rivers and water quality

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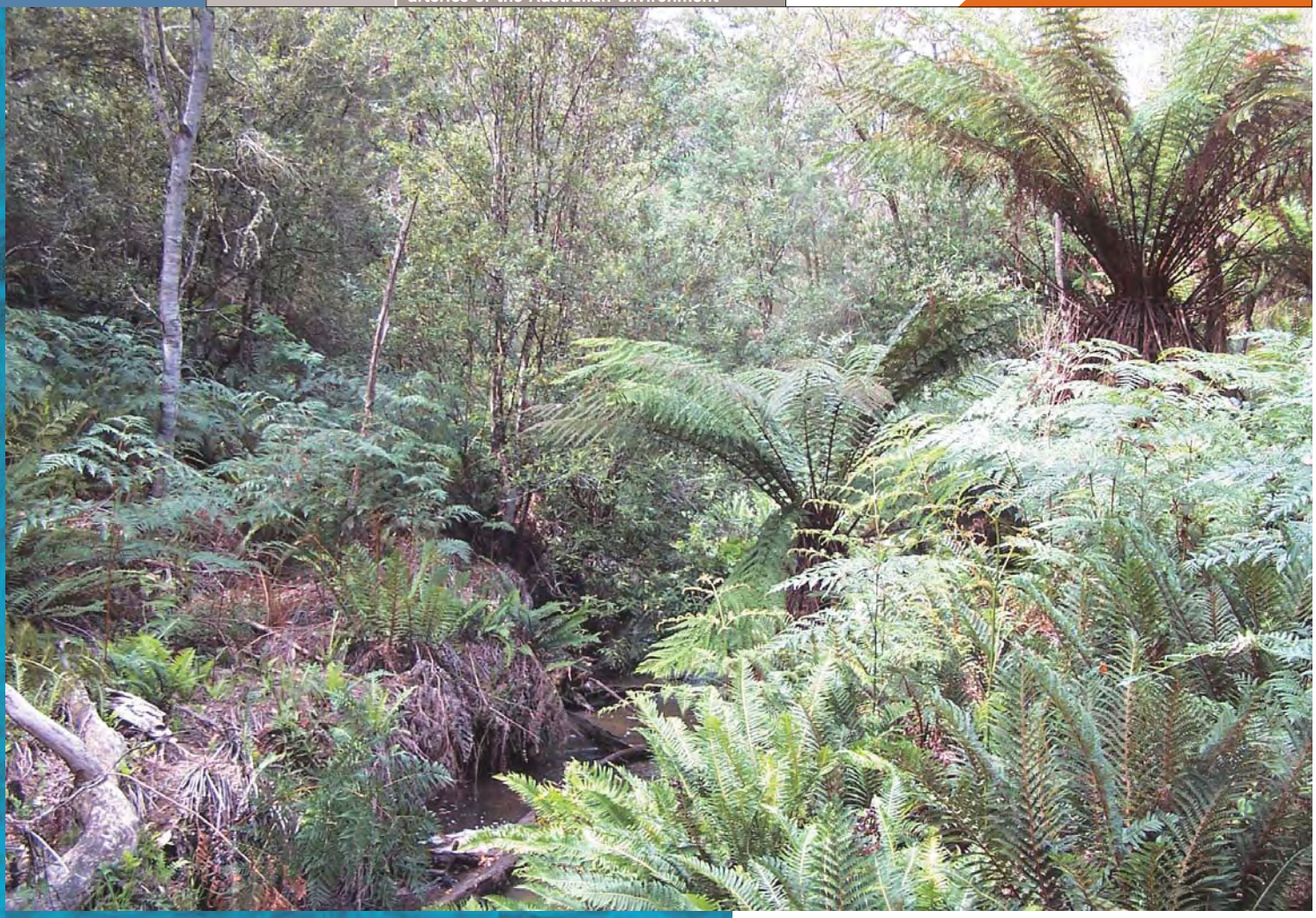

Managing rivers and streams in Tasmania: A woolgrowers guide

Tasmania

rivers and
water quality

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Rae Young, Amy Jansen, Siwan Lovett, Phil Price and Jo Dean were responsible for delivering different aspects of the project in Tasmania and in compiling this Guide for woolgrowers. Portions of the text in the Proof section are based on unpublished work by Sharon Cunial (DPIW).

Special thanks to Rae Young (nee Glazik) who worked on this project for three years before succumbing to the lure of wool growing and marrying Lindsay Young.

Michael Askey-Doran
and Biz Nicolson

Photo Laura Eves.

Introduction

by Biz Nicolson and Siwan Lovett

Australian Wool Innovation and Land & Water Australia have developed a unique sub-program combining the skills of researchers and the knowledge of woolgrowers to develop ways to measure and remind us that every stream is special, distinctive and worth appreciating. This sub-program is called Land, Water & Wool – Rivers & Water Quality.

Whilst the focus of projects of this kind is generally on practical outcomes such as the kilometres of fencing completed, amount of trees planted or the success of revegetation treatments, the people working on the Land, Water & Wool program believe that the real success of any natural resource project is when the mind or hearts of the farmers involved have been changed, and they have a long-term commitment to their project outcomes.

A key element of this program is the recognition that landowners have a rich knowledge of their landscape and that it expresses itself as a "knowing" which has more to do with sight, sound, touch and feeling of the place. The "knowing" and the science are talking about the same issues; but separated by a different language — a bridge we need to cross together.

Through the Land, Water & Wool – Rivers & Water Quality sub-program, scientists and woolgrowers have worked together to look at ways rivers and riparian areas can be managed within the farming system to meet a range of different objectives. What became clear during this work was that river and riparian areas are far more than a source of drinking water for stock, and that woolgrowers have many reasons for wanting to care for these parts of the farm.

In recognition of this, the Five Ps of People, Place, Profit, Proof, and Promise were used to highlight the many different ways rivers and riparian areas are thought about, valued and managed by woolgrowers. The Five Ps are:

- **People** — investing in people and communities is important so that their experience is recognised and valued, and people can share ideas, stories and knowledge.
- **Place** — we need to appreciate that the land where experimental or demonstration sites are located is also someone's farm and home and therefore special to them and to their identity. These 'places' are also important because they have environmental and social values for the wider community.
- **Profit** — the outcomes from the research into river and riparian management needs to consider economic implications of management decisions as well as the environmental implications. Landowners have a greater capacity to implement change if it contributes to the overall profitability of the farm business. Profit is also used to express the environmental and social gains that can be made from improving river and riparian management.
- **Proof** — excellent science is needed with credible researchers investigating how river and riparian areas will respond to different management approaches. Woolgrowers need good science to have confidence to act.
- **Promise** — a promise to give something back to wool growing communities we work with so that they can benefit from the research and implement the recommended management approaches that are developed.

Andrew Cameron, Marathon. Photo Laura Eves.

This Guide summarises the work of the Rivers & Water Quality sub-program in Tasmania and is divided into sections based on the Five Ps.

The first of these is 'People', and Jo Dean introduces the work she has done in compiling a number of stories from woolgrowers around Tasmania. The woolgrowers in these stories reflect the very essence of their social and biophysical landscape with lightness and honesty, reminding us that wool growing is not just a business, it's also an emotional connection with the landscape. The full collection of stories entitled 'Reflections of Tasmanian woolgrowers', is on the CD-ROM in the sleeve at the back of this publication.

In section two, Cynthia Dunbabin, a woolgrower from the Tasman Peninsula and Ross, writes about the importance of 'sense of Place', and reminds us that it is fundamental to a person's identity and, as such, must be respected and cared for when working together to 'improve' river management on farms.

Sections three and four focus on the practical realities of managing rivers and waterways within the context of a commercial wool growing farm. We look at the 'Profit' that can be gained, in so many ways, from managing rivers to achieve multiple objectives. The section on 'Proof' explains how river systems work and provides a range of recommended management practices to get the most out of the waterways on your farm. These two sections have been prepared by Amy Jansen and Michael Askey-Doran from the Tasmanian Department of Primary Industries and Water.

This Guide delivers on the promise we made at the outset of this project which was to listen to woolgrowers, work with them to develop joint solutions, and leave them with the skills and resources to enable them to continue working for improved river and riparian management. We hope that you will dip in and out of the sections and find something inspirational, useful and relevant to assist you to manage rivers, streams and creeks on your farm.

People

Place

Profit

Proof

Promise

Small photos from left: Laura Eves, Jean Bentley, Laura Eves, Michael Askey-Doran collection, Roger Charlton.

People

Valuing woolgrower experiences

by Jo Dean and Biz Nicolson

people (pe'pl) ***n***. 1. Persons composing community, tribe; persons belonging to a place; commonality. 2. Stories, history, shared memories of family, group. 3. Pride; empathy; knowledge; community; sense of belonging. 4. memories of rivers; shared or individual; rivers of memories.

"I think most people love their own home. They love home. It's my job, it's where my husband and I have a happy time. It is where grandchildren come and play and people visit and I think it is the same for 99.9% of all people, it's home. It also happens to be a business and it is a happy marriage between the two. It's all the people that are in it which makes it work. It's the whole thing."

VALERIE LE MAITRE

People and their connection to their land, family and community are a most precious 'natural resource'. This often goes unrecognised in our attempts to improve water quality, save remnant vegetation or protect a rare bird. Through our work with woolgrowers it became clear that people and their relationships with each other are fundamentally important to achieving healthier rivers and streams. Woolgrowers in Tasmania have a wealth of experience about their land and livelihoods and we have combined this knowledge gained through experience with science, to develop this Guide. In so doing, we talked to woolgrowers and recorded their stories, giving us an insight into their lives, their loves and motivation to do the things they do to protect, maintain and restore the environments they live in. The full transcripts of these stories are in the 'Reflections of Tasmanian woolgrowers' CD in the sleeve at the back of this Guide. The following section introduces these fascinating discussions.

Royal George Landcare Group. Photos Laura Eves.

Great people working in great places — reflections of Tasmanian woolgrowers

On the CD are stories told by 23 woolgrowers in Tasmania. They have been selected as a broad representation of people involved in wool growing and caring for the land and rivers in their regions. Interviews were conducted at kitchen tables, alongside rivers, on top of hills, in bush, on verandahs, in gardens, shearing sheds, offices, front of utes and nestled close to shelter belts. The purpose of the discussions was to capture a glimpse of the underbelly of wool growing, to allow people the space to talk about the things they are passionate about. Sometimes we are frightened of passion because it can express itself as anger or pain. Other times it can show itself as love for something beyond our understanding. Either way, there is an energy associated with these feelings which influences what people do and where they direct their efforts on a daily basis. Some people call it motivation, or the driving force of action — what gets people out of bed each day to do what they do.

The Land, Water & Wool Steering Committee, consisting of woolgrowers from around Australia, defined the project as "The Five P Project", with the Ps being — People and their sense of Place, Proof, Profit and Promise. Proof was explored along the lines of what indicators people use to determine the effectiveness of a particular management technique; be it land, water or animal management. The definition of Profit was encouraged to include the unmeasurable; the sorts of things that enrich people on a personal or 'feel good' level as well as financial. Promise revealed how people felt about the future of wool growing and management of riparian areas. Together, the Five Ps formed the guiding framework for questioning, with the underlying P of Passion being the binding thread.

The project was first explained to me as an historical exploration of rivers in the landscape and recognising the important role they play in the livelihood of woolgrowers. Knowing that everybody has a story to tell, it is interesting to hear the way in which rivers connect people through the landscape and how a river can become the focus for bringing people together. The stories on the CD are a reflection of various woolgrowers and their associations with the water that passes through the patches of land on which they grow wool.

There are a lot of things which I want to say 'thank you' for with this project, mostly the way in which people so warmly gave of their time to be involved. I constantly left people's properties with an admiration of human spirit. There were a lot of things which people spoke of which expressed times of difficulty and I left with a sense of admiration of people's strength, tenacity and courage.

Change is the only certainty in this life and the changes in rural communities sometimes seem swift and many. Humans are such adaptable creatures, finding new ways to be successful in agriculture which is developing as part of a global economy and experiencing constraints imposed by a changing climate. Part of this current age of agriculture is a willingness to care for land and water for future generations. As someone living close to a river in an urban setting I feel thankful for the people I met upstream who respect the catchment. It is in good hands and I have been very fortunate to meet them.

Also thanks to everyone interviewed for the many cups of tea, home-baked treats and snippets of lives told through the stories. Great people working in great places. The wider world needs to hear about these people because it is their strength, compassion, courage, sense of community, optimism and mateship which makes rural communities so special and needing to be shared across the world. Selling their wonderful wool, of course!

Jo Dean

The stories and people featured on the CD-ROM and throughout this Guide are:

Biodiversity for long term benefits — Lindsay and Rae Young, 'Lewisham', Ross ~ Macquarie River and 'Green Valley', Bothwell ~ Clyde River

Never a dull moment — Valerie Le Maitre, 'Lochiel' and 'Wetmore', Ross ~ Macquarie River

We do what we do, because we want to do it! — Tom and Cynthia Dunbabin, 'Bangor' Tasman Peninsula and 'The Quoin', Ross ~ Macquarie River

It's the place that makes it all worthwhile — Bob and Patricia (Pat), Adam and Grainne Greenhill, 'Gala', 'Glen Gala' and 'Riversdale', Cranbrook ~ Swan River

Look after what we have got — Frank and Melissa (Milly) Youl, 'Barton', Cressy ~ Macquarie River

No banks in heaven — Sue Rapley, 'Roseneath' and 'Plassey', Ross ~ Macquarie and Isis Rivers

Sue Rapley photo Jean Bentley. Other photos Laura Eves.

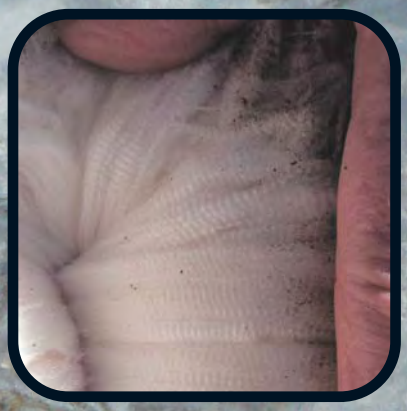
All about living — Royal George Landcare Group, Tony and Joan Gee, Guy Marshall, Damian Gee, Trevor Williams ~ St Pauls River

I wonder what it will be like next year? — Angie, Bob and Damian Gee, 'Royslea' and 'North View', Royal George ~ St Pauls River

Helping nature look after itself — Andrew and Diana Cameron, 'Marathon', Deddington ~ Nile River

Doing the best that we can — Tim and Jane Parsons, 'Curringa Farm', Hamilton ~ Clyde River

Two years on — Lindsay and Rae Young, 'Lewisham', Ross ~ Macquarie River and 'Green Valley', Bothwell ~ Clyde River

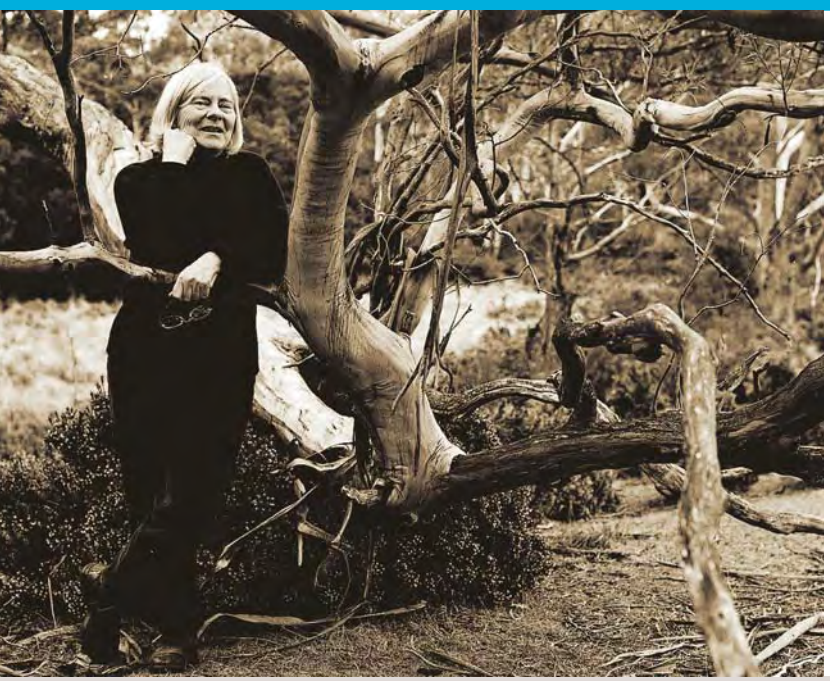


Photos Laura Eves.

Place

Understanding 'sense of place'

by Siwan Lovett and Cynthia Dunbabin



place ***n***. 1. Particular part of space; part of space occupied by person or thing or feeling. 2. Town, village, farm, etc., usu. one not forming a street; residence, dwelling; country-house with surroundings; river; hills; paddocks. 3. Find ~ for connection, contemplation, fishing, family outings, peace. 4. To make room for, special place.

"No orchestra in the world can match the sounds of the bush at the base of the Tiers at sunrise. Some people see it and feel it and some don't. I can't explain it, you can only know if you have experienced it for yourself. My whole senses change, I just get this feeling, I feel it in every part of my body, it is not describable. I can't explain it to you; I just wish that all my friends could have been there. I can't explain to you how I feel because there are no words to explain or describe it. The words just aren't there."

SUE RAPLEY

When you ask someone what motivates them to change their behaviour, it generally comes down to a feeling, for example, wanting to leave their 'place' in good condition for future generations, or wanting to preserve the special 'place' where they went fishing with their Dad. Emotion is what drives us to do most things, yet it is often not talked about and few resources are allocated to taking the time to understand the socio-cultural context within which someone is located. Without this understanding it is difficult to develop guidelines, management recommendations or tools that will be used. Trust and confidence take a long time to build, and asking someone to change their behaviour overnight is difficult when there may be no immediate benefit to them. Cynthia Dunbabin is one of the woolgrowers we have worked with through the Land, Water & Wool project, and she writes about a 'sense of place' as follows:

Photo Jean Bentley.

The Land has Spirit. Indigenous Australians have known this for millennia. Theirs has been a close association with the land, seeing, smelling, hearing, tasting, touching and thinking about it. For me, my every-day existence is entwined with the land and I cannot help but to be powerfully affected by its spirit. It defines my sense of place, my belongings in life. I belong to the land, it doesn't belong to me. I am a steward of this land and I have a fierce passion for, and a sense of responsibility towards it.

This spiritual connection underpins my actions as a farmer and drives my natural resource management (NRM) actions and activities. My passion drives my thirst for knowledge, my desire to intimately know the land. In turn, my knowledge enhances my sense of place and connectedness. Not surprisingly, I have found this passion for the land, this strong sense of place, is shared by other farmers, and they agree that this deeply personal aspect of our lives must be talked about. And it hasn't just been women, but older men, those who have been on the land for years, those guys who have weathered everything nature and society is capable of delivering.

Too often I have heard that "farmer's attitude to the land must change". Why should anyone want to change the connectedness and responsibility felt by farmers? What is needed is for the passion to be shared, for the pooling of skills and resources to enable us to move forward. We need growth together, not enforced change in the form of regulation and social stigmas.

So what does this tell us about Natural Resource Management?

Social research tells us that for NRM to be successful, farmers need recognition, ongoing support and trust. I would take this notion further and suggest that recognition needs to be not only for the works done on the land, which represents one aspect of our sense of place, but a deeper recognition of the meaning of sense of place. Recognition, support and trust are not one way. They are things that happen between people. They require each person to have respect and an understanding of the other.

We all have our own personal sense of place

Each individual's place, and their sense of place, is different. If we are going to be successful in our cooperative efforts to repair and enhance Australia's natural environment it is imperative that we recognise the importance and the meaning of each person's place to them and understand and respect differences.

People can have different connections to the same place. This is often the case with an NRM officer and a farmer. For the officer the farm is a **place of interest**, a place where the community's, and more specifically the regional Catchment Management Authority's goals and aspirations can be met. For the farmer the land is very much a **place of identity**, and changes imposed from the outside can be difficult to make, particularly if they do not respect the farmer's sense of place and vision. The implications of this difference in perception of the same place can be very profound.

The diagram shows that the area of overlap can be a place of conflict and destruction, or it can be a place of enhancement and **creativity**.

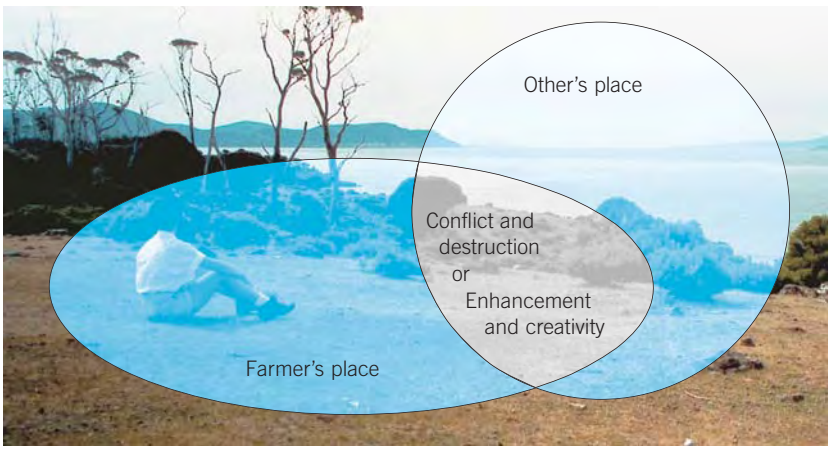


Photo Tom and Cynthia Dunbabin.

- To develop creative solutions to NRM issues it is essential that we have **respect** for each other. Each person is valuable and their 'sense of place' is very important.
- **Expect diversity**; not only expect it, but welcome it! **Encourage new players**. The more diverse the group of people the more knowledge, ideas, experience and energy available to harness. All knowledge is important. People on the land have a relationship of knowledge with the land, and this is as valuable when it comes to managing the environment as scientific knowledge.
- Be prepared to **learn**, learning can be exciting and **transcending your boundaries** can also be exciting. Remember, there is only a small step between fear and excitement!
- Always **focus on what you want** and not on what you don't want. What you concentrate on is what you will get!
- We must establish **meaningful dialogue** and processes that are **inclusive**. Jargon can be exclusive and creates power hierarchies.
- Processes must be **based on solutions**. It is the goal that is important. Don't get stuck on the steps.
- Processes that make people **feel good** are essential. They nurture **growing involvement** and generate energy.
- Enhance relationships within groups. **Partnerships** based on respect, common interest, support and encouragement can be very creative.
- **Celebrate** successes. Notice what has been achieved, not just what needs to be done.
- **Security** and **economic viability** of all involved is fundamental. Without a sound economic base farmers are unable to carry out the works required, no more than NRM officers are able to work without wages!

In summary, it is my belief that we have to talk about and recognise peoples' sense of place in order to achieve the environmental outcomes we desire and that are so urgently needed.

Photo Laura Eves.

"Practices that respect and enhance people's spirit and sense of place produce outcomes that respect and enhance the environment."

CYNTHIA DUNBABIN

Photo Laura Eves.

"It's the place that makes it all worthwhile."

BOB, PAT, ADAM AND GRAINNE GREENHILL

Pictured here Grainne and Adam with Auley.

"If you are driving home from the airport, as soon as I can get to the coastal sea, just as I get a lovely glimpse across to Freycinet and Schouten Island I feel, ahh, I'm home."

PAT GREENHILL

Grainne Greenhill pictured here.

"Every day is a free art show. There is a sunrise and a sunset and everything in between. Every day is one. Fresh air and fresh water."

TONY GEE

"I think the lake in front of the house is my special spot. I have a little row boat and I row up the lake, no distractions apart from birds — black swans, ducks, moor hens, native hens and even the odd sea eagle. As a child I spent many an hour on the lake. It was a happy playground for me. We swam in it, water skiied from one end to the other, watched the birds in the reeds."

VALERIE LE MAITRE

Photos Laura Eves.

Profit

Matching environmental action with economic sustainability

by Amy Jansen and Michael Askey-Doran

pro'fit ***n***. 1. Advantage, benefit; pecuniary gain, excess of returns over outlay (usu. pl.); ~ *and loss account*, (book-keeping) account in which gains are credited and losses debited so as to show net profit or loss at any time; change in management leading to profit; stock benefit. 2. ~ to a community; pride; belonging; cooperation; knowledge. 3. ~ sharing demonstrating richness in spirit, connection, memories and love of place.

"There are other drivers that give far greater satisfaction than money. But the trouble is that they are few and far between. There are no banks in heaven. So much more joy comes from one's success just through one's abilities than one's bank account."

SUE RAPLEY

Rivers, creeks and wetlands are the focal points of our landscapes. They provide the water to sustain not only wool growing and other agricultural industries, but also support many different plant and animal communities. They are highly productive and provide many benefits for humans and their activities. However, they are also increasingly under threat, having been damaged by past clearing of vegetation, overgrazing, weed infestation, channelisation and dam construction. In this section we outline some of the many benefits that flow to woolgrowers and the wider community from well-managed riparian areas. More detailed information on the processes which lead to these benefits can be found in the following chapter on Proof.

Photo Laura Eves.

Photo Laura Eves.

WOOLGROWER PERSPECTIVES

Andrew and Diana Cameron, Marathon

"…the other reason for fencing off the river is to maintain good water quality because both Deddington and Nile directly take water out of the river. It is a good idea if those people can drink the water without having cattle in the river and that sort of thing."

Some of the many benefits of well-managed riparian areas include the following.

1. **Clean water**
   - safer water for domestic use
   - healthier livestock
   - more fish and platypus.
2. **Healthy floodplain soils**
   - better retention of water, nutrients and sediment
   - improved agricultural production
   - healthier soil organisms.
3. **Stable banks**
   - less erosion of land and productivity
   - retention of fences, infrastructure and stock.
4. **Flood control**
   - slow down and reduce "flashiness" of floods
   - erosion problems reduced
   - fewer losses of stock and infrastructure.

These riparian zones are in healthy condition and are providing a range of benefits including clean water, stable banks and healthy ecosystems. Photos Roger Charlton (left), Tim Cohen (right).

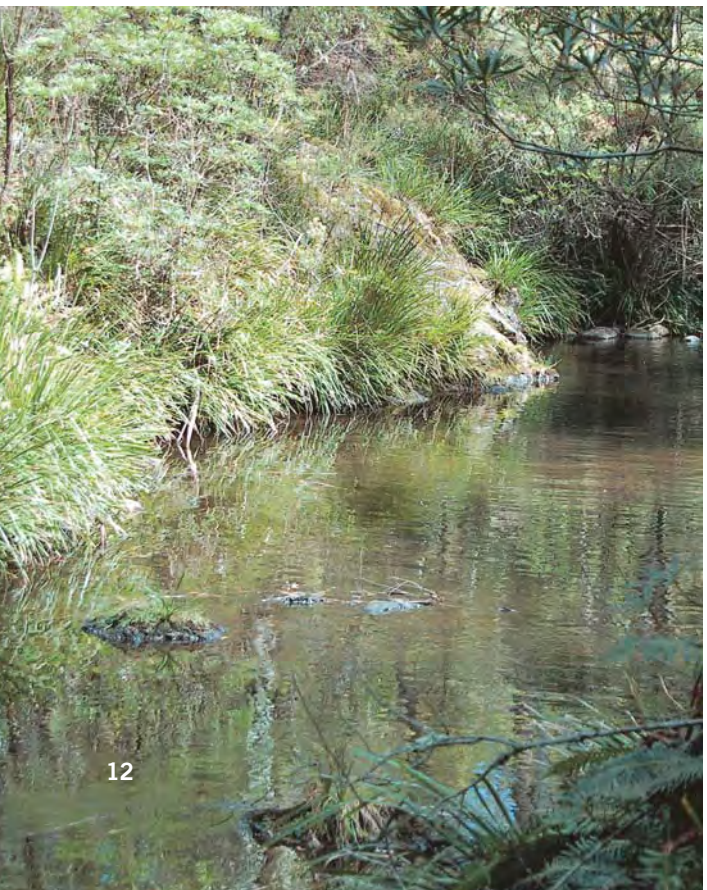


Photo Laura Eves.

WOOLGROWER PERSPECTIVES

Lindsay and Rae Young, Lewisham and Green Valley

"The floodplains add real balance to the grazing because if you have two or three beneficial floods over them in the spring time you get tremendous summer grazing at a time of the year when the rest of the farm is closed down basically. It adds real balance. Five per cent of our land is floodplains so it is significant beneficial grazing that we get over the summer time. The pastures on the flats are mainly ryegrass and annuals and the silver tussocks are definitely coming back in one section of the floodplain. It seems to provide a good balance of pasture feed. At certain times of the year they really eat *Poa*, especially the heavier black soils which hold on into the summer. With careful management, with short grazing and long rest, they seem to get plenty of green leaves on them and sheep eat them readily at certain times of the year."

Riparian areas remain green longer, providing a store of feed for drought periods when other parts of the property are becoming dry — however, they must be used with care, so that overgrazing does not occur. Photo Michael Askey-Doran collection.

5. **Healthy plant communities**
   - good shade and shelter for stock, particularly off shears and during lambing
   - good stock fodder during less productive times
   - good habitat for birds and other animals
   - control of weeds
   - perennial plants help stabilise banks
   - woody debris and leaf litter provide habitat for fish and other in-stream wildlife
   - moderate stream temperatures
   - trap carbon
   - create corridors across the landscape.

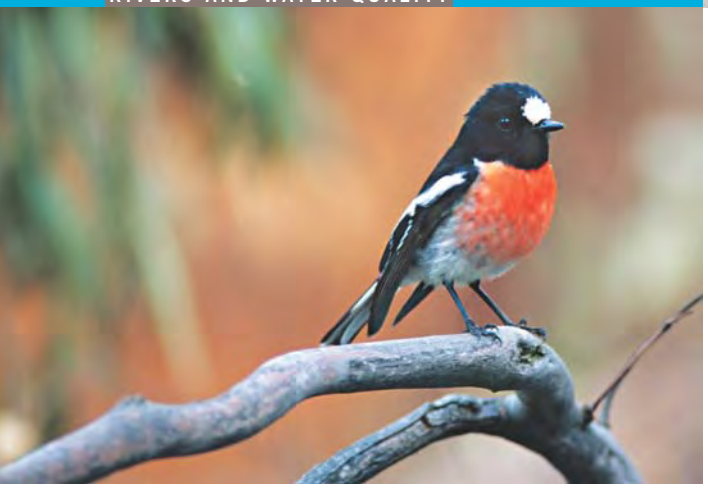


Photo Andrew Tatnell.

Woolgrower photos this page and opposite Laura Eves.

6. **Healthy animal communities**
   - birds and bats help control crop pests
   - insects provide pollination and help control pests and diseases
   - fish for recreation and tourism opportunities
   - greater biodiversity overall improves farm productivity.

7. **Better stock management with fenced riparian areas**
   - losses of stock, either into the river or over to the neighbours, are minimised by the additional fencing
   - reduced mixing of stock with that of your neighbours can reduce disease transmission across properties
   - mustering stock is easier.

WOOLGROWER PERSPECTIVES

Tim and Jane Parsons, Curringa

"It is my view that anything that we do and touch, if you are going to plant a tree somewhere or divert a bit of water to prevent erosion, or pull out some weeds it is a universal thing. It is doing good and fitting in. What we are doing on this farm and the farm next door and the farms right through, it is generational contracts. It is lifetime stuff. So I think if somebody wants to plant some trees somewhere, be it on that hill or down in that gully or whatever there is a benefit. Even if it is just a benefit for bees or butterflies or insects and ants or birds. It is just a little toe hold."

Controlled stock access and a protected riparian zone.
Photo Jenny O'Sullivan.

Fencing around the Blackman River.
Photo Laura Eves.

WOOLGROWER PERSPECTIVES

Adam Greenhill, Gala, Glen Gala, Riversdale

"Biodiversity on the farm is really important, for hundreds of reasons that I can't even see or tell you about, but there is always an imbalance in something. If you have something in its natural state next door it tends to even things out. If you have a reserved forest you are unlikely to have an insect plague start in the paddock next door because you have a population of birds. With the vegetable seed crops we certainly notice the pollination is a lot better around the reserved areas because the native insects do a better job than the bees. Last year we paid $10,000 to hire bees to pollinate our crops. That's a big deal. You think you are doing a better job with the native insects anyway, so what's reserving a bit of bush?"

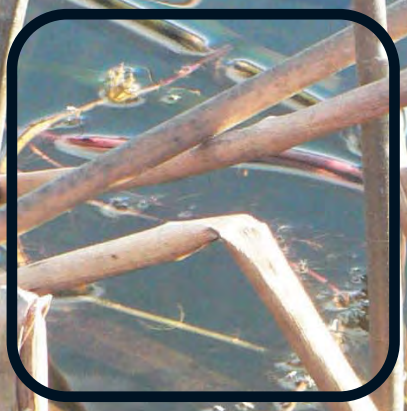
WOOLGROWER PERSPECTIVES

Tom Dunbabin, Bangor and The Quoin

"If you are going to fence off a streamside for example or a riparian area, you think there is a whole lot of things that are going to be important as outcomes, including water quality and habitat, stock management is easier. Certainly in terms of business, I didn't appreciate how big the gains were going to be for grazing management and productivity of pastures once you start putting up fences."

8. **Aesthetics**
   - diversity of plants and animals contribute to a unique and special environment
   - recreation
   - increase in land value.

Healthy riparian areas are beautiful places. Photo Guy Lampert.



Photos Laura Eves.

Proof

Understanding, managing and rehabilitating riparian areas

by Amy Jansen and Michael Askey-Doran

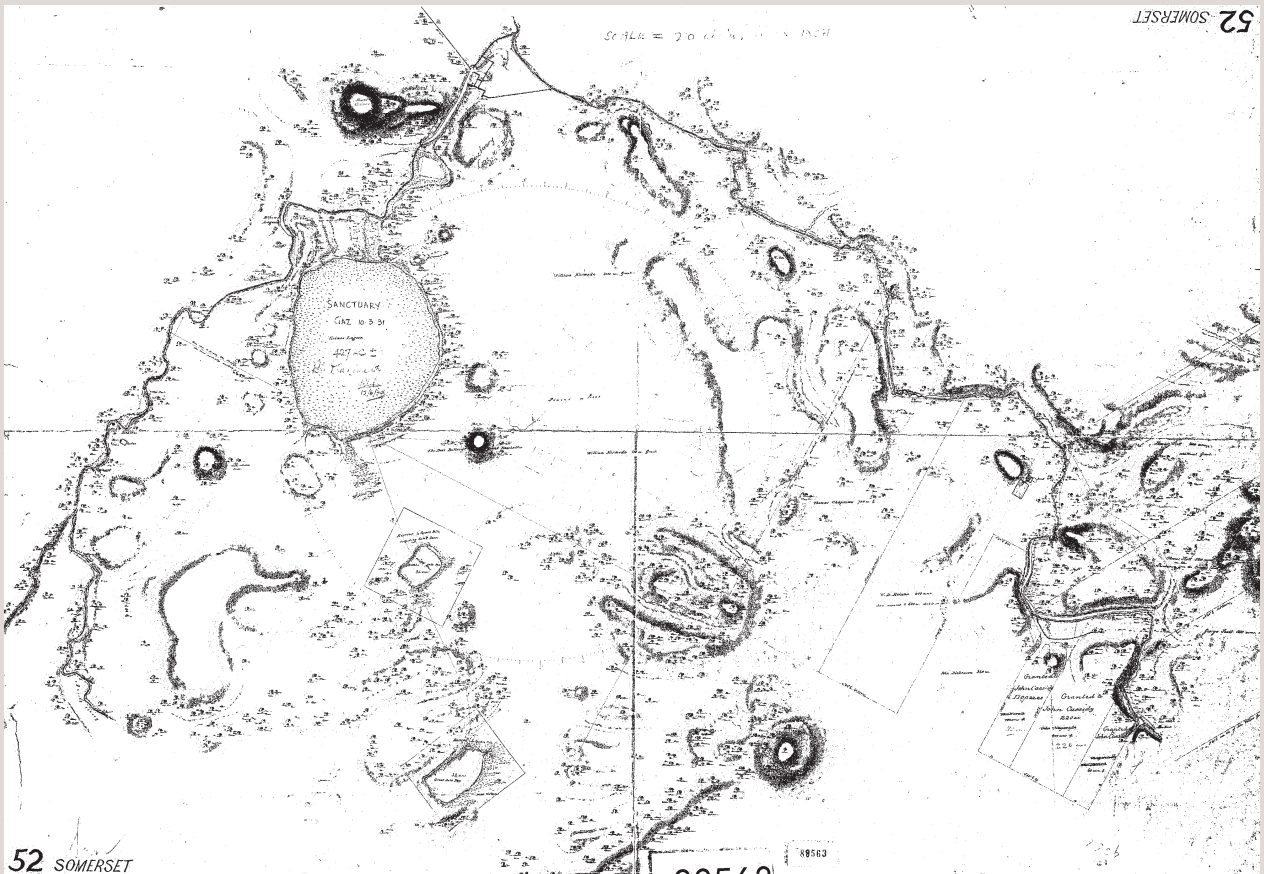
Photo Michael Askey-Doran collection.

proof ***n***. 1. Evidence sufficing or helping to establish a fact; proving, demonstration. 2. Test, trial. 3. Compare old maps with present day maps. 4. Photographic evidence change over time. 5. Ability to implement management based on sound scientific principles. 6. Indicators to provide proof of positive or negative management. 7. Evidence of participation, ownership of issues. 8. Proof of understanding, past, present, future.

Proof of environmental change can be gauged by remembering the past and how things were — the look, feel, sound and movement of the bush or animals. Proof can also be measured by comparing old maps and diaries with knowledge and memories of today.

Lachlan Macquarie described his travels through the Midlands. He notes many interesting things about the landscape:

Map from the 1830s of the Blackman River and surrounding Salt Pans Plains. Map courtesy DPIW.



Wednesday 4th December 1811.

I have named this 'High Hill' or mountain on account of the fine view it commands, *Prospect Hill.* — After descending from this Hill, we pursued our Journey to *Jerico Plains*, where we halted at 1/2 past 10 a.m. close to the *River Jordan*, a small stream running through an extensive meadow; this being 8 miles distant from our last Ground. — We travelled over a succession of very fine Hills and fertile Vallies for 10 miles to a Jungle with fine Springs of fresh Water —.

Thursday 5th December 1811.

Having left *Salt Pans [sic] Plains*, and passed Grimes's Lagoon, a very fine one a quarter of a mile long, on our left, we entered *Argyle Plains* — and Encamped on the Banks of "*Macquarie River*" (so named now) which flows out of Grimes's Lagoon and runs by many windings all the way to Port Dalrymple.

This figure shows an overlay of one of the original surveyor's maps on a current aerial photograph of the Macquarie River south of Ross. Map courtesy DPIW.

Friday 6th December 1811.

At 6 a.m. Set out from *Macquarie River* — travel for 3 miles through *Argyle Plains* — which contains good Pasturage; thence through Hills & Vallies for 3 miles more — poor Soil — to "*Mount Campbell*" leaving it on our left; then enter "*Maclaine Plains*" and travel through them for 2 miles to a rising Ground covered with wood, which separate them from the next Plains. Thence travel 2 miles over "*Antill Plains*", which are beautifully interspersed with Trees and contain good Pasturage for Cattle. — At 10 a.m. halted on the Left Bank of *Elizabeth River* in Antill Plains.— At 1/2 past 3 p.m. Pursued our Journey from *Elizabeth River*, which we forded close to where we Encamped, and travelled for 7 miles across "*Macquarie Plains*" (— now so named and commencing from Elizabeth River, and which is *40 miles* from the settlement at Port Dalrymple); these Plains are very extensive and beautifully interspersed with Trees and small Eminences and skirted by fine ranges of Hills, well calculated for grazing of Horned Cattle & Sheep, the Plains also being in most Places a good Soil for Tillage & Pasturage.

Saturday 7th December 1811.

— travelling for 10 miles through *Epping Forest*, which is all very poor bad soil, to the open Plains; which I have named *Henrietta Plains*; — These Plains are by far the richest and most beautiful we have yet seen in Van Diemen's Land; forming a grand, and interesting fine Landscape, and having a fine noble view of *Ben-Lomond*, *the Butt*, and a long lofty Range of smaller Mountains on the East and West of our Track, extending all the way to Port Dalrymple; the New River, or *South Esk*, meandering in a beautiful manner through the Plains, making the Landscape complete. — The Soil and Herbage of Henrietta Plains far excel anything of the kind we have yet seen. —

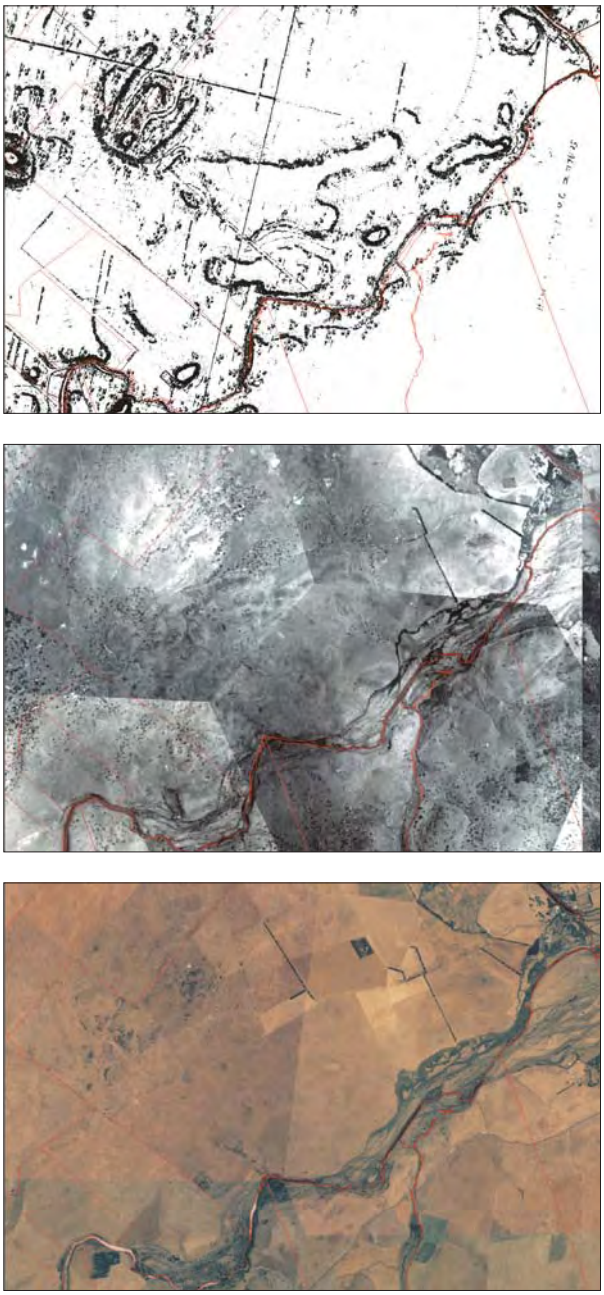
Macquarie, Lachlan, *Journal to and from Van Diemen's Land to Sydney in New South Wales*. 4 November 1811 – 6 January 1812. Original held in the Mitchell Library, Sydney. ML Ref: A777, pp. 1–34. [Microfilm Reel CY302 Frames #347–380.]

The black arrow indicates channel change on the Macquarie River. Map courtesy DPIW.

By the 1830s surveyors were marking blocks of land along the Macquarie River for settlers in the region. The figure on the opposite page shows an overlay of one of the original surveyor's maps on a current aerial photograph of the Macquarie River south of Ross. These original maps are accurate as well as artistic: the surveyors spent time drawing the hills as well as the essentials of property boundaries and the location of the river.

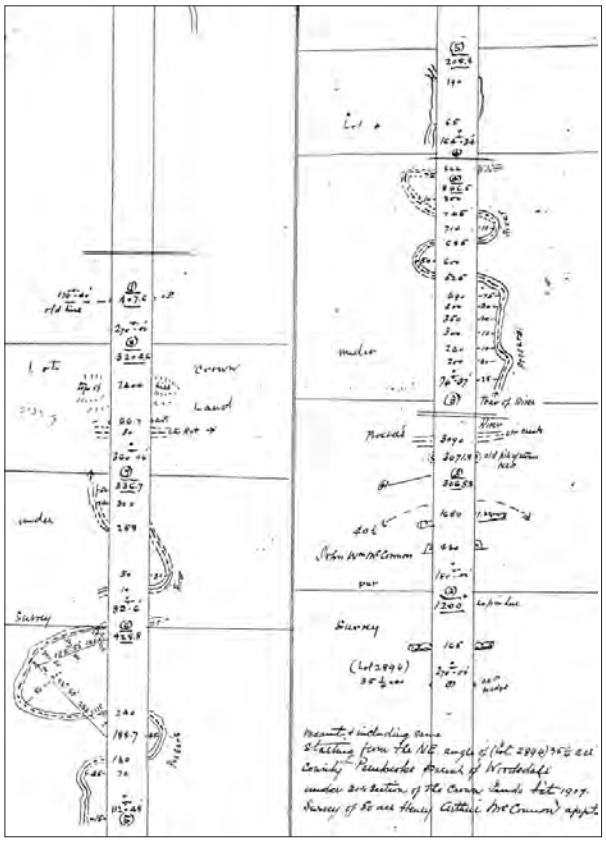
Today, we can use these maps to see if there have been changes to the river. The figure above shows the original survey map (in black) overlain on the current aerial photograph, and overlaid with the current cadastral boundaries (in red). The arrow indicates where it looks like the channel has been straightened.

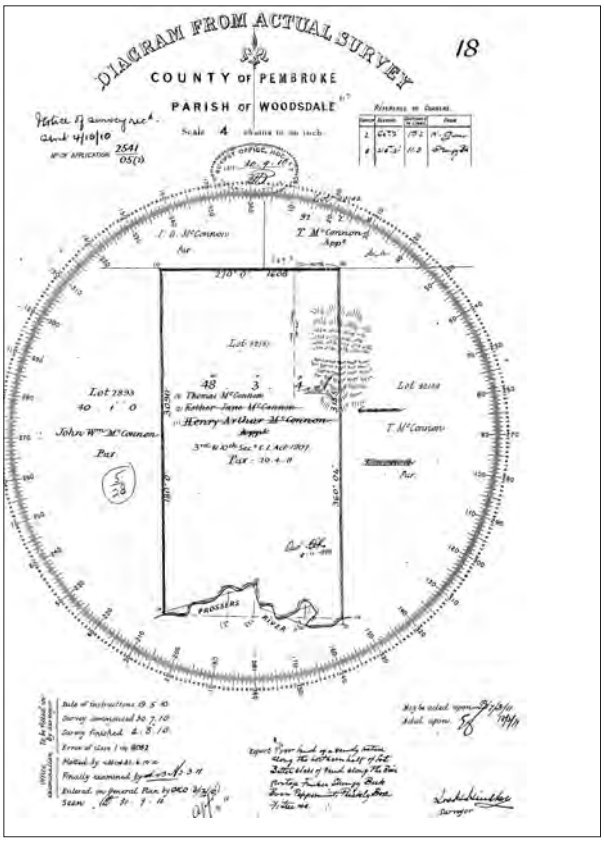
Often we think that the river is very unstable and we need to spend a lot of money repairing it. However, a time series of maps and photos shows the river has actually been relatively stable for a long time and that erosion is localised. Most changes to the river and the surrounding landscape probably occurred in the 1800s. The photos at the right show that, since the 1940s there have been no obvious changes to the position of the river channel.



These figures are of the same location on the Macquarie River showing an early surveyors map from the 1830s, an aerial photograph from the late 1940s and an aerial photograph from 1997. Maps courtesy DPIW.

The most evident changes have been an increase in the amount of vegetation along the river (mainly willows and gorse) and a decrease in the number of trees on the hillslopes. These changes in the vegetation have led to significant changes to the riverine environment.





Above: The surveyor's notes. Right: The original survey. Images courtesy DPIW.

WOOLGROWER PERSPECTIVES

Lindsay Young, Lewisham

"I was talking to an older fellow in Ross the other day and he said that a late friend of his could remember when the bottom of the river around our area was covered in tea-tree and it was clear enough to see the bottom in his young day which was about 90 years ago. I think there has been a steady decline because stocking rates have gone up over the last 50 years and stock have had access to the river, grazing there and tracking down for drinks. Now stock water is pumped all over the farm anyway so it is no problem just to put a trough in the paddocks that are fenced off."

Photo Laura Eves.

A similar assessment of the Prosser River in Tasmania's south-east was also completed. An early surveyor carefully mapped all the bends in a section of the Prosser River in drawing a plan of a property which was sold to Henry Arthur McConnon in 1911.

Since then there have been major changes to this section of the river. It became infested with Crack willow and in 1992 the willows were removed and the channel altered (Prosser Landcare Survey 1995). These changes are evident in the time series shown in Figure 1 on the opposite page. Both the original survey and the photograph from 1984 show the channel in a similar position to that shown by the cadastral layer (with some minor changes that may be due to errors in the surveys, or to small changes in the channel). However, the photograph from 2003 shows that the channel in this section has been completely straightened (and significantly shortened).

Figure 1. The original survey map completed in 1910, an aerial photograph from 1984, and an aerial photograph from 2003 of the same section of the Prosser River, with the cadastral layer overlain in red for reference. Source Prosser Landcare Survey 1995.

Proof can also be assessed scientifically in terms of current condition and trajectory of change. As part of the Rivercare planning process, the entire length of the upper catchment of the Macquarie River was assessed. Figure 2 summarises the condition based on this assessment.

- 'Intact' reaches are in very good condition, with good coverage of native vegetation both in the riparian areas and on adjacent hillslopes.
- Reaches with 'Some impact' have been cleared to some extent but retain native vegetation in patches and are often under threat from overgrazing by livestock, weed infestations and further clearing.
- 'Impacted' reaches contain some remaining native vegetation but have been extensively cleared and are subject to stock access and weed invasion.
- 'Heavily impacted' reaches have been almost entirely cleared of native vegetation and the channels have been altered by straightening or construction of weirs.

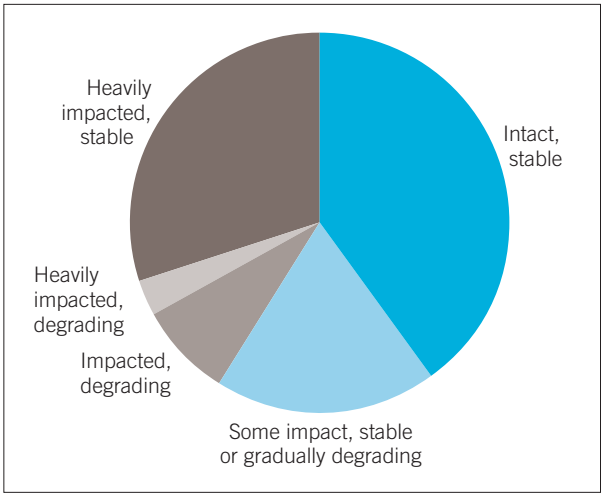


Figure 2. Proportional lengths of the upper Macquarie River and main tributaries classified according to condition and trajectory of change. Data from Rivercare Plan, Hamlet 2002.

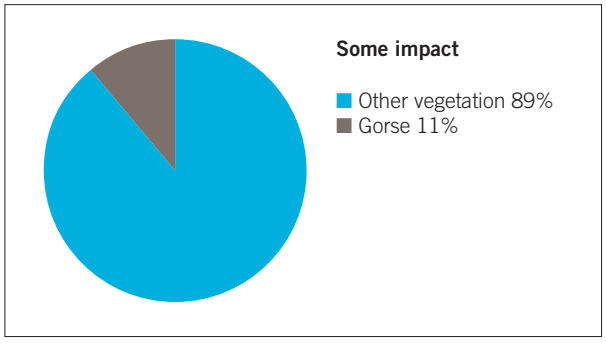
Figure 2 shows that 40% of the length of the river and its main tributaries is in 'Intact' and stable condition (all in the higher parts of the catchment). However, 60% of the river shows some signs of impact, and is either degrading or so heavily impacted that it can get little worse (including all of the lowland floodplain areas of the river).

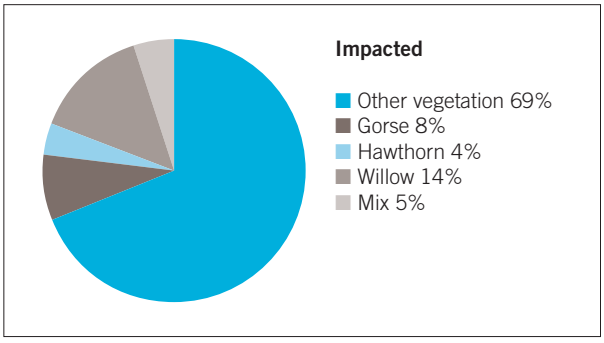
This reach shown in the photo below would be classified as having 'some impact', whilst the photo below right shows a stretch of river that has been heavily impacted by stock and vegetation clearing. Photos Michael Askey-Doran collection.

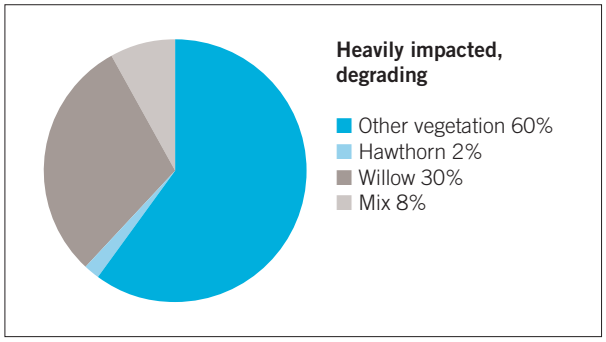
As an indication of the impact of agricultural activities, 63% of the riparian area in the reaches not classified as 'intact', was agricultural land, i.e. either improved pasture and cropland or land cleared for agriculture. One of the major problems in these areas is weed infestation. Figure 3 shows the total lengths of serious weed infestations along reaches of the upper Macquarie River in the different condition categories (there were virtually no serious weeds found in the 'Intact' reaches).

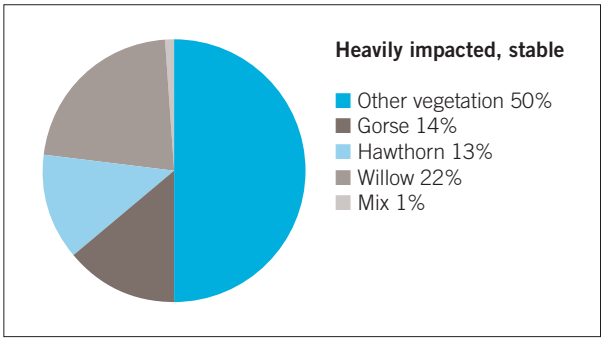
In total, of 188.5 kilometres of river length assessed for vegetation, 12.9 kilometres were dominated by gorse, 8.1 kilometres by hawthorn, 16 kilometres by willow and 1.7 kilometres by a mix of these weeds as well as briar rose. This compares to 74.7 kilometres that was classified as 'intact'.

Figure 3. Proportional lengths of serious weed infestations along the upper Macquarie River and main tributaries in reaches classified according to condition (see previous figure — data from Rivercare Plan). 'Mix' is a mixture of the serious weed species, 'Other vegetation' is dominated by improved pasture but can also include native riparian vegetation. Reference Hamlet 2002.









Willows, gorse and hawthorn dominate this riparian area. Photo Michael Askey-Doran collection.

It is clear that agricultural land use and invasion by exotic weeds have had major impacts on the Macquarie River and its tributaries. The majority of these impacts probably happened 100–150 years ago, although weed invasion is an on-going process, as is localised degradation due to uncontrolled stock access. These problems are not unique to the Macquarie River, but are fairly typical of many rivers in agricultural landscapes. The Macquarie landowners have undertaken Rivercare planning and a series of rehabilitation projects so that they can rectify these problems in an effective and strategic way.

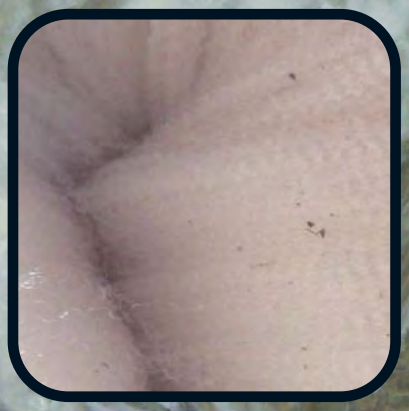
WOOLGROWER PERSPECTIVES

Tim and Jane Parsons, Curringa

"It is my view that anything that we do and touch, if you are going to plant a tree somewhere or divert a bit of water to prevent erosion, or pull out some weeds it is a universal thing. It is doing good and fitting in. What we are doing on this farm and the farm next door and the farms right through, it is generational contracts. It is lifetime stuff. So I think if somebody wants to plant some trees somewhere, be it on that hill or down in that gully or whatever there is a benefit. Even if it is just a benefit for bees or butterflies or insects and ants or birds. It is just a little toe hold."

Photo Laura Eves.

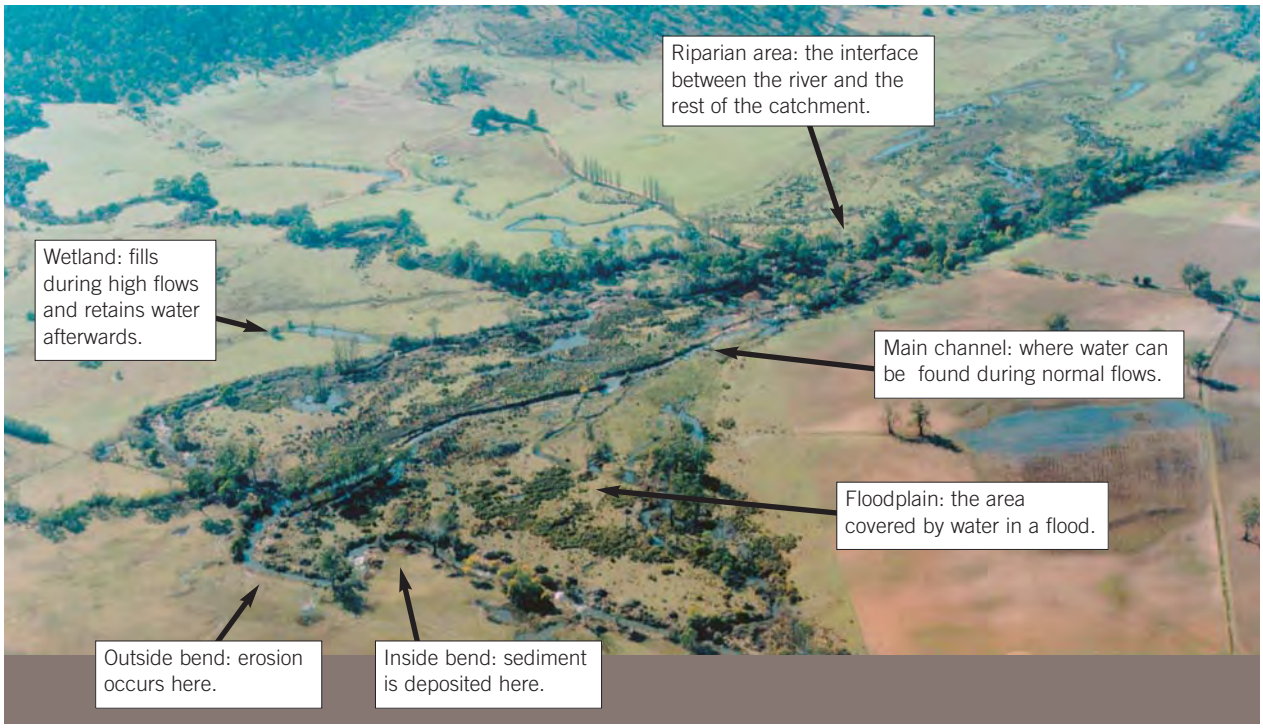
Photo at left Michael Askey-Doran collection. Other photos this page Laura Eves.

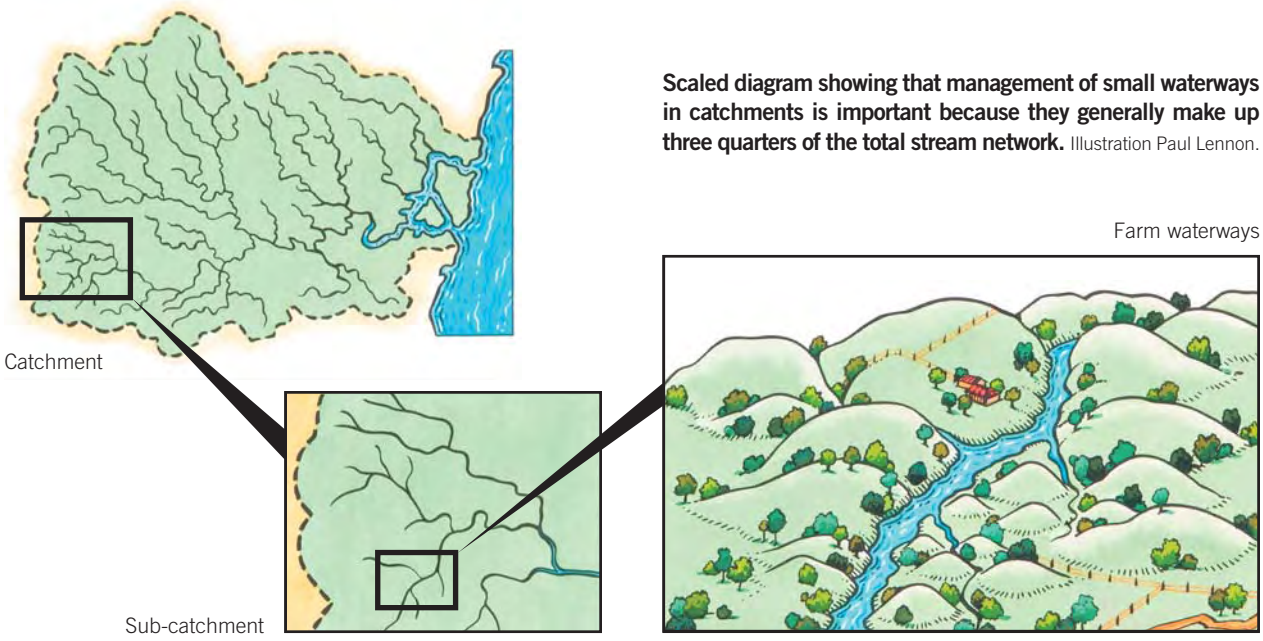


What makes up river systems?

The flow of water through the landscape, down gullies, depressions, drainage lines into creeks and streams and further into the main rivers helps define catchments. The ridges, hills and mountains that act as catchment boundaries are also the sources or headwaters for a catchment's river system. Catchments occur at different scales in the landscape. For example, the Macquarie River is a sub-catchment of the South Esk River and the Blackman River is a sub-catchment of the Macquarie River. A range of smaller tributaries flow into these rivers making up a complex network of drainage lines that can greatly exceed the length of the main part of the river.

River systems are made up of a number of components as shown in the photograph below. Photo Michael Askey-Doran collection.





Scaled diagram showing that management of small waterways in catchments is important because they generally make up three quarters of the total stream network. Illustration Paul Lennon.

As well as the main channel, there are a number of types of wetlands which can be a part of the river, or off to the side:

Marsh.

Lagoon.

In-stream wetlands are a feature of rivers in the Midlands.

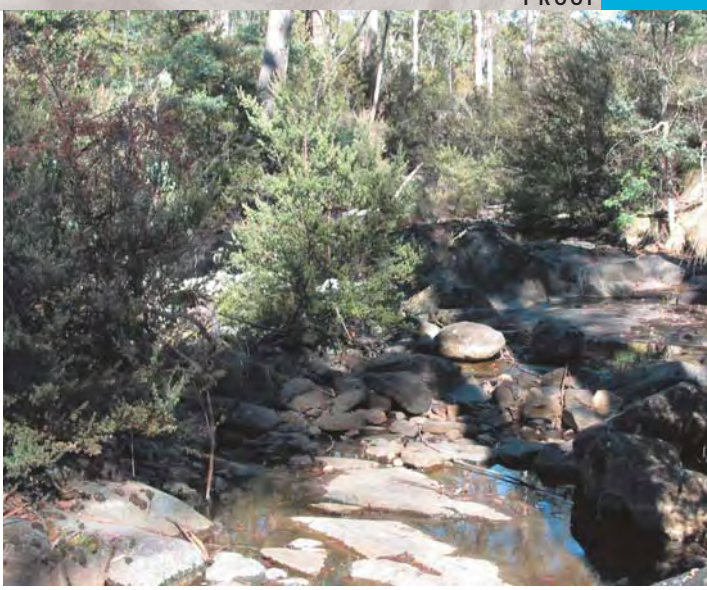
The riparian area is a highly productive but vulnerable, part of the landscape. This is where management can make a difference: what we do in riparian areas has implications for the entire catchment. Understanding the importance of these riparian areas, and learning how to better manage them, are the focus of this Guide.

What are riparian areas and why are they important?

Riparian areas are at the boundary between land and water, so they are important buffers between what happens on land and what occurs in the water. Because of their position in the landscape, they are also moister and more fertile than surrounding areas, making them important resources both for humans and native plants and animals. They are often small in area (commonly only 2–5% of the landscape), yet they are critical parts of the catchment, performing many important functions and providing many benefits to human users.

Riparian vegetation is distinct from the drier vegetation up-slope. Photos this page Michael Askey-Doran collection.

Healthy vegetation traps sediment. Photo Jenny O'Sullivan.



Healthy vegetation stabilises banks.

A channel that has filled with sediment.

Unstable banks and woody weeds.

Key functions

Riparian areas perform many important functions within the landscape:

1. **Trap and store sediment**
   - sediment from land adjacent to the riparian area is prevented from entering the water
   - sediment builds soil and banks in the riparian area.

2. **Stabilise banks**
   - stable banks resist erosion, preventing movement and widening of the channel.

Photos on pages 27–29 Michael Askey-Doran collection unless credited otherwise.

Healthy vegetation slows down and takes up water.

Flood waters have stripped this floodplain.

3. Store water and energy

- flood waters are slowed down, reducing erosion and flood damage
- high flows over the floodplain are trapped to recharge underground aquifers.

4. Filter and buffer water

- riparian plants absorb and trap nutrients, preventing them entering the water
- sediment and contaminants such as nutrients, pathogens are trapped and prevented from entering the water
- overhanging vegetation shades the water, reducing high temperatures which may kill in-stream animals and allow unwanted algae to grow.

5. Provide food and habitat for *in-stream* plants and animals

- in-stream animals rely on inputs of organic matter (dead leaves and wood from the riparian area) for their food
- many animals living in the river also require dead wood or litter on the bottom to hide from predators or shelter from fast-flowing water.

Overhanging and in-stream vegetation provides habitat for animals.

6. **Provide habitat for *riparian* plants and animals**
   - many plants and animals can only live in riparian areas, where there is abundant water, rich soils, and cool, moist conditions
   - many other animals which aren't dependent on riparian zones year round may use them during certain times of the year or in certain parts of their life-cycle.

7. **Provide corridors for movement of animals and seeds across the catchment**
   - plants, via their seeds, and animals move about the landscape along corridors between patches of native vegetation.

Left: Standing dead trees provide hollows and perching sites for a variety of animals.

Riparian corridor of vegetation.

What shapes rivers?

Rivers aren't as simple as they look; there are many different processes at work which control how they function. Understanding these processes is important in order to manage rivers effectively. Rivers are dynamic environments and water is a powerful agent of change. The processes operating in healthy river systems can be seen to be in balance. The natural balance is reflected in the relationship between discharge (the amount of water conveyed) and sediment load (gravels, sands, debris etc.) that move through the system. Rivers become unstable when this relationship slips out of balance and there is either too much or too little of either water or sediment available to the river. Too little sediment and the river may start to erode its bed and banks; too much and the river can't shift it and the channel begins to fill in. Similarly if there is an unnatural increase in the amount of water in the river, streambanks will begin to erode; too little water, and the river won't be able to maintain its channel shape. Geology, climate, vegetation and land-use all influence condition and the way that rivers function.

Geology determines:

- the slope and topography (shape) of the drainage system
- controls channel form and position
- the nature of bed and bank material and sediment that moves through the channel
- soil types and characteristics
- vegetation communities across the catchment.

Climate influences:

- the volume and timing of rainfall, run-off and flooding
- seasonal changes and temperature extremes, such as freeze and thaw
- vegetation communities across the catchment.

Vegetation helps:

- control the energy of the river
- stabilise the streambanks
- filter sediments and nutrients from the surface and sub-surface water.

Patterns of land-use affect:

- the catchment water and sediment yield by altering vegetation, topography, drainage and soils
- the physical condition of channels and banks.

Plants return organic matter to the soil which increases the soil's water holding capacity. Organic material can hold nine times its own weight in water. Sediments build more quickly on well-vegetated riparian areas. The cycle of flooding, sediment deposition and soil building increases the capability for water absorption and storage. Where vegetation is lacking sediment capture is less as is the capability for water absorption and storage.

Erosion processes

There are two main types of erosion that landowners usually have to manage for — streambank erosion and streambed erosion.

Streambank erosion

Even healthy rivers erode their streambanks, it's a normal process that shapes the river. However, a problem begins to occur when changes along the river affect the rate at which streambank erosion occurs. Such changes include clearing of native riparian vegetation and the introduction of stock along the river. The loss of vegetation reduces the stability of the banks, whilst the mechanical action of stock on the streambank causes the bank to break away and start to erode. This can also lead to erosion downstream, as the riparian vegetation hanging over the river helped to slow the river, reducing its erosive impact on the river channel.

Collapsing streambank. Photo Michael Askey-Doran collection.

Streambank erosion can be caused by many different factors, and often they act in combination. By observing the river in its many different stages and monitoring changes that have occurred along its length, it may be possible to identify the likely causes of the erosion. The rate and extent of bank erosion is influenced by:

- the erosive or abrasive effect flowing water and sediment can have on streambanks
- the type of bank material and its susceptibility to erosion
- the presence and condition of riparian vegetation
- the presence of obstructions within the channel that constrict or redirect flow
- irregular bank alignment
- streambed erosion increasing the relative height of banks, making them vulnerable to collapse
- increased channel capacity enabling greater flood volumes
- poorly managed stock access resulting in stock tracks, loss of soil structure, soil compaction, *pugging* of the wetted edge of the stream and damage to protective riparian vegetation
- rapid fall (or *draw down*) in stream water level, particularly in highly regulated stream systems, leaves saturated soil banks without the buoyant support of water
- the entry of water into the channel from off-stream sources, such as dams, road works, contour banks and floodplain channels
- wave action due to wind
- the wash from boats.

Streambed erosion

Streambed erosion occurs when the bed of the river starts to erode away and the channel deepens. Streambed erosion is a sign that the channel gradient has become steeper, and the river is adjusting itself to a more stable gradient. Bed erosion is commonly caused by straightening of the channel or through removal of bed materials such as gravel. An obvious sign of bed erosion is a headcut, which appears as a sharp change in gradient, like a small waterfall, in the bed of the river. The headcut makes its way upstream until the river establishes a new gradient.

An example of a gully with several active head cuts moving up the slope. Photo Samantha Burt.

There are four main processes leading to bed erosion:

- *sediment starvation* when weirs, dams and blockages obstruct the downstream movement of sediment
- *increased channel slope* arising from channel straightening, gravel extraction and de-snagging activities within the channel
- *channel constrictions* that narrow the channel and increase the energy (velocity) of flow sufficiently to erode the streambed
- *increasing flow (energy)* due to an increase in the amount of water that enters the drainage system through catchment clearance, releases from dams, de-snagging and riparian vegetation clearance.

Some cases of bed erosion are quite obvious, whilst others are much more subtle and require a trained eye and some technical experience to identify. There are a number of observable indicators to suggest that bed erosion is affecting, or has affected, a stream:

- a steepening in the bed, often a very steep *riffle* (shallow, turbulent section) that is moving upstream
- bank erosion on both sides of the channel
- a lowering of pool levels
- hanging streamside vegetation or a perched line of lichen on rocks
- exposed bridge footings
- significant alteration to channel shape and behaviour downstream, including sedimentation
- exposure of bedrock, old bed logs or clays in the channel base.

Potential impacts include:

- loss of channel stability and normal stream behaviour
- bank erosion and downstream sedimentation
- streambank collapse as the height of banks increases
- collapse of streamside vegetation into the channel
- lowering of water levels in pools leading to lower ground water levels
- smothering of aquatic habitat by sediment
- reduced water quality due to sedimentation
- reduced natural flooding regimes due to the enlarged channel capacity
- undermining of stream-related infrastructure such as bridges.

Dead wood in rivers

Fallen logs in rivers, called 'Large Woody Debris' (LWD) are important for many reasons, but are often blamed for problems such as erosion and flooding and hence removed. We now know that LWD is extremely important in rivers and that fallen logs in the channel and on the banks help protect the banks from erosion by slowing down the flow. Fallen logs also provide very important food and habitat for a variety of animals. The logs provide a surface for algae to grow on, and this in turn provides food for bugs and fish. This is particularly true in rivers which lack rocky areas in the bed, such as many parts of the floodplain reaches of the larger rivers. Many animals also shelter from the fast flowing water amongst logs.

While it is true that local erosion can occur around fallen logs in rivers, this is actually beneficial, in creating pools and riffles in the stream, which are favoured habitats for particular kinds of fish and invertebrates. Removing a log to prevent this erosion from occurring may be detrimental to the river, and may also just move the problem further downstream. Fallen logs in some circumstances can increase local flooding, but it takes a *lot* of wood to do so. At any point

In-stream woody debris aligned with the flow. Photo Michael Askey-Doran collection.

along the river, the cross-sectional area of wood must be at least 10% of the channel capacity to have any significant influence on flooding. Single fallen logs are very unlikely to influence flooding. Wood should only be re-positioned or removed from streams if it can be shown to be causing problems.

The solution may simply be a matter a moving the wood so that it is aligned with the flow. Removing logs from your section of the river is likely to just move any flooding problems downstream.

Linkages upstream and downstream along the river

It is important to understand that processes occurring in one part of the river affect other parts of the river. While it may be obvious how some events influence downstream areas, there can also be upstream influences. For example, gravel extraction which causes bed lowering will increase the energy and flow of the water upstream, since the gradient of the channel will increase. This can result in increased erosion *upstream*. Downstream effects may also not be very obvious. For example, straightening the channel in one section will increase water flow, possibly leading to increased erosion downstream. Planting a section of bank on a small stream may have effects both up and downstream, once the plants get to a reasonable size. The planting can slow down the water flow and reduce its energy, possibly leading to increased flooding upstream, and a lower risk of flooding as well as less erosion downstream.

Linkages are particularly important to consider when it comes to trying to deal with water quality issues. Revegetation and control of stock access along rivers are only likely to have visible, on-site effects on very small channels. If a large river flows through your property, there is unlikely to be anything you personally can do to improve the water quality of your section of it. However, whatever you do will influence the water quality for your neighbours downstream. The effects are cumulative, so the more people who address the issue, the greater the benefits will be.

The bottom line is that you need to consider your neighbours up- and down-stream when planning any works on rivers.

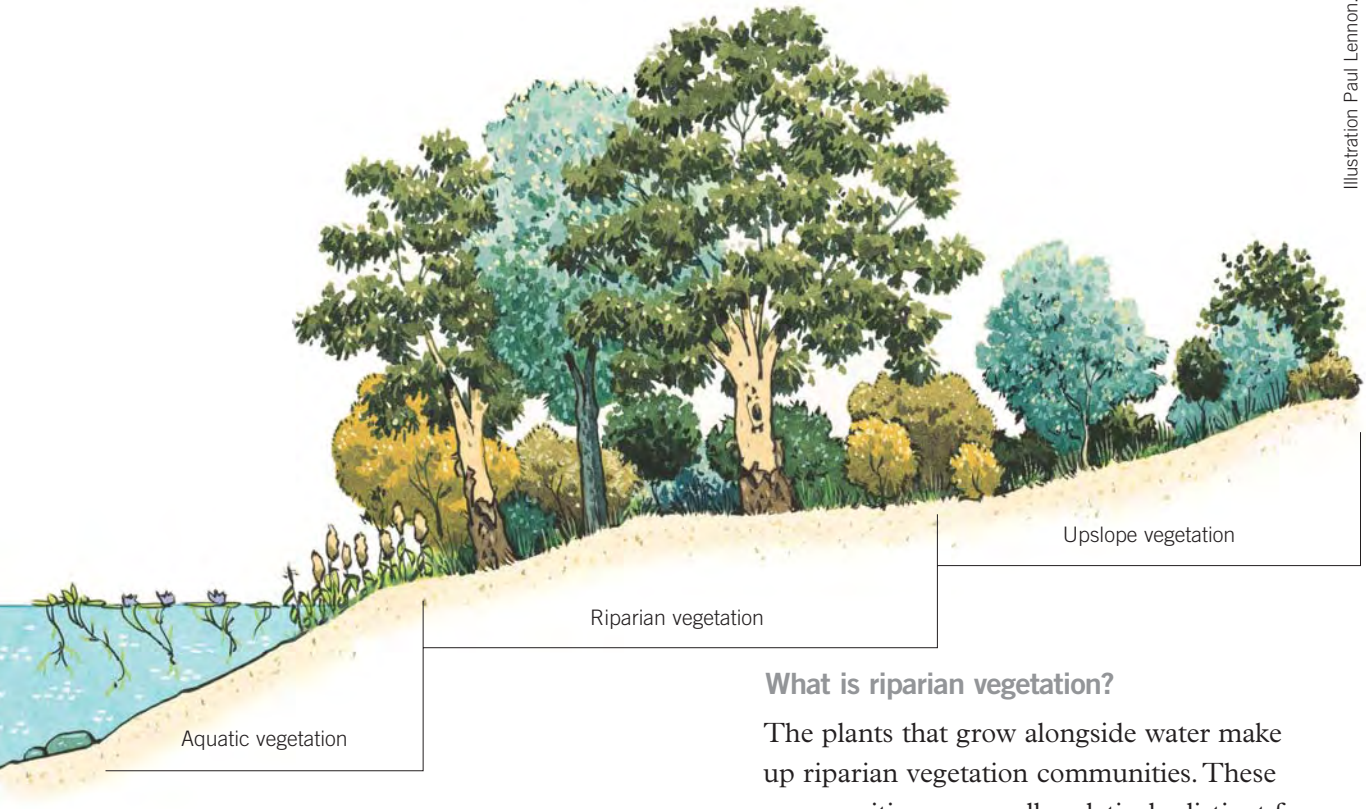


Illustration Paul Lennon.

Riparian vegetation

The question is often asked: What was the vegetation here like before Europeans arrived? This is an important question because we assume that riparian vegetation in its original state (before 1750) performed all of the essential functions of riparian areas. Thus, if we wish to restore riparian functions, it makes sense to try to restore the vegetation to what it was like before we changed it. Many headwater streams still have riparian vegetation in a state similar to its original condition, so we know what to aim for in restoring these types of sites.

However, vegetation in lowland areas has been significantly altered by clearing and grazing, and we can often only guess what the original vegetation was like. We can get some clues from early explorer's descriptions, and from surveys of existing remnant patches of vegetation. Here we will summarise what we *do* know about riparian vegetation in Tasmania's wool growing areas, and how it has been altered since European settlement.

What is riparian vegetation?

The plants that grow alongside water make up riparian vegetation communities. These communities are usually relatively distinct from the communities which grow in drier parts of the landscape upslope, although many species may be common to both areas. It is often the *set* of species, and the abundances of particular species, which make riparian plant communities distinctive. The extent to which they differ is influenced by the surrounding vegetation. In wetter areas, riparian vegetation might be denser but not very different otherwise to the surrounding vegetation. However, in drier areas, the riparian vegetation might be quite distinctive, containing trees, shrubs and other types of plants which are virtually absent in the surrounding landscape.

How does riparian vegetation vary?

Riparian vegetation varies both along the length and with distance away from the river. Whilst there will be plants that are common throughout the length of the river, there will also be a range of plants that only occur in the headwaters or on particular rock or soil types. Variation away from the river's edge is a function of the plant species' preferences and/or tolerance of moisture and

disturbance. Plants that are happy to grow in perennially wet areas occur along the river margins, whilst plants that prefer better drained sites will be further away from the stream on higher ground. Tolerance of flooding also influences where plants grow. There are plants that rely on the disturbance that floods create to release seed and establish new generations, however, if flooding occurs too frequently these new generations cannot establish. Conversely, if flood frequency is reduced the triggers for germination may be removed. Some plants can also tolerate being under water for extended periods of time, while others cannot. This will determine the types of plants, and hence the plant communities, that can grow in areas which are inundated frequently or for long periods of time (for example, on floodplains of large rivers). If flood frequency is reduced, for example by damming upstream, then plants less tolerant of flooding may invade and out-compete the flood-tolerant species, changing the plant community.

Typical vegetation communities and plants

The riparian plant communities growing along Tasmania's rivers and their condition vary depending on location and land use. The healthiest and most diverse vegetation communities are usually found in the upland or headwater areas of catchments. In contrast, native riparian vegetation is usually fragmented and in poor condition on the floodplains, where much of the land has been developed for agriculture.

Riparian areas are special places for plants. Nearly half of Tasmania's native plant species have been recorded in riparian areas. Although only two species of plants in Tasmania are considered to only occur in riparian areas, 76 species mainly occur there. Of these species, nearly 30% are listed as threatened in Tasmania, indicating that riparian areas have been extensively impacted by human activities.

A number of riparian species have seeds which germinate in response to flooding. Photo Laura Eves.

In wetter upland areas riparian vegetation usually consists of a canopy of eucalypts over a tall layer of shrubs and small trees such as blackwood, musk, dogwood and tea-tree. In drier areas the riparian vegetation may consist of scattered eucalypts over a dense shrub layer of tea-tree and wattles, but may also be a more open woodland community with a sparse understorey and a grassy/sedgey ground layer. Remnant riparian vegetation on the floodplain is usually dominated by a mixture of tea-tree, dogwood, wattles and occasional eucalypts (swamp gum, white gum, snow gum).

Surveys of relatively intact riparian vegetation in the Midlands have shown that most riparian areas have a relatively open canopy of *Eucalyptus* species (mainly white gum, snow gum and black gum) a variable shrub layer (often with wattles, dogwood and tea-tree) and usually a grassy and/or sedgey ground layer (dominated by sagg, tussock grass and *Carex* species).

More detailed information on the species of plants and where they are found is in Appendix 1, page 79.

Weeds of riparian areas

Riparian vegetation in the wool growing areas of Tasmania has been greatly altered by clearing and grazing. This has coincided with the introduction of many non-native (exotic) plants. There are a large number of weed species on Tasmanian rivers (e.g. 22 species of declared weeds are listed in the Macquarie Rivercare Plan, Hamlet, 2002). Generally we think of the highly visible species such as willows, hawthorn and gorse, which are nuisance species and affect river flows. However, there are many other weeds, including aquatic and terrestrial herbs, grasses, sedges, shrubs and trees. Some of these could become noxious weeds in the future. Possible future problem species, which are locally common in certain areas, include sycamore, erica, Elisha's tears, creeping jenny, elderberry and fuschia. The most dominant exotic species in riparian areas are pasture grasses.

Teasel is a locally common weed in riparian areas.

Areas dominated by native tussocks can have many exotic species in the bare spaces between them. Photos on this page Michael-Askey-Doran collection.

Tasmanian scrubwren. Photo Vin Lam.

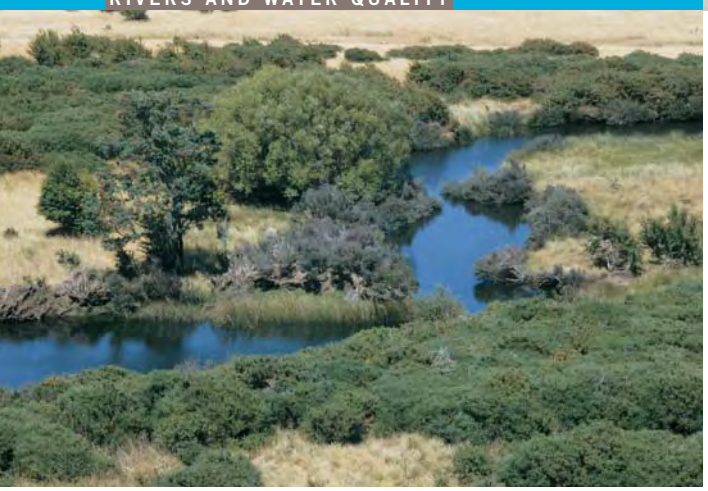
Riparian animals

Many animals are found in riparian areas. Typical animals that come to mind are frogs, dragonflies, platypus and water-rats, which all depend on rivers and riparian areas. However, many other animals also use riparian areas. Some, such as the Azure kingfisher, are only found there. Others, such as the Tasmanian scrubwren, preferentially use riparian areas, although they can also be found in other wet forests. The structural complexity and diversity of riparian habitats makes them suitable for a wide range of animals. However, due to the extensive alterations to riparian habitats in Tasmania, the numbers and kinds of animals found in them can be greatly reduced. Here we will discuss some typical riparian vegetation communities (natural and altered) and the animals that we might expect to find in them. In Appendix 2 is a list of all Tasmanian birds (excluding seabirds) with their specific habitat requirements.

Cleared and grazed streambanks

Streambanks that have been cleared of native vegetation and grazed are usually dominated by short pasture grasses and there is often bare, compacted ground on the banks. Few animals like these conditions — mostly large farmland birds and insects, rather than those that normally occur in riparian areas. Magpies and crows will use these areas, and provide benefits to the farm by eating beetles, grubs, grasshoppers, etc. which can damage pastures. Birds of prey will also use these areas, and provide a service by eating carrion, grasshoppers and mice and rats.

Cleared and grazed streambank.
Photo Michael Askey-Doran collection.



Gorse and grass dominated riparian area.

The bare, compacted ground and the high nutrient levels favour introduced plants over natives, leading to insects and other small animals living in the soil and ground cover being limited, and often dominated by a few exotic species. The lack of stream shade and few large pieces of wood in the stream mean that water quality can be poor, with little habitat for fish and other animals to live in.

Gorse or hawthorns and grass

Some riparian areas have patches of woody weeds such as gorse or hawthorns. Exclusion of grazing from these areas can result in the spread of these weeds, which is not a desirable outcome. Whilst these woody weeds can provide habitat for pest animals such as sparrows, starlings, and rabbits they can also provide valuable habitat for native animals. A number of small birds (e.g. wrens) and mammals (e.g. possums, wallabies, wombats, potoroos, bettongs and bandicoots) will use prickly shrubs such as hawthorn for nesting and refuge areas, if there are suitable areas nearby where they can feed (e.g. areas of long grass).

Right: Fenced long grass. Photos this page and opposite Michael Askey-Doran collection unless credited otherwise.

Willow dominated riparian area. Photo Rae Young.

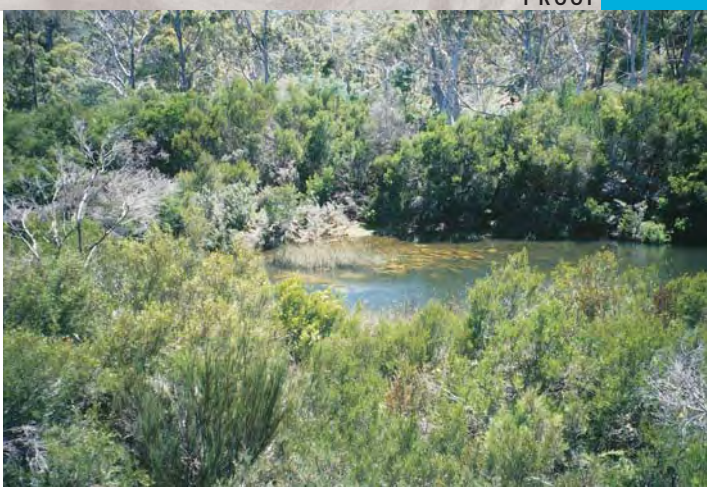
Willows

Riparian areas dominated by willows provide habitat for a limited range of animals. Some birds and mammals will use the trees for shelter and foraging, but for many species they do not provide suitable habitat. The nutritional value of dead willow leaves is low, and cannot be utilised by most in-stream animals that depend on inputs of native leaf litter. Dead willow wood also rots much more quickly than that of native trees, so its habitat value for fish and other animals is limited.

Long tussock grasses

Native tussock grasses provide habitat for many small insects, reptiles and frogs that cannot live amongst short pasture grasses. These in turn provide food and feeding areas for a wider range of birds in addition to the larger farmland birds found in pasture areas. These may include waterbirds (e.g. herons and plovers), as well as grassland birds (e.g. pipits and chats). These birds will consume insects in the pastures adjacent to riparian areas. Native reeds and sedges growing along the banks will reduce erosion and provide habitat for waterbirds including ducks and swans, as well as grassbirds and wrens.

Open grassy woodland.



Shrubby riparian vegetation.

Open grassy woodland

Riparian areas with a mix of native grasses and scattered native trees can provide habitat for a range of animals. Larger birds such as magpies, crows and birds of prey will readily use these areas because they provide good perching sites as well as suitable open areas in which to forage. Hollows in the scattered trees provide nesting sites for birds and mammals such as cockatoos and parrots, bats and possums. Smaller birds that forage in open areas, such as chats, robins and pipits will also use these areas, as will wetland birds such as ducks, swans, herons and egrets. Frogs can be found in reeds and sedges along the banks. Areas of shade and woody debris in the water will provide habitat for fish and other in-stream animals. The lack of a shrub layer and only a few trees means that small bush birds and mammals may lack shelter and be absent. Noisy miners particularly like these open, 'park-like' habitats, and can be quite common. They also tend to chase away smaller birds, particularly other honeyeaters.

Shrubby riparian vegetation

Good riparian vegetation will have a diverse mix of native plant species of lots of different types, including grasses and herbs, reeds and sedges, a mix of shrubs of different heights, and a tree layer of one or more species, with seedlings of the trees and shrubs evident. There will also be dead timber and leaf litter on the ground and in the stream. These components will provide shelter, nesting sites and foraging sites for a diverse range of animals, including small bush birds and mammals, bats, lizards and frogs, as well as fish, platypus and other animals in the stream. Larger birds and mammals will also use this riparian vegetation for perching and nesting sites, even if they forage over a wider area including nearby paddocks and open areas. All of these animals will help to control insect pests on the farm. The riparian area will also provide habitat for a wide range of beneficial insects that perform services such as pollination and maintenance of soil health.

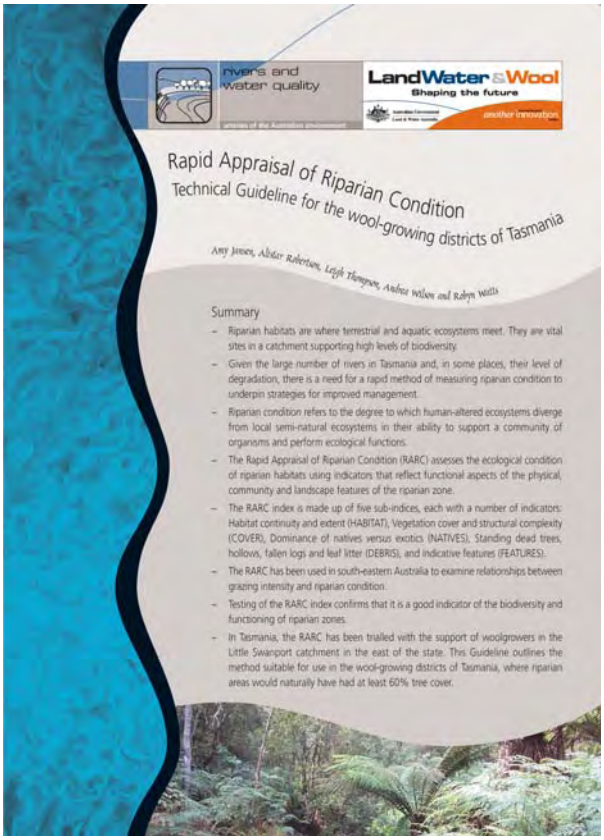
For more information on animals found in Tasmania, see "Birds on farms" (Donaghey 2005) and the DPIW website.

Platypus. Photo Andrew Tatnell.

Photo at left Michael Askey-Doran collection. Other photos this page Laura Eves.

How healthy is my river?

The key to a healthy river is a healthy riparian area, and this is where your management can have an impact. The 'health' (or condition) of a riparian area is a measure of how well it can perform all of the functions discussed earlier. It can be determined by examining a number of indicators, which are related to the key functions. To assess the health of your riparian area, fill in the checklist provided on the following page. In the remainder of this section you will find explanations of the importance of each of the indicators used in the checklist, and some photographic examples. These indicators can be examined at any time, along your stretch of river bank. There are also some larger-scale indicators of river health that will be discussed later. A more in-depth assessment of riparian condition is the Rapid Appraisal of Riparian Condition, which uses similar indicators, and can be used for comparisons and monitoring of riparian areas.



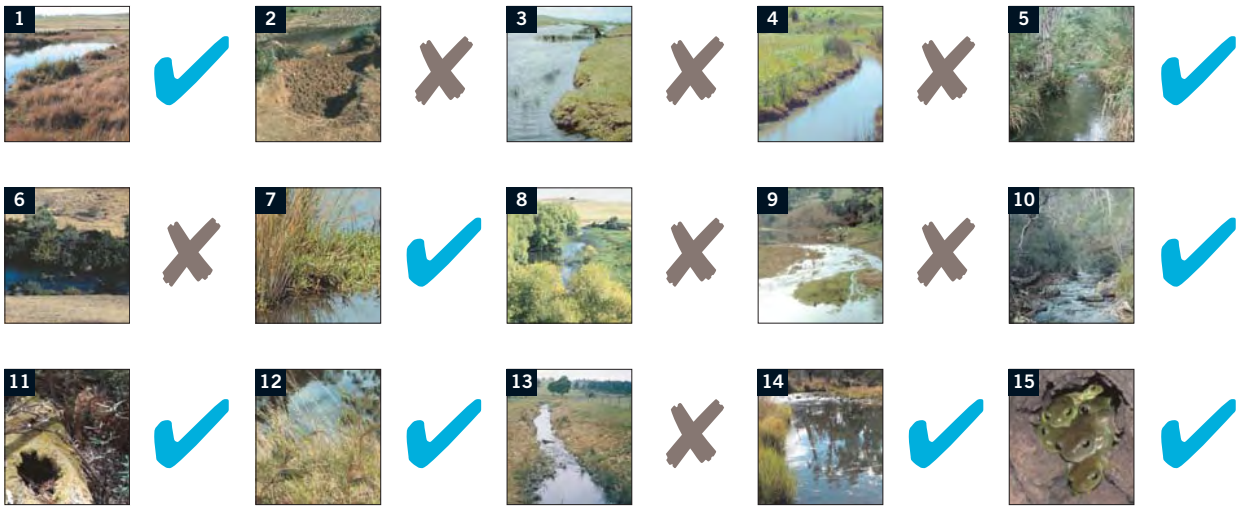
For details about the 'Rapid Appraisal of Riparian Condition: Technical Guideline for the wool-growing regions of Tasmania', see page 76.

Sheep grazing in riparian areas can cause a decline in stream health. Photo Michael Askey-Doran collection.

Stream health checklist

Answer yes or no to the questions below		Yes	No
1	Does vegetation (of any kind) cover at least 85% of the ground in your riparian area?		
2	Is the ground in your riparian area soft, spongy and full of organic matter, with no pugging evident along the banks?		
3	Does vegetation provide some shade along the banks?		
4	Are the majority of plants in your riparian area deep-rooted perennial species?		
5	Is there a mix of different kinds of plants, including trees, shrubs, grasses, herbs and reeds in your riparian area?		
6	If the answer to 5 is **yes** is the strip of native vegetation along the banks at least 5 metres wide and continuous?		
7	Are there reeds and other plants growing in-stream, particularly if riparian vegetation is lacking?		
8	Is your riparian area dominated by native plant species?		
9	Is your riparian vegetation connected to other patches of native vegetation?		
10	Is there leaf litter and fallen logs on the ground and in the water?		
11	Are there standing dead trees and hollow-bearing trees in your riparian area?		
12	Are there seedlings of the local native trees and shrubs in your riparian area?		
13	Have there been any alterations to the channel which have caused a change in the frequency or timing of flood events?		
14	Is the water clear and free of surface scums of algae?		
15	Is there a diversity of small woodland birds (e.g. robins, honeyeaters, wrens, fantails), mammals (e.g. bandicoots and bettongs), frogs, reptiles and native fish in your riparian area?		

If you answered "yes" in the majority of these boxes there is a good chance your river is in good health. The boxes answered "no" provide an indication of where work may still be needed. An explanation for what each these checklist indicators means can be found in the next few pages.



1 Bare ground. Does vegetation (of any kind) cover at least 85% of the ground in your riparian area?

Effects of bare ground:
- increased runoff
- increased sediment, nutrients entering water
- loss of good farming land
- aquatic life smothered

Bare ground can be a result of natural erosion processes along rivers, particularly on vertical banks or after major flooding events. However, bare ground caused by overgrazing and trampling may indicate that the health of the riparian area is declining.

2 Effects of pugging and soil compaction. Is the ground in your riparian area soft, spongy and full of organic matter, with no pugging evident along the banks?

Effects of pugging:
- increased runoff
- increased sediment, nutrients entering water
- poor habitat for soil organisms
- increased bank erosion

Soil compaction and pugging, caused by hard-hooved animals, damage the soil structure and exacerbate the problems caused by bare ground in riparian areas.

3 Shade along the banks. Does vegetation provide some shade along the banks?

Effects of lack of shade:
- aquatic animals killed by high temperatures
- nuisance algae and aquatic plants grow unchecked

Shade along the banks, preferably in the form of overhanging trees or shrubs, or at least tall reeds, helps keep water temperatures low and reduces light levels. This is particularly important in small streams with low flows, where shade can really make a difference. Clearly larger rivers are not going to be shaded by vegetation out in the middle. However, shade along the banks will benefit aquatic animals and reduce algal growth.

4 Deep-rooted plants. Are the majority of plants in your riparian area deep-rooted perennial species?

Effects of shallow-rooted plants:

- less stable banks
- higher water tables
- increased risk of salinity problems
- more prone to drought

Deep-rooted plants, particularly trees and shrubs, but also native perennial grasses, help stabilise the banks. The roots of these plants extend right through the depth of the bank as far as the mean low water level of the stream, and are the major contributor to bank stability, particularly in sandier soils.

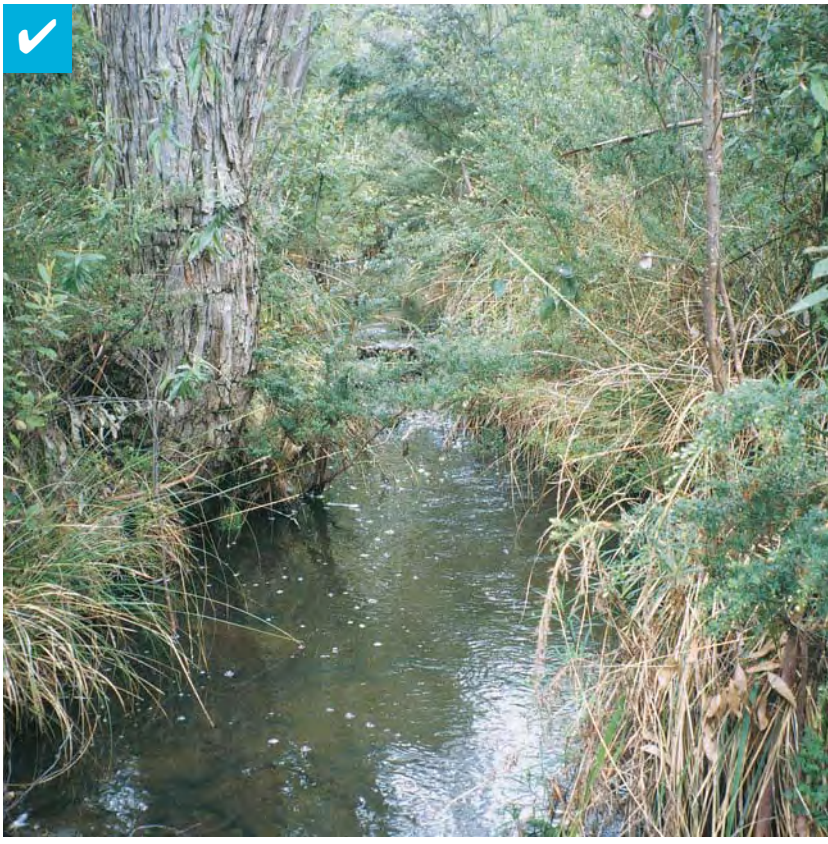
Large photo Ian Rutherfurd.

5 Several different kinds of plants. Is there a mix of different kinds of plants, including trees, shrubs, grasses, herbs and reeds in your riparian area?

Effects of lack of diversity:

- less suitable habitat for riparian animals

A mixture of different kinds of plants, including trees, shrubs, grasses, herbs and reeds, provides structural diversity and contributes to all the key riparian functions. Apart from the benefits already discussed, a range of different kinds of plants provide food and habitat (places to live and breed) for a wide range of animals which depend on riparian areas. For example, many species of woodland birds depend on a shrubby layer for perches and places to hide, while reptiles require low shrubs and tussocks. Many different sorts of insects and other invertebrates such as spiders live in different types of plants, and are important both as predators of other insects and as food for other animals.



6 Riparian buffers and corridors. If the answer to 5 is "yes" is the strip of native vegetation along the banks at least 5 metres wide and continuous?

Effects of lack of a corridor:

- difficult for small native animals to move across open paddocks between patches of native vegetation
- plants and animals cannot recolonise isolated patches of vegetation
- narrow strips are more prone to weeds and the effects of disturbance

A continuous strip of vegetation, in addition to helping perform the functions discussed above, will also provide a 'corridor', allowing native birds and other animals to move around the landscape. This is particularly important in dry landscapes such as the Midlands, where floodplains have been largely cleared. To be effective, a corridor must be at least 5 metres wide, but the wider the better. A width of 30–40 metres would provide a useful corridor for the majority of animals.

7 Reeds and rushes. Are there reeds and other plants growing in-stream, particularly if riparian vegetation is lacking?

Effects of lack of aquatic plants:

- less suitable habitat for aquatic animals
- increased flow rates and more bank erosion

In the absence of much riparian vegetation, aquatic plants can provide cover, sources of food and shelter from predators for aquatic animals. They also help slow the river and protect the banks from erosion.

Photo Roger Charlton.

8 Native plants. Is your riparian area dominated by native plant species?

You may need some help with this one if you are unfamiliar with different kinds of plants. However, the common weeds, such as willows, gorse, hawthorn, briar rose and blackberries, as well as the majority of annual (short-lived) pasture grasses and weeds are introduced species, while the majority of other woody species (trees and shrubs) and many perennial (long-lived) grass, herb and reed species are native. While many introduced species of plants can provide **some** important riparian functions, such as helping to stabilise banks, shading the stream and providing some habitat for native animals, native species of plants generally perform these functions better. Native animals generally prefer to use native plant species for food and living places, simply because they are adapted to them.

Effects of willows:
- widening of small channels
- narrowing of large channels
- logs provide poor fish habitat due to rapid breakdown
- seasonal leaf drop reduces water quality
- outcompete native species

9 Connectivity. Is your riparian vegetation connected to other patches of native vegetation?

Riparian vegetation will function best as a corridor if there are other patches of remnant native vegetation connected to it, through which native animals can move. It is recommended that a minimum of 30% of your property should remain uncleared or be restored to native vegetation, and that the patches should be linked by corridors, to provide the best possible chance for native animals, particularly small birds, mammals and reptiles, to survive.

Photo Danielle Warfe.

10 Logs and leaf litter. Is there leaf litter and fallen logs on the ground and in the water?

Effects of lack of debris:

- little habitat and food for aquatic and riparian animals
- flood waters more powerful, causing more erosion
- riparian soils dry out more quickly

Logs in the riparian area, as well as in-stream, provide important habitat for a variety of small animals. Leaf litter on the ground and falling into the stream, provide an important food source and hiding place for large numbers of small insects and other invertebrates. In fact, a large proportion of aquatic organisms in natural systems rely almost entirely on leaf litter for food and nutrients. Riparian areas which look 'untidy', with lots of logs and litter, etc. are much better places for animals than areas where all of the debris has been removed and should not be 'cleaned up'.

11 Dead trees and hollows. Are there standing dead trees and hollow-bearing trees in your riparian area?

Effects of lack of dead trees and hollows:

- few perches and roosts
- lack of nesting sites

Standing dead trees, and hollow-bearing trees (hollows are usually present in large old trees which have dead broken-off branches), provide perching and nesting places for a variety of birds and mammals, including parrots, bats, owls, etc. While a large number of dead trees is clearly not a good sign, particularly if there are no live ones, by keeping a few they will add to the habitat value of your riparian area.

Photo Roger Charlton.

12 Seedlings. Are there undamaged seedlings of the local native trees and shrubs in your riparian area?

Effects of lack of regeneration:
- no replacement of existing plants when they are lost

If riparian areas are to remain healthy, there needs to be continuous regeneration for different species to persist. Grazing and browsing animals can damage seedlings every time they start to sprout, so that they never grow. If there has been a flood or fire which has stimulated regeneration, it is a good idea to exclude stock until the seedlings have grown enough to be safe from browsing.

Photo Amy Jansen.

Other indicators

Some other indicators can be used to assess the 'bigger picture' of the health of the river system as a whole — as part of the landscape and over time. To assess these indicators, you will need to become familiar with your river over time and learn how it functions within the landscape.

13 Extent and frequency of flooding. Have there been any alterations to the channel which have caused a change in the frequency or timing of flood events?

Role of flooding:
- floods supply floodplains with water, sediment and seeds
- flood disturbance brings new life to riparian zones

Upstream dams and diversions can affect the frequency and timing of flood events in your section of the river. This can have consequences for the vegetation in the riparian area, which has adapted over a long period of time to a particular pattern of flooding. Too much water and some plants may die from waterlogging, while too little water and some soils may become too dry for riparian plants. The disturbance caused by flooding is also important for the regeneration of many riparian species. Flooding opens up new spaces for plants to colonise, releases seed from canopies and stimulates germination from the soil seed bank. Levee banks, channel straightening and deepening, either on your property or upstream, can affect the extent of flooding, perhaps preventing any flood waters from reaching the riparian area (except in very large floods). The riparian area is unique because it does flood regularly, so reducing flooding here means that the vegetation will gradually change from a riparian community to one adapted to drier and/or less disturbed sites, with consequent loss of diversity and other values.

14 Water quality. Is the water clear and free of surface scums of algae?

Effects of poor water quality:

- death of aquatic life
- overgrowth of nuisance plants and algae in-stream
- unhealthy for stock and people

Detailed assessment of water quality requires laboratory analysis, but a few simple indicators can be assessed on-site. Clear water, with no sediment, that enables you to see the bottom of the channel, is a good sign that soil is not being washed in from up-slope or upstream. Green scums of algae that cover the surface of the water can be a sign of high nutrient levels and/or light levels. On smaller streams, and near headwaters, water quality can be influenced by what is happening in your riparian area. However, as you move further downstream and into bigger rivers, water quality may be determined much more by what is happening upstream, which you may not be able to influence.

Inset photo Roger Charlton.

15 Diversity of small animals. Is there a diversity of small woodland birds (e.g. robins, honeyeaters, wrens, fantails), mammals (e.g. bandicoots and bettongs), frogs, reptiles and native fish in your riparian area?

It should be clear from the discussions above that many elements go into making a good place for small native animals to live. If there are lots of these often present, then clearly your riparian area is functioning well in this respect. However, lots and lots of starlings, sparrows and rabbits are clearly not what we want! It matters what **kinds** of animals are present. Patient looking and listening might be required to detect some of these animals.

Photo Peter Davies.

Photo Vin Lam.

Controlling sheep acces to riparian land (right side of diagram) is the key step to maintaining waterways in good condition. Illustration Paul Lennon.

The table below shows the relationships between the indicators discussed earlier and the key functions of riparian areas. A tick shows a positive link between the indicator and the function, while a cross indicates a negative impact.

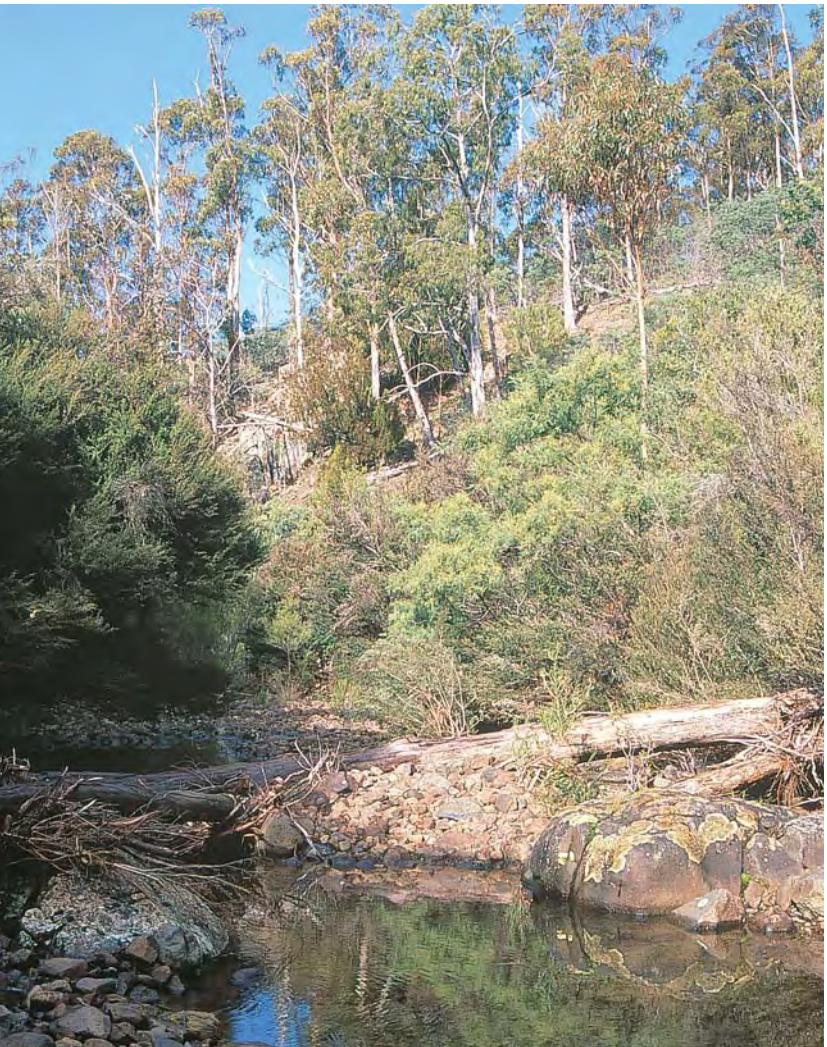
	Functions						
Indicators	Trap sediment	Stabilise banks	Store water and energy	Filter and buffer water	In-stream life	Riparian life	Corridors
Bare ground	✘	✘	✘	✘	✘	✘	✘
Pugging, soil compaction	✘	✘	✘	✘		✘	
Shade				✔	✔		
Deep-rooted plants	✔	✔	✔				
Diversity of plants	✔	✔			✔	✔	✔
Continuous vegetation	✔	✔	✔	✔	✔	✔	✔
Aquatic plants	✔	✔	✔		✔		
Native plants		✔	✔	✔	✔	✔	✔
Connectivity					✔	✔	✔
Debris	✔			✔	✔	✔	✔
Dead trees and hollows						✔	
Seedlings	✔	✔	✔	✔	✔	✔	✔

Managing rivers — how can we do it?

There are a number of things we can do to improve the condition and health of our rivers and riparian areas. Restoring at least some of the key functions of riparian areas will provide many benefits — to our native plants and animals, to the quality of our water, and to our wool growing enterprises and other uses of riparian areas and rivers. This section looks at some of the key issues related to managing and restoring rivers including:

1. Appropriate widths for the riparian zone
2. Retaining native vegetation
3. Revegetation
4. Managing stock
5. Weed management

This stretch of river is in good condition. Making decisions that will protect and maintain this asset is a part of managing natural resources so that they can provide a range of positive environmental, economic and social benefits. Photo Michael Askey-Doran collection.



1. How wide should my riparian area be?

There is no simple answer to this question; it depends on a variety of factors such as:

- the management objectives
- the size of the river and its floodplain
- the location of your area along the catchment
- the slope of the surrounding landscape.

The following table provides a summary of the *minimum* widths of native riparian vegetation that are considered necessary to achieve particular management objectives. The best width will vary depending on the circumstances and the condition of the existing riparian zone. As a general rule, wider is better and will last longer. A well managed riparian area will enable you to achieve increases in both productivity and environmental condition. Wider riparian buffers reduce weed invasion, provide greater shade to the stream, reducing water quality problems and improving habitat quality. Healthy, wide riparian zones help prevent erosion, ensuring your land stays where it belongs rather than disappearing down the river to your neighbours.

Management objective	Recommended minimum width
Improve water quality	10 metres
Reduce streambank erosion	Half the channel width
Maintain natural light and temperature levels	10 metres
Provide food inputs and in-stream habitat	10 metres
Provide habitat for riparian life	30 metres
Provide corridors	10 metres

Further information, 'Managing riparian widths', *Fact Sheet 13*, Land & Water Australia.

2. Getting native plants back along your river

Retaining native vegetation

Retaining healthy riparian vegetation is the cheapest and most effective way of preventing degradation, as there is usually no rehabilitation required. Maintaining healthy native vegetation may simply mean keep managing it the way you already are. At most it may require fencing and monitoring for weeds. These native riparian areas are also an important source of seeds to help the recovery of downstream areas.

In areas where the native vegetation has been lost, some form of intervention is likely to be needed. Options include natural regeneration, direct seeding, and planting. Each of these options is discussed on the following pages.

Photo Greening Australia.

Photo Laura Eves.

WOOLGROWER PERSPECTIVES

Andrew and Diana Cameron, Marathon

"I started fencing off the creek 15 years ago, back in the last wool boom. It has started regenerating naturally. So I fenced off about two or three kilometres then. There has been very little tree recovery but there has been good native grass and tea-tree recovery, but not many eucalypts. Game are pretty hard on eucalypts. Where there is native vegetation there is not much point doing replanting. As long as the ground is stable, that is the most important thing. If there is tea-tree and sedges and tussocks and then it is OK. We have got 75% of the property in reserve and then on top of that we have got streamside exclusion zones for several kilometres."

Below: Remnant native vegetation provides a source of seeds for downstream areas. Photo Michael Askey-Doran collection.

The transformation between 1986 and 2004, where the only difference has been a fence to exclude stock. Photos Biz Nicolson.

Natural regeneration — the best, easiest and cheapest method

Natural regeneration is a cheap and easy way to revegetate riparian areas. For natural regeneration to be successful there needs to be a ready supply of seeds stored in the soil or in the canopy of plants on site or upstream. The fact that there appear to be no small seedlings at the moment does not mean there are no seeds in the soil, as any new seedlings may be grazed immediately. Once stock are excluded anything that germinates naturally will have a better chance of surviving.

Nature has an enormous capacity to heal and rebuild the landscape, just fence the stream, remove livestock, sit back and do nothing! Pioneer plants are the first to establish along rivers, often in large numbers. Species such as Silver wattle *Acacia dealbata* and Tree everlasting *Ozothamnus ferrugineus* are pioneer species found along rivers in the Midlands. These plants help rebuild the river landscape. The roots hold, condition and cool the soil ready for other seedlings. A variety of species will eventually dominate the landscape and pioneer plants will only appear again in large numbers when the land is trying to repair itself after damage from flood, fire, overgrazing or other disturbances. Simply fencing from livestock allows long grass to establish and this alone has many positive effects for the river including holding the soil, providing habitat for many small insects, reptiles, frogs and birds that cannot live amongst short grasses, filtering pesticides and nutrients and allowing the soil to become softer and more permeable to water, reducing runoff into the stream. If there is no regeneration after several years planting will need to be undertaken.

Tea-tree seedlings germinate after floods. Photo Rae Young.

3. Revegetating riparian areas

Revegetating riverbanks is in some ways a last resort option. That is, it is required where there is little or no native vegetation and the chances for natural regeneration are limited. In Tasmania, revegetation needs to be carefully considered as it involves significant investment in time, effort and resources. However, when successful it can deliver multiple benefits to both the river and the property.

Purpose of planting and methods

Revegetation of streambanks is usually done:

- to stabilise streambanks
- to improve water quality
- to provide habitat for fauna
- to provide economic benefits.

The aims of the planting will determine the approach to revegetation taken. For example, planting to improve water quality may be most effective along the small drainage lines that run through paddocks. Planting to stabilise banks will be most effective at the toe of the bank and on areas susceptible to erosion.

Once the aims of the revegetation are established it will be important to identify methods. The work may involve several techniques depending on the nature of the site or a single method. Whether it is direct seeding or planting or both, plants and seeds will need to be sourced, equipment and materials (fencing, growing or bulking mediums etc) organised.

The two most common methods used in revegetation are direct seeding and planting nursery stock. Planning is an essential part of successful revegetation and should occur at least 12 months ahead. Planning needs to consider:

- seed collection
- ordering plants, which are likely to require time to grow — up to 18 months depending on method (tubestock, advanced plants, longstem tubestock)
- site preparation (weed control, ripping)
- monitoring and maintenance.

WOOLGROWER PERSPECTIVES

Frank and Milly Youl, Barton

"The long-term plan is to fence the river off. We have got it fenced in odd places, we have got a bit more to do there. We haven't done any replanting but when we fence off there will be enough things happen, silver tussock and tea-tree and stuff that will be there to do that."

Photos Laura Eves.

Replanting was necessary at this location since there were no nearby sources of seed for natural regeneration.

Photo Michael Askey-Doran collection.

Planting

Planting is an effective means of revegetating areas and the outcomes are usually more predictable than for direct seeding. A number of different methods can be used including tubestock, longstem tubestock and advanced plants.

Tubestock plants

Tubestock are grown from seed with an initial addition of fertiliser, grown for 6 months and put outside for hardening after 2 months. They are the easiest way to put in a large number of plants as they are relatively cheap and easy to plant. The site needs to be well prepared, with the removal of competition for water and nutrients from introduced grasses. If the site is in a flood prone area spot spraying is adequate. Planting can be undertaken when the ground is moist and unlikely to dry out for some months. Plant losses can be high if there is an extended dry spell after planting. Guarding will need to be undertaken if browsing is a problem.

Advanced plants

More advanced plants are potted on from tubestock with fertiliser mixed into the soil and grown for 18 months in 140 mm pots or 24 months in 200 mm pots. In sites where browsing animals are a problem a few well grown trees may be a better option than many smaller cheaper trees that don't survive. Advanced plants have bigger root systems, are less likely to dry out, can withstand outbreaks of grazing and competition for moisture from surrounding grasses. Investing in a few advanced trees every year can have a significant effect on the landscape.

Photos Rae Young.

Left: Before replanting this site was prepared by herbicide spraying to reduce competition from weeds. Right: It was planted with a mix of trees and shrubs. Photos this page and opposite page Rae Young.

Success of plantings using different types of nursery stock

The table below shows the success of plantings of different types of nursery stock at two different sites on the Macquarie River. It is clear that survival varied greatly between the different sites, but larger plants tended to do better.

Per cent survival after two years:

	Lewisham	Beaufront
Plant type	% survival	% survival
Advanced plants (140 mm)	15.3	19.2
Advanced plants (200 mm)	21.5	50.5
Longstems	18.9	50.5
Tubestock	20.1	6.9

Longstem plants

Longstems are started as seedlings germinated in trays without fertiliser then pricked on into tubes with a special concentrated nutrient regime that aims to stimulate vertical growth but burn off roots (i.e. limit root expansion). These plants remain in tubes for 18 months, making sure the outer layer of the stem is hardened. Advantages of longstems and advanced plants include their improved tolerance to drought because of more deeply penetrating root systems and a capacity to cope with grazing because of their height.

Planting involves making a metre deep hole using a waterjet or post hole digger and the entire plant except for the top 5–10 cm is immersed into the cool, moist sub-soil. Soil is put back into the hole and watered well to remove air pockets. The plant now becomes a live cutting with each leaf node producing roots. The plant quickly develops a robust root system, allowing it to withstand floods and extended dry spells. With a large root system in moist ground these plants grow very quickly and are ideal for erosion control or in dry areas. Plants are more expensive than regular tubestock and take longer to plant.

Regrowth at the site one year later.

Regrowth at the site two years later.

Direct seeding

Direct seeding is quick, cheap and effective. Direct seeding of native trees and shrubs, like any field crop, requires excellent site preparation and watering or follow up rains to get good results. The areas to be sown need to be completely bare as grass and weeds will compete with germinating seed. Direct seeding is not appropriate if the site is likely to erode or if in a flood prone area as seed may wash away; however it is ideal along feeder creeks especially if near irrigated paddocks where the site can be watered. Direct seeding can be completed by contractors or by hand spreading of seed. Direct seeding is ideal for revegetating on a broadscale as very little effort is required, it's quick, easy and can be very effective if the conditions are right.

A simple form of direct seeding is the use of slash cut from local bank species; tea-tree works particularly well for this purpose. This can be pinned down with ringlock on bare areas. The capsules on the tea-tree will drop seeds and the slash will protect the seedlings from browsing and weather. Choose slash containing grey and woody capsules closed at the top.

The ground may need to be prepared including weed removal and ripping / scarifying the soil. On bare patches it may simply be a matter of using a heavy rake on any areas that have formed a hard crust that might inhibit germination and moisture absorption.

Species selection

The species used in riparian revegetation should reflect the locality and purpose of the planting. Local native plants provide the specific food, habitat and structure that birds and other animals require. Seeds and plants will be of the same 'provenance' which means that they will already be adapted to local temperature and other environmental conditions. Information on the common native plants found in riparian areas in some of Tasmania's wool growing districts can be found in Appendix 1.

Position of plants

When revegetating, the siting of different species is also important. The riparian area can be broken down into sections, each of which have slightly different characteristics, and consequently support different types of plants. For example, along some rivers woolly tea-tree most commonly occurs right on the edge of the stream, whilst blackwood and dogwood occur further back. Tea-tree may find it too dry further back from the river whilst the blackwood and dogwood may find it too wet right on the river's edge. It is important to try and replicate this pattern when revegetating the banks. It will also improve the success of your revegetation.

Sedges and herbaceous species are important in protecting the toe area of riverbanks. Species such as *Carex*, *Juncus*, *Schoenus* and *Eleocharis* have extensive underground root systems, which bind the soils. Many nurseries grow these plants, but they should also be encouraged to establish along the river if they occur locally.

Grasses and sedges in the clumps that have fallen from the tops of the banks can establish and help stabilise the toe, but this will only happen once some of the stream energy has been reduced. In some cases other actions may be needed to stabilise the banks before revegetation of the toe and vertical faces of banks can be proceed.

The soils on the bank faces are generally unfriendly, being compacted and having limited fertility. The banks are under regular pressure from the erosive action of water and any vegetation which establishes may be washed away. There may be a need to reduce the angle of the banks and run a heavy rake over them in order to break up any surface crusts, prior to revegetation.

To successfully revegetate the tops of riverbanks, a range of local tree, shrub and groundcover species can be used. The roots of trees and shrubs will penetrate deep into the soil profile helping to bind the soils together.

The information in Appendix 1 indicates where in the riparian area each species is likely to grow.

Different types of plants suit different parts of the riparian area.

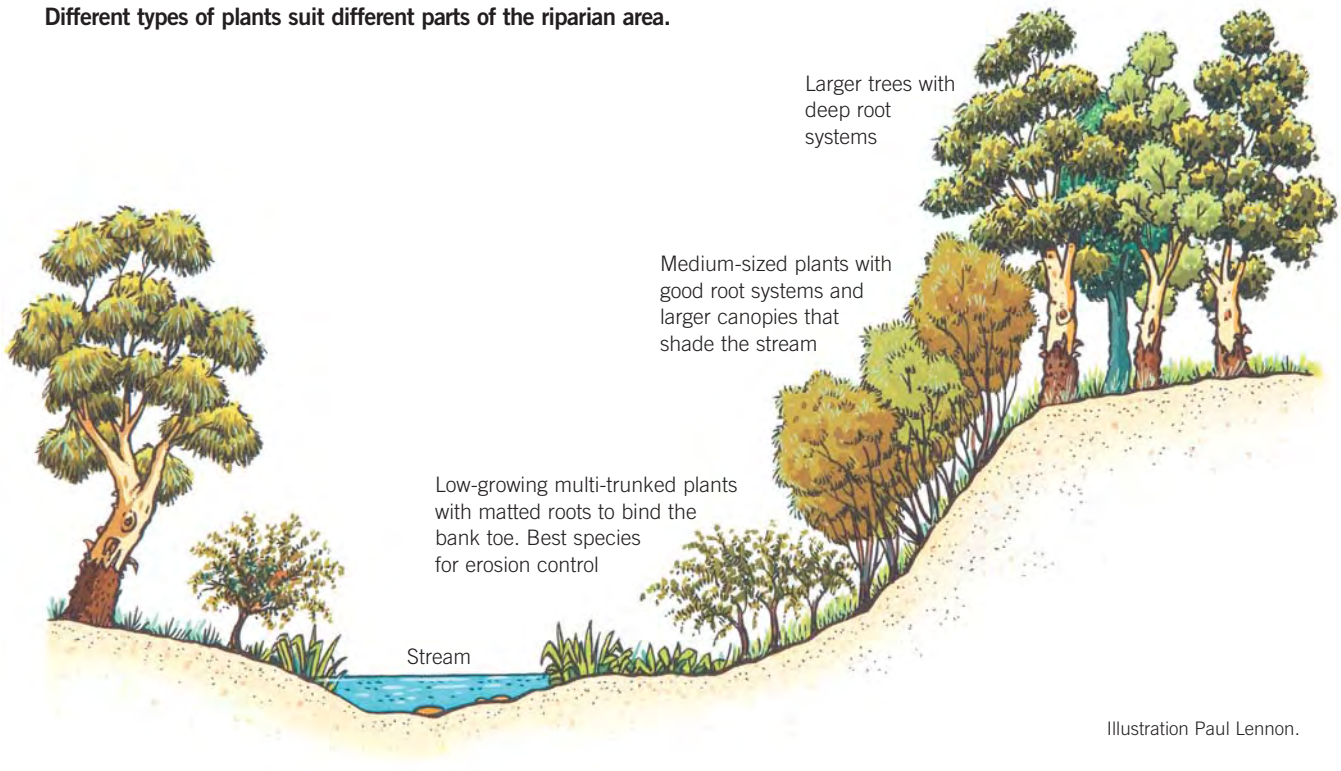
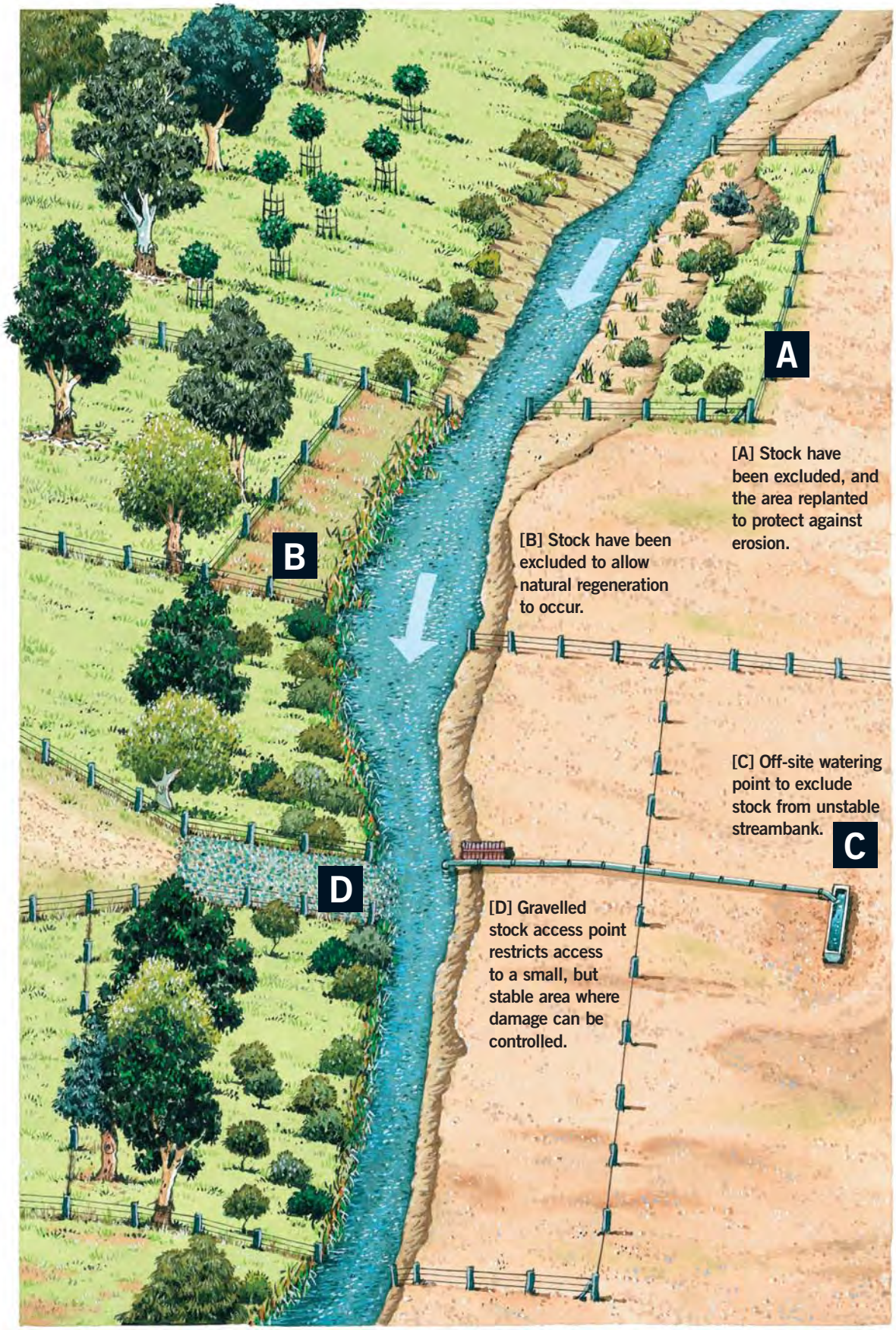
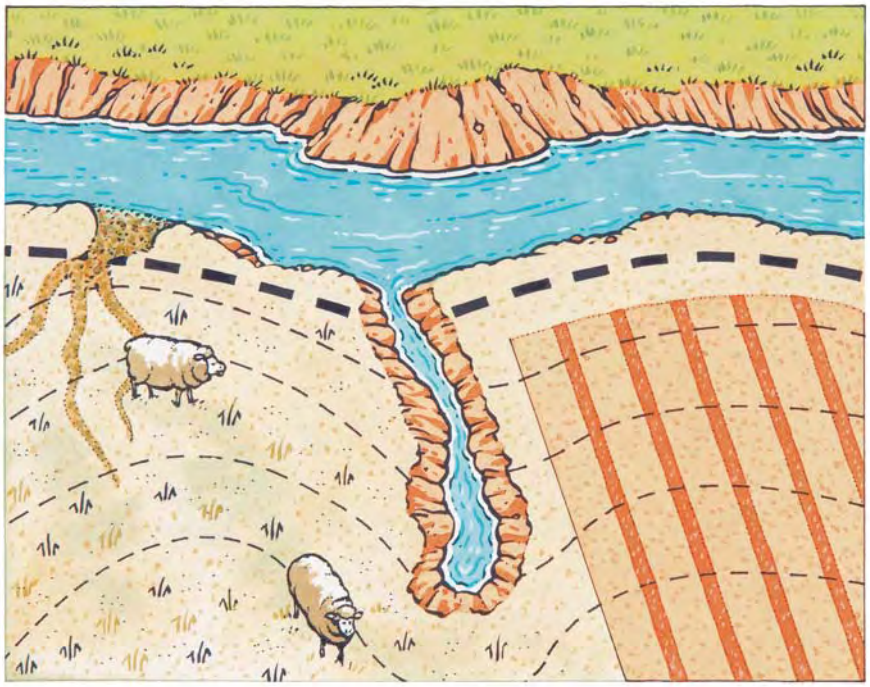


Illustration Paul Lennon.

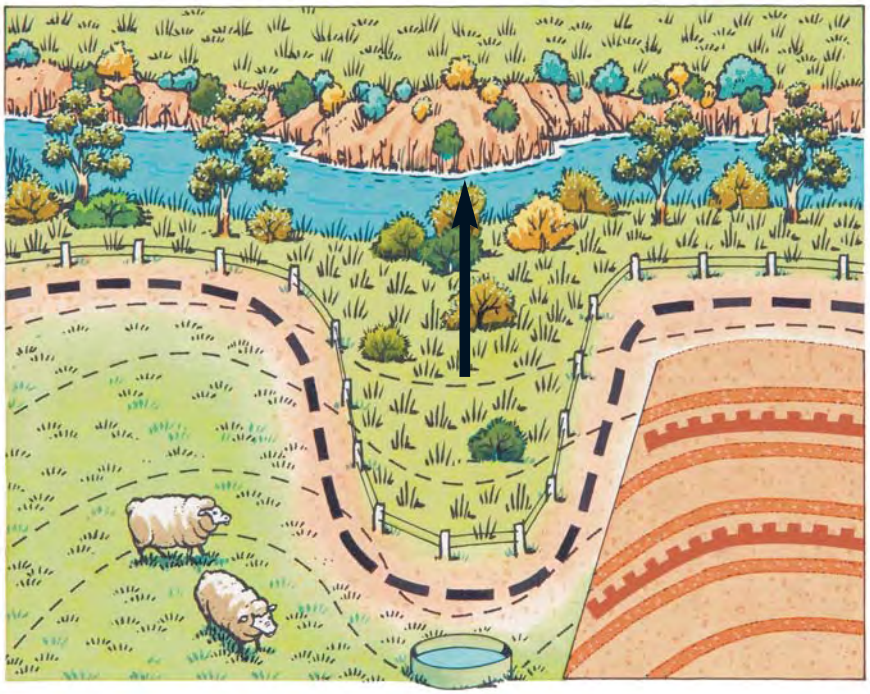


This diagram illustrates how management needs can vary along a watercourse and how you can stage your efforts of revegetating and restricting stock access to when time and resources are available. Illustration Paul Lennon.



Stock tracks
Erosion gully
Cropland
Vehicle track
Contours
Degraded pasture

A degraded stream and riparian area. Significant sediment and nutrient is derived from degraded pasture, poor crop layout, unlimited stock access and gully erosion. Illustrations Paul Lennon.



Riparian vegetation
Grass filter strip
Pasture
Cropland
Vehicle track
Contours
Contour banks
Concentrated flow
Fence
Off-stream watering

A riparian filter strip protects water quality by trapping sediment, absorbing nutrients and providing shade over the stream to reduce water temperatures. Crop layout and a vigorous pasture with good cover reduce the potential for soil erosion.

Placing feed and water troughs away from the creek can control stock and reduce erosion. Photo Roger Charlton.

4. Keeping stock where they belong

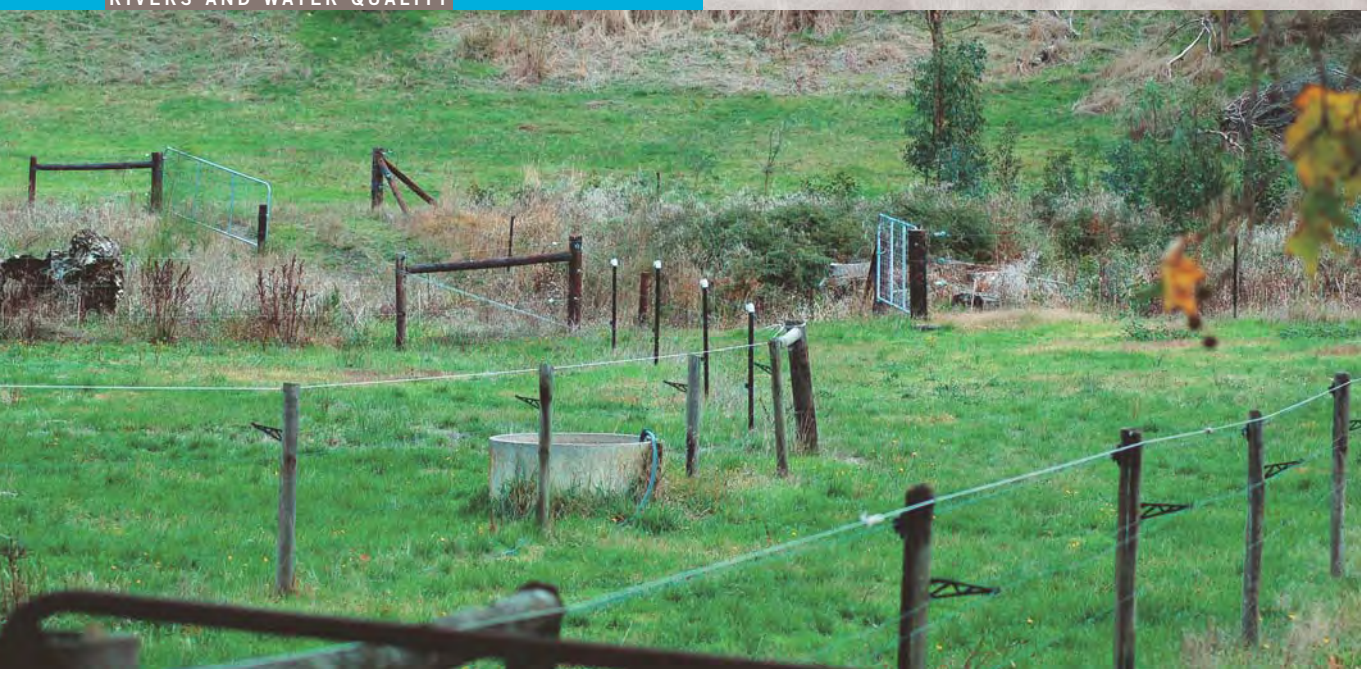
In order to protect plantings or maintain a healthy river environment, it is important that access by stock is controlled. This generally means fencing, but does not necessarily result in stock being totally excluded, rather the timing and stocking rate is carefully managed. Ideally riparian areas should be fenced above the limits of the highest flood, to minimise flood damage to fencing, etc. However, if this is not possible, or if grazing is to be totally excluded, there are a number of things to consider. The location and type of fencing used will depend on the purpose, topography, size of the area, flood regime and stock type.

Uncontrolled stock access. Photo Michael Askey-Doran collection.

Grazing principles

There are a number of techniques which can be used to reduce the impact of grazing in riparian areas (and other parts of the property if you wish to maintain healthy native vegetation in your grazing paddocks). These are:

1. Balance animal demand with available feed:
   - Determine stocking rates so that available feed is utilised, but there is enough plant material left to allow the plants to regrow and to protect the soils, conserve moisture and trap sediment. A minimum of 70% plant cover should be maintained at all times.
2. Distribute livestock impact evenly across the landscape:
   - Use a variety of tools such as fencing (temporary or permanent) and watering points to control where stock graze so that no particular areas become overgrazed (see following pages).



Well fenced stock crossing. Photo Roger Charlton.

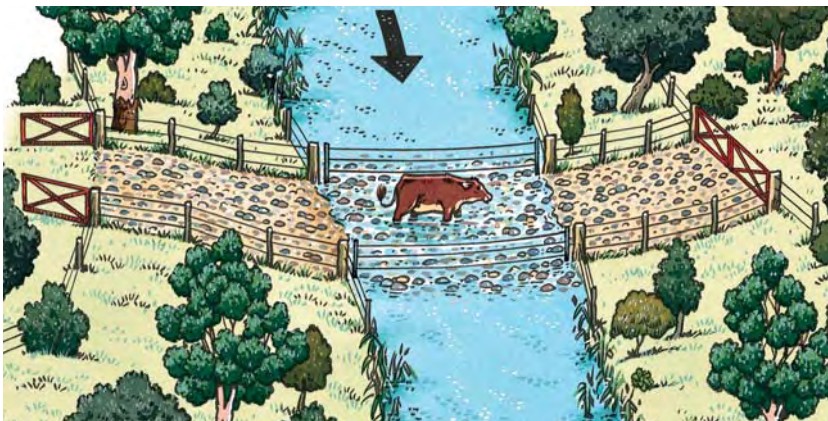
3. Minimise or avoid grazing at vulnerable times, including:
   - For riparian areas this may be when soils and banks are saturated and vulnerable to damage from trampling.
   - When there is little available green feed available, and livestock are likely to start browsing trees and shrubs.
   - Periods when native grasses are flowering and setting seed. Some native grasses handle being grazed quite well, but if they are never able to set seed, they will eventually be lost from the site, leading to a decline in feed quality and loss of perennial plants.
   - Periods after fires and floods, while recovery from the disturbance is occurring, and when many native plants are likely to germinate.
4. Allow areas rest after being grazed:
   - Plants need some time, during the growing season, to rest so that they can rebuild roots and put on new growth for their long-term survival.

Stock watering options

Given the choice, stock generally prefer to drink clean water from a trough rather than muddy, contaminated water in a stream. Keeping stock out of streams permanently will involve providing alternative watering. Several options exist:

- Formed access points at suitable sites along the watercourse. They should be situated on the inside of meander bends in areas which already have a hardened base. Alternatively, the area can be protected with rocks or other materials to prevent erosion. Points chosen should be relatively flat and stock should not be able to move up or downstream or into adjacent riparian areas. Note that these principles also apply if you need to construct crossing points on your stream, to allow movements of stock between paddocks on opposite sides.

An example of how a stock crossing can be constructed to minimise damage to the waterway. Illustration Paul Lennon.



– Water troughs outside the riparian zone. Water can be fed to troughs by gravity or pumping. These can be set up to be shared between two paddocks, or as a central watering point in a cell grazing system.
– There is a range of pumps available, including solar powered, electric and nose pumps (which allow cattle to regulate water in the trough).

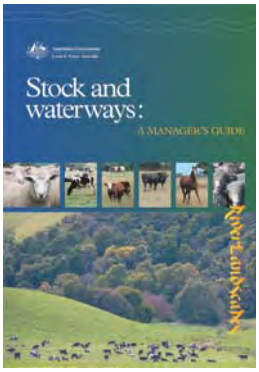
One of the most effective ways to provide off-stream watering is to capture water in higher country using a dam and then gravity feed down to troughs. These may be used as a central watering point in a cell grazing system, shared between paddocks, or moved periodically to spread grazing pressure and improve feed utilisation. The dam needs to be large enough to store enough water for stock needs throughout the year or longer and evaporation losses need to be taken into consideration.

Gravity fed water is the cheapest option but if this isn't possible water can be pumped from the stream to troughs or to a higher storage point where it can then be gravity fed to troughs down slope. There is a range of pumps available including ram pumps which use the streamflow to operate a ram that pumps a smaller volume of water up to a storage tank, solar powered and air–driven pumps.

For further information about pumps and fences (described overleaf), see publications section beginning on page 75.

Managing Streamsides: Stock control, fencing and watering options, David Wright and Terence Jacobson, DPIW.

Stock and waterways: A manager's guide, Jillian Staton and Jenny O'Sullivan, LWA.



Above: Portable trough. Photo Jenny O'Sullivan.

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

Above: Nose pump. Photo Michael Askey-Doran collection.

Below: Solar powered pump with back up petrol pump. Photo Roger Charlton.

Fencing options in flood prone areas

Fencing streams is sometimes easier said than done. Streams with high banks that can be fenced above the limits of the highest flood can be fenced using regular farm fencing but streams on the floodplain can be a challenge. In order to ensure the streambank and channel remain stable and benefit the property, an adequate width needs to be fenced (preferably more than 6 metres). Fencing on floodplains can be achieved more readily when the fencing is parallel to water flow but this is often not possible and minimising flood damage to fences can be achieved in a number of ways.

There are a number of fencing options available for riparian areas. These include:

- drop and lay down fences
- electric fences
- suspended fences and flood gates
- non-electric suspended fences
- electrified flood gates
- permanent and semi-permanent electrified stream crossing fences
- semi-permanent fences with disposable sections
- mesh flood gates
- electronic fences.

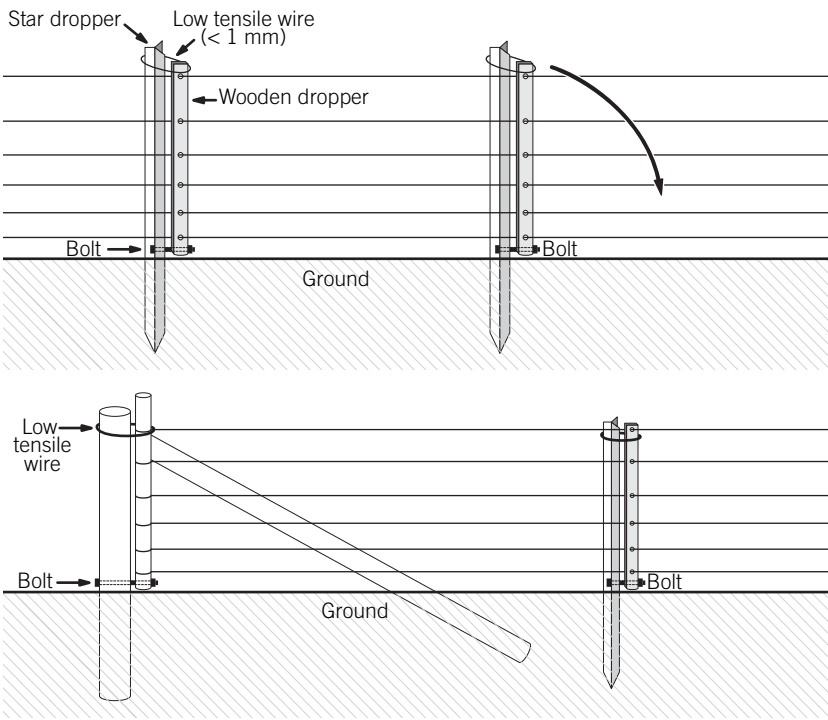
These types of fences are discussed in more detail in the publications listed on the previous page.

Electrified chain flood gate. Photo Jenny O'Sullivan.

Drop and lay down fences

Ian Bell has designed an innovative drop down fence (as seen on ABC's *The New Inventors* program) that has panels hinged at the bottom and held in place by a tension bolt at the top. When flood debris pushes against a slack wire underneath the mesh, the bolt is released and the fence lays flat on the ground allowing flood water and trash to pass over. Once the flood has passed the panel can be lifted up and re-hung using the tension bolt.

Other drop/lay down fence designs



Drop/lay down fence. Upper diagram showing drop-down wooden posts at star droppers and bottom diagram showing drop-down end strainer post. Photo Ian Bell.

5. Are weeds a problem?

Weeds like disturbed environments. Rivers are naturally prone to soil disturbances, and water provides a means to disperse weed seeds. Weeds will out-compete native species for light and nutrients, often growing faster than their native counterparts. The number and diversity of weeds in riparian areas increases as the stream or river flows downstream from the healthier headwaters and into more highly developed and fertile alluvial soil flats. Weed infestations can also occur in highly degraded sites once grazing pressure is removed, particularly if there is a lot of bare ground and nutrient levels are high (both are common if livestock previously spent large amounts of time in the riparian area).

WOOLGROWER PERSPECTIVES

Valerie Le Maitre, Lochiel

"We also have to keep track of the invasiveness of some of the odds and ends, which have come in. I think it is impossible to remove the crack willows and the cumbungi and that sort of stuff but I think an effort should be made to control it the best we can. I mean there should be an ongoing mechanism where you have been funded or after you have expended the money and paid for specific cleaning up of the river."

Photo Laura Eves.

Crack willow infests many rivers in Tasmania. Photo Lizzie Pope.

Willows

Willows are a major environmental weed in the wool growing areas of Tasmania. Being naturally riparian species, they are perfectly adapted to colonising and thriving along Tasmania's rivers.

Generally, two methods for removing willows on the bank are used:

- cutting the willow off at stump level and painting it with a herbicide
- poisoning (stem injection, frill cuts or ring-barking) the entire tree on-site and cutting it off at stump level once dead.

Whatever method is used it is important that the stumps are retained in the ground to stabilise the streambanks until native vegetation has established. Willows growing in the stream channel are not so straightforward. Advice should be sought before their removal.

Top: Cut stump. Above: Stem injection. Below: replanting following willow removal. Photos Lizzie Pope.

It is important not to remove too much willow in a short period of time because:

- the greater the amount of willow removed from a river the greater the chance for problems such as erosion, and the harder it will be to manage any subsequent problems. Too much willow removal can impact on the ecology of the river
- the potential to release silt and destabilise soil is high. This will increase turbidity and blanket aquatic habitat with silt
- duty of care: we should always be good neighbours, and excessive clearing of willows can lead to water quality, flooding and channel stability problems downstream. It is important to work cooperatively with all landowners along the river.

WOOLGROWER PERSPECTIVES

Lindsay and Rae Young, Lewisham and Green Valley

"We have removed all the willows from half of the river and this winter we are going to plant longstems to try and get some native vegetation going. The other half of the river I want to actually do it the opposite way; get the native vegetation going before we remove the willows. Because at the moment the willows are the only things that are providing any shade at all for the river, for the fish or whatever."

Photo Laura Eves.

Other weeds

Gorse and hawthorn do not receive as much attention as willows but are significant riparian weeds. Traditionally gorse is controlled by fire, however this can be a problem in fire sensitive riparian vegetation. Fire is only a stop-gap measure as gorse has prolific soil seed banks and germinates freely after fire. Gorse removal needs to be done in a systematic way that may require a number of years of continued action. Hawthorn can be eradicated by the cut and paint method used for willows.

Before removing hawthorn, blackberries or gorse from riparian areas it is important to identify the role that they play in bank stability and habitat provision. Blackberries can protect seedlings from browsing animals. When no other riparian vegetation exists, blackberries and hawthorn should be left in place, or removed in small sections at a time (revegetating areas as they are cleared). In landscapes where little remnant vegetation remains, riparian areas, even if they are dominated by introduced species, may provide the last refuge for native animals.

Use only herbicides registered as suitable in water-courses. Seek advice from DPIW on the most suitable herbicide to use and how it should be applied.

Further information

Willow Management Guideline, Rivercare, DPIW.

Guideline for safe and effective herbicide use near water, Rivercare, DPIW.

Strategic planning for willow management in Tasmania, 2003, Tasmanian Conservation Trust.

'Controlling willows along Australian rivers', *Technical Guideline*, no. 6, LWA.

Photo Laura Eves.

WOOLGROWER PERSPECTIVES

Damian Gee, Royslea and North View

"As kids we used to go down to the waterhole on St Paul's River with Mum in a vehicle and have a swim for an hour or so in the afternoon. It used to be all thick with gorse on the floodplain there. As part of the Landcare project we mulched the gorse and it did a good job. It is starting to come back in places so I will need to come in and spray it or rip it up to get on top of it. At a certain stage of the gorse, when it is really young, coming up from seed and shooting, the sheep actually eat it when it is still soft. The gorse was knocked down with a big roller on the front of the tractor and then behind it was mulched 6 inches into the ground. The gorse was over 10 feet high in places."

Photo Roger Charlton.

Small photo at left Amy Jansen. Other photos Laura Eves.

Bringing it all together — rivercare planning

The condition of our rivers is a major concern for land managers in Tasmania. Over the last decade community groups have undertaken a broad range of river rehabilitation projects ranging from straightforward fencing and revegetation through to more complex erosion and woody weed control measures. As these projects became more complex, and risks associated with undertaking works increased, the need for careful planning became essential. Rivercare planning is a means of documenting the condition of a river, identifying the issues affecting that condition, determining the appropriate strategies to improve condition and prioritising where works will be done.

Rivercare planning allows you to develop a clear picture of your river along with the issues and solutions so that right from the start you have a good idea of where the investment of time, effort and money can be most effective. It also helps you to avoid pitfalls, such as problems that are too difficult to tackle or the actual benefit received is relatively minor compared to the effort required. Planning places the problems along a river in context and helps you to determine the real causes for issues such as erosion. For example, erosion on one part of the river may appear bad, but in actual fact, it could have been like that for a long time, and is relatively minor compared to erosion elsewhere along the river. Additionally, the cause of that erosion may stem from a problem further upstream, and unless that is fixed, tackling the erosion on site may be a waste of time.

Rivercare planning can be broken down into a number of stages:

1. Initial consultation with landowners/ community group
2. Desktop study to gather information related to the river
3. River survey to identify:
   - biological and physical characteristics
   - river condition
   - important assets
   - management issues
4. Document findings of the river survey
5. Report findings and consult with community on priorities
6. Complete plan.

Water quality sampling, Tasmania. Photo courtesy Peter Davies.

Community consultation

It is important that the rivercare plan is owned by the landowners that live along the river. For this to happen community consultation is essential to the development of the plan. The amount of consultation will vary from group to group, but there needs to be at least an initial meeting at the start and a reporting session towards the end before the plan is completed. Landowners should also participate in the surveys, as this allows them to pass on their knowledge of the river and its problems, as well as learn from the various "experts" that might be involved in the survey work.

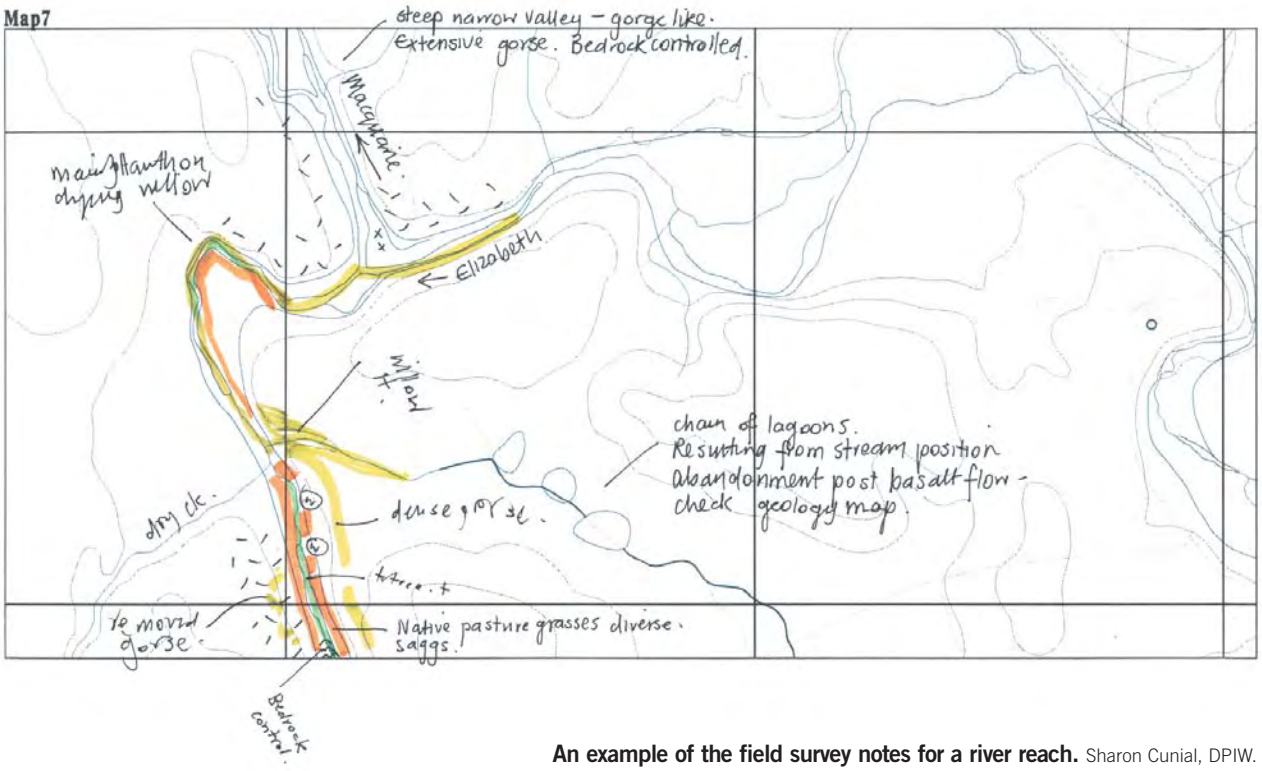
Desktop study

A desktop study provides an opportunity to gather any existing information on your river. This can be in the form of existing reports on water quality, flora and fauna surveys etc. Historical information exists in the form of old survey maps, aerial photos starting from the late 1940s, old paintings and sketches, diaries and historical studies. This information provides some insight into changes in the river over time and some clues on how the river looked when Europeans first arrived.

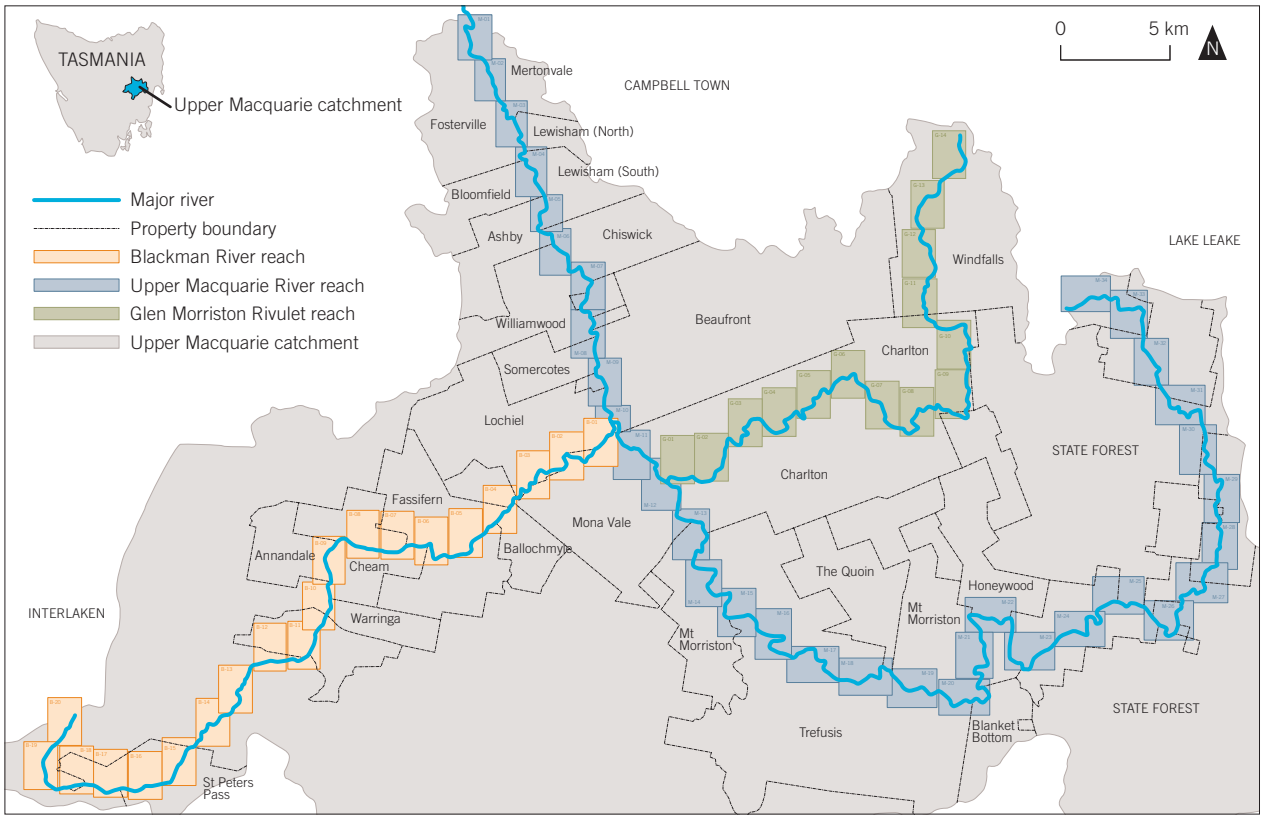
River characterisation

The aim of the river survey is to identify the natural biological and physical components of the river, determine the important functions they perform and assess their condition and potential to be restored. The physical component of the river is based on geomorphic or river-based landform units. These might include features such as valleys, gorges, floodplains and broadwaters. The biological component focuses largely on riparian vegetation, but there is no reason that other biological components such as terrestrial fauna and aquatic bugs could not be included. Linkages between the physical and biological components are identified, especially in relation to condition and functions. For example, particular plant species and/or plant communities may be confined to rocky gorges or alluvial floodplains. By linking the biological surveys to the physical surveys, these relationships can be identified.

In assessing the condition of the river, scores or categories are used to define the relative condition of the vegetation and physical condition of the river. The vegetation is divided into areas dominated by woody weeds versus native vegetation, whilst the physical condition is broken down to different types of streambank and streambed problems. The extent to which the different components are broken down depends on the level of detail required in the plan. There are different methods available to assess condition including River Styles®, Rapid Assessment of Riparian Condition (RARC) and vegetation benchmarking.



An example of the field survey notes for a river reach. Sharon Cunial, DPIW.



River sections for the Upper Macquarie River Rivercare Plan. Hamlet (2002).

The rivercare plan

A rivercare plan contains the results of the surveys, desktop analysis and landowner consultations. The river survey results and condition analysis are usually presented in the form of maps and tables that cover sections of river from 1–2 kilometres in length. However, the scale at which the plan operates depends on the objectives of the plan and the amount of time and resources that are available. One of the main outputs of the plan is the list of priority actions for the landowners to implement. The priorities are classified from highest to lowest and include an explanation of possible actions required to address the problem.

The rivercare plan is most useful if it covers either the entire river or sub-catchments within a large river system. This allows the plan to address a range of issues that are affecting the condition of the river along multiple reaches. This provides a more accurate picture of what might be causing particular problems. Determining priorities for rehabilitation is a much easier and more effective use of limited resources when done over several property frontages rather than for a single property. This however does not stop individual landowners implementing actions identified for their section of the river.

The map on the following pages shows an example of a rivercare plan represented as a map, with significant physical and biological characteristics identified and priority actions for different sections of the river outlined.

Further reading

Geomorphology and River Management — Application of the River Styles Framework, 2005, Brierley, G. & Fryirs, K., Blackwell Publishing.

A Rehabilitation Manual for Australian Streams Volumes 1 & 2, 2000, Rutherfurd, I., Jerie, K. & Marsh N., Land & Water Australia.

Overleaf: Crabtree Rivulet Rivercare Plan. Telfer (2003).

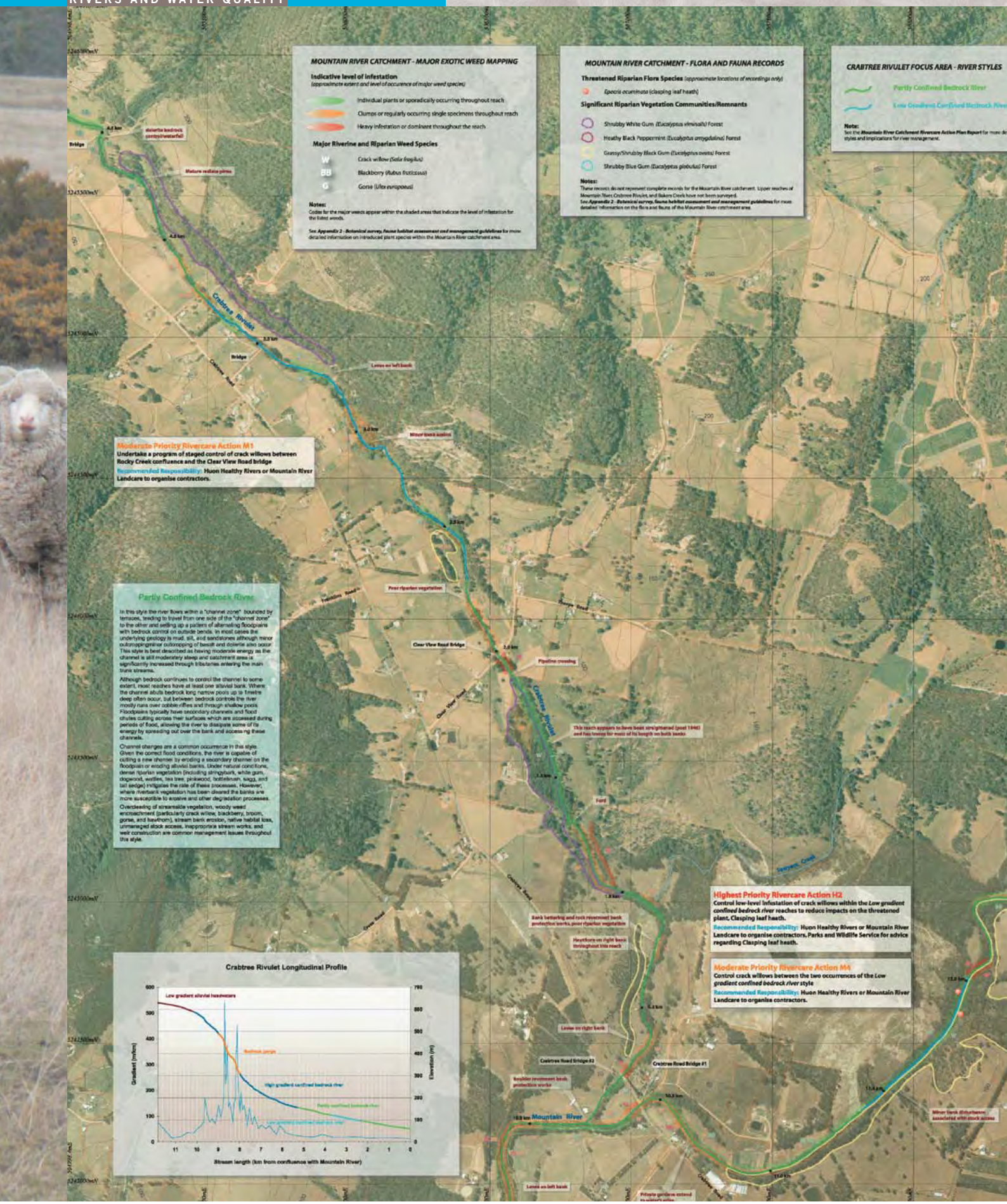
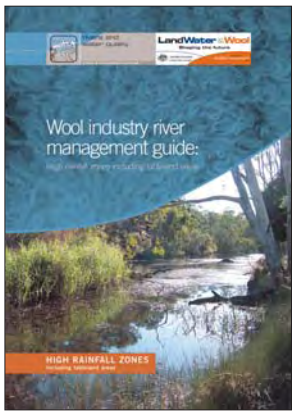

MOUNTAIN RIVER CATCHMENT - MAJOR EXOTIC WEED MAPPING
Indicative level of infestation
(approximate extent and level of occurrence of major weed species)
Individual plants or sporadically occurring throughout reach
Clumps or regularly occurring single specimens throughout reach
Heavy infestation or dominant throughout the reach
Major Riverine and Riparian Weed Species
W Crack willow (Salix fragilis)
BB Blackberry (Rubus fruticosus)
G Gorse (Ulex europaeus)
Notes:
Codes for the major weeds appear within the shaded areas that indicate the level of infestation for the listed weeds.
See Appendix 2 - Botanical survey, fauna habitat assessment and management guidelines for more detailed information on introduced plant species within the Mountain River catchment area.
MOUNTAIN RIVER CATCHMENT - FLORA AND FAUNA RECORDS
Threatened Riparian Flora Species (approximate locations of recordings only)
Epacris acuminata (clasping leaf heath)
Significant Riparian Vegetation Communities/Remnants
Shrubby White Gum (Eucalyptus viminalis) Forest
Healthy Black Peppermint (Eucalyptus amygdalina) Forest
Grassy/Shrubby Black Gum (Eucalyptus ovata) Forest
Shrubby Blue Gum (Eucalyptus globulus) Forest
Notes:
These records do not represent complete records for the Mountain River catchment. Upper reaches of Mountain Rivers Crabtree Rivulet, and Bakers Creek have not been surveyed.
See Appendix 2 - Botanical survey, fauna habitat assessment and management guidelines for more detailed information on the flora and fauna of the Mountain River catchment area.
CRABTREE RIVULET FOCUS AREA - RIVER STYLES
Partly Confined Bedrock River
Low Gradient Confined Bedrock River
Note:
See the Mountain River Catchment Rivercare Active Plan Report for more de
styles and implications for river management.
Moderate Priority Rivercare Action M1
Undertake a program of staged control of crack willows between Rocky Creek confluence and the Clear View Road bridge
Recommended Responsibility: Huon Healthy Rivers or Mountain River Landcare to organise contractors.
Partly Confined Bedrock River
In this style the river flows within a "channel zone" bounded by terraces, tending to travel from one side of the "channel zone" to the other and setting up a pattern of alternating floodplains with bedrock control on outside bends. In most cases the underlying geology is mud, silt, and sandstones although minor outcropping/minor outcropping of basalt and dolerite also occur. This style is best described as having moderate energy as the channel is still moderately steep and catchment area is significantly increased through tributaries entering the main trunk streams.
Although bedrock continues to control the channel to some extent, most reaches have at least one alluvial bank. Where the channel abuts bedrock long narrow pools up to 1metre deep often occur, but between bedrock controls the river mostly runs over cobble riffles and through shallow pools. Floodplains typically have secondary channels and flood chutes cutting across their surfaces which are accessed during periods of flood, allowing the river to dissipate some of its energy by spreading out over the bank and accessing these channels.
Channel changes are a common occurrence in this style. Given the correct flood conditions, the river is capable of cutting a new channel by eroding a secondary channel on the floodplain or eroding alluvial banks. Under natural conditions, dense riparian vegetation (including stringybark, white gum, dogwood, wattles, tea tree, paperbark, tasmanian, sagg, and tall sedge) mitigates the rate of these processes. However, where riverbank vegetation has been cleared the banks are more susceptible to erosive and other degradation processes.
Overclearing of streamside vegetation, woody weed encroachment (particularly crack willow, blackberry, broom, gorse, and hawthorn), stream bank erosion, native habitat loss, unmanaged stock access, inappropriate stream works, and weir construction are common management issues throughout this style.
Crabtree Rivulet Longitudinal Profile
Low gradient alluvial headwaters
Bedrock gorge
High gradient confined bedrock river
Partly confined bedrock river
Low gradient confined bedrock river
Gradient (m/km)
Elevation (m)
Stream length (km from confluence with Mountain River)
Highest Priority Rivercare Action H2
Control low-level infestation of crack willows within the Low gradient confined bedrock river reaches to reduce impacts on the threatened plant, Clasping leaf heath.
Recommended Responsibility: Huon Healthy Rivers or Mountain River Landcare to organise contractors, Parks and Wildlife Service for advice regarding Clasping leaf heath.
Moderate Priority Rivercare Action M4
Control crack willows between the two occurrences of the Low gradient confined bedrock river style
Recommended Responsibility: Huon Healthy Rivers or Mountain River Landcare to organise contractors.
Bridge
Mature radiata pines
Crabtree Rivulet
Crabtree Road
Leves on left bank
Minor bank scalds
Poor riparian vegetation
Frankton Road
Rowes Road
Clear View Road Bridge
Pipeline crossing
Clear View Road
This reach appears to have been straightened (post 1946) and has leves for most of its length on both banks
Ford
Sawyers Creek
Bank battering and rock revetment bank protection works, poor riparian vegetation
Hawthorn on right bank throughout this reach
Leves on right bank
Crabtree Road Bridge #2
Crabtree Road Bridge #1
Boulder revetment bank protection works
Mountain River
Minor bank disturbance associated with stock access
Leves on left bank

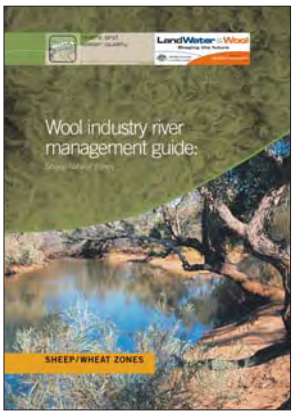
Photo Laura Eves.

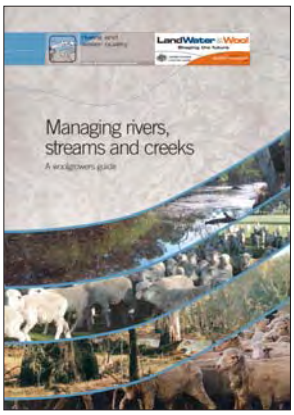
Water photo Roger Charlton. Other photos Laura Eves.

Further information

Publications for woolgrowers







The *Wool industry river management guides* bring together the latest science and recommended management practices for riparian areas within the context of a commercial wool growing property. The Guides are available for the high rainfall regions (above 600 mm) and sheep/wheat regions (300–600 mm) of Australia. Each book has over 200 full-colour pages.

In addition www.rivers.gov.au/lww offers an active contents list which will give you a snapshot of what is in each section.

High rainfall zone: product code PX050951
Sheep/wheat zone: product code PX050952

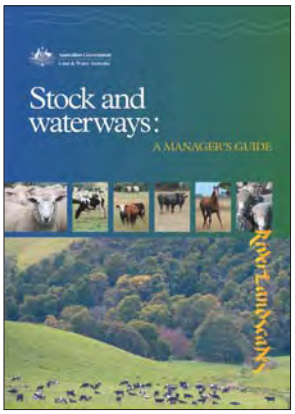
Managing rivers, streams and creeks: A woolgrowers guide — is a summary of the key recommendations from the 'Wool industry river management guides' and provides an introduction to river and riparian management issues on farm.

Product code PX051003

Are my waterways in good condition? — is a checklist that provides colour coded pictures that you can use to assess the condition of your stream or creek. It is a quick and easy way to work out the health of the streams or creeks running through your property, and it suggests management actions to improve or maintain these vital parts of your farm.

Product code PB061114

Photo Laura Eves.



River insights — this publication features the stories of ten woolgrowers and what has motivated them to manage their rivers, creeks and streams in ways that make both economic and environmental sense.

Product code PK050950

Stock and waterways: a manager's guide — offers practical advice on how stock farmers can manage riparian land both productively and sustainably, and includes a number of case studies from farmers throughout Australia who have seen the benefits of changing their management practices.

Product code PR061132

Rapid Appraisal of Riparian Condition: Technical Guideline for the wool-growing regions of Tasmania — the Rapid Appraisal of Riparian Condition (RARC) is a 'tool' that enables people to assess the ecological condition of riparian habitats using indicators that reflect different features of riparian zone functioning. Training is required to use the RARC, contact DPIW on page 78.

Product code PB061229 (also available from DPIW)

River Landscapes Legacy CD — brings together 15 years of work by the National Riparian Lands R&D Program. It contains fact sheets, guidelines and manuals on different riparian management issues, as well as PowerPoint presentations that highlight key findings from the Program.

Product code EC061241

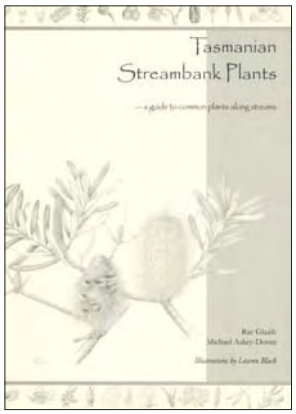
These products are available from CanPrint Communications on freecall 1800 776 616 in hard copy, or can be downloaded from — www.landwaterwool.gov.au or www.rivers.gov.au

Photo Laura Eves.

Tasmanian publications

Tasmanian Streambank Plants, Glazik, R., Askey-Doran, M. & Black, L. 2004, Rivercare Section, Department of Primary Industries, Water and Environment, Hobart. This book aims to help people identify common plants that occur along Tasmanian streams. Thirty two plant species are described, with notes on their distribution, habitat, propagation and revegetation potential. Guidance is also provided on how to care for and manage these plants in riparian areas.

Willow Management Guideline, Rivercare Section, Department of Primary Industries, Water and Environment, Hobart. The purpose of this guide is to provide an introduction to the impacts of willows on our environment and to offer a range of options for their management and control. The guide covers basic information on impacts, biology, planning, control techniques, monitoring and evaluation.



Growing native plants from seed in Tasmania, Glazik, R. 2006, Rivercare Section, Department of Primary Industries and Water, Hobart. Propagating plants from seed requires little equipment and can be very rewarding. This pamphlet has information on: seed collection, cleaning and storage, propagation mixes, basic materials required for growing plants, pre-germination requirements, time from sowing to planting and, seed longevity.

Guideline for safe and effective herbicide use near water, Noble, M. 2002, Rivercare Section, Department of Primary Industries and Water, Hobart. This guide discusses ways to minimise the use and impacts of herbicides on waterways.

Postcard fact sheets on river management issues that matter to woolgrowers. These postcards provide fast facts on topics identified by woolgrowers as being important to know about when managing rivers and stock. Topics include managing cumbungi, algal blooms and the problems of rivers as unreliable boundaries. The easy-to-read style puts woolgrowers in touch with where to go for more information.

These Tasmanian products are freely available from the Department of Primary Industries and Water — www.dpiw.tas.gov.au

Other useful publications

Common Grasses of Tasmania: An agriculturalists' guide, Lane, P., Morris, D. & Shannon, G. 1999, Tasmanian Environment Centre Inc., Hobart (www.tasmanianenvironmentcentre.org.au).

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

Tasmanian contacts

Department of Primary Industries and Water
134 Macquarie Street (GPO Box 44)
Hobart TAS 7000
Tel: 1300 368 550
Web: www.dpiw.tas.gov.au

Regional NRM bodies (see web address below)
NRM North
49–51 Elizabeth Street, Launceston TAS 7250
Tel: 03 6333 7777
E-mail: admin@nrmnorth.org.au

NRM South
13 St Johns Avenue, New Town TAS 7008
Tel: 03 6208 6111
E-mail: admin@nrmsouth.org.au

Cradle Coast NRM
PO Box 338, Burnie TAS 7320
Tel: 03 6431 6285
E-mail: sfenner@cradlecoast.com

Web: www.nrmtas.org/about/regionSelect.shtml

References

Askey-Doran, M.J. 1993, *Riparian vegetation in the Midlands and Eastern Tasmania*, Parks and Wildlife Service, Hobart, Tasmania.

Barrett et al. 2003, *The new atlas of Australian birds*, Birds Australia, Hawthorn East, Victoria.

Donaghey, R. 2005, *Birds on farms: a glovebox guide to birds and habitat restoration and management in NW Tasmania*, North-West Environment Centre, Launceston, Tasmania.

Hamlet, A.G. (ed.) 2002, *Upper Macquarie Catchment Management Plan, First Edition*, Northern Midlands Council, Longford, Tasmania.

Munks, S.A. (ed.) 1996, *A guide to riparian vegetation and its management*, Department of Primary Industry and Fisheries, Tasmania.

Telfer, D. 2003, *Mountain River Catchment — Rivercare Plan*, Mountain River Catchment Landcare Group.

Appendices

Appendix 1. Plant species found on some rivers in the wool growing areas of Tasmania

On the following pages are lists of plant species found within the given altitudinal ranges (metres above sea level) for a number of rivers in the wool growing areas of Tasmania (see map at the end of the section). For each river and altitudinal zone, lists of ground covers, shrubs and trees are provided for the lower, middle and upper sections of the riparian area. The figure below indicates these sections.

The lower section of the river may include marshes and the toe of the streambank. These areas will probably be submerged during flood events. The grassy or non-woody plants in this area often regenerate readily without the need for planting. Shrubs growing along the streambank edge are multi-trunked plants with fine matting roots that hold and bind the soil together. These plants are designed to bend without breaking during floods.

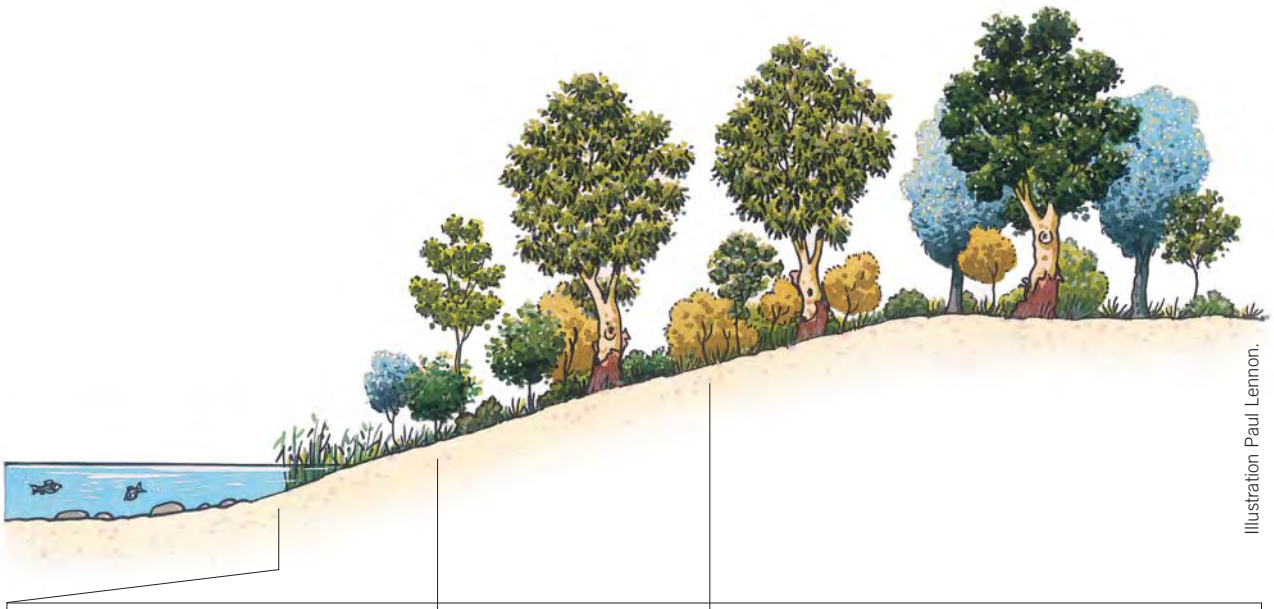


Illustration Paul Lennon.

LOWER	MIDDLE	UPPER
The lower section which includes the toe of the bank is immediately adjacent to the general summer low-water level. It may become submerged during winter flows.	The middle section starts at the edge of general winter level. It is only likely to become submerged during floods.	The upper section is the area which is submerged with only rare high level floods.

Note that only the most common plants found in each situation are listed. Asterisks indicate groups suitable for planting. These lists are derived from a survey of riparian vegetation in the Midlands by Askey-Doran (1993) and published in Munks (1996).

Profile 1. Macquarie River 100–200 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Acaena novae-zelandiae Biddy-widdy	*Geranium potentilloides* Mountain geranium	*Geranium potentilloides* Mountain geranium
Gratiola peruviana Austral brooklime	*Oxalis perennans* Native oxalis	*Euryomyrtus ramosissima* Rosy heath myrtle
Carex appressa Tall sedge	*Acaena echinata* Sheeps burr	*Oxalis perennans* Native oxalis
Poa labillardierei Tussock grass	*Gratiola peruviana* Austral brooklime	*Rumex brownii* Swamp or slender dock
Lomandra longifolia Sagg	*Carex appressa* Tall sedge	*Acaena echinata* Sheeps burr
SHRUBS	*Poa labillardierei* Tussock grass	*Acaena novae-zelandiae* Biddy-widdy
Hakea microcarpa Small-fruit hakea	*Lomandra longifolia* Sagg	*Gratiola peruviana* Austral brooklime
TREES	**SHRUBS***	*Veronica gracilis* Slender speedwell
Leptospermum lanigerum Woolly tea-tree	*Melaleuca gibbosa* Small leaved melaleuca	*Carex appressa* Tall sedge
	Hakea microcarpa Small-fruit hakea	*Juncus pauciflorus* Loose flower rush
	TREES	*Poa labillardierei* Tussock grass
	Leptospermum lanigerum Woolly tea-tree	*Themeda triandra* Kangaroo grass
		Lomandra longifolia Sagg
		SHRUBS*
		Melaleuca gibbosa Small leaved melaleuca
		Epacris impressa Common heath
		TREES*
		Leptospermum lanigerum Woolly tea-tree

Profile 2. Macquarie River 200–300 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Hydrocotyle sibthorpioides Shining pennywort	*Oxalis perennans* Native oxalis	*Dichondra repens* Kidney weed
Oxalis perennans Native oxalis	*Acaena novae-zelandiae* Biddy-widdy	*Oxalis perennans* Native oxalis
Carex appressa Tall sedge	*Carex appressa* Tall sedge	*Carex appressa* Tall sedge
Lepidosperma laterale Variable sword-sedge	*Lepidosperma laterale* Variable sword-sedge	*Lepidosperma laterale* Variable sword-sedge
Ehrharta stipoides Weeping grass	*Ehrharta stipoides* Weeping grass	*Ehrharta stipoides* Weeping grass
Poa labillardierei Tussock grass	*Poa labillardierei* Tussock grass	*Poa labillardierei* Tussock grass
Lomandra longifolia Sagg	*Lomandra longifolia* Sagg	*Lomandra longifolia* Sagg
SHRUBS	**SHRUBS***	**SHRUBS***
Beyeria viscosa Pinkwood	*Acacia mucronata* Variable sallow wattle	*Acacia verticillata* Prickly mimosa
Acacia mucronata Variable sallow wattle	*Acacia verticillata* Prickly mimosa	*Bursaria spinosa* Prickly box
Leptospermum lanigerum Woolly tea-tree	**TREES**	**TREES***
Olearia lepidophylla Clubmoss daisy bush	*Eucalyptus viminalis* White gum	*Eucalyptus viminalis* White gum
TREES	*Leptospermum lanigerum* Woolly tea-tree	*Acacia mucronata* Variable sallow wattle
Allocasuarina littoralis Black she-oak	*Pomaderris apetala* Dogwood	*Pomaderris apetala* Dogwood
Pomaderris apetala Dogwood		

Profile 3. Macquarie River 300–400 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Lagenophora stipitata Blue bottle daisy	*Geranium potentilloides* Mountain geranium	*Euchiton collinus* Cud weed
Carex breviculmis Sedge	*Oxalis perennans* Native oxalis	*Lagenophora stipitata* Blue bottle daisy
Carex polyantha Sedge	*Clematis aristata* Australian clematis	*Oxalis perennans* Native oxalis
Lepidosperma laterale Variable sword-edge	*Acaena novae-zelandiae* Biddy-widdy	*Poranthera microphylla* Small poranthera
Poa labillardierei Tussock grass	*Galium australe* Tangled bedstraw	*Lepidosperma laterale* Variable sword-sedge
Lomandra longifolia Sagg	*Carex breviculmis* Sedge	*Pultenaea juniperina* Prickly beauty
Juncus Rush	*Lepidosperma filiforme* Common rapier sedge	*Rytidosperma dimidiatum* Wallaby grass
Oxalis perennans Native oxalis	*Lepidosperma laterale* Variable sword-edge	*Poa labillardierei* Tussock grass
SHRUBS	*Rytidosperma dimidiatum* Wallaby grass	**SHRUBS***
Cyathodes glauca Cheese berry	*Austrodanthonia penicillata* Slender wallaby grass	*Cyathodes glauca* Cheese berry
Acacia mucronata Variable sallow wattle	*Ehrharta stipoides* Weeping grass	*Acacia mucronata* Variable sallow wattle
TREES	*Poa labillardierei* Tussock grass	*Notelaea ligustrina* Native olive
Leptospermum lanigerum Woolly tea-tree	*Poa sieberiana* Tussock grass	*Dodonaea filiformis* Fine-leaved hop-bush
Pomaderris apetala Dogwood	*Lomandra longifolia* Sagg	*Pomaderris phylicifolia* Narrow leaf pomaderris
	SHRUBS*	**TREES***
	Cyathodes glauca Cheese berry	*Leptospermum lanigerum* Woolly tea-tree
	Poranthera microphylla Small poranthera	*Pomaderris apetala* Dogwood
	Acacia mucronata Variable sallow wattle	
	Agrostis parviflora	
	TREES	
	Pomaderris apetala Dogwood	
	Leptospermum lanigerum Woolly tea-tree	

Profile 4. Macquarie River 400–500 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Hydocotyle muscosa	*Hydocotyle sibthorpioides* Shining pennywort	*Hydocotyle sibthorpioides* Shining pennywort
Hydocotyle sibthorpioides Shining pennywort	*Lagenophora stipitata* Blue bottle daisy	*Euchiton collinus* Cud weed
Hypericum japonicum Matted St Johns wort	*Ranunculus amphitricus* River buttercup	*Clematis aristata* Australian clematis
Nymphioides exigua Marshwort	*Acaena novae-zelandiae* Biddy-widdy	*Acaena novae-zelandiae* Biddy-widdy
Acaena novae-zelandiae Biddy-widdy	*Mazus pumulio* Swamp mazus	*Carex gaudichaudiana* Sedge
Carex gaudichaudiana Sedge	*Veronica gracilis* Slender speedwell	*Lepidosperma laterale* Variable sword-sedge
Eleocharis gracilis Slender spike-rush	*Carex gaudichaudiana* Sedge	*Schoenus apogon* Common or fluke bog-rush
Schoenus apogon Common or fluke bog-rush	*Gonocarpus tetragynus* Poverty raspwort	*Poa labillardierei* Tussock grass
Lachnagrostis filiformis Blown grass	*Eleocharis gracilis* Slender spike-rush	*Lomandra longifolia* Sagg
Poa labillardierei Tussock grass	*Lepidosperma laterale* Variable sword-sedge	**SHRUBS***
Juncus australis Austral rush	*Schoenus apogon* Common or fluke bog-rush	*Acacia mucronata* Variable sallow wattle
SHRUBS	*Lachnagrostis filiformis* Blown grass	*Leptospermum lanigerum* Woolly tea-tree
Acacia mucronata Variable sallow wattle	*Notodanthonia semianularis* Wallaby grass	**TREES***
Leptospermum lanigerum Woolly tea-tree	*Poa labillardierei* Tussock grass	*Pomaderris phylicifolia* Narrow leaf pomaderris
	Lomandra longifolia Sagg	
	SHRUBS*	
	Epacris gunnii Heath	
	Acacia mucronata Variable sallow wattle	
	Leptospermum lanigerum Woolly tea-tree	
	TREES	
	Pomaderris phylicifolia Narrow leaf pomaderris	

Profile 5. Elizabeth River 200–300 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Oxalis perennans Native oxalis	*Centella cordifolia*	*Ehrharta stipoides* Weeping grass
Bossiaea riparia River leafless bossiaea	*Hypericum japonicum* Matted St Johns wort	*Poa labillardierei* Tussock grass
Carex gaudichaudiana Sedge	*Carex gaudichaudiana* Sedge	*Poa sieberiana* Tussock grass
Rytidosperma dimidiatum Wallaby grass	*Eleocharis gracilis* Slender spike-rush	*Lomandra longifolia* Sagg
Echinopogon ovatus Hedgehog grass	*Ehrharta stipoides* Weeping grass	*Oxalis perennans* Native oxalis
Ehrharta stipoides Weeping grass	*Poa labillardierei* Tussock grass	*Acaena novae-zelandiae* Biddy-widdy
Elymus scaber Rough wheat grass	Lomandra longifolia Sagg	*Juncus pauciflorus* Loose flower rush
Lomandra longifolia Sagg	**SHRUBS***	**SHRUBS***
SHRUBS	*Melaleuca ericifolia* Swamp paperbark	*Hakea microcarpa* Small-fruit hakea
Acacia axillaris Midlands mimosa	*Leptospermum lanigerum* Woolly tea-tree	*Melaleuca ericifolia* Swamp paperbark
Leptospermum lanigerum Woolly tea-tree	**TREES**	**TREES***
Melaleuca ericifolia Swamp paperbark	*Callistemon pallidus* Yellow bottlebrush	*Beyeria viscosa* Pinkwood
		Pomaderris apetala Dogwood

Profile 6. Elizabeth River 300–400 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Hypericum japonicum Matted St John's wort	*Lomandra longifolia* Sagg	*Veronica calycine* Hairy speedwell
Gratiola peruviana Austral brooklime	*Oxalis perennans* Native oxalis	*Gahnia grandis* Cutting grass
Eleocharis gracilis Slender spike-rush	*Carex gaudichaudiana* Sedge	*Austrodanthonia penicillata* Slender wallaby grass
Isolepis subtilissima	*Gahnia grandis* Cutting grass	*Ehrharta stipoides* Weeping grass
Schoenus maschalimus Dwarf bog-rush	*Ehrharta stipoides* Weeping grass	*Elymus scaber* Rough wheat grass
Austrodanthonia penicillata Slender wallaby grass	*Viola betonicifolia* Purple violet	*Poa gunnii* Tussock grass
Lomandra longifolia Sagg	*Poa labillardierei* Tussock grass	*Lomandra longifolia* Sagg
SHRUBS	**SHRUBS***	*Galium australe* Tangled bedstraw
Acacia axillaris Midlands mimosa	*Hakea epiglottis* Beaked hakea	**SHRUBS***
Hakea microcarpa Small-fruit hakea	*Leptospermum lanigerum* Woolly tea-tree	*Acacia axillaris* Midlands mimosa
Leptospermum lanigerum Woolly tea-tree	*Acacia axillaris* Midlands mimosa	**TREES***
Coprosma quadrifida Native currant	*Coprosma quadrifida* Native currant	*Beyeria viscosa* Pinkwood
TREES	**TREES**	*Callistemon pallidus* Yellow bottlebrush
Beyeria viscosa Pinkwood	*Pomaderris apetala* Dogwood	*Pomaderris apetala* Dogwood
Pomaderris apetala Dogwood	*Notelaea ligustrina* Native olive	
Callistemon pallidus Yellow bottlebrush	*Acacia melanoxylon* Blackwood	
Notelaea ligustrina Native olive	*Callistemon pallidus* Yellow bottlebrush	
	Beyeria viscosa Pinkwood	

Profile 7. Elizabeth River 400–500 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Carex gaudichaudiana Sedge	*Veronica formosa* Tasmanian speedwell	*Lilaeopsis polyantha*
Gahnia grandis Cutting grass	*Carex gaudichaudiana* Sedge	*Geranium potentilloides* Mountain geranium
SHRUBS	*Ozothamnus ferrugineus* Tree everlasting	*Rumex brownii* Slender dock
Acacia axillaris Midlands mimosa	*Eleocharis gracilis* Slender spike-rush	*Clematis aristata* Australian clematis
TREES	*Gahnia grandis* Cutting grass	*Carex gaudichaudiana* Sedge
Pomaderris apetala Dogwood	*Schoenus maschalinus* Dwarf bog-rush	*Eleocharis gracilis* Slender spike-rush
	Poa labillardierei Tussock grass	*Gahnia grandis* Cutting grass
	Lomandra longifolia Sagg	*Isolepis inundata* Swamp club-rush
	SHRUBS*	*Austrodanthonia racemosa* Wallaby grass
	Acacia axillaris Midlands mimosa	*Deyeuxia quadrisesta* Reed bent-grass
	Leptospermum lanigerum Woolly tea-tree	*Poa gunnii* Tussock grass
	Leptospermum scoparium Manuka	*Lomandra longifolia* Sagg
	TREES	*Veronica calycina* Hairy speedwell
	Beyeria viscosa Pinkwood	**SHRUBS***
	Pomaderris apetala Dogwood	*Epacris acuminata*
	Notelaea ligustrina Native olive	*Acacia axillaris* Midlands mimosa
		Leptospermum scoparium Manuka
		Hakea epiglottis Beaked hakea
		Leptospermum lanigerum Woolly tea-tree
		Callistemon pallidus Yellow bottlebrush

Profile 7. continued

		TREES*
		Beyeria viscosa Pinkwood
		Bursaria spinosa Prickly box
		Acacia melanoxylon Blackwood
		Pomaderris apetala Dogwood

Profile 8. Elizabeth River 500–600 metres above sea level

LOWER	**MIDDLE**	**UPPER**
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Hydrocotyle hirta Pennywort	*Hydrocotyle hirta* Pennywort	*Hydrocotyle hirta* Pennywort
Hypericum japonicum Matted St Johns wort	*Hydrocotyle pterocarpa* Pennywort	*Euchiton collinus* Cud weed
Myriophyllum pedunculatum	*Hypericum japonicum* Matted St Johns wort	*Hydrocotyle sibthorpioides* Shining pennywort
Hydrocotyle sibthorpioides Shining pennywort	*Euchiton collinus* Cud weed	*Hypericum japonicum* Matted St Johns wort
Oxalis perennans Native oxalis	*Oxalis perennans* Native oxalis	*Phyllanthus australis* Austral spurge
Lepidosperma laterale Variable sword-sedge	*Acaena novae-zelandiae* Biddy-widdy	*Oxalis perennans* Native oxalis
Carex gaudichaudiana Sedge	*Viola hederacea* Ivy-leaf violet	*Acaena novae-zelandiae* Biddy-widdy
Gahnia grandis Cutting grass	*Carex appressa* Tall sedge	*Viola hederacea* Ivy-leaf violet
Schoenus maschalinus Dwarf bog-rush	*Carex gaudichaudiana* Sedge	*Carex gaudichaudiana* Sedge
Agrostis parviflora Grass	*Gahnia grandis* Cutting grass	*Gahnia grandis* Cutting grass
Poa labillardierei Tussock grass	*Lepidosperma laterale* Variable sword-sedge	*Lepidosperma laterale* Variable sword-sedge
	Lachnagrostis filiformis Blown grass	*Schoenus maschalinus* Dwarf bog-rush
	Agrostis parviflora Grass	*Agrostis parviflora* Grass
	Austrodanthonia penicillata Slender wallaby grass	*Austrodanthonia penicillata* Slender wallaby grass

Profile 8. continued

LOWER	MIDDLE	UPPER
SHRUBS	**GROUND COVERS***	**GROUND COVERS***
Callistemon viridiflorus Bottlebrush	*Notodanthonia semianularis* Wallaby grass	*Deyeuxia monticola* Bent grass
Leptospermum lanigerum Woolly tea-tree	*Pentapogon quadrifidus* Five-awned spear grass	*Dichelachne rara* Plume grass
Leptospermum scoparium Manuka	*Poa labillardierei* Tussock grass	*Ehrharta stipoides* Weeping grass
Acacia axillaris Midlands mimosa	*Juncus australis* Austral rush	*Elymus scaber* Rough wheat grass
	SHRUBS*	*Poa gunnii* Tussock grass
	Callistemon viridiflorus Bottlebrush	*Poa labillardierei* Tussock grass
	Epacris acuminata	**SHRUBS***
	Leptospermum lanigerum Woolly tea-tree	*Epacris acuminata*
	Acacia axillaris Midlands mimosa	*Acacia axillaris* Austral spurge
	Leptospermum scoparium Manuka	*Callistemon viridiflorus* Bottlebrush
	TREES	*Leptospermum lanigerum* Woolly tea-tree
	Eucalyptus rodwayi Swamp peppermint	*Leptospermum scoparium* Manuka
		TREES*
		Eucalyptus rodwayi Swamp peppermint

Profile 9. Nile River 100–200 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Viola hederacea Ivy-leaf violet	*Uncinia riparia* River hook-sedge	*Uncinia riparia* River hook-sedge
Uncinia riparia River hook-sedge	*Clematis aristata* Australian clematis	*Blechnum nudum* Fishbone water-fern
Oxalis perennans Native oxalis	*Lepidosperma* laterale Variable sword-sedge	*Ehrharta stipoides* Weeping grass
Ehrharta stipoides Weeping grass	*Agrostis parviflora* Grass	*Oxalis perennans* Native oxalis
Clematis aristata Australian clematis	*Austrodanthonia penicillata* Slender wallaby grass	*Acaena novae-zelandiae* Biddy-widdy
Agrostis parviflora Grass	*Ehrharta stipoides* Weeping grass	*Carex longebrachiata* Drooping sedge
Lomandra longifolia Sagg	*Oxalis perennans* Native oxalis	*Lepidosperma laterale* Variable sword-sedge
Blechnum nudum Fishbone water-fern	*Acaena novae-zelandiae* Biddy-widdy	**SHRUBS***
Blechnum wattsia Hard water-fern	*Poa tenera* Slender tussock-grass	*Coprosma quadrifida* Native currant
SHRUBS	*Lomandra longifolia* Sagg	*Micrantheum hexandrum* Box micrantheum
Coprosma quadrifida Native currant	*Blechnum nudum* Fishbone water-fern	*Poranthera microphylla* Small poranthera
Leptospermum lanigerum Woolly tea-tree	**SHRUBS***	**TREES***
	Prostanthera lasianthos Christmas bush	*Acacia melanoxylon* Blackwood
	Coprosma quadrifida Native currant	*Pomaderris apetala* Dogwood
	Micrantheum hexandrum Box micrantheum	*Leptospermum lanigerum* Woolly tea-tree
	Poranthera microphylla Small poranthera	*Notelaea ligustrina* Native olive
	TREES	
	Leptospermum lanigerum Woolly tea-tree	
	Pomaderris apetala Dogwood	

Profile 10. Nile River 200–300 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Hibbertia riparia Erect guinea-flower	*Lomandra longifolia* Sagg	*Carex breviculmis* Sedge
Oxalis perennans Native oxalis	*Viola hederacea* Ivy-leaf violet	*Lepidosperma laterale* Variable sword-sedge
Clematis aristata Australian clematis	*Lepidosperma laterale* Variable sword-sedge	*Schoenus apogon* Common or fluke bog-rush
Viola hederacea Ivy-leaf violet	*Acaena novae-zelandiae* Biddy-widdy	*Ehrharta stipoides* Weeping grass
Lepidosperma laterale Variable sword-sedge	*Ehrharta stipoides* Weeping grass	*Lomandra longifolia* Sagg
Schoenus apogon Common or fluke bog-rush	**SHRUBS***	**SHRUBS***
Austrodanthonia penicillata Slender wallaby grass	*Bursaria spinosa* Prickly box	*Leptecophylla juniperina (1)* Pink mountain-berry
Ehrharta stipoides Weeping grass	*Prostanthera lasianthos* Christmas bush	*Micrantheum hexandrum* Box micrantheum
Lomandra longifolia Sagg	*Leptospermum lanigerum* Woolly tea-tree	*Bursaria spinosa* Prickly box
SHRUBS	*Grevillea australis* Australian grevillea	**TREES***
Micrantheum hexandrum Box micrantheum	*Coprosma quadrifida* Native currant	*Beyeria viscosa* Pinkwood
Leptospermum lanigerum Woolly tea-tree	**TREES**	*Pomaderris apetala* Dogwood
Coprosma quadrifida Native currant	*Pomaderris apetala* Dogwood	
Bursaria spinosa Prickly box	*Beyeria viscosa* Pinkwood	
TREES	*Acacia melanoxylon* Blackwood	
Beyeria viscosa Pinkwood		

1. *Leptecophylla juniperina* subsp. *parviflora*

Profile 11. Nile River 500–600 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**SHRUBS***
Euchiton collinus Cud weed	*Hydrocotyle sibthorpioides* Shining pennywort	*Lomatia tinctoria* Guitar plant
Schoenus apogon Common bog-rush	*Geranium potentilloides* Mountain geranium	*Micrantheum hexandrum* Box micrantheum
SHRUBS	*Oxalis perennans* Native oxalis	*Pultenaea juniperina* Prickly beauty
Leptospermum lanigerum Woolly tea-tree	*Ranunculus pimpinellifolies* Bog buttercup	**TREES***
Pultenaea juniperina Prickly beauty	*Urtica incisa* Nettle	*Acacia melanoxylon* Blackwood
Olearia stellulata Starry daisy-bush	*Viola hederacea* Ivy-leaf violet	*Banksia marginata* Silver banksia
Olearia viscosa Daisy bush	*Lachnagrostis filiformis* Blown grass	
Leptecophylla juniperina (1) Pink mountain-berry	*Dichelachne rara* Plume grass	
Epacris impressa Common heath	*Elymus scaber* Rough wheat grass	
Micrantheum hexandrum Box micrantheum	*Polystichum proliferum* Mother shield-fern	
TREES	**SHRUBS***	
Acacia dealbata Silver wattle	*Coprosma quadrifida* Native currant	
Pittosporum bicolor Cheese wood	*Olearia argophylla* Musk	
Notelaea ligustrina Native olive	*Olearia lirata* Dusty daisy bush	
Banksia marginata Silver banksia	*Olearia stellulata* Starry daisy-bush	
	TREES	
	Beyeria viscosa Pinkwood	
	Pomaderris apetala Dogwood	
	Acacia dealbata Silver wattle	

1. *Leptecophylla juniperina* subsp. *parviflora*

Profile 12. Blackman River 200–300 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Poa labillardierei Tussock grass	*Oxalis perennans* Native oxalis	*Veronica gracilis* Slender speedwell
Indigofera australis Native indigo	*Acaena novae-zelandiae* Biddy-widdy	*Poa tenera* Slender tussock-grass
Acaena novae-zelandiae Biddy-widdy	*Poa tenera* Slender tussock-grass	*Geranium potentilloides* Mountain geranium
Geranium potentilloides Mountain geranium	*Beyeria viscosa* Pinkwood	*Acaena novae-zelandiae* Biddy-widdy
Lomandra longifolia Sagg	**TREES**	*Poa labillardierei* Tussock grass
Carex appressa Tall sedge	*Acacia melanoxylon* Blackwood	**TREES***
Elymus scabrus Rough wheat grass		*Eucalyptus viminalis* White gum
SHRUBS		*Beyeria viscosa* Pinkwood
Leptospermum lanigerum Woolly tea-tree		*Eucalyptus pulchella* White peppermint
TREES		
Acacia dealbata Silver wattle		

Profile 13. Blackman River 400–500 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Veronica calycina Speedwell	*Ajuga australis* Austral bugle	*Poa labillardierei* Tussock grass
Elymus scaber Rough wheat grass	*Oxalis perennans* Native oxalis	*Geranium potentilloides* Mountain geranium
Poa labillardierei Tussock grass	*Polystichum proliferum* Mother shield-fern	**SHRUBS***
Geranium potentilloides Mountain geranium	*Corysanthes diemenica* Stately helmet orchid	*Coprosma quadrifida* Native currant
Oxalis perennans Native oxalis	**SHRUBS***	*Zieria arborescens* Stinkwood
Acaena novae-zelandiae Biddy-widdy	*Coprosma quadrifida* Native currant	**TREES***
SHRUBS	**TREES**	*Beyeria viscosa* Pinkwood
Leptospermum lanigerum Woolly tea-tree	*Beyeria viscosa* Pinkwood	*Acacia dealbata* Silver wattle
Coprosma quadrifida Native currant	*Acacia dealbata* Silver wattle	*Pomaderris apetala* Dogwood
Epacris lanuginosa Swamp heath	*Pomaderris apetala* Dogwood	*Olearia argophylla* Musk
Pimelea drupacea Cherry rice-flower	*Eucalyptus viminalis* White bum	
TREES	*Eucalyptus delegatensis* Stringy bark	
Pomaderris apetala Dogwood	*Bedfordia salicina* Tasmanian blanket leaf	
Acacia dealbata Silver wattle	*Olearia argophylla* Musk	
Eucalyptus amygdalina Black peppermint		
Beyeria viscosa Pinkwood		
Olearia argophylla Musk		

Profile 14. Coal River 100–200 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Chrysocephalum apiculatum Everlasting	*Ozothamnus ferrugineus* Everlasting	*Juncus pauciflorus* Loose-flower rush
Euchiton collinus Cud weed	*Juncus pauciflorus* Loose-flower rush	*Acaena novae-zelandiae* Biddy-widdy
Juncus pauciflorus Loose-flower rush	*Juncus sarophorus* Rush	*Austrodanthonia racemosa* Wallaby grass
Juncus sarophorus Rush	*Austrodanthonia penicillata* Slender wallaby grass	*Ehrharta stipoides* Weeping grass
Myriophyllum pedunculatum Milfoil	*Geranium potentilloides* Mountain geranium	*Blechnum nudum* Fishbone water-fern
Carex appressa Tall sedge	*Carex appressa* Tall sedge	**SHRUBS***
Acaena novae-zelandiae Biddy-widdy	*Acaena novae-zelandiae* Biddy-widdy	*Coprosma quadrifida* Native currant
Epilobium billardierianum Common willowherb	*Epilobium billardierianum* Common willowherb	*Cassinia aculeata* Dolly bush
Austrodanthonia penicillata Slender wallaby grass	*Poa labillardierei* Tussock grass	*Leptospermum lanigerum* Woolly tea-tree
Oxalis perennans Native oxalis	*Blechnum nudum* Fishbone water-fern	**TREES***
Poa labillardierei Tussock grass	**SHRUBS***	*Eucalyptus viminalis* White gum
Polystichum proliferum Mother shield-fern	*Leptospermum lanigerum* Woolly tea-tree	*Acacia melanoxylon* Blackwood
Blechnum nudum Fishbone water-fern	*Indigofera australis* Native indigo	*Pomaderris apetala* Dogwood
Blechnum wattsia Hard water-fern	*Coprosma quadrifida* Native currant	
SHRUBS	**TREES**	
Coprosma quadrifida Native currant	*Acacia melanoxylon* Blackwood	
Leptospermum lanigerum Woolly tea-tree	*Pomaderris apetala* Dogwood	

Profile 15. Coal River 200–300 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Juncus pauciflorus Loose flower rush	*Senecio linearifolius* Fireweed groundsel	*Polystichum proliferum* Mother shield-fern
Senecio linearifolius Fireweed groundsel	*Dicksonia antarctica* Tree fern	*Asplenium flabellifolium* Necklace fern
Senecio minimus Fireweed	*Carex appressa* Tall sedge	*Dicksonia antarctica* Tree fern
Epilobium billardierianum Common willowherb	*Polystichum proliferum* Mother shield-fern	*Hymenophyllum cupressiforme* Common filmy-fern
Acaena novae-zelandiae Biddy-widdy	*Blechnum nudum* Fishbone water-fern	*Microsorum pustulatum* Kangaroo fern
Carex appressa Tall sedge	**SHRUBS***	**SHRUBS***
Ehrharta stipoides Weeping grass	*Coprosma quadrifida* Native currant	*Coprosma quadrifida* Native currant
Poa sieberiana Tussock grass	**TREES**	*Olearia lepidophylla* Clubmoss daisy bush
Poa tenera Slender tussock-grass	*Asterotrichion discolor* Currajong	**TREES***
Polystichum proliferum Mother shield-fern	*Pomaderris apetala* Dogwood	*Olearia argophylla* Musk
Blechnum nudum Fishbone water-fern		*Acacia dealbata* Silver wattle
SHRUBS		*Pittosporum bicolor* Cheese wood
Leptospermum lanigerum Woolly tea-tree		*Pomaderris apetala* Dogwood
Coprosma quadrifida Native currant		
TREES		
Olearia argophylla Musk		
Acacia dealbata Silver wattle		

Profile 16. Clyde River 200–300 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Acaena novae-zelandiae Biddy-widdy	*Poa labillardierei* Tussock grass	*Oxalis perennans* Native oxalis
Carex appressa Tall sedge	*Acaena novae-zelandiae* Biddy-widdy	*Acaena novae-zelandiae* Biddy-widdy
Eleocharis acuta Common spike rush	*Carex appressa* Tall sedge	*Epilobium billardierianum* Common willowherb
Juncus pauciflorus Loose flower rush	*Ehrharta stipoides* Weeping grass	*Poa labillardierei* Tussock grass
Lemna disperma Common duck weed		*Poa sieberiana* Tussock grass
		Austrodanthonia penicillata Slender wallaby grass
		Austrodanthonia tenuior Wallaby grass
		SHRUBS*
		Leptospermum lanigerum Woolly tea-tree

Profile 17. St Pauls River 200–300 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Acaena novae-zelandiae Biddy-widdy	*Acaena novae-zelandiae* Biddy-widdy	*Dichondra repens* Kidney-weed
Carex breviculmis Sedge	*Poa labillardierei* Tussock grass	*Poranthera microphylla* Small poranthera
Poa labillardierei Tussock grass	*Ehrharta stipoides* Weeping grass	*Oxalis perennans* Native oxalis
SHRUBS	**SHRUBS***	*Acaena novae-zelandiae* Biddy-widdy
Leptospermum lanigerum Woolly tea-tree	*Acacia mucronata* Variable sallow wattle	*Carex breviculmis* Sedge
Micrantheum hexandrum Box micrantheum	*Leptospermum lanigerum* Woolly tea-tree	*Ehrharta stipoides* Weeping grass
Acacia mucronata Variable sallow wattle	*Micrantheum hexandrum* Box micrantheum	*Poa labillardierei* Tussock grass
TREES	**TREES**	*Agrostis parviflora*
Acacia melanoxylon Blackwood	*Beyeria viscosa* Pinkwood	**SHRUBS***
Allocasuarina littoralis Black she-oak	*Callitris oblonga* South Esk pine	*Leptospermum lanigerum* Woolly tea-tree
	Notelaea ligustrina Native olive	*Acacia mucronata* Variable sallow wattle
		Micrantheum hexandrum Box micrantheum
		TREES*
		Callistemon pallidus Yellow bottlebrush

Profile 18. St Pauls River 500–600 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Isolepis subtilissima Club rush	*Hydrocotyle sibthorpioides* Pennywort	*Hydrocotyle sibthorpioides* Pennywort
Drosera pygmaea Dwarf sundew	*Carex gaudichaudiana* Sedge	*Gahnia grandis* Cutting grass
Lepidosperma filiforme Common rapier-sedge	*Acaena novae-zelandiae* Biddy-widdy	*Schoenus apogon* Common bog-rush
Acaena novae-zelandiae Biddy-widdy	*Gahnia grandis* Cutting grass	*Ranunculus amphitrichus* River buttercup
Eleocharis gracilis Slender spike rush	*Schoenus apogon* Common bog-rush	*Gonocarpus teucrioides* Rasp wort
Gahnia grandis Cutting grass	*Rytidosperma dimidiatum* Wallaby grass	**SHRUBS***
Carex gaudichaudiana Sedge	*Ehrharta stipoides* Weeping grass	*Callistemon viridiflorus* Bottlebrush
SHRUBS	**SHRUBS***	*Bauera rubioides* Bauera
Leptospermum lanigerum Woolly tea-tree	*Bauera rubioides* Bauera	*Micrantheum hexandrum* Box micrantheum
Bauera rubioides Bauera	*Micrantheum hexandrum* Box micrantheum	*Acacia mucronata* Variable sallow wattle
Hakea microcarpa Small-fruit hakea	*Acacia mucronata* Variable sallow wattle	*Leptospermum lanigerum* Woolly tea-tree
Leptospermum scoparium Manuka	*Callistemon viridiflorus* Bottlebrush	*Leptospermum scoparium* Manuka
Melaleuca squamea Swamp melaleuca	*Leptospermum lanigerum* Woolly tea-tree	*Melaleuca squamea* Swamp melaluca
Acacia mucronata Variable sallow wattle	*Leptospermum scoparium* Manuka	**TREES***
Micrantheum hexandrum Box micrantheum	**TREES**	*Beyeria viscosa* Pinkwood
TREES	*Eucalyptus gunnii* Cider gum	*Banksia marginata* Silver banksia
Allocasuarina littoralis Black she-oak		*Eucalyptus gunnii* Cider gum
Banksia marginata Silver banksia		

Profile 19. St Patricks River 400–500 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Blechnum nudum Fishbone water-fern	*Olearia stellulata* Starry daisy-bush	*Acaena novae-zelandiae* Biddy-widdy
Blechnum penna-marina Alpine water-fern	*Lotus pedunculatus*	*Galium australe* Tangled bedstraw
Blechnum wattsii Hard water-fern	*Deyeuxia gunniana* Bent grass	*Uncinia riparia* River hook-sedge
Senecio minimus	*Ehrharta stipoides* Weeping grass	*Stellaria flaccida* Forest starwort
Pratia pedunculata Wetdew	*Poa labillardierei* Tussock grass	*Geranium potentilloides* Mountain geranium
Lotus pedunculatus	*Poa tenera* Slender tussock-grass	*Poa tenera* Slender tussock-grass
Euchiton collinus Cud weed	*Blechnum nudum* Fishbone water-fern	*Polystichum proliferum* Mother shield-fern
Geranium potentilloides Mountain geranium	*Geranium potentilloides* Mountain geranium	*Blechnum nudum* Fishbone water-fern
Acaena novae-zelandiae Biddy-widdy	*Acaena novae-zelandiae* Biddy-widdy	*Blechnum penna-marina* Alpine water-fern
Oxalis perennans Native oxalis	*Oxalis perennans* Native oxalis	*Dicksonia antarctica* Tree fern
Viola hederacea Ivy-leaf violet	**SHRUBS***	**SHRUBS***
Carex appressa Tall sedge	*Coprosma quadrifida* Native currant	*Olearia ramulosa* Twiggy daisy bush
Juncus sarophorus Rush	*Pimelea drupacea* Cherry rice-flower	*Olearia stellulata* Starry daisy-bush
Deyeuxia gunniana Bent grass	**TREES**	*Sambucus gaudichaudiana* Native elderberry
Hydrocotyle sibthorpioides Pennywort	*Nothofagus cunninghamii* Southern myrtle	*Leptospermum lanigerum* Woolly tea-tree
Ehrharta stipoides Weeping grass		*Prostanthera lasianthos* Christmas bush
Poa labillardierei Tussock grass		*Coprosma quadrifida* Native currant
SHRUBS		*Olearia erubescens* Daisy bush
Leptospermum lanigerum Woolly tea-tree		*Pimelea drupacea* Cherry rice-flower
Coprosma quadrifida Native currant		*Pimelea linifolia* Slender rice-flower
Pimelea drupacea Cherry rice-flower		*Tasmannia lanceolata* Mountain pepper
Pimelea linifolia Slender rice-flower		

Profile 19. continued

LOWER	MIDDLE	UPPER
TREES		**TREES***
Nothofagus cunninghamii Southern myrtle		*Pittosporum bicolor* Cheese wood
		Pomaderris apetala Dogwood
		Eucalyptus delegatensis Stringy bark
		Nothofagus cunninghamii Southern myrtle

Profile 20. St Patricks River 500–600 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Gahnia grandis Cutting grass	*Hydrocotyle sibthorpioides* Pennywort	*Agrostis parviflora* Grass
Isolepis habra Club rush	*Agrostis parviflora* Grass	*Stellaria flaccida* Forest starwort
Ehrharta stipoides Weeping grass	*Euchiton collinus* Cud weed	*Austrodanthonia penicillata* Slender wallaby grass
Poa labillardierei Tussock grass	*Stellaria flaccida* Forest starwort	*Deyeuxia gunniana* Bent grass
Polystichum proliferum Mother shield-fern	*Asperula gunnii*	*Ehrharta stipoides* Weeping grass
Blechnum nudum Fishbone water-fern	*Oxalis perennans* Native oxalis	*Acaena novae-zelandiae* Biddy-widdy
Oxalis perennans Native oxalis	*Acaena novae-zelandiae* Biddy-widdy	*Poa labillardierei* Tussock grass
Acaena novae-zelandiae Biddy-widdy	*Pimelea drupacea* Cherry rice-flower	*Polystichum proliferum* Mother shield-fern
Blechnum penna-marina Alpine water-fern	*Geranium potentilloides* Mountain geranium	*Blechnum fluviatile* Ray water-fern
Blechnum wattsia Hard water-fern	*Pimelea linifolia* Slender rice-flower	*Blechnum nudum* Fishbone water-fern
SHRUBS	*Isolepis habra* Club rush	*Uncinia riparia* River hook-sedge
Tasmannia lanceolata Mountain pepper	*Uncinia riparia* River hook-sedge	
Coprosma quadrifida Native currant	*Ehrharta stipoides* Weeping grass	

Profile 20. continued

LOWER	MIDDLE	UPPER
TREES	**GROUND COVERS***	**SHRUBS***
Acacia dealbata Silver wattle	*Poa labillardierei* Tussock grass	*Aristotelia peduncularis* Heart berry
Nothofagus cunninghamii Southern myrtle	*Poa tenera* Slender tussock-grass	*Coprosma quadrifida* Native currant
Atherosperma moschatum Sassafras	*Polystichum proliferum* Mother shield-fern	*Pimelea drupacea* Cherry rice-flower
	Blechnum fluviatile Ray water-fern	*Tasmannia lanceolata* Mountain pepper
	Blechnum nudum Fishbone water-fern	*Leptospermum lanigerum* Woolly tea-tree
	Blechnum penna-marina Alpine water-fern	**TREES***
	Grammitis billardiera Finger fern	*Nothofagus cunninghamii* Southern myrtle
	SHRUBS*	
	Aristotelia peduncularis Heart berry	
	Leptospermum lanigerum Woolly tea-tree	
	Coprosma quadrifida Native currant	
	Tasmannia lanceolata Mountain pepper	
	TREES	
	Acacia dealbata Silver wattle	
	Nothofagus cunninghamii Southern myrtle	

Profile 21. Prosser River 0–100 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Eleocharis gracilis Slender spike rush	*Lepidosperma laterale* Variable sword-sedge	*Ehrharta stipoides* Weeping grass
Isolepis inundata Swamp club-rush	*Ehrharta stipoides* Weeping grass	*Carex gaudichaudiana* Sedge
Poa labillardierei Tussock grass	*Oxalis perennans* Native oxalis	*Lepidosperma laterale* Variable sword-sedge
Lomandra longifolia Sagg	*Clematis aristata* Australian clematis	*Poa labillardierei* Tussock grass
Carex appressa Tall sedge	*Carex gaudichaudiana* Sedge	*Lomandra longifolia* Sagg
Carex fascicularis Tassel sedge	*Carex longebrachiata* Drooping sedge	*Oxalis perennans* Native oxalis
Carex gaudichaudiana Sedge	*Viola hederacea* Ivy-leaf violet	**SHRUBS***
SHRUBS	*Poa labillardierei* Tussock grass	*Micrantheum hexandrum* Box micrantheum
Acacia mucronata Variable sallow wattle	*Lomandra longifolia* Sagg	*Coprosma quadrifida* Native currant
Leptospermum lanigerum Woolly tea-tree	**SHRUBS***	*Acacia mucronata* Variable sallow wattle
	Acacia mucronata Variable sallow wattle	*Leptospermum lanigerum* Woolly tea-tree
	Leptospermum lanigerum Woolly tea-tree	**TREES***
	Coprosma quadrifida Native currant	*Pomaderris apetala* Dogwood
	TREES	*Beyeria viscosa* Pinkwood
	Notelaea ligustrina Native olive	*Bursaria spinosa* Prickly box
	Pomaderris apetala Dogwood	*Notelaea ligustrina* Native olive

Profile 22. Prosser River 200–300 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Eleocharis sphacelata Tall spike-rush	*Agrostis parviflora*	*Ehrharta stipoides* Weeping grass
Carex inversa Knob sedge	*Ehrharta stipoides* Weeping grass	*Poa labillardierei* Tussock grass
Acaena novae-zelandiae Biddy-widdy	*Poa labillardierei* Tussock grass	*Carex gaudichaudiana* Sedge
Oxalis perennans Native oxalis	*Viola betonicifolia* Purple violet	*Lepidosperma laterale* Variable sword-sedge
Isolepis subtilissima	*Lepidosperma laterale* Variable sword-sedge	*Dianella revoluta* Black-anther flax-lily
Carex appressa Tall sedge	*Juncus pauciflorus* Loose flower rush	*Pomaderris apetala* Dogwood
Juncus pauciflorus Loose flower rush	**SHRUBS***	*Veronica calycine* Hairy speedwell
Dichelachne rara Plume grass	*Coprosma quadrifida* Native currant	**SHRUBS***
Isolepis aucklandica Club-rush	*Prostanthera lasianthos* Christmas bush	*Prostanthera lasianthos* Christmas bush
Glyceria australis Australian sweet-grass	*Leptospermum lanigerum* Woolly tea-tree	*Coprosma quadrifida* Native currant
SHRUBS	**TREES**	*Hakea microcarpa* Small-fruit hakea
Cyathodes glauca Cheese berry	*Beyeria viscosa* Pinkwood	**TREES***
Leptospermum lanigerum Woolly tea-tree	*Pomaderris apetala* Dogwood	*Beyeria viscosa* Pinkwood
Coprosma quadrifida Native currant		*Bursaria spinosa* Prickly box
TREES		*Banksia marginata* Silver banksia
Pomaderris apetala Dogwood		

Profile 23. Prosser River 300–400 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Juncus pauciflorus Loose-flower rush	*Carex gaudichaudiana* Sedge	*Hydrocotyle sibthorpioides* Shining pennywort
Agrostis parviflora Grass	*Lagenophora stipitata* Blue bottle daisy	*Oxalis perennans* Native oxalis
Oxalis perennans Native oxalis	*Austrodanthonia penicillata* Slender wallaby grass	*Acaena novae-zelandiae* Biddy-widdy
Acaena novae-zelandiae Biddy-widdy	*Deyeuxia contracta* Bent grass	*Lagenophora stipitata* Blue bottle daisy
Lomandra longifolia Sagg	*Dichelachne rara* Plume grass	*Viola hederacea* Ivy-leaf violet
Polystichum proliferum Mother shield-fern	*Agrostis parviflora* Grass	*Lepidosperma laterale* Variable sword-sedge
Carex appressa Tall sedge	*Comesperma volubile* Blue love creeper	*Gastrodia sesamoides* Potato orchid
Ehrharta stipoides Weeping grass	*Clematis aristata* Australian clematis	*Deyeuxia contracta* Bent grass
Isolepis inundata Swamp club-rush	*Oxalis perennans* Native oxalis	*Poa labillardierei* Tussock grass
Poa labillardierei Tussock grass	*Billardiera longiflora* Climbing blueberry	*Lomandra longifolia* Sagg
Lepidosperma laterale Variable sword-sedge	*Ehrharta stipoides* Weeping grass	*Ehrharta stipoides* Weeping grass
SHRUBS	*Carex longebrachiata* Drooping sedge	*Blechnum nudum* Fishbone water-fern
Leptospermum lanigerum Woolly tea-tree	*Lepidosperma laterale* Variable sword-sedge	*Pimelea drupacea* Cherry rice-flower
Coprosma quadrifida Native currant	*Juncus pauciflorus* Loose-flower rush	**SHRUBS***
TREES	*Acaena novae-zelandiae* Biddy-widdy	*Leptospermum lanigerum* Woolly tea-tree
Acacia dealbata Silver wattle	*Carex appressa* Tall sedge	*Olearia lepidophylla* Clubmoss daisy bush
	Poa labillardierei Tussock grass	*Acacia mucronata* Variable sallow wattle
	Lomandra longifolia Sagg	*Cassinia aculeata* Dolly bush
	Polystichum proliferum Mother shield-fern	*Coprosma quadrifida* Native currant
		Acacia verniciflua Juniper wattle
		Cyathodes glauca Cheese berry
		Prostanthera lasianthos Christmas bush

Profile 23. continued

LOWER	MIDDLE	UPPER
	SHRUBS*	**TREES***
	Coprosma quadrifida Native currant	*Bursaria spinosa* Prickly box
	Pimelea drupacea Cherry rice-flower	*Notelaea ligustrina* Native olive
	Leptospermum lanigerum Woolly tea-tree	*Acacia verticillata* Prickly mimosa
	TREES	*Acacia dealbata* Silver wattle
	Olearia argophylla Musk	*Pomaderris apetala* Dogwood
	Asterotrichion discolor Currajong	
	Pomaderris apetala Dogwood	
	Notelaea ligustrina Native olive	
	Bursaria spinosa Prickly box	

Profile 24. Lake River 100–200 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Lepidosperma laterale Variable sword-sedge	*Acaena novae-zelandiae* Biddy-widdy	*Poa labillardierei* Tussock grass
Poa labillardierei Tussock grass	*Ehrharta stipoides* Weeping grass	*Austrodanthonia penicillata* Slender wallaby grass
Lomandra longifolia Sagg	*Carex appressa* Tall sedge	*Ehrharta stipoides* Weeping grass
Ehrharta stipoides Weeping grass	*Lepidosperma laterale* Variable sword-sedge	*Lomandra longifolia* Sagg
Schoenus maschalinus Leafy bog-rush	*Austrodanthonia penicillata* Slender wallaby grass	*Acaena novae-zelandiae* Biddy-widdy
Austrodanthonia penicillata Slender wallaby grass	*Carex gaudichaudiana* Sedge	*Carex longebrachiata* Drooping sedge
Carex gaudichaudiana Sedge	*Carex polyantha* Sedge	**SHRUBS***
Oxalis perennans Native oxalis	*Lomandra longifolia* Sagg	*Epacris acuminata* Heath
Isolepis inundata Swamp club-rush	*Oxalis perennans* Native oxalis	*Micrantheum hexandrum* Box micrantheum
Acaena novae-zelandiae Biddy-widdy	*Poa labillardierei* Tussock grass	*Leptospermum lanigerum* Woolly tea-tree
Dichelachne rara Plume grass	**SHRUBS***	**TREES***
SHRUBS	*Epacris acuminata* Heath	*Acacia dealbata* Silver wattle
Leptospermum lanigerum Woolly tea-tree	*Leptospermum lanigerum* Woolly tea-tree	*Callistemon pallidus* Yellow bottlebrush
Micrantheum hexandrum Box micrantheum	*Micrantheum hexandrum* Box micrantheum	*Eucalyptus amygdalina* Black peppermint
Hakea microcarpa Small-fruit hakea	*Coprosma quadrifida* Native currant	*Pomaderris apetala* Dogwood
Epacris acuminata Heath	**TREES***	*Notelaea ligustrina* Native olive
Coprosma quadrifida Native currant	*Bursaria spinosa* Prickly box	*Bursaria spinosa* Prickly box
TREES	*Pomaderris apetala* Dogwood	
Pomaderris apetala Dogwood	*Callistemon pallidus* Yellow bottlebrush	
Acacia dealbata Silver wattle	*Acacia dealbata* Silver wattle	
Acacia melanoxylon Blackwood	*Acacia melanoxylon* Blackwood	
Callistemon pallidus Yellow bottlebrush	*Notelaea ligustrina* Native olive	

Profile 25. Lake River 400–500 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Euchiton collinus Cud weed	*Hydrocotyle sibthorpioides* Pennywort	*Oxalis perennans* Native oxalis
Senecio minimus Fireweed	*Euchiton collinus* Cud weed	*Senecio minimus* Fireweed
Isotoma fluviatilis Swamp isotoma	*Stellaria palustris* Swamp starwort	*Bossiaea riparia* River leafless bossiaea
Hypericum japonicum Matted St Johns wort	*Hypericum japonicum* Matted St Johns wort	*Geranium potentilloides* Mountain geranium
Crassula helmsii Swamp stonecrop	*Geranium potentilloides* Mountain geranium	*Gonocarpus tetragynus* Poverty raspwort
Geranium potentilloides Mountain geranium	*Epilobium billardierianum* Common willowherb	*Acaena novae-zelandiae* Biddy-widdy
Oxalis perennans Native oxalis	*Oxalis perennans* Native oxalis	*Clematis aristata* Australian clematis
Acaena novae-zelandiae Biddy-widdy	*Acaena novae-zelandiae* Biddy-widdy	*Elymus scaber* Rough wheat grass
Carex gaudichaudiana Sedge	*Veronica gracilis* Slender speedwell	*Poa gunnii* Tussock grass
Eleocharis acuta Common spike rush	*Carex inversa* Knob sedge	*Poa labillardierei* Tussock grass
Isolepis setacea Club rush	*Eleocharis acuta* Common spike rush	*Carex inversa* Knob sedge
Juncus sandwithii Rush	*Isolepis setacea* Club rush	*Isolepis setacea* Club rush
Poa labillardierei Tussock grass	*Isolepis subtilissima* Club rush	*Juncus planifolius* Broad-leaf rush
	Schoenus apogon Common bog-rush	*Austrodanthonia penicillata* Slender wallaby grass
	Juncus planifolius Broad-leaf rush	**SHRUBS***
	Elymus scaber Rough wheat grass	*Leptospermum lanigerum* Woolly tea-tree
	Poa labillardierei Tussock grass	**TREES***
		Acacia dealbata Silver wattle

Profile 26. Lake River 500–600 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Euchiton collinus Cud weed	*Geranium potentilloides* Mountain geranium	*Geranium potentilloides* Mountain geranium
Hypericum japonicum Matted St Johns wort	*Acaena novae-zelandiae* Biddy-widdy	*Oxalis perennans* Native oxalis
Geranium potentilloides Mountain geranium	*Carex appressa* Tall sedge	*Clematis aristata* Australian clematis
Acaena novae-zelandiae Biddy-widdy	*Carex gaudichaudiana* Sedge	*Acaena novae-zelandiae* Biddy-widdy
Carex gaudichaudiana Sedge	*Carex inversa* Knob sedge	*Carex longebrachiata* Drooping sedge
Schoenus apogon Common bog-rush	*Carex longebrachiata* Drooping sedge	*Gahnia grandis* Cutting grass
Schoenus maschalinus Leafy bog-rush	*Gahnia grandis* Cutting grass	*Elymus scaber* Rough wheat grass
Juncus procerus Robust rush	*Elymus scaber* Rough wheat grass	*Poa sieberiana* Tussock grass
Juncus sandwithii Rush		**TREES***
Austrodanthonia penicillata Slender wallaby grass		*Eucalyptus rodwayi* Swamp peppermint
Austrodanthonia tenuior Wallaby grass		
Elymus scaber Rough wheat grass		
Poa labillardierei Tussock grass		
Poa rodwayi Tussock grass		
Poa sieberiana Tussock grass		

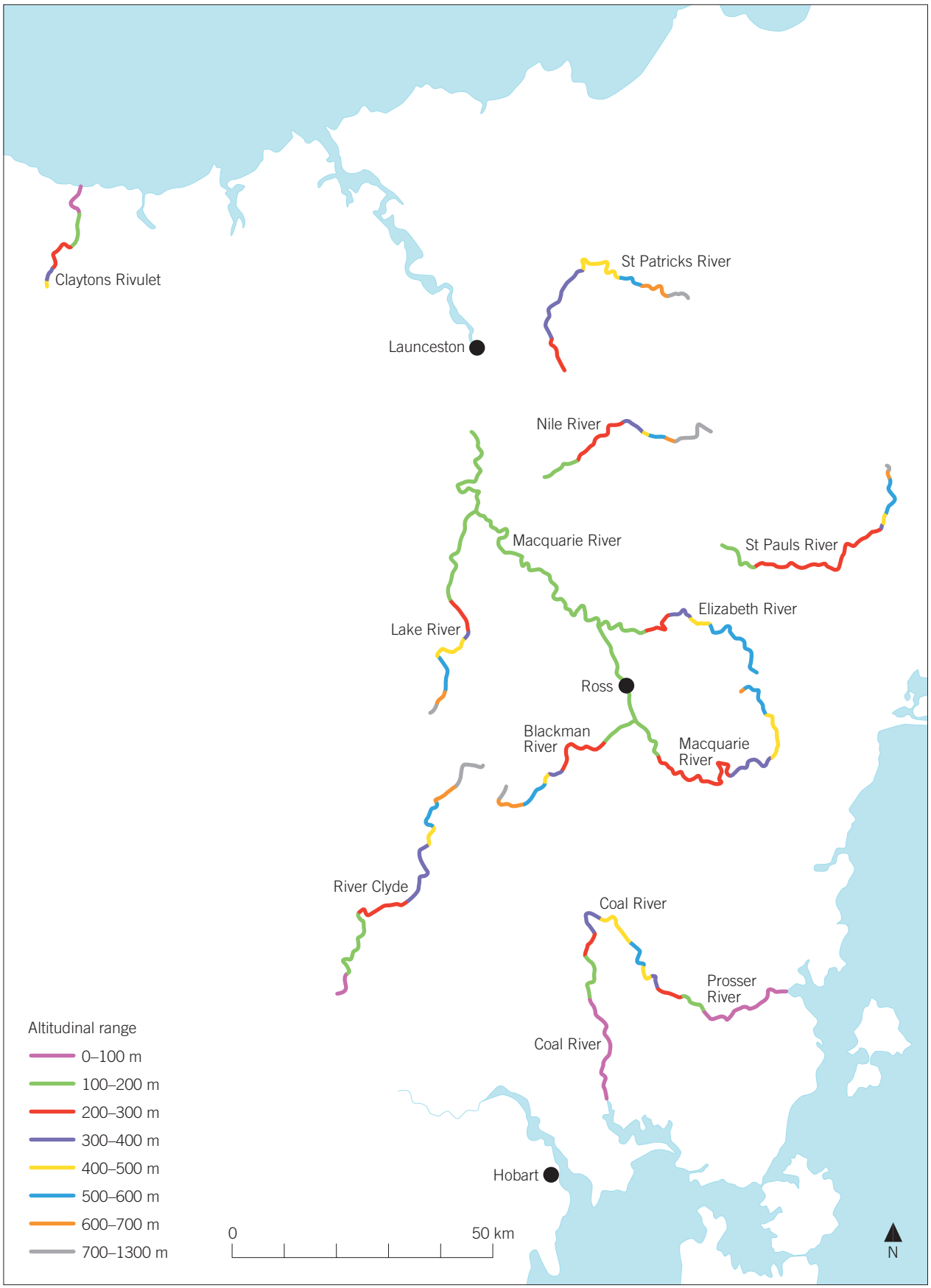
Profile 27. Lake River 600–700 metres above sea level

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Ozothamnus ferrugineus Everlasting	*Acaena novae-zelandiae* Biddy-widdy	*Austrodanthonia penicillata* Slender wallaby grass
Oxalis perennans Native oxalis	*Carex appressa* Tall sedge	*Austrodanthonia racemosa* Wallaby grass
Acaena novae-zelandiae Biddy-widdy	*Carex gaudichaudiana* Sedge	*Ehrharta stipoides* Weeping grass
Asperula gunnii Mountain woodruff	*Elymus scaber* Rough wheat grass	*Elymus scaber* Rough wheat grass
Carex breviculmis Sedge	**SHRUBS**	*Dichondra repens* Kidney-weed
Carex gaudichaudiana Sedge	*Olearia phlogopappa* Dusty daisy-bush	*Oxalis perennans* Native oxalis
Gahnia grandis Cutting grass	*Leptecophylla juniperina (1)* Pink mountain-berry	*Acaena novae-zelandiae* Biddy-widdy
Lepidosperma laterale Variable sword-sedge	*Leptospermum lanigerum* Woolly tea-tree	*Poa compressa* Tussock grass
Dianella tasmanica Blue berry	*Dodonaea filiformis* Fined-leaved hop-bush	*Poa labillardierei* Tussock grass
Austrodanthonia penicillata Slender wallaby grass		*Lomandra longifolia* Sagg
Deyeuxia quadriseta Reed bent-grass		*Carex gaudichaudiana* Sedge
Dichelachne rara Plume grass		*Lepidosperma inops*
Ehrharta stipoides Weeping grass		*Lepidosperma laterale* Variable sword-sedge
Elymus scaber Rough wheat grass		*Dianella tasmanica* Blue berry
Poa labillardierei Tussock grass		**SHRUBS**
Lomandra longifolia Sagg		*Dodonaea filiformis* Fined-leaved hop-bush
		Pimelea pauciflora Poison rice-flower
		Leptecophylla juniperina (1) Pink mountain-berry
		TREES
		Acacia dealbata Silver wattle
		Pomaderris apetala Dogwood
	1. Leptecophylla juniperina subsp. *parviflora*	*Eucalyptus rodwayi* Swamp peppermint

Profile 28. Claytons Rivulet

LOWER	MIDDLE	UPPER
GROUND COVERS*	**GROUND COVERS***	**GROUND COVERS***
Juncus pallidus Pale rush	*Gahnia grandis* Cutting grass	*Lomandra longifolia* Matt rush
Isolepis nodosa Knobby rush grass	*Acacia verticillata* Prickly moses	**SHRUBS***
SHRUBS	*Atherospermum moschatum* Sassafras	*Acacia verticillata* Prickly moses
Leptospermum lanigerum Woolly tea-tree	*Clematis aristata* Old mans beard	*Cassinia aculeata* Dolly bush
Leptospermum scoparium Common tea-tree	*Lomandra longifolia* Matt rush	*Coprosma quadrifida* Native currant
TREES	*Muehlenbeckia gunnii* Macquarie vine	*Leptospermum scoparium* Common tea-tree
Acacia melanoxylon Blackwood	**SHRUBS**	*Monotoca glauca* Goldiewood
	Leptospermum lanigerum Woolly tea-tree	*Prostanthera lasianthos* Christmas bush
	Leptospermum scoparium Common tea-tree	*Pultenaea juniperina* Prickly beauty
	Monotoca glauca Goldiewood	*Olearia lirata* Dusty daisy bush
	Olearia lirata Dusty daisy bush	*Olearia phlogopappa* Daisy bush
	Olearia phlogopappa Daisy bush	*Pittosporum bicolor* Cheese wood
	Pittosporum bicolor Cheese wood	**TREES***
	Prostanthera lasianthos Christmas bush	*Eucalyptus obliqua* Stringybark
	Pultenaea juniperina Prickly beauty	*Acacia dealbata* Silver wattle
	TREES	*Eucalyptus regnans* Mountain ash
	Nothofagus cunninghamii Myrtle	*Eucalyptus viminalis* White gum
	Olearia argophylla Musk	*Phebalium squameum* Satinwood
	Phebalium squameum Satinwood	*Pomaderris apetala* Dogwood
	Pomaderris apetala Dogwood	*Olearia argophylla* Musk
	Acacia dealbata Silver wattle	

Tasmanian rivers and altitudinal ranges referred to in the species lists.



Appendix 2. Tasmanian birds (excluding seabirds) and their habitat requirements

Information in the table on the following pages was compiled from 'Birds on farms' (Donaghey 2005) and 'The new atlas of Australian birds' (Barrett et al. 2003).

* denotes endemic species (species which only occur in Tasmania).

A tick indicates that the species requires this habitat.

Tasmanian native hen. Photo Andrew Tatnell.

	Family name	Common name	Scientific name	Well vegetated wetland area	Tree hollows	Mature trees	Under-storey shrubs
Waterbirds	Anatidae	Chestnut teal	*Anas castanea*	✔			
		Grey teal	*Anas gracilis*				
		Australasian shoveler	*Anas rhynchotis*	✔			
		Pacific black duck	*Anas superciliosa*	✔			
		Musk duck	*Biziura lobata*	✔			
		Cape Barren goose	*Cereopsis novaehollandiae*				
		Australian wood duck	*Chenonetta jubata*		✔		
		Black swan	*Cygnus atratus*	✔			
		Blue-billed duck	*Oxyura australis*				
		Australian shelduck	*Tadoma tadornoides*	✔	✔		
	Ardeidae	White-faced heron	*Egretta novaehollandiae*	✔	✔		
		Cattle egret	*Ardea ibis*			✔	
		Australasian bittern	*Botaurus poiciloptilus*	✔			
		Great egret	*Ardea alba*				
		Little egret	*Egretta garzetta*				
		Intermediate egret	*Egretta intermedia*				
		Nankeen night heron	*Nycticorax caledonicus*	✔			
	Charadriidae	Masked lapwing	*Vanellus miles*				
		Banded lapwing	*Vanellus tricolor*				
		Black-fronted dotterel	*Elseyornis melanops*				

	Family name	Common name	Scientific name	Well vegetated wetland area	Tree hollows	Mature trees	Under-storey shrubs
Waterbirds cont.	Podicipedidae	Hoary-headed grebe	*Poliocephalus poliocephalus*	✔			
		Australasian grebe	*Tachybaptus novaehollandiae*	✔			
		Great-crested grebe	*Podiceps cristatus*	✔			
	Rallidae	Eurasian coot	*Fulica atra*	✔			
		Tasmanian native hen	*Gallinula mortierii**	✔			
		Dusky moorhen	*Gallinula tenebrosa*	✔			
		Purple swamphen	*Porphyrio porphyrio*	✔			
		Australian crake	*Porzana fluminea*	✔			
		Baillons crake	*Porzana pusilla*	✔			
		Spotless crake	*Porzana tabuensis*	✔			
		Lewins rail	*Rallus pectoralis*	✔			
		Buff-banded rail	*Rallus philippensis*	✔			
Raptors (Birds of prey)	Accipitridae	Collared sparrowhawk	*Accipter cirrhocephalus*			✔	
		Brown goshawk	*Accipiter fasciatus*			✔	
		Grey goshawk	*Accipiter novaehollandiae*			✔	
		Swamp harrier	*Circus approximans*	✔			
		Whistling kite	*Haliastur sphenurus*			✔	
		White-breasted sea eagle	*Haliaeetus leucogaster*			✔	
		Wedge-tailed eagle	*Aquila audax*			✔	

Raptors cont.	Falconidae	Brown falcon	*Falco berigora*			✔	
		Australian kestrel	*Falco cenchroides*			✔	
		Australian hobby	*Falco longipennis*			✔	
		Peregrine falcon	*Falco perigrinus*				
Nocturnal birds	Aegothelidae	Australian owlet-nightjar	*Aegotheles cristatus*		✔		
	Podargidae	Tawny frogmouth	*Podargus strigoides*			✔	
	Strigidae	Southern boobook	*Ninox novaehollandiae*		✔	✔	
	Tytonidae	Masked owl	*Tyto novaehollandiae*		✔		
Pigeons	Columbidae	Common bronzewing	*Phaps chalcoptera*				✔
		Brush bronzewing	*Phaps elegans*				✔
Cockatoos and parrots	Cacatuidae	Sulphur-crested cockatoo	*Cacatua galerita*		✔		
		Galah	*Cacatua roseicapilla*		✔		
		Yellow-tailed black cockatoo	*Calyptorhynchus funereus*		✔		✔
	Platycercidae	Swift parrot	*Lathamus discolor*		✔	✔	
		Orange-bellied parrot	*Neophema chrysogaster*				
		Blue-winged parrot	*Neophema chrysostoma*		✔		
		Ground parrot	*Pezoporus wallicus*				✔
		Green rosella	*Platycercus caledonicus**		✔		
		Eastern rosella	*Platycerus eximius*		✔		
	Loriidae	Musk lorikeet	*Glossopsitta concinna*		✔		
Kingfishers	Alcedinidae	Azure kingfisher	*Alcedo azurea*	✔			
Swifts	Apodidae	Fork-tailed swift	*Apus pacificus*				
		White-throated needletail	*Hirundapus caudacutus*				

	Family name	Common name	Scientific name	Well vegetated wetland area	Tree hollows	Mature trees	Under-storey shrubs
Cuckoos (parasitic)	Cuculidae	Horsfields bronze-cuckoo	*Chrysococcyx basalis*				✔
		Shining bronze-cuckoo	*Chrysococcyx lucidus*				✔
		Pallid cuckoo	*Cuculus pallidus*				
		Fan-tailed cuckoo	*Cacomantis flabelliformis*				✔
Quails and Button-quail	Phasianidae	Brown quail	*Coturnix ypsilophora*	✔			
		Stubble quail	*Coturnix pectoralis*	✔			
	Turnicidae	Painted button-quail	*Turnix varia*	✔			
Bush birds	Artamidae	Dusky woodswallow	*Artamus cyanopterus*			✔	
	Campephagidae	Black-faced cuckoo-shrike	*Coracina novaehollandiae*			✔	
	Acanthizidae	Yellow-rumped thornbill	*Acanthiza chrysorrhoa*				
		Tasmanian thornbill	*Acanthiza ewingii**				✔
		Brown thornbill	*Acanthiza pusilla*				✔
		Tasmanian scrubwren	*Sericornis humilis**				✔
		Striated fieldwren	*Calamanthus fuliginosus*				
		Scrubtit	*Acanthornis magnus**				✔
	Corvidae	Little raven	*Corvus mellori*			✔	
		Forest raven	*Corvus tasmanicus*			✔	

Bush birds cont.	Cracticidae	Grey butcherbird	*Cracticus torquatus*				
		Australian magpie	*Gymnorhina tibicen*			✔	
		Black currawong	*Strepera fuliginosa**			✔	
		Grey currawong	*Strepera versicolor*				
	Ephthianuridae	White-fronted chat	*Epthianura albifrons*	✔			
	Hirundinidae	Fairy martin	*Hirundo ariel*		✔		
		Tree martin	*Hirundo nigricans*		✔		
		Welcome swallow	*Hirundo neoxena*				
	Maluridae	Superb fairy-wren	*Malurus cyaneus*				✔
		Southern emu-wren	*Stipiturus malachurus*				✔
	Meliphagidae	Eastern spinebill	*Acanthorhynchus tenuirostris*				✔
		Little wattlebird	*Anthochaera chrysoptera*				✔
		Yellow wattlebird	*Anthochaera paradoxa**			✔	
		Yellow-throated honeyeater	*Lichenostomus flavicollis**				✔
		Noisy miner	*Manorina melancephala*			✔	
		Black-headed honeyeater	*Melithreptus affinus**			✔	
		Strong-billed honeyeater	*Melithreptus validirostris**			✔	
		Tawny-crowned honeyeater	*Phylidonyris melanops*				✔
		New Holland honeyeater	*Phylidonyris novaehollandiae*				✔
		Crescent honeyeater	*Phylidonyris pyrrhoptera*				✔
	Motacillidae	Richards pipit	*Anthus novaeseelandiae*	✔			

	Family name	Common name	Scientific name	Well vegetated wetland area	Tree hollows	Mature trees	Under-storey shrubs
Bush birds cont.	Muscicapidae	Grey shrike-thrush	*Colluricincla harmonica*				✔
		Dusky robin	*Melanodryas vittata**		✔		
		Satin flycatcher	*Myiagra cyanoleuca*			✔	
		Olive whistler	*Pachycephala olivacea*				✔
		Golden whistler	*Pachycephala pectoralis*				✔
		Pink robin	*Petroica rodinogaster*				✔
		Flame robin	*Petroica phoenicea*				
		Scarlet robin	*Petroica multicolor*				✔
		Grey fantail	*Rhipidura fuliginosa*				✔
		Bassian thrush	*Zoothera lunulata*				✔
	Orthonychidae	Spotted quail-thrush	*Cinclosoma punctatum*				✔
	Pardalotidae	Spotted pardalote	*Pardalotus punctatus*			✔	
		Forty-spotted pardalote	*Pardalotus quadragintus**		✔	✔	
		Striated pardalote	*Pardalotus striatus*		✔	✔	
	Ploceidae	Beautiful firetail	*Stagonopleura bella*				
	Sylviidae	Clamorous reed warbler	*Acrocephalus stentoreus*	✔			
		Golden-headed cisticola	*Cisticola exilis*	✔			
		Little grassbird	*Megalurus gramineus*	✔			
	Zosteropidae	Silvereye	*Zosterops lateralis*				✔

Introduced species		Emu	*Dromaius novaehollandiae*				
		Mallard	*Anas platyrhynchos*				
		Mute swan	*Cygnus olor*				
		California quail	*Lophortyx californicus*				
		Indian peafowl	*Pavo cristatus*				
		Common pheasant	*Phasianus colchicus*				
		Weka	*Gallirallus australis*				
		Rock dove	*Columba livia*				
		Spotted turtle-dove	*Streptopelia chinensis*				
		Little corella	*Cacatua sanguinea*				
		Long-billed corella	*Cacatua tenuirostris*				
		Cockatiel	*Nymphicus hollandicus*				
		Budgerigar	*Melopsittacus undulatus*				
		Laughing kookaburra	*Dacelo novaeguineae*				
		Superb lyrebird	*Menura novaehollandiae*				
		Skylark	*Alauda arvensis*				
		Blackbird	*Turdus merula*				
		European greenfinch	*Carduelis chloris*				
		European goldfinch	*Carduelis carduelis*				
		House sparrow	*Passer domesticus*				
		Common starling	*Sturnus vulgaris*				

Reflections of Tasmanian woolgrowers

File name in bold	Woolgrower story and location	File size
Reflections	This is the complete document	3.8 MB
00 Introduction	Acknowledgements The process — Jo Dean	354 KB
01 Young	Biodiversity for long-term benefits — Lindsay and Rae Young, 'Lewisham', Ross and 'Green Valley', Bothwell	339 KB
02 LeMaitre	Never a dull moment — Valerie Le Maitre, 'Lochiel' and 'Wetmore', Ross	365 KB
03 Youl	Look after what we have got — Frank and Melissa (Milly) Youl, 'Barton', Cressy	483 KB
04 Dunbabin	We do what we do, because we want to do it! — Tom and Cynthia Dunbabin, 'Bangor', Tasman Peninsula and 'The Quoin', Ross	450 KB
05 Greenhill	It's the place that makes it all worthwhile — Bob and Patricia (Pat), Adam and Grainne Greenhill, 'Gala', 'Glen Gala' and 'Riversdale', Cranbrook	448 KB
06 Rapley	A successful blend — genetics, environment, wool and lateral thinking — Sue Rapley, 'Roseneath' and 'Plassey', Ross	472 KB
07 RoyalGeorge	All about living — Royal George Landcare Group: Tony and Joan Gee, 'Snow Hill'; Guy and Debbie Marshall, 'Rock House' and 'Brookstead'; Trevor and Jeanette Williams, 'Robin Lawn'; Damian Gee, 'Royslea' and North View', Royal George	508 KB
08 Gee	I wonder what it will be like next year? — Angie, Bob and Damian Gee, 'Royslea' and 'North View', Royal George	435 KB
09 Cameron	Helping nature look after itself — Andrew and Diana Cameron, 'Marathon', Deddington	307 KB
10 Parsons	Doing the best that we can — Tim and Jane Parsons, 'Curringa Farm', Hamilton	382 KB
11 Young	A couple of years down the track — Lindsay and Rae Young, 'Lewisham', Ross and 'Green Valley', Bothwell	258 KB