

North Burnett Riparian Revegetation Guidelines

Burnett River, Queensland

Prepared for
Burnett Catchment Care Association
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Kirra Weir, Upper Burnett River – land management practices have exposed the riparian area to erosive influences and events such as those of Australia Day 2013. There was virtually nothing left, no deep-rooted native vegetation to hold the banks (landscape) together, and nothing to slow the overland flow

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1 Introduction

These North Burnett Riparian Revegetation Guidelines are designed to inform and support step-by-step through the process to stabilise and restore riparian areas, the same processes in part, are applicable for landscape recovery in various differing contexts.

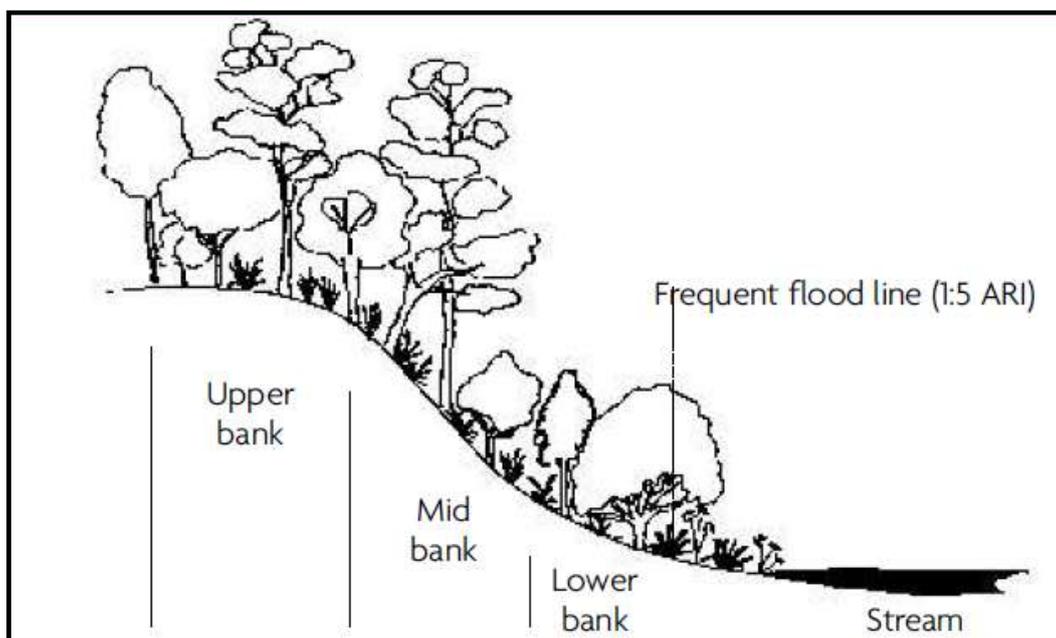
The jointly funded Queensland and Australian Government's Flood Recovery Program provided the opportunity and means to develop these guidelines to stabilise and revegetate the Burnett River to protect associated productive lands and industries.

To be successful when undertaking riparian revegetation works, it is recommended to follow these guidelines closely, alternatively, there is a high probability that your project will fail and public funds (taxpayer dollars) will be wasted. Despite appearance, it is not necessarily a difficult procedure, but having defined processes to follow will simplify the matter further.

2 Riparian areas

What is a riparian zone? There are several explanations of what a riparian area is. Definitions range from simple to complex including:

- The area within the high banks of a waterway or watercourse (river, stream, gully);
- The land that is directly influenced by the waterway, or which influences the waterway;
- The corridor of land through which a watercourse flows, whether annual or ephemeral;
- The immediate vicinity of the watercourse and can include the bed, banks and adjacent land, and associated floodplains;
- The margins of lakes, dams, and wetlands; and
- Any combination of the above.



Typical densities of riparian vegetation and the different growth forms in the various parts of the bank. The frequent flood line is inundated at least 1 in every 5 years (RDI = average recurrence interval) Diagram courtesy Ipswich City Council

What is a riparian buffer? The buffer is the zone or area from the waterline to the high banks and beyond. It naturally consists of unique plant communities, often mapped as regional ecosystems that are commonly associated with riparian land. These ecosystems tend to have different species mixes, densities, and structure from those ecosystems of the surrounding lands.

This native vegetation is generally taller and often more dense because of the fertile alluviums (alluvial soils) and increased moisture levels within the riparian zone.

To be effective, the riparian buffer needs to be maintained free of pest species (weeds and animals), with good fire management practices in place to protect the native riparian vegetation. Grazing is an effective means of reducing fuel loads during dry, fire-prone periods, but generally it is best if stock access is limited to further reduce erosion and bank slumping.

Well-developed and well-maintained vegetation will not entirely stop streambank erosion, for watercourses are by their nature migratory (constantly moving, and shifting); however, healthy, intact riparian buffers significantly reduce the rate of erosion.

Based on the Abernathy and Rutherford (1999) scientifically calculated formula, the recommended buffer widths for the Burnett River are between approximately 230-255 metres wide, depending upon the bank height. The formula represents total Buffer Width (m) as $B = k + h + (r + t)$.

B is the required buffer width for bank stabilisation, k is the recommended *minimum* buffer width (*Vegetation Management Act 1999*), h is the stream bank height, t is the time that it takes for riparian vegetation to mature, and r is the rate of bank erosion. This formula is also used for SedNet (BMT WBM 2012) modelling.

In most areas, it is not possible to re-establish buffer widths to the desired dimensions as historic land clearing and infrastructure development dominate land use from the top of the high bank, sometimes even extending below the high bank down into the riparian zone.



A well-grassed buffer of native species above intact riparian vegetation, grazed periodically for maintenance access and fire and management purposes. Dead hollow trees retained as habitat, with weeds kept under control and eradicated regularly

Today recovery works can occur within the area that remains vacant only, but if there is an opportunity to extend the riparian buffer, then it should be taken to maximise the benefits to water quality and bank stabilisation.

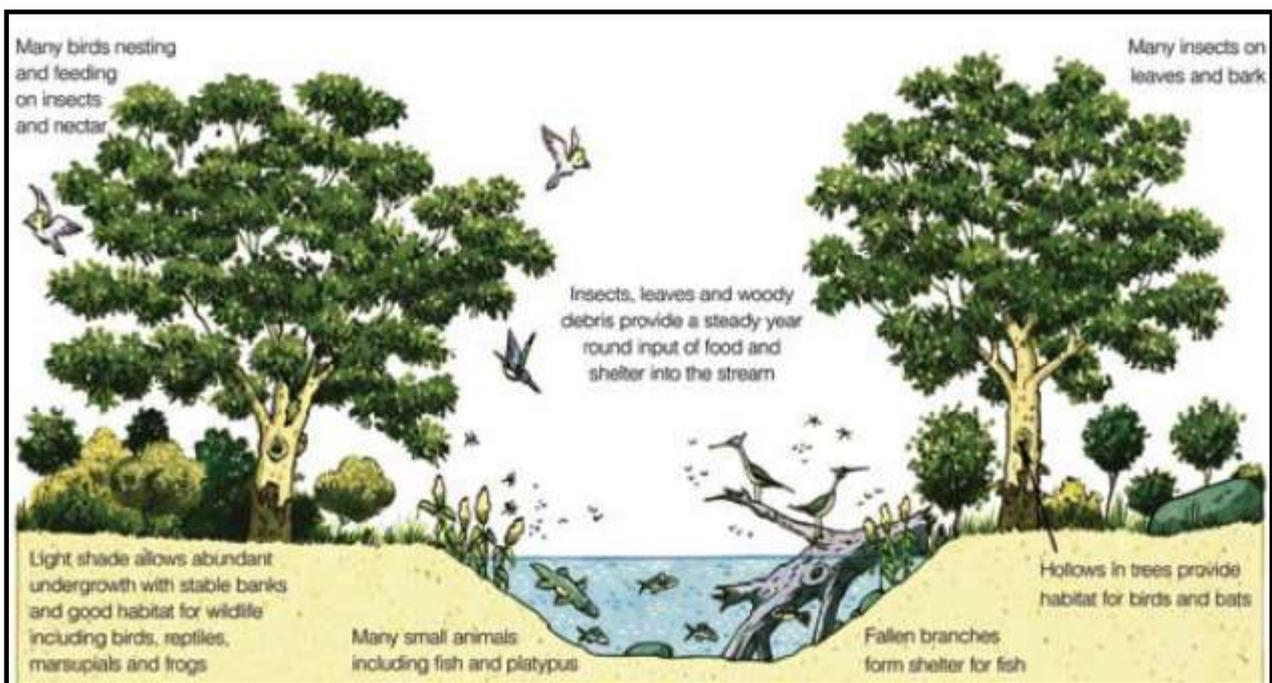
What are the values of the riparian buffer? Buffer zones slow overland flow and filter out particles, which improves water quality. The vegetation within the high bank protects the banks from mass erosion (bank stabilisation), and moderates temperatures and light, which reduces algal growth, evaporation and aquatic weeds.

Dappled overhead shade provided by native vegetation closer to the waterline helps protect aquatic fauna from predation. Organic matter falling into the water provides food for many in-stream species and is a source of carbon, which drives the aquatic ecosystem. Vegetation within the riparian buffer is directly responsible for the maintenance of in-stream life and consequently, water quality.

In-stream detritus and a content of up to 10% large woody debris will slow flows of lower intensity and provide essential habitat for many aquatic and terrestrial species, without causing hydrologic issues during higher intensity flows. This diversity of life forms or biodiversity is essential to the supply and quality of water resources (water quality) – everything cycling together keeps the water cleaner for longer. Like arteries and veins, waterways are the vascular network in the landscape, enabling production and supporting life with clean, healthy water.

According to the Queensland Department of Natural Resources and Water (2006), there is increasing recognition of the important functions of streambank vegetation and of its aesthetic appeal associated with property values.

It is generally said that the benefits of retaining biodiversity can be broken into three clusters: ecosystem services, biological resources, and social benefits (Australian Government 1993). Biodiversity, associated ecosystems and the services they provide, is one of the best “front-line” responses to a changing climate and rising sea levels (Islands Business, 2013).



The benefits of native vegetation in riparian areas. Illustration courtesy of Land and Water Australia

3 The process

The first step in any project concerning riparian revegetation, bank stabilisation, and recovery of the riparian buffer is to seek specialist or technical advice. The services of a soil scientist and botanist will be required, but large-scale structural solutions will require an engineer's specialist skills.

Professional expertise with assessment and planning provides the best methodology from which to develop a plan and program of works for the riparian revegetation (or restoration) project at an individual property level.

What needs to be assessed? Assessment of the geomorphic processes (landscape formation, flow dynamics, and river channel stability) is essential to identify the cause of riparian instability and therefore the possibility of success of stabilisation methods, including revegetation. Other information required includes the extent of damage, soil type or types, land use, vegetation (natives and weeds), excavation and bank restructuring requirements to address bank instability, infrastructure location, condition of fencing or need for fencing, buffer width, and the necessary legislative controls permits and procedures required to undertake the project.

Refer to the appendices for a series of fact sheets and links to further fact sheets for further information on these and other topics. Searching online for these topics will deliver an overwhelming amount of information. Whilst most information available online is of a suitably high standard, some specific knowledge of the local site is required as online sources may not be strictly relevant to local conditions and natural systems.

Soil type

Soils along the Burnett River are dominated by very deep, sandy to loamy textured soil derived from alluvial deposition during flood events. The soils are often layered with a soft or firm surface and neutral pH throughout the profile (DNR 1996). These soil types are unconsolidated, with little structural strength when wet and prone to erosion, particularly in cleared over-grazed areas. Unconsolidated materials, including gravel, sand, silt, and clay are generally loose to weakly coherent superficial materials that have not consolidated into rock (NSW Government, 1999).

Where technical assessment of riparian areas concludes that revegetation will be effective (sufficient) to stabilise the banks then these guidelines apply. Where there is doubt or hard engineering is required, refer to the Cardno report, "Channel and Bank Stability of Selected Reaches of the Burnett River System, Queensland Australia, and Designs for Selected Sites".

Vegetation

Assess vegetation and its location within the riparian zone and the associated communities in the buffer above the high banks, before starting any on-ground works. The image on page 1 represents typical bank positions – the lower slope may also be referred to as the toe of the bank.

If little vegetation remains at the property level, ensure assessment of vegetation in a similar reach of the river to gain an understanding of the indigenous species that originally occurred there, and the degree of biodiversity and structure of the desired ecosystems on the restoration site. Maintaining genetic integrity through use of locally occurring plant species *is critical to success*.

In highly disturbed and fragmented landscapes, regional ecosystem (vegetation community) mapping available from the Department of Natural Resources and Mines at <http://www.dnrm.qld.gov.au/land/vegetation-management/vegetation-maps/vegetation-map-request> is a valuable aid to determining species composition and as a source of additional legislative regulations regarding essential habitat for threatened species such as *Phascolarctos cinereus* (Koala).

A regional ecosystem (RE) is described generally as a complex of dominant canopy species, with additional information on assorted understorey and ground layer species (if present). The numbering system of REs changes to the north and west from the South-east Queensland Bioregion (12) to the Brigalow Belt South (11). Full descriptions of REs are available from the Regional Ecosystem Description Database (REDD), which can be accessed and downloaded from http://www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/how_to_download_redd.html

A brief description of some common riparian REs in the North Burnett include:

12.3.1 – a rainforest ecosystem

12.3.3 – woodland, dominated by *Eucalyptus tereticornis* (Qld Blue Gum)

12.3.7 – woodland, dominated by *Eucalyptus tereticornis* (Qld Blue Gum), with rainforest species in the understorey

12.3.10 – woodland, dominated by *Eucalyptus populneus* (Poplar Box) with or without (\pm) *E. tereticornis* (Qld Blue Gum)

11.3.4 – woodland to open forest dominated by *Eucalyptus tereticornis* (Qld Blue Gum)

11.3.25 – open forest to woodland dominated by *Eucalyptus camaldulensis* (River Red Gum) and *E. tereticornis* (Qld Blue Gum)

Engage a botanist to record every species to identify what the desirable species are or what a weed is and what is not. Projects often fail after planting because of poor weed management of the site, and competition from invasive weed species. Correct identification of species and targeted control of competitive non-native species will save many hours' labour and considerable amounts of chemicals (time and money).

Failure of revegetation projects regularly occurs due to a lack of botanical expertise and management information. Refer to the Fact Sheet: Master Species List, in the appendices for a range of suitable species for revegetating riparian zones in the North Burnett.

Revegetation and genetic provenance

In addition to identifying species, a professional botanist will provide information on which species are best for revegetation works, what densities to plant at, and which zone species belong in. This list forms the basis for ordering tubestock from local native nurseries. It is important to use local native plant specialists who will collect seed locally to maintain genetic provenance.

Generally, plant densities vary between the different types of regional ecosystems present – when revegetating it is advisable to reflect these densities across the different zones, taking into consideration any natural regeneration that may already be occurring.

Poor genetic provenance causes projects to fail because plants bought in from elsewhere will not have inbuilt environmental resistance to local conditions because they are not genetically adapted to local conditions – they have not evolved to withstand local conditions.

For example if plants you purchase have a warm coastal provenance, they are highly unlikely to withstand frost and dry conditions, even though members of this species from every other known location have an in-built genetic capacity to do so. As a result, recommended species often fail in a specific location when they would otherwise thrive.

Depending on time of year, order plant stocks a minimum of 6 months ahead of the commencement of revegetation works – if the plan is to start work during the cooler months, there may be limited seed available. Refer to the appendices for a list of specialist suppliers and revegetation job supplies.



Use of local provenance seed is essential from which to produce tubestock for revegetation works

Complete other tasks before revegetation begins. For example, mapping of the site to establish the location of infrastructure and to provide a total area for revegetation to calculate the number of tubestock required for planting out (number of plants per hectare).

Undertake and complete earthworks and other preparatory works such as soil conditioning with fertilisers or ameliorants, construction of fences and gates, treatment of weed species, and establishment off-stream watering points for stock, if required.

Plant densities in the Burnett River riparian zone occur at varying densities, but for revegetation, plantings at 3 to 5 metre (m) intervals are adequate. Additional species will recruit in and some natural regeneration could occur from soil-stored seed (the soil seedbank). This is an additional reason to have a trained botanist assist with site assessment prior to commencement of works – killing naturally regenerating species because they are not recognised is an unacceptable cost and waste of limited resources.

This recruitment of additional species over time, as the vegetation develops, will bring the complement of species and densities nearer to the natural order. It is critical at all times during this process to control and exclude weed species, as they will outcompete desirable native species and disrupt the developmental process of the recovering ecosystems.

Further information is available in the accompanying Fact Sheet: Planting and establishment process.

Pest management

Always seek specialist advice on the latest control methods and approved herbicides before initiating weed control activities. Call the Queensland Department of Agriculture Forestry and Fisheries or visit their site at <http://www.daff.qld.gov.au/plants/weeds-pest-animals-ants> for further information. Overwhelming infestations of *Dolichandra unguis-cati* (Cat's Claw Creeper) like that below are best treated manually to free the canopy and then through establishment of populations of biocontrol agents such as *Hylaeogena jureceki* (Leaf-mining Jewel Beetle). These take some years to establish and become truly effective, providing time to affect additional manual and chemical control from the outer perimeter inwards.



Do not allow pest species to go unchecked, as this Cat's Claw Creeper has been allowed in this riparian zone. Invasion by competitive species results in rapidly deteriorating water quality from lack of shade and the lack of filtering capacity in the groundlayer

Engineering works

Notes for excavation and bank restructuring to address bank instability are located in the appendices, in the Fact Sheet: Slope stabilization and stability of cuts and fills.

Buffer width

In earlier discussion, it was noted that recommended buffer widths for the Burnett River are between 230-255 metres wide, depending upon a range of criteria including bank height. In most areas, this is not possible as historic land clearing and infrastructure development dominate land use from the top of the high bank, sometimes extending down into the riparian zone.

Therefore, the buffer width must take into account and reflect general management objectives, provided the current management practices will facilitate establishment of a functional self-sustaining native ecosystem.

Fire and stock management

Fencing to exclude stock is essential to establishment of revegetation or restoration plantings, but fire management can pose a risk once grasses mature and 'hay off' during dry periods and the coldest months.



Discourage grazing until young plants are at least 1.5 m tall. If grazing is required to reduce grass competition or for feed at other times, implement the 'pulse' grazing technique

Exclude fire for a minimum of 10 years, longer if possible (25-year minimum intervals preferred); if fuel loads become dangerous, reduce with a short, intense 'burst' or 'pulse' of grazing.

Pulse grazing is pressuring small pasture areas with a large number of animals for a very short time, and then repeating these steps again (Christine Jones 2000), whenever fuel loads become dangerous.

Establish off-stream watering points for ease of stock exclusion from the riparian zone.

Large woody debris (LWD)

Reinstate LWD at various angles to impede water flow – lay debris as most of the flood deposited LWD currently lays – at a slightly offset angle, which slows water flow. If available, place some logs into the water as basking and/or resting sites for fauna. LWD makes useful resource traps, provides habitat for wildlife and it slows and impedes overland flow of stormwater, further assisting infiltration rates. Refer to site-specific plans and fact sheet diagrams or photographs for placement of LWD along banks.



An excavator can be used for all phases of earthworks and reinstatement of LWD

Legislative controls permits and procedures

The *Vegetation Management Act 1999* regulates the removal of standing trees where mapped as remnant vegetation, which requires a permit from the Department of Natural Resources and Mines. Unstable live trees on eroded riverbanks can be removed if they threaten the health and safety of workers undertaking revegetation works. Any works involving the clearing of remnant vegetation for access to undertake revegetation and engineering works will require a permit. An Area Management Plan has been prepared to facilitate riparian revegetation works for environmental reasons.

If required to work with machinery in the toe area, the *Water Act 2000* applies and a notification form from the Department of Natural Resources and Mines will be required to carry out works in this area – ‘self-assessable development of operational works that interfere with water in watercourse, lake or spring’.

In some instances, the *River Improvement Trust Act 1940*, the *Rural Lands Protection Act 1985*, the *Fisheries Act 1994*, the *Nature Conservation Act 1992*, the *Environmental Protection Act 1994*, the *Sustainable Planning Act 2009*, and the *Land Act 1994* may also apply, particularly in relevance to leasehold lands.

Before initiating any works, contact the Department of Natural Resources and Mines for guidance on 13 74 68.

Additional works

Bare sites can be hydromulched with native seed mixes, or broadcast by hand where site access is difficult or the economy of scale makes hydromulching impractical. This is a useful method to reintroduce native grass species, which can be difficult to source in tubestock.

Add seed of Green Couch, a short stolonising lawn grass species to seed of a short-lived cover crop, and purchase or locally collect seed of a variety of native species and add to this mix.

It is best to use short stolonising grass species because they will not out-compete regenerating native species and additionally will reduce fuel loads across the site. Whenever possible avoid tall tussock species such as Green Panic or stolonising species such as Callides Rhodes Grass, or Creeping Bluegrasses such as Bissets.

These species are good for filtration purposes and stabilising the soil against erosion, but are an impediment to native species and can promote fire damage to native species if not adequately controlled. Additionally, the shorter grasses allow native herbs, legumes and other grasses to germinate and regenerate amongst them quite successfully. Over time, this assists the vegetation to transition to a better-structured native ecosystem.

If mulch is required (other than hydromulch) it must be uncontaminated, that is free of serious pathogens and weeds such as Parthenium and Giant Rat's Tail Grass. As such, it is preferable to receive a weed hygiene declaration form from the vendor – these forms are a requirement of supply of any materials (fodder, grain, gravel, machinery, mulch, sand, soil, etc).

Please follow this hyperlink for full details of legal responsibility for transporting and supplying materials <http://www.daff.qld.gov.au/plants/weeds-pest-animals-ants/weeds/preventing-weed-spread/legal-requirements/weed-hygiene-declaration>

Please also refer to the general Queensland Department of Agriculture, Fisheries and Forestry (DAFF) for advice regarding cleandown procedures for vehicles and mobile plant <http://www.daff.qld.gov.au/plants/weeds-pest-animals-ants/weeds/preventing-weed-spread/cleandown>

This link <http://www.daff.qld.gov.au/plants/weeds-pest-animals-ants> leads to information on specific pest species including controls and which chemicals to apply.

4 Checklist/revegetation work plan

- 1 Assess and become familiar with the area of works (repeat this step before beginning site works);
- 2 Seek expert advice to assess the site and to prepare a property/project specific management plan;
- 3 Ensure remaining remnant (native) vegetation is preserved;
- 4 Fence out the riparian buffer;
- 5 Install off stream watering points as required;
- 6 Ensure the riparian zone is as wide as possible, otherwise as wide as practicable, and that it reflects management objectives;
- 7 Stabilise the river channel and banks;
- 8 Scatter and place large woody debris (LWD);
- 9 Place stakes at planting intervals and spot spray weeds;
- 10 Knock down remaining weeds with brush cutter and spray out after revegetation works are complete;
- 11 Complete fencing or other large woody weed control and/or chainsaw work whilst waiting for spot spraying withholding period (7 days);
- 12 If conditions are dry pre-water planting holes (refer to Fact Sheet 1);
- 13 Use appropriate native species for revegetation;
- 14 Develop a weed removal program;
- 15 Exclude fire for a minimum of 25 years;
- 16 Refer regularly to the fact sheets in the Appendices;
- 17 If employing staff, prepare a Job Safety and Environment Analysis/Job Safety Analysis/Safe Working Method Statement;
- 18 Undertake and complete on-ground works; and
- 19 Implement a maintenance program to facilitate establishment of tubestock and regenerating species, and incorporate monitoring and evaluation - that is monitor conditions and survival rates on a monthly basis.

5 References

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6 Appendices

- Fact sheet 1 Planting and establishment processes
- Fact sheet 2 Slope stabilisation and stability of cuts and fills
- Fact sheet 3 Revegetation supplies and suppliers
- Fact sheet 4 Master species list
- Fact sheet 5 Large woody debris
- Fact sheet 6 Fire in the landscape

Additional information:

Queensland Department of Agriculture, Fisheries and Forestry *Cleandown*

<http://www.daff.qld.gov.au/plants/weeds-pest-animals-ants/weeds/preventing-weed-spread/cleandown>

Queensland Checklist for Cleandown Procedures

http://www.daff.qld.gov.au/_data/assets/pdf_file/0011/58178/IPA-Cleandown-Procedures.pdf

Government of Western Australia, Department of Water, reprinted reference, Water Note 19 *Floodproofing fencing for waterways*

http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCKQFjAA&url=http%3A%2F%2Fwww.water.wa.gov.au%2FTools%2FWater%2BEducation%2BTools%2FResources%2FDownloads_GetFile.aspx%3Fid%3D908&ei=Os4uU4SoBMvklAWQwoH4BA&usg=AFQjCNEWSmKegTAaEvV3p1R-wuvX-Lg06Q&bvm=bv.62922401,d.dGI

Floodplain fencing

http://www.necma.vic.gov.au/ResourceLibrary/images/Rip_fence_brochure_FINAL_sfs1.pdf