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Stock and waterways:

A MANAGER'S GUIDE






RiverLandscapes

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Photo Jenny O'Sullivan.

Introduction

This Guide is designed to help you:

- recognise your riparian land and its multiple values,
- identify how stock access and grazing in and around your riparian land can be improved, and
- develop a strategy to manage your riparian land productively and sustainably.

In many cases, complete exclusion of domestic stock from riparian land may not be possible, practical or even desirable. This Guide seeks to help you manage your riparian land in a way that it is appropriate for your situation — for example, the type of stock you run, the extent of your enterprise, your climate, land type and whether you want to graze your riparian land.

The Guide is based on the central principle that your riparian land forms an important part of your entire farm, but should be managed taking into account its special needs. It aims to help you develop the infrastructure that you need to use your riparian land productively, but without damage to the land or waterway.

Section One outlines the problems caused by uncontrolled stock access to riparian land and the benefits of managing access.

Section Two discusses how you can assess for yourself the health of your riparian land.

Section Three gives practical advice on planning and prioritising your strategies.

What is riparian land?

Riparian land is land that is connected to a waterway.

Section Four relates to crossings and water access points and how they can be integrated into your overall farm management.

Section Five discusses the best place to locate fences and gates.

Section Six describes the various types of fencing available.

Section Seven suggests ways to make your fences more flood resistant.

Section Eight deals with stock watering.

Section Nine describes controlled grazing techniques.

Section Ten discusses some of the challenges that can arise when you start to alter the way you use your riparian land.

Section Eleven outlines some alternative methods of controlling stock behaviour if fencing is not practicable or additional protection is required.

Following the numbered sections, we have case studies of farmers who have all benefited from some financial or practical assistance in reaching their goals of better managing their stock and waterways.

Finally, we list some of the incentives and resources available to encourage you to improve your use and management of your riparian land. These incentives include funding (such as the Natural Heritage Trust and National Landcare Program), and the provision of practical assistance (for example, your local Catchment Management Authority).

SECTION 1

Why managing stock in riparian areas is important

Did you know that excluding or restricting stock from your waterways, and the land surrounding your waterways ('riparian land') is one of the quickest and easiest ways of improving waterway health?

Did you also know that healthy waterways and healthy riparian land can lead to healthier stock, healthier farms and a healthier bottom line?

And did you know that financial incentives and practical assistance are available to farmers to help them exclude or restrict stock from their waterways and riparian land?

Photos Jenny O'Sullivan.

What is riparian land and why is it important?

Riparian land is land that is connected to a waterway.

We've used the term 'waterway' to mean any body of water that you might find on your property, including a creek, billabong, river, wetland or lake — even if it is dry for part of the year or for longer periods.

Photo PJ Waddell.

Photo Guy Roth.

Photo Roger Charlton.

These three photographs show examples of the many different riparian environments that exist in Australia.

Land can be connected to a waterway in many ways — by proximity, like a riverbank, or by water flow, as for floodplain or wash country.

The size and extent of your riparian land will depend on the size of your waterway, whether it is permanent, the land type and your climate. The riparian zone of a large river in the northern Queensland rangelands, for example, will probably have wide and distinct floodplains, and may extend more than 1 kilometre from the river. In contrast, the riparian zone alongside a small gully creek may be less than 10 metres wide.

It is the connection, or relationship, between the land and the waterway that makes riparian land so important. The health of the riparian land will influence the health of the waterway (and the quality of the water in it). Things that happen on the riparian land will have an impact on the waterway. Good management of your riparian land will result in a healthy waterway.

This riparian area has been fenced, and stock allowed access only when other feed is exhausted or when shelter is required. Photo Phil Price.

Your waterways and riparian land are valuable assets. Riparian areas are the most productive parts of some farms due to their deeper soils and retained moisture, and may provide good, green feed when other paddocks have dried off. Unfortunately, they are also at risk of damage, particularly as a result of uncontrolled stock access. This damage can result in the loss of soil, land, stock, and water quality — that is, loss of money.

How healthy is your riparian land?

You can make a rough assessment of the health of your riparian land using the method described in Section 2 as your guide. This method will help you identify what areas — if any — need attention, what action is needed, and in what order of priority.

Studies have shown that removing stock from waterways and riparian areas totally, or for controlled periods, can have a significant improvement on riparian health[1]. Increased vegetation cover will lead, over time, to a reduction in erosion, better water quality, valuable shelter belts and biodiversity. This means healthier stock, more efficient use of nutrients and rainfall, and thicker, improved pasture cover — in summary, higher productivity. Healthy waterways and healthy riparian land will also add to the capital value of your property.

At the end of the Guide we have included several case studies describing the strategies a range of farmers throughout Australia have developed to use their riparian land more sustainably and productively.

John and Jill Neal on their property 'Campview' protect riparian areas as they value them as special places on their farm. Photo Currie Communications.

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Five reasons to exclude stock from your waterways and riparian land

1. Stock eat and trample much of the vegetation "binding" the banks, including regenerating seedlings, causing instability and erosion. Bank instability can be dangerous to both humans and stock, and erosion results in the loss of valuable farmland and nutrients.
2. Stock trampling can also destroy the soil structure, preventing growth and regeneration of desirable species. This lack of plant growth can lead to erosion, salinity and run off of excess nutrients. The opening up of the plant canopy, combined with high nutrient loads from dung and urine, provides the ideal conditions for invasion by exotic and often unpalatable weeds.
3. Stock wear paths to the water edge, causing gully erosion, which causes sediment to wash into the waterway during heavy rains.
4. Stock stir up the water which increases downstream sedimentation and pollution, and destroys native aquatic habitats.
5. Stock effluent pollutes fresh water, destroys fish breeding cycles and encourages the proliferation of disease organisms and algae. Water quality is impaired for downstream users and stock.

Erosion is evident on the right hand bank where stock have access, compared to the stable, vegetated bank on the left where stock have been excluded. Photo Wayne Bath.

This farmer is losing valuable farming land through erosion. Photo Gary Caitcheon.

Stock effluent encourages the growth of nuisance algae. Photo Nick Schofield.

Stock prefer to drink water that is clean. Improving water quality can improve stock performance. Photo Phil Price.

Preventing stock access to waterways will improve water quality downstream. Photo Jenny O'Sullivan.

Multiple benefits

Multiple benefits of excluding stock from your waterways and riparian land

Improved water quality

Excluding stock from your riparian land will improve water quality, by reducing fecal contamination, nutrient run off, turbidity and sedimentation. Farm productivity increases when stock have access to clean water[2]. This is because clean water helps prevent disease (such as scour)[3], maintain good condition, and improve wool and milk production.

Decreased erosion and improved rainfall efficiency

The prevention of trampling and overgrazing will promote the growth of riparian vegetation. Deep rooted riparian vegetation will stabilise banks and protect topsoil, particularly in times of flood. It will also improve rainfall efficiency — the ability of your land to trap and use available rainfall. This will help to protect your valuable farmland and infrastructure such as bridges, roads and buildings, and improve pasture production.

Reduction of stock losses

Stock losses during floods, and as a result of bank instability, will be avoided if stock are excluded from the riparian zone.

Healthy, vegetated riparian land provides a shelter belt for neighbouring paddocks by reducing wind velocity and moderating extreme temperatures. This is particularly valuable during lambing and calving.

Stock losses can be high in unfenced waterways.
Photo Wayne Bath.

Stock can cause significant erosion by camping around waterways.
Photo below and lower right, Jenny O'Sullivan.

Fencing off waterways can provide valuable shelter belts for stock.

Photo Siwan Lovett.

Safer work environment

Unstable banks (see above) pose a risk to humans. Excluding stock from the riparian zone reduces the need for human access, and encourages banks to restabilise.

Improved stock manageability

Sick or injured stock will often seek refuge in the riparian zone. Preventing access minimises the time spent searching for them.

Specially designed laneways and access points will assist in moving stock over your farm and can reduce mustering time — even making it a one-person job.

Appropriate fencing gives you greater control over the circumstances in which stock are permitted access to your riparian land, for example for shelter during lambing season or extreme weather conditions, or for fodder when feed is in short supply.

Reduction of sedimentation, water and nutrient runoff

Excluding stock reduces the amount of effluent (dung and urine) entering your waterway, which restricts the spread of disease microorganisms and algae that flourish in water containing excessive nutrients. Excluding stock also protects the vegetation that "filters" soil, water and nutrients that would otherwise be washed into your waterway and get carried downstream.

Reduction in salinity and waterlogging

Deep rooted riparian vegetation (particularly native vegetation) helps to lower water tables, which can combat salinity and waterlogging problems. If riparian vegetation is removed, the water table may rise, creating salinity problems (in areas where the subsoil water is saline) or waterlogging. Both result in the loss of valuable farmland.

Opportunity feedlot with effluent and erosion problems. This farmer was prosecuted for polluting the waterway by the Environment Protection Authority. Photo Wayne Bath.

Salt affected valley floor. Photo LWA.

Natural regeneration following stock exclusion has improved water health and biodiversity in this stream. Photo Jenny O'Sullivan.

Benefits of biodiversity

Healthy riparian land and streams (particularly those containing native flora) support a number of beneficial organisms, including native fish, birds and insects, which can help reduce parasite numbers on your farm. Healthy riparian land often contains a higher percentage of native perennial grasses which are both highly palatable to stock, and are more effective in binding the soil than most exotic species[4].

Improvement in land value

Evidence suggests that well managed stream frontage can increase property values by up to 10%[5].

Opportunities for diversification

It may be possible to use your riparian land to produce timber, hay, firewood or other specialist crops to increase the diversity and sustainability of your property.

1 Jansen, A. & Robertson, A. 2001, Relationship between livestock management and the ecological condition of riparian habitats along an Australian floodplain river. *Journal of applied ecology*, p. 38.

2 Lovett, S., Price, P. & Lovett, J. 2005, *River Guide, Volume 1: Higher rainfall zones including tableland areas*, Land & Water Australia, p. 28.

3 Wright, D. & Jacobson, T. 2000, *Managing Streamsides: Stock control, fencing and watering options*, p. 5.

4 Roth, C.H., Prosser, I.P., Post, D.A., Gross, J.E., Webb, M.J., O'Reagain, P.J., Shephard, R.N. & Nelson, B.S. 2004, *Keeping it in place — Controlling sediment loss on grazing properties in the Burdekin River Catchment. A Discussion Paper.*

5 Lovett, S., Price, P. & Lovett, J. 2005, *River Guide, Volume 1: Higher rainfall zones including tableland areas*, Land & Water Australia, p. 31.

SECTION 2

Assessing the health of your riparian areas

Being able to measure the health of your riparian areas is a useful management tool.

Researchers have developed a method called the Rapid Appraisal of Riparian Condition[6] (RARC) for assessing the health and condition of your riparian areas. RARC is based on five main indicators (described at right) that reflect the functional aspects of the riparian zone. Using the RARC method, you will be able to identify and prioritise areas of concern, and structure your management strategy to deal with them.

You will also have a reference point for future use to be able to evaluate the success of your management strategy, and to change it if necessary to achieve your goals.

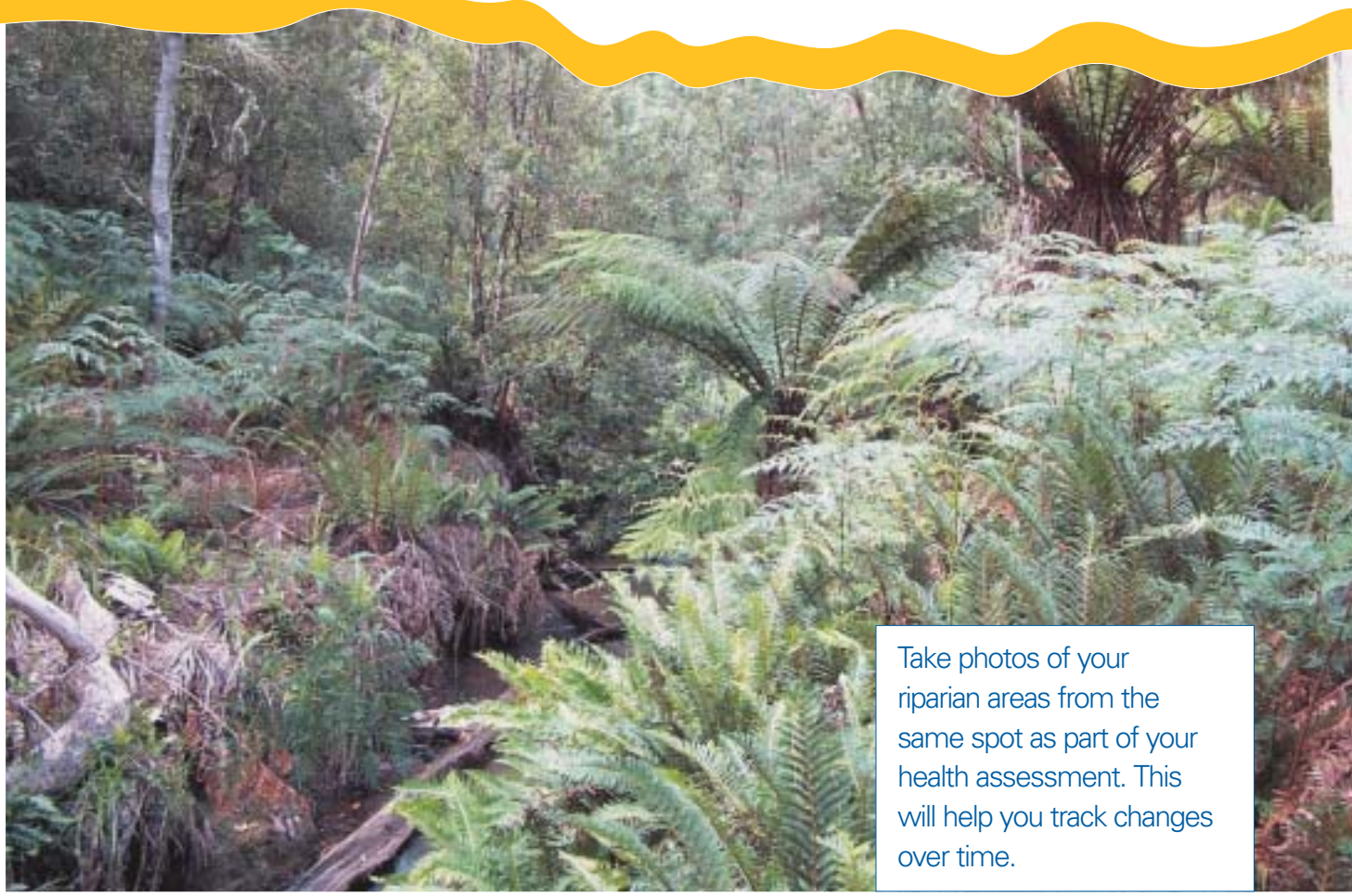
The five indicators of riparian health are:

1. Extent and continuity of habitat.
2. Layered vegetation.
3. Dominance of native plants.
4. Presence of plant debris.
5. Natural regeneration of vegetation.

Poor health is indicated by a lack of layered vegetation, plant debris and regeneration. Photo Michael Askey-Doran.

A site in excellent health. Note the continuous canopy of native trees, standing dead trees and fallen logs, native shrub understorey, reeds and regeneration of trees. Photo Amy Jansen.

A more-detailed description of the RARC method, together with instructions for its use and a scoring sheet, can be found at www.rivers.gov.au. The RARC method has been modified for use in a few specified regions across southern Australia and people trained in its use are available to help others; there is also a special version designed for use in tropical areas.



Take photos of your riparian areas from the same spot as part of your health assessment. This will help you track changes over time.

A healthy riparian area with layered native vegetation provides habitat for many animals. Photo Robyn Watts.

1. Extent and continuity of habitat

Healthy riparian land provides food, shelter, nesting sites, cover and pathways (collectively called 'habitat') for a variety of native animals. These animals help to maintain the health of their habitat in many ways, including spreading seed and pollen, providing nutrients for plant growth, and controlling pests.

A larger riparian area will obviously provide more habitat than a smaller area. Smaller areas can still provide valuable habitat if wildlife can move easily and safely between them. Aim to create "corridors" of riparian vegetation by fencing as widely as possible (see Section 3), and by replanting any bare patches along your waterway with local native ("indigenous") plants.

2. Layered vegetation

Ideally, you should be able to see three fairly distinct layers of vegetation in your riparian area — groundcover, understorey and canopy.

- The groundcover includes mosses, lichens, grasses, sedges and reeds. This layer is important for trapping nutrients (essential for plant regeneration and preventing water contamination), and binding the soil.
- The understorey, or middle layer provides food and shelter for many birds and insects, and can include bushes, shrubs, tree ferns, saplings and tall reeds.
- The canopy (tall shrubs and trees) provides shade and shelter for smaller plants and native animals, as well as livestock (in the form of shelterbelts). The canopy is important in regulating the temperature of both the water and the riparian microclimate. Fallen tree limbs and leaves also provide nutrients and shelter for other organisms.

Photo Bruce Mundy.

Photo Mike Wagg.

The first photo shows a creek in poor condition, as a result of clearing and grazing. Erosion and a lack of tree canopy and shrubby understorey are evident. Contrast the second photo, showing layered vegetation, stable banks and good habitat for native animals.

The height of each layer will depend on your climate. As a rough guide, in temperate areas, groundcover plants are smaller than 1 metre, understorey plants range from 1 to 5 metres, and the canopy is taller than 5 metres. In hotter and drier areas, the plants in each layer may be lower.

Photo Jenny O'Sullivan.

Exotic willows dominate this site, to the exclusion of native plants.

3. Dominance of native plants

Some vegetation is better than no vegetation, but your riparian areas will be healthier if the majority of the vegetation is native. This is because native plants are best suited to Australian conditions, and play an important role in maintaining the health and natural biodiversity of our riparian areas and streams. Exotic plants, on the other hand, are often invasive and unpalatable and can inhibit the natural processes necessary for riparian health. Willows, for example, lose all their leaves in autumn creating a flush of organic matter that starves fish and plants of oxygen, and reduces water quality.

Remember that even native plants can become pests if planted in the wrong areas.

Try to plant indigenous species — that is, plants that are native to your area. Local Landcare groups and Greening Australia can advise you on the most appropriate plants for your area.

Photo Amy Jansen.

This site is in poor health. Note the small amounts of debris, discontinuous canopy, lack of native shrubs, reeds and groundcover, and little regeneration of tree canopy.

In most riparian areas where stock are allowed to graze without control, you will see little or no understorey, and groundcover will be low and sparse. Over time, the canopy will also disappear, as trees will not be able to regenerate due to soil trampling and the overgrazing of seedlings.

4. Amount of debris present

Leaf litter, fallen logs and dead trees provide habitat for many animals including reptiles, birds and small mammals. Leaf litter is also important for plant regeneration because it provides nutrients, and keeps soil moist by acting as a mulch. Debris is often lacking in areas where vegetation is sparse, or where erosion is a problem.

Leaf litter increasing from top to bottom. Photos Amy Jansen.

5. Regeneration of native species

Natural regeneration of native plants is an important indicator of riparian health. Sedges, grasses, herbs (small native broad-leaved plants) and reeds are amongst the first native plants to regenerate. By trapping nutrients and binding the soil they create the perfect conditions for other taller plants to become established. You can encourage regeneration by excluding stock, and planting native sedges, grasses, herbs and reeds.

Young trees need to be protected to give them a good start. Photo Lori Gould.

Photos Ken Lamb.

Glenmaggie Creek showing significant natural revegetation over a 12-year period, following stock exclusion.

6 Jansen, A., Robertson, A., Thompson, L. & Wilson, A. 2005, 'Development and application of a method for the rapid appraisal of riparian condition', *River Management Technical Guideline No. 4A*, Land & Water Australia, Canberra.

Good

1 Standing dead trees and fallen logs provide habitat.
2 Healthy multi-layered vegetation.
3 Wide corridor for native animals.

Poor

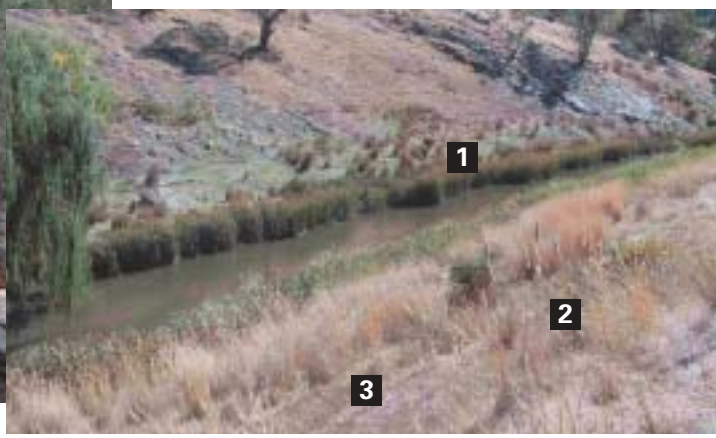
1 No leaf litter or debris.
2 No regeneration of tree canopy.
3 Absence of groundcover and shrubby understorey.

Good

1 Fallen logs, leaf litter and debris provide habitat.
2 Good variety of native vegetation.
3 Regeneration of tree canopy.
4 Healthy, layered vegetation.

Photos.Top left and right John Dowe, below left and right Amy Jansen.

Poor



1 Reeds are a good sign but provide a very narrow corridor for habitat.
2 Absence of shrubby understorey and tree canopy.
3 No regeneration of tree canopy.

SECTION 3

Getting started — planning for good stock management

Most of the farmers interviewed for this Guide prepared some type of plan to help them decide the best way to manage their riparian land. A rough sketch of your waterway and surrounding areas will suffice, but an even better idea is to prepare a whole farm plan. A whole farm plan helps you see each part of your property as a separate but integral part of your business. Different parts of your farm — such as your riparian areas — require special treatment to get the most rewards. Spending a bit of time to plan for good stock management will also save you time, cost and effort in the long run.

This farm layout shows paddock areas, tree plantings and windbreaks (cross-hatching), and the riparian area fenced out (vertical meandering line through middle of the property). * See end of section for credit.

Start by identifying the natural features of your property — waterways and waterholes, hills and gullies, rocky outcrops, vegetation and pasture, soil type and fertility. Then identify the man-made features of your property — fences, buildings, stock watering points and crossings, laneways etc. Map out areas of concern or degradation — places where special management is required to protect or utilise that land. Your riparian areas, and land subject to flooding, erosion, high winds, seasonal parasites or noxious weeds are some examples of areas hat may need special management.

What types of land do you own?

Ideally, you should subdivide your property into areas of similar management requirements and capabilities, with your fences following the landforms. A productive farm will often comprise a number of smaller, irregularly shaped paddocks rather than square paddocks whose boundaries include different classes of land[7]. A recent aerial photograph is great for helping you to identify the different classes of land on your property, and the landforms that will guide your fencing. (Even if you're not preparing a whole farm plan, an aerial photograph will help you determine the extent of your riparian land and the best places to build your fences.) You can usually get an aerial photograph of your farm from your local natural resources department or catchment authority.

A mosaic of land uses and land types are shown in this photo. Each requires different management strategies. Photo CSIRO Ecosystems Services Project.

Photo Roger Charlton.

Fencing has been used to prevent stock access and promote revegetation.

Using this process, you should be able to divide your farm into different classes of land.

When you know what classes of land are on your property, you can start to think about where to place your fences. Let land class boundaries and natural landforms guide you — fences should usually be along ridges, depressions, breaks of slope and at right angles to the slope[8]. Sections 5 and 6 contain detailed information on how to best fence off your riparian areas, and the farmers in the case studies also explain the processes they used to decide where to build their fences.

Water supply to each paddock is critical when planning your fencing. A watering system that lets you add, move and switch off watering points can also be a valuable tool for manipulating stock behaviour. Section 8 contains information to help you design and install a watering system that will help you control stock access to both your waterway and other parts of your property.

Planning your most efficient subdivision

Think of fencing as the silent partner on your farm. An efficient subdivision helps you boost productivity by letting you use each part of your farm — not just your riparian areas — according to its capabilities and its limitations.

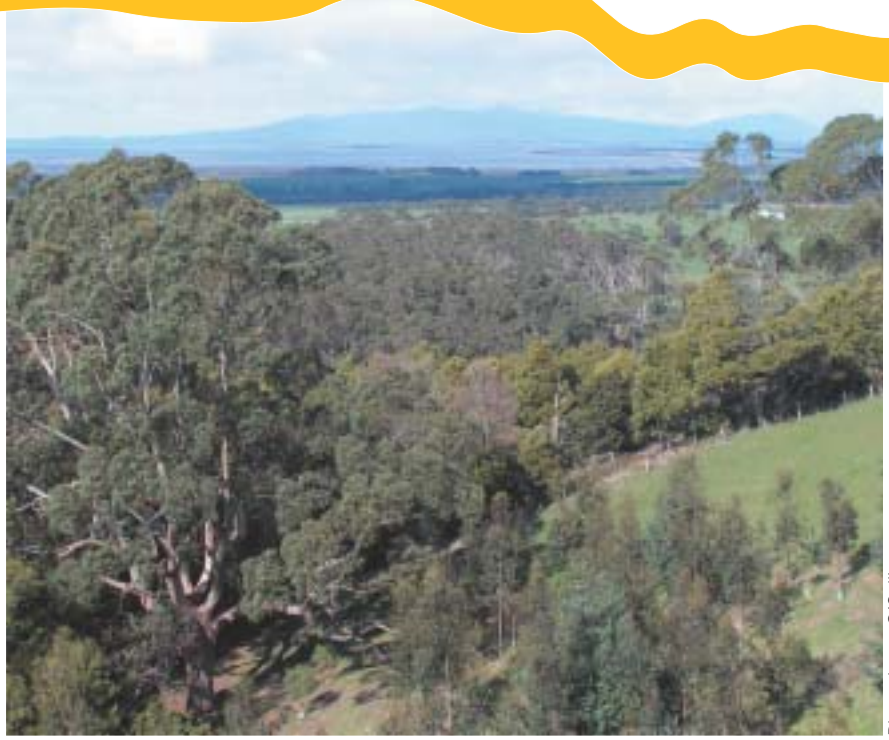


Photo Jenny O'Sullivan.

This property owner identified steep gullies as a threat to livestock and staff, when preparing his whole farm plan. These gullies have now been safely fenced off.

Prioritise

Be realistic! These works will take time, effort and money. Prioritise your works according to need, expected cost and effort.

Access is also an important consideration. Carefully sited laneways, gates, stock crossings and other easements will help you control stock and manage grazing pressure in your riparian areas. Section 4 discusses factors relevant to building your crossings and water access points. Section 9 contains information to help you devise a grazing strategy to use your riparian areas (if necessary) sustainably and without damage to the environment.

Get assistance

All of the farmers in the case studies have benefited from some type of help, whether in the form of advice, funding or practical help. Tapping into your local networks can also be of significant assistance to you. See page 87 for a list of valuable resources.

The farmers have also taken a long term view when planning their riparian works and have undertaken their projects in stages, often completing or improving works when funding has become available. Taking this approach will help you to manage your time and costs, and make it more likely that you will achieve your objectives.

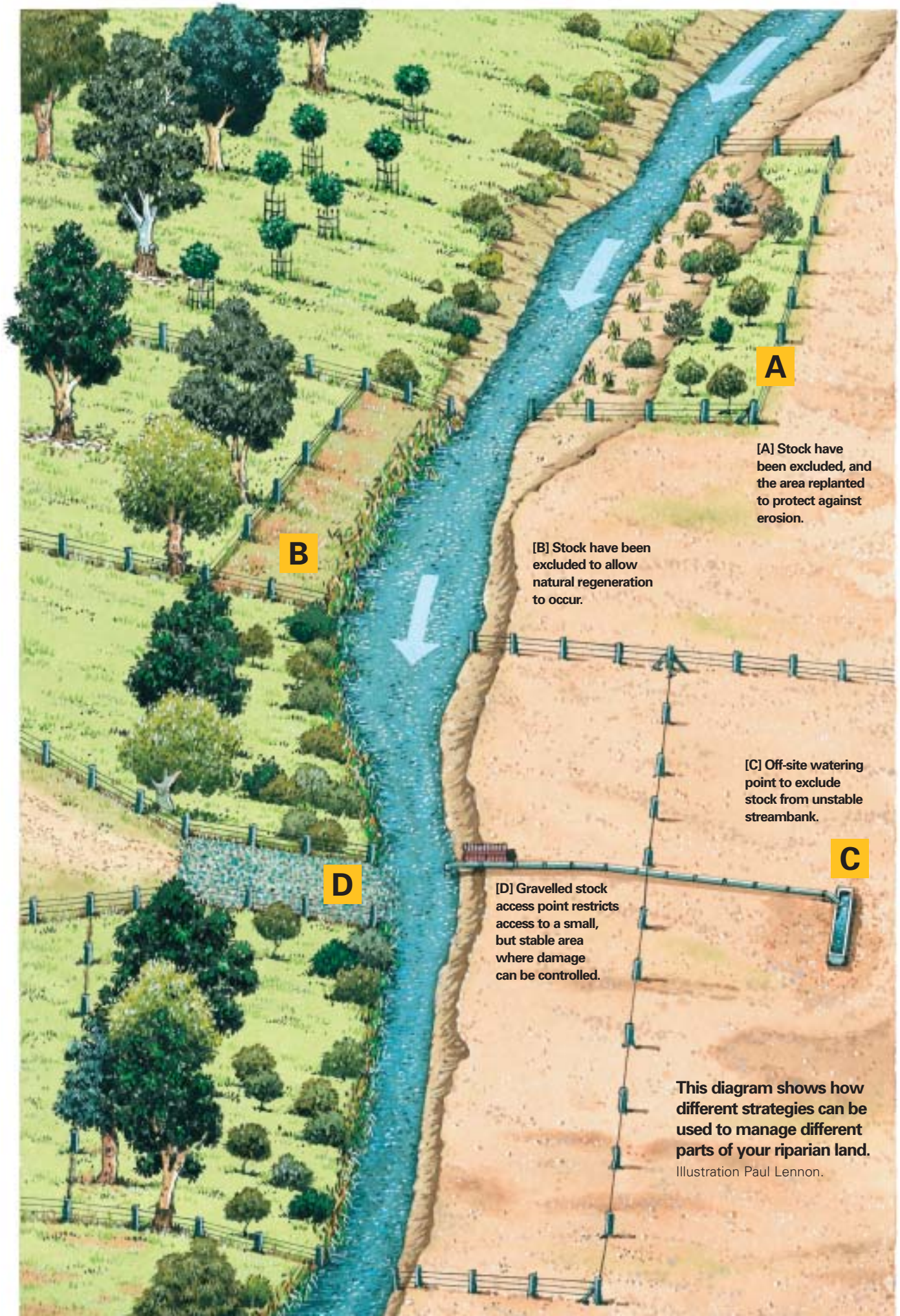
7 Garrett, B.G. 1993, *Whole Farm Planning*, p. 25.

8 Garrett, B.G. 1993, *Whole Farm Planning*, p. 25.

* Aerial photography courtesy NSW Land and Property Information, Bathurst. Datum GDA Geocentric Datum of Australia. Grid: MGA94 (GDA94) Map Grid of Australia. The paddock overlays were developed in Practical Systems' FarmMap software. Information courtesy Rob and Annabel Dulhunty, Nant Lodge, Glen Innes.

Field day organised by the Murchison Land Conservation District Committee, to explore ways to address erosion problems in the Murchison catchment.

Photo PJ Waddell.



This diagram shows how different strategies can be used to manage different parts of your riparian land.
Illustration Paul Lennon.

SECTION 4

Water access points and crossings

Fencing off your riparian areas and waterways can be problematic if your waterway is the main source of drinking water for your stock, or your stock need to cross the waterway to move between paddocks. However, with good planning, you can incorporate water access points and crossings within your riparian fencing to control your stock's access to the waterway. This Section contains advice on designing and building crossings and water access points to limit the damage caused by stock, particularly from trampling and overgrazing.

Poor water quality may still be a problem, however, even with well-sited and well-constructed water access points. This is because much of the effluent produced in and around the crossings and access points ends up in the waterway. As well as polluting the water, effluent encourages algal growth and helps to spread disease and parasites.

Many producers find that watering stock off the waterway significantly improves water quality. An efficient watering system can also help farmers to manage their stock better, which reduces mustering time, and control grazing patterns, which improves pasture utilisation. Section 8 includes information on a number of watering systems that can be used to water stock away from your waterway.

Photo Jenny O'Sullivan.

Well-sited crossings and water access points can be invaluable in helping to manage your property more efficiently and more productively, as well as protecting your riparian areas.

Photo Peter Hairsine.

Cattle with unrestricted access to the waterway — an example of poor management.

Did you know that the average dairy herd of 200 cows produces more effluent in a day than a town of 2000 people?

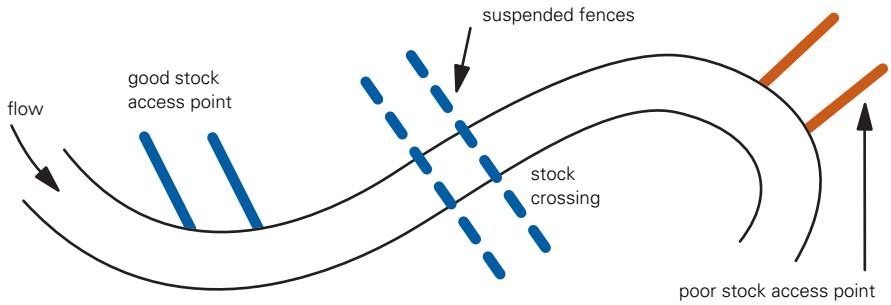
A 200 cow dairy herd produces 2–4 million litres of effluent per year. Only 10% is collected at the shed, the rest is spread around the paddock.

The location of your crossings and water access points

Choose the location of your stock crossing or water access point carefully, as the wrong location can create or exacerbate erosion. Crossings, in particular, can be expensive and time consuming to build. The wrong location could result in the loss of a valuable asset during a flood.

The location of crossings

Crossings should always be built along a straight section of the waterway, or at the crossover point in the middle of a meander where the main flow is naturally directed to the centre of the channel[9]. Never build a crossing on a bend as water flow tends to accelerate around the outside of the bend, and causes erosion. Instead, build your crossing after the bend.



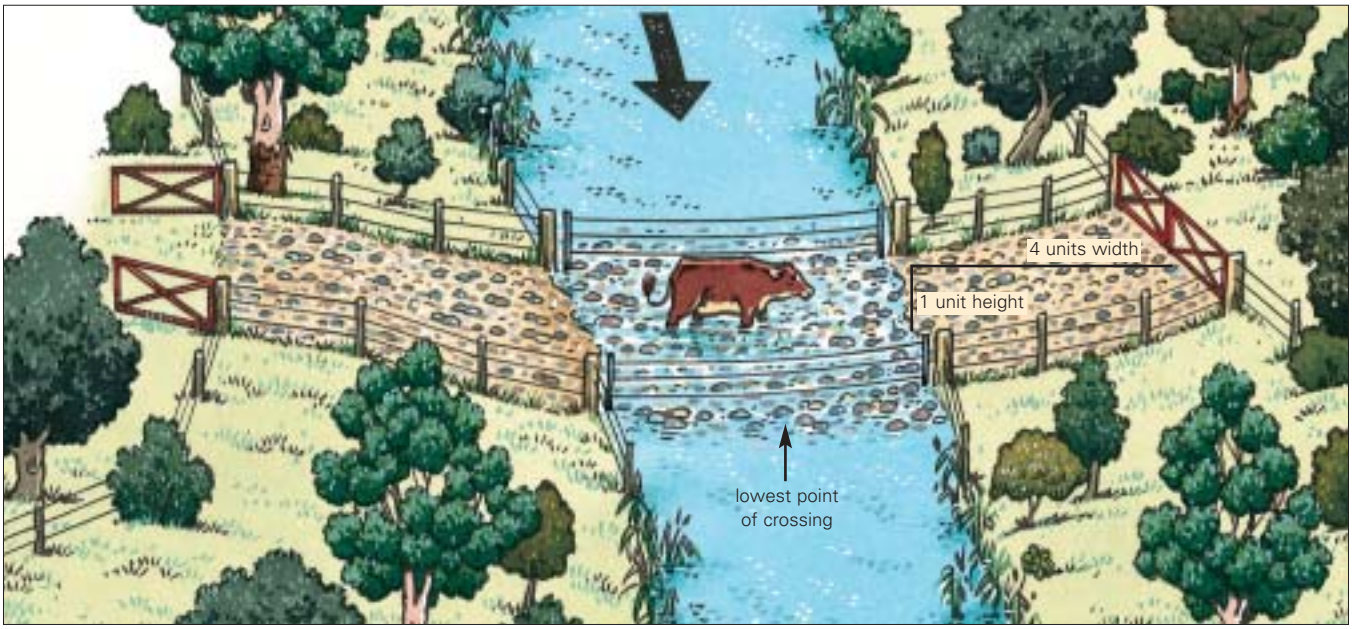
Source: Price, P. & Lovett, S. (eds) 1999, p. 114.

Building your crossing on a higher point will save you time and money because it reduces the height to which you need to build the crossing. It also reduces the crossing's exposure to the force of the water, making it more flood resistant.

When selecting the site for a crossing, choose:

- a naturally higher site within the waterway,
- a site that has a firm footing,
- a site that is not boggy, eroded or degraded,
- a site where the bank slope is not too steep (ideally a slope of less than 4:1),
- a narrow section of the waterway, in preference to a wider section (all other factors being equal),
- a site for easy stock movement when mustering.

Note: These principles also apply when choosing the best place to build a fence across a waterway.



An example of how a stock crossing can be constructed to minimise damage to the waterway. Illustration Paul Lennon. Adapted from *Water Note 6*, Water and Rivers Commission (Western Australia).

Constructing your crossings

Crossings come in many shapes and sizes, depending on the waterway, materials available, and the ingenuity of the farmer.

You may need planning approval to build a crossing, particularly if it alters the flow of your waterway. Check with your local authority before starting construction.

A well-constructed crossing is a valuable farm asset. Photo Alex Hams.

One of the easiest ways of making a crossing is by laying rock or gravel on the waterway bed. If the waterway bed is soft (sand, for example), you may need to stabilise it. This can be done by digging out a channel and filling it with rock, or by placing filter cloth over the bed before covering it with rock or gravel. Filter cloth should be buried about 1 metre into the bed and banks on the upstream edge, and overlaid with rock[10]. The rock or gravel should extend to the top of the banks to prevent erosion and to stabilise the access points to the crossing.

The banks of the crossing should be graded to a maximum 4:1 slope, with the lowest section of the crossing being in the centre of the channel. The downstream slope of the crossing should not exceed 10:1 (20:1 is preferred to allow fish passage)[11].

Funding is often available for the construction of crossings. See page 87 for details of organisations that may be able to assist you.

The location of water access points

Water access points should be located on the inside of a bend, where water flow is slower and banks less prone to erosion.

When selecting a site for an access point, choose a site:

- with a firm footing,
- that slopes gently (see illustration below),
- where there is little or no shelter, to discourage stock from remaining in the area.

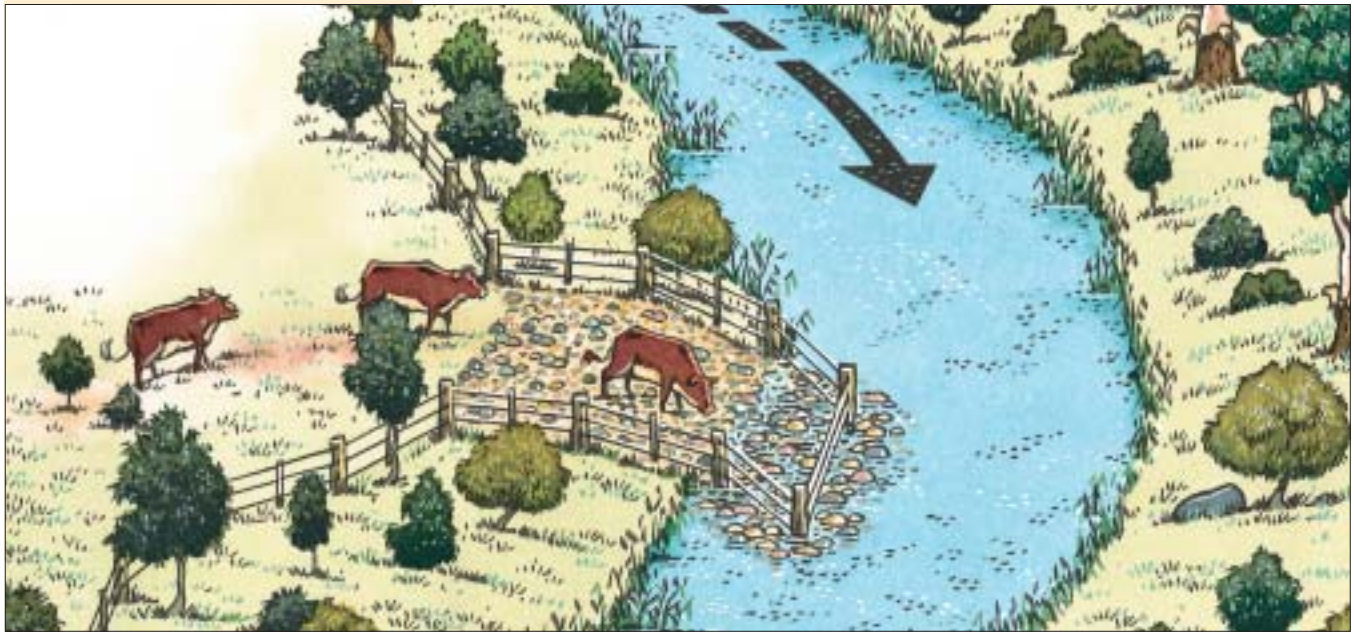
Constructing your water access points

Access points can be made using a variety of different materials, including concrete, compacted gravel, rocks and logs. The surface of an access point should be rough to discourage stock from remaining in the waterway.

Access points should be:

- relatively flat, with a maximum slope of 1:6, to reduce the risk of erosion and make it easier for stock to reach the water's edge,
- built at an angle in a downstream direction so that stock enter the stream in the direction of the water flow (this prevents water flowing into the access point and creating erosion)[12]. See also diagram of the cross section of a crossing on page 19.

Take note of seasonal fluctuations in the water level. If there is no alternative water supply, build your access point so that stock can reach the water, even when levels are low.



Water access point. Illustration Paul Lennon. Adapted from *Water Note 7*, Water and Rivers Commission (Western Australia), p. 2.

Rocky streams may provide a natural access point, but fencing is still required to prevent animals wandering along the waterway and surrounding riparian areas. Photo Roger Charlton.

Well-sited crossing made from a truck tray. Note the gates at either end of the crossing. Photo Jenny O'Sullivan.

Fencing your crossings and access points

Water access sites should be fenced to prevent stock from entering the waterway and the surrounding riparian land. A crossing may not need to be fenced if it is only used to move stock under supervision, and the rest of the waterway is fenced off. Alternatively, a visual barrier, such as lightweight mesh, erected either side of the crossing may be enough to deter stock from straying from it.

Fences should be connected to, but built independently of, your main fence. Many farmers include a gate in the main fence at either end of the crossing, or at the entrance to the access point, to increase their control over the area.

A number of different types of fences that are suitable for fencing across waterways (crossings and access points) are described in Section 7.

9 *Water Note 6*, January 2000, Water and Rivers Commission (Western Australia), p. 3.

10 *Water Note 6*, January 2000, Water and Rivers Commission (Western Australia), p. 2.

11 *Water Note 6*, January 2000, Water and Rivers Commission (Western Australia), p. 2.

12 Price, P. & Lovett, S. (eds) 1999, *Riparian Land Management Technical Guidelines, Volume Two: On-ground management tools and techniques*, LWRRDC, Canberra, p. 113.

Well-fenced stock crossing. Photo Roger Charlton.

SECTION 5

The location of your fences and gates

The best place to build your fences and gates will depend on many factors, including:

- the size, shape and flow of your waterway,
- landform features,
- the condition of your riparian area,
- flood levels,
- flood frequency,
- how you intend to use your riparian area.

A 10 or 30 metre setback probably seems a large sacrifice of land. Long term, however, this sacrifice will be worthwhile in reducing erosion, improving water quality and minimising damage to your fences from floods or erosion.

A well-sited fence enables this landholder to use riparian pastures while protecting the area immediately adjacent to the waterway. Photo Roger Charlton.

Some funding bodies (such as the Natural Heritage Trust and Greening Australia) specify minimum widths for riparian zones before they approve funding for fencing, revegetation or other riparian works. Check with your local Landcare officer or relevant funding body to make sure you don't miss out on funding — either now or in the future.

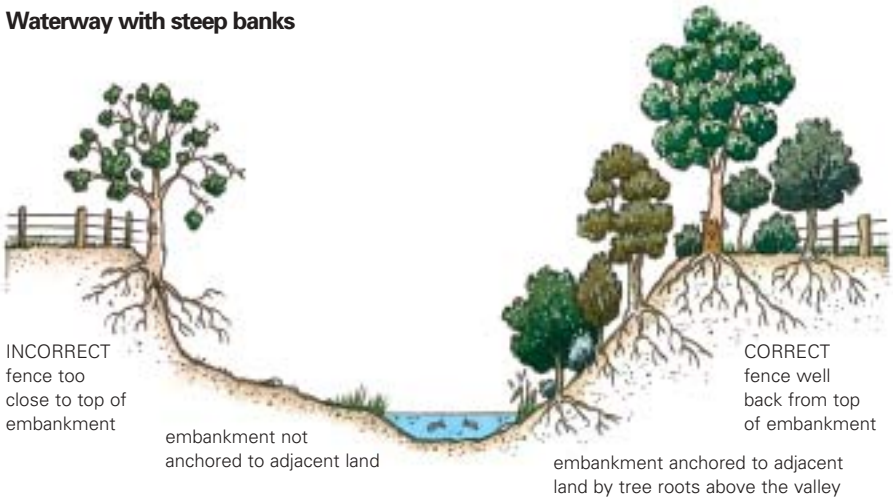
The location of your fences

You should place your fence as far from the waterway as possible. As a general rule, you should build your fence at least 5 metres (but preferably 10 metres) from the top of the banks of small creeks and streams, and at least 30 metres from the banks of major creeks and rivers.

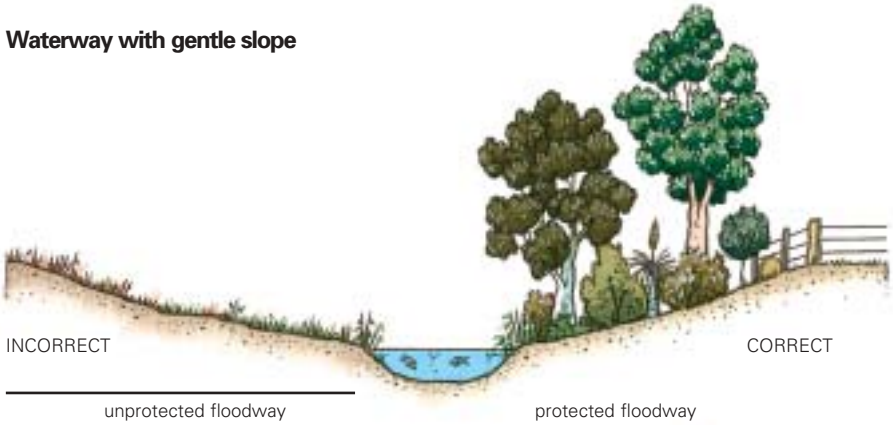
If erosion is active (on the outside of a stream bend, for example, at gully heads, or where waterflow is very rapid), allow a greater setback. This will encourage revegetation, and will protect your fence if the erosion continues.

The ideal place to build your fences is often where there is a change of land type, or a natural landform, such as a ridge. Use the landforms and landtypes as your guide, remembering to allow more distance from areas where erosion is active, banks are steep or unstable, vegetation cover is poor or there are other signs of degradation such as scalding.

Waterway with steep banks



Waterway with gentle slope



Waterway with broad, gentle slope

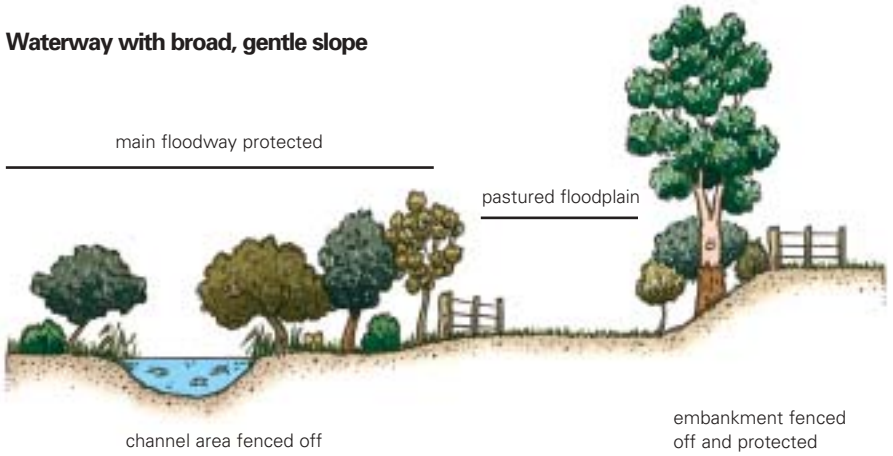


Illustration Paul Lennon. Adapted from *Water Note 18*, Water and Rivers Commission (Western Australia), p. 3.

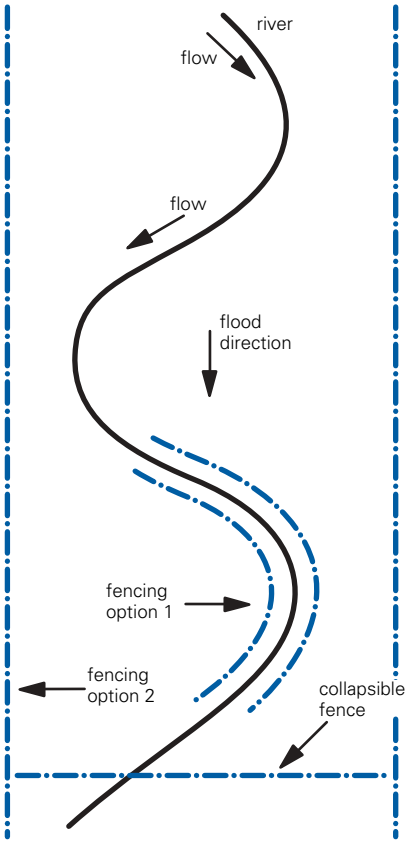
Change in land type is usually indicated by a change in slope, and a change in vegetation. The immediate riparian zone (often called the fringe or the channel corridor), is often characterised by a relatively steep slope and denser, multilayered vegetation. If vegetation cover is poor, this area will be prone to erosion and instability, and soil and nutrient run off will be excessive. Ideally, you should protect this area by fencing at the top of the embankment (or further back if the slope is very steep or degraded) to completely exclude stock.

The floodplain (also called the floodway, river country or river frontage) is probably the most fertile and productive country on your property. It is characterised by a gentler slope, and produces the perennial grasses favoured by stock. The high floodline signals the upper boundary of the floodplain. The high floodline is valuable in determining the location of your fenceline, particularly if floods are frequent or you intend grazing the floodplain.

Aim to build above the floodline. This will reduce the risk of flood damage and stock losses, and will let your riparian zone function as nature intended. Many native plants will regenerate in the riparian zone after flooding, if grazing is excluded or carefully monitored. If this excludes too large an area, consider the use of cheap, replaceable electric fencing closer to the waterway, with a more-durable fence at, or above the floodline. This combination will let you maximise grazing when safe to do so, and also to exclude stock at other times.

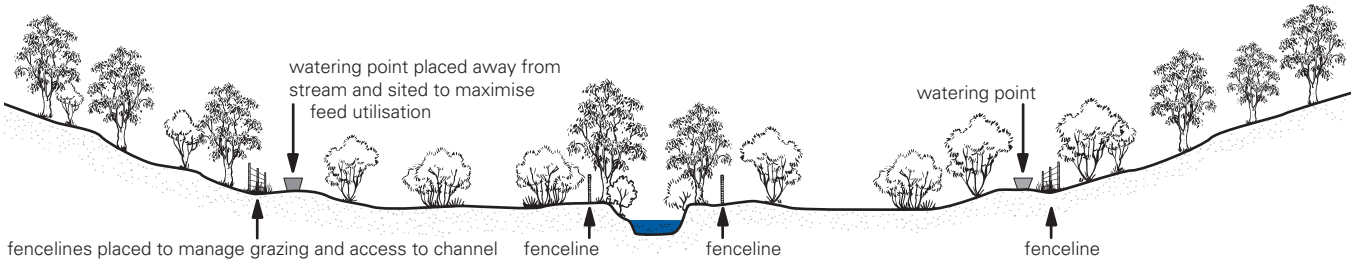
Whether you follow the contours of your waterway may be determined by cost. Straight (or almost straight) fences are cheaper and simpler to erect than fences that follow the bends and curves of the waterway. This is because corners increase the amount of wire, and the number of posts and end assemblies required.

The risk of flood damage is also reduced as debris can't become caught in the bends of the fence. Straight fences set back some distance from the waterway are a good option if your waterway is dynamic (changing course), or if bank erosion is a problem.



Adapted from Price, P. & Lovett, S. (eds) 1999, p. 106.

Try to fence around pockets or strips of native vegetation. This will protect the vegetation, and reduce the risk of damage to your fences caused by falling branches.



Locating watering points as far away from the waterway as possible, will help protect riparian land. Adapted from Roth et al., 2004, p. 16.

If the risk of flooding is great, position your fence parallel to the direction the river or stream takes when in flood. Section 7 contains more information on how to construct flood resistant fences.

If your objective is to provide habitat for wildlife, fence at least 30 metres (but preferably more than 50 metres) from the bank to create a corridor for animal movement. Position your fences to protect as many shrubs and trees as possible to encourage biodiversity.

Build as few fences across your waterway as possible, particularly if you are in a floodprone area.

If your fence will cross the waterway, select the location as if you were building a stock crossing (see Section 4). Build your fence independently of your other fences to avoid the risk of damage to those fences during a flood.

Consider the position of any crossings or water access points, as you will need to provide access to these sites (via gates, or perhaps lay down fencing — see page 33). Section 4 contains advice on the best place to build crossings and water access points.

The location of your gates

Place gates as far from the waterway as possible, and on the highest ground. Avoid building your gates in fragile areas or where degradation is already a problem. Drop down or lay down fencing (see page 33) is a cost-effective alternative to gates, particularly if you need wide or emergency access to your riparian areas. A variation on this theme is a lift up gate (pictured) which is ideal for moving large mobs and drifting ewes. Openings of 60 metres are possible, depending on topography.

Top. David Read demonstrating the use of a lift up gate. Photo Jenny O'Sullivan. **Below. Simple cockie's gate, providing easy access to the riparian zone.** Photo Phil Price.

Remember to include a gate, or some other form of access, even if you're fencing to permanently exclude stock. This will let you remove any stock that stray into your riparian area, and provides access for spot spraying weeds or baiting for vermin.

Building a gate at the end of a fence, or where there is a change of direction, will reduce the number of end assemblies required.

Fences have been placed along the contours of these gullies and stream to exclude stock. This fencing has created corridors for wildlife as well as helping to control erosion. Photo Jenny O'Sullivan.

SECTION 6

Choosing the best type of fence

The best type of fence for your riparian areas will depend on several factors, including:

- the type of stock you run,
- the risk of flood damage,
- cost,
- whether your fenceline will follow the contours of your waterway.

Riparian fencing is usually subject to greater strains and pressures than fencing in other areas. Flooding is a common problem. Stock pressure is often high, particularly when feed outside the riparian area is in short supply, and as the riparian area regenerates, you may find that wildlife and vegetation start to impact on your fences.

Fenced crossings will need careful planning, especially where there are fluctuations in the level and flow of your waterway.

This Section discusses the main fencing options for riparian areas, while Section 7 suggests ways to make your fences more flood resistant. Section 7 includes information about fences that have been specifically designed for use in floodprone areas, and for fencing across waterways.

We also encourage you to read the case studies to discover how different farmers have approached their riparian fencing, and their suggestions for tackling specific problems.

Many farmers in our case studies have built their riparian fences in the same way as their internal fences. This works best if:

- you are prepared to fence well above the floodline; and
- in areas used for extensive grazing, you reduce stock pressure on your riparian fences by placing watering points and any feed supplements some distance from those fences.

Fencing options

Conventional/suspension fences are used by many producers to fence their riparian zones, particularly in floodprone areas. They are cheaper than mesh fences, and do not collect as much debris during floods. As the wires are easy to repair, it is often worth cutting them before a flood to avoid greater damage (i.e. loss of posts or assemblies). Adding electric hot wires or barbed wires to conventional/suspension fences will make them more effective for a range of animals. This makes them a good choice for producers who run (or intend to run) more than one type of stock.

The cost of your conventional/suspension fence will increase with the number of wires, posts and strainer assemblies required. The number and type of wires are governed by the type of stock you want to exclude, and whether you graze intensively or extensively. A cattle and sheep producer grazing intensively in southern Victoria, for example, may use up to nine plain wires, while a cattle producer in northern Queensland may find three or four barbed wires are sufficient.

The number of posts (and droppers, if erecting a suspension fence) will vary, depending on your terrain and the type of wire being used. Obviously, using fewer posts will keep your costs down, but equally, you do not want to compromise the strength of your fence by using too few posts. As a general guide:

- wider spacings of up to 20 metres are possible using high tensile wire (suspension fencing),
- wider spacings are possible on flat country.

Posts and droppers are an important visual aid, alerting animals (and humans) to the presence of the fence.

Conventional/suspension fencing is cheaper and easier if your fenceline is straight, or almost straight. If you want to follow the contours of your fenceline, you will need to construct a number of strainer assemblies which will add significantly to the overall cost. Conventional/suspension fencing is not suitable if you want to fence around a curve.

In fireprone areas, Iowa barbed wire (a softer but thicker wire) is often a better option than high tensile barbed wire[14].

Combination of permanent conventional fencing and temporary electric fencing used to prevent access to the riparian area of an ephemeral stream. Photo Jenny O'Sullivan.

Strictly speaking, suspension and conventional fencing are different kinds of fences. Conventional fencing produces a fairly rigid fence, characterised by closely spaced posts, soft wires and wire tensioned by guesswork. Suspension fencing produces a more flexible fence, and is characterised by widely spaced posts, suspended droppers and measured tension on wires[15]. For the purposes of this Guide, however, conventional and suspension fences are being discussed together to distinguish them from prefabricated (mesh) fences and electric fences.

A table listing the advantages and disadvantages for the three most popular types of fences is on page 31.

Conventional fence for excluding both sheep and cattle, with second, third and fourth wires electrified. Photo Jenny O'Sullivan.

Prefabricated (mesh) fences are stronger than conventional/suspension fences at the same spacings, and when erected properly, will form a solid, impenetrable barrier to stock and vermin. Depending on the size of the spacings, prefabricated fencing can be used to exclude most animals, including lambs, pigs, rabbits and goats. Effectiveness can be increased by adding electric or barbed wires. A prefabricated fence will cope better with minor damage than other fences, because a snapped wire will be supported by the surrounding wires. Unfortunately, this characteristic makes them more susceptible to flood damage, because debris is easily caught in the mesh. Recent innovations in the form of lay down fencing, however, mean that this may be less of a problem (see page 33).

The main disadvantage of prefabricated fences is their high cost in relation to other types of fencing. However, the cost should be weighed up against the ease of construction and the high degree of protection provided by prefabricated fences. For many farmers, particularly those farming intensively or fencing short distances, these benefits may outweigh the initial cost of the fence. Prefabricated fences are not suitable for fencing along contours or around curves.

If rust is likely to be a problem, choose a ring lock style of prefabricated fencing over a hinge joint style. Also, running a sacrificial wire beneath your fence will save you time and money as it can be easily replaced when rusted.

Electric fencing is the cheapest and most effective option for many producers, provided a reliable source of power is available, and a strong electric current can be maintained. Electric fencing is quick to erect, moveable and is the easiest way to fence along curves and contours. It is suitable for fencing across waterways (see page 34) and can be clipped to posts, making it easy to lay down if access is required or a flood is imminent.

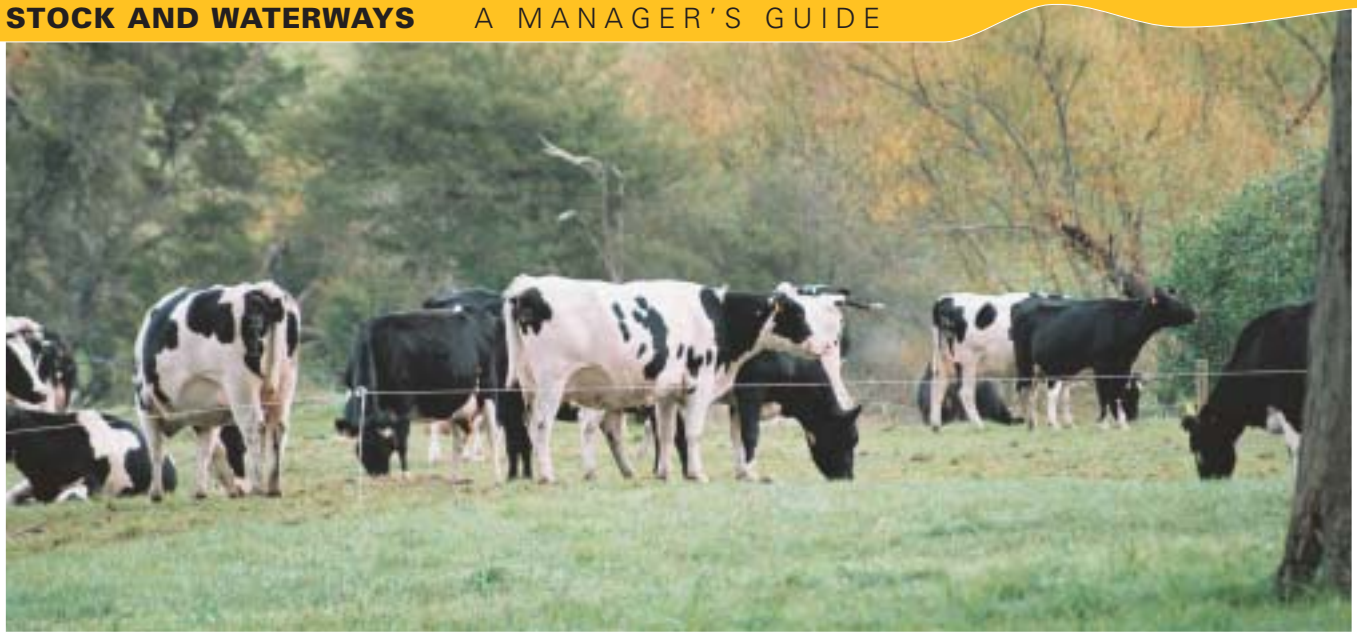
Electric fence built using a combination of posts and pickets. Photo Jenny O'Sullivan.

The important point when designing your electric fence is to consider which of the animals that will encounter your fence you wish to stop. You then position a live wire where they are most likely to touch that wire with a part of their body. As a general guide:

- three wires will exclude cattle,
- four wires will exclude sheep and cattle,
- five wires will exclude cattle, sheep and lambs,
- six wires will exclude all stock, including goats,
- seven wires will exclude all feral animals, including kangaroos and dogs[16].

Electric fencing is considered by many producers to be ineffective against sheep. Poor electrical current (less than 4500 volts), too few hot wires, or incorrectly spaced wires may be the reason an electric fence fails to exclude sheep. An important aspect to remember with wool (or heavy fur) is that the wire spacing affects the pressure of the electric wire on the animal. The closer the spacing, the higher the wire pressure, making it more likely that the animal will get a shock when pushing through the fence[17].

Electric fencing is a psychological, rather than a physical, barrier, so wire strength is not critical to its effectiveness. This results in a cheaper, and more quickly erected fence, as less wire, and fewer and smaller posts, are required. As well, posts do not have to be driven as far into the ground as for other types of fencing. However, you must be able to power, and maintain, a strong electric current to ensure your stock respect the fence wires, and energy and maintenance costs should be taken into account. Mains power is the cheapest and most reliable source of power, although improvements in technology mean that solar is now a viable alternative, particularly in remote areas. Battery powered energisers need constant recharging and are really only suitable for temporary fencing[19].



Even a single electric wire will be effective if voltage is adequate. Photo Jenny O'Sullivan.

A short in one part of an electric fence will render a large part of it ineffective. Electric fences may not suitable, then, in areas where the vegetation is likely to become overgrown, or there is a lot of wildlife traffic. Some farmers report, however, that maintaining a high voltage will often burn off new growth before too great a load is created, and deter wildlife.

You can reduce the risk of vegetation shorting your fence by slashing or spraying along your fenceline. Depending on your conditions, this may only need to be done every one or two years.

Some farmers cull stock that do not 'respect' electric fences. This improves the effectiveness of their fences even if the electricity supply fails.

Plan your electric fencing carefully so that you can trace faults quickly. The use of cut out switches at gates and where fence lines divide, and using a good quality voltmeter, will make this job easier[19]. The critical part of electric fencing is the earthing system, as it is through the earth or the earth return wires that the animal gets a shock. In damp conditions, the fence wires can all be live with the animal always receiving a shock through its feet. In arid conditions, the earth return system is generally utilised so that the animal receives a shock through two adjacent wires[20].

Virtual fencing is potentially a revolutionary alternative to conventional fencing, particularly for producers running stock over large distances. Stock wear ear tags which emit an irritating sound if they move out of a remotely controlled, electronic exclusion zone. Virtual fencing is still being developed for Australian conditions and is not discussed in detail here.

Belmont Red cow and calf wearing contact logging collars for measuring the social interactions of animals. This sort of technology is being developed for applications such as virtual fencing. Photo CSIRO Livestock Industries.

Type of fence	Advantages	Disadvantages
Conventional/ suspension	• relatively flood proof • cheaper than mesh fences • simple to cut if flood imminent, to reduce damage • simple to repair • relatively effective against cattle • additional wires can improve effectiveness against sheep and lambs	• droppers may be needed, depending on post spacing • difficult to follow curves • less effective against sheep than mesh fences
Prefabricated (mesh) (e.g. Ringlock® or Hingejoint®)	• very effective in controlling cattle, sheep and vermin • most effective against lambs • strong • copes well with minor damage as snapped wires are supported by surrounding wires • droppers not needed • fairly quick to erect	• expensive • susceptible to flood damage (although see Section 7 for cases where this type of fence can work) • difficult to follow curves • difficult to repair if many wires are cut
Electric fencing	• comparatively cheap • quick to erect • relatively flood proof • effective against a range of stock and feral animals • curved fence line possible • can be used easily to fence off stock crossings and watering points • easy to move (good option for temporary fencing) • less damage or injury to stock	• not as effective against sheep (but additional wires and closer spacing can improve effectiveness) • droppers may be needed • relies on electricity supply (but solar power is becoming more reliable as technology improves) • vegetation and wildlife can cause shorting

13 Based on table contained in Wright, D. & Jacobson, T. 2000, *Managing Streamsides: Stock control, fencing and watering options*, Department of Primary Industries, Water & Environment, Tasmania, p. 12.

14, 15, 16, 17
Waratah® — 1990 Australian Wire Industries Pty Ltd, *The Complete Fencing System*, pp. 20–24.

18 Wright, D. & Jacobson, J. 2000, *Managing Streamsides: Stock control, fencing and watering options*, Department of Primary Industries, Water & Environment, Tasmania, p. 14.

19, 20
Waratah® — 1990 Australian Wire Industries Pty Ltd, *The Complete Fencing System*, p. 23.

SECTION 7

Building flood resistant fences

It will probably never be possible to design a fence that will withstand the force of a major flood. You can, however, take steps to minimise the risk of your fence being damaged by a flood, and to reduce the amount of damage suffered in the event of a flood.

This Section suggests principles to consider when designing your fences to improve their resistance to floods[21]. It also provides information about different types of fences specifically designed for floodprone areas, and for fencing across waterways.

This Section should be read in conjunction with Section 5 which contains information on locating your fences to avoid the risk of flood damage.

The remains of a fence that was built below the flood line. Photo Michael Askey-Doran.

- **Consider using drop down or lay down fences in high-risk areas** (see below).
- **Build your fences parallel to the likely direction of the flood flow.**
- **Build as few fences as possible across the waterway.**
- **Build your fences as far above the high flood level as possible.**
- **Isolate fences that are at risk of being damaged by floodwaters.** If your strainer (end) assemblies fail, your entire fence will also fail. It makes sense, then, to build at-risk fences independently of your main fences. Fences that cross waterways or are below the flood level, such as access point fences, should be constructed using separate strainer assemblies.

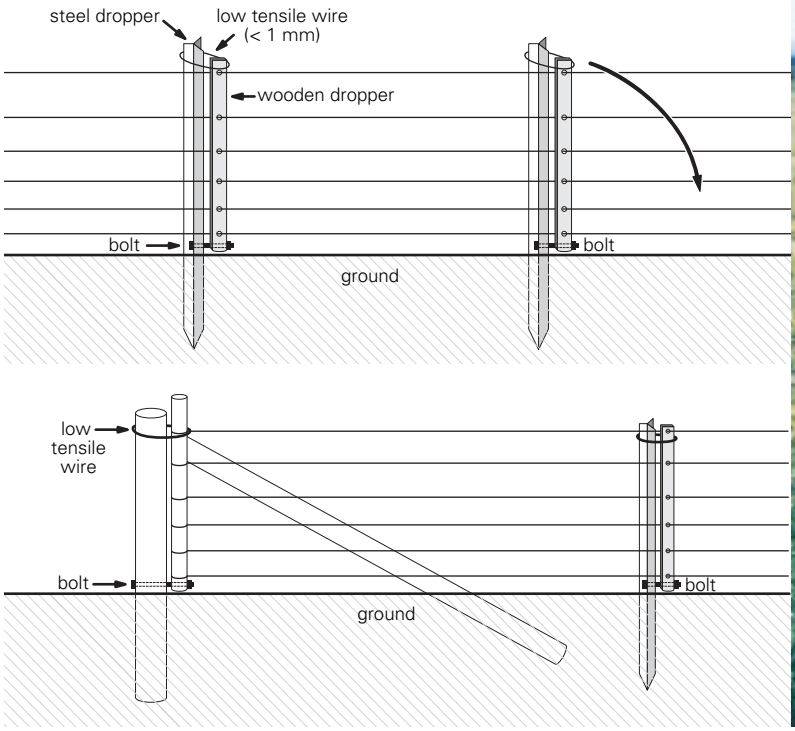
- **Strainer (end) assemblies should be as strong as possible.** Use box end or post and stay assemblies constructed using the principles below.
- **Use thick posts.** Thicker posts provide greater resistance than smaller posts.
- **Reduce the space between your posts.** Positioning your posts closely together will provide more resistance against floodwaters.
- **Increase the depth of your posts.** Posts dug deep into the ground are less likely to push over in a flood. Increasing the depth of a post by one third will double its resistance to overturning[22]. Posts in sandy soils should be dug deeper into the soil than posts in clay soils.
- **Drive your posts into the ground.** A driven post will be 1.5 times more secure than a post that has been placed in an oversized hole with the earth rammed back around it[23].
- **Keep the number and types of wires that can collect debris to a minimum.** A five strand fence will collect less debris than a seven strand fence. Plain high tensile wires are less likely to catch and collect debris than prefabricated (mesh) fencing or barbed wire. (Electric fences which use fewer wires than other fences, and generally use plain wire, are often the best choice in floodprone areas.)
- **Keep the number of droppers to a minimum,** to reduce the likelihood of collecting debris.
- **Maintain wire tension** to promote wire vibration, which will help to minimise debris load.
- **Keep fence heights to a minimum,** as fences lose stability with height.
- **Use anti-sink and anti-lift devices with posts on crests and in depressions.**
- **Be prepared to cut wires to reduce the risk of significant damage.**

Drop down and lay down fences

Drop down and lay down fences are designed to fold down, or to be folded down, so that they can't accumulate debris and be damaged during a flood. Drop down fences fold down automatically as pressure from water and debris builds up behind them[24]. Lay down fences are designed to be folded down manually before a flood, and obviously depend on good forecasting to be effective. If your area is prone to sudden flooding, or access to your fences is not good, choose a drop down fence over a lay down fence. You can make drop down and lay down fencing using plain wire, barbed wire, electric wire and/or mesh.

Lay down and drop down fencing can be used instead of expensive gates, to provide access for stock and vehicles into your riparian areas.

This simple 'cockie's gate', made from a mesh panel, can be used as a form of lay down fence.
Photo Phil Price.



Drop/lay down fence. Upper diagram shows drop-down wooden posts at steel droppers and bottom diagram shows drop-down end strainer post. Adapted from Price P. and Lovett. S. (eds) 1999, p. 107. Photo Ian Bell.

There are several types of drop down and lay down fences, ranging from the simple 'cockie's gate' (see page 33) to more sophisticated systems. Some drop down fences are constructed using a hinge system. Wooden droppers are attached to the posts (usually steel pickets) using loops of high tensile wire at the bottom, and low tensile wire at the top.

The softer, low tensile wire at the top is intended to break under high pressure, while the high tensile wire remains intact and acts as a hinge. When the top loop breaks, the fence lies flat, and any debris is released. Once the flood has passed, the fence can be lifted up and re-tied to the posts.

Another type of drop down fence uses a pivot system. Steel posts and triangular end assemblies, which both pivot at ground level, are used in conjunction with spring-loaded bolts and a special release wire. This wire runs the length of the fence and triggers when a flood passes through. The water pressure on debris caught by this wire pulls the bolts from their holes against the spring pressure, allowing the whole section to drop down and the flood to pass over it. The fence is easily re-erected after the flood.

Fencing across waterways

As with drop down and lay down fences, there are several types of fences that can be used across waterways, ranging from the very simple (one or more electric wires) to the more sophisticated (hinged floodgates). Your choice of fence will depend on the size of your waterway, the potential for flooding, the type of stock you run, the likely amount of stock pressure on the fence, and cost.

Any fence that crosses a waterway should be built independently of the rest of your fences. This avoids the risk of damage to those fences if the fence crossing the waterway is damaged during a flood.

Electric fencing

Plain wire electric fencing can be very effective across waterways, and is easy to repair in the event of a flood. Portable electric fencing is particularly useful for fencing off temporary crossings. Because electric fencing requires less structure than other types of fencing, it is ideal for wide waterways. If vertical support is required within the waterway, steel pickets can be inserted in the bed much more easily, and with less damage to the bed, than ordinary posts.

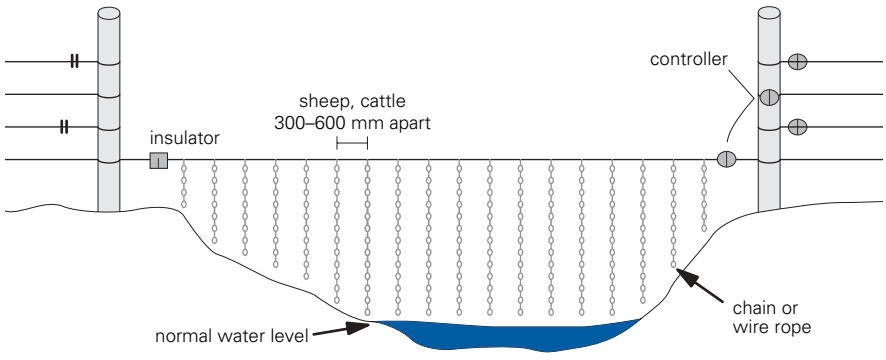
Photo John and Sue Holt.

Suspended (hanging) fences

Suspended, or hanging, fences are often used to fence off narrow, steep sided waterways. They are particularly useful for gullies where erosion is an issue. Steel cable, high tensile wire or chain is suspended across the waterway between two secured posts. A 'curtain' of material such as mesh, chains, corrugated iron or planks of wood is attached to the cable. While the cable remains taut, the curtain is designed to remain flexible and rise with the flow (some farmers attach foam or plastic floats at the bottom of the fence to aid flotation). The bottom of the fence should remain below water level, to prevent stock from going under the fence if the water level falls.

A curtain made of horizontal sections, such as mesh, will be more likely to be damaged during a flood than a curtain containing vertical sections, such as chains.

Suspended fences made of chains or hinged panels can be electrified, if you need more stock control. In this situation, the chains or panels should be set just above the normal water level. You will need an energy limiter (also called a voltage loss limiter) on the posts supporting the suspended fence for when the water level rises. The energy limiter will ensure that the rest of your fences continue to have sufficient voltage during a flood.



Adapted from Price P. and Lovett. S. (eds) 1999, p. 111.

If the normal water level varies seasonally, it is worth installing a hand winch or tensioner to adjust the height of the chains or panels. When an adjustable cable is set at the low point, it must have a parabola. Shorten the centre chains or panels so that when the cable is tightened, the chains or panels hang uniformly over the water.

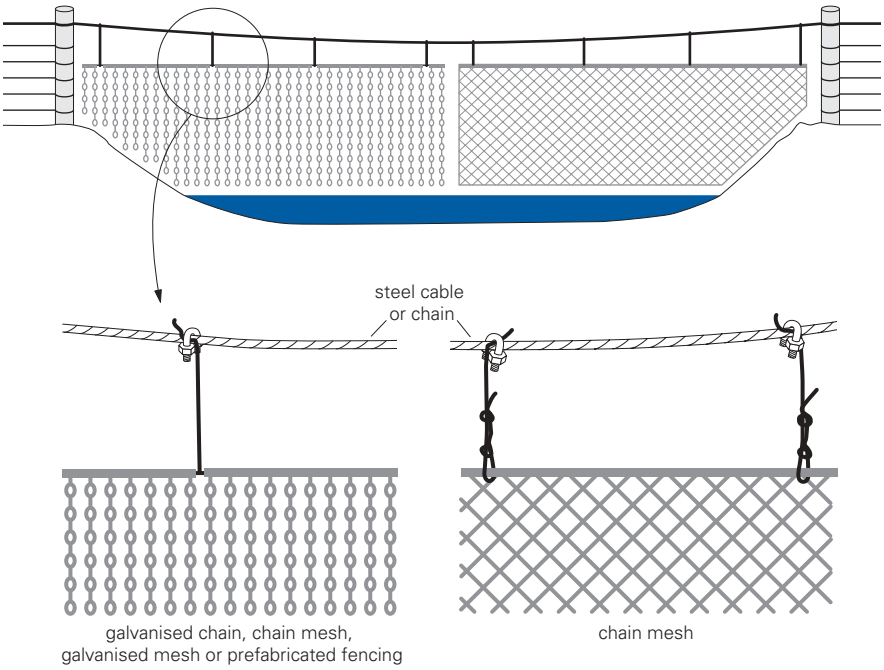
If you are considering making your curtain out of sheets of corrugated iron, or planks of wood, remember to take into account the possibility of wind damage.

Hinged floodgates

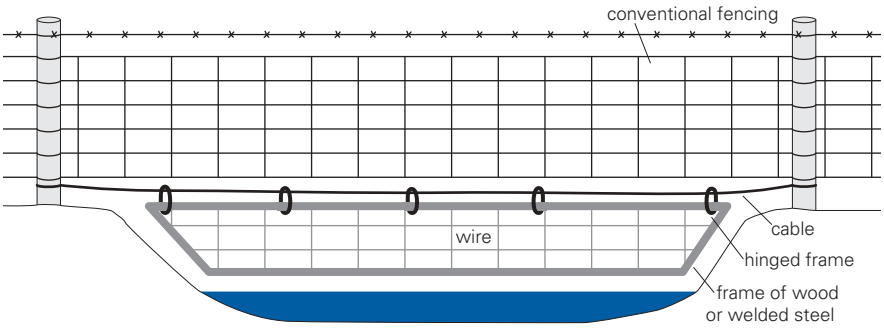
Hinged floodgates are really only suitable for narrow waterways where floodwaters are contained within the waterway and do not rise above the floodgate. A conventional fence is built across the waterway, and a steel cable strung between the posts either side of the waterway (i.e. beneath the fence). A wooden or steel frame is attached to the cable in a way that allows it to move with the flow of the water[25]. If floodwaters are higher than the top of the floodgate, the conventional fence will be at risk of damage from debris.

Horizontal sections of the frame can trap debris and be damaged or destroyed, even when water level and flow are normal.

Suspended cable fence. Both diagrams sourced from: *Water Note 19*, Water and Rivers Commission (Western Australia), p. 5.



Hinged flood gate.



21 Collated using information collected in Wright, D. & Jacobson, J. 2000, *Managing Streamsides: Stock control, fencing and watering options*, Department of Primary Industries, Water & Environment, Tasmania, p. 22, and *Water Note 19*, July 2000, Water and Rivers Commission (Western Australia), pp. 1–2.

22 Waratah® — 1990 Australian Wire Industries Pty Ltd, *The Complete Fencing System*, p. 9.

23 Waratah® — 1990 Australian Wire Industries Pty Ltd, *The Complete Fencing System*, p. 20.

24 Price, P. & Lovett, S. (eds) 1999, *Riparian Land Management Technical Guidelines, Volume Two: On-ground management tools and techniques*, LWRRDC, Canberra, p. 107.

25 *Water Note 19*, July 2000, Water and Rivers Commission (Western Australia), p. 5.

SECTION 8

Watering systems

A reticulated watering system can be a valuable tool for integrating all parts of your property, including your riparian areas. Many of the farmers in our case studies found that installing a watering system was instrumental in improving not only the way they managed their riparian areas, but the way they managed their entire farm as well.

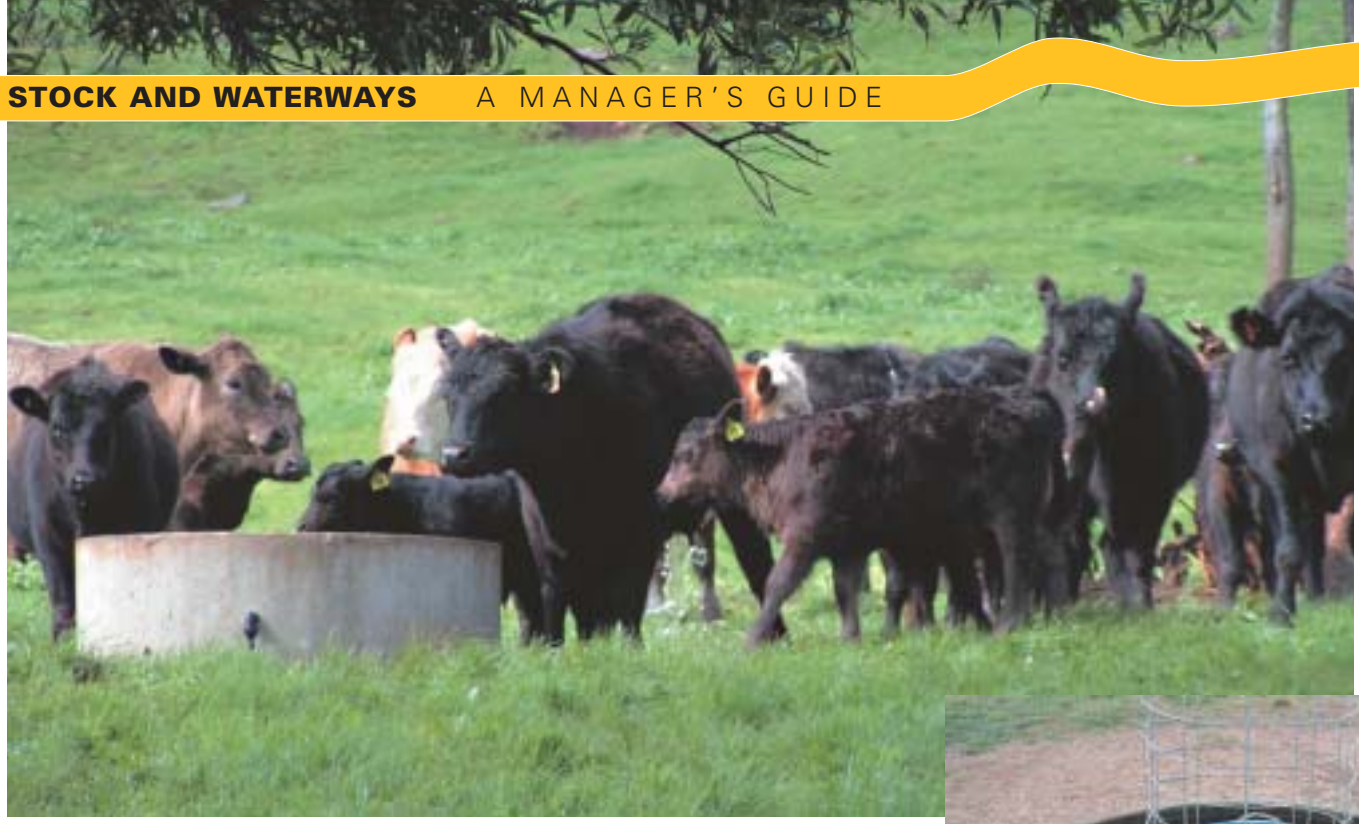
Some of the benefits of a watering system include[26]:

- cleaner water (which can lead to healthier stock, less disease, increased growth rates and better wool, milk or meat production),
- more flexibility to match the needs of stock (e.g. pregnant or lactating animals) to the available pasture,
- better control over grazing patterns and improved feed utilisation,
- better control over stock, including the potential for rotational or cell grazing,
- reduction of stock losses due to floods or being trapped in the waterway,
- reduced mustering times,
- improvements in overall riparian health, as a result of reduced stock access to the riparian area.

Installing a watering system can initially be expensive and time consuming, and requires ongoing maintenance and operating costs. It is important, therefore, that you think carefully about the best system for your purposes and property, and how it will fit with your existing paddock plan.

Installing a watering system is often the trigger for a more efficient paddock subdivision.

For this reason, we encourage you to read this Section in conjunction with Section 3 (Farm planning), and Section 9 (Controlled grazing). We also suggest you read the case studies which describe the watering systems installed by farmers in different parts of the country. The case studies include information about alternative water sources, trough layout, pumps, piping and tanks.



Stock spend time loitering around water points. Photo Jenny O'Sullivan.

Choosing a watering system

The choice of watering system for your property will depend on several factors, including:

1. your water source,
2. paddock layout,
3. the amount of water required,
4. the distance between the water supply and the watering point, and the distance between watering points,
5. the height difference between the water supply and the watering point(s).

1. Water source

Some producers may be able to take water from their waterway and gravity feed or pump it to other parts of their property. Others may need to establish alternative water sources, such as groundwater bores or dams, and pump or pipe water from those sources.

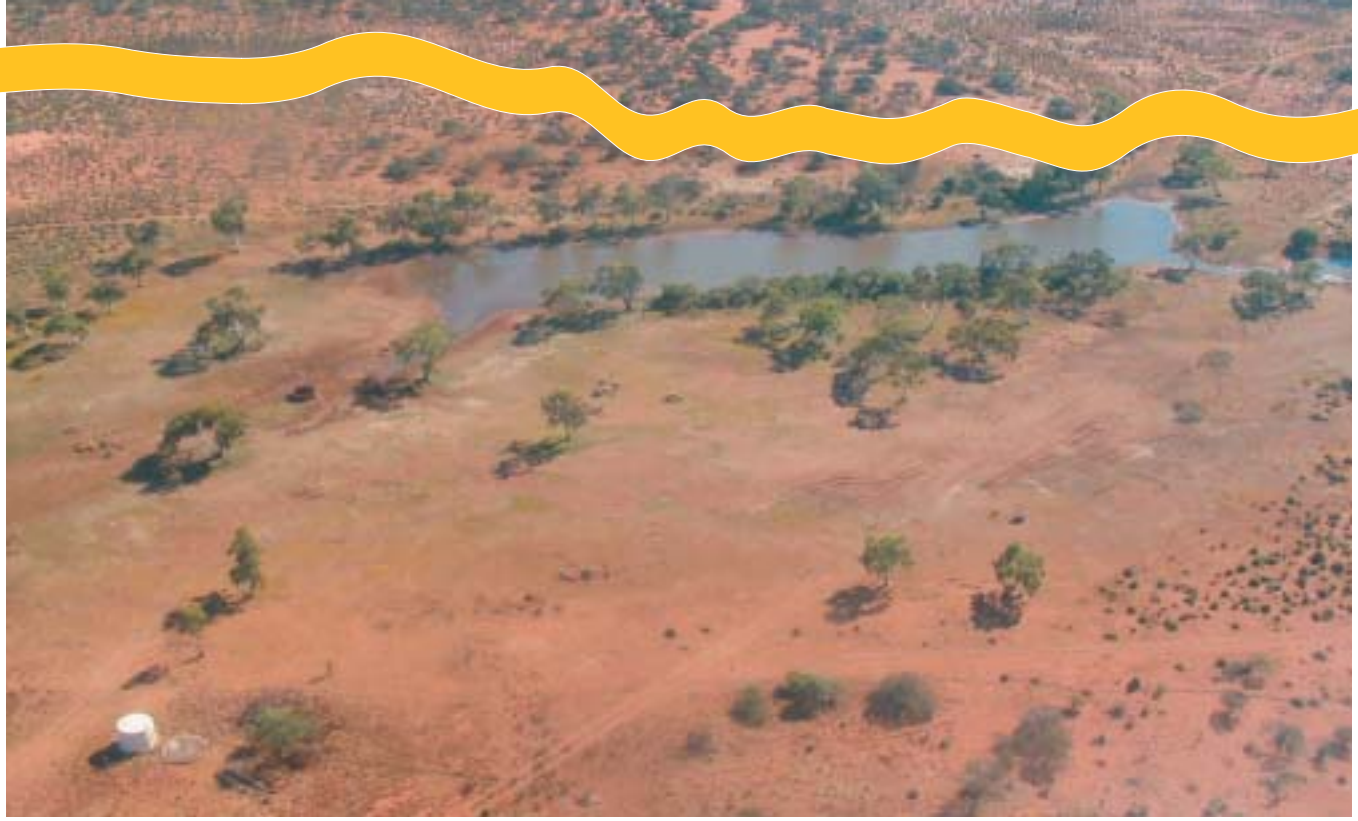
A permit or licence may be required to:

- take water from a waterway, surfacewater or groundwater source,
- build a dam or weir,
- collect water in a dam,
- drill an artesian bore.

The costs of dams and bores will vary according to soil type, the level of the water table, and, in the case of dams, the size required.

This "ecotrough", developed by David and Ruth Read, shows reeds planted in a restricting container. When grown the reeds will keep the water temperature down.
Photo David and Ruth Read.

The location of your water source may determine the type of watering system you can install. Piping water (using gravity feed) is a cheaper option than pumping, but is only feasible if your water source is located higher than your endpoint(s). Many producers pump from the waterway (or other source) to a higher storage point, such as a dam or tank, and then pipe to lower parts of the property using gravity.



The manager of this property has moved all watering points (see bottom left) away from the riparian zone. Photo PJ Waddell.

2. Paddock layout

Obviously you will need to make sure that stock in each paddock have access to adequate water. You may find that in the long term, it is more practical to establish a new water source to supply the surrounding paddocks, than pumping over long distances or uphill. You may consider altering fencelines to take advantage of an existing water source or favourable landform, such as a slope (for gravity feed), or a spring, soak or depression (which can be used to create a dam).

The location of your watering points will also be relevant. Permanent watering points should be located as far upslope from the riparian zone as practical, and away from boggy, fragile or degraded areas.

Allowing for additional watering points at the time of installation will save you money in the long run. Additional watering points give you a back up if the main endpoint fails or needs repair, and also the means to 'force' stock to another endpoint. This can be helpful during mustering, to even up grazing patterns, and to move stock from degraded areas. Allowing for additional watering points can be as simple as including extra taps along your pipeline for use with plastic troughs.

3. Water requirements

You will need to determine your water requirements, according to the maximum number of stock you plan to run in each paddock.

As a general guide, the daily amount of water required per head of stock during summer is as follows:

Sheep	7 litres
Beef cattle	30 litres
Dairy cattle	50 litres[27]

Structuring your system so that you can shut off or close off watering points can be a useful stock management tool.

These requirements will vary depending on a number of factors, including temperature, the amount of available feed, and the type of available feed.

4. Distance

You will need to consider the maximum distance stock will be prepared to travel to water, when considering your watering system. As a guide, healthy cattle will travel 10 kilometres to water, but for effective grazing and animal production no more than 3 kilometres is recommended between water points.

The distance and height differential between your water source or supply point and your water point(s) will be relevant to deciding whether gravity feeding is an option, the size of pipe required, and the type of pump (if any) required (see point 5).

> Larger pipe is necessary to deliver the same volume of water over a longer distance.

5. Height differential

Gravity feed, a cheaper option than pumping, is only feasible when the supply point is higher than the endpoint(s). Building a dam or tank on higher ground, or placing a tank on stands, can resolve this problem. However, the smaller the height differential, the slower the flow will be. Therefore a gravity fed system needs to be designed to ensure sufficient flow particularly at times of peak water demand. This planning is critical especially if there are numerous troughs being supplied by the system. If watering points are higher than your supply point, you will need to pump the water (see below).

Pumps

There are many different types of pumps available, classed according to the means of power. A table summarising the advantages and disadvantages of the main types of pumps available is on page 43.

Electrical mains power

If mains power is available, an electric pump is often the best option for continuous pumping, and for pumping large volumes of water uphill or over long distances. Electric or solar pumps can be set so that they start or stop with changes in water pressure.

Trough with height indicator on David and Ruth Read's property.
Photo Jenny O'Sullivan.

Petrol/diesel pumps

The main disadvantage of petrol and diesel powered pumps is the need for constant refuelling, and that they are not as easily automated as electric pumps. While diesel pumps are suitable for continuous pumping of high volumes of water, petrol pumps are more suitable for occasional use. Many operators use petrol pumps in particular as back up pumps, in case of power failure or if the main pump needs repair.

Photo Jenny O'Sullivan.

Photo Roger Charlton.

Above: Water is pumped from this dam to a tank using a petrol pump. Right: A wind-powered bore with storage tank.

Solar power

Recent developments in technology mean that solar power is now an efficient and economical way of supplying electricity. Solar pumps are often ideal for use in remote areas. Solar powered pumps are not as powerful as other types of pumps, and are best suited for moving low volumes of water over shorter distances (less than 2 kilometres) and lower heights. To increase their power requires additional solar cells which can be uneconomical over the short term, and unwieldy. However, solar technology is improving rapidly and has the advantage of no running costs.

Pumping performance varies according to latitude and number of sunny days, with more water being pumped in summer than winter. To compensate for any variability, solar pumps are often used in conjunction with a tank with a 5 day capacity. Batteries can also be used as a back up for cloudy days.

Wind power

Wind is fast losing popularity to solar power as the preferred method of pumping water in remote areas due to high maintenance costs and unreliability. A larger pump requires higher wind speed to start the pump, so wind is more suitable for pumping low volumes of water. To compensate for the fickle nature of the wind, wind powered pumps are generally used in conjunction with a tank of 7–10 day capacity[28].

Solar powered pump with back up petrol pump. Solar panel shown above right. Photos Roger Charlton.

Air

The main advantage of an air powered system is that the air compressor can be located remotely from the pump. This makes air powered pumps ideal for properties where mains power is available, but is too far from the water supply to be able to use an electric pump. Other forms of power (solar, for example) can also be used to power the compressor. Air powered pumps are especially suited for situations requiring continuous operation at low volumes per hour and where the water supply is intermittent (low producing bores, for example)[29].

Ram pumps

Ram pumps use water flow to pump water out of a waterway. The amount of water able to be pumped is dependent on water velocity. Ram pumps require a fall of at least 1 metre to operate. Ram pumps are most suitable for pumping low volumes of water throughout winter (when water flow is greatest) into a storage area for use during summer.

Stock operated pumps

These are simple systems which rely on the stock pushing some part of their body against a lever to drive a piston (or other mechanism) to pump the water. Stock are easily trained to operate the system. Stock operated pumps are cheap to purchase and have no operating costs. Easily mounted on skids, these pumps can be extremely portable. An advantage of the fact that stock operated pumps can only deliver very low volumes of water on demand, is that the risk of water wastage is unlikely.

Cattle operated nose pump. Photo Malcolm Brown.

26 Lovett, S., Price, P. & Lovett, J. 2005, *Wool Industry River Management Guide: High rainfall zones including tableland areas*, Land & Water Australia, p. 74.

27 *Water Note 7*, January 2000, Water and Rivers Commission (Western Australia), p. 3.

28 *Water Note 7*, January 2000, Water and Rivers Commission (Western Australia), p. 3.

29 Lovett, S., Price, P. & Lovett, J. 2005, *Wool Industry River Management Guide: High rainfall zones including tableland areas*, Land & Water Australia, p. 77.

Funding is often available to help set up watering systems to take pressure off your riparian areas. Contact your local Landcare facilitator to find out what funding is available.

Type of pump	Advantages	Disadvantages
Electric (mains power)	• most suitable for pumping large volumes uphill or long distances • reliable (provided electricity supply is reliable) • can be automated	• need access to mains power • can be expensive to purchase
Diesel	• suitable for pumping large volumes uphill or long distances • portable	• can be expensive to run • needs refuelling • difficult to automate • can be expensive to purchase
Petrol	• good back up option for other pumps (e.g. electric) • portable	• can be expensive to run • needs refuelling • difficult to automate • can be expensive to purchase
Solar	• cheap to operate • ideal for remote areas • reliable • easy to maintain	• not suitable for pumping large volumes or uphill (but becoming more effective as technology improves) • can be expensive to set up (but price is falling as technology improves)
Wind	• cheap to operate • used in remote areas	• least reliable • not suitable for pumping large volumes or uphill • needs to be used with large storage tank
Water (ram pump)	• good option for continuous, low volume pumping • no operating costs (provided stream is flowing)	• needs 1 metre fall in waterway • not suitable for pumping large volumes • capacity can decrease in summer months • can be expensive to purchase
Air	• good option where mains power is available, but located too far from pump to use an electric pump • good option where water supply is intermittent (e.g. bore) • suitable for pumping low volumes over long distances	• not suitable for pumping large volumes • air leaks can be difficult to detect • compressor requires second source of power (e.g. mains electricity or solar)
Stock operated	• cheap to buy • stock are easily trained to operate pump • no operating costs • portable • no water wastage	• suitable for low volumes only

SECTION 9

Controlled grazing

Many people argue that the only way to restore riparian health is to completely exclude stock from the area. Complete exclusion is generally the preferred course of action on properties where the riparian area is in poor condition, or where grazing is carried out on an intensive level. In these situations, the risk of damage is so severe that it usually outweighs any benefits of grazing.

There are, however, situations where grazing can form part of a sustainable riparian management plan — provided:

- you have the ability to control (and reduce if necessary) grazing pressure (e.g. using fencing, feed supplements, salt licks),
- stock are restricted from accessing the waterway (e.g. alternative watering sites, fenced watering sites and crossings),
- you regularly check the grazed area for signs of actual or potential damage,
- you remove stock or reduce grazing pressure, in response to signs of actual or potential damage.

Degraded areas such as this will continue to deteriorate unless stock are completely excluded. Exclusion will allow vegetation to re-establish and stabilise the banks.
Photo Robyn Watts.

This Tasmanian dairy farmer has protected native remnant vegetation and riparian areas to gain environmental and economic benefits. Photo Jenny O'Sullivan.

It's important to remember that the farmers in the case studies whose riparian land was in poor condition, did not graze the land until complete exclusion had allowed the land to recover.

Several of the farmers in our case studies use controlled grazing as part of their riparian management strategy. The reasons for, and benefits of, controlled grazing of riparian land vary between farmers and regions, but include:

- better pasture quality in riparian areas,
- presence of green pasture in riparian areas, when feed is lacking in other parts of the property,
- shelter, particularly during lambing or calving,
- weed control,
- fire control,
- encouraging regeneration, through seed dispersal, and trimming trees and shrubs to allow light to penetrate for germination.

This Section contains information to help you develop your own grazing strategies, so that you can graze productively and without damage to your riparian areas.

Principles of controlled grazing

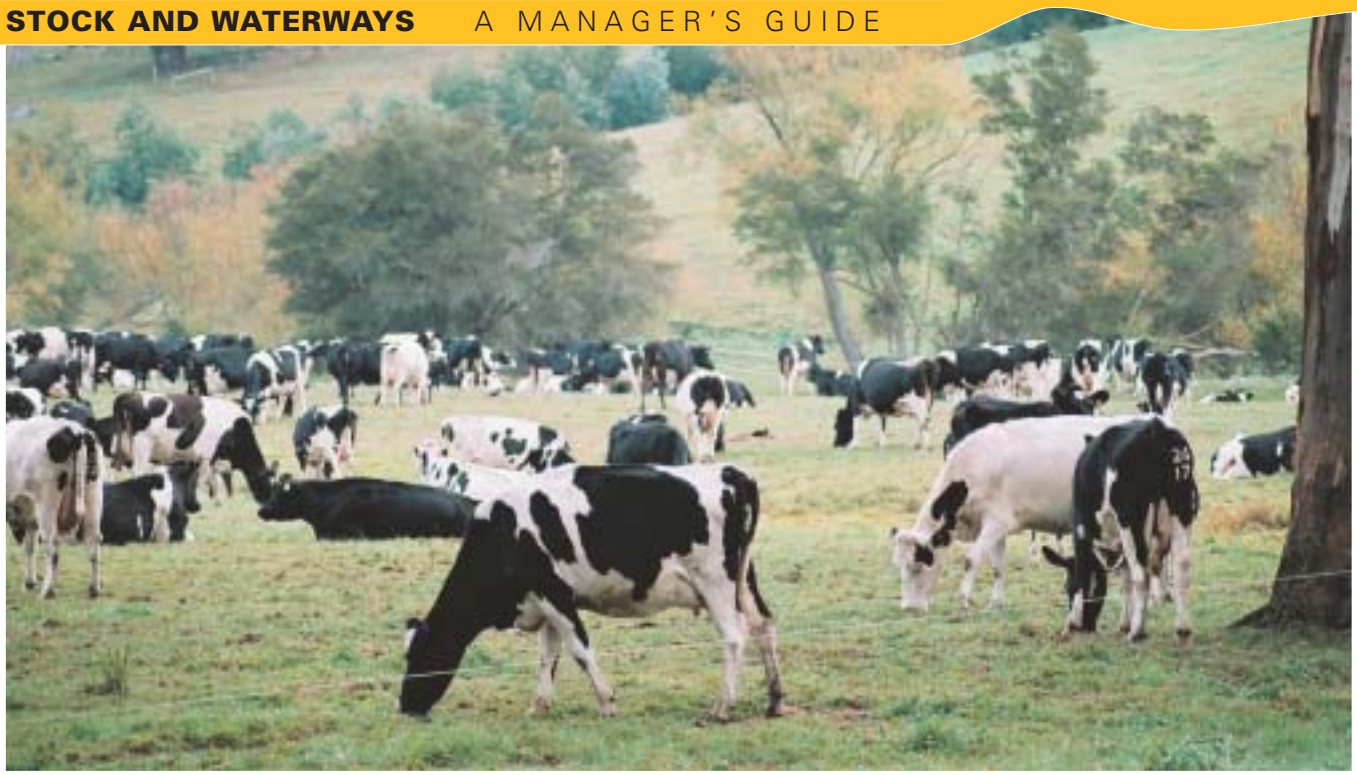
Controlled grazing depends on regular monitoring, and the ability to manipulate grazing pressure to avoid damage to your soil or vegetation. It also requires the ability to identify, and respond to, signs of potential damage, such as lowered pasture or vegetation cover.

Grazing pressure can be manipulated by controlling:

1. the timing of grazing,
2. the duration of grazing,
3. the intensity of grazing.

1. The timing of grazing

Riparian land should only be grazed when the bulk of the vegetation is dormant and when soil moisture levels are low. This is because heavy grazing when plants are entering their annual growth phase, can damage or substantially weaken both pastures and natural vegetation. The plants' ability to set seed and send out new growth is hampered, and perhaps even prevented entirely. It is better to graze when plants are dormant, or when there will be less impact on plant growth, and seed and root production. Obviously, a good understanding of the growth cycles of the plants in your riparian zone will be critical to the success of your grazing strategy.



In high rainfall areas where cattle are grazed intensively, total stock exclusion from the riparian zone is recommended.
Photo Jenny O'Sullivan.

However, as a general guide:

- winter is often an appropriate time for grazing (provided the ground is not too wet, see below), as many plants, including natives, are dormant,
- grazing should be avoided or restricted when plants are in flower or setting seed,
- grazing should be avoided or restricted following heavy rains, floods or fire as these events usually trigger germination in native plants,
- in tropical and sub-tropical areas, grazing of riparian areas should be avoided during all or part of the wet season (wet season spelling)[30].

Stock should be excluded from the riparian zone when soil moisture levels are high because there is significant risk of pugging and compaction of soil. This means that in areas of high winter rainfall, controlled grazing will often not be appropriate. However, the opposite is not always true — if the soil is very dry (during a drought or hot summer, for example) and vegetation is sparse, stock should also be excluded to avoid erosion and degradation[31].

Being able to exclude stock from your riparian zone at different times (when the risk of flood is high, for example, or to control disease or parasites such as fluke), can be a useful management tool.

2. The duration of grazing

Continuous grazing (often called 'set stocking') gives the vegetation no chance to recover. Native vegetation will eventually die out and be replaced with unpalatable, weedy species[32]. Continuous grazing (even at low grazing pressure) can be very detrimental to riparian pastures and other vegetation.

In contrast, studies have shown that riparian areas recover quickly in response to periods of rest, either as a result of complete exclusion or rotational grazing (including wet season spelling)[33, 34].

Stock excluded from wetlands. Photo Jenny O'Sullivan.

More frequent and longer spelling will benefit the land, and may also give you more options in respect of your riparian land. Allowing pasture to build up can provide you with an emergency feed source if feed is poor elsewhere. Or it can be used to fuel a burn to control woody weeds (if this is an appropriate weed control strategy in your area).

3. The intensity of grazing

Conservative stocking rates, and the ability to move stock out of the area in response to signs of damage, are critical for good riparian management.

Low vegetation cover, heavily grazed trees and shrubs, poor water quality and pugging all indicate the need to remove some or all of your stock from your riparian area immediately. Alternatively, if fire or weed control are your management objectives, increased growth may indicate the need to graze more intensely. Grazing young, lighter weight stock can be a way of reducing both grazing intensity and the trampling effect.

30 Roth, C.H., Prosser I.P., Post D.A., Gross, J.E., Webb, M.J., O'Reagain, P.J., Shephard, R.N. & Nelson, B.S. 2004, *Keeping it in Place — Controlling sediment loss on grazing properties in the Burdekin River Catchment. A Discussion Paper*, p. 14.

31 *Water Note 18*, July 2000, Water and Rivers Commission (Western Australia), p. 4.

32 Price, P. & Lovett, S. 2002, 'Managing stock', *Fact Sheet 6*, Land & Water Australia, Canberra, p. 11.

33 Jansen, A. & Robertson, A.I. 2001, 'Relationship between livestock management and the ecological condition of riparian habitats along an Australian floodplain', *British Ecological Society*, vol. 38, pp. 63–75.

34 Ash, A., Corfield, J. & Ksiksi, T. *The Ecograze Project — developing guidelines to better manage grazing country*.

SECTION 10

Challenges — dealing with weeds, pests and fire

Excluding or restricting stock from riparian areas can bring significant benefits to a property, particularly over the long term. This has certainly been the experience of the farmers in our case studies. Unfortunately, as with any changed management practice, it can also throw up some challenges. These challenges include the risks that riparian areas will become havens for weeds, feral animals and wildlife, and that increased vegetation will pose a fire hazard. These risks often deter farmers from changing their riparian management practices. However, with some forward planning and special management, these risks can usually be avoided or controlled.

This Section contains general information on planning for and dealing with the most common problems encountered by farmers when they exclude stock from their riparian areas.

Weeds

The risk that riparian areas will become infested by weeds is a major deterrent for many farmers. The threat comes from at least two different fronts — first, that grazing will no longer keep undesirable species at bay, and second, that fenced off areas will be difficult to access for spraying or slashing.

The reality is that weed control is likely to become part of your ongoing management routine following the restriction or exclusion of stock from your riparian areas. Factoring in a few days in your annual management plan for weed control, particularly in the first years following restriction or exclusion of stock, will help you manage the issue. Your local Landcare officer may also be able to advise you on obtaining funding or other assistance to help with weed control.

Left: Artichokes, a problem weed in drier environments. Photo Phil Price. **Right: This rainforest area has become infested with blackberries.** Photo Jenny O'Sullivan.

Above: To reduce weed problems, this area was replanted immediately following the removal of willows. Right: Stem injection of poison is an effective method for killing willows. Photos Lizzie Pope.

It is important to remember that weeds find it difficult to invade and become established in areas where the natural vegetation is relatively intact. Maintaining a healthy mix of pastures and native vegetation, therefore, will provide a good barrier against weed infestation. You will probably find that as your riparian area regenerates, weed management will take up less of your time — provided you have kept on top of the problem early on.

Your riparian areas will be most vulnerable to weed invasion if they are degraded, or bare — following fire, flood or weed removal, for example. In these situations, taking immediate steps to revegetate the area, either by replanting or by encouraging natural regeneration, will help to prevent weeds becoming established. You can encourage natural regeneration by excluding stock, deterring wildlife and removing any weeds as soon as they become apparent. Cessation of grazing and the associated nutrient inputs from dung and urine, will help to make your riparian area less suitable for many exotic weeds.

Sheep carry the seed of many kinds of weeds in their coats and their faeces. Locking stock up for a day before letting them into your riparian areas will reduce the number of seeds transported into the area. If you can exclude sheep until after shearing, this will further reduce the number of seeds carried into the area.

Photo Jenny O'Sullivan.

When building riparian fences, ideally provide vehicle access so that you can enter the area to slash, rip rabbit warrens or lay baits.

Wombat damage. Photo Jenny O'Sullivan.

If weeds do become an issue, and your riparian areas are not bare or degraded, controlled grazing (see Section 9) may be an appropriate way to control certain weeds. Stock will selectively graze some nuisance plants (ragwort and paragrass, for example), or graze other vegetation to a height that allows weeds to be sprayed or removed more easily. Reading Section 9 will help you implement a grazing strategy to control weeds, without damage to the riparian area or other vegetation.

Weeds can also be sprayed, or removed by hand (on smaller properties) or by slashing. If spraying, choose a herbicide that is suitable for use around waterways, and only spray when the risk of the herbicide entering the waterway is low.

In some areas, fire may be an appropriate method of weed control. The danger with using fire, however, is that it leaves the area vulnerable to weed invasion (see photos opposite).

Wildlife and feral animals

As your riparian area regenerates, you may find that it becomes home to increasing numbers of native and feral animals. These animals can destroy native vegetation, cause or exacerbate erosion, damage fences, spread disease and kill stock. Native animals, and some feral animals, are protected throughout Australia and may only be culled in certain circumstances (if at all).

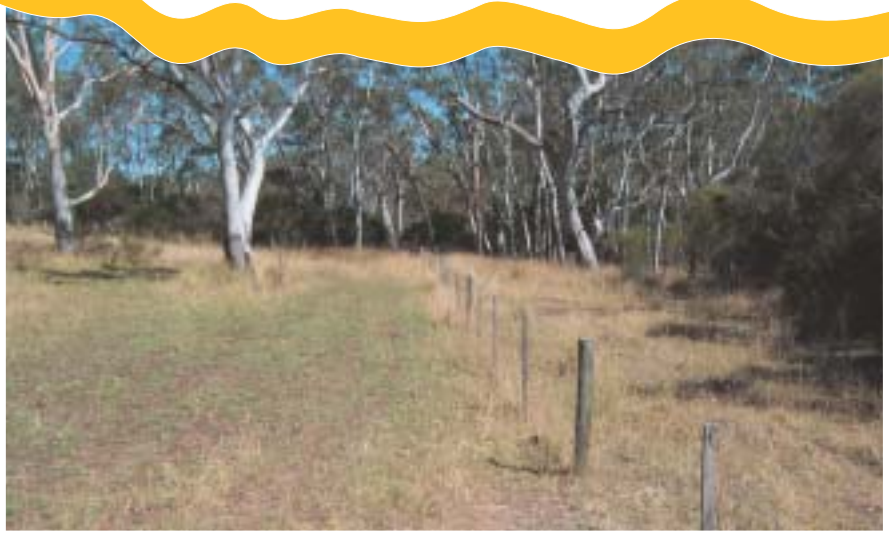
Methods of preventing or controlling pest animals are specific for each type of animal and for certain situations. These details are beyond the scope of this Guide, but readers seeking further information are referred to the series of publications available from the Department of Agriculture, Forestry and Fisheries, including "PESTPLAN: a guide to setting priorities and developing a management plan for pest animals", and the series of guides for control of vertebrate pests including rabbits, feral goats, feral horses, rodents, feral pigs and wild dogs and dingoes (http://affashop.gov.au/product.asp?prodid=12598).

Depending on the severity of the situation, you may wish to consider building your fences to exclude certain pest animals (see Section 6). Section 6 also includes advice on building your fences to reduce the risk of damage from wildlife and feral animals.

One or two electric wires placed low to the ground can be effective in deterring vermin such as foxes and rabbits, particularly if used jointly with prefabricated (mesh) fencing.

Photo Jan and Neville Lubke.

Photo Ian Dixon.



This riparian area has been fenced, but is wide enough to allow access for farm vehicles. In summer, this track could double as a firebreak. Photo Mike Wagg.

Fire

In bushfire-prone areas, it is prudent to reduce fire risk by managing the amount of fuel available in and around your riparian area, and preparing adequate firebreaks. You can manage your available fuel using controlled grazing (see Section 9) and/or slashing prior to the bushfire season. Making sure that you provide for vehicle access when you are building your fences will make this job a lot easier. A track for vehicle access can also double as a firebreak. Firebreaks that run parallel to the waterway should be located above the floodplain to reduce the risk of canalised erosion.

Some farmers use controlled burns prior to the bushfire season to manage their available fuel, but this can leave the area vulnerable to weeds.

The aftermath of a controlled burn that rapidly turned out of control. While native vegetation usually regenerates very quickly, the bare ground provides the perfect opportunity for weeds to become established. Photos Tim Le Roy.

SECTION 11

Alternative methods of stock control

This Guide has focused on fencing as the main method of controlling stock access in and around your waterways. This Section suggests alternative methods of stock control that can be used where riparian fencing is not available or possible, or additional protection is required. These methods are very useful on extensive properties where fencing off the entire riparian zone would be prohibitive or impracticable. However, they can also be applied on smaller properties to deter stock from 'camping' in the riparian zone, or to use paddocks more evenly to avoid localised damage.

Understanding stock behaviour

Stock, particularly cattle, tend to 'camp' around a watering hole. As feed is usually more plentiful, and of a better quality, around the riparian zone, stock will naturally prefer to remain in the area. This leads to trampling, sedimentation, erosion and the discharge of large amounts of dung and urine into the waterway. Stock also tend to loiter around artificial watering points, which can lead to degradation of the surrounding land. If a watering point is located near to a waterway, dung and urine are likely to wash into the waterway.

Photo Jenny O'Sullivan.

Cattle will often loiter near water and riparian areas.

Photo George Lukacs.

Portable trough (main image) and permanent trough (inset). Photos Jenny O'Sullivan.

If stock cannot be prevented from accessing an area, they must be enticed from the area, or discouraged from remaining in the area. The most effective methods of moving stock from an area involve:

- the provision of clean water in another area,
- the provision of feed supplements or mineral licks in another area,
- making sure that watering points are free of shade, to deter stock from camping in the area,
- burning off another area to stimulate new growth ('green pick'), to attract stock to that area.

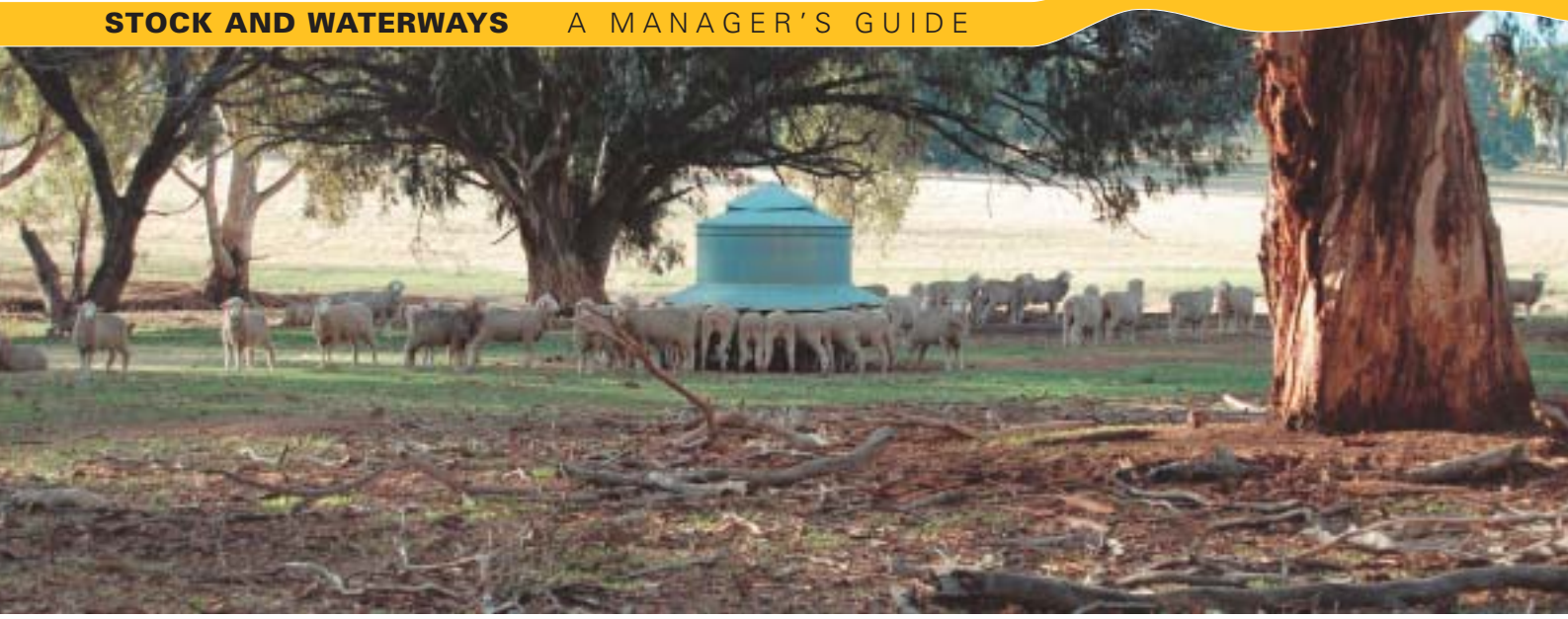
Watering points

A watering system that lets you add and remove watering points, and to switch watering points on and off, is a valuable stock management tool. Being able to move watering points will help you to control grazing pressure, and being able to switch your points on and off can assist in locating and mustering stock.

Installing a sufficiently large number of permanent troughs, reservoirs or other watering points can be an expensive exercise. A cheaper (and more flexible option) may be to use plastic troughs in conjunction with polypiping and frequently spaced taps. Plastic troughs are now available in a range of shapes and sizes to suit a variety of stock and capacity requirements.

More information on watering systems is contained in Section 8, but as a guide:

- place watering points as far from the waterway as possible,
- avoid placing watering points in areas where dung and urine could be 'channelled' into the waterway,
- avoid placing watering points in fragile areas,



Feed and water troughs (like the ones shown on this page) when placed away from the riparian zone encourage stock to use the paddock more evenly and spend less time damaging the waterway. Photos Roger Charlton.

- be aware of the distances both healthy and weak stock will be prepared to travel for water,
- more watering points will help you achieve a more even grazing pattern,
- be aware that cattle can develop a preference for particular watering points, and may need extra encouragement to leave them.

Photo Angus Emmott.

Feed supplements, mineral licks and 'green pick'

The judicious placement of feed supplements, mineral licks and 'green pick' can encourage stock to move away from a particular area. When deciding where to place supplements and licks, avoid fragile areas or areas close to the waterway. If burning off to encourage 'green pick', be aware of any fire restrictions or hazards, and remember that land is extremely vulnerable to erosion and damage after a fire.

Mark and Carolyn Halleen, 'Boolardy Station'

Where: Murchison District, Western Australia
Enterprise: beef (3500 head)
Size: 347,000 hectares
Riparian area: 190 kilometres of river frontage (Murchison and Roderick Rivers)

What have they done?

- Fenced off both sides of their Murchison River frontage and more than half of their Roderick River frontage
- Strategic grazing
- Conservative stocking
- Moved watering points to less fragile areas
- Reticulated entire property using artesian water
- Significant land restoration works (ponding banks, filter fences, scrub packing)
- Revegetated with native perennial grasses

Why did they do this?

- Reduce loss of water, soil and nutrients from catchment
- Restore and protect degraded areas
- Prevent further erosion
- Improve pasture

Cost

- $1,000,000 over a 5 year period

Assistance

- Natural Heritage Trust
- Pastoral Water Grant

Benefits

- Improved water utilisation
- Improved pasture base
- Reduction in erosion
- Reduction in water, nutrient and soil run off

Their story…

Mark and Carolyn Halleen, as managers of Boolardy Station, are part of a community initiative aimed at restoring the health of the Murchison and Roderick River catchments. Recognising that decades of overgrazing have resulted in significant damage to the catchments, the Halleens and other landholders are taking steps to improve land management in the area. Almost 200,000 hectares of riparian land have been fenced off within the catchments, and landholders are implementing innovative strategies to reduce grazing pressure on the fragile floodplains. Already, positive results are being seen. Erosion, and water, soil and nutrient runoff have all declined, and native vegetation is thriving. And, despite the region being in drought, the Halleens report a tenfold increase in both the quality and quantity of their pasture.

The Halleens became involved in the Murchison River Project in 2000, due to concerns about declining rainfall efficiency (the ability of the land to retain and utilise the rainfall). Erosion and canalised drainage were channelling excessive amounts of water, soil and nutrients into the Indian Ocean. This was having a devastating effect on the fragile floodplains, particularly in times of drought.

Working with the Ecosystem Management Understanding Project team, the Halleens and their neighbours realised that the health of the floodplains was dependent on the health of the entire catchment. They also recognised that restoration of the catchment required the cooperation and contribution of each landholder within the catchment. An integrated catchment planning exercise involving eight landholders began, based on:

1. fencing off the floodplains from the upslope catchments,
2. innovative grazing strategies (strategic rest and/or conservative stocking rates),
3. controlling total grazing pressure (feral and native animals as well as stock).

Some landholders, including the Halleens, have also carried out works designed to slow down the flow of water through the catchment. These works include creating ponding banks and installing filter nets in the headwaters. The Halleens have also revegetated parts of their riparian areas, using the seed of native perennial grasses.

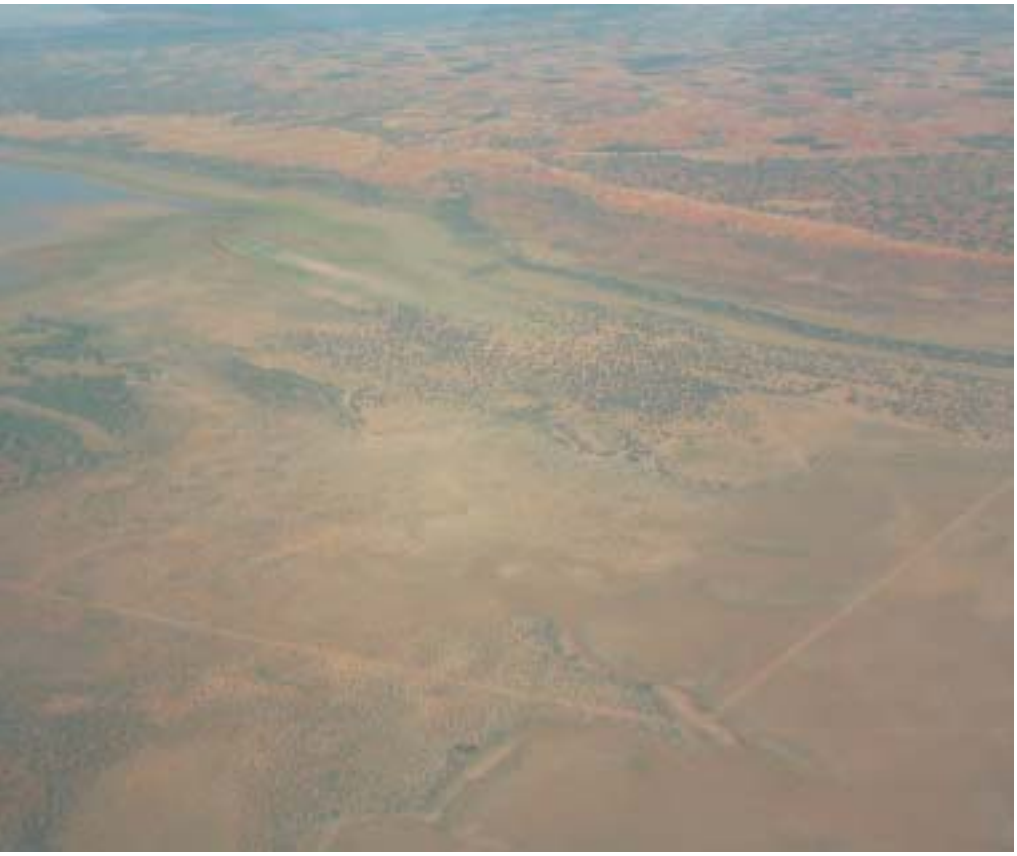
The Halleens have used ponding banks to control erosion. Photos throughout this case study PJ Waddell.

These strategies have involved considerable time, money and effort, but the results are impressive. Rainfall efficiency has increased by 25 millimetres, which has lead to a significant increase in the quality and quantity of their pasture. There is also a visible difference in tree health throughout the riparian zone.

1. Fencing

The Halleens began altering their internal fences some 15 years ago, according to land type. The average size of Boolardy's paddocks is now 15,000 acres, up from 5000 acres. Mark studied the property from the air before deciding on his fencing plan, noting the vegetation cover, stock movements and erosion. The wash country (floodplain land that is 'washed' by a light trickle of water when it rains), is home to the highly palatable perennial grasses and annuals. This makes it attractive to stock, which in turn causes erosion. Likewise, the soft wandrie country is also susceptible to erosion, blowing away if too much vegetation is removed. Accordingly, Mark fenced both the wash and the soft wandrie country, ensuring that fences were outside any existing erosion. Fences are approximately 3 kilometres from the waterways but do not necessarily follow the contours of the waterways. The fences are the same as the other internal fences on the property, comprising two plain and two barbed wires, with posts at 15 metre intervals. All posts and box sets are made of steel.

Boolardy's fences are built above the floodline and are not susceptible to flood damage. The main risk to fences, however, is wildlife — mainly kangaroos, emus and goats. Mark does not use electric fences as he believes that the frequent shorting of the wires caused by wildlife creates too much maintenance.



To reduce damage to fences from wildlife, the Halleens:

- string the bottom wire one foot above the ground, to let wildlife slip underneath,
- maintain a 1.5 grader width clearing either side of their fences, to alert wildlife to the existence of the fence.

Aerial photograph showing extent of the Wooleen enclosure fence.

2. Stock watering

The Halleens have been changing the location of watering points to reduce gully erosion and degradation. Previously, a watering point was located in the southeastern corner of each paddock. These corners had become severely degraded, mainly due to the sheep that until fairly recently were run on the property, and tended to follow the direction of the prevailing wind.

Mark fenced out these areas, which now form part of the northern corners of adjoining paddocks, and installed new watering points in the middle of each paddock. There are generally two watering points in each paddock, and Mark ensures they are located well away from the fragile wash and soft wandrie country. The watering points are generally 3–4 kilometres apart.

All of Boolardy's pumps were originally windpowered, but are gradually being converted to solar power for easier maintenance and reliability. Each tank stores 5000 gallons which supplies enough water for more than 50 head for two days in the summer. Tanks and equipment are mounted above ground to avoid stock damage. All water is pumped from artesian bores, which does not currently require a licence in Western Australia.

Improvements in technology mean that solar pumps are now a reliable and economically viable way of supplying electricity. See Section 8 for more information about solar pumps.

3. Revegetation and strategic grazing

The Halleens have carried out some direct sowing of native grasses on their banks, including Murchison grass and ribbon grass, with considerable success. As well as providing pasture for stock, these grasses are helping to trap soil and nutrients, and slow down water as it travels through the catchments.

Aerial photograph showing a water point (see bottom left) located away from the riparian area.

Cattle sheltering under tree with watering point close by.

Boolardy's grazing strategy involves resting the floodplains for the majority of the year, and maintaining conservative stocking rates (one beast per 120 hectares). Mark believes that grazing in the floodplain is necessary for regeneration of the native perennials and annuals. The stock play a valuable role in spreading seed, and breaking down scrub, ensuring that the grasses receive adequate light and rainfall. Stock are, therefore, mustered into the floodplains in May, when the majority of native vegetation is dormant, and remain there until the October muster. The floodplains are then rested for the rest of the year (unless they have an exceptional summer season) which allows perennial natives to send out new growth and set seed.

Challenges

The main challenge for the Halleens is controlling native and feral grazing, with huge numbers of kangaroos, emus and goats ranging the property. Mark is campaigning for changes in government policy to help combat these problems. He is particularly keen for the economic potential of these animals to be recognised, both as meat, and for by-products such as oil and leather.

An example of the internal fencing used on Boolardy.

Summary

The Halleens and their neighbours are demonstrating how significant improvements can be achieved by taking a long term, whole of catchment approach to riparian management. Their new generation approach, which seeks to look after the land rather than exploit it, is bringing with it many rewards. The improvements in erosion, run off and pasture quality are impressive enough, but the speed with which the land has responded to the changed management is particularly encouraging.

In addition, the Halleens received a 2005 Alcoa Water Award for their work. They are quick to commend the *Ecosystem Management Understanding Project* team, however, for the motivation and assistance they have given both to them and the other landholders in the initiative.

John and Sue Holt, 'Burn Brae'

Where: Eden Valley, lower north South Australia
Enterprise: merino ewes (600 head), breeding cows (85 head) and hay cutting enterprise
Size: 405 hectares
Riparian area: 3 kilometres of creek frontage (tributary of the North Para River)

What have they done?

- Fenced off 3 kilometres of creek frontage and several dams
- Excluded stock from creek and most dams
- Reticulated stock water throughout most of the property using water from dams
- Extensive revegetation of riparian areas, including land surrounding dams, using indigenous plants
- Extensive shelter belts

Why did they do this?

- Reduce erosion, bank instability and silting
- Improve water quality

Cost?

- $20,000 over a 13 year period

Assistance

- Some funding through the (then) Department of Natural Resources for fencing and revegetation

Benefits

- Reduced erosion and silting
- Improved water quality
- Valuable shelter belts
- Increase in biodiversity
- Improved weed management
- Improved stock management

Fencing off and revegetating the area around this dam has created valuable habitat for wildlife. Photos in this case study John and Sue Holt.

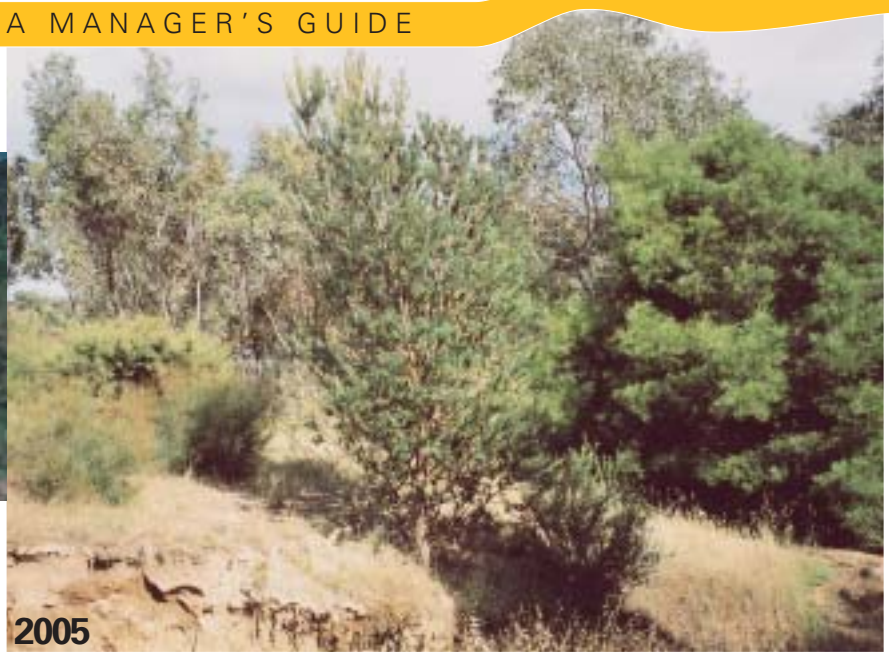
Cleaning out their dams appears to be a thing of the past, for John and Sue Holt. Fencing off and revegetating their creeks and dams has put an end to the silting that was sending acres of valuable topsoil down the creek and sullying the water. It has also led to the virtual elimination of the weed Salvation Jane (also known as Paterson's Curse) from their riparian areas.

Their story…

Better stock management was a catalyst for a series of improvements that have seen big changes on John and Sue Holt's property. When the Holts took over in 1976, Burn Brae comprised a number of similarly sized paddocks, fenced without regard to the hilly and rocky terrain. All paddocks opened onto the creek for water. The Holts decided to make the job of mustering both safer, and easier, with a more efficient paddock layout. They were also interested in improving pasture management by fencing according to land type.

They started by subdividing a paddock and creating a fenced off shelter belt along a ridge. One thing led to another, and the Holts have continued to divide their property according to land type, fencing off and revegetating as they have gone. Areas that are not suitable for grazing — rocky areas, for example — are fenced off and revegetated, creating valuable habitat for an increasing number of animals, especially birds.

The success of their revegetation efforts on other parts of the farm led them to investigate the possibility of rehabilitating their riparian land. Stock access meant that silting, erosion and bank instability were a major problem around their dams and creeks, and water quality was poor. In addition, they were losing time and money when they had to clean out a dam filled with valuable topsoil.



These photos and those on page 65, show the remarkable transformation that has occurred by excluding stock from the riparian area.

Today, erosion, bank instability and silting have all been reduced, and water quality improved, thanks to the healthy swathe of native vegetation growing along their riparian areas. Biodiversity is continually increasing, and weed control has been made significantly easier.

Fencing

The Holts have fenced according to land type, using natural landforms such as the creeks and rocks to guide their fencing. They have fenced following the contours of the creek, allowing enough room between the creek and the fence to direct sow with a tractor. Depending on rocks, the distance between the creek and fence varies between 20 and 50 metres.

John has used electric fencing along the riparian areas from the start, finding it cheap and convenient, and the best way to deal with the creek's deviations. He uses 7 foot posts, located between 30 and 40 metres apart, knocked in at a slant away from the fenced paddock. As tension is not such an issue with an electric fence, he has kept the number of end assemblies to a minimum, only building box end strainers if the posts will not go in easily. The Holts' fences comprise two live wires and three plain wires, with droppers. The fences are powered using mains power electricity.

John says that some maintenance is required as a result of falling redgums and wildlife, but considers the benefits of fencing off riparian areas outweigh the problems.

Stock watering

The most expensive aspect of the Holt's creek rehabilitation has been installing a reticulation system to water stock. John says that the expense has been worth it, however, believing that stock that have access to clean water are in better condition than those that haven't.

The Holts pump water from their dams into tanks, using either a solar powered pump or windmill. While the windmills have been on the property for some time, John prefers the solar pumps for reliability and efficiency. There are no more than 600 metres between a tank and dam. Water is gravity fed to a trough in each paddock, using one inch polypiping, laid underground. The longest distance between a tank and trough is 1 kilometre. Over time, the Holts intend to increase the number of troughs in each paddock to reduce erosion around the watering points.

Above (main photo): This three-sided shelter belt was formed when the Holts fenced off and revegetated their creeks.

Above (inset): The Holts use one side of the shelterbelt as a laneway.

Left: Fenced off spring with solar pump.

Revegetation

The Holts' riparian areas act as valuable shelter belts for stock, and provide habitat for a large number of birds and other wildlife. They initially used a preselected seed mix, comprising a number of different types of plants indigenous to the area. Today, they collect and propagate seed themselves, but John admits that this requires a good deal of perseverance and commitment.

Their first sowing took place in 1992, which turned out to be a very wet year. Consequently, germination and growth were quick and vigorous, and encouraged the Holts to continue rehabilitating the rest of their creeks and dams. Had the weather not been so kind, however, they may not have been so enthusiastic. The Holts have experienced a number of failures with direct seeding, discovering that follow up rain at the right time is critical to its success. The Holts now seed in August or September, and hope for enough spring rain to establish growth.

The Holts believe that excluding stock enabled the reeds and grasses to get a foothold, which helped to reduce erosion and silting. The reeds are particularly valuable during a flood, laying flat and slowing down the water flow, while the extensive root system of the phalaris grass has helped to stabilise the soil.

Electrified chain floodgate.

While many farmers complain that fencing off their riparian areas creates a weed control problem, the Holts have experienced exactly the opposite. Native vegetation has covered the patches of bare soil where Salvation Jane (*Echium plantagineu*) was becoming established, and has virtually eliminated the weed from the Holts' riparian areas. And apart from the odd thistle, the Holts have not noticed any other weeds in their fenced off areas.

The Holts began by planting in 10 metre wide strips, but have found that wider, more irregular shaped areas provide better habitat, particularly for birds.

Stock crossings

The Holts chose the sites for their stock crossings carefully, selecting areas that were naturally rocky, particularly on the upstream side. All crossings are fenced using electrified floodgates. John has tried two different types of floodgates — one made of loose, vertical chains, the other made of wire mesh. The vertical chains withstand flood damage far better than mesh, because there are no horizontal wires to trap debris. The floodgates are suspended from posts that are independent from the main fences. The floodgates are electrified using an insulated wire strung between the main fence and the floodgate. The floodgates are not otherwise connected to the main fences, which minimises damage to those fences during floods.

Lift up gates located between the floodgates make it easier to extract any stock that manage to get into the Holts' riparian areas.

Strategic grazing

Stock are excluded from the Holts' riparian areas, other than for short periods to reduce the risk of fire. Each fire season, they try to balance the need to reduce the fuel load, with the need to protect the vegetation. As a result, stock are only sent in for very short periods, and not until the vegetation is sufficiently large to withstand damage. John prefers to crash graze using sheep rather than cattle, as cattle tend to break branches and cause damage by rubbing and running up the sides of the creek.

2005

Challenges

Wildlife numbers have increased in the area, but John does not think this is attributable to their rehabilitation efforts. Their riparian areas are definitely a haven for vermin such as rabbits and foxes, but rather than baiting, he prefers to let nature take its course.

The main challenge has been cost, both in terms of time, money and effort. As a result, they plan their rehabilitation work in stages, when time and finances allow, and accept that their work will never quite be over!

Summary

Although the costs involved in fencing off and revegetating their creeks and dams have been high, the Holts consider that the benefits have been greater. As well as saving time and money in not having to clean out their dams, John believes that his stock are much healthier having access to clean water. Other productivity benefits include having shelter for stock, particularly lambing ewes, and easier stock management as a result of a more effective paddock plan. In contrast to earlier days, their stock are now moved between paddocks using a ute filled with hay — often beating the ute to the yards without raising a sweat.

The increase in biodiversity is especially pleasing to the Holts, who keep a tally of the birds seen on the property. Even now, they get a surprise by the number and variety of birds using their riparian areas as habitat. Added to this the reduction in erosion, silting and bank instability, and weed control advantages, it is easy to see why the Holts are continuing to rehabilitate all the creeks and dams on their property.

This case study was prepared for Land, Water & Wool — Rivers and Water Quality Subprogram, Burra Project. For more information see the website: www.landwaterwool.gov.au

Rob and Annabel Dulhunty, 'Nant Lodge' and 'Hillside'

Where: Glen Innes, New South Wales
Enterprise: stud and commercial fine wool, and beef fattening
Size: Nant Lodge (247 hectares), Hillside (630 hectares) and White Rock (420 hectares)
Riparian area: 1.5 kilometres of Furracabad Creek frontage and 2.5 kilometres of Reddestone Creek frontage

What have they done?

- Fenced off 4 kilometres of creek frontage (both sides)
- Extensive fencing, including laneways
- Strategic grazing
- Planted shade and shelter belts
- Created dams to reticulate their properties, which double as wetland habitats
- Encouraged regeneration of native vegetation along creeks

Why did they do this?

- Reduce stock losses (stock bogging)
- Improve water quality
- Encourage biodiversity
- Better stock management
- Drought proof the properties

Benefits

- Improved pasture health
- Improved water quality
- Productivity gains
- Improved stock condition
- Valuable shade and shelter belts
- Increase in biodiversity
- Aesthetics
- Enhanced property value

Hillside has some special natural values that the Dulhuntys are confident contribute to better production outcomes. Photos throughout Karen Forge.

Rob and Annabel Dulhunty redeveloped their farm and revised the paddock layout of their property. The new farm layout shows paddock areas (hectares), tree plantings and windbreaks (cross-hatching), and the riparian area fenced out (meandering line through middle of the property). * See below for credit.

Rob Dulhunty and his wife Annabel recognise that their farm's productivity depends on the health of the underlying resource base. Spending money, then, to improve water quality, reduce erosion and encourage biodiversity is regarded as a long term investment in the future of their farm. Already, the amount of their expenditure has been covered by the increase in their properties' capital value, even before the productivity improvements are factored in.

Their story…

When Rob and Annabel took over their properties in 1989, they were presented with a varying mix of land types and conditions. Nant Lodge, situated on the base of the Furracabad Valley, was devoid of native vegetation and had been heavily grazed over many years. Its riparian areas were also in poor condition, given that most paddocks relied on direct creek access for water.

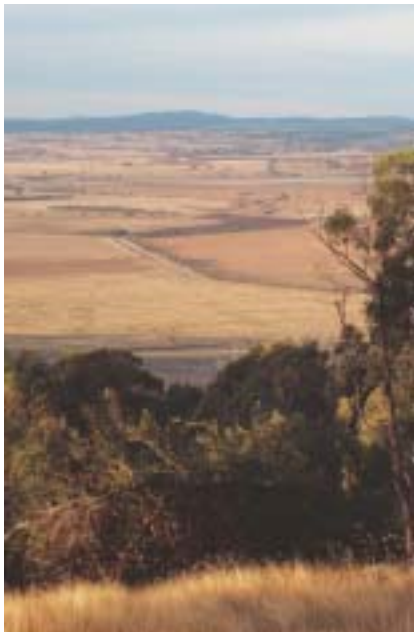
In contrast, Hillside, which is situated on the slopes of the valley, had only been lightly cleared, and was in much better condition. Native vegetation had been retained, particularly in the steeper areas, and work had been done in the 1960s and 1970s to combat streambank and gully erosion.

This comparison demonstrated to the Dulhuntys the importance of preserving their natural resource base. It also inspired them to undertake major capital works to restore Nant Lodge to bring it back into full production. The Dulhuntys studied farm planning with Landcare and decided to redesign both their farm infrastructure and enterprise from scratch.

* Aerial photography courtesy NSW Land and Property Information, Bathurst. Datum GDA Geocentric Datum of Australia. Grid: MGA94 (GDA94) Map Grid of Australia. The paddock overlays were developed in Practical Systems' FarmMap software. Information courtesy Rob and Annabel Dulhunty, Nant Lodge, Glen Innes.

Integral to their new farm plan was the creation of a watering system that would eliminate the need for stock access to the creek and dams. Using some lateral thinking, the Dulhuntys converted an eroding, rubbish filled gully (itself a problem area) into a drought-proof water supply.

Careful engineering, extensive revegetation and complete stock exclusion, have resulted in a wetland that teems with biodiversity and supplies high quality water throughout the property. They also planted extensive shade and shelter belts through the property, and block plantings to protect the wetland and parts of their riparian zone along the creek.



Looking down onto part of Nant Lodge.

The Dulhuntys believe that the Nant Lodge ecosystem is more stable, more productive and more resilient as a result of the biodiversity that now exists there. The benefits they have seen on Nant Lodge have led them to undertake similar works, including establishing wetland water supplies, on both of their other properties.

Fencing

The Dulhuntys used an aerial photograph to plan their subdivision. They fenced off their riparian area, and divided the property into 15 hectare paddocks with a laneway that has facilitated rotational grazing. The subdivision has proven so successful that their other properties will be fenced in the same way.

The wetland end of the Nant Lodge water supply.

Stock crossings and access points

An advantage of establishing an alternative water supply is that there are now only two floodgates in the Dulhuntys' riparian area. Previously, there were many more, most of which needed to be repaired after each flood. The Dulhuntys provide emergency stock access into their wetland areas, in case a trough fails or they spend time away from the property. Each access point is paved with basalt rock, and is double gated.

Stock watering

Rob had noticed that stock were in better condition if provided with clean water, but found that maintaining water quality was impossible if they had access to the creek, dams and surrounding land. He also wanted to stop the losses that were occurring when stock became bogged and died in the mud around the dams. In addition, the Dulhuntys wanted to create a permanent water supply, given that the property had been through two droughts since 1994.

A rubbish filled gully system that was eroding and adding sediment to the creek, provided the solution to their problem.

One of the many troughs distributed across Nant Lodge and Hillside and fed by the water supply on each property.

On one morning alone, Rob discovered 10 dead stud lambs, bogged in the muddy area surrounding a dam.

Six and a half acres of the gully system were fenced out and dammed, to create a drought proof water supply. The dam was engineered to provide multiple water levels for aquatic flora and fauna, as well as a deep hole for farm water. The sides of the dam were revegetated with native trees and shrubs, and stock were excluded both to encourage regrowth and maintain high water quality.

Clean water is reticulated underground to troughs throughout the property, using gravity feed. The Dulhuntys have been so impressed with the results of their wetland system that they are fencing off and revegetating all their farm dams in the same manner.

Strategic grazing

Fencing off the creek allows the Dulhuntys to manage the riparian area separately from the rest of the property. Rob and Annabel originally locked up part of their riparian area, and rotationally grazed the other part. After five or six years, they noticed that pasture density in the ungrazed area had declined, there were more bare patches and as a result, more blackberries. They concluded that the grass in their riparian area needs to be eaten, and now graze cattle and sheep periodically to control blackberry and maximise grass cover.

Challenges

Blackberries are a problem in the Dulhuntys' riparian area, however periodic grazing helps to keep them under control.

Summary

A long term view and lateral thinking have had positive environmental and economic outcomes for the Dulhuntys. Rob admits that (in comparison to capital appreciation) the production benefits of restoring shade, shelter and wildlife habitat to Nant Lodge are difficult to quantify. Despite this, Rob believes that the benefits to productivity have been tangible. "The bottom line," he says, "is that I spend money on things that I think are going to improve my productivity. Put simply, investing in improvements to our natural resource base flows through to improvements in productivity."

This case study was prepared for Land, Water & Wool — Native Vegetation and Biodiversity Subprogram, Northern Tablelands Project. For more information see the website: www.landwaterwool.gov.au

Bruce, Rae and Daniel Knee, 'Kewita'

Where: Toora, South Gippsland, Victoria
Enterprises: dairy (250 head), sheep (800 head) and beef (35 head)
Size: 250 hectares
Riparian area: 8 kilometres of river frontage (Franklin River)

What have they done?

- Fenced off 7 kilometres of river frontage
- Excluded stock from river in all but three paddocks
- Reticulated stock water throughout the entire property using water from the river
- Extensive willow removal
- Replanted banks with native vegetation

Why did they do this?

- More effective stock control
- More efficient use of grazing land
- Reduce erosion
- Preserve river for future generations

Cost

- $35,000 over a 10 year period

Assistance

- Catchment Management Authority (willow removal, fencing, troughs)
- Landcare (replanting, weed control)
- GreenCorps
- Prisoners (replanting)

Benefits

- Improved stock manageability
- Improved water quality
- Valuable shelter belts
- Increase in biodiversity
- Enhanced property value due to attractive river frontage

Above: Historic shot of Kewita in the late 1800s. Photo supplied by Rae Knee.
Right: The Knees' dairy property.

Their story…

Buying the property on the other side of the Franklin River in 1981 provided much needed land for the Knee family's dairy enterprise, but also brought a few challenges. While the original property was reticulated, all paddocks on the new property relied on stock accessing the river for water. Overgrazing and erosion of the river banks were the result, and stock control was difficult. To top it all off, the riverbanks were infested with blackberries.

The Knees saw fencing and reticulation as the key to managing their farm more efficiently, and to halt the damage being done to the riverbanks. They subdivided the properties into 50 similarly sized paddocks and, using the existing stock crossing, created laneways to the dairy. A trough was installed in each paddock, and the watering system on the original property was modified to supply the entire property.

Fencing above the existing erosion and the high water mark, has helped to stabilise this streambank. Photos throughout this case study Jenny O'Sullivan, unless credited otherwise.

Photo Rae Knee.

The Knees' property, Kewita, demonstrates how a slow and steady approach to riparian management can bring significant, long term rewards. It is also a good example of how protecting the riparian environment can improve productivity on a commercial dairy farm.

This fence prevents cattle and sheep accessing the riparian zone.

Layered vegetation, fallen logs and debris provide habitat for wildlife.

Fencing

When deciding where to fence their riparian land, the Knees were guided by the flood level and terrain. All fences are above where the river would normally flood; on a steep bank this may be 10 metres from the river bank; on a more gradual slope, perhaps 30 metres. Looking back, the Knees say that an aerial map would have been useful, but straight lines and logic have kept things simple and relatively inexpensive. When fencing the river frontage Bruce uses end strainers (7 foot 8 inches long) with no stays. Between these strainers he uses 7 foot 6 inch posts on each bend of the river, and between these posts, steel pickets 10 metres apart. Ratchet adjusters are used to tension fence wires with lengths of up to 800 metres between each strainer. Plastic insulators are used for ease and low cost.

Bruce always uses ratchet adjusters so that when trees fall on the fences and stretch the wire, he can tension the fence with a screwdriver from the motorbike.

The Knees find that three to four strand fences are sufficient to control cattle, provided the top wire is electric. When funding has been available, they have installed extra wires to make the river and boundary fences more effective against sheep.

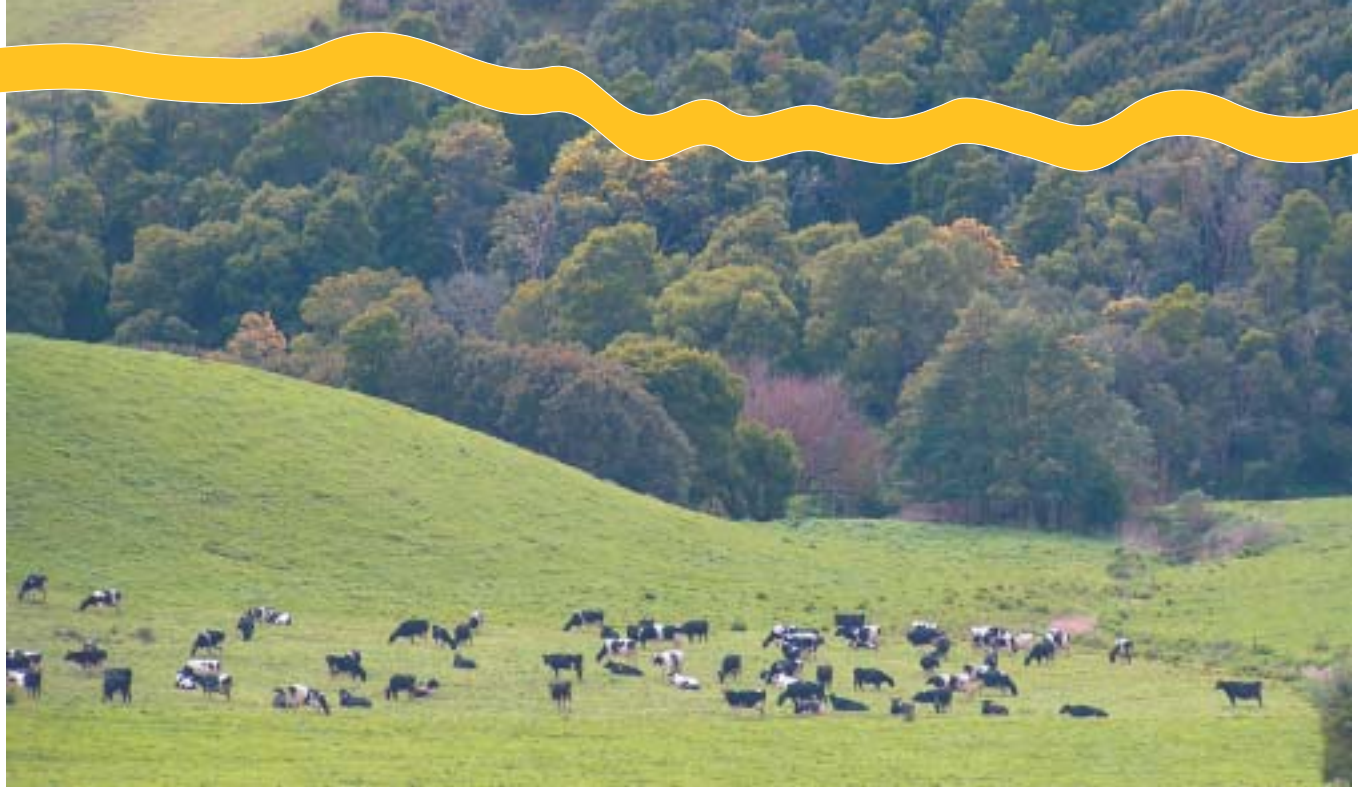
Stock watering

The existing watering system was extended by installing two extra tanks, and now comprises three tanks (3000, 5000 and 7000 gallon). Water is pumped from the river into the header tank and gravity fed back down to the troughs using heavy duty C class polypiping. All troughs are located within 1 kilometre of a tank. The Knees use an electric rotor pump, and estimate that power to the pump costs $1200 per year.

The Knees now use 1 and a half inch polypipe, having discovered (the hard way) that anything less is insufficient on a hot day.

Do you need a water licence?

The Knees needed a water licence to draw water from their river. It is important to contact local Natural Resources Management or catchment groups before drawing water from any waterways.



Vegetation along the Knees' riparian areas provides valuable shelter for livestock.

Revegetation

The Knees have focused on removing willows and other weeds from their river banks, and replanting with native plants indigenous to the area. They have also created shelter belts, again using locally grown natives. They originally planted densely for weed control, but realised that this prevented grass production, particularly in dry seasons. It also prevented the development of an understorey which is critical for trapping water and reducing erosion. Trees and branches falling on fences and across laneways are a constant problem.

Shelter belts have been valuable in protecting the Knees' stock from cold and heat. The Knees find that the most effective shelter belts are at least 10 metres wide.

The Knees are now planting a more diverse mix of shrubby natives. They have relied on their local Landcare group and the Catchment Management Authority for assistance in choosing the best plants for their location. See page 87 for a list of organisations and people that can help.

Willows have been removed and erosion stabilised.

Strategic grazing

Thanks to subdivision, the Knees are now able to graze the entire property on a rotational basis, moving their herd to a new paddock at each milking. While they plan to exclude cattle from the entire river, the three paddocks that still have river access are grazed less intensively (less than 10 hours per day), to minimise damage to the area.

The Knees have used sheep as the first step in their blackberry eradication program. Spraying and replanting are carried out after the sheep have reduced the growth to a more manageable level.

Challenges

The revegetated areas are home to increasing numbers of feral and native animals which are not always completely compatible with farming practices. Weeds can be a problem after willows are removed, but the Knees estimate that this involves no more than seven extra days' work per year, and they need to spray the rest of the farm anyway. The Knees rent their local Landcare Group's spray unit to tackle the problem.

Summary

The Knees say they cannot quantify the benefits of their efforts, however productivity has improved significantly in the past ten years, and their financial performance is above average. The property's capital value has also increased due to the health and beauty of their river, an efficient subdivision and established shelter belts.

Above and below: Excluding stock from their riparian areas has seen water quality and biodiversity improve to such an extent that both platypus and crayfish have returned to the river.

Be realistic about what you can achieve. Know your limitations — money, time and expertise — and get what assistance you can.

Work started with the West Gippsland Catchment Management Authority to remove willows and fence off the creek in 1996 (inset). The photo below shows the same site nine years later. The old gums are just visible behind the new growth. 1996 photo courtesy of the Knees.

Ken and Cathryn Lamb, 'Meadowlea'

Where: East Gippsland, Victoria
Enterprise: beef (400 head)
Size: 240 hectares
Riparian area: 1.5 kilometres of creek frontage (Glenmaggie Creek)

What have they done?

- Fenced off 1.5 kilometres of creek frontage (both sides)
- Strategic grazing
- Fenced stock crossings
- Reticulated stock water throughout entire property using water from the creek
- Encouraged regeneration of native vegetation along creek

Why did they do this?

- Restore and protect degraded areas
- Prevent further erosion
- More effective stock control
- Improve water quality
- Reduce reliance on creek during drought
- Protect native flora and fauna

Cost

- $25,000 over a 25 year period

Assistance

- Catchment Management Authority
- Landcare
- Natural Heritage Trust

Benefits

- Improved stock control
- Aesthetics
- Improved water quality
- Reduction in erosion
- Improved bed and bank stability
- Valuable shelter belts
- Increase in biodiversity
- Enhanced property value due to attractive creek frontage

The success of the waterway regeneration at Meadowlea is due largely to a sustainable management plan that treats each riparian area as an integral, but different part of the farm.

Their story…

Well thought out fencing and strategic grazing let the Lambs use their riparian land productively, while at the same time preserving and improving it for future generations.

When Cathryn and Ken Lamb purchased Meadowlea in 1979, the property — in Ken's words — had been knocked around a fair bit. The creek bisecting the property — a tributary of the Macalister River running into Lake Glenmaggie — was straight and rapidly eroding, water quality was good but deteriorated during floods, and there was very little vegetation on the unstable banks. The creek was so degraded that a major flood in 1990 saw the Lambs lose 3 hectares of soil over a 24 hour period.

The Lambs had begun to fence off parts of the creek in the 1980s and were impressed with the results, but it was the Whole Farm Planning course they completed in 1991 and involvement in the Beef Cheque grazing management program that triggered the improvements that have since taken place.

Over a 20 year period, the Lambs have fenced off both sides of the creek and reticulated stock water to their entire property. This has allowed them to implement a grazing management strategy that has seen marked increases in productivity, and has more than paid for the costs of fencing and reticulation. It has also brought about amazing changes in their waterway.

The Glenmaggie Creek has regained its natural curves and now meanders within its banks through their property. Erosion is under control, beds and banks are stable, water quality is consistently good, and the banks are teeming with native vegetation.

Glenmaggie Creek in 1990 after flood. Photo Ken Lamb.

Glenmaggie Creek with natural regeneration as a result of strategic grazing. Photos throughout this case study by Jenny O'Sullivan unless credited otherwise.

Simple electric gateway.

Ken uses single or two wire electric fencing wherever possible. It is low cost (requiring no end or corner stays, and fewer posts), fencelines are easily altered, and if a beast pushes through it is a simple task to turn off the power and lay the wire on the ground to let it return to the mob.

Fencing

Fencing has provided the framework for the Lambs' successful grazing management strategy which relies on smaller paddocks and rotational grazing. The Lambs used an aerial photograph to plan their fencing. They have fenced as far from the banks as possible (between 40 and 100 metres, depending on the terrain).

The two factors the Lambs considered when building their fences were cost, and the potential for flood damage (Meadowlea is the first property the Glenmaggie Creek enters from State Forest, and it is not uncommon for 40 foot trees to be washed down during floods). The Lambs find that single or two wire electrified fences keep out most cattle, and are less likely to be damaged by flood debris. Additional wires are used in areas where there is likely to be more pressure on the fence.

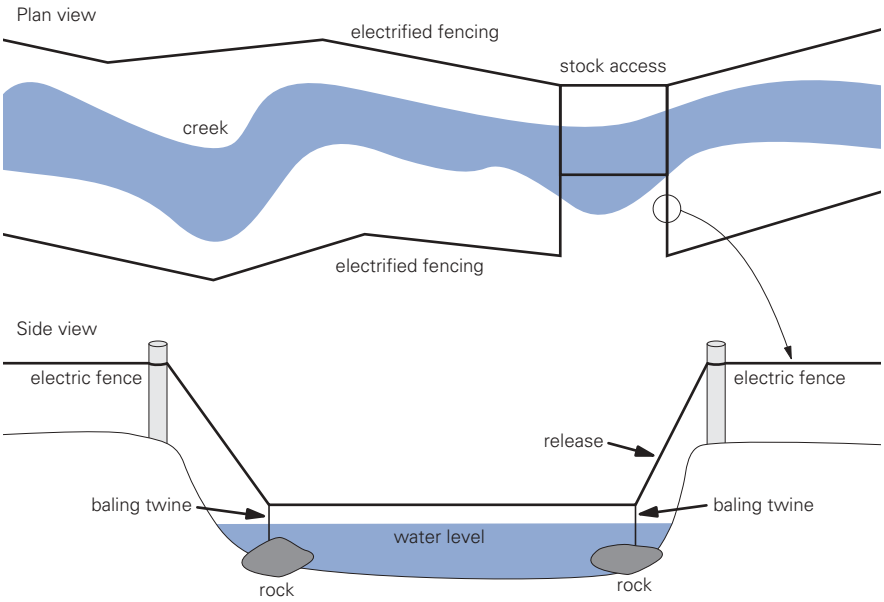
The Lambs initially made end sets from steel posts where necessary but when Natural Heritage Trust funding became available replaced them with 8 foot treated pine posts driven in to a depth of 4 feet. Posts are generally steel star pickets with plastic insulators.

Single wire electric fencing is used to create stock crossings. One wire is strung across the creek either side of the access point, creating a corridor (see diagram overleaf). These crossings can be blocked to create a water access point, by stretching another electrified wire down the middle of the creek, between the two cross wires.

Quick release baling twine attached to single wire at stock crossing.

Ken has devised a clever system to avoid damage during floods. The wires across the creek are held down using rocks and a 'noose' made of baling twine. During a flood, the rocks are pushed out of the noose, allowing the wires to spring up and out of the way of the floodwater. A 'release point' made of soft wire, located near to the bank, is designed to break in the event of a big flood. The wire simply swings to one side, avoiding further damage to the rest of the fence.

A diagram of Ken Lamb's simple, but effective, crossing/water access point, using single wire electric fencing. The corridors were constructed as follows:



Stock crossings and water access points

The Lambs sought advice from what is now their Catchment Management Authority on the best places to locate their stock crossings and watering points. The areas selected for stock crossings were generally rocky outcrops where there was less danger of flood damage, and for watering points, where there was a sandy reach into the water. Any areas already suffering erosion were avoided.

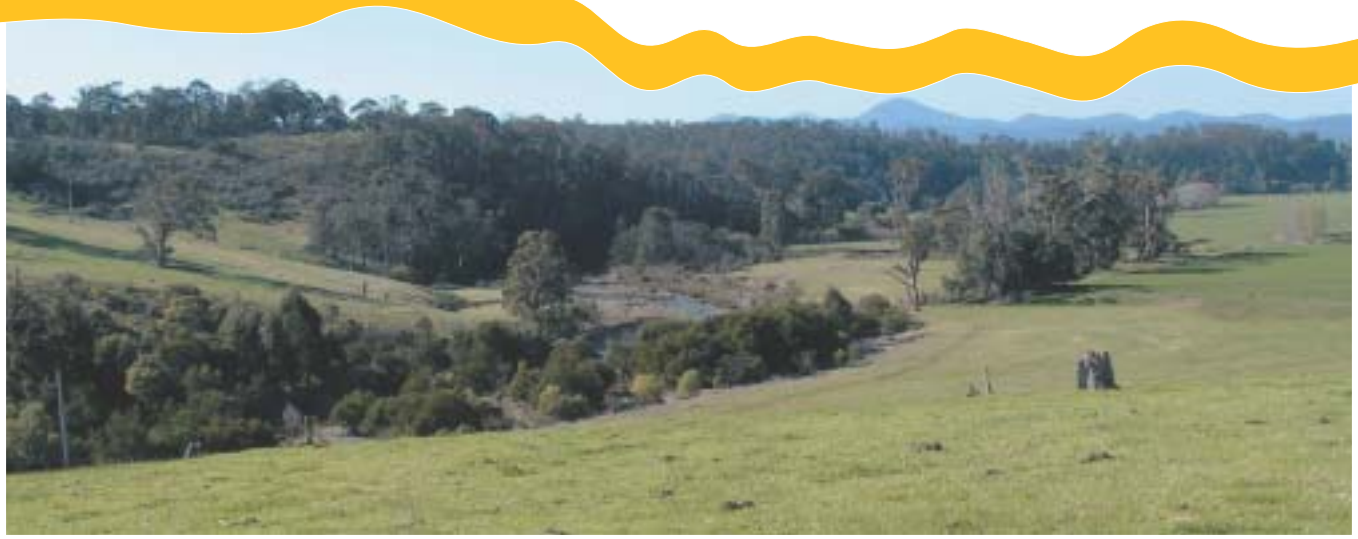
Choose your water access points carefully. Avoid the outside of bends, and areas that are boggy or already eroding. See Section 4 for more information about building crossings and water access points.

Stock watering

Reticulating stock water to the entire property cost the Lambs $10,000, but being able to the shut off the water access points in the creek made a big difference to the health of the creek. The existing system that supplied the house and a couple of paddocks was modified to supply the entire property. Siting the header tank (60,000 litres) on a hill ensures sufficient pressure to gravity feed to all 20 troughs, some of which are 1.5 kilometres from the tank. Water is supplied by heavy duty C class polypiping that ranges from 1 and a half inches to 2 inches wide. Ken uses an electric pump connected to mains power, to extract water from the creek, but has a small petrol pump as backup, in case of power or pump failure.

Glenmaggie Creek at pumpsite 1982 (right) and at pumpsite 2005 (below).

Photo Ken Lamb.



The natural regeneration that has occurred along the Lambs' creekbanks provides valuable shelter for stock. Photo Jenny O'Sullivan.

Revegetation

The Lambs have relied on nature to do their replanting. Carefully monitored grazing, and fencing some distance from the bank, has allowed seeds carried down the creek from the neighbouring forest to regenerate naturally. The bush that has regrown along the banks has had a stabilising effect on the banks, and has created a shelter belt that protects stock from the wind and sun.

> You can help nature along by snipping off seed heads from native plants and spreading them over bare areas.

Strategic grazing

The Lambs treat their riparian area as an integral, but different, part of their farm. They have devised a special grazing regime to use these paddocks effectively, without causing damage to the fragile environment. They use the 'crash grazing technique', which involves grazing a big mob (up to 100 head) for a short period, until the grass is eaten. On a 10 hectare paddock, and depending on the season, this may take anywhere from three days to one week. The key to the Lambs' strategic grazing is careful monitoring, to make sure that the mob is removed before they start eating other vegetation.

> The Lambs only graze young cattle in their riparian areas as they are less destructive than larger beasts.

Challenges

The main challenge for the Lambs was overcoming the mindset that they were losing valuable grazing land, and therefore fencing too close to the waterway. When the Lambs realised the area could be both grazed *and* protected at the same time, then wide riparian fencing became a viable management option.

The Lambs say their other challenge was the cost of reticulating stock water to the property, but this has been outweighed by the improvements to the health of the creek, and the benefits of having an independent water supply.

Summary

Treating their riparian areas as 'special needs paddocks' has paid off for the Lambs. Studies completed as part of the Beef Cheque program indicate that the costs of fencing and reticulation were more than covered by the increases in productivity brought about by the Lambs' grazing management strategy. In addition, they have transformed a property with degraded waterways and little native vegetation into an oasis of biodiversity that will be enjoyed by generations to come.

Lindsay and Biz Nicolson, 'Bonneys Plains'

Where: Northern Midlands, Tasmania
Enterprise: fine wool merino (8500 head)
Size: 5000 hectares
Riparian area: 15 kilometres of river frontage to South Esk River and Buffalo Brook

What have they done?

- Complete exclusion of stock from riparian areas
- Fenced off 5 kilometres of Buffalo Brook frontage (both sides) and some smaller tributaries
- Reticulated parts of property affected by fencing, using dam and creek water
- Encouraged regeneration of native vegetation along Buffalo Brook

Why did they do this?

- Prevent further erosion of rapidly eroding creek
- Restore and protect degraded areas
- Restore native flora and fauna
- Improve water quality
- Reduce stock losses
- Reduce reliance on creek during drought

Cost

- $34,000 over a 5 year period

Assistance

- Greening Australia helped fund first 400 metres of fencing
- Department of Primary Industries provided $4000 for troughs and pipe as part of a stock watering trial

Benefits

- Improved water quality (reduction in sedimentation, turbidity, algal growth)
- Reduction in effluent and nutrients entering waterway
- Reduction in erosion
- Improved bank stability
- Increase in biodiversity
- Reduction of stock losses
- Better stock control

Permanent exclusion of stock from riparian areas is the basis of Biz and Lindsay Nicolson's management strategy, and has resulted in a remarkable improvement in the health of their waterway, Buffalo Brook.

These photographs demonstrate the remarkable transformation that took place on the Nicholson's farm over a decade, following the exclusion of stock from Buffalo Brook. All photos Biz and Lindsay Nicolson.

Their story…

When Biz and Lindsay Nicolson began running 'Bonneys Plains' in 1988, the banks of Buffalo Brook were severely eroded, there was little or no riparian vegetation, water quality was poor and there was no sign of aquatic life. Today, fencing off the stream would seem the obvious solution to the degradation. In 1986, however, the decision to exclude stock was contrary to the prevailing management practice which relied on direct waterway access for all paddocks.

Biz and Lindsay's 'radical' decision paid almost instant dividends. The regrowth in the fenced off area was, in Lindsay's words, 'phenomenal' and far more diverse than they had expected. This encouraged them to implement a whole farm plan that involved fencing off Buffalo Brook and some of its smaller tributaries, and reticulating the affected paddocks.

Seventeen years later, Buffalo Brook is teeming with biodiversity. More than 40 species of native plants have regenerated naturally along its banks, including two species of eucalypt, and one acacia that were not seen on the property prior to fencing. Platypus, new populations of fish and many species of small birds have also returned to the waterway. Erosion has healed in all but a few areas, and although it was not monitored at the time, water quality appears to have improved significantly.

Certainly, the new life in and around the stream, and the clarity of the water, suggest that this is the case.

Fencing

The Nicolson's fencing program took four years to complete and cost approximately $23,000. The meandering nature of the stream, which required large numbers of end assemblies contributed to the relatively high cost of the fencing. Apart from Greening Australia funding for the first 400 metres, the Nicolsons paid for their fencing themselves.

The distance that fences are set back from the stream varies, depending on the severity of the erosion, and the estimated 'healing' time. However, on average, the fenceline is 15 metres from the bank, and follows the contours of the stream. Most of the fences are constructed of Ringlock, with wooden posts at 21 metre intervals and droppers at 7 metre intervals. In retrospect, Lindsay would probably use a six wire plain wire fence which would not be as secure as Ringlock, but would be cheaper.

In floodprone areas, Lindsay has used four wire electric fencing. Although it is cheap and easy to install, Lindsay says that it would not be practical to fence off the entire stream using electric fencing. This is because of increasing numbers of native and introduced wildlife that constantly short the system. The Nicolsons have not fenced their crossings, but drive their stock across the stream at two shallow points.

Stock watering

The Nicolsons constructed a 3 megalitre dam in the higher country, to gravity feed a series of troughs in paddocks which no longer have waterway access. The pump supplying the homestead (a Davey pressure pump) is used to pump water from Buffalo Brook to the paddocks closer to the homestead. The system relies on 2 inch polypiping, with troughs up to 2.5 kilometres from the dam or pump.

A licence is not currently required in Tasmania to pump for livestock or domestic use.

Rotational grazing reduced the total number of troughs required throughout the property.

This photograph, and the one opposite, show the extent of natural regeneration that has occurred over a 20 year period of stock exclusion.

Revegetation

Biz and Lindsay began their own replanting program, but found that as soon as stock was excluded, nature was able to do the job far more successfully. The bare shale beds (the result of erosion) were the perfect habitat for seeds to regenerate after floods. The Nicolsons observed nature's own regeneration process, which began with sedges, reeds and lilies establishing themselves at the toe of banks. This not only halted the erosion process, but paved the way for other plants to regenerate by trapping sediments and binding the soil. As the banks became more stable, larger shrubs such as wattles and banksias were able to reestablish further up the bank.

Follow nature's lead and plant sedges, reeds, lilies and grasses to control bank erosion. Let these plants become established before attempting to introduce other types of plants.

Strategic grazing

The Nicolsons do not graze their riparian areas at all, and believe this is the main reason that regeneration has been so successful along their banks. Lack of grazing initially led to an increase in weeds (Californian thistle, briar rose, hawthorn and willows). Some of the thistles died out as shade cover increased, but the other weeds are an ongoing management issue that is tackled in quieter periods with herbicide.

Challenges

The Nicolson's riparian areas are home to an increasing number of wildlife. Feral deer are ringbarking trees, and native animals are grazing down the understorey. It is assumed that this increased browsing pressure has been responsible for the disappearance of a couple of species of shrubs. This increased grazing pressure is also impacting on surrounding pastures, but is seen as part of the larger issue of overall game management.

Summary

Thinking outside the square and recognising their property's limitations have allowed the Nicolsons to implement management practices that work with — rather than against — their environment. Lindsay believes that there is no recipe for riparian restoration — what works for one waterway may not work for another. The results achieved in Buffalo Brook have come about by the complete and permanent removal of livestock. In this case, says Lindsay, there was no compromise.

Photo Toni Somes.

Shane and Tracy Meteyard, 'Milray'

Where: Cape River, Northern Queensland (300 kilometres from Townsville)
Enterprise: beef (5000 head)
Size: 44,800 hectares
Riparian area: 40 kilometres of river and 60 kilometres of creek frontage (Cape River, Betts and Warrigal Creeks)

What have they done?

- Fenced off 58 kilometres of river and creek frontage (both sides)
- Strategic grazing
- Extensive reticulation using bore water

Why did they do this?

- Improve water quality
- Reduce downstream run off of nutrients and soil into the Great Barrier Reef
- Sustainable management of productive but sensitive sweeter creek and riverbank pastures
- Weed control
- Restore and protect degraded areas

Cost

- $150,000 on stock watering

Assistance

- All fencing costs were covered by Natural Heritage Trust

Benefits

- Improved pasture quality
- Improved water quality
- Reduction of downstream nutrient run off and sedimentation
- Potential for improved weed control
- Easier to manage stock

Extensive fencing and reticulation are enabling Shane and Tracy Meteyard to improve the management of their productive, but sensitive, 'sweeter' riparian country. Controlled grazing and wet season spelling are paying dividends, with significant improvements in the quality and density of their pasture, and a reduction in erosion. As pasture cover increases, less sediment and nutrients are entering the waterways. This has resulted in improved water quality for the Meteyards, and many miles downstream, less run off to the Great Barrier Reef.

Their story…

Shane and Tracy Meteyard were fortunate in being able to take a long term, staged approach to tackling the erosion and sedimentation problems facing their property. They were also fortunate to receive Natural Heritage Trust funding to defray the significant costs of fencing and reticulating a property this size. The first stage in the process was to fence off their 'sweeter' creek and riverbank pastures, to create a series of smaller riparian paddocks on both sides of their waterways. The second stage was to install a series of new, off-stream watering points in each paddock, taking pressure off the existing, degraded sites.

Once this framework was in place, they were able to implement grazing strategies designed to maintain adequate pasture cover. Stock are excluded from the riparian zone in the wet season when hoof damage is most likely, and allowed in under controlled conditions in the dry season. Regeneration of the riparian pastures was visible within the first year, despite poor rain and an infestation of army grubs. The proportion of desirable native perennial grasses is steadily increasing, while the rates of sedimentation, erosion and nutrient run off are slowing.

Although it will be many years before they recover their costs, the Meteyards are now able to manage their entire property more effectively, and sustainably. They are also sending a positive message to those who believe that regeneration can only be achieved by completely excluding stock from the riparian zone.

Fencing

The Meteyards' long term plan is to create a larger number of smaller paddocks, no more than 1000 hectares in size, all determined according to land type. To determine the boundaries of the riparian paddocks, which currently range in size from 500 to 2200 hectares, Shane was guided by soil type. Each fence is built above the high floodline, follows the contours on the waterway wherever possible, and is between 50 and 200 metres from the waterway.

All riparian fences are constructed in the same manner as the internal fences on the property. Fences are suspension fences, with three barbed wires and two plain electric wires. The metal pickets holding the electric wires are 35 metres apart, while the posts holding the barbed wire are 10 metres apart. Assemblies are constructed using metal railway lines and are no more than 1.5 kilometres apart.

All of Milray's electric fences are solar powered. Shane believes electric fences are less costly to erect than other types of fences, as they require less posts and end assemblies to keep them straight, and require less maintenance. He also believes that they are more wildlife friendly than other types of fences. Floods are known to occur, but as all fences are built above the high floodline, and parallel to the waterway, flood damage is not a major issue.

Stock watering

Much of the damage on the property was occurring at the watering points. These watering points, which were located in sandy areas close to the waterways, had suffered from almost 100 years of stock access. Shane established alternative watering points in each riparian paddock using a comprehensive reticulation system. A second artesian bore was drilled, and 40 kilometres of polypiping laid along the new fencelines to supply nine tanks and 16 new troughs. There are between two and five troughs in every paddock. Troughs are no more than 5 kilometres apart, and are located close to the upslope fenceline to reduce the risk of erosion.

Shane uses 63 or 75 millimetre polypiping, depending on the distance between pump and trough, and a combination of solar and mains powered electric pumps. Solar works well for distances up to 2 kilometres, but anything greater (some troughs are 30 kilometres from a bore) requires too many panels to be cost effective. However, apart from this shortcoming, Shane is very positive about the benefits of using solar pumps.

It is not currently necessary to have a licence to operate an artesian bore in Queensland.

Strategic grazing

Stock are excluded from the riparian paddocks during the wet season (from December to April) to avoid hoof damage and to let the pasture recover. Stock are grazed in the riparian paddocks for periods during the dry season when the risk of damage from hoof impact is reduced. Shane prefers to graze younger stock in the riparian paddocks because they have greater phosphorus requirements. A side benefit of this is that younger, lighter stock generally have a lesser impact on the environment than older stock.

Shane runs no more than one beast per 8 hectares in the riparian paddocks over the dry season, and currently uses a four paddock rotational system. He monitors the grazing carefully, and maintains healthy pasture coverage by removing stock when one third of the standing grass remains.

Revegetation

The Meteyards have not actively revegetated, but wet season spelling is encouraging a stronger, healthier groundcover with an increasing proportion of native perennial grasses. Allowing these grass levels to build up should help with weed control, by providing fuel for a hot fire to burn out woody weeds such as rubbervine.

Shane is confident that the changes he is making will result in economic and environmental gains. Photo Toni Somes.

Challenges

The main challenge has been the high capital cost of the projects. While benefits are definitely being seen, Shane admits that it will be a long time before they will see a positive return, particularly as the region is in prolonged drought.

Summary

While the costs have been high, the Meteyards are confident that the long term advantages of their improved management practices will be significant. As a result, they are continuing to develop their infrastructure at their own expense, including riparian fencing, and plan to regenerate areas that have been previously overgrazed.

Appendix A: Incentives and grants to help farmers

You should also be aware there are several tax incentives which may reduce the overall costs involved in improving your riparian management. These range from the ability to deduct all or part of your expenditure, tax rebates and depreciation. You should speak to your tax adviser about some of the tax incentives that are available.

Who helps and what is their focus?

Catchment or Natural Resources Management groups

These groups attract and delegate funding to individuals, and community groups. Check with your local authority listed in contact lists (beginning on page 89) to see which grant will best suit you.

Grants

- Envirofund (Natural Heritage Trust) — individuals and groups can apply to conserve biodiversity and promote sustainable resource use. Website: www.nht.gov.au/envirofund
- National Landcare Program (NLP) — for individuals and group that support sustainable use and management of natural resources. Website: www.daff.gov.au/nlp
- Second generation Landcare grants, state funded grants are administered by Catchment Management Authorities and Natural Resources Management groups.
- National Action Plan for Salinity and Water Quality (NAP) — funds are targeted to worst affected areas. Website: www.napswq.gov.au

Local government

Various rate rebate programs, incentives and technical advise with a focus on weed and pest management and biodiversity.
Website: www.mav.asn.au

Department of the Environment and Heritage (DEH)

Establishment of protected areas for inclusion in the Australian Government funded National Reserve Program. Used to establish a protected area through entering into a nature conservation covenant agreement.

DEH also has responsibility for administrating tax concessions that seek to conserve and protect the natural environment.

Environment tax concessions

- Donations of $5000 to the environment or heritage organisations can be claimed over 5 years.
- Income concessions can be provided for landowners entering conservation covenants.

Australian Government Department of Agriculture, Fisheries and Forestry

Reimbursements with the development and implementation of an Environmental Management System (EMS).

Grants of up to $3000 from the EMS incentives program.

Water boards

Some water boards assist with rehabilitation of stream frontage.

Grants for stream frontage management programs.

World Wildlife Fund (WWF)

Protecting nationally threatened species and ecological communities. Habitat restoration, weeds and feral animal control, fencing, fire management, monitoring and surveying species populations.

Threatened Species Network Community grants. Australian Government and WWF up to $30,000. Groups only eligible. Website: www.wwf.org.au/tsn

Bird Observers Club

Improve and extend habitat for birds and other native animals and plants.

Grants from the Australian Bird Environment Fund.
Website: www.birdobservers.org.au/abef.htm

Conservation Volunteers Australia

Can provide team of volunteers to assist with revegetation projects, or can assist part time on local natural environment and cultural heritage conservation projects.

Australian Government — Labour support and Green Reserve Program funded by Australian Government. Website: www.conservationvolunteers.com.au

BHP and Conservation Volunteers Australia

Wetland revitalisation program focusing on 100 of Australian wetlands. Projects can be taken on public and private land.

Website: www.reviveourwetlands.net

Appendix B: Where do I get help?

There are a number of organisations that produce useful information. For river and riparian management the most comprehensive range of fact sheets, technical guidelines and manuals can be accessed at www.rivers.gov.au. This website also has a number of interactive catchment diagrams that show well managed and poorly managed riparian areas in relation to a particular topic. Other useful contacts at the national and state level are listed below.

National contacts

Australian Legal Information Institute (free access to Australian legal documents) Website: www.austlii.edu.au
Australian Wool Innovation Tel: 1800 070 099, Website: www.wool.com.au
Birds Australia Website: www.birdsaustralia.com.au
Bureau of Rural Sciences Tel: (02) 6272 4282, Website: www.daff.gov.au/brs/
Dairy Australia Tel: (03) 9694 3700, Website: www.dairyaustralia.com.au
Department of Agriculture, Fisheries and Forestry Tel: (02) 6272 3983, Website: www.daff.gov.au
Department of the Environment and Heritage Tel: (02) 6274 1111, Website: www.deh.gov.au
Environment Protection and Biodiversity Conservation Act 1999 This act, in particular, protects native species from extinction and promotes the recovery of threatened species. Website www.deh.gov.au/epbc/index.html
Environmental Defenders Office State contacts provided Website: www.edo.org.au

Greening Australia Tel: (02) 6281 8585, Website: www.greeningaustralia.org.au
Kondinin Group Tel: (08) 9478 3343, Website: www.kondinin.com.au
Land & Water Australia Tel: (02) 6263 6000, Websites: www.rivers.gov.au and www.lwa.gov.au
Land, Water & Wool Website: www.landwaterwool.gov.au
Meat & Livestock Australia Tel: (02) 9463 9333, Website: www.mla.com.au
Murray–Darling Basin Commission Tel: (02) 6279 0100, Website: www.mdbc.gov.au
National Farmers Federation Tel: (02) 6273 3855, Website: www.nff.org.au
National Land and Water Resources Audit Tel: (02) 6263 6000, Website: www.nlwra.gov.au
National Plan for Salinity and Water Quality State contacts provided Website: www.napswq.gov.au
Natural Resources Management Tel: 1800 552 008, Website: www.nrm.gov.au
Natural Heritage Trust Tel: 1800 065 823 Website: www.nht.gov.au
Waterwatch State contacts provided Website: www.waterwatch.org.au
WebLaw-Environmental Law This site provides a list of legislation and government agencies that deal with the environment in all states and territories. Website www.weblaw.edu.au, choose the Environmental Law section
Weeds Australia Tel: (03) 6344 9657, Website: www.weeds.org.au

Funding projects

For advice on sources of funding for your project you are best to contact your local Landcare facilitator, Greening Australia or visit the federal government website on www.nrm.gov.au

Landcare

You local catchment authority or shire should be able to put you in contact with your regional Landcare facilitator. Alternatively look online at www.landcareonline.com. People can use the Landcare Online website to search for their catchment authority and their local landcare group — as long as they have a postcode for the search.

Australian Capital Territory

Environment ACT

Environment ACT is the agency responsible for managing all aspects of the environment.
Tel: 13 22 81, Website www.environment.act.gov.au

Environment Protection Authority

Tel: 13 22 81

ACT Commissioner for the Environment

Tel: (02) 6207 2626, Website: www.environmentcommissioner.act.gov.au
E-mail: env.com@act.gov.au

Regional Natural Resources Management Groups

Murrumbidgee Catchment Management Authority
Tel: (02) 6923 0404 (Wagga Wagga Office), Website: www.murrumbidgee.cma.nsw.gov.au

Upper Murrumbidgee Catchment Management Coordinating Committee

This network includes local government, community groups and ACT and NSW government agencies. The Committee has also produced a fact sheet entitled *Wetlands of the Upper Murrumbidgee — Fact Sheet for Rural Landholders*.
Tel: (02) 6207 2999, Website: www.actlandcare.org/umccc.htm

Catchment Groups

Website: www.actlandcare.org/catchment_groups.htm
Ginninderra Catchment Group, Tel: (02) 6278 3309
Southern ACT Catchment Group, Tel: (02) 6296 6400
Molonglo Catchment Group, Tel: (02) 6298 4012

Waterwatch

ACT and Region Facilitator, Tel: (02) 6207 2246, Website: www.act.waterwatch.org.au
Ginninderra Waterwatch and ACT and Region Frogwatch, Tel: (02) 6278 3309
Southern ACT Waterwatch, Tel: (02) 6296 6400
Molonglo Waterwatch, Tel: (02) 6242 1191

Non-government organisations

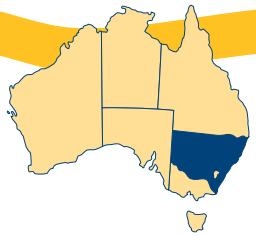
Conservation Volunteers Australia, Tel: (02) 6247 7770, Website: www.conservationvolunteers.com.au/
Greening Australia, Tel: (02) 6253 3035, Website: www.greeningaustralia.org.au

Landcare

ACT Natural Resource Management and Landcare Facilitator, Tel: (02) 6207 7131
Rural Landcare, Tel: (02) 6207 2193

Environmental Defenders Office

Tel: (02) 6247 9420, Website: www.edo.org.au/edoact



New South Wales

Department of Natural Resources (DNR)

DNR have produced a number of fact sheets covering natural resource management issues, that can be accessed at the website.
Tel: (02) 9762 8044, Website: www.dnr.nsw.gov.au

New South Wales Agriculture

Tel: (02) 9372 0100, Website: www.agric.nsw.gov.au

Catchment Management Authorities

- Central West Catchment Management Authority, Tel: (02) 6721 9810, Website: www.cw.cma.nsw.gov.au
- Border Rivers-Gwydir Catchment Management Authority, Tel: (02) 6339 4900, Website: www.brg.cma.nsw.gov.au
- Hunter-Central Rivers Catchment Management Authority, Tel: (02) 4930 1030, Website: www.hcr.cma.nsw.gov.au
- Lachlan Catchment Management Authority, Tel: (02) 6341 1600 and 1800 885 747 (freecall), Website: www.lachlan.cma.nsw.gov.au
- Murray Catchment Management Authority, Tel: (03) 5881 9200, Website: www.murray.cma.nsw.gov.au
- Murrumbidgee Catchment Management Authority, Tel: (02) 6923 0479, Website: www.murrumbidgee.cma.nsw.gov.au
- Namoi Catchment Management Authority, Tel: (02) 6742 9220, Website: www.namoi.cma.nsw.gov.au
- Lower Murray Darling Catchment Management Authority, Tel: (03) 5021 9460, Website: www.lmd.cma.nsw.gov.au

Environment Protection Authority

Tel: 131 555, Website: www.epa.nsw.gov.au

NSW Fisheries

Tel: (02) 9527 8411, Website: www.fisheries.nsw.gov.au

NSW Parks and Wildlife Service

Tel: (02) 9585 6444, Website: www.npws.nsw.gov.au

Greening Australia

Tel: (02) 9560 9144, Website: www.greeningaustralia.org.au
NSW legislation can also be viewed at the website: www.legislation.nsw.gov.au

Streamwatch

Tel: (02) 9228 6111, Website: www.streamwatch.org.au

Atlas of NSW Wildlife (contains sightings of plants and animals, not fish, on a regional basis)

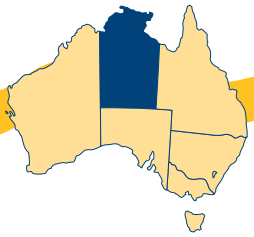
Website: www.nationalparks.nsw.gov.au/wildlifeatlas

New South Wales Farmers' Association

Information sheets entitled 'Legislation relevant to NSW Landholders' and 'NSW Landholders and Environmental Planning Instruments'.
Tel: (02) 8251 1700, Website: www.nswfarmers.org.au/policy/conservation/legislation

Conservation Volunteers Australia NSW

Tel: (02) 9564 1244, Website www.conservationvolunteers.com.au/



Northern Territory

Department of Natural Resources Environment and the Arts
Tel: (08) 8999 4139, Website: www.nt.gov.au/nreta
Use Contact Us to get relevant area telephone number.

Environment Protection Agency
Office of Environment and Heritage
Tel: (08) 8924 4139, Website: www.nt.gov.au/nreta/environment/

Department of Agriculture, Forestry and Fisheries
Tel: (08) 8999 5511, Website: www.primaryindustry.nt.gov.au

Regional Facilitators
Regional Facilitator Darwin, Tel: (08) 8999 3493, E-mail: kath.nash@nt.gov.au
Regional Facilitator Katherine, Tel: (08) 8973 8106, E-mail: madonna.mackay@nt.gov.au
Regional Facilitator Alice Springs, Tel: (08) 8951 9255, E-mail: michelle.rodrigo@nt.gov.au

Indigenous Land Management Facilitators
Northern Land Council, Tel: (08) 8944 8406 / (08) 8920 5210, E-mail: wayne.barbour@nlc.org.au
Central Land Council, Tel: (08) 8950 5013, E-mail: smarty@clc.org.au

Landcare
Website: www.nt.gov.au/nreta/naturalresources/landcare
Includes a list of groups and local facilitator contacts for Northern Region, Katherine Region and Southern Region.

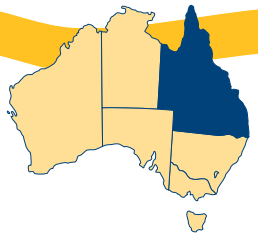
Natural Heritage Trust
Manager Community Programs, Tel: (08) 8999 4464, E-mail: NHTAdministration.dnreta@nt.gov.au

Northern Territory Cattlemen's Association
Tel: (08) 8981 5976 (Darwin), (08) 8952 5122 (Alice Springs), Website: www.ntca.org.au

Pastoral Landcare
Northern Territory State Landcare Coordinator, Tel: (08) 8981 5976, Mobile: 0428 330 131
Website: www.ntca.org.au
Click on Pastoral Landcare to obtain information on groups and the state coordinator.

Conservation Volunteers Australia
Tel: (08) 8981 3206, Website: www.conservationvolunteers.com.au/

Environmental Defenders Office
Tel: (08) 8982 1182, Website: www.edo.org.au/edont



Queensland

Department of Natural Resources, Mines and Water (DNRMW)

DNRMW has a number of fact sheets covering natural resources management issues that can be accessed via the website.
Tel: (07) 3896 3111, Website: www.nrm.qld.gov.au

Department of Primary Industries

Tel: 132 523, Website: www.dpi.qld.gov.au

Regional Natural Resources Management groups

For more information on regional Natural Resources Management groups visit the website: www.regionalnrm.qld.gov.au

- Burnett Mary Regional Group for Natural Resources Management Inc, Tel: (07) 4132 8333, Website: www.burnettmarynrm.org.au
- Condamine Alliance, Tel: 1800 181 101, Website: www.condaminealliance.com.au
- Fitzroy Basin Association, Tel: (07) 4999 2800, Website: www.fba.org.au
- Natural Resource Management South East Queensland Inc., Tel: (07) 3211 4404, Website: www.nrmseq.com
- Queensland Murray Darling Committee, Tel: (07) 4637 6270, Website: www.qmdc.org.au
- South East Queensland Western Catchments Group, Tel: (07) 3816 9700
- South West Natural Resource Management Group; Tel: (07) 4654 7382

Environment Protection Agency

Tel: (07) 3227 7111, Website: www.env.qld.gov.au

Greening Australia

Tel: (07) 3902 4444, Website: www.greeningaustralia.org.au

Queensland Landcare and Catchment Management

Regional contacts are provided on the website of those involved in Landcare activities
Website: www.landcareqld.org.au

Waterwatch

Tel: (07) 3896 9625, Website: www.qld.waterwatch.org.au

Environmental Defenders Office

Tel: (07) 4031 4766, Website: www.edo.org.au/edonq.html

Queensland Farmers Federation

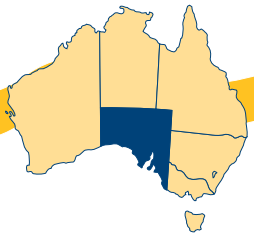
QFF has put out Fact Sheets covering the implications of the Vegetation Management Act 1999, and it can be accessed via the website.
Website www.qff.org.au/Policies/Environment

Agforce

Tel: (07) 3236 3100, Website: www.agforceqld.org.au

Conservation Volunteers Australia Queensland

Tel: (07) 3846 0893, Website www.conservationvolunteers.com.au/



South Australia

Department of Water, Land and Biodiversity Conservation (DWLBC)

Tel: (08) 8463 6800, Website: www.dwlbc.sa.gov.au

Department for Environment, Heritage and Aboriginal Affairs

Tel: (08) 8204 9000, Website: www.dehaa.sa.gov.au

Department of Primary Industries and Resources South Australia

Tel: (08) 8226 0222, Website: www.pir.sa.gov.au

Integrated Natural Resources Management groups

- Northern and Yorke Agricultural District Integrated Natural Resources Management Group, Tel: (08) 8260 1266, Website: www.dwlbc.sa.gov.au/nrm/delivery/plans/yorke.html
- Adelaide and Mount Lofty Ranges Integrated Natural Resources Management Group, Tel: (08) 8303 9712, Website: www.dwlbc.sa.gov.au/nrm/delivery/plans/mtlofty.html
- Eyre Peninsula Integrated Natural Resources Management Group, Tel: (08) 8688 3400, Website: www.dwlbc.sa.gov.au/nrm/delivery/plans/eyre.html
- Kangaroo Island Natural Resources Board, Tel: (08) 8553 4940, Website: www.dwlbc.sa.gov.au/nrm/delivery/plans/ki.html
- Arid Lands (formerly Rangelands) Integrated Natural Resource Management Group, Tel: (08) 8648 5173, Website: www.dwlbc.sa.gov.au/nrm/delivery/plans/arid_lands.html
- SA Murray Darling Basin Integrated Natural Resources Management Group, Tel: (08) 8536 4809, Website: www.dwlbc.sa.gov.au/nrm/delivery/plans/murray.html
- South East Natural Resources Consultative Committee, Tel: (08) 8762 9120, Website: www.dwlbc.sa.gov.au/nrm/delivery/plans/southeast.html

Environment Protection Authority

Tel: (08) 8204 2004, Freecall: (country) 1800 623 445, Website: www.epa.sa.gov.au

Government Information Centre

Tel: (08) 8204 1900, Freecall (country): 1800 182 234, Legislation may be viewed on www.parliament.sa.gov.au

Greening Australia SA

Tel: (08) 8372 0120, Website www.greeningaustralia.org.au

Environmental Defenders Office (SA) Inc

Tel: (08) 8232 7599 for advisory service, Freecall: (country) 1800 337 566, Website: www.edo.org.au

Legal Services Commission of South Australia

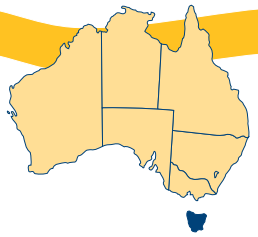
'The Law Handbook' contains information on environmental law and can be accessed via the website: www.lawhandbook.sa.gov.au

South Australian Farmers Federation

Tel: (08) 8232 5555, Website: www.saff.com.au

Conservation Volunteers Australia SA

Tel: (08) 8212 0777, Website www.conservationvolunteers.com.au/



Tasmania

Department of Primary Industries, Water and the Environment (DPIWE)

Wetlands and Waterways Works Manual covers works on waterways and methods often undertaken by farmers and community groups. Can be accessed along with other information on river management from the website by clicking on 'water' and then via the A–Z Guide.
Tel: (03) 6233 8011, Website: www.dpiwe.tas.gov.au

Regional Natural Resources Management committees

- Cradle Coast Natural Resources Management Committee, Tel: (03) 6431 6285, Website: www.nrmtas.com.au
- Northern Tasmania Natural Resources Management Regional Committee, Tel: (03) 6336 5371, Website: www.nrmtas.com.au
- Southern Regional Natural Resources Management Committee, Tel: (03) 6234 2248, Website: www.nrmtas.com.au

Environmental Defenders Office

Tel: (03) 6223 2770, Website: www.tased.edu.au/tasonline/edo

Greening Australia Tasmania

Tel: (03) 6223 6377, Website www.greeningaustralia.org.au

Parks and Wildlife Service

Tel: (03) 6233 8011, Website: www.parks.tas.gov.au

Tasmanian Conservation Trust

Tel: (03) 6234 3552, Website: www.tct.org.au

Tasmanian Farmers' and Graziers' Association

Tel: (03) 6332 1800, Website: www.tfga.com.au

Conservation Volunteers Australia Tasmania

Tel: (03) 6231 1779, Website www.conservationvolunteers.com.au/

Victoria

Department of Sustainability and Environment (DSE)

The DSE website has a list of all the legislation administered by the department. Go to 'About Us' and click on 'legislation'. They also have a series of brochures including: Changes to riparian vegetation and sedimentation. Go to 'Plants and animals' and click on 'publications'.
Tel: 136 186, Website: www.dse.vic.gov.au

Department of Primary Industry

The Notes Information Series includes information on a number of topics e.g. willow control and declared noxious weeds.
Tel: 136 186, Website: www.dpi.vic.gov.au

Catchment Management Authorities

- Wimmera Catchment Management Authority, Tel: (03) 5382 1544, Website: www.wcma.vic.gov.au
- Glenelg-Hopkins Catchment Management Authority, Tel: (03) 5571 2526, Website: www.glenelg-hopkins.vic.gov.au
- Corangamite Catchment Management Authority, Tel: (03) 5571 2526, Website: www.ccma.vic.gov.au
- Goulburn Broken Catchment Management Authority, Tel: (03) 5822 2288, Website: www.gbcma.vic.gov.au
- Port Philip and Westernport Catchment Management Authority, Tel: (03) 9785 0183, Website: www.ppwcma.vic.gov.au
- North East Catchment Management Authority, Tel: (03) 6043 7600, Website: www.necma.vic.gov.au
- North Central Catchment Management Authority, Tel: (03) 5448 7124, Website: www.nccma.vic.gov.au
- West Gippsland Catchment Management Authority, Tel: (03) 5175 7800 and 5662 4554, Website: www.wgcma.vic.gov.au

Greening Australia Victoria

Tel: (03) 9450 5300, Website www.greeningaustralia.org.au

Victorian legislation can be accessed on
Website: www.dms.dpc.vic.gov.au

Gateway to environment matters: A–Z Guide to Victorian and Commonwealth matters
Website: www.environment.vic.gov.au

Environmental Defenders Office

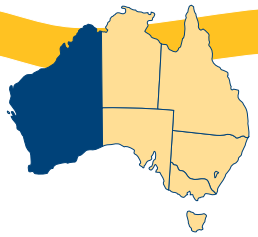
Tel: (03) 9328 4811, Website: www.edo.org.au/edovic/

Victorian Farmers Federation

Tel: 1300 882 833, Website: www.vff.org.au

Conservation Volunteers Australia Victoria

Tel: (03) 9686 5554, Website www.conservationvolunteers.com.au/



Western Australia

Department of Environment
Tel: (08) 9278 0300, Website: www.environment.wa.gov.au

Department of Conservation and Land Management
Tel: (08) 9334 0333, Website: www.calm.wa.gov.au

Department of Agriculture WA
Tel: (08) 9368 3333, Website: www.agric.wa.gov.au

Catchment Councils
- Avon Catchment Council, Tel: (08) 9690 2250, Website: www.avonicm.org.au
- Northern Agricultural Catchment's Council, Tel: (08) 9973 1444, Website: www.nacc.com.au
- South Coast Regional Initiative Planning Team, Tel: (08) 9892 8537, Website: www.script.asn.au
- South West Catchments Council, Tel: (08) 9780 6193, Website: www.swcatchmentscouncil.com
- Swan Catchment Council, Tel: (08) 9374 3333, Website: www.swancatchmentcouncil.org

Department of Environmental Protection
Tel: (08) 9222 7000, Website: www.environ.wa.gov.au

Department of Planning and Infrastructure
Tel: (08) 9264 7777, Website: www.dpi.wa.gov.au

Environmental Protection Authority
Tel: (08) 9222 7000, Website: www.epa.wa.gov.au

Greening Australia WA
Tel: (08) 9335 8933, Website www.greeningaustralia.org.au

Commissioner of Soil and Land Conservation
Tel: (08) 9368 3282, Website: www.agric.wa.gov.au

State Law Publisher (for copies of legislation)
Tel: (08) 9321 7688, Website: www.slp.wa.gov.au

Environmental Defender's Office WA Inc
They provide legal advice on environmental issues and has a number of useful Fact Sheets
Tel: (08) 9221 3030, Website: www.edo.org.au/edowa

Statewide Natural Resources Management Groups
Website: www.nrm.org.au

Pastoralists' and Graziers' Association of WA
Tel: (08) 9478 4599, Website: www.pgaofwa.org.au

Conservation Volunteers Australia WA
Tel: (08) 9336 6911, Website www.conservationvolunteers.com.au/

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Burrows, D. & Butler, B. 2001, *Managing Livestock to Protect the Aquatic Resources of the Burdekin Catchment, North Queensland*, Third Australian Stream Management Conference 2001, pp. 95–101.

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Furnas, M. 2004, *Australian Farm Journal*, April 2004, pp. 68–71.

Garrett, B.G. 1993, *Whole Farm Planning*.

Jansen, A. & Robertson, A.I. 2001, *Relationship Between Livestock Management and the Ecological Condition of Riparian Habitats Along an Australian Floodplain*, British Ecological Society, vol. 38, pp. 63–75.

Jansen, A. & Robertson, A. 1999, 'Rapid assessment of riparian health and relationships with land management practices', *RipRap*, Edition 15, Land & Water Australia, Canberra.

Jansen, A. & Robertson, A. 2002, 'Stock management in riparian zones of the Murray-Darling Basin', *RipRap*, Edition 22, Land & Water Australia, Canberra.

Karafilis, A. *Repairing Farm Waterways*, Blackwood Stories.

Lovett, S., Price, P. & Lovett, J. 2005, *Wool Industry River Management Guide: High rainfall zones including tableland areas*, Land & Water Australia, Canberra.

Lovett, S., Price, P. & Lovett J. 2003, *Managing Riparian Lands in the Cotton Industry*, Cotton Research and Development Corporation.

McCullough, M. & Musso, B. (eds) 2004, *Healthy Rangelands — Principles for Sustainable Systems, Focus on Australia's Burdekin Rangelands*.

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Price, P. & Lovett, S. (eds) 1999, *Riparian Land Management Technical Guidelines, Volume Two: On-ground management tools and techniques*, LWRRDC, Canberra.

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Waratah® — 1990 Australian Wire Industries Pty Ltd, *The Complete Fencing System.*

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Wright, D. & Jacobson, T. 2000, *Managing Streamsides: Stock control, fencing and watering options*, Department of Primary Industries, Water & Environment, Tasmania.

Photo Roger Charlton.

Local contacts

Note down local organisations and people who can help you put some of the ideas in this Guide into action.

Photo this page and overleaf Jenny O'Sullivan.

River Landscapes