Lower Caboolture river bank stabilisation – Two years on

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Key points

- Methods and construction-phase learnings from this bank stabilisation program were shared at 11ASM (Dickson and Ivezich, 2024). Two years on, the nature-based intervention successfully protects estuarine vegetation from boat wash and appears to be building resilience in most locations.
- However, in some locations fluvial scour has emerged as a significant additional driver of erosion and is not addressed by the intervention. A modified design has been proposed for upcoming similar works, based on observations to date.
- Diverse native vegetation successfully established on the intertidal bench through a combination of active planting and natural recruitment. Across the sites, groundcover approached 100% in 12-18 months.
- Mangrove propagules at different age classes are now emerging, with successful germination in multiple fruiting events. At this point in time, mangrove height and pneumatophore development remain insubstantial from an erosion control perspective. Nature based solutions take time to develop resilience.
- Ripping of the overbank was implemented after the first site in response to revegetation contractor feedback. Anecdotal observation strongly supported this technique in early vegetation establishment phase, but 12 months post-planting there are no meaningful differences in tree height.

Abstract

Bank stabilisation works in the tidal zone of the Caboolture River aim to re-establish a mangrove fringe and native riparian vegetation. This is being achieved on approximately 1km of riverbank (5 separate sites) using a combination of earthworks and hardwood logs.

At 11ASM, Healthy Land & Water and Alluvium presented on the recently-completed works, construction-phase learnings and observations from the first wet season (Dickson and Ivezich, 2024).

Two years on, this case study offers further learnings from the field to support other organisations designing and implementing bank stabilisation programs and working in estuarine ecosystems. It contributes to our sector's shared knowledge about the performance of nature-based solutions and aims to improve investment confidence and restoration outcomes across the many catchments where these techniques may be applied.

Key observations and lessons from this case study include:

- Application of a nature-based design solution to accommodate some acceptable bank retreat while vegetation establishes. At two sites, this flexible application of hardwood timber has performed as designed, with visible adjustment and stabilisation after flood events.
- At one site, the mangrove bench has retreated much more quickly than expected, and a design modification has been developed for future similar sites.
- Two years of site monitoring captures the establishment of intertidal vegetation, achieving species diversity and complete groundcover in 12-18 months.

Mangrove restoration can provide protection and resilience to waterways and infrastructure in many locations, and we hope the restoration method and on-ground learnings will be of use to others working

in similar ecosystems and as an approach to increase climate resilience associated with rising sea levels.

Keywords

Bank stabilisation, nature based solutions, mangrove restoration, estuarine ecosystems

Introduction

Bank stabilisation works in the tidal zone of the Caboolture River aim to re-establish a mangrove fringe and native riparian vegetation for bank stabilisation on approximately 1km of riverbank (5 separate sites).

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Restoration design and performance

Early project scoping identified boat wash as a key driver of ongoing erosion at the project sites. This boat wash pressure continually eroded soil from the intertidal zone and prevented a fringing mangrove community from re-establishing, despite healthy and mature mangroves elsewhere in the reach providing an ample supply of propagules and evidence of germination. This causal assessment supported design for bank stabilisation and delivery of the bank stabilisation sites for local water utility Unitywater under a nutrient offset framework.

The design is described in detail in the 11ASM Paper *Restoring mangroves for bank stabilisation on the Caboolture River* (Dickson and Ivezich, 2024). In essence, a 4m wide gently sloping intertidal bench was created near the top of the intertidal range to support mangrove establishment. Hardwood logs were pinned on this bench in an arrangement designed to break up boat wash energy and provide a protected zone for mangrove establishment (See Figure 1 and Figure 2). There was no further intervention on the bank or bank toe below the intertidal zone.

It is acknowledged that nature-based solutions require time to develop resilience, as vegetation establishes and matures. Some level of continued erosion should reasonably be expected during that time and were accommodated within the design. In this case, rootball logs were fixed using a single pile close to the bank and a pair of boulders near the riverward edge of the bench (See Figure 2). This design allows the log to hinge downwards if the front of the bench erodes, keeping the rootball in contact with the bank surface, interacting with flow and providing ongoing protection from boat wash (Figure 3, Figure 4).

Figure 1 Site B1 showing the intertidal bench with rootball logs and plain logs arranged to break up boat wash and provide a sheltered environment for mangrove establishment. Construction winter 2023. Photo September 2024

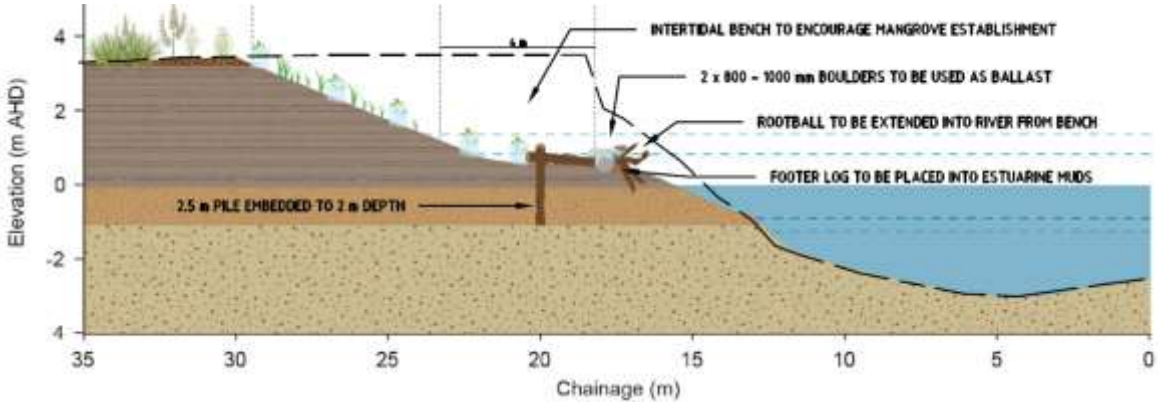

Figure 2 Design cross section showing bank profile and log placement in relation to tidal planes

This mechanism performed as expected following high flow events in 2024 and 2025. The pattern of log movement also illustrated the varying influence of fluvial scour along the length of the sites. Typically, bench erosion and hinging movement of the rootball logs was observed towards the downstream end of the remediation sites. At the downstream end of Site 5 (Figure 3), boulders placed against the rootball logs have dislodged and disappeared, the rootballs have rotated from pointing upstream to pointing downstream and there is a visible gap between the end of the log and the vegetation, where the bench has retreated slightly. However, the rootball logs remain in contact with the bench and the water and are still providing protection from boat wash. This site is considered to be progressing consistent with restoration intent.

On one of the sites (site 24), the stabilisation works extend along an inside bend and an outside bend. Accelerated bench retreat and hinging of logs was only noted on the outside bend portion of the site, which is expected for an erosion mechanism driven by fluvial scour and loss of the bank toe below the intertidal works.

Site 24 was constructed through winter and spring 2024, and experienced significant flow in March 2025. At this stage, the intertidal bench had not yet established continuous groundcover or mangrove saplings. During the March 2025 flood event, severe bank retreat along some sections of the site left

insufficient width of bench to establish a fringing mangrove community (Figure 5). Consequently, the intervention is considered partially unsuccessful at this site.

The restoration design focuses on the upper portion of the intertidal zone, guided by observed elevation of mature fringing mangrove communities in adjacent sections of the river. However, fluvial scour of the submerged bank toe remains a threat to restoration works. An adapted design, currently submitted for approvals, for a proposed site in a tidal reach of the Caboolture River has incorporated short pilefields interspersed between the tidal bench wood placement, with the aim of providing additional protection to the bank below the intertidal zone. However, there are also constructability limits and considerations for boat navigation of the river. Consequently, full mitigation of the risk of toe scour may not be possible and a level of risk assessment is still required within project investment decision-making.

Figure 3 Site 5 showing an area with log rotation, loss of boulders and modest bench erosion. This area is still progressing consistent with the design intent. Construction Spring 2023. Photo May 2026

Figure 4 Acceptable bench adjustment. One boulder dislodged, but the rootball remains in contact with flow. Complete groundcover of intertidal vegetation, with mangrove saplings growing slowly. This site is progressing consistent with the design intent. Photo May 2026. Construction Spring 2023

Figure 5 Site 24 showing bench as constructed (left of image) and a section of severe bench erosion and log movement (right of image). In this location, the restoration is considered unsuccessful as there is very limited remaining intertidal zone to support future establishment of a resilient mangrove fringe. Photo March 2025 (post flood), following construction winter 2024

Intertidal vegetation establishment

Vegetation establishment on the intertidal bench is key to the long-term success of these bank restoration sites, with mangroves playing the key structural role in root reinforcement of the soil and dissipation of boat wash energy on complex trunk and pneumatophore structures. Some active planting of intertidal species was undertaken to meet approval requirement, including propagule translocation of two species of mangroves during the first mass fruiting event after site completion. This was up to a year after site completion in several instances.

Mangrove saplings at different age classes are now evident, following successful germination of natural recruitment during multiple fruiting events. However, mangrove height and pneumatophore development remain insubstantial from an erosion control perspective at this point in time.

Within the restoration time scale to date, other fast-growing intertidal species are playing an important role in providing groundcover and surface protection of the intertidal bench. They also build ecological and physical complexity, which assists in capturing additional mangrove propagules. As captured in monitoring quadrats and illustrated in the photo series below, establishment of diverse intertidal vegetation generally approached 100% groundcover in 12-18 months. No effort has been made to manage the species mix during this establishment process, and all of the species present are native and considered either desirable or acceptable. There was some debate about the inclusion of *phragmites australis* in the planting mix as it can form dominant monocultures, but it was ultimately included and is establishing alongside mangrove propagules in several areas (Table 1).

Table 1 Time series illustrating establishment of 100% intertidal groundcover over 12-18 months

Site B1	Site 5
4 months post-construction 	3 months post-construction 
6 months 	
13 months 	12 months 
2 years and 4 months 	1 year and 6 months 

Riparian vegetation establishment

While the intertidal mangrove fringe provides critical bank support and protection against boat wash pressures, riparian vegetation planted on the batter and overbank zones also plays important roles in soil protection and stabilisation, slowing flow against the bank during flood events and offering biodiversity benefits.

The 2024-2026 summer growing seasons have been generally warm with good rainfall, providing excellent conditions for vegetation establishment. The project was also well-resourced from a maintenance perspective, resulting in low weed competition and rapid growth rates.

The first site within the program, site B1, was planted in October 2023. This is towards the end of the South-East Queensland dry season. The contractor found the ground very hard and not conducive to ease of planting or rapid root establishment. Compaction from machinery was identified as a likely contributing factor and, as an adaptive management response, soil ripping of the overbank was proposed for subsequent sites.

This approach was adopted on Site 5, which was planted in November/December 2023. Feedback from the revegetation crew was positive and anecdotal comparison of sites B1 and 5 indicated more rapid and vigorous growth in the ripped site.

However, comparison of vegetation monitoring data for three sites with similar profiles and species palette suggests that soil ripping has no marked effect on ultimate revegetation success. At 6 months post-planting, one of the monitoring plots at site 5 (with ripping) had close to double the vegetation height of the plots at Site B1 (no soil ripping). However, by 12 months post planting the relative difference between the sites had diminished and beyond the 12 months there is no notable difference in vegetation height. Note that survey estimation accuracy diminishes substantially beyond 5m. Tree canopy cover and diameter at breast height are also measured, but provide limited meaningful information at this relatively early stage of vegetation establishment.

Another learning from this aspect of the project arose at the interface of different specialist disciplines. The overbank on Site 5 was planted using the original specification of jute squares and grass seed, with the late addition of soil ripping at the end of civil construction to address compaction concerns. However, the project erosion and sediment control (ESC) specialist raised concerns about this methodology during a site visit due to the level of soil disturbance near the waterway. On subsequent sites, the overbank was ripped, seeded and then entirely covered in jute mesh. Saplings were then planted through the jute mesh. This approach had a higher cost but offered the most acceptable balance between ESC and revegetation perspectives. On review of the two years of monitoring data, ripping need not be treated as essential from the perspective of long-term vegetation outcomes. It may be beneficial in some situations, for example where very dry conditions exacerbate machinery impacts to produce very hard soil during the planting season.

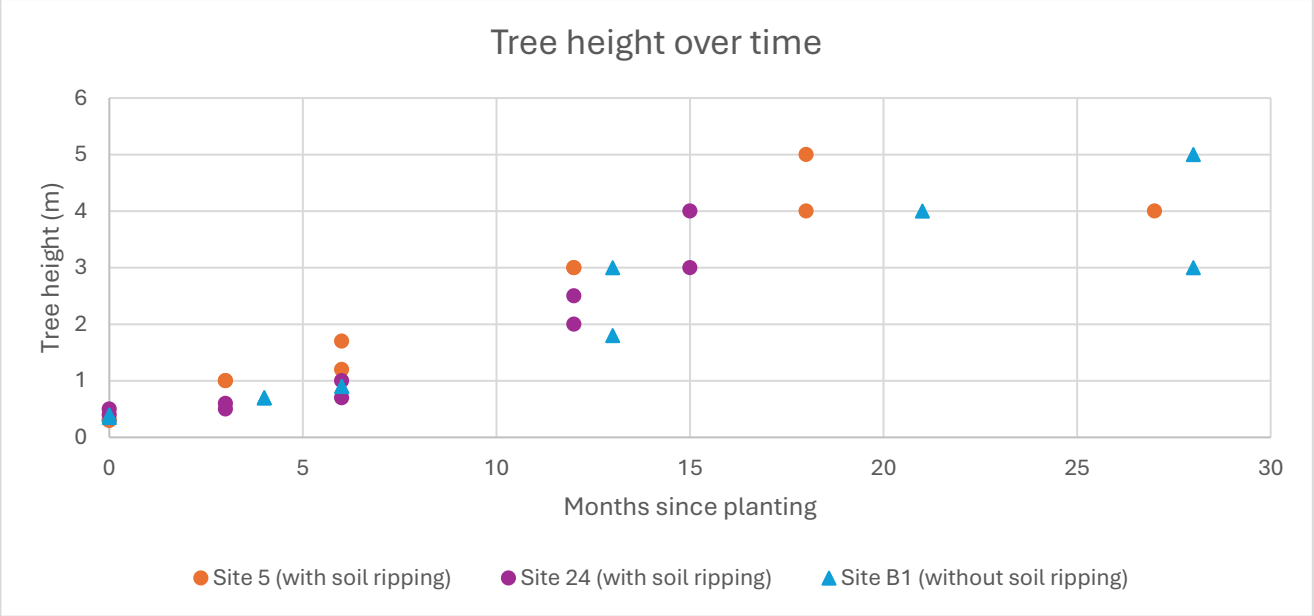

Figure 5 Monitoring data across three sites with similar bank profile and species palette, tracking vegetation height, or canopy height once a canopy layer is determined to have formed. Sites B1 and 5 were planted in 2023 while site 24 was planted in 2024

Conclusions

This project aims to re-establish a mangrove ecosystem for long-term protection of eroded sections of the Caboolture River. Nature-based approaches have potentially excellent long-term resilience and environmental co-benefits. However, they also have inherently higher uncertainty than hard engineering approaches. Lack of evidence or certainty can pose an obstacle to investment decision-making. By continuing to share observations and learnings from this work, Healthy Land & Water aims to improve sector-wide knowledge, investment confidence and restoration outcomes across the many catchments where these techniques may be applied.

Key findings include:

- Consideration of multiple erosion mechanisms in the project definition and design stage is essential.
- Flexible hinging design of the rootball logs is performing as intended and adjusting within acceptable rates of bank retreat on several sites.
- At Site 24, fluvial scour has emerged as a dominant driver of erosion, and the rate of bank retreat has outpaced establishment rates for the marine vegetation on some areas of the site. An adapted design has been proposed at an upcoming site on the same river, incorporating short pilefields for improved toe protection beyond the edge of the intertidal bench.
- In the intertidal zone, diverse native vegetation has successfully established through a mixture of active planting and natural recruitment, approaching 100% groundcover within 12-18 months at all sites. Mangrove propagules at different age classes are now emerging, following successful natural germination in multiple fruiting events. However, mangrove height and pneumatophore development remains insubstantial from an erosion control perspective at this point in time.
- Ripping and jute mesh covering of the flat overbank planting zone was adopted in response to concerns raised by both revegetation contractors and erosion and sediment control specialists. Monitoring indicates that ripping may possibly have supported more rapid growth with the first 12 months. Beyond 12 months there was no meaningful difference in vegetation height.

The approaches adopted for this project have the potential to be more widely utilised across estuarine and coastal zones as an alternative to hard engineering. These approaches have co-benefits of improved fish habitat, riparian habitat connectivity and flood resilience.

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References

Dickson, M. Ivezich, M. (2024). *Restoring mangroves for bank stabilisation on the Caboolture River*. Proceedings of the 11th Australian Stream Management Conference.