NSW GOVERNMENT

DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT
AND NATURAL RESOURCES COMMISSION

Good practices in riparian rehabilitation

Benchmarks for Environmental Trust funded projects

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Photography, front cover: Williams River, Clarence town (Jenny Weingott, Hunter Local Land Service)

Acknowledgements

The Natural Resources Commission and Environmental Trust would like to thank all those who contributed to the development of this guide including, the Coastal Rivers and Estuaries Project Advisory Group and key stakeholders who participated in interview sessions and the workshop. Special thanks to Dr Andrew Brooks from Griffith University who provided technical review and assistance.

Published by:

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ISBN 978-1-922493-50-7
EES 2020/0505
November 2020

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Photography: Little River, Bargo State Conservation Area (Nick Cubbin, DPIE)

Overview

What is riparian rehabilitation?

Riparian rehabilitation recreates healthy riparian corridor functions, such as habitat, bank stability, filtration of water entering the stream and shading. It can also achieve other outcomes such as flood mitigation, aesthetic and cultural values.

For this guide, the riparian corridor is defined as the land within and next to a stream or river. It includes the bed and banks, and land beyond the bank crest.

If the riparian corridor is in good health, protecting and maintaining that good health is important.

What are benchmarks?

There is a lot of guidance and advice available on how to undertake riparian rehabilitation, and some of it varies. The benchmarks have been developed by the Natural Resources Commission for the NSW Environmental Trust (the Trust) to clarify what is meant by good practices.

These benchmarks set a minimum standard for the Trust's investment in riparian rehabilitation projects. By adopting these benchmarks your project is more likely to achieve beneficial ecological outcomes.

How to use the benchmarks

This guide is provided to help you understand the practices to use when applying for riparian rehabilitation grant funding from the Trust. If your project doesn't adopt the benchmarks, your application may not be successful.

If you're unable to adopt the benchmarks but can provide clear evidence your project will achieve the ecological outcomes in another way, the Trust will still consider your application. This allows the Trust grant managers to consider innovative proposals and alternative solutions.

This guide focusses on riparian rehabilitation for environmental improvement. It does not focus on asset protection or other functions provided by a healthy riparian corridor but recognises these other functions are important considerations in riparian management.

Who needs to apply these benchmarks?

- Organisations or individuals seeking funding from the NSW Environmental Trust for riparian rehabilitation projects
- NSW Environmental Trust grant managers when assessing funding applications

Anyone seeking to rehabilitate riparian corridors in NSW is encouraged to consider these benchmarks

Why set benchmarks?

The research for this guide found there are reasons why rehabilitation projects fail. The benchmarks in this guide have been developed to overcome these barriers and increase a project's likelihood of success.

Problems for rehabilitation projects:

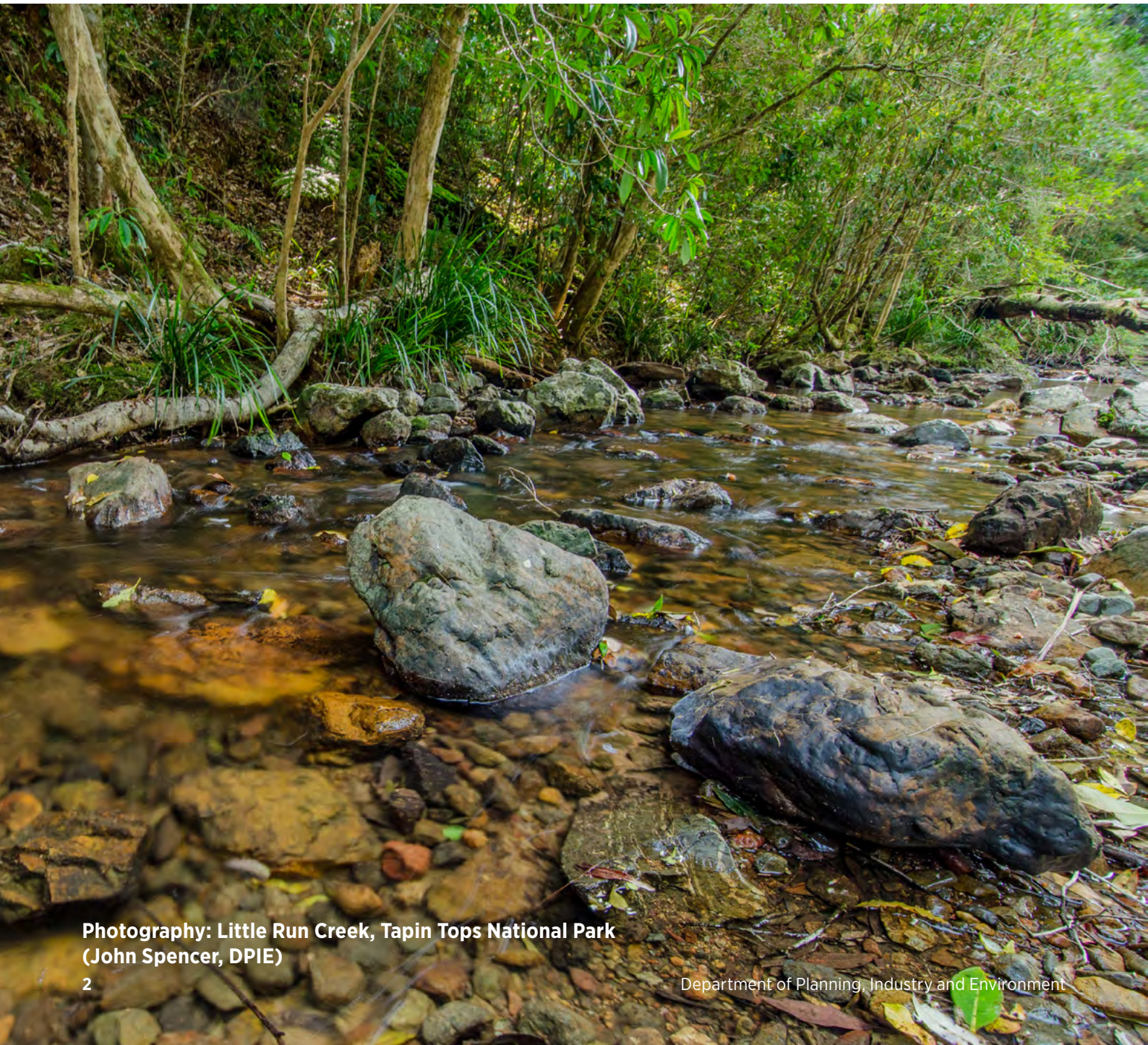
- projects often address symptoms of the problem rather than the causes
- actions are not always implemented in the right combinations (e.g. channel rehabilitation plus riparian vegetation planting) or at locations that would optimise benefits
- decision-making is commonly ad hoc and planned at too local a scale
- projects with relatively narrow riparian rehabilitation width can lead to persistent poor plant cover, erosion and/or weeds.
- failure to consider drivers of problems at a scale adequate to capture the ecological processes involved
- lack of consideration of socio-economic aspects

Planning and monitoring your project

Good planning is one of the best ways to set your project up for success. This includes making sure you have the right skills and resources, you understand what needs to happen to achieve the desired ecological outcomes, and you track the success of your project over time.

Your grant application needs to demonstrate you have a very good understanding of the need for the project and the site where works are proposed. Different practices will be relevant for different site conditions and the ecological function you're trying to achieve through rehabilitation.

Setting the rehabilitation objective will influence how you undertake most aspects of your project and will often be restricted by available resources, both people and money. You need to understand the catchment context and priorities, assess your site, and determine the desired ecological outcomes before deciding on the most appropriate practice or practices.



Photography: Little Run Creek, Tapin Tops National Park (John Spencer, DPIE)

Benchmarks for planning and monitoring your project

Your grant application must include:

- **an outline** of why riparian rehabilitation is proposed ☐
- **the rehabilitation objective**, including the ecological function(s) to be restored ☐
- a **detailed description of the site** including the extent of the area to be rehabilitated, its bioregional context, channel scale and type, slope, soil type and erosivity, aspect, presence of weeds or pest animals, flow regime including flooding, rainfall intensity, existing condition of vegetation and soil on the site, bed and bank geomorphology, adjacent land use, and the location of any intact remnant riparian vegetation relative to the site ☐
- **a description of the catchment context**, including upstream and downstream influences as well as information about any other project activities that complement the project ☐
- **evidence that the planned works are a priority for action** in the catchment, for example they are a high priority action within a catchment-based erosion or riparian vegetation prioritisation assessment ☐
- **use of the best available information** to characterise riparian vegetation communities and their physical structure, and quantify channel morphology and bank erosion, including remote sensing data (e.g. satellite, aerial and drone imagery) ☐
- **details of the rehabilitation techniques proposed** (aligned with the benchmarks in this guide) ☐
- **details of appropriate experts or practitioners** spoken to regarding the feasibility of your proposal, including Aboriginal groups or native title holders ☐
- **landowner / land manager consent** for the project ☐
- **all relevant approvals and permits** that have been obtained ☐
- **a data management statement** that commits to appropriate collection, storage and provision of data to the Trust ☐
- **good quality photographs** of the site(s) where works are proposed, including location information and a map to ensure you can take a photo at the same spot in the future to report progress ☐

You must also prepare:

- a **weed and pest management plan** to implement before, during and after the project works have been completed. This must include: ☐
  - ☐ site preparation works including weed removal if this is appropriate (there are exceptions, such as the complete removal of willows is not recommended, rather co-planting with subsequent staged removal is encouraged)
  - ☐ ongoing maintenance to maintain established vegetation
  - ☐ ongoing and strategic monitoring to ensure early identification and treatment actions to prevent established vegetation being compromised by future weed or pest animal impacts
- if relevant, a **drought management plan** for establishing plants, including appropriate planting techniques, species selection and watering requirements to increase survivability ☐
- if relevant, a **grazing management plan** including fencing needs, stock management arrangements to reduce grazing pressure on the riparian zone, and off-stream water access – more information is provided under protecting, establishing and maintaining vegetation ☐
- if relevant, a **management plan for other activities** that can impact on riparian condition – such as walking trails, vehicle access or wave impacts from boats ☐
- a **monitoring plan** to cover the full life cycle of your project, including how you will track project progress and what you'll do if the project is not going as well as expected. The monitoring plan should cover multiple years and be appropriate for the project type and scale. For example, to cover the establishment and maintenance of vegetation, at least 10 years of monitoring may be required. ☐

Protecting, establishing and maintaining vegetation

An essential feature of a healthy riparian zone is vegetation. Vegetation provides key ecological functions such as channel bed and bank stability, reduced sediment and nutrients entering the waterway, habitat for wildlife and other biodiversity benefits.

Your Local Land Services office or local council may be able to provide useful information on plant species suitable for your site. Organisations who regularly undertake planting projects in your local area are also valuable sources of information and local catchment knowledge.

A catchment-scale riparian vegetation prioritisation assessment should be undertaken to inform where and what riparian vegetation protection and establishment measures are needed. The best available information should be used to undertake this assessment, which includes high-resolution mapping products (e.g. hyper-spectral satellite, airborne light detection and ranging (LiDAR) and drone imagery). This assessment should be undertaken collaboratively by key organisations responsible for river and estuary management in the catchment and be used to inform riparian vegetation programs.

Photography: Hunter River fenced riverbank (Jenny Weingott, Hunter Local Land Services)

Principles for riparian vegetation works

Protect intact, remnant or established riparian vegetation by monitoring condition and taking action to prevent weed infestation or damage from grazing animals.

Connect intact riparian zones, rather than establishing a patchwork of isolated riparian zones.

Encourage natural regeneration where there are intact riparian areas and seed sources upstream.

Revegetate when native vegetation is: unlikely to recover naturally, specific plant species are required to achieve the rehabilitation objective, or when erosion is relatively rapid and active revegetation is likely to have more immediate benefits.

Start in the upper catchment, as the benefits of riparian rehabilitation accumulate in the downstream direction, unless there is a compelling case for intervention elsewhere. For example to:

- address the point source of a problem (e.g. highly active bank erosion in lowland reaches)
- provide critical habitat needs for rare and threatened species
- protect high value Aboriginal cultural sites or places

Select plant species that are best suited to the site conditions. For example:

- species that previously grew in local riparian areas may become less resilient as the climate changes. It may be more appropriate to select non-local native species that are better adapted to the predicted future climatic conditions.
- many rivers today have different hydrology, substrate, microclimate, light and nutrient conditions than under pre-development conditions. Some species that originally grew on these sites may no longer be suited to the current conditions.
- climate change and impacts on channels will likely cause major changes in flow regimes, flow conditions and the local climate at your site. Understanding these future changes is important to plan for in your project design and selection of species.

Photography: Weed control and planting (Gavin Farley)

Benchmarks for protecting, establishing and maintaining vegetation

You must demonstrate your project sites are a high priority:

- your project must align with identified catchment priorities for riparian vegetation works ☐

Assisted natural regeneration is preferred over revegetation:

- the best way of achieving riparian revegetation is via assisted natural regeneration – encourage native riparian trees, shrubs and plants to re-establish themselves by controlling weed competition and grazing pressure ☐
- use assisted natural regeneration if there is intact remnant vegetation upstream of your site (i.e. a seed source) and your site is not heavily degraded (e.g. from earthworks) ☐

For projects using direct seeding or planting:

- explain why assisted natural regeneration is not feasible ☐
- do not use exotic plant species (non-Australian) or invasive native species ☐
- select native plant species that: ☐
  - ☐ are suitable for the site conditions, **AND**
  - ☐ will achieve the rehabilitation objective including ecological functions, **AND**
  - ☐ will provide a structurally diverse riparian community that best meets the rehabilitation objective – this could involve using shrubs, trees and ground cover species such as rushes and sedges, unless you are trying to replicate a plant community that does not have all of these structural components, **AND**
  - ☐ are indigenous to the area –you can identify local plants through observations of remnant vegetation, vegetation surveys or historical records, **OR**
  - ☐ will thrive under projected changes to climate – to select appropriate species, use the information and resources in **Climate-ready revegetation – A guide for natural resource managers**
- consult your Local Land Services office on the ideal species to select for planting on the site and to meet the rehabilitation objective ☐
- only plant or direct seed at a suitable time of year, based on the optimal season and prevailing conditions ☐
- if planting woody seedlings, use the long-stem planting method where appropriate. This method is encouraged for most woody stemmed plant species, site conditions and climate. Follow the instructions in **The Longstem Planting Guide** produced by the Australian Plants Society NSW. ☐
- if collecting seed from remnant vegetation: ☐
  - ☐ seed collection needs a license if it relates to threatened ecological communities or threatened species
  - ☐ think carefully about where you're collecting your seed from so you're not over-collecting from the same remnant

For projects where grazing stock have access to the riparian zone:

- develop a **grazing management plan** to outline how you will reduce grazing pressure on the riparian corridor ☐
- onsider **fencing** or other control measures to limit the duration, intensity and timing of grazing to avoid damage to vegetation and soil structure, or the installation of appropriate off-stream water access for stock ☐
- further information managing stock are provided in **Stock and Waterways - a NSW manager's guide** ☐

Benchmarks for protecting, establishing and maintaining vegetation

For projects undertaking revegetation during drought:

- if possible, avoid planting activities during **severe drought** ☐
- develop a **drought management plan**, which may include actions to water plants ☐
- select **plant species that are more resilient to drought** conditions, including hotter air and soil temperatures, less rainfall, less soil moisture and other harsh site-specific conditions ☐
- in very severe, extended droughts the deeper soil profile may dry out and long-stem tube stock may not be appropriate – **regular tube stock** with a shallower root system may have better access to moisture from limited rainfall events or require less water if hand watering is needed ☐
- undertake planting at a time of year when it is more likely to be **cooler and wetter** ☐
- track how vegetation is establishing, what plants and planting techniques are working well, and adjust your revegetation and maintenance approach to improve your chance of success ☐

Photography: Hunter River fenced riverbank (Jenny Weingott, Hunter Local Land Services)

Photography: Riverbed in Capertee National Park (Jenny Weingott, Hunter Local Land Services)

Riparian corridor and buffer widths

A 'buffer' is a strip of land adjacent to an area you're trying to protect. For waterways, it provides separation from surrounding activities that could lead to degradation. It's not straightforward to specify how wide a buffer should be. To protect waterways from the potential impacts of adjacent land use, there are many factors that can influence what's needed to keep the waterway healthy.

Surrounding land use is one consideration. The size of the stream, type of vegetation, slope, soil type, flooding regime and other factors can influence the width of buffer needed to protect and provide beneficial environmental outcomes for the waterway.

What's pragmatic to achieve should also be a significant consideration for riparian rehabilitation projects, particularly where the riparian corridor may be used for agriculture or other purposes. The riparian corridor is a landscape system and should be managed as such.

Defining the riparian corridor:

- the riparian corridor includes the area within the channel and extends past the bank crest onto the surrounding land (see **Figure 1**)
- the riparian corridor should be determined using the best available information, including field survey and remotely sensed data
- the preference is to include all the riparian corridor in your rehabilitation project; however, this may not be possible, pragmatic or necessary to achieve your rehabilitation objective
- the buffer width is measured from the top of the high bank (the bank crest), with the buffer extending away from the waterway.

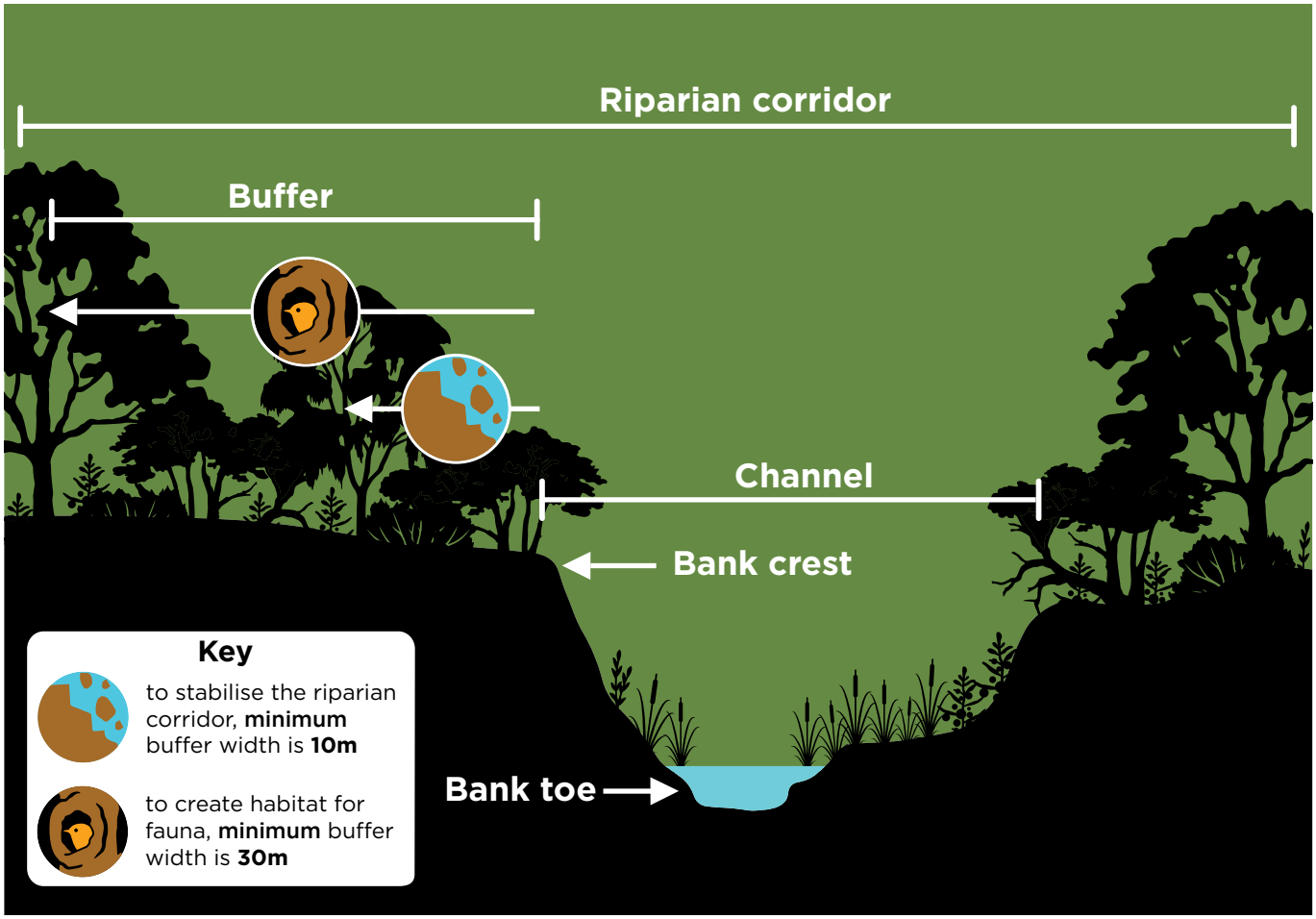


Figure 1 The riparian corridor and waterway features, showing a buffer

Benchmarks for riparian corridor and buffer widths

When working out what area your riparian rehabilitation project will address, you must include the in-channel component, from the toe of the bank (which may be under water) to the crest, plus a minimum width beyond the crest, shown in **Figure 1** as the 'buffer'

Selecting appropriate buffer widths requires you to consider the rehabilitation objective, the size and type of waterway, the steepness and height of the bank, and other factors:

- **If the rehabilitation objective is to stabilise the riparian corridor:**

  the minimum buffer width used is to be the greater of 10 metres or the width determined using the **Guidelines for Stabilising Streambanks with Riparian Vegetation** ☐

- **If the rehabilitation objective is to create habitat for fauna:**

  the minimum buffer width used is to be the greater of 30 metres or the width determined using the **Guidelines for Stabilising Streambanks with Riparian Vegetation** ☐

Remote sensing methods

Airborne light detection and ranging (LiDAR) imaging is freely available for all of NSW and should be used to build a detailed understanding of your project site's topography and to delineate the channel margin.

Other useful remote sensing data that could help you to understand your site and the surrounding landscape is available on Digital Earth Australia, Sentinel Playground and Google Earth Engine.

Photography: Bed erosion in a creek, Williams River tributary (Jenny Weingott, Hunter Local Land Services)

Erosion control and mitigation

Erosion is both a natural process that occurs in waterways and a process that can be caused or exacerbated by human activities.

If the erosion is part of a natural process (e.g. the normal movement of a river on a floodplain), the preference is to allow the erosion to occur.

If the erosion can be linked to land use practices, human disturbances or a degraded riparian zone, erosion treatment options should be considered.

A catchment-scale erosion prioritisation and risk assessment are essential to inform any project proposing to treat erosion. An important part of this is a catchment-wide assessment of historic disturbances. In many waterways there is often a major lag between the initial disturbance and the erosion response, which can sometimes take over 100 years to be fully realised. For example, increased bed instability may be due to historic de-snagging operations. Understanding what's causing the erosion enables you to target the treatment location and option.

Erosion treatment options are generally categorised into 'soft' and 'hard' engineering approaches.

Soft engineering approaches attempt to re-establish the stream's natural geomorphology, materials or habitat and may include works to re-establish vegetation and stabilise channel banks through, for example, installing large woody debris.

Hard engineering approaches involve using concrete, rock or other building materials to construct permanent structures, and these approaches are often used to protect assets.

Benchmarks for erosion control and mitigation

CHECK LIST

What's causing the erosion? Natural or human influences?

- the cause of the erosion and anticipated changes must be considered by a suitably **qualified geomorphologist or environmental engineer**, including: ☐
  - ☐ natural stream erosion and deposition patterns, which can be estimated through consideration of stream power, bank material and channel confinement
  - ☐ historic or current disturbances and their link to active or ongoing erosion
- your project must demonstrate it's not treating erosion formed as part of a **natural process** ☐
- you must demonstrate the treatment location and option is based on an understanding of what's causing the erosion ☐

You must demonstrate your project is a high priority for action:

- your project must align with identified catchment **high priorities for erosion control works** and consider risks associated with the erosion (e.g. is it active and how rapidly is it expanding) ☐
- **the right people** (e.g. your local council, Local Land Services, academics etc.) need to review your project before you submit your grant application ☐

Soft versus hard engineering approaches?

- **soft engineering approaches** are generally encouraged over hard engineering approaches, although they will not always be appropriate or cost effective depending on the situation ☐
- a combination of treatment options may be required ☐
- hard engineering approaches must be designed by a suitably **qualified engineer** and obtain all necessary approvals ☐

Need more information on geomorphic classification of waterways in NSW?

The River Styles database for NSW classifies rivers based on geomorphic qualities that include river type, fragility, sensitivity to disturbance, condition, rarity and recovery potential. The database can be used to inform the prioritisation of small-scale direct interventions at points where extensive erosion, sediment transport or deposition is occurring, and is available online.

Need more information on types of erosion and treatment options?

Optimising the management of riparian zones to improve the health of the Great Barrier Reef (pages 61-62) provides useful information on types of erosion, how they're caused, when to use vegetation and what type, when to use rocks or wood, or when to use mechanical protection (e.g. rocks placed at the toe of the bank) and when bank battering may be required. This document is available online.

Photography: Hunter River erosion stock trampling (Jenny Weingott, Hunter Local Land Services)

Reinstating wood in waterways

In an unmodified waterway, trees and branches may fall into the channel. This wood plays an important role in ecosystem health, providing habitat and food for aquatic species and creating channel complexity and stability.

Historically, wood was routinely removed from Australian waterways. Now that its benefits are better understood, catchment managers have been reinstating wood to achieve multiple benefits.

Figure 2 Rehabilitation of Gwydir River using installed wood and vegetation (photography: Peter Corlis, NSW Soil Conservation Service)

Benchmarks for reinstating wood in waterways

You need approvals to reinstate, modify or remove wood from waterways in NSW:

- Find out more about approvals for wood removal, modification or reinstatement from the Water Group within the Department of Planning, Industry and Environment. ☐

Reinstating wood in waterways:

- If you plan to reinstate wood in a waterway, the works must: ☐
  - ☐ be conducted in conjunction with activities to **re-establish vegetation**, except where riparian areas are already well vegetated
  - ☐ be designed by an **experienced geomorphologist, environmental engineer or other suitably qualified professional** in accordance with current industry practices or the **Design Guideline for the Reintroduction of Wood into Australian Streams**
  - ☐ be installed by an **experienced practitioner**
  - ☐ use **multi-limbed, native wood** with a minimum diameter of the structural component of the trunk of 0.3 metres
  - ☐ use native wood with **different sized branches** (i.e. non-structural components) to provide different habitat structure and complexity to meet the rehabilitation objective
  - ☐ use **appropriate material to anchor** the wood – this could be gravel (unless the waterway has a sand bed) and/or driven piles, or cable in some cases
- Further useful information is available in **A Rehabilitation Manual for Australian Streams** ☐

Removing or modifying wood in waterways:

- If the project proposes to remove or modify existing wood in waterways, **justification must be provided** and meet the rehabilitation objective. ☐

Photography: Resinstating wood at Richmond River (Peter Corlis, NSW Soil Conservation Service)

Documents and weblinks

Documents referred to in this guide

Abernethy B and Rutherfurd ID (1999), *Guidelines for Stabilising Streambanks with Riparian Vegetation*, Technical Report 99/10, Land and Water Resources Research and Development Corporation, Canberra. Available online at https://ewater.org.au/archive/crcch/archive/pubs/pdfs/technical199910.pdf

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Staton J and O'Sullivan J (2019), *Stock and waterways – a NSW manager's guide*, Australian River Restoration Centre. Available online at: http://www.stockandwaterways.com.au/

Webpage references

ELVIS - Elevation and Depth – Foundation Spatial Data http://elevation.fsdf.org.au/

Digital Earth Australia https://www.ga.gov.au/dea/home

Geoscience Australia https://www.ga.gov.au/

Google Earth Engine https://earthengine.google.com/

Sentinel Playground https://www.sentinel-hub.com/explore/sentinel-playground

River Styles NSW https://www.industry.nsw.gov.au/water/science/surface-water/monitoring/river-health/river-styles

If in doubt, ask your grant manager

If you need assistance to plan and design a riparian rehabilitation project to meet these benchmarks, contact the grant manager at the Environmental Trust. They will help guide you through what is required.

Other practices

Other practices in riparian rehabilitation exist and this guide has not covered niche or emerging practices. If you think your project would best be delivered using a different practice, please call the grant manager to discuss before preparing your application.

For more information

For more information about riparian rehabilitation and the Environmental Trust visit https://www.environment.nsw.gov.au/funding-and-support/nsw-environmental-trust

For more information about the development of the benchmarks visit https://www.nrc.nsw.gov.au/environmental-trust

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