



Local Land
Services
North Coast



Managing and Preventing Riverbank Erosion

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Natural Assets Protection Team
North Coast Local Land Services



What we will cover today...

- Key concepts for best-practice river rehabilitation
- Common scenarios after floods
- Management options
- Case study examples
- Common pitfalls
- Contacts for support
- Funding options
- Approvals
- Q&A



- Civil disputes
- Compliance
- Unapproved works
- Insurance claims
- Non-best-practice methods



Key erosion processes and types

Processes

- 'Draw down effect - flood (annually) and tidal (daily)
- Bank Slope (angle of repose) resulting in slumping and sloughing
- Lack of vegetation and complementary root matrix (no roughness)
- Wind and wave wash
- Outside bend helical flows
- Opposing inside point bar accretion and associated channel adjustment
- Bed lowering and subsequent bank failure

Exacerbated by

- Stock access to the riparian zone
- Weeds with shallow roots
- Fencing along the bank crest only (no suitably wide buffer)

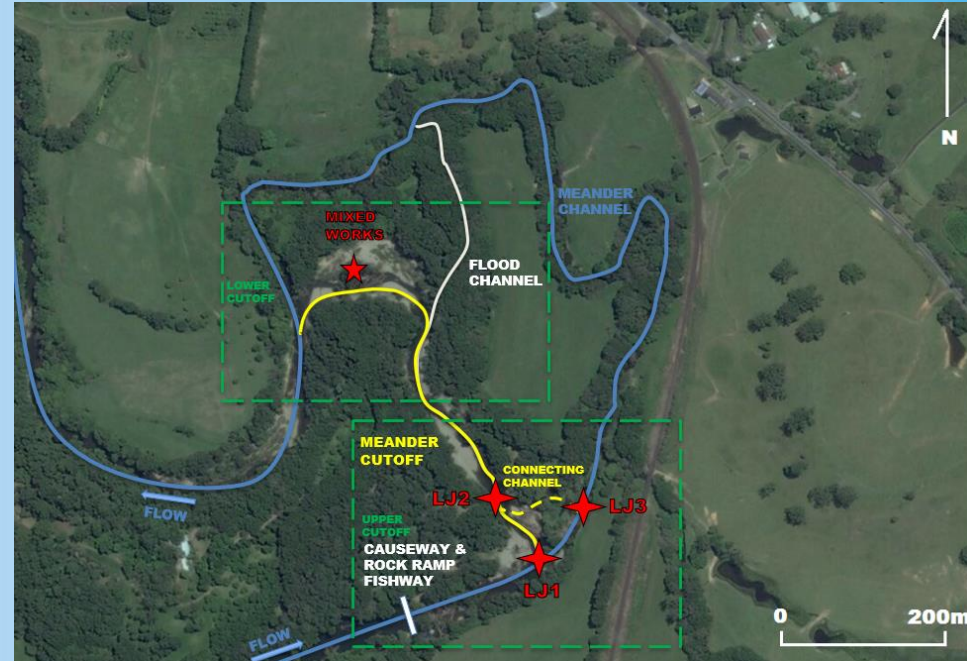
Outcomes

1. Scour
2. Undercutting
3. Slumping/Sloughing



Biggest River Worries

- Bed controls/headcuts
- Hanging Tributary Or Flood Runner Adjusting To Main Stem
- Meander Cutoffs
- Floodplain Stripping
- Straightening



Local Examples

Wanganui Crossing



Upper Huonbrook



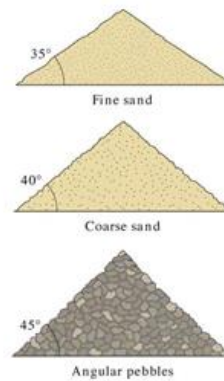
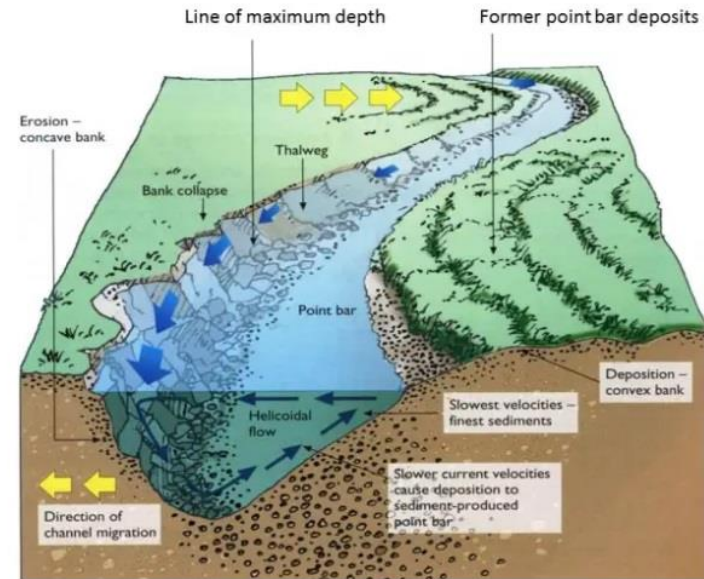
Local Examples

Albert Park, Lismore



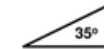
Typical river behaviour and erosion response

- Thalweg is the deepest part of the channel
- Many rivers migrate laterally (side to side) and longitudinally (up to down)
- Often the goal of remediation is being able to shift the thalweg away from the affected area by deflecting structures (logjams)
- AND/OR
- Increase roughness/increase shear strength via rocks, logs or combination
- Provide a suitable angle of repose of the bank (battering)



Angle of Repose

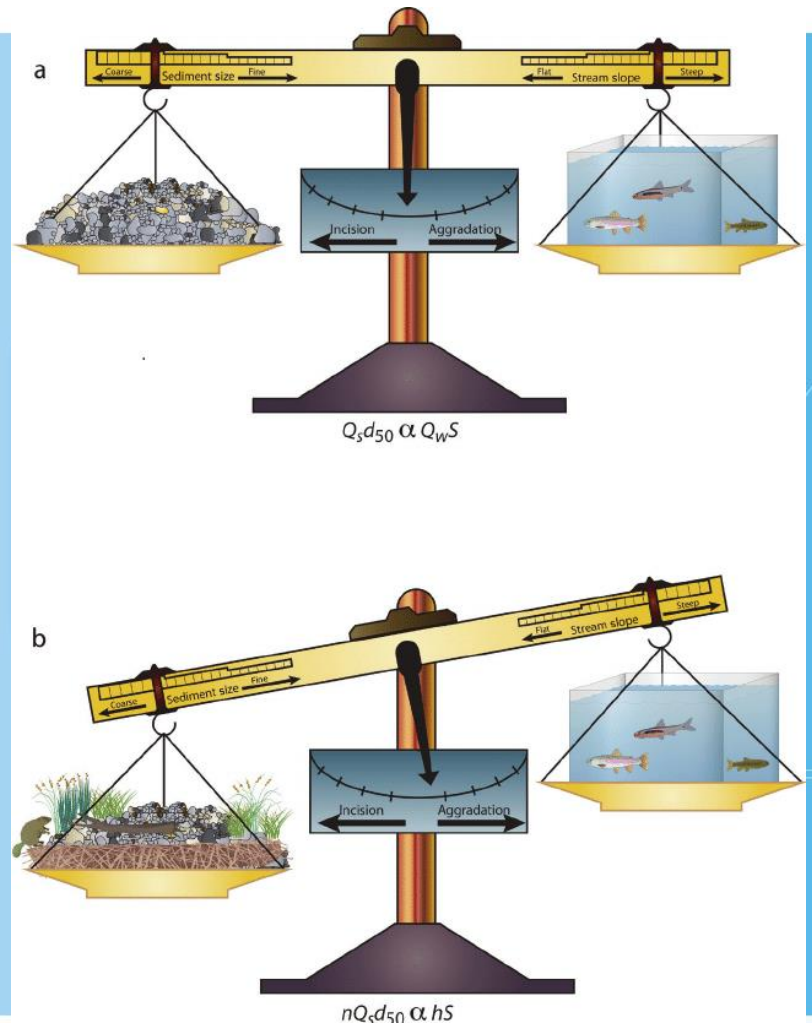
Dry sand cannot support an angle of $>35^\circ$ from horizontal: this is termed the *angle of repose*.



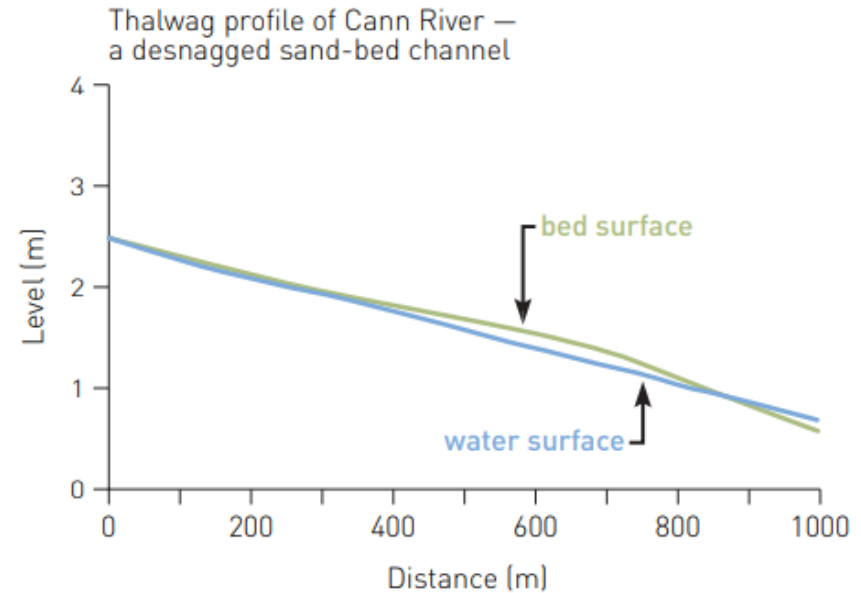
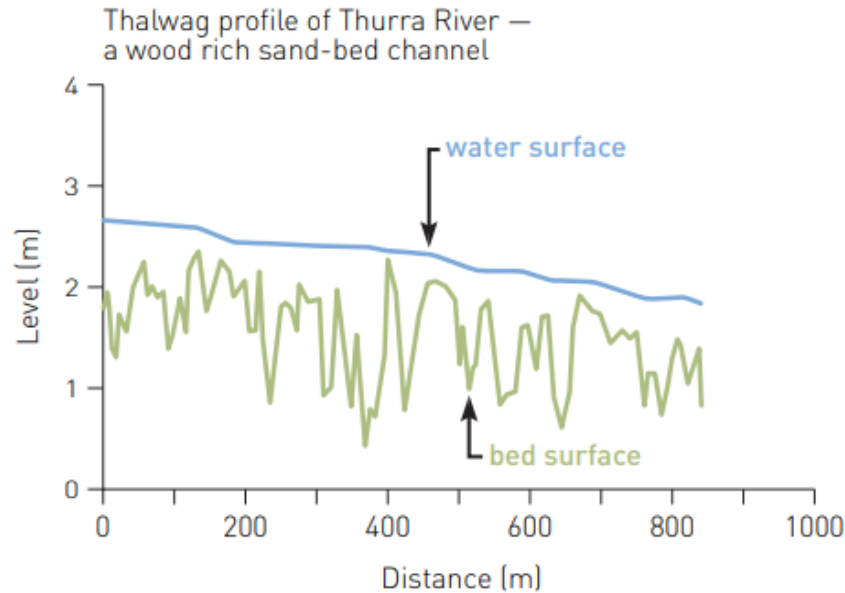
Coarser grains (and more angular materials) support steeper angles of repose.

Balancing Flow vs Roughness and Erosion vs Deposition

- The rate of erosion is a function of the erodibility of the bank material and the hydraulic **shear stress** exerted on the bank from flow.
- Soil, vegetation, channel curvature, and armoring all affect the resistance to erosion
- Erosion is a natural function (<5cm/year)
- Accelerated erosion (for example >20cm/year) is a sign of discharge being greater than roughness or discharge exceeding the shear stress characteristics of the bank

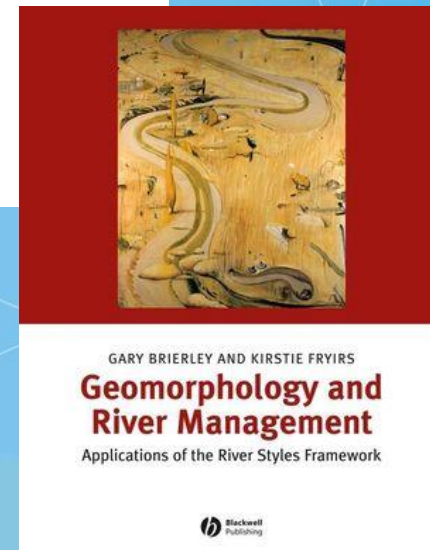


Benefits of roughness via Large Woody Debris



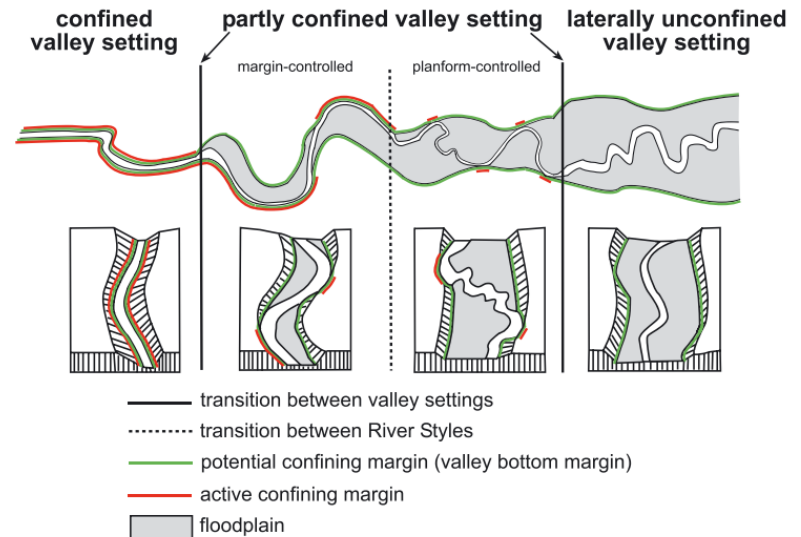
Basis of Design Concepts – River Styles Framework

- Principle of design must be application of the river styles framework in the first instance.
- Essentially 'Each catchment must be managed in its own right, recognising patterns and connectivity of river forms and processes'
- Four Key Principles
 1. Respect river diversity
 2. Work with dynamic river behaviour and change
 3. Work with linkages between biophysical processes
 4. Use geomorphology as an integrated physical template for river management activities



River Styles

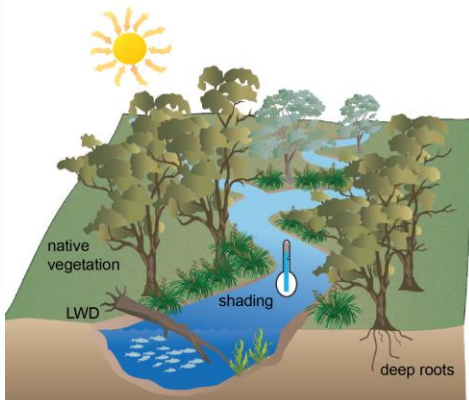
- There are over 50 river styles in NSW
- Typically they transition from gorge (upstream) where it is fully confined, to a partly confined valley and down to fully unconfined (downstream floodplains)
- Its important to apply works and outcomes that are applicable to that river style
- Wood for example may be inappropriate in upper reaches due to flow power and rock in lower sections may be an unnecessary expense
- River styles links (unofficially) with bio-indicators of stream health such as fish and invertebrates



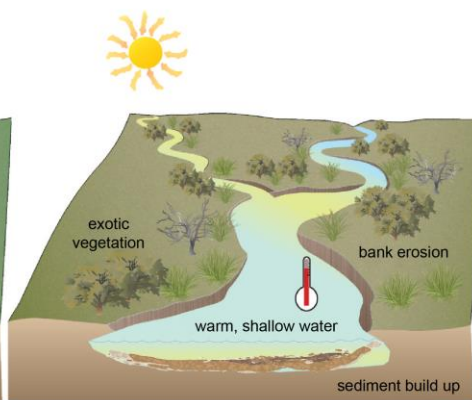
Importance of Riparian Vegetation

Riparian Vegetation Condition

GOOD



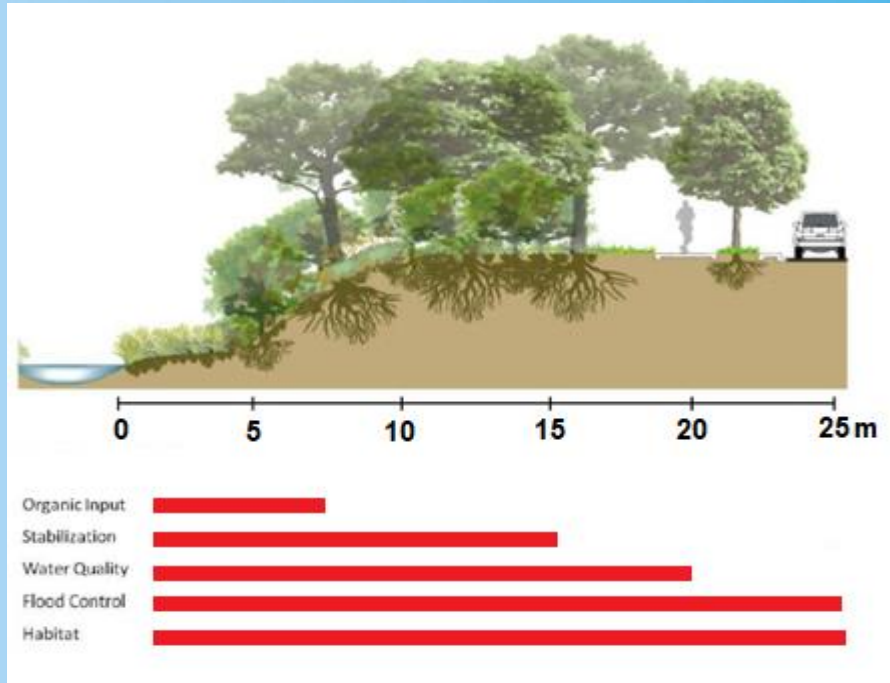
POOR



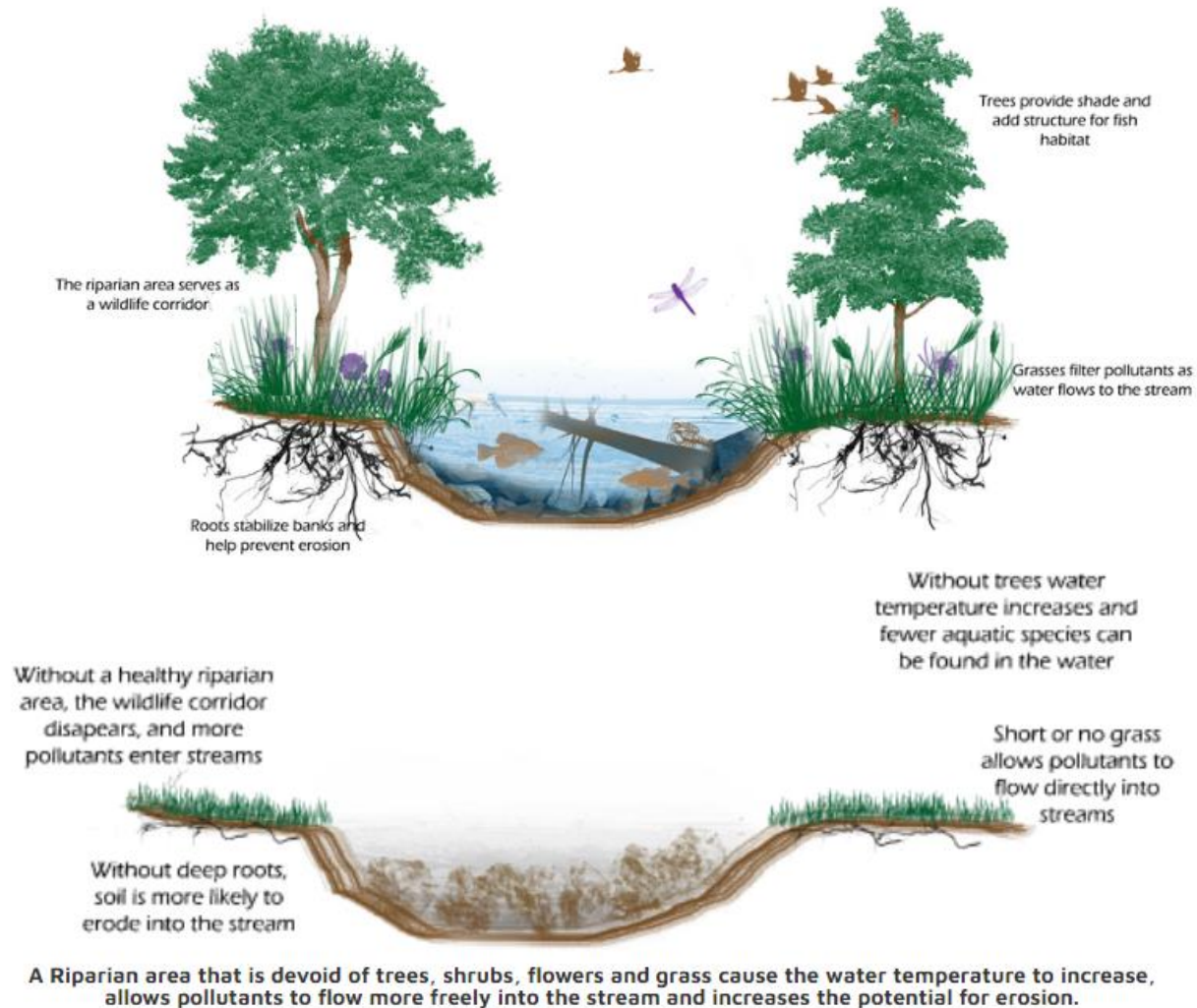
Good vegetation will contract and deepen the channel
 Deep roots help maintain bank structure and stability, and reduce erosion
 Large woody debris (LWD) provides habitat

Without vegetation, the channel will become wider and shallower
 Absence or loss of vegetation increases channel instability and erosion
 An absence of LWD reduces habitat

Most symbols for diagrams courtesy of the Integration and Application Network (ian.umces.edu/symbols), University of Maryland Center for Environmental Science



Benefits of vegetation



Matching aquatic life needs to river restoration

The **Goldilocks** theory of **Cool Rivers**



Two assumptions:



Pool habitat is available



Available
(just right)



Unavailable
(not enough)

Pool temperature is survivable



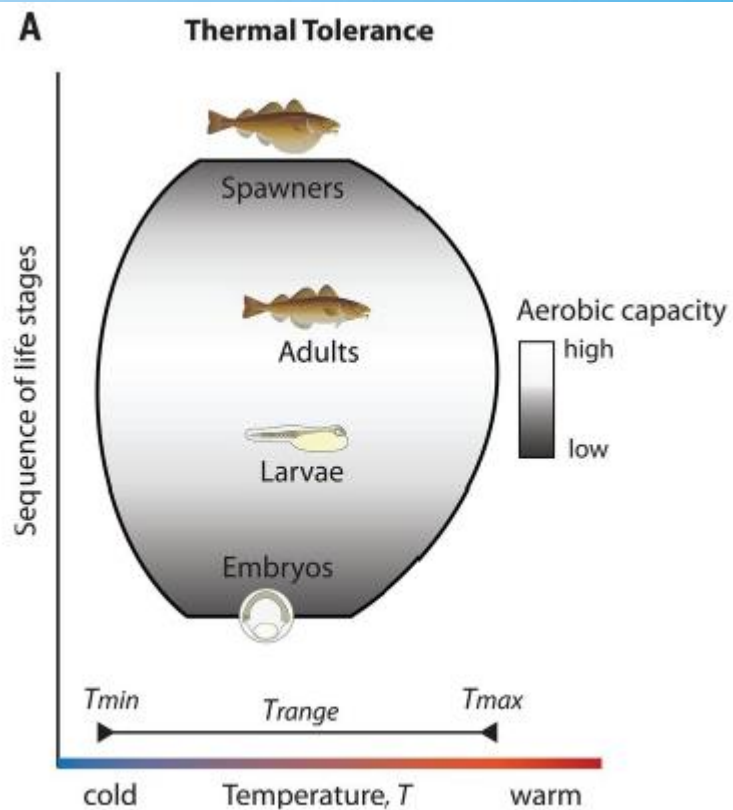
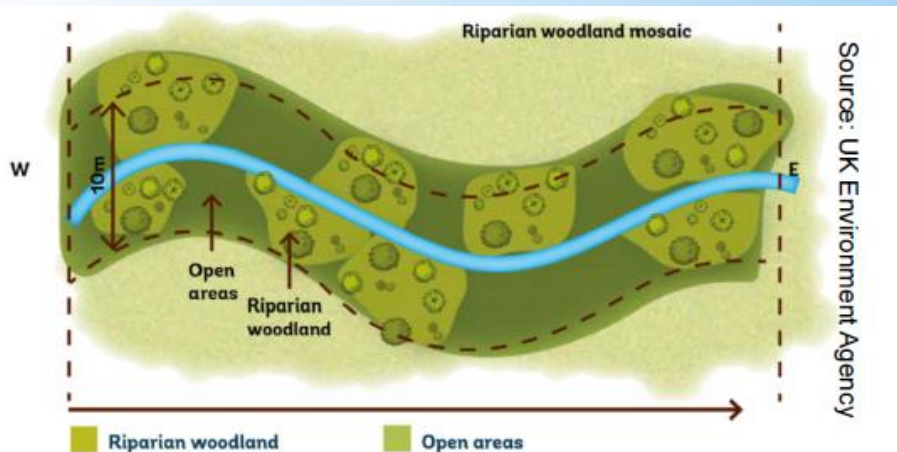
Survivable
(just right)



Unsurvivable (too hot)

What does that mean?

- Hot rivers without vegetation are prone to erosion and major effects from floods but also don't provide for the key life history requirements of aquatic life in Australia
- This leads to poor recruitment, reduced biodiversity and localised extinctions.
- Cool rivers are more resilient to flood events and protect adjacent agricultural lands from erosion



Source: Dahlke et al. 2020 Science, 369(6499): 65-70

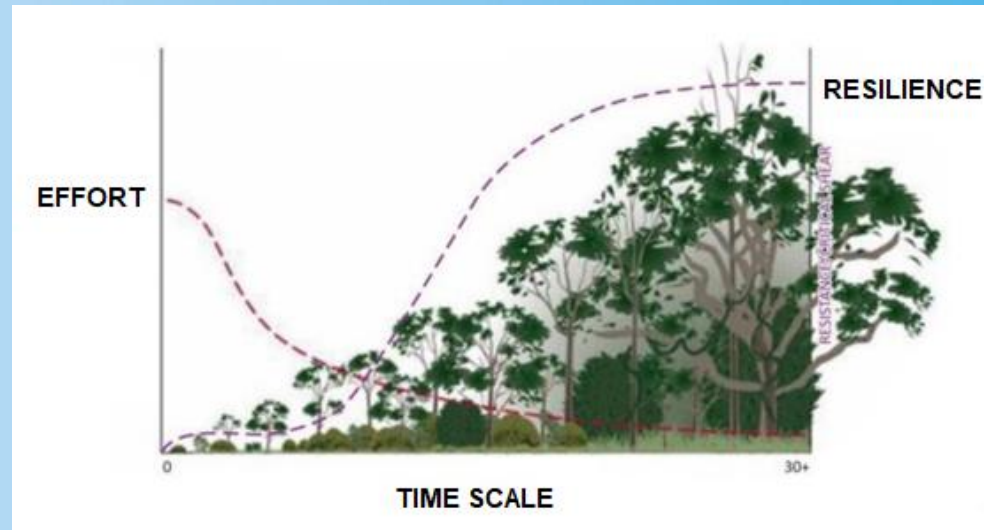
Environmental Needs

- 20 Species of native freshwater fish unchanged for millions of years
- Over 10 endemic crayfish species
- Threats includes:
 - Sedimentation
 - Loss of fringe vegetation
 - Loss of macrophytes
 - Loss of micro habitat
 - Changes in water quality



Rehabilitation effort, time and resilience

- The mean erosion rate of banks with riparian vegetation on the Daintree River was 85% lower than that of banks without riparian vegetation (Bartley et al., 2008).
- Stream bank erosion during a large flood event was much less at revegetated sites than at comparable sites without intact vegetation (Hardie et al., 2012).
- Riparian fencing on its own, without active revegetation, reduced stream suspended sediment (SS) loads by ~40% (Owens et al., 1996).
- Fencing off and actively revegetating streams can reduce sediment yields by up to 80% (Line et al., 2000).
- Cattle exclusion from riparian areas resulted in a rapid transition from a wide, shallow stream with an unstable bed and heavily grazed and trampled banks, to a stream with more stable, vegetated banks (Howard-Williams and Pickmere, 2010).
- Studies by Robertson and Rowling (2000) demonstrated that seedlings and saplings of dominant Eucalyptus tree species were more abundant in areas with no stock access, and the biomass of groundcover plants was an order of magnitude greater in areas with no stock access. See also Jansen & Robertson (2001).



As restoration matures effort reduces and shear stress capacity increases

Short term achievable outcomes

- Keep stock off the bank and out of the riparian zone. They may eat weeds but they will also spread them
- Monitor for weed intrusion and target priority weed types such as vines, camphor seedling, tropical soda apple and thorny weeds
- Hand broadcast native grass seed over exposed areas to promote ground cover
- Place monitoring pegs 1m away from erosion edge to track the rate of further erosion.
- Refer to Landholders Guide to Looking after waterways in the Richmond Catchment



INVASIVE WEED ALERT

**TROPICAL SODA APPLE
MUST BE ERADICATED**

IF YOU HAVE:

- > Seen this plant growing on your property
- > Suspect you may have this plant on your property
- > Purchased or transported livestock from infested areas

**PLEASE CONTACT YOUR COUNCILS WEEDS OFFICER ON (02) 6643 0200
OR THE NSW DEPARTMENT OF PRIMARY INDUSTRIES FOR ASSISTANCE.**

This plant is regulated under the Biosecurity Control Order under the NSW Biosecurity Act 2015. This plant must be destroyed and stock must not be transported or sold without quarantine. Failure to comply can incur an on the spot penalty notice of \$2000 or a fine up to \$440,000. Council's Invasive Weeds Team are ready to assist in identification and control.

**THE
LANDHOLDER'S
GUIDE TO
LOOKING AFTER
WATERWAYS IN
THE RICHMOND
CATCHMENT**

Presented by
Rous County Council

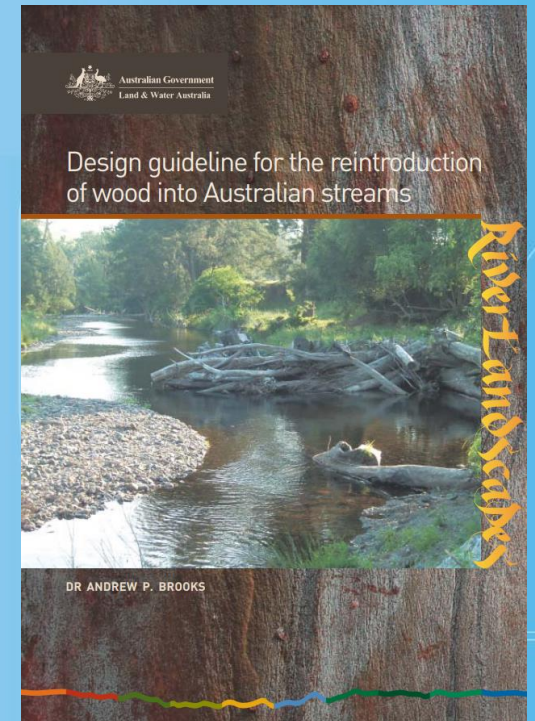
In association with
North Coast Local Land Services
and Richmond Landcare Inc.

Best practice erosion control works



Old ☹️

New 😊



If you have to use rock.....



Seelands Project – Clarence River best practice



Applying roughness, use of pins and after works

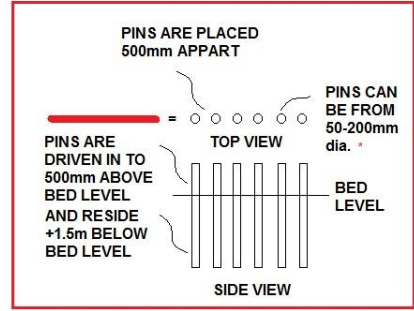
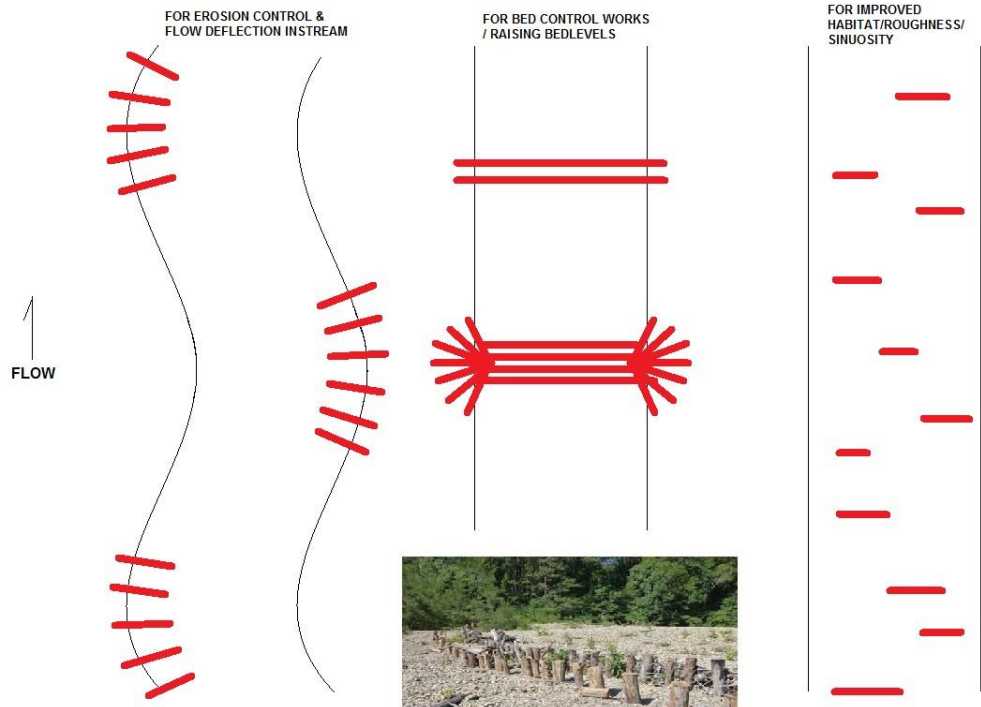


Applying roughness, use of pins and after works



Pin fields Orara River

OVERHEAD DESIGN FOR PIN WORKS



* The smaller the diameter of the pins the closer they should be placed together and used in smaller streams/ flows



Northern Rivers Catchment Management Authority	STANDARD DESIGNS FOR PIN WORKS
	DRAWN BY SHAUN MORRIS
	Not to Scale

LWD Examples

- Pin groynes and Engineered Log Jams
- Suspended log sills
- Channel spanning log jams and pin rows

Aim of Structures

- At a reach and localised scale simultaneously Influence:
 - flow direction,
 - hydraulic gradients,
 - flow power,
 - scour and deposition



Logjams, rock caps and bank battering



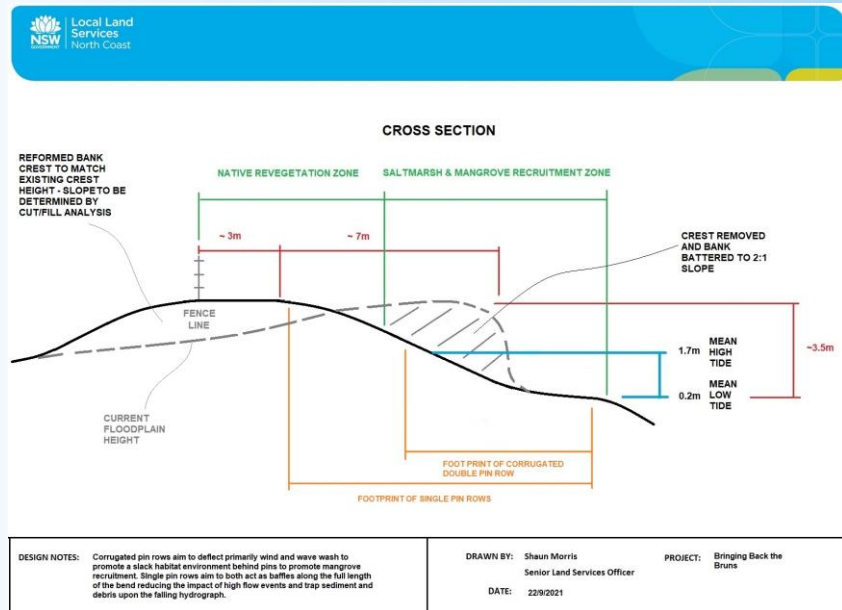
Composite logjam and bank battering Orara River

Logjams, rock caps and bank battering

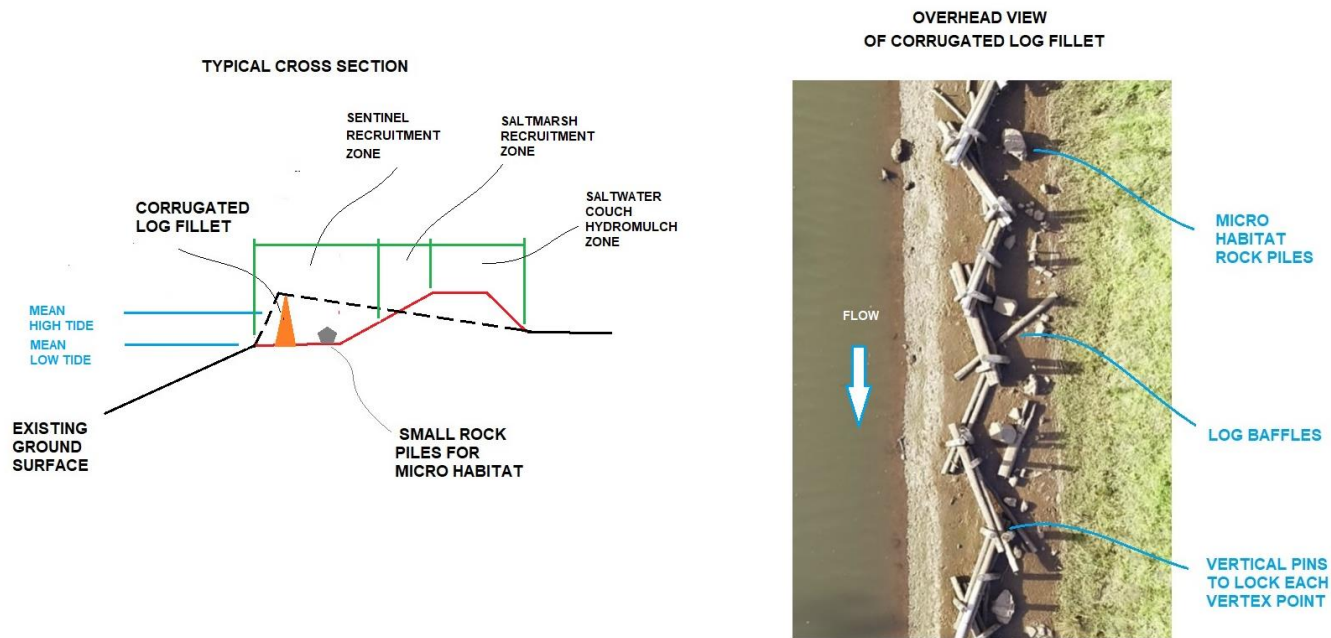


Pin and logjams Urumbilum River

Fish Habitat Project – Brunswick River



Corrugated Log Fillet Concept Design



NOTES: EMBAYMENT FLOOR TO INCLUDE
ADDITIONAL LOGS FOR BAFFLES TO REDUCE
FLOWS BEHIND STRUCTURE
EACH HORIZONTAL LOG BUNDLE TO BE
METAL BANDED FOR DURABILITY

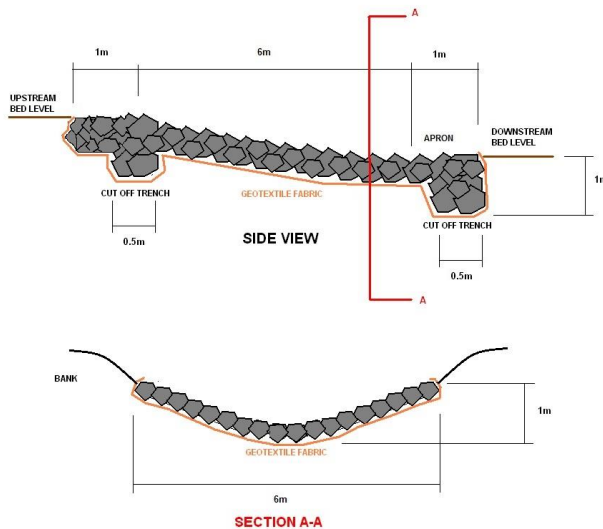
DRAWN BY: Shaun Morris
Senior Land Services Officer
DATE: November 2021

PROJECT: EMIGRANT CREEK
EMBAYMENT 2 MEMS

From end of works in July 2020 to now

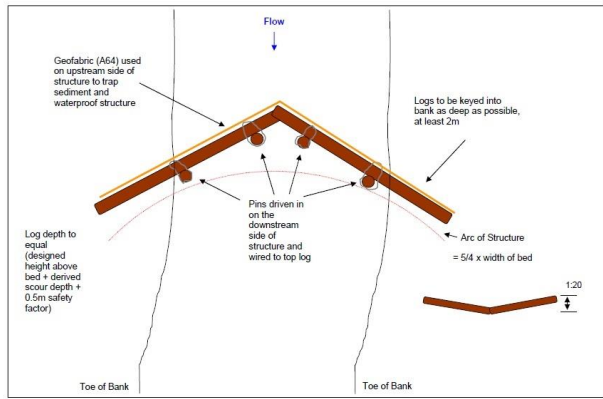


Bed Control Options - Rock Ramp



V- Shaped Sill maturity

STANDARD DESIGN V-SHAPED LOG SILL

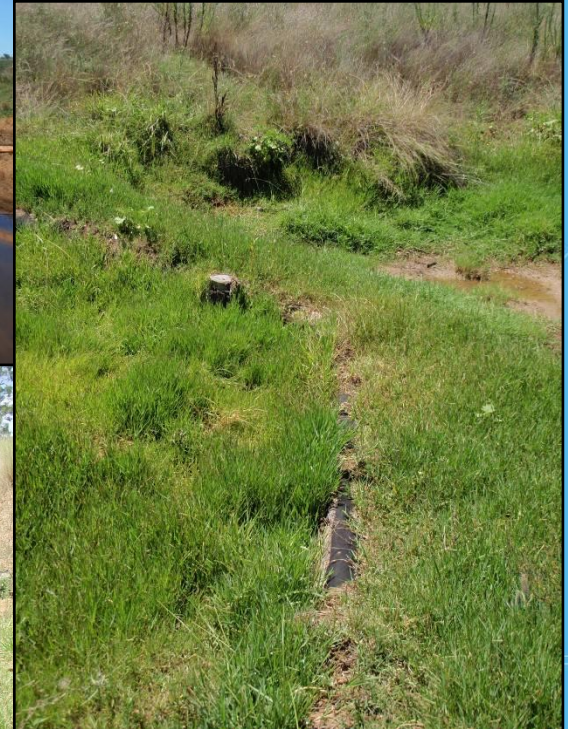


TOP VIEW



FRONT VIEW

Right: Completed structure showing deposition of material upstream of the crest and scour on the downstream side.



Northern Rivers Catchment Management Authority	STANDARD DESIGN V-SHAPED LOG SILL
	Not to Scale

How can I get help?

Contact your Local Land Services office

Ph 1300 795 299

Email riverrehabproject@lls.nsw.gov.au

Send your:

- Contact details
- Property address
- Waterway name
- Photos and corresponding map



Thankyou

