Instream Erosion Control – General

EROSION CONTROL TECHNIQUES

Revegetation	✓	Temperate Climates	✓	Short-Term	
Non Vegetation	✓	Wet Tropics	✓	Long-Term	
Weed Control	[1]	Semi-Arid Zones	✓	Permanent	✓

[1] Weed control attributes can be incorporated into many instream erosion control techniques.

Photo 1 – Erosion control blankets installed during channel revegetation

Photo 2 – Jute mesh scour protection on the upper bank and lower rock protection

Disturbed instream surfaces need to be rehabilitated as soon as practicable after instream works have been completed. Channel banks, and the channel bed where appropriate, should be actively revegetated rather than waiting for natural regeneration.

One of the best ways of minimising instream soil erosion resulting from instream construction and maintenance activities is to minimise any in-channel disturbance, and the disturbance of high-risk areas such as the outside of channel bends. This can be achieved by:

- avoiding unnecessary disturbance to bed or bank vegetation;
- avoiding disturbance on the outside bank of a channel bend;
- minimising the soil disturbance needed to provide access to a work site;
- not accessing the channel via the outside of a channel bend, or via an unstable bank;
- using long-reach excavation equipment that allows all work to be done from the top of bank, rather than allowing machinery to access the channel bed.

Revegetation is one of the most effective long-term stabilisation techniques for both natural and modified waterway channels. In-stream ecology can be further enhanced through the re-establishment of associated bank and over-bank riparian vegetation. Attributes of healthy riparian vegetation include shading for water temperature control, the establishment of habitat diversity, the creation of snags, and the linking of aquatic and riparian habitats.

Wherever reasonable and practicable, vegetation should extend to the water's edge to increase the value and linkage of the aquatic and riparian habitats. Rock protection of the bank toe (Photo 2) is usually required to provide stabilisation during the plant establishment phase.

During plant establishment it may also be necessary to protect disturbed surfaces from short-term erosion with the aid of *Erosion Control Blankets, Mats* or *Mesh*. *Erosion Control Blankets* and *Mats* reinforced with synthetic netting are **not** recommended for use along waterways containing ground-dwelling wildlife (this is likely to include most natural waterways).

The stabilisation of active channel erosion requires an understanding of the various types of bed and bank erosion, the ability to recognise the causes of such erosion, and the ability to identify appropriate treatment measures. This usually requires the advice of experts, and the approval of the relevant State authorities.

(a) Bank scour:

Photo 3 – Bank scour

Photo 4 – Bank scour on channel bend

Bank scour is the removal of material from the surface of the creek bank as a direct result of stream flow. The erosion may be the result of excessive turbulence (Photo 3), or high flow velocity, such as on the outside of a channel bend (Photo 4).

Causes include: high velocity stream flows, poor vegetation cover, excessive reed growth within the bed of the creek, turbulence caused by trapped debris such as fallen trees, or high velocity water discharged from stormwater pipes or culverts.

Vegetative treatment measures primarily rely on the use of flexible ground covers placed within the lower bank and along the water's edge, and low-branch woody species (e.g. shrubs) placed on mid and upper bank areas, and on the outer bank of channel bends. Generally, planting schemes need to ensure that the banks need to be 'hydraulically' rougher than the channel bed.

The use of trees within the channel may increase flow turbulence aggravating the erosion.

(b) Bank slumping:

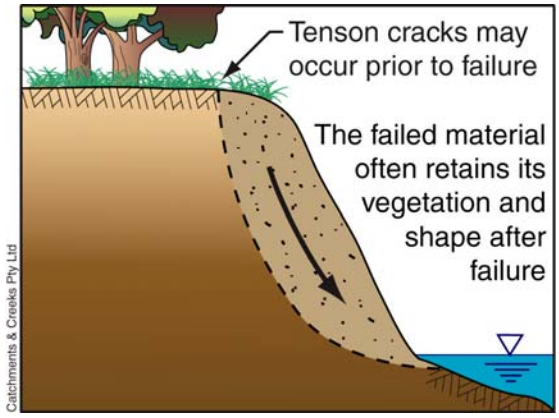

Figure 1 – Bank slump

Photo 5 – Bank slumping

Bank slumping is the mass movement of bank material (Figure 1). Geological slip circle failures are included in this category.

Causes include: the removal of trees from the top of the bank, deepening of the channel by erosion or dredging, an unusual or rapid lowering of flood waters following saturation of the banks, or excessive fill material placed on or near the top of bank.

Vegetative treatment measures primarily rely on the use of shrubs on the channel banks, especially on the outer bank of channel bends; and deep-rooted trees placed planted on the upper and over-bank areas, especially on steep and/or high banks.

(c) Bank undercutting:

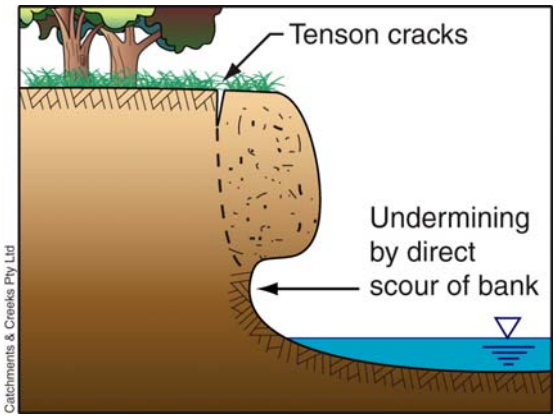

Figure 2 – Bank undercutting

Photo 6 – Bank undercutting

Bank undercutting is the removal of material from the lower portion of a channel bank by 'bank scour'. This erosion results in the creation of an overhanging bank that usually fails in a more violent motion than occurs in 'bank slumping'. In effect, bank undercutting is a combination of bank scour within the lower bank, which ultimately causes upper bank slumping. The two actions may not occur simultaneously.

Causes include: a migrating low-flow channel, frequent high-velocity in-bank flows, exposure of a weak soil layer within the lower bank, changing catchment hydrology (e.g. urbanisation), or the removal of essential lower bank vegetation.

Vegetative treatment measures primarily rely on the stabilisation of the lower bank with rock and tall, flexible, ground covers. Shrubs are normally located on mid and upper bank, and on the outer bank of channel bends. Trees are primarily located on the upper bank and over-bank areas, especially on steep and/or high channel banks.

The lower bank area often requires additional scour protection (e.g. rock and/or groynes) during the plant establishment phase.

(d) Bed scour

Photo 7 – Bed scour

Photo 8 – Head-cut erosion

Bed scour is the direct removal of material from the bed of the creek either by high velocity flows (causing uniform scour along the bed, Photo 7), or the formation of a head cut (waterfall) that migrates up the creek (Photo 8).

Causes include: clearing of vegetation from the channel resulting in increased flow velocities (e.g. weed removal or de-snagging), changes in catchment hydrology (e.g. urbanisation and land clearing), or the exposure of weak (e.g. dispersive) soils within the channel bed.

Bed stabilisation with grasses and other flexible, non-clumping, ground covers may be suitable on ephemeral streambeds, otherwise the bed may need to be stabilised with rock. In gullies, the erosion often exposes poor quality soils that will require appropriate chemical adjustment prior to revegetation.

(e) Lateral bank erosion

Photo 9 – Lateral bank erosion

Photo 10 – Lateral bank erosion

Lateral bank erosion is the erosion of the creek bank resulting from the entry of lateral inflows (usually stormwater) into the creek. The erosion usually takes the form of an upstream progressing erosion head (head-cut) that propagates laterally from the main channel forming a new gully (Photo 10).

Causes include: excavation of the downstream channel bed, a change in catchment hydrology, or a change in the quantity or direction of overland flows entering a waterway channel.

Treatment normally involves engineered measures such as rock chutes, pool–riffle systems, and grade control structures. In gullies, stiff grasses such as Vetiver grass, can be used to slowly stabilise and partially back-fill the gully with sediment—this can help to reduce the rate of progression of the head-cut.

(f) Fretting

Photo 11 – Wave induced erosion

Photo 12 – Fretting erosion

Fretting is the direct removal of erosion prone material from the bank of a creek by wave action (Photo 11). This erosion results in the undercutting (Photo 12) and possible failure of the bank.

Causes include: wind-generated wave action, waves generated by boat traffic, or the removal of essential vegetation such as mangroves.

The bank can be stabilised through the formation of a sandy 'beach' in front of the eroded bank or the formation of a retaining wall (generally undesirable). The beach acts as an effective energy dissipater for the waves. Alternatively, the bank can be stabilised with rock, either with or without vegetation.

It is usually better to incorporate treatment measures that help to dissipate the wave energy, rather than hard engineering measures, such as retaining walls, that simply reflect the wave energy to another location. Rock protection measures should maintain an open void structure to help adsorb the wave energy; however, it should be noted that the placement of rock along the toe of the bank can adversely affect the habitat value of the water's edge.

Table 1 provides general guidance on the use of vegetation in the control of channel erosion.

Table 1 – Vegetation types and erosion control characteristics

Type	Scour control	Bank stability	Location of plants
Aquatic plants	Provide good stability to the low-flow channel and water's edge.	Can assist bank stability by protecting the toe of the bank. Some plants (e.g. reeds) can become inflexible as plant density increases. This can aggravate bank erosion. Bank erosion can be controlled through rock placement.	Aquatic plants naturally appear only within the channel bed. If their impact on upstream flooding must be controlled, then heavy shading of any reed beds can reduce their density and thus their impact on flood levels.
Ground covers	The most effective plant for the control of 'scour'. To be effective, ground cover plants should be flexible and continuous. Isolated, clumped plants may aggravate soil erosion. Plants with a matted or fibrous (hairy) root system are most effective in sandy soils.	These plants are usually ineffective in the control of bank slumping, bank undercutting, and head-cut erosion. They can be very effective in the stabilisation of channel banks during the early stages of revegetation. For example, the establishment of a temporary grass cover can help control erosion in active gullies while the slower growing permanent plant species are being established.	Ground covers are generally located at all bank elevations and in over-bank areas. Planting densities usually increase within the lower bank area. Isolated ground covers can help stabilise leaf litter under tree stands. Some clumping plants, such as *Lomandra*, are best placed in locations where they will be fully submerged during regular flood events (e.g. in the lower bank area).
Shrubs	Shrubs can provide effective scour control if their interlocking branches prevent high velocity water from coming into direct contact with the soil. Localised soil scour can occur around the edge of isolated plants.	Shrubs can contribute to overall bank strength if the depth of their root system exceeds the height of the bank. Shrubs are unlikely to prevent bank under-cutting unless the shrubs are located in the lower regions of the bank.	Shrubs are generally best located in the upper bank and over-bank areas. Shrubs are very important on the outside bank of channel bends. Extreme care must be taken when planting shrubs within critical flood control areas.
Trees	Trees usually provide little protection against bed and bank scour; however, significant stands of trees can reduce channel flow velocities, thus reducing erosion, but they will also increasing flooding. Some trees have root systems that survive when exposed to air. Such plants are usually located close to the channel bank.	Trees are the most effective plants for stabilising banks, but not necessarily stabilising the gully head. Tree roots provide bank reinforcement to control bank slumping and bank undercutting. To be most effective, tree roots should be encouraged to extend below bed level.	Trees are best located within the top-of-bank and over-bank areas. Tree species can vary significantly over the first 5m from top-of-bank. Well-spaced, single-trunk trees with branches above flood height are best in critical flood control areas. Grouped trees should be avoided in critical flood control areas.

Table 2 outlines the attributes of various short- and long-term channel bank stabilisation methods applicable during the channel revegetation phase.

Table 2 – Bank stabilisation methods during channel revegetation

Bank stabilisation method	Uses and attributes
Short-term measures	
Hydraulically applied blankets (Photo 16)	• Includes *Bonded Fibre Matrix* and *Compost Blankets*. • Low to medium shear strength, thus only suitable for low velocity channels. • Suitable for application on irregular surfaces and steep bank slopes. • *Compost Blankets* can provide a nutrient source.
Jute or coir blankets/matting (Photo 13)	• Low shear strength, thus only suitable for low velocity channels. • Require good soil preparation and removal of surface irregularities from the bank.
Jute or coir mesh (Photo 17)	• Medium shear strength. • Generally suitable for the short-term protection of drainage channels and minor stream and creeks. • Typical design life in dry environments of 12 to 24 months. • Do not represent a threat to wildlife.
Synthetic reinforced blankets/matting (Photo 19)	• Medium shear strength • Plastic mesh can represent a threat to wildlife. • Generally **not** suitable for the stabilisation of watercourses where wildlife such as lizards, snakes and birds may be present.
Geo Logs (Photo 14)	• Diversion of minor high-velocity flows away from seedlings planted close to the water's edge. • Protection of plants along the water's edge from wave action, particularly in lakes. • Must be used with extreme care if placed parallel to the stream flow, otherwise erosion may occur behind the logs.
Long-term measures	
UV-stabilised Turf Reinforcement Matting (TRM)	• High shear strength. • Can be damaged by grass fires. • Generally **not** suitable for the stabilisation of watercourses where ground-dwelling wildlife such as platypus and bank-nesting birds may be present.
Rock stabilisation of the water's edge or toe of bank (Photo 18)	• Used in areas where channel velocities are high, but near-bankfull flow velocities are low. • Commonly used to minimise the risk of bank erosion caused by minor flows during the revegetation phase.
Rock stabilisation (rock beaching) of full bank	• Stabilisation of very steep channel banks, with or without vegetation. • Commonly used on the outside face of high velocity or sharp channel bends, or to minimise the risk of bank erosion caused by near-bankfull flows during the revegetation phase.

Photo 13 – Erosion control blankets

Photo 14 – Geo log

Photo 15 – Gabions

Photo 16 – Hydraulically applied blankets

Photo 17 – Jute mesh

Photo 18 – Rock & vegetation

Photo 19 – Synthetic reinforced blankets

Photo 20 – Vegetation