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Case study

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Gully erosion repair

Healthy land & water

Case study: Gully erosion repair - Using a concrete mat

Defining the problem

Gully erosion was affecting the overflow area of a small farm dam on a grazing property near Rosevale in South East Queensland. The gully had cut into the dam wall and without intervention would soon cause the dam to fail. The area had been used as a cattle pad, which in combination of fast-flowing water from a nearby poorly designed spillway, wore away the thin topsoil and exposed the sodic subsoil.

Sodic soil disperses or 'melts' very quickly when it gets wet, meaning that once the few centimetres of topsoil are gone, gully erosion can quickly take hold. About 360 tonnes of soil has been lost from this gully over the last ten years, which is 36 tonnes per year. Runoff from the adjacent pasture was causing further damage (Inset A).

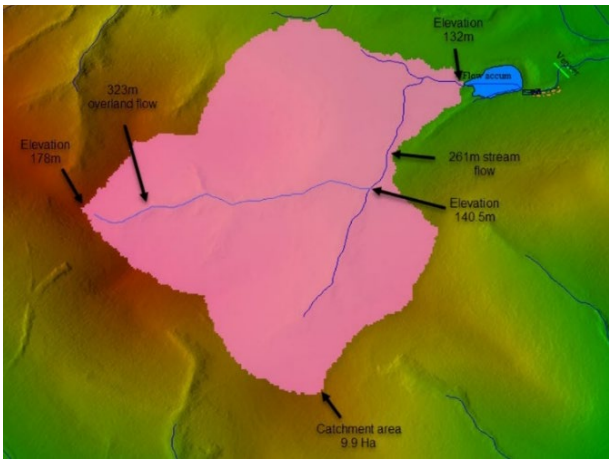

Figure 1. The catchment area of the dam and adjacent pasture was relatively small (under 10 ha), however it was still enough to cause a lot of erosion under the right (or wrong!) conditions.

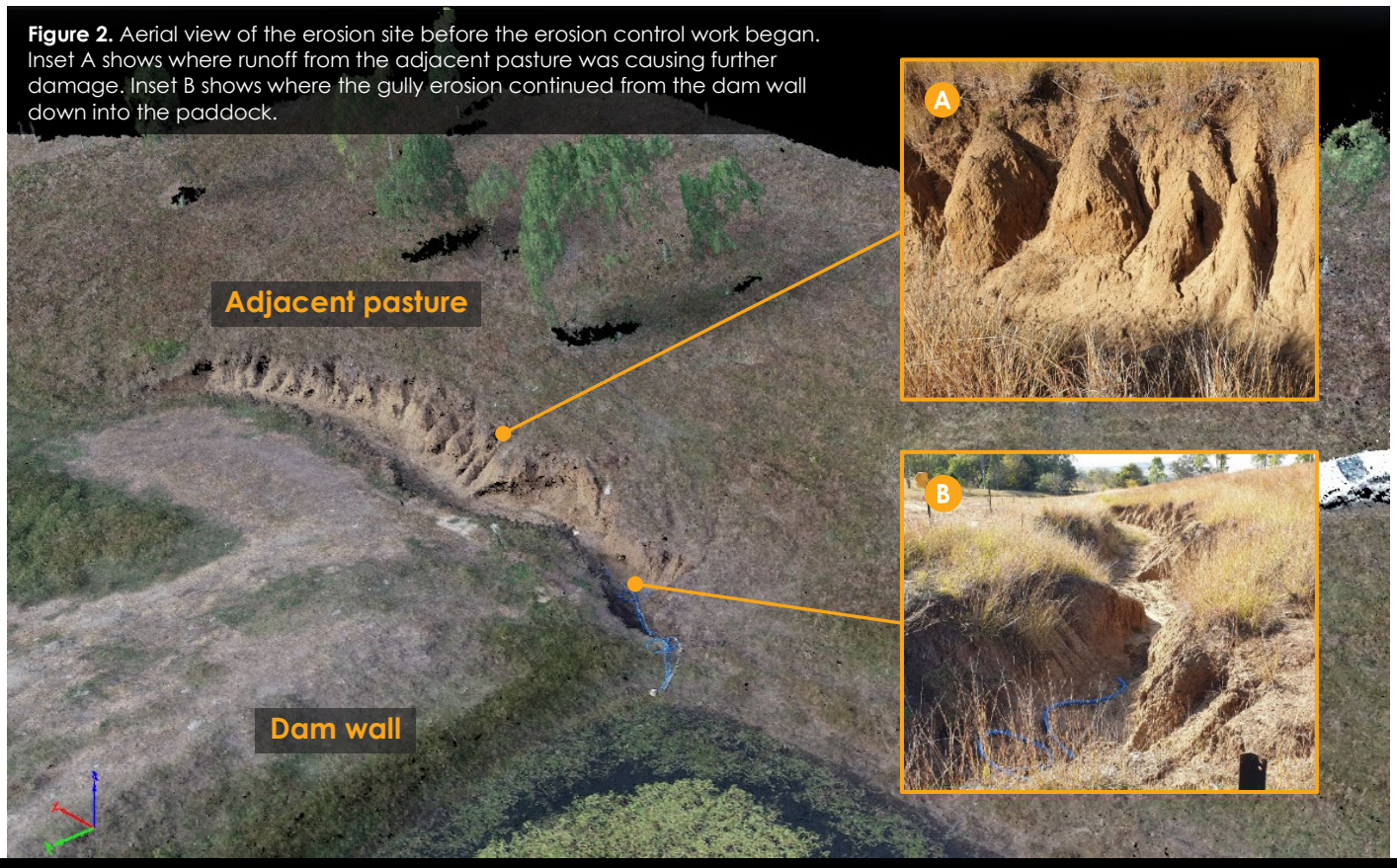

Figure 2. Aerial view of the erosion site before the erosion control work began. Inset A shows where runoff from the adjacent pasture was causing further damage. Inset B shows where the gully erosion continued from the dam wall down into the paddock.

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Designing a solution

Fixing the dam wall and spillway

The two main options considered were:

a) Traditional rock chute.
b) Concrete matting chute supported by rock edging.

The concrete matting option was chosen for this site because it is a more cost effective and environmentally friendly option that is easy for land managers to implement themselves. The concrete mats weigh about one tonne and can be transported in the back of a utility vehicle. Cement chutes also allow vegetation to grow through the mats, which can be mowed over by a commercial mower.

Figure 3. In field.

Essential design features:

- **Gully head reprofiling** 1:4 batter slow velocity is ideal (15° or 25%).
- **Rock edging** to secure the matting.
- **Overhang cement matting** into trenching (0.5 m at the top end and 0.4 m at the sides).
- **Lining of gully with geofabric** of an adequate grade.
- **Stilling well** at the base of the structure.
- **Contour bank** to redirect runoff away from gully sides.
- **Vetiver hedges** to slow water before it enters the chute.

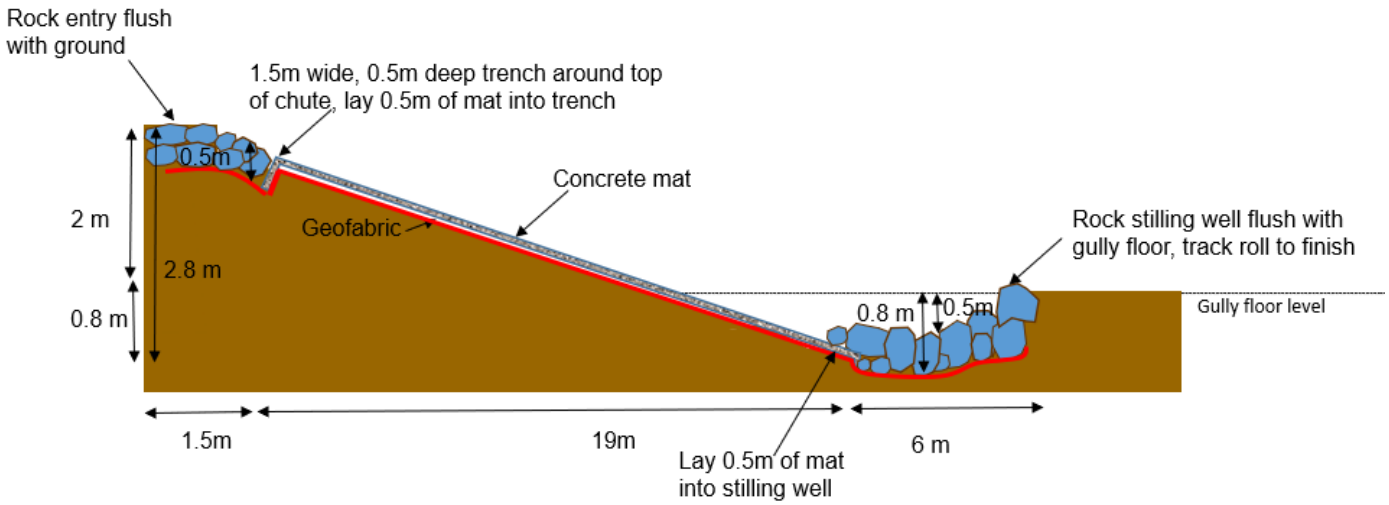


Figure 4. Concrete matting.

Diverting runoff from the adjacent pasture

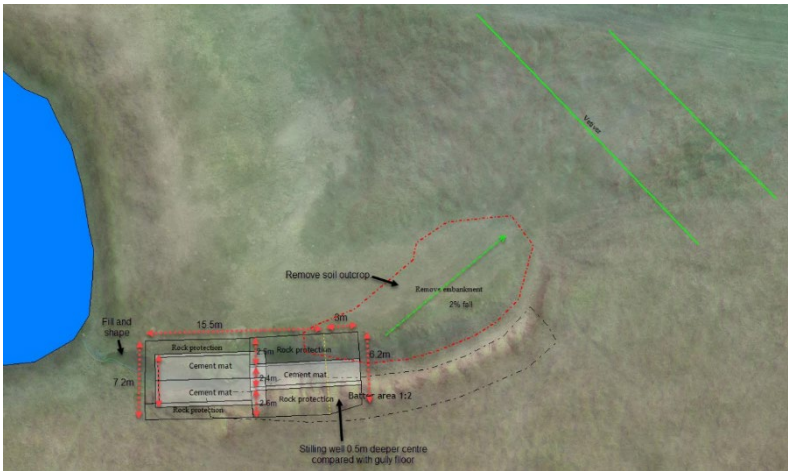
To ensure runoff from the pasture upslope from the site didn't continue to cause ongoing problems, a contour bank was included in the design to redirect runoff to the catchment above the dam. This not only protects the erosion repair works, but also helps keep water in the landscape for longer by delivering it higher up into the catchment to flat areas not prone to erosion.

Installing vegetative infrastructure

With appropriate species selection and planting design, vegetation can be used to slow, control and redirect both overland and subsurface flow of water across the landscape. In this instance, vetiver hedges and tree plantings were used to support and enhance the functionality of the cement mat chute.

Implementing the design

After careful planning and design, a cement mat chute supported by rock edging and stilling well (apron) was installed.



The restoration process:

- **Batter gully sides** and remove the bank confining flows.
- **Reprofile the head cut and gully sides** using clay fill (from dam) and subsoil from reshaping the gully to create a 1:4 batter.
- **Create trenching** to secure the chute and profile the stilling well at the base of the chute to allow for a minimum of 0.5m from the top of the rock to natural ground level (refer to figure).
- **Overlay geofabric** across the entire chute and trenching.
- **Overlay cement mats** ensuring a minimum of two rows of cement blocks over the sides.
- **Place rocks into trenches** surrounding the cement chute, ensuring that rock entry is flush with ground at the top of the chute.
- **Revegetate the batter** with grass cover across all exposed soil and plant vetiver hedges at the base of the chute.
- **Restore native shrubs and trees** back into the surrounding landscape, away from dam wall, spillway and gully.

Figure 6. The gully sides were reprofiled to a 1:4 batter.

Figure 7. Geofabric overlayed across the entire chute and trenching and cement matting overlayed across the chute.

Figure 8. After construction the bare areas were seeded with a mix of productive perennial grasses and a cover crop.

Figure 9. A contour bank was installed to divert runoff away from the restoration site.

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Contour bank construction an essential design features:

- 1:10 fall ensuring topsoil is separated and put back on top.
- Compacted every 400 mm.
- Push up the hill from below contour.
- Ending the contour directing the water to a wide open, flat area above the dam.
- Seed the contour and the exposed soil below it to establish groundcover.
- Vetiver hedges installed where water is entering the gully above dam to slow velocity of runoff to prevent future erosion.

The materials used for this project included:

Rocks for chute and stilling well	D50	Ensure rock is sized appropriately for your catchment size. If it is too small it will fail/wash away.
Geofabric	A44 Bidum minimum spec	Under all surfaces of rock
Cement mats	2.4 x 10m	Refer to manufacturer for installation guide.
U anchors		Refer to cement mat manufacturer.
Vetiver sedge	3 x 10 m long hedges	Hedges to be width of channel intercepting flow at 90 d, with rows 1-1.5 m apart and spacing of 25 cm between plants.
Grass seed	Kikuyu and Rhodes grass	Stoloniferous grasses and season appropriate cover crops.

Evaluating & improving

Challenges & key learnings

- The concrete matting came with its own geofabric lining which was too thin and broke down during a big rain event. This caused some erosion to occur underneath the matting. A44 bidum is the recommended minimum specification geofabric needed to protect the integrity of the chute and underlying soil.
- Don't step down from a two mat width to a one mat design. The excavation and boxing was more time consuming and expensive and did not deliver additional benefits.

Avoiding future erosion problems when installing a farm dam:

Pre-construction	• Ensure dam is well planned and takes into account the location and size in relation to catchment, soils and safe disposal of water (considering neighbouring properties and roads). • Correctly design a wide and stable bywash to gently spread overflows. • Factor in adequate freeboard to prevent dam failure.
Construction	• Compact wall every 400 mm. • Set topsoil aside and redistribute after construction.
Post-construction	• Immediately establish desirable perennial grasses (preferably stoloniferous) and a cover crop (appropriate for time of planting) to revegetate and protect the soil. • Install fencing to protect the establishing grasses and existing vegetation around the dam from concentrated livestock grazing.
Ongoing monitoring & maintenance	• Establish a photo monitoring point and keep a record of observations. • Identify, seek expert advice and act on potential problems early.

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Australian Government

Queensland Government

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