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Case study

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Gully erosion repair

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Case study: Gully erosion repair Using a rock chute

Defining the problem

Gully head erosion had formed on a creek flowing through an alluvial blue gum flat. Over time this gully head had retreated back into the paddock creating an incision 8 m wide by 3 m deep.

Three main driving factors worked in concert to initiate this erosion problem:

1. **Historical changes to the main channel** redirected a segment of the natural drainage line to accommodate new cultivation paddocks. Where the new drainage line re-enters the natural stream there is a steep drop.
2. **The large catchment area** (405 hectares) of mostly timbered rocky slopes generates a lot of fast flowing runoff that is then funnelled into a narrow channel.
3. **An exceptional rainfall event** in March 2019 fell on an already saturated catchment. This event was the final trigger for initiating the erosion.

Figure 1. The erosion site before restoration works.

Figure 2. Aerial view of the erosion site before the erosion control work began. Inset A shows the erosion site looking upstream.

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Designing a solution

The challenge was to design a solution that would transfer the high energy, concentrated flow from the channel safely to the gully floor.

Usually, we would reshape the gully head and sides to 1:4 batter (25% slope), but in this case there were existing large blue gums on the sides of the gully that the landholder wanted to retain. This means the gully sides would remain relatively narrow.

Careful attention was paid to the design of the chute so that it could accommodate the more concentrated flow which, in combination with the alluvial soils along the stream, could lead to erosion retreating quickly into the surrounding paddock. To protect the steep gully sides, contour banks were included in the design to redirect runoff away from this area and deliver it safely to the chute.

Essential design features

- **Gully head reprofiling** 1:4 batter (25% slope) and gully side reprofiling within limitations of presented by blue gums.
- **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.

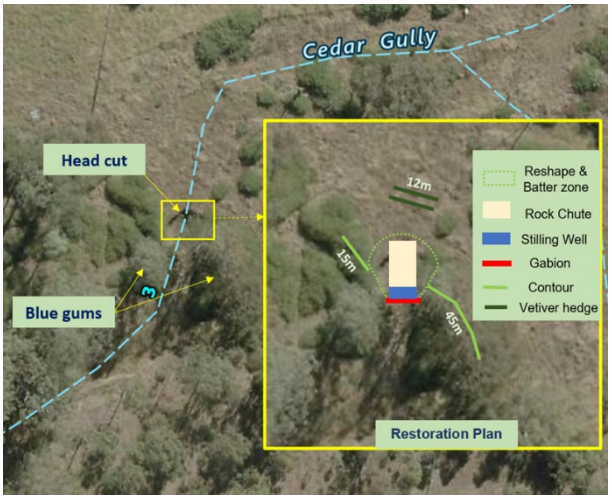

Figure 3. Site plan for restoration. Refer to Figure 4 and 5 for more details on the rock chute design.

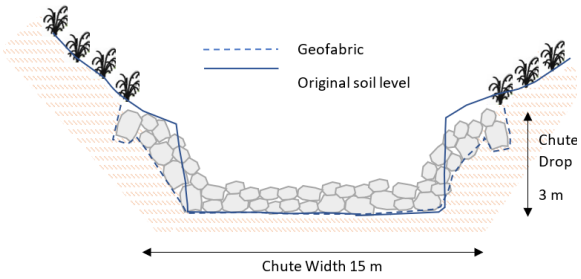

Figure 4. Cross-section of the rock chute design.

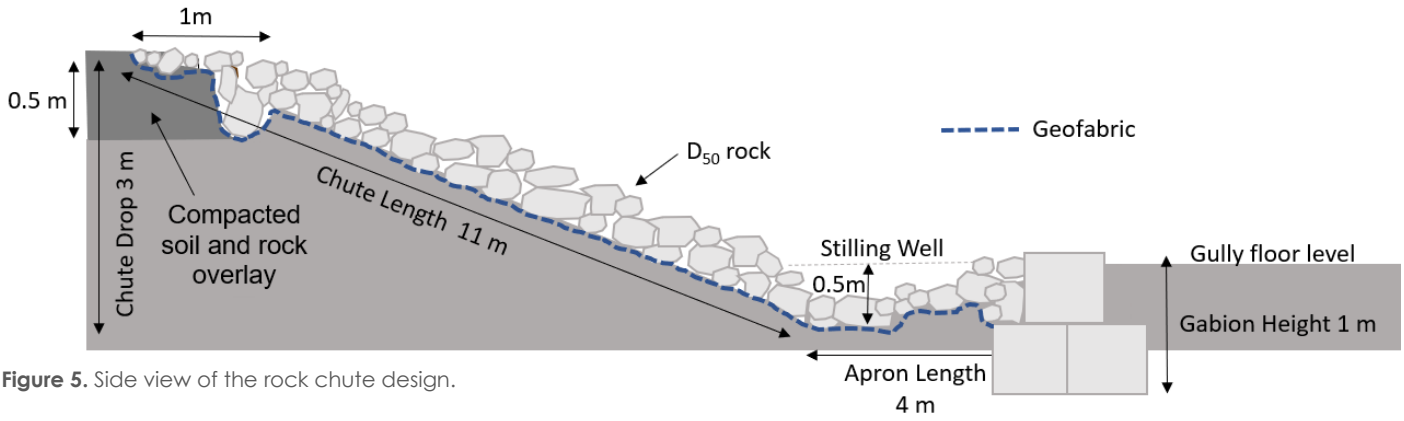

Figure 5. Side view of the rock chute design.

Diverting upslope 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

The restoration process:

- **Reprofile the head cut and gully sides** with a 1:4 slope where possible.
- **Create trenching** to secure the geofabric at the top of the chute.
- **Overlay geofabric** across the entire chute and trenching.
- **Lay sandstone rock and track roll** down to create a compacted, interlocking surface.
- **Construct contours** 1.2 m high with topsoil separated and spread over the top of the contour.
- **Revegetate the batter and contours** with grass cover across all exposed soil.
- **Install vetiver hedges** across the channel to slow incoming flow.

Figure 6. The rock chute after track rolling (looking downstream).

Figure 7. Vetiver hedges were installed to slow and redirect the flow of runoff entering the chute.

Contour bank construction and 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.
- Seed the contour and the exposed soil below it to establish groundcover.
- Vetiver hedges installed to slow velocity of runoff to prevent future erosion.

The materials used for this project included:

Rocks for chute and stilling well	400 mm D50 rock (dry weight 2.5 t/m³) – 160 tonnes	Ensure rock is sized appropriately for your catchment size. If it is too small it will fail/wash away.
Geofabric	240 m² (based on 6 m wide roll)	Under all surfaces of rock or s
Contour	45 m & 15 m (1.2 m high)	
Gabion wall	18, 2 m long, 0.5 m high gabion baskets with gabion rock (dry weight 3 t/m³) – 20 tonnes	
Vetiver hedge	2 hedges 15 m long, 120 slips (single row 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.

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Evaluating & improving

A few months after installation, a significant rain event occurred which cause damage to the chute. The rock moved through the centre of the chute creating a bare patch which compromised the integrity of the structure and would continue to erode under subsequent rainfall events. To reduce the risk of further damage, the dislodged rocks were moved back into position and concrete was placed over the chute, ensuring good penetration and integration with the rocks. This has worked successfully in three flood events that followed holding the rock in place and protecting the old gully head cut from advancing into the paddock.

Figure 8. Some of the rock had been displaced during a rainfall event exposing the underlying damaged geofabric and soil.

Figure 9. Concrete was used to secure the rock and stabilise the chute.

Avoiding problems with rock chutes:

Pre-construction	• Ensure chute 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). • Use design features such as contour banks and vetiver hedges to slow and/or redirect runoff flowing into the chute.
Post-construction	• Immediately establish desirable perennial grasses (preferably stoloniferous) plus a cover crop (appropriate for time of planting) to revegetate and protect bare soil. • Install fencing to protect the establishing grasses and existing vegetation around the dam from concentrated livestock grazing. • Conduct 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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