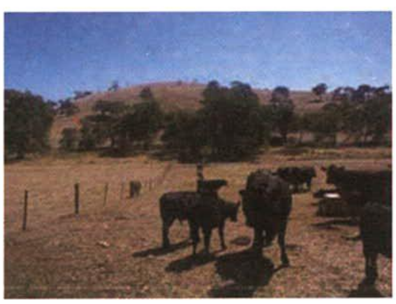
Riparian vegetation

benefits to landholders and ecosystems



in the Goolwa to Wellington Local Action Planning region

Eastern Mount Lofty Ranges, South Australia

Sally A Roberts

GOOLWA TO WELLINGTON
LOCAL ACTION PLANNING BOARD INC

Government
of South Australia

Native Vegetation Council

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Cover photographs: (clockwise from top) permanent pools along the Finniss River (January 2008), Scented Sundew (*Drosera whittakeri*), Finniss River (September 2008) and cattle in fenced paddock (at Ashbourne).

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1. Introduction

1.1. Definition of a riparian zone

The riparian zone is any land that adjoins, directly influences or is influenced by a body of fresh water.

Within this definition, a body of water includes streams (and creeks and rivers) and standing waterbodies, such as lakes and swamps. For streams, the riparian zone includes any related floodplains.

Riparian areas provide a link between aquatic (water) and terrestrial (land) ecosystems. Healthy riparian vegetation plays a critical role in maintaining the health of waterbodies and in supporting terrestrial and aquatic biota (flora and fauna).

The focus of this booklet is on riparian zones for streams. However, the broad ecological principles discussed will relate to riparian zones for other types of waterbodies in the Goolwa to Wellington Local Action Planning (GWLAP) region. For clarification of issues that relate to specific site characteristics, expert advice should be sought, and Section 6 provides a list of useful contacts.

1.2. Aims of this booklet

The purpose of this booklet is to provide information that will be useful to those interested in learning about the fundamental values of riparian vegetation. It provides an explanation of the numerous benefits to landholders and ecosystems (biological systems of our natural environment) of conserving riparian areas, and includes discussion of the related ecological principles.

This booklet is targeted at the many landholders in the GWLAP region who have decided to rehabilitate their watercourses, and those who may want to consider the benefits to farming systems and the environment of such rehabilitation.

Landholders can make a valuable contribution to the restoration of their waterways and, ultimately, to their catchment area by rehabilitating the riparian areas on their property. To assist in achieving this important goal, strategies for rehabilitation are discussed, and a case study of a restoration project being undertaken by a farmer local to the region is presented. A list of contacts is also provided for information about financial and technical assistance.

Part of the planning process for rehabilitation activities is to gain an understanding of the health of the riparian area. Therefore, a rapid health assessment method for riparian zones has been included. Field data sheets are provided in the back inside-pocket of the booklet and a sample assessment is presented in the Appendix.

To aid in the understanding of some environmental terms, a glossary can be found in the endmatter.

1.3. Description of the GWLAP region

The Goolwa to Wellington Local Action Planning region is the southern-most section of the Murray-Darling Basin in South Australia, and lies within the Eastern Mount Lofty Ranges region. Its catchments cover the area from Meadows, Kanmantoo and Harrogate in the northern section to Port Elliot and Hindmarsh Island in the south. The most prominent landscape features of the area are the hills, plains, lakes and coastline.

The GWLAP area comprises the main catchments of the Bremer River, Angas River, Finniss River, Tookayerta Creek and Currency Creek, all of which drain into Lake Alexandrina between Goolwa and Wellington. The majority of streams in the region are ephemeral, and most of the major watercourses feature permanent pools during the dry part of the year.

The species and structure of pre-European riparian vegetation for the region would have typically been a eucalypt overstorey (River Red Gums); a Blackwood Wattle sub-canopy; tea tree, melaleuca and bursaria shrub layer; and sedges and rushes, as well as native grasses, in the groundcover layer. However, various other vegetation community types also occurred.

Most of the watercourses in the GWLAP region have become degraded as a result of human activities, such as vegetation clearance, alterations of flow rate and frequency and some agricultural practices. In general, they have been affected by a loss of native plants on their river banks, erosion of stream banks and streambeds, weed invasion and the consequential degradation of related ecosystems.

1.4. An invitation to the reader

To gauge the ways in which the reader considers this booklet to be useful, as well as an invitation for suggestions from the reader for any further information they would find useful about riparian habitats, a questionnaire is provided in the back inside-pocket of this booklet.

The completed questionnaire should be returned to the author by 31 March 2009 (please see postal details on copyright page). For the respondent's convenience, a reply-paid, self-addressed envelope is included.

2. Value of the riparian zone

2.1. Benefits of riparian vegetation to the landholder

Protection of livestock, and crops and pasture

The understorey of a healthy riparian area can provide livestock in nearby paddocks with shelter from extreme weather conditions, such as storms and intense heat, thus reducing heat and cold stress.

Healthy riparian vegetation can also serve as a windbreak for crops and pasture downwind. Semi-permeable windbreaks are recommended, which native vegetation is able to provide. The protected area provided by the windbreak usually lies between three times the height of the windbreak (H) and 20 times H. Windbreaks also help to reduce levels of evaporation of soil moisture and of surface water in nearby waterbodies—a significant benefit during hot, dry periods.

Consequently, healthy native riparian vegetation can provide conditions conducive to improved stock health and an increase in crop and pasture yields and, therefore, an increase in productivity.

Pollination of crops and natural pest control

Healthy riparian vegetation not only provides a windbreak for crops, but also provides habitat for crop pollinators, including birds, bats, small possums and, most importantly, pollinating insects.

It also helps to control insect pests that can damage crops, by providing habitat for insect-eating birds and insect parasites. Therefore, it provides natural pest control that helps to achieve on-farm economic and environmental benefits.

Maintenance of good soil structure and stability

Vegetated banks help maintain soil structure, allow increased water infiltration into the soil and reduce bank erosion and topsoil stripping.

The largely undecomposed plant debris on the soil surface, called litter, helps protect the mineral soil against rain and wind erosion, and extreme temperatures. This organic matter also has a significant water-holding capacity, which means that water is then available to plants. Plant litter is the source of food for most soil organisms that break down organic matter, allowing elements to be returned to the simple forms that are available to plants. These organisms also help to improve soil structure, which is important for air, water and root penetration and also helps prevent erosion.

Roots of riparian vegetation bind the soil and, fine roots in particular, help to prevent stream banks from erosion caused by scouring from flowing water. This is particularly important close to the bottom (toe) of the bank and on the outside bends of meanders.

Another contribution riparian vegetation makes to bank stability is that it uses water that it has helped to infiltrate into the soil. This further improves bank stability by preventing soil saturation.

By preventing erosion, valuable soil is not lost from the property, and good water quality is maintained in the stream.

Aesthetic and recreational benefits

Vegetation that occurs alongside waterways provides an environment where recreational pursuits, such as picnicking and bird-watching, can be enjoyed. Being a buffer to noise from, for example, road traffic and nearby properties, riparian vegetation allows appreciation of its intrinsic beauty to be experienced in a relaxing setting.

Increase in property value

Well-managed riparian areas may increase the market value of a property because of the benefits already discussed. The habitats they contain and the benefits they supply to ecosystems also provide the potential for environmental education.

2.2. Ecological value of riparian vegetation

Valuable habitat for plants and animals

Riparian vegetation provides habitat for many plant and animal species, including endangered ones. In the Goolwa to Wellington Local Action Planning (GWLAP) region, a healthy riparian zone may provide habitat for threatened plant species such as Pale Everlasting (*Helichrysum rutidolepis*), Leafy Twig-rush (*Cladium procerum*) and Thatch Saw-sedge (*Gahnia radula*). Examples of threatened animals that may be found include the Golden Bell Frog (*Litoria raniformis*) and Broad-shelled tortoise (*Chelodina expansa*).

It also serves as a protective corridor for the movement of wildlife from one patch of remnant vegetation to another, which is particularly important in areas that are largely cleared. The width, composition and continuity of riparian vegetation impact on the provision of suitable habitat for native wildlife.

Buffering excessive nutrients, sediment and pesticides

Riparian vegetation, particularly that which provides a dense cover at ground level (in other words, grasses, sedges and small shrubs), slows the passage of surface water runoff. As a result, a significant quantity of nutrients, sediments and pollutants are trapped before they enter the waterway, in a process called 'biofiltration'.

Nutrients

Nutrients are essential for all life, including primary nutrients such as nitrogen and phosphorus. However, they have become increasingly available (an example of agricultural inputs being from fertilisers and animal manure) and more mobile due to soil structure decline and erosion as a result of the clearing of native vegetation for urban and agricultural land use.

Elevated nutrient levels in waterbodies (eutrophication) can lead to excessive algal growth (algal blooms). This is made worse where there is a lack of riparian vegetation, because the loss of shade over the stream creates warm conditions in the surface water, which favour algal blooms.

Algae clouds the water, thereby reducing light penetration, which can threaten the survival of submerged aquatic plants. This causes problems for native fish species that depend on submerged plants for food and shelter, or eat the invertebrates that inhabit them.

Blooms of cyanobacteria (often referred to as blue-green 'algae' and is a photosynthetic bacteria) cause further problems due to the toxins that some species produce, which can have detrimental effects on human and animal health. Some of these toxins have the potential to bioaccumulate up the food chain. Problems caused by such blooms are compounded when the cyanobacteria die and decompose, along with the plants they have killed, because this process uses up dissolved oxygen and can result in fish kills.

Heavy metals can be found in fertilisers. For example, cadmium is often contained in superphosphate, and comes from the original phosphate rock. This is of concern if it enters waterways, as it can bioaccumulate in some aquatic food chains.

Sediment

Sedimentation (process of sand, clay, silt, pebbles and organic material being deposited and accumulating) is part of the natural process of erosion. Coarse sediment (cobbles and gravels) on river beds is vital for providing suitable habitat for macroinvertebrates and spawning fish. Nutrients that are necessary for healthy aquatic ecosystems are carried on fine sediments (silts and clays), and can dissolve to become incorporated into the aquatic food web.

However, where there is accelerated erosion, excess quantities of sediment cause many problems for stream ecosystems. In this context, coarse sediments can infill pools (which are important for fish as permanent refuges during dry conditions). Excessive fine sediment can clog river bed interstices, thereby degrading benthic habitat. This will negatively impact upon benthic invertebrates, which are a major food source for native fish species. It can also smother spawning beds, making them unsuitable, or smother the eggs themselves.

When carried in suspension, fine sediment can also interfere with the ability of some animals to breathe or, in the case of visual feeders, to find food.

Because suspended sediments increase turbidity, which reduces light penetration, this reduces the ability of submerged aquatic plants to photosynthesise. Algal species, as well as cyanobacteria (or blue-green 'algae'), on the other hand, can move into and spread within the upper, narrow zone of light. Some species of cyanobacteria are toxic to a variety of organisms including humans and livestock.

Sediments also provide a mechanism for the transport of toxicants such as pesticides, and heavy metals and nutrients, and a substrate upon which they can react.

Pesticides (herbicides, insecticides and fungicides)

Pesticides can enter waterways by aerial drift, surface runoff (either in solution or bound to sediment particles) or having leached into groundwater that supplies baseflow to streams.

Some pesticides can be lethal to non-target organisms such as fish. Herbicides can destroy non-target plants, which provide food and habitat for aquatic animals. In addition, pesticides can reduce fertility and life expectancy, and increase the incidence of abnormalities, in some aquatic organisms. Pesticide residues can also bioaccumulate up the food chain.

Although currently not well-understood, certain combinations of pesticides have been shown to have synergistic effects. Therefore, it is important to consider that the potential impacts from individual pesticides could greatly underestimate the overall toxic effects of a mixture, on aquatic ecosystems.

Riparian vegetation acts as a physical barrier to pesticides from aerial drift and runoff, reducing the amount of pesticides entering waterways.

Value of large woody debris

Large woody debris (LWD) consists of fallen limbs or whole trees that provide habitat for many terrestrial animals, including reptiles, birds and small mammals. Where it falls into a stream, to become partly exposed or submerged, it provides important habitat for aquatic animals.

Many native invertebrates and fish are found in greater numbers around LWD, as it provides shelter from fast-flowing water and direct sunlight, and a good source of food. LWD also provides fish with shelter from predators and surfaces on which they can lay their eggs. In addition, it provides birds with sites for preening and feeding vantage points.

LWD is a source of dissolved and solid organic carbon that becomes incorporated into the aquatic food web (see Figure 1). The fungal, algal and bacterial biofilms, and invertebrates that slowly decompose the wood also become food for other aquatic organisms, including other invertebrates and fish.

Misconceptions about LWD include its influence on stream flow and erosion. These only become issues where LWD significantly blocks the watercourse, in which case, the LWD can be repositioned if necessary. In terms of erosion, LWD actually helps to stabilise the streambed.

Regulating in-stream temperatures

Shade provided by healthy riparian plants regulates the amount of light and heat that reaches the water in streams.

Increased sunlight encourages the growth of weeds and algae, which can alter the in-stream ecosystem to one that does not support native fish and other native animals. Excessive growth of in-stream weeds and algae can result in bed sediment being trapped, which can choke the stream channel, reducing its ability to carry flood waters. In addition, because these plants are composed of soft material, they decompose rapidly, and can deplete the water of oxygen.

Some animal species are particularly sensitive to high temperatures, for example, mayfly nymphs (from the Order: Ephemeroptera)—invertebrates that are an important dietary component for fish.

As temperatures increase, the ability of water to absorb oxygen decreases. To compound the problem, warmer waters result in an increase in rates of ecosystem respiration, which contributes to a reduction in dissolved oxygen. Furthermore, as photosynthesis does not occur at night, increased rates of respiration by plants and animals can result in dissolved oxygen levels approaching anoxia. This creates conditions that are unfavourable to forms of aquatic life sensitive to oxygen levels, including some species of macroinvertebrates and fish.

Healthy riparian vegetation reduces the effects of extreme seasonal temperature variations and, generally, keeps the water cooler in summer and warmer in winter, compared with temperatures in streams that lack riparian vegetation. Several fish species use seasonal changes in water temperature as a cue to lay eggs. If those temperatures do not reflect natural changes, then the necessary cues for spawning may not be present, which will have a detrimental effect on their reproduction. Riparian vegetation also helps maintain cool water temperatures in pools that act as refuges for fish during dry periods.

Input into aquatic food webs

Aquatic and terrestrial biodiversity holds intrinsic value, and forms part of the ecosystems that we are ultimately reliant upon for our own survival. Food webs form the part of ecosystems that transfers energy and nutrients from one type of organism to another, through a number of interrelated food chains in a biological community.

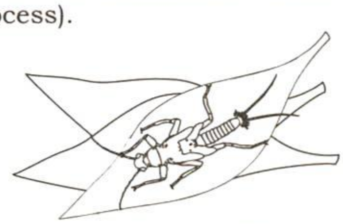
The provision of organic matter to aquatic food webs of streams comes from two sources: from within the stream (autochthonous) and from terrestrial input (allochthonous). The relative proportions of these two sources of nutrients can vary between stream reaches.

Riparian vegetation supplies allochthonous organic matter input into streams in the form of leaf litter and other organic debris (for example, bark, branches, fruit, flowers and seeds), and terrestrial invertebrates (for example, insects) that fall into the water from the riparian zone. Therefore, the riparian zone makes an important contribution of nutrients to riverine food webs.

It is not possible in this booklet to show the high level of complexity of most aquatic food webs. Therefore, a simple example is provided in Figure 1 that shows how coarse particulate organic matter can be incorporated from the riparian zone into an aquatic food web. Of course, a complete food web would be much more complicated, as it would consist of many other interrelated food chains.

The example provided by Figure 1 shows that inputs, such as leaf litter, fallen logs or roots, fall into the stream as coarse particulate organic matter (CPOM). Nutrients are leached from the debris as dissolved organic matter (DOM) and are quickly taken up by water plants. Fungi, bacteria and micro-algae break down the CPOM to form DOM, the major component of which is dissolved organic carbon (DOC). DOC is utilised mainly by bacteria, and single-celled animals (Protozoa) consume the bacteria that provide a rich source of nutrients.

In turn, the Protozoa become food for small, multicellular animals, that themselves become food for larger predators. Bacteria provides the means by which DOC can become available to higher consumers, for example, fish that cannot assimilate DOC themselves. This link between DOC and higher consumers is referred to as the 'Microbial Loop' (the 'loop' includes the return of DOC to the food web via, for example, animal excretion, for assimilation again by bacteria—a recycling process).



Another series of interactions in the aquatic food web begins with 'shredders' (invertebrates, such as stone-fly larvae) that break down the CPOM into fine particulate organic matter (FPOM). This becomes available to 'collectors' (invertebrates, such as riffle beetles) that filter FPOM that is being transported downstream or gather it from the sediments. Shredders gain nutrition from the old plant material as well as from attached periphyton. Collectors also use microbes attached to plant material for nutrition. Shredders and collectors, as well as grazers that feed directly on periphyton, become food for predators, such as fish.

The transfer of nutrients and energy between plants and animals within the stream involves a continuous cycling of nutrients that moves slowly downstream, which is referred to as 'nutrient spiralling'. Floodplain rivers also gain nutrients from the lateral exchange of nutrients between the floodplain and the channel.

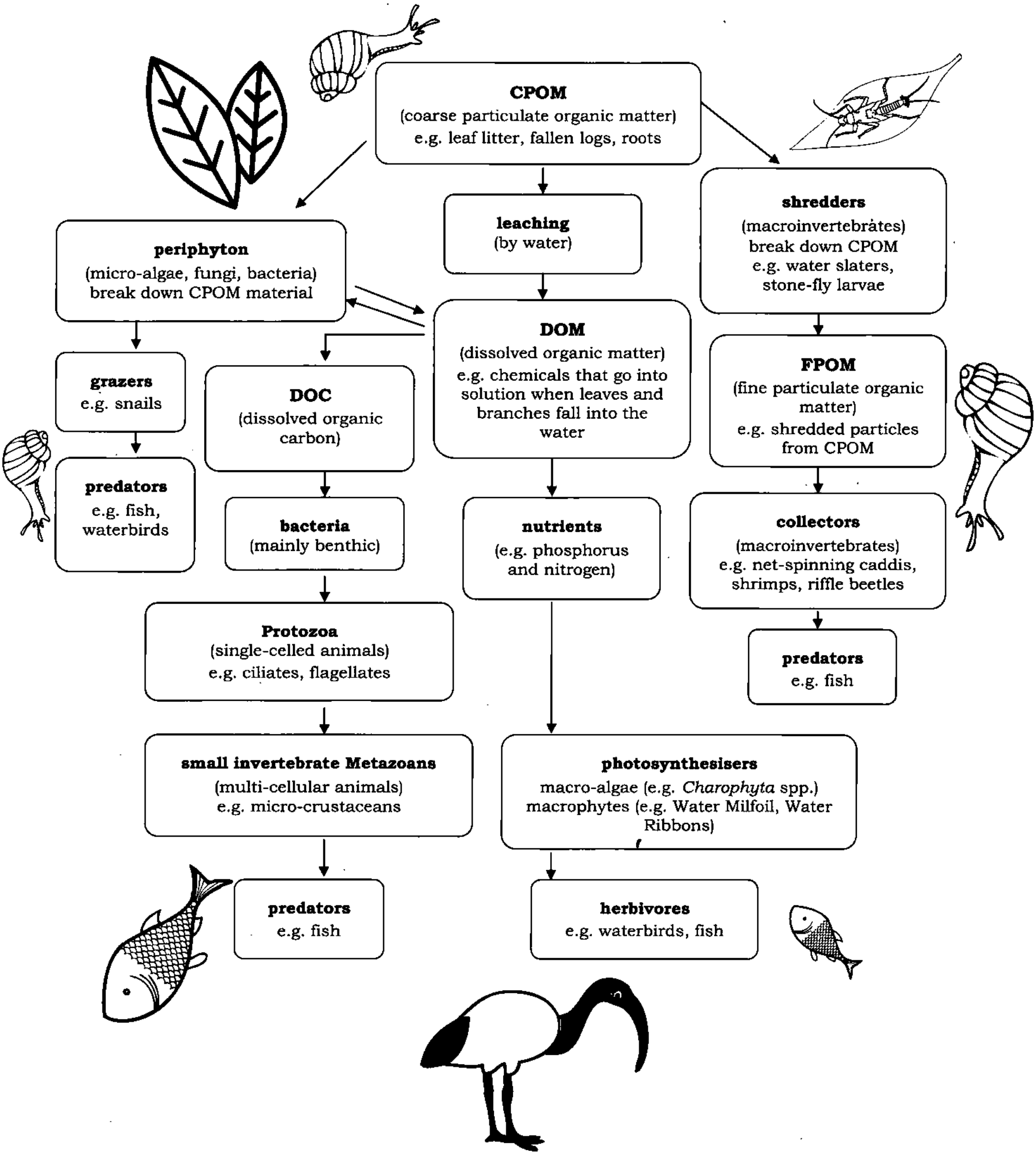


Figure 1 Simplified aquatic food web relating to terrestrial input of CPOM into a stream

Figure 1 provides a simplified example of how coarse particulate organic matter can become incorporated into the aquatic food web and broken down to become available as food for aquatic organisms. This diagram shows related food chains through to the trophic level (functional feeding group) that includes fish and waterbirds. It is not possible, here, to include other parts of the food web, such as terrestrial insects that have fallen in or landed on the water that provide food for fish or predators at the higher tropic levels. Suffice to say that healthy riparian vegetation supports healthy stream food webs.

3. Assessing the health of a riparian zone

A healthy riparian area has a diverse habitat structure, a dominance of native plants and obvious signs of their regeneration, abundant leaf litter and fallen limbs, and stable stream banks. This provides the aquatic ecosystem with good water quality, filtered light and runoff interception. It also provides diverse and abundant terrestrial and in-stream resources, including food, refuges, and spawning and nursery habitat.

Rapid assessment of riparian health

Rapid appraisal of riparian health assesses the ecological condition of riparian habitats, using measured characteristics (or indicators) to assist land managers in making decisions about management and rehabilitation of those areas. It allows for a quick turnaround of results, and gives the assessment scientific validity without the need for specialist skills (although it may be necessary to obtain expert advice for the identification of native plant species (see Section 6)).

It is suitable for repeat assessments and, therefore, can be used in monitoring the effectiveness of rehabilitation projects. Repeat assessment would need to be done at the same locations to compare results over time. Rapid assessment field data sheets are provided in the back inside-pocket of this booklet, and a sample assessment can be found in the Appendix.

The rapid assessment method presented is suitable for single-channel watercourses that are no wider than 25 m, and has been adapted from Jansen et al. (2005) and Costelloe and Sheldon (2008). It presents criteria and scoring for use in the field, with the opportunity to record information for four cross-sections (transects) of the riparian zone. A final score can then be obtained that represents a measurement of the overall health of the riparian area.

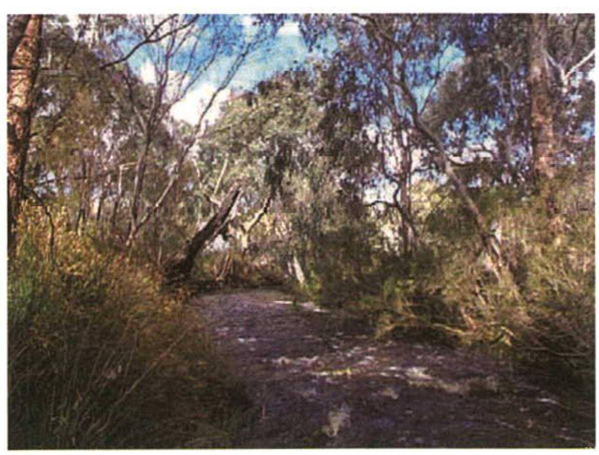
Indicators of riparian health are grouped into five main categories, as follows:

- Habitat Continuity and Extent (longitudinal continuity, proximity to the nearest patch of relatively intact native vegetation and width of riparian zone)
- Debris (leaf litter and fallen logs) and Hollow-bearing Trees
- Vegetation Cover and Structural Complexity (percentage vegetation cover and number of layers)
- Natives versus Exotic Plants (percentage cover)
- Regeneration of Natives (seedlings, saplings, native tussock grasses and reeds, and grazing impact).

1. Very poor condition: shows pugging on right and lack of regeneration of native vegetation

2. Still poor condition—lacks understorey and native groundcover—although better

3. Structurally good, but has lots of weeds: willows, blackberry, thistles, broom and herbaceous weeds



4. Good condition (Cox Scrub Conservation Park): mainly native plants, including Sweet Bursaria, River Bottlebrush, Pink Gum, Cup Gum and native grasses.

4. Rehabilitating a riparian area

4.1. Protecting riparian zones

Controlling livestock access is the most important management strategy for protecting and restoring riparian zones. When stock have access to riparian areas they graze and trample existing vegetation, including native species, and can prevent regeneration of those species by grazing the seedlings. Soil compaction that results from stock using these areas makes water infiltration into the soil more difficult. This means that less water is available to plants in the riparian zone. Destruction of riparian vegetation also leads to a lack of soil stability and eventual soil erosion.

Fencing off watercourses

The only effective way to restrict or prevent livestock access to waterways and associated riparian zones is by fencing off those areas. Fences that are positioned well-back from the stream are less prone to flood damage, and provide more protection for riparian vegetation. For shallow stream valleys, fencing needs to be located to protect any related floodplain, and well-back from the top of the bank for deep river valleys so that riparian vegetation is able to stabilise the embankment. By enclosing the widest possible area of riparian zone and revegetating any bare sections with local native species, 'corridors' of riparian vegetation can be created, that provide protected pathways for the movement of native animals. (See Section 6 for useful contacts for assistance with fencing.)

Shelterbelts

Having excluded livestock from the waterway, alternative shelter should be provided in paddocks. The recommended design for an effective shelterbelt is one with several rows of native species, that allow some airflow (to avoid turbulence on the leeward side) and which has three layers of vegetation, namely trees, shrubs and groundcover species. This will provide protection for stock in harsh weather conditions and habitat for native flora and fauna. Using native plant species also means less management of the shelterbelt. For information about appropriate plant species, contact the Goolwa to Wellington LAP Board (see Section 6).

4.2. Alternative livestock watering

Limited waterway access points

Some sections of a stream may be suitable for stock access, for example, the inside bend of a meander where flow is slower and sediment is deposited (as opposed to the outside of a bend, where water tends to accelerate and stock access would create a significant risk of erosion).

Access points should be relatively flat and consist of a suitable ramp surface, such as gravel, that will reduce the risk of erosion and make it easy for stock to reach the water's edge. They should also be fenced to prevent stock from entering the waterway and surrounding riparian zone.

Although limited access points protect riparian vegetation, they still allow some amount of added nutrients to enter the stream from stock excrement. Also, if not located and constructed properly, they can cause stream bank erosion.

A permit may be necessary to construct fenced access points (see Section 6 for details about who to contact).

Off-stream watering points

To provide maximum protection for a waterway and its associated riparian zone, the preferred option for watering stock is to install troughs away from the watercourse.

One method is to use a different water source, such as piping water from a reticulated water supply or pumping water from a groundwater bore to troughs in paddocks. Another option is to gravity feed or pump water from the stream to supply troughs in paddocks. Having excluded stock from the stream will mean that this source of water is now cleaner than when stock had direct access to it for drinking. Systems that are worth considering include nose pumps and solar-powered pumps. (See the References for useful sources of information).

Note: A permit is necessary for bore construction and a licence will be necessary to extract groundwater. (See Section 6 for details about who to contact). Extraction of surface water for watering stock does not require a licence.

Stock crossings

Where it is necessary to move stock across a waterway, for example, when moving them between paddocks, then a carefully constructed stock crossing should be used. Crossings should be located across a straight section of the stream to avoid problems of erosion. The location should also be on a naturally higher site within the waterway—this will reduce the height of fencing needed and reduce exposure of the fenced crossing to the force of the water, making it more flood resistant—and where the bank is not steep so as to minimise damage from livestock.

There should be a firm footing across the bank and the waterway, for example, gravel, for easy stock movement. The crossings will need to be fenced so that stock cannot enter any other part of the waterway or riparian zone. A permit must be acquired to construct a crossing (see Section 6 for details about who to contact).

Strategic grazing

Having established off-stream watering points for stock in paddocks, sustainable grazing methods should be devised.

Rotational grazing involves rotating stock between paddocks, thereby allowing pasture time to rest and recover to ensure that pastures are not destroyed through overgrazing. For example, for eight paddocks, a one-week graze in each paddock and a seven-week rest for each paddock could be used. Rotational grazing often results in increased pasture production and healthier livestock, and less need for supplemental feeding.

Time-managed grazing (including 'crash grazing'), which should only be done for fire fuel reduction and to assist in weed management until the native riparian vegetation community is well-established (see Section 4.5), may be appropriate. It involves stock being allowed into the fenced-off riparian zone occasionally, for short periods of time, and only when native plants are mature enough to withstand some damage. Landholders with considerable skill and experience in stock management can use this method effectively.

For more information about restricting livestock access to waterways, including limited water access points, alternative watering points and strategic grazing, refer to the publication: *Stock and waterways: a manager's guide* by Land & Water Australia.

4.3. Benefits to landholders of excluding stock from waterways

Easier stock management

Streams can be difficult areas within which to manage stock. Mustering can be time consuming, and stock can get bogged or drown during floods. Also, strategic grazing through the use of paddock sub-division (discussed in Section 4.2) enables better pasture management.

Improved water quality and stock health

Livestock effluent increases nutrient levels in waterways. Stock can also stir up sediments causing turbidity of stream water, which reduces light penetration to submerged plants. The consequences of these impacts are discussed in Section 2.2. Also, some water-borne diseases, that are lethal to livestock, are spread by stock defecating in waterbodies. Therefore, excluding stock from watercourses will improve water quality in streams.

In cases where water from the stream is used for alternative watering points (discussed in Section 4.2) stock exclusion from the riparian area and waterway provides a much cleaner source of water that leads to healthier stock and improved wool, milk or meat production.

Reduction in stream bank erosion

Stock can create areas of bare soil and pugging as they form walking tracks to the water's edge, and this causes stream bank erosion during rainfall events. The result is the transport of increased levels of sediment into the stream, the impacts of which are discussed in Section 2.2. Preventing erosion that is caused by stock access also retains valuable soil on the property.

4.4. Weed management

Riparian areas are most vulnerable to invasion by environmental weeds if they are degraded. Where native vegetation is relatively intact, weeds find it difficult to become established. Gradual and consistent removal of weeds, working from least degraded to most degraded, together with the re-establishment of local native (indigenous) plant species is important for weed management to be successful.

Blackberry and willows are common weeds along watercourses in the region, and are discussed in the following sub-sections. Being two of a number of declared plants under the South Australian *Natural Resources Management Act 2004*, land managers have a legal obligation to control them.

It can be easy to confuse some native plants with weeds, for example, Native Raspberry (*Rubus parvifolius*) resembles blackberry, and can often be found growing in similar locations. Therefore, expert advice about identification of weeds and native plants is strongly recommended prior to commencement of weed control.

It is recommended that a weed management plan be developed that incorporates identification of plant species, a rough sketch of the riparian zone showing the location of priority weeds, control options, and time frames and costs for weed control and follow-up. It is also important to measure the success of the plan and to revise aspects of it if appropriate. (See Section 6 for useful contacts).

Blackberry (*Rubus fruticosus*)

Blackberry is a highly invasive weed, and creates problems of access to land, fire risk from large amounts of dead material within thickets and a decrease in property value.

Slashing or use of a 'groomer' with a hydraulic arm (which can preserve native plants) can help open up dense stands for follow-up by other methods of control, such as herbicide application. It may be worth considering a staged removal of blackberry while replacing with native plants, as it can provide alternative habitat for wildlife in the meantime.

Willows (*Salix* spp.)

Willows are also a highly invasive weed. Being deciduous, they drop all their leaves in autumn. Aquatic ecosystems in Australia are adapted to the incorporation of leaf litter from native trees, such as eucalypts, consistently throughout the year, that has a relatively slow rate of decomposition. Willows, on the other hand, provide a flush of organic matter that decomposes rapidly, and inputs excessive amounts of nutrients into the stream. This reduces oxygen levels through heightened microbial activity, and threatens native aquatic plants and animals.

Willows also create heavy shade on the bank and produce mat-forming roots, both of which suppress the regeneration of indigenous understorey plants. In addition, willows do not develop hollows that provide habitat for terrestrial animals, or provide in-stream habitat from large woody debris. This important habitat is provided by the River Red Gums that willows replace.

Before removal of willows, it is important to plan for their replacement with native species, to avoid any erosion problems. Physical removal (hand-pulling) of seedlings is the simplest method of removal. Mature trees should be injected with herbicide—using this method, trees can be left in situ to gradually deteriorate. (It is important to remove any stray branches as they may sprout new growth.) If this method is not suitable, lopping and stump-painting can be carried out. All lopped material should be stacked above flood height and burned 12 months later.

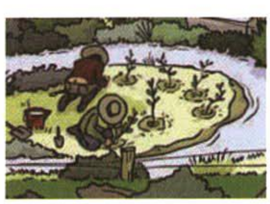
Herbicide use near waterways

If possible, weed control should be carried out using non-chemical techniques, such as slashing, mulching or hand-pulling. However, if using herbicide, it is important to choose one that is suitable for use near waterways. If spraying with herbicide, it is important to safeguard native plants from accidental eradication. Spray drift can be reduced by the use of a shroud fitted over the spray nozzle.

Another concern is possible harmful effects of herbicide on non-target organisms such as frogs, invertebrates and fish, where it has entered the stream from spray drift or surface water runoff. Some chemicals accumulate in organisms to harmful levels over the long term (bioaccumulation)—see Section 2.2, under Pesticides.

Note: It is important to seek advice from the South Australian Murray-Darling Basin Natural Resources Management Board before the commencement of weed removal or herbicide application, including any regulations that might apply to the use of herbicides in South Australia. Also, the Environment Protection Authority of South Australia can provide information about the disposal of unwanted concentrated pesticide. (See Section 6 for contact details).

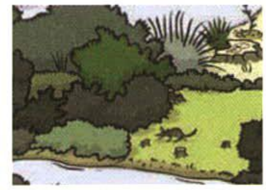
4.5. Revegetation



Having fenced off the riparian area, a choice of natural regeneration, direct seeding and/or planting of tubestock can be made, depending on site conditions.

For a riparian area to perform functions discussed in Section 2.2, a healthy structure, consisting of various species of native trees, shrubs and groundcover plants, should be maintained. For streams in the GWLAP region, a suitable width for the riparian zone is at least 15 m for each side of the waterway, unless impractical.

Seed fall and material in the soil seed bank can provide reproductive material for natural regeneration of riparian vegetation. The Bradley Method of natural regeneration, discussed in Joan Bradley's book: *Bringing back the bush*, involves the systematic removal of weeds to allow native (indigenous) plants to establish themselves. The three principles applied by this method are: (1) work from the least weed-infested areas to the most weed-infested, (2) cause minimal disturbance and (3) complete native plant regeneration in the best areas before progressing the weed removal program to adjacent areas.



If using direct seeding to re-establish native vegetation, weed removal needs to take place beforehand. Collection and use of local native seeds from the property or adjoining areas will provide a seed supply that is suitable to local habitat conditions. It may be necessary to gain permission to collect seed from private property, or acquire a permit for public reserves. (This can be verified with the local council.) Alternatively, a commercial seed supplier can be used, but it is important to ensure they supply records to show the seed was collected locally.

Planting out seedlings can be done as a revegetation strategy in its own right or in combination with the other strategies discussed above. Tubestock should be propagated from locally-collected seed or cutting-material—refer to the case study presented in Section 5 that discusses this approach to revegetation. Planting tubestock is often a more successful revegetation approach along watercourses than direct seeding. However, where possible, natural regeneration is the ideal revegetation strategy.

Native plants, for example, Common Reed (*Phragmites australis*)[1], do not become 'weedy' where a natural balance is reached between canopy and understorey native plant species.

For detailed information about revegetation techniques for the region, refer to the Goolwa to Wellington LAP Board's booklet entitled *Watercourse restoration guideline for the Goolwa-Wellington LAP Region*, prepared by Catherine Miles.

Riparian vegetation may provide harbour for feral animals, such as foxes and rabbits. Various methods of control can be used, including non-destructive ones such as fencing and planting unpalatable species alongside preferential ones. See Section 6 for useful contacts.

[1] *Phragmites australis* is actively growing (green) in summer and dormant (brown) in winter and, therefore, does not pose a fire risk.

5. Case study—Cherry Macklin's watercourse rehabilitation

Introduction

Cherry runs a farm in Ashbourne, where she breeds about 150 head of beef cattle and 30 sheep. Soil type on the property is loam river flats, sand over clay further back from the watercourse and loam over clay on the hills. Average annual rainfall for Ashbourne is around 600 mm.

Before Cherry took over her property, it was a mostly cleared landscape with a few scattered mature River Red Gums visually predominant. The Finniss River and Bull Creek (which is a tributary of the lower reaches of the Finniss River) run through this property. Willows, poplars and ashes were the dominant trees along the watercourses, and very little native vegetation was present. Stock had free access to the waterways and relied on them as their only source of drinking water. As a result, water quality was poor and the riparian areas were degraded.

Over the last six years, Cherry has been carrying out revegetation projects on her land, including the rehabilitation of her watercourses.

Stock management

Since taking over the property, Cherry has fenced off 7 km of riparian area along the watercourses to control livestock access, as well as using 1 km of fencing to protect a swamp. Stock are only allowed to use a watercourse as a crossing when being moved between paddocks, ideally where the river bed is rocky.

To water stock, a trough has been located in each of the 15 paddocks, and this was completed before fencing and rehabilitation of the watercourses began. The troughs are gravity fed from a header tank near the top of a hill, which fills from bore water.

When deciding upon the width of the riparian area to be fenced off, Cherry took factors such as including any remnant riparian native vegetation and fencing well-landward of any unstable sections into consideration. As a result, the width of the fenced-off riparian zone varies, depending on landform, vegetation and land use issues, but she has aimed for at least 15 m on each side of the waterway.

Cherry avoids overgrazing by using rotational grazing methods, which has maintained good groundcover on the property. This helps to retain the topsoil, and means that water running off the hills is clearer, thus preventing excessive sedimentation of the watercourses. Generally, stock are held in the larger paddocks for one week and smaller paddocks for 3–4 days, although spells between rotations are longer during the growing period (in spring) and shorter during dry periods.

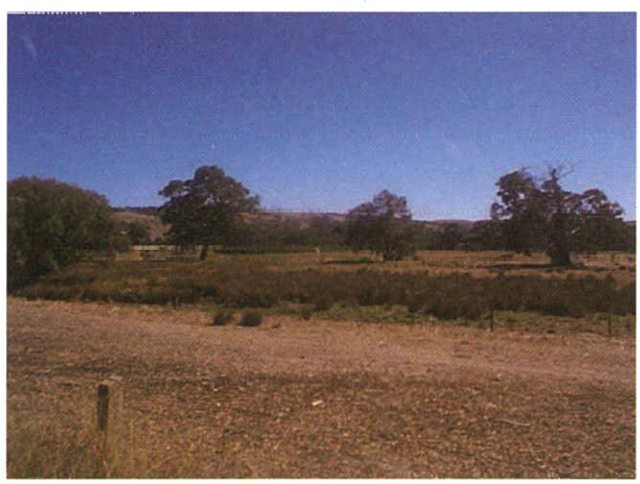
Cherry has incorporated other benefits into her rotational grazing program, which include moving stock into suitable microclimates: making use of north-facing paddocks in winter to provide stock with more warmth and locating stock in shadier paddocks in hot weather.

For fire control purposes, Cherry allows occasional time-managed grazing in the riparian area, where two cows graze for three months at a time. She sets up temporary fencing to prevent the cows accessing the revegetated areas, and doesn't allow them to drink from the watercourse, but brings in a 300-litre water trough that she can fill from a tank on the back of her utility or the carry-all of the tractor.

Revegetation

Since the riparian area has been fenced off, a significant amount of native vegetation has become established by itself, particularly in the river bed and along the edge of the watercourse, including reeds, sedges and wattles.

Permanent waterhole, showing natural regeneration along edge and in-stream, plantings further back and mature River Red Gums in background.



Swamp that was fenced off. It was not necessary to plant tubestock as revegetation is taking place entirely from natural regeneration.

As can be seen from the photograph of the swamp, natural regeneration has been occurring there since it was fenced off, and it was considered unnecessary to plant tubestock. Cherry allows time-managed grazing in the swamp once every few years to remove weeds, particularly Fog Grass (*Holcus lanatus*).

Cherry has planted over 4000 native plants in the riparian area during the last six years, to enhance the revegetation resulting from natural regeneration. The main species that have been planted are River Red Gum (*Eucalyptus camaldulensis*), Blackwood Wattle (*Acacia melanoxylon*), Swamp Wattle (*Acacia retinodes*) and bottlebrush species (genus: *Calistemon*).

To carry out revegetation, Cherry collected seed from her property, which was propagated through the Trees for Life (TFL) Tree Scheme. Also, TFL and the GWLAP Board collected seed from the local area for propagation. Of the tubestock she has planted, Cherry has had a good success rate, in terms of survival and growth, of about 80%. Watering was only necessary for the first year after planting!

Cherry has carried out extensive weed control in the riparian area as a gradual process. Also, being along the lower reaches of the Finniss River, her watercourses are subject to infestation by some weed species from upstream, which means that control of those weed species is still an ongoing task. However, she has noticed that as the native vegetation becomes established, the need for weed management is significantly decreased.

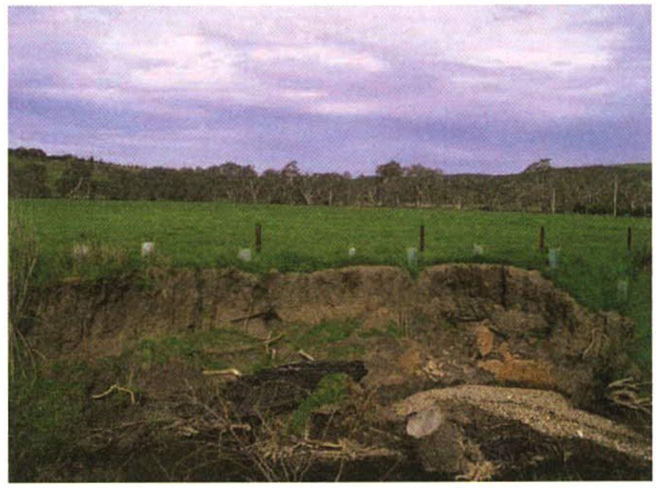
Cherry retains large logs that have fallen into the watercourse, as they provide habitat for fish and invertebrates. However, where they will interfere with flow, she moves them towards the edge, which also prevents erosion of the banks by ensuring that water is not forced to flow around the debris.

Shade for stock

Some of the eucalypts in the riparian area are around 200–300 years old, and their shade reaches well-beyond the riparian zone. This provides stock with protection in hot conditions. As Cherry's rehabilitation efforts bring about further establishment and growth of native vegetation, the amount of shade for stock provided by the riparian zone will increase.

Benefits of rehabilitation

The quality of water in Cherry's watercourses has improved from exclusion of stock, as has the condition of the riparian and aquatic habitats. Rehabilitation efforts of this kind can result in improvements to the health of livestock when they no longer drink water of poor quality that was caused by their unlimited access to a waterway.
For Cherry, this means increased survival of stock and, therefore, increased productivity.



Revegetation using tubestock in fenced-off riparian zone (take note of erosion)—September 2004.

Growth of tubestock and natural regeneration in same location as above—August 2008.

A number of native fish, turtles and swamp rats now inhabit the area. There has also been a significant increase in bird life, including kingfishers that have made a home of the watercourses. Due to the creation of suitable habitat, the riparian zone now serves as a corridor for the protected movement of wildlife to Bullock Hill Conservation Park.

Cherry is also working on a project to increase shade available to her stock on the remainder of the property, by fencing off selected sections of paddocks for 5–6 years to enable revegetation through natural regeneration and planting of native species, incorporating significant trees where possible.

Cherry's watercourse rehabilitation project has also increased the aesthetic and potential market value of her property. As the benefits of rehabilitation of the watercourses and provision of alternative watering points for stock continue to be realised, so the value of her farming property will continue to increase.

6. Useful contacts for assistance

Organisation	Assistance	Phone
Goolwa to Wellington Local Action Planning Board	Technical advice about native plant and weed species identification, fencing and revegetation. Financial assistance for approved priority projects and help with project implementation.	8536 4551
South Australian Murray-Darling Basin Natural Resources Management Board	Specialist advice on watercourse management, and pest plant and animal control.	8391 7501
Strathalbyn Natural Resources Centre	Practical advice and services in relation to seedlings and fencing, as well as potential financial assistance.	8536 3137
Trees for Life	Assistance with seed collection and propagation.	8406 0500
Environment Protection Authority SA	Information about disposal of unwanted concentrated pesticide.	8204 2004
Department of Water, Land and Biodiversity Conservation	Permit to construct a bore, and to build a crossing or erect fencing for limited stock access to a watercourse.	8463 6810
	Licence to extract bore water (MLR Program).	8339 9807
Rural Solutions SA	Advice on revegetation, weed and feral animal control, and integrating environmental management into the management of a rural property.	1300364322
Department of Primary Industries and Resources SA	Regulations about use of herbicides in South Australia.	8463 3000
Victorian Department of Primary Industries	Information about the Better Fertiliser Decisions Project.	136 186

7. Glossary of environmental terms

anastomosing Multi-branched stream system, forming a network.

anoxia When water is low in dissolved oxygen.

baseflow Portion of stream flow that comes from groundwater.

benthic Associated with the river bed (e.g. benthic invertebrates).

bioaccumulate Accumulation of a substance in the body of living organisms up the food chain, increasing in concentration with each level.

biofilm A thin layer of microscopic organisms on the surface of vegetation, soils and rocks that are kept constantly wet.

biota All living plants and animals of a region, for example, in a stream.

canopy Uppermost level of foliage formed by branches and leaves.

carbon Naturally abundant non-metallic element that occurs in many inorganic and in all organic compounds.

contiguous Abutting.

dissolved oxygen The oxygen found in microscopic bubbles of oxygen that occur between water molecules that is available to aquatic organisms.

ecosystem Interdependent biological system involving the interaction between living organisms and their immediate physical, chemical and biological environment.

environmental weed Any plant species that is not locally indigenous to the area in which it is located, and which adversely affects the regeneration of indigenous plants.

exotic Introduced/not native to Australia.

floodplain Land adjacent to streams that is occasionally inundated.

food chain Transfer of food energy from plants through herbivores to carnivores.

indigenous species Organism that is native to a given region or ecosystem.

interstices Very small spaces between grains in the substrate.

invertebrate Animal without a backbone.

macroinvertebrate Animal without a backbone that is typically of a size that is visible to the naked eye.

microclimate Local atmospheric zone where the climate differs from the surrounding area.

overstorey Uppermost, dominant vegetation layer (if a grassland, then the overstorey would be grasses).

periphyton Biota attached to submerged surfaces (i.e. algae, fungi, bacteria).

photosynthesis Synthesis of organic material by plants from sunlight, carbon dioxide and water, and the aid of a catalyst such as chlorophyll.

pugging Soil compaction caused by stock, from deep footprints.

respiration Metabolic processes within living cells, whereby organisms obtain energy from organic molecules.

significant trees Remnant indigenous trees that provide important habitat.

spp. Several species (plural).

sub-canopy Trees forming a vegetation layer below the canopy layer and above the shrub layer.

synergistic Where the combined effect is greater than the sum of individual effects.

understorey Vegetation layer below the canopy/predominant layer.

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Sources of photographs

Photograph: page 12 (September 2004) by Tony Randall (GWLAP Board).

Photographs: front cover and pages 7, 11, 12 and 17 by Sally Roberts.

Appendix Sample riparian health assessment

This assessment method is for single-channel ephemeral streams up to 25 m wide. For wider or anastomosing ephemeral streams, refer to Costelloe and Sheldon (2008).

Longitudinal continuity

Measure the length of the vegetated (native and introduced vegetation combined) and *not* vegetated riparian zone along the watercourse. Ideally, sites to be assessed should be at least 200 m long, with 500 m being the optimal length, if appropriate. Draw a simple line-map to show these measurements. Calculate the percentage (%) vegetated and score.

vegetated (V): woody vegetation greater than 2 m high, where the canopy cover of the dominant (tallest) vegetation occurs along the bank without a break of more than 50 m. For trees, 'vegetated' will also mean a canopy cover of at least 5 m wide.

***not* vegetated (NV)**: gap of more than 50 m in length of dominant canopy cover. (It is expected that most riparian zones for streams in the GWLAP region would have naturally had a dominant tree canopy layer, and some would have been dominated by tall shrubs. Therefore, a section with a dominant layer of less than 2 m is also considered to be a gap.)

discontinuity: each section that is '*not* vegetated'

<: less than; >: greater than

Line map (vegetated and *not* vegetated sections, in metres) ———— **vegetated** - - - - - - **not vegetated**		
250m	100m	150m

Calculations			
total vegetated (**V**) =		400	metres
total *not* vegetated (**NV**) =		100	metres
total of vegetated and *not* vegetated (**V + NV**) =		500	metres
% vegetated = **V / (V + NV)** = 400/500	x 100 =	80	%

Scoring		Score (a)
< 10%	0	4
10–25%	1	
25–50%	2	
50–75%	3	
> 75%	4	

Number of discontinuities (gaps >50 m)	Number of discontinuities /2 (b)
1	1/2

Result a – b	4 - 1/2 (LC)

Longitudinal continuity score (LC)	3.5 (A)

Proximity to the nearest patch of relatively intact native vegetation

Shortest distance from site being assessed to nearest patch of at least 10 ha of relatively intact native vegetation. (Nearest intact vegetation can be riparian.)

relatively intact vegetation: should have at least the expected dominant overstorey remaining. (Advice about this can be sought from the GWLAP Board: see Section 6 of the booklet for contact details.)

Criteria	Scoring	Score
>1 km (to nearest patch of at least 10 ha)	0	1 (B)
200 m to 1 km (to nearest patch of at least 10 ha)	1	
contiguous (with patch of at least 10 ha)	2	
contiguous (with patch >50 ha)	3	

Transect work

Each transect is set up in the riparian zone, perpendicular (i.e. at a 90° angle) to the direction of the stream bank, and is used to carry out measurements for vegetation width, cover and structural diversity; native vegetation regeneration; and other habitat diversity features.

Transect length is determined by channel width—40 m long for channels <10 m wide and four times the channel width for larger streams. However, if the riparian zone is clearly narrower than 40 m (i.e. relating to width perpendicular to direction of stream bank), then transect length can be adjusted accordingly. (If a narrow riparian zone is the result of degradation, this will be evident from the results of the overall assessment.) Suggested width of transects is 10 m.

Replication is necessary to make the assessment valid, and it is recommended that several, evenly spaced transects be used. For example, for a 200 m length of riparian zone, 50 m between transects would be considered an acceptable distance, and for a 500 m length: 125 m between.

Calculating average scores: add scores for each transect together and divide by the number of transects.

Width of canopy vegetation

width of canopy vegetation: distance perpendicular from stream bank to first gap of >10 m

Transect	Canopy width (m)	Score
1	15	3
2	12	3
3	23	4
4	9	2
	Average	3 **(C)**

Width	Scoring
<1 m	0
1–5 m	1
6–10 m	2
11–20 m	3
>20 m	4

Grazing impact

Transect	Score
1	1
2	1
3	2
4	0
Average	1 **(D)**

Assessment	Scoring
none	2
minor	1
extensive	0

Debris and hollow-bearing trees

fallen logs: >10 cm diameter

Transect	Leaf litter	Native leaf litter	Fallen logs	Hollow-bearing trees
1	2	2	1	1
2	2	2	1	1
3	2	2	2	1
4	1	1	1	0
Average	1.75 **(E)**	1.75 **(F)**	1.25 **(G)**	0.75 **(H)**

Assessment	Scoring
none	0
scattered	1
abundant	2

Vegetation cover

Cover (%)	Scoring
none	0
1–10	1
11–30	2
31–60	3
>60	4

Vegetation cover is estimated for the entire length and width of each transect.

Canopy cover—vegetation cover (including branches) of trees >5 m

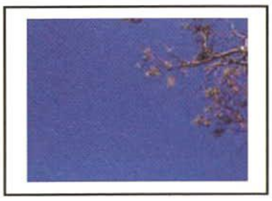
Understorey cover—foliage cover of shrubs (middle layer of vegetation)

Groundcover—includes lichens, mosses, grasses, herbs, reeds and sedges

Limitations of the vegetation cover health indicator

Healthy native vegetation communities have cover densities that vary according to the vegetation community type. Therefore, scoring used in the 'Vegetation cover' section of this rapid assessment method may underestimate the health of a 100% native vegetation layer that has a naturally- low-density cover. In such cases, the vegetation cover indictor of health will still be a valuable assessment of the ecological functions of the riparian vegetation, such as regulation of in-stream temperatures, habitat for wildlife and soil stability.

As a guide for estimating % cover, please refer to the following photographs.



≈ 10% cover

≈ 30% cover

≈ 50% cover

≈ 70% cover

≈ 90% cover

Transect	General (% cover)						Natives (% cover)					
	Canopy		Under-storey		Ground-cover		Canopy		Under-storey		Ground-cover	
	%	Score	%	Score	%	Score	%	Score	%	Score	%	Score
1	50	3	60	3	70	4	30	2	30	2	20	2
2	70	4	80	4	80	4	40	3	30	2	30	2
3	60	3	70	4	70	4	50	3	60	3	50	3
4	50	3	30	2	20	2	30	2	10	1	0	0
Average		3.25 (I)		3.25 (J)		3.5 (K)		2.5 (L)		2.0 (M)		1.75 (N)

An estimation of % cover of general vegetation along the transect is made, followed by an estimation of % cover for native vegetation. For example, if the % cover for general vegetation along a transect is estimated to be 50%, and native vegetation cover along that transect is estimated to be 30%, this would mean that introduced vegetation would make up 20% of the total cover.

Number of layers (of general vegetation)

Transect	Score
1	3
2	3
3	3
4	3
Average	3 (O)

Layers	Scoring
none	0
one layer	1
two layers	2
three layers (groundcover, understorey and canopy)	3

Regeneration of natives

For native shrubs and trees—assess regeneration, i.e. seedlings and saplings
For large native tussock grasses and reeds: assess their occurrence

Seedlings and saplings

Transect	Shrub seedlings	Saplings <1 m	Saplings 1–2 m	Saplings >2 m
1	1	2	1	2
2	1	1	1	1
3	2	2	2	1
4	0	0	0	1
Average	1 **(P)**	1.25 **(Q)**	1 **(R)**	1.25 **(S)**

Assessment	Scoring
none	0
scattered	1
abundant	2

Large native tussock grasses and reeds

Transect	Native tussock grasses	Reeds
1	1	1
2	1	2
3	2	2
4	0	1
Average	1 **(T)**	1.50 **(U)**

Assessment	Scoring
none	0
scattered	1
abundant	2

Working out the health indicator score

Assessment categories	Indices	Calculations
Habitat Continuity and Extent (longitudinal continuity, proximity and width)	**A + B + C**	7.5
Debris (leaf litter and fallen logs) **and Hollow-bearing Trees**	**E + F + G + H**	5.5
Vegetation Cover and Structural Complexity (percentage vegetation cover and number of layers)	**I + J + K + O**	13.0
Natives versus Exotic Plants (percentage cover)	**L + M + N**	6.25
Regeneration of Natives (seedlings, saplings, native tussock grasses and reeds, and grazing impact)	**D + P + Q + R + S + T + U**	8.0
	Total Score	40.25

Results (maximum possible score is **60**)

<30	30–36	37–42	43–48	>48
very poor	poor	average	good	excellent

Questionnaire

The following questionnaire is designed to gather responses from the reader to evaluate the ways in which they found this booklet useful. It also invites suggestions for any additional topics that would be helpful in gaining an understanding of the value of riparian areas to landholders and ecosystems.

Please tick the appropriate boxes.

My reason for reading this booklet stems from my interest as a:

hobby farmer			☐
large-scale farmer			☐
high-school student			☐
university student			☐
general environmentalist			☐
other	☐	(you may use the space on the right to provide more information)	

I found the following sections of the booklet useful (5 = strongly agree, 1 = strongly disagree)

Section name	5	4	3	2	1
Introduction					
Key illustration					
Benefits of riparian vegetation to the landholder					
Ecological value of riparian vegetation					
Rapid assessment of riparian health					
Protecting riparian zones					
Alternative livestock watering					
Benefits to landholders of excluding stock from waterways					
Weed management					
Revegetation					
Case study: Cherry Macklin's watercourse rehabilitation					
Useful contacts for assistance					

The space below is provided for explanation of the reasons for finding particular sections the most useful/interesting and other sections less useful/interesting.

I would have liked more information about the following topics

Thank you for your responses to this questionnaire. The results of this survey will be a valuable means of assessing the information needs of the target readership in relation to the management of riparian areas in the Goolwa to Wellington Local Action Planning region.

Rapid riparian health assessment—field work data sheets

This assessment method is for single-channel ephemeral streams up to 25 m wide. For wider or anastomosing ephemeral streams, refer to Costelloe and Sheldon (2008).

Longitudinal continuity

Measure the length of the vegetated (native and introduced vegetation combined) and *not* vegetated riparian zone along the watercourse. Ideally, sites to be assessed should be at least 200 m long, with 500 m being the optimal length, if appropriate. Draw a simple line-map to show these measurements. Calculate the percentage (%) vegetated and score.

vegetated (V): woody vegetation greater than 2 m high, where the canopy cover of the dominant (tallest) vegetation occurs along the bank without a break of more than 50 m. For trees, 'vegetated' will also mean a canopy cover of at least 5 m wide.

***not* vegetated (NV)**: gap of more than 50 m in length of dominant canopy cover. (It is expected that most riparian zones for streams in the GWLAP region would have naturally had a dominant tree canopy layer, and some would have been dominated by tall shrubs. Therefore, a section with a dominant layer of less than 2 m is also considered to be a gap.)

discontinuity: each section that is '*not* vegetated'

<: less than; >: greater than

Line map (vegetated and *not* vegetated sections, in metres) ———— **vegetated** - - - - - - **not vegetated**

Calculations		
total vegetated (V) =		metres
total *not* vegetated (NV) =		metres
total of vegetated and *not* vegetated (V + NV) =		metres
% vegetated = V / (V + NV) =	x 100 =	%

Scoring		Score (a)
< 10%	0	
10–25%	1	
25–50%	2	
50–75%	3	
> 75%	4	

Number of discontinuities (gaps >50 m)	Number of discontinuities /2 (b)

Result a – b	(LC)

Longitudinal continuity score (LC)	(A)

Proximity to the nearest patch of relatively intact native vegetation

Shortest distance from site being assessed to nearest patch of at least 10 ha of relatively intact native vegetation. (Nearest intact vegetation can be riparian.)

relatively intact vegetation: should have at least the expected dominant overstorey remaining. (Advice about this can be sought from the GWLAP Board: see Section 6 of the booklet for contact details.)

Criteria	Scoring	Score
>1 km (to nearest patch of at least 10 ha)	0	
200 m to 1 km (to nearest patch of at least 10 ha)	1	
contiguous (with patch of at least 10 ha)	2	(B)
contiguous (with patch >50 ha)	3	

Transect work

Each transect is set up in the riparian zone, perpendicular (i.e. at a 90° angle) to the direction of the stream bank, and is used to carry out measurements for vegetation width, cover and structural diversity; native vegetation regeneration; and other habitat diversity features.

Transect length is determined by channel width—40 m long for channels <10 m wide and four times the channel width for larger streams. However, if the riparian zone is clearly narrower than 40 m (i.e. relating to width perpendicular to direction of stream bank), then transect length can be adjusted accordingly. (If a narrow riparian zone is the result of degradation, this will be evident from the results of the overall assessment.) Suggested width of transects is 10 m.

Replication is necessary to make the assessment valid, and it is recommended that several, evenly spaced transects be used. For example, for a 200 m length of riparian zone, 50 m between transects would be considered an acceptable distance, and for a 500 m length: 125 m between.

Calculating average scores: add scores for each transect together and divide by the number of transects.

Width of canopy vegetation

width of canopy vegetation: distance perpendicular from stream bank to first gap of >10 m

Transect	Canopy width (m)	Score
1		
2		
3		
4		
	Average	**(C)**

Width	Scoring
<1 m	0
1–5 m	1
6–10 m	2
11–20 m	3
>20 m	4

Grazing impact

Transect	Score
1	
2	
3	
4	
Average	**(D)**

Assessment	Scoring
none	2
minor	1
extensive	0

Debris and hollow-bearing trees

fallen logs: >10 cm diameter

Transect	Leaf litter	Native leaf litter	Fallen logs	Hollow-bearing trees
1				
2				
3				
4				
Average	**(E)**	**(F)**	**(G)**	**(H)**

Assessment	Scoring
none	0
scattered	1
abundant	2

Vegetation cover

Vegetation cover is estimated for the entire length and width of each transect.

Canopy cover—vegetation cover (including branches) of trees >5 m

Understorey cover—foliage cover of shrubs (middle layer of vegetation)

Groundcover—includes lichens, mosses, grasses, herbs, reeds and sedges

Cover (%)	Scoring
none	0
1–10	1
11–30	2
31–60	3
>60	4

Limitations of the vegetation cover health indicator

Healthy native vegetation communities have cover densities that vary according to the vegetation community type. Therefore, scoring used in the 'Vegetation cover' section of this rapid assessment method may underestimate the health of a 100% native vegetation layer that has a naturally- low-density cover. In such cases, the vegetation cover indictor of health will still be a valuable assessment of the ecological functions of the riparian vegetation, such as regulation of in-stream temperatures, habitat for wildlife and soil stability.

As a guide for estimating % cover, please refer to the following photographs.

≈ 10% cover

≈ 30% cover

≈ 50% cover

≈ 70% cover

≈ 90% cover

Transect	**General** (% cover)						**Natives** (% cover)					
	Canopy		Under-storey		Ground-cover		Canopy		Under-storey		Ground-cover	
	%	Score	%	Score	%	Score	%	Score	%	Score	%	Score
1												
2												
3												
4												
Average		(I)		(J)		(K)		(L)		(M)		(N)

An estimation of % cover of general vegetation along the transect is made, followed by an estimation of % cover for native vegetation. For example, if the % cover for general vegetation along a transect is estimated to be 50%, and native vegetation cover along that transect is estimated to be 30%, this would mean that introduced vegetation would make up 20% of the total cover.

Number of layers (of general vegetation)

Transect	Score
1	
2	
3	
4	
Average	(O)

Layers	Scoring
none	0
one layer	1
two layers	2
three layers (groundcover, understorey and canopy)	3

Regeneration of natives

For native shrubs and trees—assess regeneration, i.e. seedlings and saplings
For large native tussock grasses and reeds: assess their occurrence

Seedlings and saplings

Transect	Shrub seedlings	Saplings <1 m	Saplings 1–2 m	Saplings >2 m
1				
2				
3				
4				
Average	(P)	(Q)	(R)	(S)

Assessment	Scoring
none	0
scattered	1
abundant	2

Large native tussock grasses and reeds

Transect	Native tussock grasses	Reeds
1		
2		
3		
4		
Average	(T)	(U)

Assessment	Scoring
none	0
scattered	1
abundant	2

Working out the health indicator score

Assessment categories	Indices	Calculations
Habitat Continuity and Extent (longitudinal continuity, proximity and width)	A + B + C	
Debris (leaf litter and fallen logs) **and Hollow-bearing Trees**	E + F + G + H	
Vegetation Cover and Structural Complexity (percentage vegetation cover and number of layers)	I + J + K + O	
Natives versus Exotic Plants (percentage cover)	L + M + N	
Regeneration of Natives (seedlings, saplings, native tussock grasses and reeds, and grazing impact)	D + P + Q + R + S + T + U	
	Total Score	

Results (maximum possible score is **60**)

<30	30–36	37–42	43–48	>48
very poor	poor	average	good	excellent