



GULLY EROSION REPAIR

What is gully erosion?

Gully erosion consists of one or more open, incised and unstable channels, generally deeper than 30cm, but can be many metres deep.

A gully network consists of a main branch and one or more lateral branches.



Aerial image showing main and lateral branches of an active eroding gully.

Well managed overland flow can help prevent gullies forming.



A well designed farm drainage plan manages the volume and velocity of runoff and safely conducts it to stable discharge points.

Introduction

These guidelines outline the steps involved when planning to address gully erosion. Gully erosion poses a serious risk to rural lands and can impact:

- **Productivity** - by restricting land use and access and movement of stock and losing precious topsoil
- **Asset and infrastructure integrity** - by undermining roads, buildings, fences and irrigation pipes
- **Water quality and aquatic life** - through increased sediment delivery
- **Efficiency** - by reducing the capacity of dams as they fill with silt or the effectiveness of fences with increased sediment build up.
- **Safety** - as drop-offs represent potential hazards to people, stock and equipment.
- **Biodiversity** - as habitat values decline with the size and extent of migrating gullies.

Prevention is key

Gully erosion can be complex and expensive to fix and may require specialist advice. It is far better to avoid the impacts on your property and prevent it from occurring in the first instance.

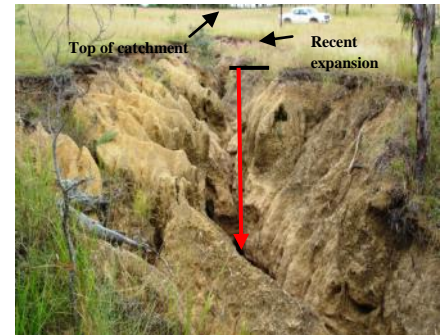
<input checked="" type="checkbox"/> Understand and conserve your soil	Know your soil and its inherent limitations, keep it in place and preserve its biological, physical and nutrient values.
<input checked="" type="checkbox"/> Maximise ground cover	Maintain more than 90% ground cover in pastures and retain crop residues to intercept raindrops and help anchor the soil in place and prevent movement of soil particles.
<input checked="" type="checkbox"/> Plan your drainage	Safely intercept and transfer overland flow to a resilient local drainage network to minimise interruptions to farm operations and avoid gully initiation.
<input checked="" type="checkbox"/> Carefully locate roads, tracks and fences	Avoid concentrating overland water flow; locate tracks on ridges where possible.
<input checked="" type="checkbox"/> Act early and seek advice	Identify, seek advice and act on potential problems early.

1. Define the problem

Understand the causes

It is important to know what initiated the erosion and why it continues to erode, as well as the extent of the gully network and its likely rate of expansion, to start planning repair work. Earlier imagery, photographs and memory can all help. Gully erosion can be initiated, or exacerbated, by:

- **Earthworks**
- Low levels of **ground cover**
- **Fallen trees**
- **Concentration of water** through changes to drainage, culverts, failed or poorly maintained contour banks
- **Altered runoff** characteristics due to changes in land use or land condition
- **Site factors** such as ground water **seepage** or **dispersive sub-soils**.



Gully heads migrate up the catchment and range in depth from 30cm to many metres.

Risk Assessment

After identifying the cause and the severity of the symptoms it is important to examine what is at risk, and the impacts this will have on farm operations and assets. Benefits include safeguarding built infrastructure, maintaining productivity, reducing the threat of deep gullies dividing lands, and reducing offsite sediment pollution.

2. Design a solution

Explore you options

Various options are available to repair eroding gullies. Expert assistance can help identify options and guide implementation. Local examples of successful gully repair works are worth investigating for ideas and issues to look out for and to help identify experienced contractors. This homework can save time, money and effort.

All gully restoration options have a number of features in common:

- **Arresting upstream migration** of gully heads , typically by battering and 'hardening' the head (for example, through grassing in smaller systems and rock lining and the use of groynes in larger systems).
- **Stabilising banks**, typically by battering and re-shaping.
- **Establishing cover**, a perennial grass and cover crop and adding shrubs and trees if appropriate.
- **Removing grazing pressure**, typically by fencing to allow a dense vegetation cover to establish.
- **Diverting upstream flows** (at least temporarily) to avoid further degradation.
- **Planning for sub-surface flows and soils** prone to dispersion if they are a risk.

Plan for increased resilience

Restoration projects will typically be designed to accommodate a 'design' flow event; often the 1 in 10 year event in rural landscapes. Restoration investment is about increasing landscape resilience; however, it is not a guarantee that all future damage will be avoided. Well designed and maintained grass, shrub and tree revegetation will continue to strengthen restored gullies as the vegetation matures.

Identify resources to implement your plan

This includes time, materials and machinery to undertake the works as well as the changes in land use practice needed to maintain the restoration investment and ensure its integrity.

Be aware of any legal obligations

This includes installing levees (diversion drains), banks and dams, removing vegetation to allow works and cleaning out and diverting dams. Check "Dial before you dig" (<http://www.1100.com.au/>).



3. Implement the design

Develop a plan

A comprehensive restoration plan will help achieve the desired end result and inform contractors involved in works. Detail all engineering works, including battering; hardening the gully head; constructing diversion drains; fencing and relocating or strengthening infrastructure; material requirements; and, revegetation works. Provide sufficient detail to allow quantity surveying and implementation by a competent contractor and include:

- **Timing** - considering expected weather and contingencies.
- **Personnel** - contractor availability; supervision and staff .
- **Machinery** - size, type, special features such as grab, compaction roller.
- **Material availability** - access, transport, on-site storage.
- **Material classification** - quantity and size distribution of rock, grade of geo-fabric, plant species and numbers.
- **Site induction and risk assessment** - safety, access, emergency procedures.
- **Installation notes** - layout of diversions, rock works, battering and fencing: placement and compaction requirements; laying geo-fabric including keying in, pinning and overlapping; and vegetation planting and sowing.
- **Hazards and potential impacts** - during works and on existing infrastructure.
- **Maintenance** - requirements and frequency; responsibilities and timing.
- **Engagement** - sharing the vision and providing appropriate people with information and copies.
- **Authorisations** - regulatory approvals, engineering signoffs if needed.
- **Evaluation** - assessing successful implementation.



Drowning out a gully head by creating a dam can be a useful way to stabilise a gully.

4. Evaluate and improve

Check your progress

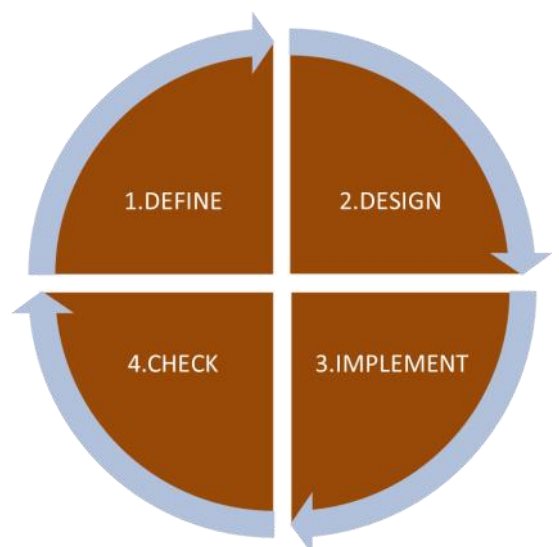
Like all farm investments, it is important to evaluate performance of gully erosion repair investments and to schedule maintenance works to ensure the factors that caused the original gully erosion do not re-emerge. Determining evaluation and future maintenance needs during the planning process is best.

Evaluation has two main components:

1. **Measurement of success:** have all works been undertaken in accordance with the plans? What worked well? What contingencies arose? What would I do differently if starting again?
2. **Monitoring the integrity of the repair and any emergent issues:** including vegetation condition, groundcover percentage, weed incursion, fence integrity, stability of diversion drains and rockworks and absence of further gully development.

Other things to consider:

- Share findings and experiences with neighbours and professional groups: to add to the community's capacity to manage gully erosion.
- Establish photo points and develop a photographic record. A photo point is a known position (post or picket placed at a known point near or in the project area) where similarly framed photos can be taken over time to monitor the progress of works and condition of a site.



A cycle of continual improvement can be used to assess and inform progress.



Gully erosion repair planning checklist

1. Define the problem

A summary of action includes:

- Seek expert input
- Identify the cause
- Describe the current extent
- Determine the rate of change
- List assets at risk
- Note the impacts to your enterprise
- State the benefits

2. Design a solution

The process to follow includes:

- Define how you want the site to look
- Share the plan with family and workers
- Explore similar local solutions
- Seek expert advice
- Consider legal obligations
- Identify hazards
- Outline resources required
- Assess feasibility
- Define maintenance needs

4. Check effectiveness

Be aware of the drivers of gully erosion to avoid re-emergence of these drivers and:

- Have a strategy to assess success
- Plan maintenance inspections
- Quantify time and resource inputs
- Be alert to re-emergence of erosion drivers
- Utilise photo monitoring
- Agree on data storage procedures
- Capture learnings and share findings

3. Implement the design

The implementation process includes:

- Prepare a plan with notes and sketches
- Itemise work stages
- Specify needs (rock type, size, and shape, compaction, slope)
- Obtain quotes
- Prepare site for safety, access, storage and operations
- Induct personnel
- Supervise works
- Schedule maintenance

Eroding gullies will continue to erode in the absence of intervention. Unstable headwalls will migrate upslope and deepen and shear banks will continue to collapse, threatening further loss of productive lands, infrastructure and access. Farm values will potentially diminish. Water quality downstream will be affected by increased sediment movement out of the gully. With good planning and using best practices, investment in removing pressures on eroding gully systems and restoration can mitigate these risks.

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