Land Notes
Natural Resource Management

GULLY REHABILITATION & STABILISATION

Gullies may occur in areas where there is excess run off and concentration of water. They are also usually associated with the loss of vegetative cover.

Common causes of gully erosion include:

- badly constructed or located roads, tracks, fence lines and firebreaks.
- land clearing on unstable or sloping country.
- deep pads caused by stock.
- inadequate drainage control, and badly designed or located drainage structures on formed roads, or within towns and communities.

Treatment of gullies depends on a range of factors including:

- the size of the gully.
- whether it is actively eroding or not.
- the soil type.
- the size and frequency of water flow.
- the topography of the area.
- the desired use of the land after rehabilitation.

METHODS OF TREATMENT

Treatment of gully erosion requires careful planning and attention to detail. Inadequate treatment often makes the problem worse.

The first requirement is to remove the cause of the gullying. This may involve the removal or exclusion of stock, relocation of tracks, revegetation of cleared areas, and/or drainage redesign.

FILLING GULLIES

Filling should only be attempted after the water flow that caused the gully has been controlled or diverted above the gully head in Figure 1. Otherwise fill placed in the gully is likely to be undermined and washed away. Gully filling operations are shown

The common practice of filling gullies with rubbish, logs, rocks, car bodies and other foreign material does very little to solve the problem. In most cases, it makes the gully worse.

CONTROL OF WATER FLOW

Diversion can be achieved through the construction of diversion banks. These are a series of surveyed earthen banks that divert run off away from the gully head, and convert it to slower, less erosive flow away from the actively eroding area.

Spreader banks can also be constructed along the length of a filled gully to disperse runoff into undisturbed areas, as illustrated in Figure 2.

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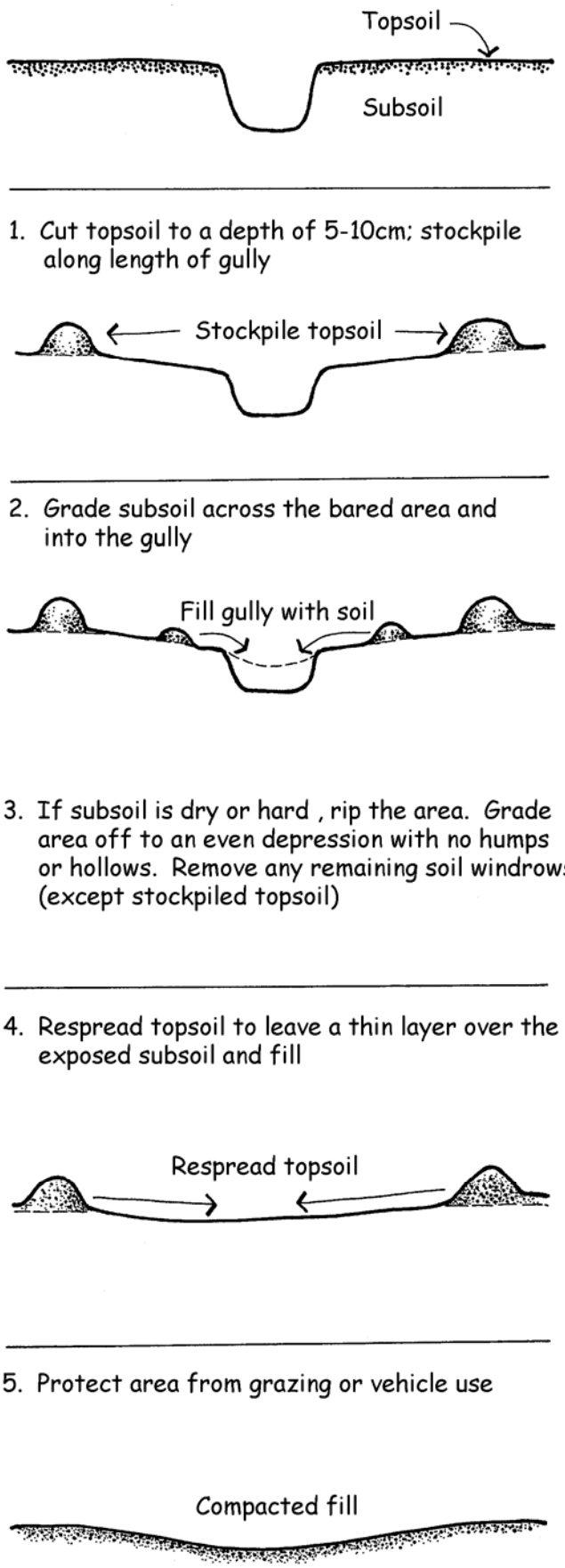

Figure 1 Filling gullies

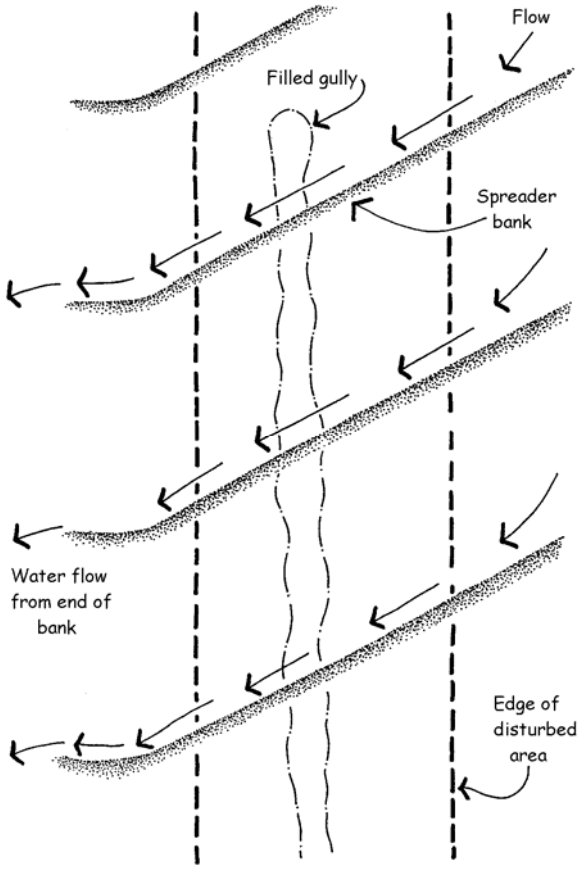

Figure 2 Rehabilitated gully

The design and pegging of gully head sills and spreader banks should be carried out by Soil Conservation Officers or persons with the expertise.

GULLY FORMALISATION

In some cases, the diversion of water may not be an option due to lack of room or the absence of safe disposal areas.

If gullies are small and not subject to a large water flow, then they can be formalised to provide a safe channel for water disposal, as illustrated in Figure 3. In effect, this method turns an unsightly gully into a stable drain.

To formalise drainage, the gully head should first be graded back to make a gentle slope rather than a sharp drop. The sides of the gully should also be battered back (smoothed off), and the gully head stabilised with formal structures made out of rock, concrete or rock mattresses. The entire gully should then be protected from grazing or vehicle use.

In most cases, a layer of topsoil will be required for grass establishment. A light ripping along the gully before topsoil application will help marry the topsoil to the subsoil.

A protective cover of erosion resistant material may be required where seeding and irrigation is impractical. This may include concrete, rip-rap, reno mattresses or geotextile.

The treated area may also need to be fenced during establishment to prevent grazing.

The final outlet must be located in an undisturbed area that is not subject to scouring. If a suitable area is not available, then the outlet must be adequately protected.

After completion, the drain must be monitored to ensure that rilling is not occurring in the channel bed. If it is, then other forms of treatment will be required, for example incorporating grade reduction structures or lining the channel with more erosion resistant material.

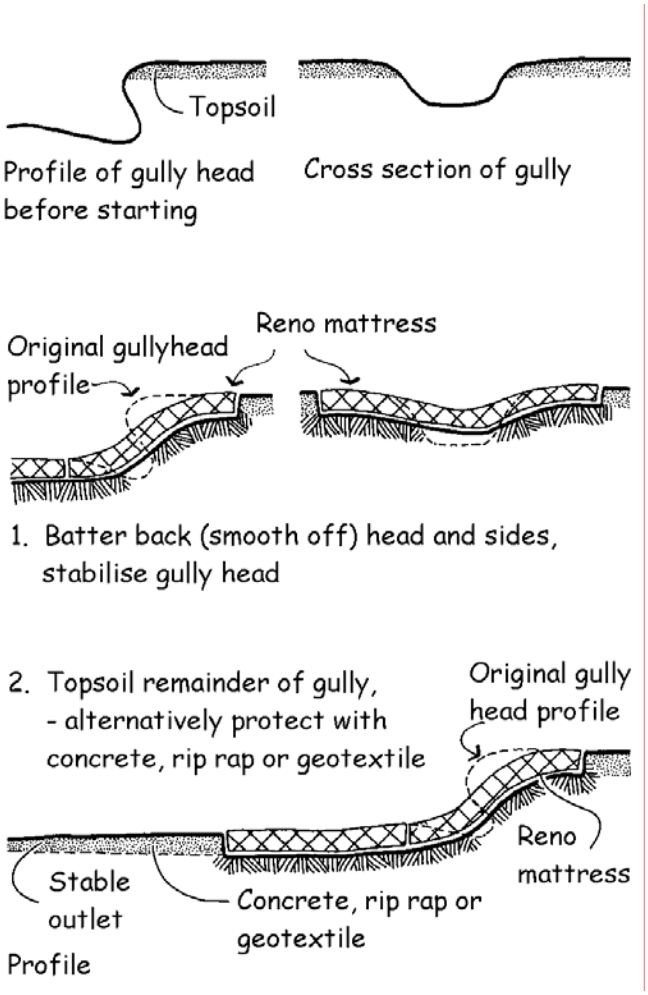

Figure 3 Gully formalisation.

GULLY STABILISATION

The control of active gully heads can be achieved through the construction of a series of grade stabilisation structures (also called drop structures). These structures are designed so that the flow in the gully is reduced to a non-scouring velocity. Sediment is dropped between the structures, filling the gully naturally, as illustrated in Figure 4. Eventually vegetation can be planted between the structures and the gully stabilised.

This method is very effective in the control of gully erosion, and is unlikely to fail if properly designed and constructed.

The locations of the structures are important; they must be placed so that as much sediment is collected as possible, while still ensuring that the structures are stable. Sites should also be relatively smooth at the gully floor, and have a gentle slope between the gully floor and sides.

However, major gullies may require more elaborate structures requiring engineering design.

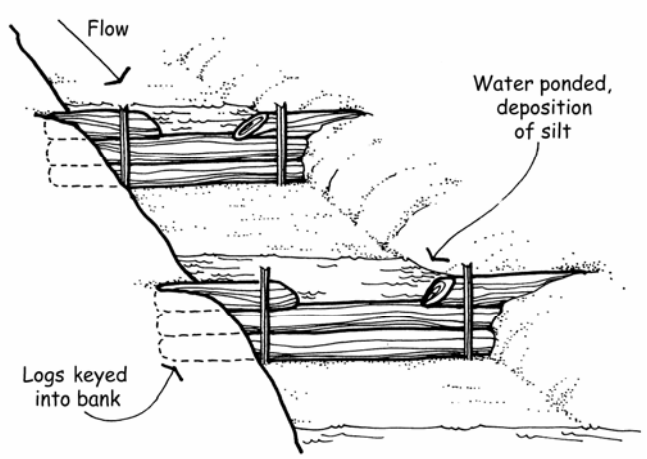

Figure 4. Action of drop structures

LOW COST DROP STRUCTURES

A variety of materials can be used to construct small grade stabilisation structures and some examples are given below.

Logs

A narrow trench is first dug into the sides and across the floor of the gully. Geotextile is then laid across and into the trench, extending both up and down the gully, and staked into place.

Treated logs or cypress pine logs are then placed horizontally across the gully floor, embedded firmly into the trench and geotextile, and gaps in the trench backfilled with compacted earth. It is important that the logs are long enough to be securely keyed in to each side of the gully. The logs are then stacked on top of one another to the height of the bank, and held in place with droppers or pickets, as illustrated in Figure 5.

Logs must be placed high enough to prevent water flowing around the edges during significant flows. Failure to do this will result in undermining and a widening of the gully. A notch can also be made in the top of the structure to contain the flow of water and prevent undermining.

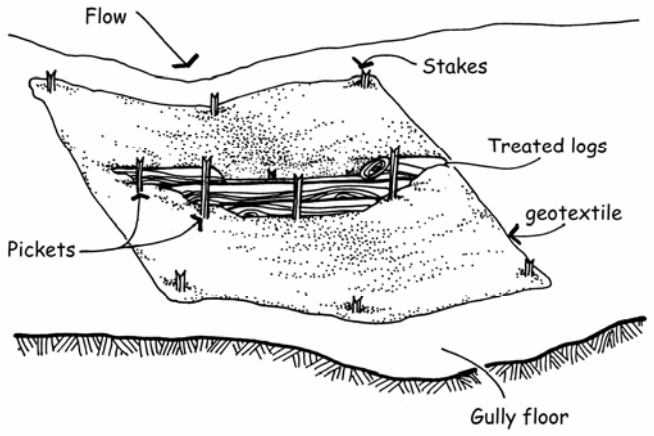

Figure 5 Small drop structure made out of logs

Rocks

Rocks can also be used to construct grade stabilisation structures. In order to be successful, rocks should be contained in wire baskets, or "sausages", and fixed in place with pickets, as illustrated in Figure 6. This will prevent individual rocks breaking free, creating breaches in the structure and channelling flow.

Construction methods are similar to those used for log structures, where a trench is dug into the gully to key in the rocks, and geotextile laid over the trench and staked in place.

Mesh is then laid out across the gully and up the sides. Loose rock is packed in one half, and the other half is wrapped over the rock and laced to the other edge, making sure that the sausage is firmly embedded in the trench. This sausage is then staked in place, and gaps in the trench backfilled. It is important that the rocks and mesh extend past the outer edge of the gully to prevent scouring.

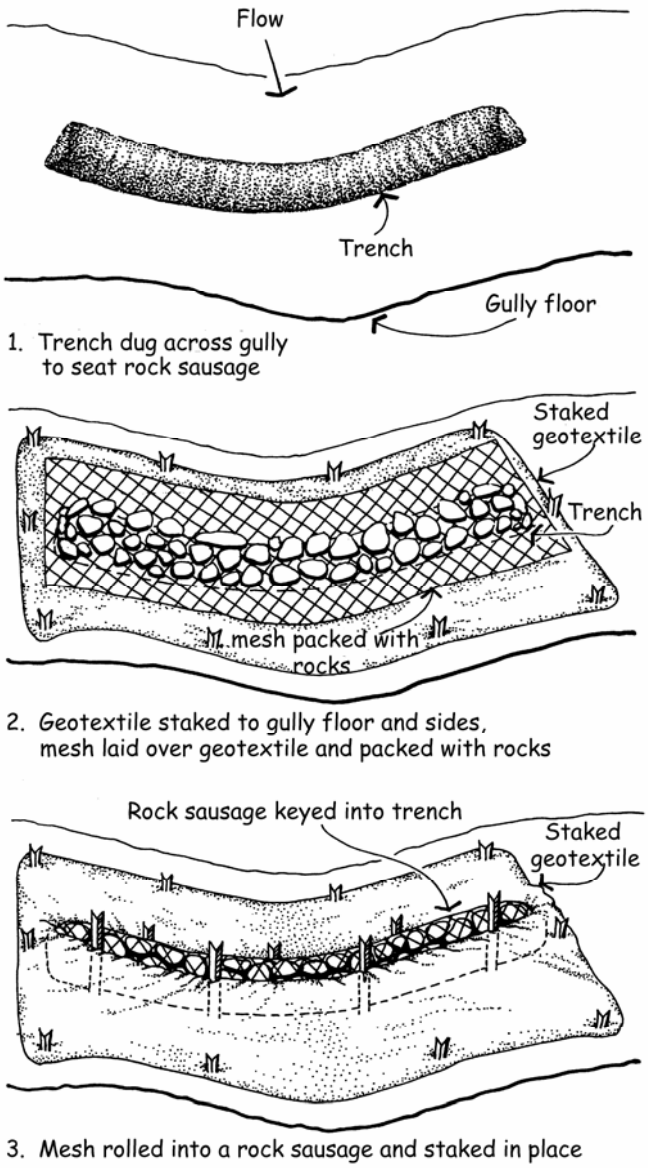

Figure 6 Small drop structure made out of rocks

MONITORING

Small low cost structures require vigilant monitoring to make sure they are working effectively. Common problems include:

- water flowing around the edges of the structure.
- erosion immediately downstream of the structure.
- breaching, particularly if rocks are used.

If any of these problems occur, downstream protection must be applied, and the edges of the structure properly keyed in. If breaches occur, then some other form of construction should be considered (for example using geotextile and wire baskets rather than unconfined rocks).

Failure to treat these problems quickly will result in further erosion.

MAJOR DROP STRUCTURES

Major structures are used for more extensive gullies, and are built according to stringent design and construction criteria. Although more expensive to implement, they have a much lower chance of failure if designed and constructed properly.

The design of major structures depends on a set of formulae which take into account the expected life of the structure, the size and nature of the catchment, rainfall intensities, soil erodibility and calculations of peak discharges. For this reason, Soil Conservation Officers or engineers should carry out design, and they can also advise on construction.

Structures may be made of treated logs, concrete, wire baskets (gabions), mesh and netting or a combination of materials.

There are several vital points that must be adhered to for these structures to be successful. Because they are more expensive to construct, and difficult to repair, it is essential that they are built properly to avoid failure.

- Where a notch is built into the top of the structure, it must be big enough to take the largest probable flow to avoid erosion of the adjacent bank.
- Each end of the structure must be keyed into the sides of the gully. Trenches are dug into the banks on both sides for a distance equal to the height of the structure, and the sides of the structure must extend into these trenches. After construction, the trenches must be refilled with tightly rammed impervious material.
- In order to prevent erosion of the gully floor, both upstream and downstream aprons must be incorporated into the design. Small stones can be used if packed together and anchored with wire netting, or a concrete apron can be constructed. Cut off walls at the end of each apron are essential to prevent sub-surface moisture flow.

The gully sides immediately downstream of the structure will be subject to higher flows than previously encountered. Protection must be extended up the side of the gully, and continued downstream until the channel flow is normal again. The best protection is in the form of flat gabions (reno mattresses).

Plate 1 Major drop structure made of logs. Note the concrete and rock apron, and the concrete keying the logs into the side

Plate 2 Major drop structure constructed from loose rock held in place by wire netting. Note stilling basin in the centre of the picture

For further information about controlling erosion in the southern region of the NT contact the Conservation and Natural Resources or visit our website

www.nreta.nt.gov.au/advis/land/soils.htm

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