RIVERS OF CARBON

Rapid Appraisal of Riparian Condition for the southern tablelands of New South Wales

Summary

- Riparian habitats are where land and water ecosystems meet. They are vital sites in a catchment supporting high levels of biodiversity. This is true even for riparian areas adjacent to creeks and gullies that may flow with water only occasionally.
- Given the extensive degradation of riparian zones in Australia, there is a need for a rapid method of measuring riparian condition to underpin strategies for improved management.
- Riparian condition refers to the degree to which human-altered ecosystems diverge from local semi-natural ecosystems in their ability to support a community of organisms and perform ecological functions.
- The Rapid Appraisal of Riparian Condition (RARC) assesses the ecological condition of riparian habitats using indicators that reflect functional aspects of the physical, community and landscape features of the riparian zone. The index is made up of five sub-indices, each with a number of indicators: Habitat continuity and extent (HABITAT), Vegetation cover and structural complexity (COVER), Dominance of natives versus exotics (NATIVES), Standing dead trees, hollows, fallen logs and leaf litter (DEBRIS), and Indicative features (FEATURES).
- The RARC has been used in south-eastern Australia to examine the relationships between grazing intensity and riparian condition. Generally, poor riparian condition was associated with high levels of grazing intensity.
- Testing of the RARC index confirms that it is a good indicator of the biodiversity and functioning of riparian zones.
- The RARC has been trialled on ephemeral and permanent creek systems around Bookham and Yass on the southern tablelands of New South Wales.

This document has been modified from the original RARC written by Amy Jansen, Alistar Robertson, Leigh Thompson, Andrea Wilson and Fleur Flanery.

Throughout this Guideline, riparian condition refers to the degree to which human-altered ecosystems diverge from local semi-natural ecosystems in their ability to support a community of organisms and perform ecological functions (c.f. Karr, 1999).

Background

Riparian habitats are where land and water ecosystems meet. They are vital places in a farm and in a catchment, supporting high levels of biodiversity and being critical in controlling flows of energy and nutrients between the land and the water (creeks and rivers) (Naiman & Decamps, 1997). This is true even on creeks and gullies that only occasionally carry flowing water. Riparian areas are powerful indicators of catchment quality (e.g. Rapport et al., 1998).

Human settlement has always been focused on rivers and is often a major determinant of riparian structure and function (e.g. Dynesius & Nilsson, 1994). One of the biggest impacts on riparian areas has been the introduction of domestic stock, with grazing being the major land use over 60 per cent of Australia's land surface (Wilson, 1990). Stock concentrate around water sources, which means riparian and wetland habitats, as well as those around artificial watering points in pastoral regions, suffer greater impacts from domestic and feral grazing herds than dryland areas (Robertson, 1997; James et al., 1999). These impacts have led to extensive loss of ecological condition in riparian areas in Australia.

To improve the management of riparian areas and help land managers decide on the priorities for management of their streams or creeks, baseline assessments of the riparian condition and the factors that have contributed to it should be undertaken. An effective and simple method for doing this has been developed based on rapid appraisal techniques to measure ecosystem condition or integrity (Fairweather, 1999; Boulton, 1999).

The Rapid Appraisal of Riparian Condition index can provide a comparison of areas on-farm and with local areas considered to be in natural condition; it helps to pinpoint problems where management intervention is required. This method is suitable for periodic repeat assessments in the same area so that changes can be tracked over time and management adjusted if necessary (an adaptive management approach). This Guideline describes the Rapid Appraisal of Riparian Condition tailored for the southern tablelands region of New South Wales.

Cover photo Lori Gould. This page and back cover G. Allen

Rapid Appraisal of Riparian Condition (RARC)

Assessment methods incorporating indicators of geophysical and biological properties and processes are likely to provide reliable estimates of ecological condition in riverine ecosystems (Fairweather, 1999; Boulton, 1999). Ladson et al. (1999) described an index of stream condition based on 18 indicators that measure alterations to the hydrology, physical form, streamside vegetation, water quality and biota of streams. This project used a similar approach, and chose indicators to reflect functional aspects of the physical, community and landscape features of the riparian zone, as defined by Naiman and Decamps (1997) (see Table 1). Some of the indicators chosen reflect the variety of functions, e.g. different aspects of vegetation cover play a role in reducing bank erosion, providing organic matter and habitat for fauna, and providing connections in the landscape. The RARC index is made up of five sub-indices, each with a number of indicator variables (see Table 2, overleaf).
The indices cover:

1. Habitat continuity and extent (HABITAT).
2. Vegetation cover and structural complexity (COVER).
3. Dominance of native versus exotic plants (NATIVES).
4. Standing dead trees, fallen logs and leaf litter (DEBRIS).
5. Indicative features (FEATURES).

Table 1. Summary of functions, components and indicators assessed in the RARC index.

Functions of the riparian zone at different levels of organisation	Components of the riparian ecosystem that perform those functions	Indicators of the functions used in the RARC
Physical		
Reduction of erosion of banks	Roots, ground cover	Vegetation cover*
Sediment trapping	Roots, fallen logs, ground cover	Canopy cover, fallen logs, ground cover vegetation, leaf litter** cover
Controlling stream microclimate/ discharge/water temperatures	Riparian forest	Canopy cover
Filtering of nutrients from upslope	Vegetation, leaf litter	Ground cover vegetation, leaf litter cover
Community		
Provision of organic matter to aquatic food chains	Vegetation	Vegetation cover, leaf litter cover
Retention of seeds, bulbs, stems and other sources of natural plant regeneration	Fallen logs, leaf litter	Fallen logs, leaf litter cover
Maintenance of plant diversity	Regeneration of dominant species, presence of important species, dominance of natives versus exotics	Native canopy and shrub regeneration, grazing damage to regeneration, reeds, native vegetation cover
Provision of habitat for aquatic and terrestrial fauna	Fallen logs, leaf litter, standing dead trees/hollows, riparian forest, habitat complexity	Fallen logs, leaf litter cover, standing dead trees, vegetation cover, number of vegetation layers
Landscape		
Provision of biological connections in the landscape	Riparian forest (cover, width, connectedness)	Vegetation cover, width of riparian vegetation, longitudinal continuity of riparian vegetation
Provision of refuge in droughts	Riparian forest	Vegetation cover

* Vegetation cover = canopy, understorey and ground cover.
** Leaf litter includes any dead plant material such as leaves, grasses, twigs and bark.

Table 2. Sub-indices and indicators of the RARC, the range within which each is scored, the method of scoring for each indicator, and the maximum possible total for each sub-index.

Sub-index	Indicator	Range	Method of scoring	Total
HABITAT				11
	Longitudinal continuity of riparian vegetation (≥ 5 m wide)	0–4	0 = < 50%, 1 = 50–64%, 2 = 65–79%, 3 = 80–94%, 4 = ≥ 95% vegetated bank; with 1/2 point subtracted for each significant discontinuity (≥ 50 m long)	
	Width of riparian vegetation (scored differently for channels < or ≥ 10 m wide)	0–4	*Channel ≤ 10 m wide:* 0 = VW < 5 m, 1 = VW 5–9 m, 2 = VW 10–29 m, 3 = VW 30–39 m, 4 = VW ≥ 40 m *Channel > 10 m wide:* 0 = VW/CW < 0.5, 1 = VW/CW 0.5–0.9, 2 = VW/CW 1–1.9, 3 = VW/CW 2–3.9, 4 = VW/CW ≥ 4, where CW = channel width and VW = vegetation width	
	Proximity to nearest patch of intact native vegetation > 10 ha	0–3	0 = > 1 km, 1 = 200 m–1 km, 2 = contiguous, 3 = contiguous with patch > 50 ha	
COVER				12
	Canopy (> 5 m tall)	0–3	0 = absent, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover	
	Understorey (1–5 m tall)	0–3	0 = absent, 1 = 1–5%, 2 = 6–30%, 3 = > 30% cover	
	Ground (< 1 m tall)	0–3	0 = absent, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover	
	Number of layers	0–3	0 = no vegetation layers to 3 = ground cover, understorey and canopy layers	
NATIVES				9
	Canopy (> 5 m tall)	0–3	0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover of native plants	
	Understorey (1–5 m tall)	0–3	0 = absent, 1 = 1–5%, 2 = 6–30%, 3 = > 30% cover of native plants	
	Ground (< 1 m tall)	0–3	0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover of native plants	
DEBRIS				10
	Leaf litter	0–3	0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% ground cover	
	Native leaf litter	0–3	0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% ground cover	
	Standing dead trees (> 20 cm dbh)	0–1	0 = absent, 1 = present	
	Hollow-bearing trees	0–1	0 = absent, 1 = present	
	Fallen logs (> 10 cm diameter)	0–2	0 = none, 1 = small quantities, 2 = abundant	
FEATURES				8
	Native canopy species regeneration (< 1 m tall)	0–2	0 = none, 1 = scattered, 2 = abundant; with 1/2 point subtracted for grazing damage	
	Native understorey regeneration	0–2	0 = none, 1 = scattered, 2 = abundant; with 1/2 point subtracted for grazing damage	
	Large native tussock grasses	0–2	0 = none, 1 = scattered, 2 = abundant	
	Reeds	0–2	0 = none, 1 = scattered, 2 = abundant	

dbh = diameter at breast height, < less than, ≤ less than or equal to, > greater than, ≥ greater than or equal to.

Photo 1. A site in excellent condition on the Upper Murrumbidgee River (RARC score = 46; this site includes continuous vegetation along the riparian zone, standing dead trees and fallen logs, native shrub understorey and regeneration of canopy trees).

Photo 2. A site in very poor condition on the Murrumbidgee River from Tamar's Bridge (RARC score = 12; note limited native overstorey, lack of understorey and no native regeneration). Both photos Greening Australia.

Photos 1 and 2 show contrasting sites in excellent and very poor condition. Scoring for these sites is below.

Example of scoring indicators for the sites shown in Photos 1 and 2 (see Table 2 for indicators and details)						
Sub-index	Excellent condition site (Photo 1)			Sub-index	Very poor condition site (Photo 2)	
Habitat	4 + 4 + 3 =	11		Habitat	0 + 0 + 0 =	0
Cover	3 + 3 + 3 + 3 =	12		Cover	1 + 0 + 3 + 2 =	6
Natives	3 + 3 + 3 =	9		Natives	1 + 0 + 1 =	2
Debris	3 + 3 + 1 + 0 + 1 =	8		Debris	1 + 1 + 1 + 0 + 0 =	3
Features	2 + 1 + 2 + 1 =	6		Features	1 + 0 + 0 + 0 =	1
TOTAL		46		TOTAL		12

Applying the RARC: Steps in assessing riparian condition

The RARC index can be used for a variety of applications. Examples include determining relationships between riparian condition and management practices, or surveying overall condition within a catchment to determine priorities for future rehabilitation works in the catchment. Whatever the application, care should be taken to clearly define the question to be answered, determine the sampling design and select sites appropriately to answer the question. This may require help from a consultant with experience in experimental design and data analysis. In general, sampling of sites should be random*, rather than only sampling sites which are easily accessible by road.

A single observer should conduct all assessments, and they should have some training beforehand**, to ensure consistency of data collection. The observer will need to have some experience in discriminating native and exotic plant species, and may benefit from previous experience in habitat surveys.

**For a small fee the RARC offers training to groups of five or more people, go to www.riversofcarbon.org.au for more information.

All sites should be surveyed at a similar time of year. Use a separate scoring sheet for each site. Allow 20–60 minutes per site, depending on size and accessibility.

*If you are interested in surveying overall catchment condition, choose sites randomly by laying a grid over a map of the catchment, locate and number all squares which contain a riparian zone, then put these numbers into a hat and pull out as many sites as you wish to sample.

Right: The Clamorous Reed Warbler. These birds live in riparian areas and their presence may be used as an indicator of riparian health. Photo Julian Robinson.

1 DETERMINE SITE SIZE

Site size must be determined according to the size of the management unit of interest. For example, studies have examined impacts of grazing management on riparian condition, so management units have been individual paddocks. On the Murrumbidgee River, where paddocks are relatively large, a 1 kilometre length of the riparian zone was defined as a 'site'.

Ideally, sites should be at least 200 metres long, with 500 metres being the preferred length where practicable. On larger rivers, only one side of the river is surveyed, while at smaller sites where it is practicable to do so, both sides may be surveyed (provided they are subject to the same management regime).

Two sections of the Yass River approximately 2 kilometres apart. Riparian areas can change dramatically depending on their management. To get an accurate assessment of the general condition of the riparian zone along a river, several RARC assessments should be conducted at randomly selected sites. Both sites have uncontrolled stock access and cleared vegetation, with the top photo showing a 'moderate' condition site and the lower photo a site in 'poor' condition. The RARC assessment can assist landholders work out which management strategies can be used in these situations to improve riparian and in-stream health. Photos Greening Australia.

The transects at each site should ideally traverse the width of the riparian zone. However, this is not always easy to determine in the field. To simplify this, we use a transect length determined by the width of the river channel—40 metres long for channels < 10 metres wide, and four times the channel width for larger rivers. A minimum width of 40 metres should be assessed, unless there is a very clear distinction between riparian and non-riparian areas. Where the riparian zone is clearly narrower than 40 metres or four times the channel width (for example, in a gorge), the transect length should be adjusted accordingly. Where the riparian zone is much wider than this (for example, on a lowland floodplain river), four times the channel width should be adequate to represent the riparian zone. Figure 1 illustrates a hypothetical river with the layout of the survey area and the transects indicated.

2 SCORE INDICATORS

A sample scoring sheet can be found on page 10. The complete scoring system is summarised in Table 2. Longitudinal continuity and proximity are given single values for the whole site. All other indicators are scored along four transects (10 metres wide; perpendicular to the direction of river flow) evenly spaced along the bank.

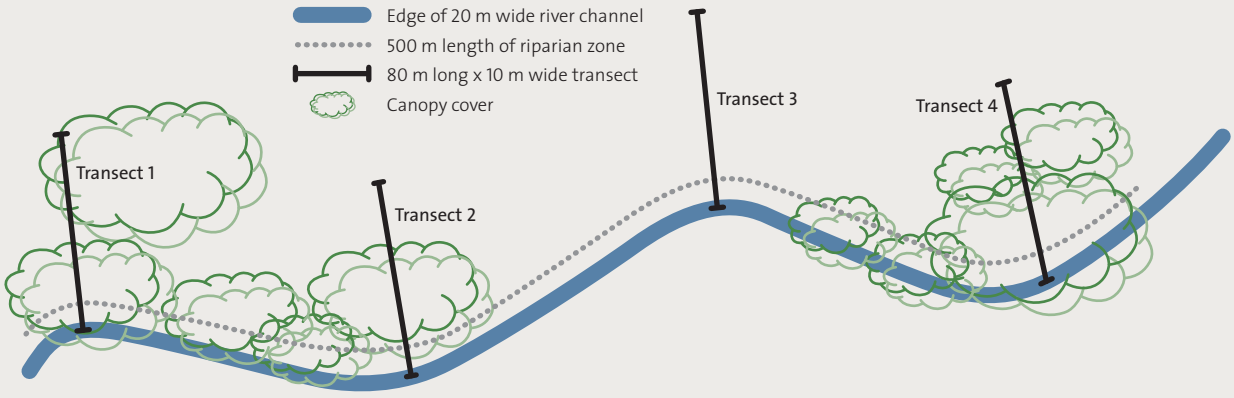
HABITAT

Longitudinal continuity of riparian canopy vegetation: At each site, canopy vegetation along the bank is mapped to show the length and number of any discontinuities (gaps of more than 50 metres) in canopy cover (the bank is considered to be vegetated if the canopy vegetation is at least 5 metres wide). Longitudinal continuity is then scored as follows:

0 = < 50%, 1 = 50–64%, 2 = 65–79%, 3 = 80–94%, 4 = ≥ 95% vegetated bank; with 1/2 point subtracted for each significant discontinuity (> 50 m long)

Proximity: An assessment is made of the shortest distance to the nearest patch of at least 10 hectares of relatively intact native vegetation (with an extra point if the area being assessed is within a patch of at least 50 hectares of relatively intact native vegetation). This can be assessed on-site or later using aerial photographs. Proximity is then scored as follows:

0 = > 1 km, 1 = 200 m–1 km, 2 = contiguous, 3 = contiguous with patch > 50 ha



Calculation of condition scores for this hypothetical riparian sample site

Longitudinal continuity of riparian canopy vegetation (> 5 m wide)

Map			Score
200 m vegetated	150 m bare	150 m vegetated	1.5 (70% vegetated with one discontinuity)

Width of riparian canopy vegetation

Transect	Channel Width (CW)	Vegetation Width (VW)	Score
1	20	> 80	4
2	20	60	3
3	20	0	0
4	20	70	3

Vegetation cover

Transect	Canopy
1	3
2	2
3	0
4	3

Figure 1. Hypothetical river with length and transects marked. The scoring for the indicators in this diagram is shown.

A patch of relatively intact native vegetation should have at least the dominant overstorey vegetation remaining. This may not be trees, if the area is a natural grassland or shrubland. For example, for a channel 12 metres wide and a vegetation width of 30 metres, VW/CW = 2.5, giving a score of 3.

Width of riparian vegetation: The channel width is defined by the area within the banks that is normally lacking any terrestrial or bankside vegetation. The width of the riparian canopy vegetation is the distance from the bank to the first gap of > 50 metres in the canopy vegetation. Channel width (CW) and width of the riparian vegetation (VW) are estimated to the nearest 5 metres in the field. For channels less than 10 metres wide, the vegetation width is converted directly to a score, while for channels more than 10 metres wide, the vegetation width is divided by the channel width to obtain the score as follows:

Channel ≤ 10 m wide: 0 = VW < 5 m, 1 = VW 5–9 m, 2 = VW 10–19 m, 3 = VW 20–39 m, 4 = VW ≥ 40 m

Channel > 10 m wide: 0 = VW/CW < 0.5, 1 = VW/CW 0.5–0.9, 2 = VW/CW 1–1.9, 3 = VW/CW 2–3.9, 4 = VW/CW ≥ 4

COVER (see photo 3 overleaf)

Vegetation cover within each layer is scored as follows:

Ground cover (lichens, mosses, grasses, herbs, reeds and sedges to 1 m tall): 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%

Understorey cover (herbs, reeds, shrubs and saplings 1–5 m tall): 0 = none, 1 = 1–5%, 2 = 6–30%, 3 = > 30%
(Note that understorey cover is scored on a different scale to the others, since it is normally less dense.)

Canopy cover (trees > 5 m tall): 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%

The number of layers of vegetation is scored as follows:

0 = no vegetation layers to 3 = ground cover, understorey and canopy layers

Photo 3. Canopy cover increasing from 1 to 3 (left to right). Photos Amy Jansen.

Tussocky perennial (long-lived) grasses tend to be native species while annual (short-lived) grasses tend to be exotic species (with a few obvious exceptions such as *Phalaris* which is a perennial exotic species).

Photo 4. Exotic annual ground cover (left) versus native perennial tussock ground cover (right). Photos Amy Jansen.

Photo 5. Leaf litter cover increasing from 1 to 3 (left to right). Photos Amy Jansen.

NATIVES (see photo 4 above)
Native vegetation cover within each layer is scored as for cover, but excluding the contribution of exotic species (to estimate cover of native species, imagine removing all exotic species and re-estimating vegetation cover with only the native species):

Ground cover (lichens, mosses, grasses, herbs, reeds and sedges to 1 m tall): 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%

Understorey cover (herbs, reeds, shrubs and saplings 1–5 m tall): 0 = none, 1 = 1–5%, 2 = 6–30%, 3 = > 30%

Canopy cover (trees > 5 m tall): 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%

DEBRIS (see photo 5 above)
Cover of leaf litter on the ground, and cover of native leaf litter are scored as follows:

0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60% cover

Standing dead trees > 20 cm diameter at breast height, and hollow-bearing trees (look for dead branches and broken-off branch stubs in large trees which may have developed hollows) are scored as follows:

0 = absent, 1 = present

Fallen logs (> 10 cm diameter) are scored as follows:

0 = none, 1 = small quantities, 2 = abundant (where small quantities = one or two logs, and abundant = three or more logs)

Photo 6. *Poa labilliardieri*, an example of a large native tussock grass found in riparian zones. Photo Amy Jansen.

FEATURES

The abundance of native canopy species regeneration (< 1 metre tall) and native understorey regeneration are scored as follows:

0 = none, 1 = scattered, and 2 = abundant, with 1/2 point subtracted for grazing damage (where scattered = one or two seedlings, and abundant = three or more seedlings; grazing damage is evidence that any of the seedlings have been browsed by grazing animals such as domestic livestock or kangaroos)

The abundances of large native tussock grasses (species such as *Poa labilliardieri*) and reeds (species such as *Phragmites*, *Typha* (Cumbungi) and *Carex* which are normally only found on riverbanks or in swampy areas) are scored as follows:

0 = none, 1 = scattered, and 2 = abundant (where scattered = one or two plants, and abundant = three or more plants)

3 ANALYSE DATA

The indicators are averaged across transects, then summed into sub-indices. The final index score is then the sum of the sub-indices, with a possible maximum of 50 indicating best condition. To examine the results, it is helpful to categorise the index scores, e.g. less than 25 very poor, 25–30 poor, 30–35 average, 35–40 good and more than 40 excellent. It is also helpful to examine sub-index scores, and to determine which sub-indices contribute most to the final condition score. This can be done by regression of sub-index scores on the total index score.

4 BENCHMARKING

The scoring system given here has been developed for a generalised riparian area in south-eastern Australia, and may need to be adjusted for particular situations. Ideally, a number of relatively pristine sites in the region should be surveyed to provide a benchmark for the scoring system. The scores for each indicator can then be checked to ensure that all indicators are present, and that the maximum score can be achieved for each indicator. For example, in wet forests with a dense canopy, there may be no large tussock grasses but ferns could be used as an indicator instead. Also, ground cover may never reach > 60 per cent due to shading, so this indicator may need to be adjusted accordingly (for example, the scores given for different levels of ground cover could be rescaled similarly to those given for understorey cover). Benchmarking against relatively pristine sites is not always possible in highly modified catchments. In these situations, we can only make a 'best guess', based on local knowledge and historical information, about the appropriate scoring for each indicator in these catchments.

5 LIMITATIONS OF THE RARC

While the RARC outlined in this booklet has been tested in a number of catchments and situations, it has some limitations:

- The RARC that is presented in this publication has been designed and tested on creeks and rivers in south-eastern Australia that are naturally dominated by trees, with at least 60 per cent canopy cover. Three modified versions of the RARC have been developed to suit particular regions. The version for tropical savannas is called the Tropical Rapid Assessment of Riparian Condition (TRARC). The mid north of South Australia has a RARC that has been developed for riparian areas that don't have overhead trees and people in the Tasmanian midlands can refer to a RARC that accounts for particular vegetation types found along their riparian zones.
- The RARC is intended as an indicator of current condition. This means that for restored areas, it will not indicate the potential for recovery of ecosystem function.

Rapid Appraisal of Riparian Condition

Site: _____ Site number: _____ GPS start: _____

Date: _____ Observer: _____ GPS end: _____

Longitudinal continuity of riparian canopy vegetation (> 5 m wide)

Map	Score

0 = < 50%, 1 = 50–64%, 2 = 65–79%, 3 = 80–94%, 4 = > 95% vegetated bank; with 1/2 point subtracted for each significant discontinuity (> 50 m long)

Width of riparian canopy vegetation

Transect	Channel Width (CW)	Vegetation Width (VW)	Score
1			
2			
3			
4			
Average			

Proximity

Score

Nearest patch of native vegetation > 10 ha: 0 = > 1 km, 1 = 200 m–1 km, 2 = contiguous, 3 = contiguous with patch > 50 ha

Channel < 10 m wide: 0 = VW < 5 m, 1 = VW 5–9 m, 2 = VW 10–19 m, 3 = VW 20–39 m, 4 = VW > 40 m vegetated.
Channel > 10 m wide: 0 = VW/CW < 0.5, 1 = VW/CW 0.5–0.9, 2 = VW/CW 1–1.9, 3 = VW/CW 2–3.9, 4 = VW/CW > 4

Vegetation cover: Canopy > 5 m, Understorey 1–5 m, Ground cover < 1 m

Transect	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	Number of layers
1							
2							
3							
4							
Average							

Canopy and ground cover: 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%. **Understorey cover**: 0 = none, 1 = 1–5%, 2 = 6–30%, 3 = > 30%

Debris

Transect	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
1					
2					
3					
4					
Average					

Leaf litter and native leaf litter cover: 0 = none, 1 = 1–30%, 2 = 31–60%, 3 = > 60%. **Standing dead trees** (> 20 cm dbh) and hollow-bearing trees: 0 = absent, 1 = present. **Fallen logs** (> 10 cm diameter): 0 = none, 1 = small quantities, 2 = abundant

Features

Transect	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
1				
2				
3				
4				
Average				

Regeneration < 1 m tall: 0 = none, 1 = scattered, and 2 = abundant, with 1/2 point subtracted for grazing damage
Reeds and large tussock grasses: 0 = none, 1 = scattered, and 2 = abundant

Calculation of scores

Site number: _____

Longitudinal continuity of riparian canopy vegetation

Score	A

Width of riparian canopy vegetation

Score	B

Proximity

Score	C

Vegetation cover

	Canopy	Native canopy	Understorey	Native understorey	Ground cover	Native ground cover	Number of layers
Average	D	H	E	I	F	J	G

Debris

	Leaf litter	Native leaf litter	Standing dead trees	Hollow-bearing trees	Fallen logs
Average	K	L	M	N	O

Features

	Native canopy species regeneration	Native understorey regeneration	Large native tussock grasses	Reeds
Average	P	Q	R	S

Totals

Site number	Habitat	Cover	Natives	Debris	Features	Total
(out of)	11	12	9	10	8	50
	A+B+C	D+E+F+G	H+I+J	K+L+M+N+O	P+Q+R+S	

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Further information

The Rivers of Carbon project, as well as other organisations in your local region, can provide incentives to landholders for looking after their waterways. The best place to start is to contact Haydn Burgess (Yass, Boorowa, Goulburn District) or Antia Brademann (Murrumbidgee), our on-ground project managers, to see if your project might be one that Rivers of Carbon can assist with. If not, Haydn or Antia can put you in touch with another organisation who might be able to help.

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You can find out more about the Rivers of Carbon project by signing up for our free monthly newsletter **www.arrc.com.au/news** or by visiting our website **www.riversofcarbon.org.au**. There are lots of free fact sheets, case studies and guidelines on the Australian River Restoration Centre website **www.arrc.com.au** that cover different waterway management topics you might be interested in. We also offer RARC training to groups of five or more people.

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Yass Area Network Landcare Groups Working Together

Photo (Eucalyptus pods) Prazeres. Design Angel Ink.