degradation of Australia's waterways. For example:

- ~ of New South Wales lakes, 38% were degraded by nutrient enrichment and only 18% were considered to be in a 'good' ecological condition (Timms 1992);
- ~ of 27 Victorian river basins, only 44% had more than half of their stream length in an excellent or good environmental category (Mitchell 1992).

Some of the other impacts of catchment development and changed land use are demonstrated in the following statistics.

- ~ Soil and water degradation is estimated to cost Australia about \$2 billion each year, made up of potential agricultural production foregone, the costs of rehabilitating degraded land, repairing effects on infrastructure (for example the effects of rising salinity on roads, houses and underground services), and in direct treatment costs (for example, to treat poor quality water to the standard required required for human consumption).
- ~ Around 14 billion tonnes of Australian soil are moved by sheet and rill erosion each year — representing about 19% of global soil movement. Much of this finds its way into water bodies, mainly through hillslope erosion in the north, and through erosion of gullies and river banks in the south.
- ~ Of the approximately 1900 plants introduced since European settlement, 220 are now declared noxious weeds, and weed control costs about \$3.3 billion annually. Many of these weeds have infested riparian areas, where control will be difficult and expensive.

Some of the consequences of allowing riparian land to degrade. Photos: (top left) Phil Price, (top right) Angus Emmott, (bottom left) Roger Charlton, (bottom right) Phil Price.



1.4 Improving riparian management

Catchment and landcare groups, as well as individual landholders, are recognising that many of the recent and current management practices employed on riparian lands (practices often derived from very different northern hemisphere environments) are unsustainable. Fortunately, it is also being recognised that often environmental and agricultural objectives can be achieved simultaneously. Research has established that those land-use practices and techniques that are attuned to prevailing environmental characteristics are more sustainable in the long term, and with careful planning at the whole-property level they can be more profitable as well. As a result, increasing attention is now being paid by individuals, community groups, rural industries and governments at all levels to halting and reversing the processes of degradation which these practices have caused and, in many places, are continuing to cause. For example, promoting natural regeneration and active revegetation are now widely accepted as cheap and effective means of erosion control and bank stabilisation in many situations. Native species are seen as more appropriate than exotic species such as willows. The distinctive riparian vegetation is being recognised as an important ecosystem, itself worthy of preservation and significant as a wildlife corridor. Healthy riparian land is being recognised for the key role it plays in aesthetic appreciation of the landscape. Some actions have been

taken by individual landholders, but in many cases it is more effective for neighbours to work together, in collaboration with local and state governments, to achieve improved management along a waterway reach that may be 10 to 30 kilometres long.

Sound riparian management is not a substitute for good land management elsewhere in the catchment. Rather, it should be seen as one part, albeit a very important part, of sound management throughout the property or catchment. Even the best management of riparian lands will not overcome management practices elsewhere that lead to excessive soil erosion, or off-site loss of nutrients or other contaminants. This publication is intended to help practitioners understand the scientific principles that underpin sound management of riparian land. Although not exhaustive, the chapters bring together a wide range of information and research results to describe the crucial riparian processes that are important in Australia.

The material in this volume concentrates on specific natural processes that dictate how riparian areas 'work' and which need to be taken into account if management decisions are to be informed and responsible. Guidelines to assist in diagnosis of problems and determining the best management response, have been published separately by Land & Water Australia as a series of River and Riparian Technical Guidelines. These are listed at the end of this document, together with information about how to obtain them.

Landholders, community groups and agencies are leading efforts to rehabilitate riparian land. Photos: (top left) courtesy Greening Australia ACT & SE NSW, (top right) Rae Glazik, (bottom left) Lizzie Pope, (bottom right) Phil Price.



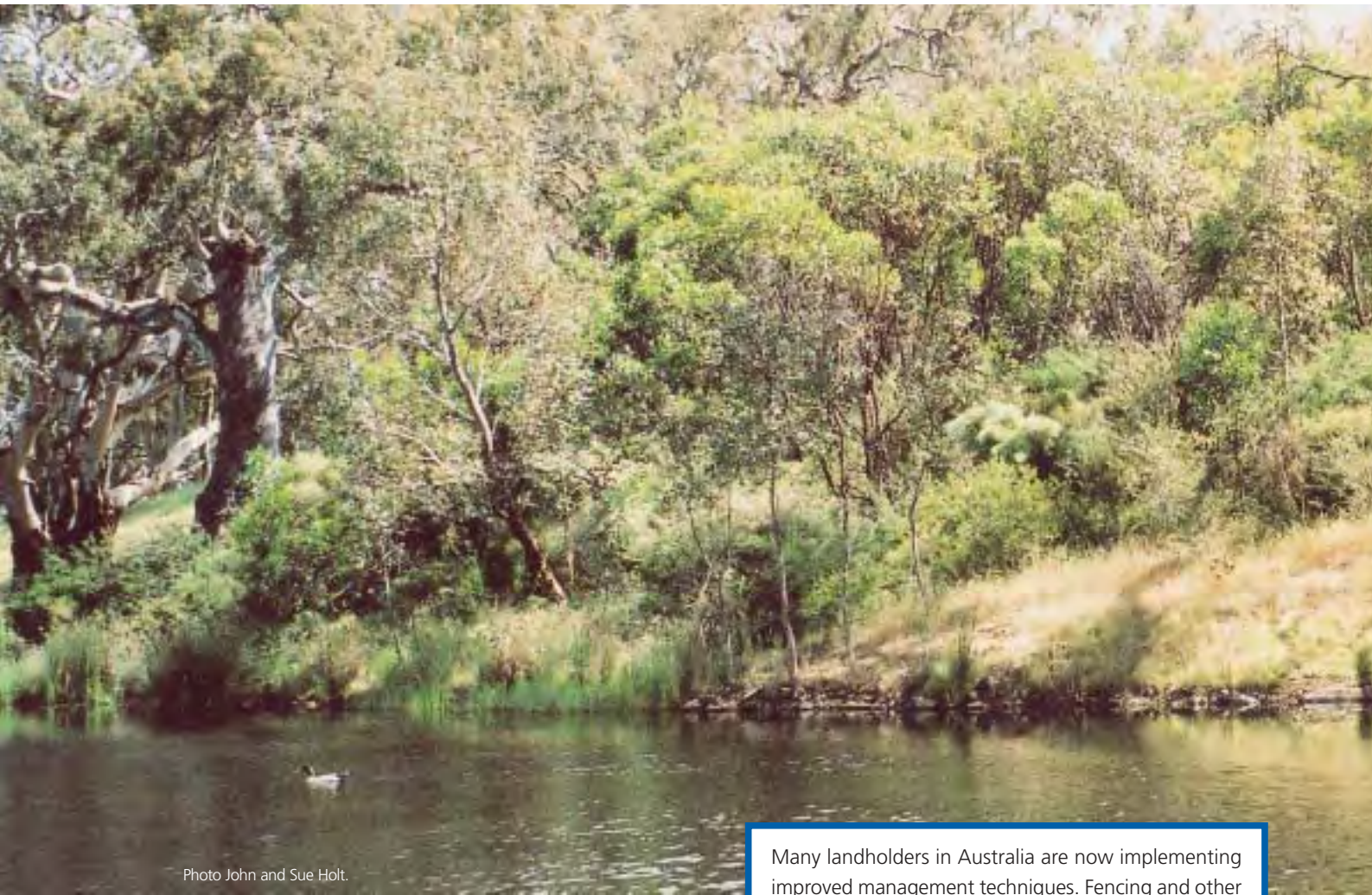


Photo John and Sue Holt.

Above: Riparian land in excellent condition. Below: A riparian area fenced to control access by stock. Bottom: Off-stream watering will discourage stock from using riparian areas.

Photo Mike Wagg.



Photo Roger Charlton.



Many landholders in Australia are now implementing improved management techniques. Fencing and other methods used to control and manage the access of stock to riparian areas are a high priority in many parts of the country. Landholders are reporting that the cost of fencing and off-stream watering can be more than recouped over time because, for example, fenced riparian land can be used for growing higher value crops, because grazing can be managed to improve pasture composition and production, or because the health and productivity of animals grazed there is improved due to reduced disease transmission and improved water quality. In recognition of the fact that improved riparian management provides public as well as private benefits, there are now many forms of community and government support available to help defray the cost of durable riparian fencing.

For information contact your local Department of Agriculture, Department of Natural Resources, or local catchment management agency.

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