COMMUNIQUE SIX
December 2021

The Innovative Gully Remediation Project

Greening Australia

Queensland Government

Photo credit: Fruition Environmental Pty Ltd 2020

Restoring eroded gullies cost-effectively reduces fine sediment entering the Great Barrier Reef over the long term

The Innovative Gully Remediation Project has demonstrated that eroding gullies can be cost-effectively restored, delivering benefits for landholders and the Great Barrier Reef. The results from 10 gully remediation trial sites at Strathalbyn Station reduced fine sediment reaching the Reef by an average of 98 per cent, with an average cost-effectiveness of $58/tonne of sediment.

Eroding gullies produce tonnes of sediment that pollute the Great Barrier Reef

Queensland's intense summer rainfall means the land is prone to erosion, especially on soils that have been heavily grazed with ground cover removed.

Large gullies—tens of metres deep and wide—form where the subsoil erodes easily once the topsoil is lost. Such gullies usually occur on the flatter landscapes next to waterways, which makes it harder to manage than the erosion occurring on hillslopes.

These large-scale, eroding gullies are the main source of the sediment in waterways flowing to the Reef. Too much sediment on reefs causes algae to grow faster, which clouds and darkens the water, smothering coral and seagrass and reducing their ability to grow or reproduce.

Gully erosion produces about 90 per cent of all fine sediments reaching the Reef.

The Innovative Gully Remediation Project's study site was at Strathalbyn Station where the Hughes family runs beef cattle. It is about 150 km south of Townsville in the Burdekin catchment. The property had several actively eroding gullies in 2017, generating between 176 and 370 tonnes per hectare (ha) of fine sediment a year. In total, about 7,700 tonnes per year were being lost (exported) from the whole property.

Cost-effective gully restoration stops more than 90 per cent of sediment reaching the Reef

The $4 million Innovative Gully Remediation Project (2017–20) directly remediated 17.41 ha of gullies and restored ground cover to 44 ha of the property.

The project measured the cost-effectiveness of 10 gully remediation trials through intensive water sampling and landform analysis. Results demonstrated that trial sites had an average effectiveness of 98 per cent in reducing fine sediments reaching the Reef. This was despite the area experiencing its sixth-wettest wet season on record.

Overall, 4,428 tonnes (370 truckloads) of fine sediment were stopped from reaching the Reef each year by remediating just over half the area affected by eroding gullies on the property.

Given the gully treatments cost $2.37 million and are expected to last 25 years, we estimate an average cost-effectiveness of $58/tonne (using 2019 figures).

The following five steps explain how gullies can be cost-effectively restored to reduce fine sediment run-off into nearby waterways. These steps include principles applicable to all Great Barrier Reef catchments.

1. Form partnerships, find collaborators and interact continually

Large gully restoration projects require public–private partnerships and the involvement of experts. Half the funding for the project was provided through the Queensland Government's Queensland Reef Water Quality Program and half through Greening Australia's Reef Aid initiative. Reef Aid includes philanthropic donations from individuals and corporations worldwide.

More than 50 local businesses supported the restoration works at Strathalbyn Station. Bristow and Ureisha Hughes — owners of Strathalbyn — facilitated the project on their property, reflecting their ongoing interest in sustainably managing their beef station. The project also pays respects to the Juru Traditional Owners of these lands.

The project relied on the expertise of Damon Telfer and others from Fruition Environmental Pty Ltd, who developed and managed the gully restoration works program, including installing water-quality monitoring equipment and collecting samples.

A team of experts brought a range of skills, including earthmoving, engineering, and soil and vegetation sciences. Dr Andrew Brooks and team from Griffith University's Coastal and Marine Research Centre were pivotal in analysing the reduction in sediment and assessing the cost-effectiveness of the project.

Continual interaction between the people funding and delivering the project was critical to the project's success.

Partners and supporters visiting Strathalbyn in 2019. Photo credit Annette Ruzicka.

2. Prioritise clusters of gullies that produce the most sediment

Strathalbyn Station was selected because it was representative of other properties with gully erosion issues, the Hughes family were interested and supportive, and the property was easily accessible.

Considerable cost savings were possible by housing workers onsite and by establishing an on-farm quarry—reducing costs to import material for construction.

Once a site has been selected, it is essential to determine priorities for remediation. Selecting gullies with the highest fine-sediment yields provided the greatest opportunity for cost-effective treatment.

Closer analysis of Strathalbyn gullies found considerable complexity and variability within and between gullies. This needs to be taken into account when tailoring restoration designs. Clusters of actively eroding gullies to the north of the property were selected for the project to maximise the likely cost-effectiveness of work.

3. Get local baseline data before starting any works

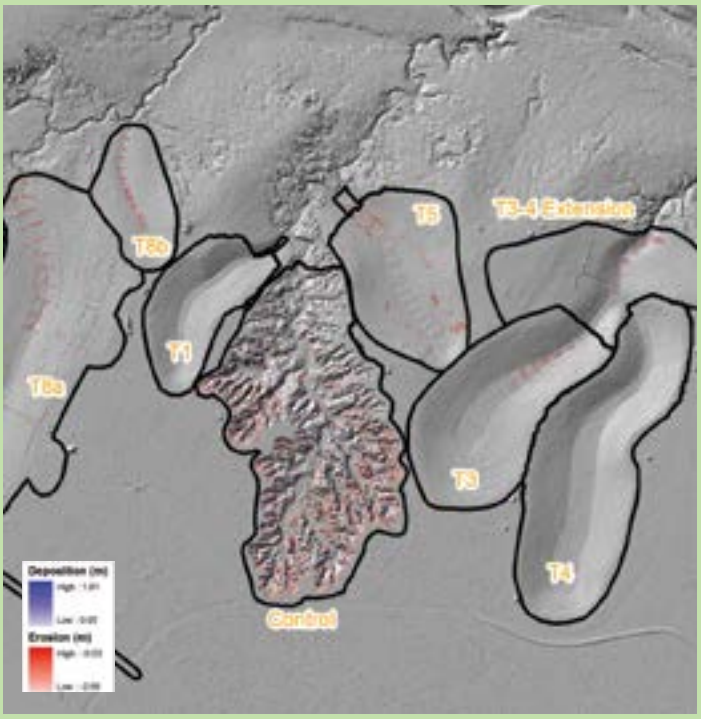
It is crucial to understand the soil, land surface and vegetation to design effective restoration works.

Soil sampling is fundamental to assessing and understanding erosion processes. The soils in the gullies targeted at Strathalbyn had high to very high levels of sodium, which degrades and breaks up the soil. Some of the topsoils were treated with gypsum and organic matter to reduce such dispersion, and with nutrients to improve their fertility.

Ground-based 3D laser scanning (LiDAR) and drones were used to estimate how fast erosion would occur and how much sediment would likely wash away. These tools were also used to design the earthworks cut and fill program.

At Strathalbyn, the gullies which had lost their topsoil had very poor ground cover. This meant the designs needed to include methods for establishing vegetation. Most of the existing vegetation (85 per cent) was exotic perennials with an absence of native annuals and perennials.

A visit to Strathalbyn during site selection process, March 2017.
Photo credit: Greening Australia



LiDAR is a very useful tool in designing restoration. This image from 2020 shows how LiDAR can be used to assess the effectiveness of treatments in reducing erosion, compared to the control (untreated gully).
Source: Griffith University

4. Design works to balance cut and fill ratio, manage flows, and establish vegetation and topsoils

Large-scale gully restoration projects need experts to help design the works based on the best available local soil, vegetation and landscape data. Designs need to be based on:

1. Modelling the surface features of the land and the quantities of earthworks required.
2. Balancing the cut and fill ratio of earthworks to reduce the need to import or export materials.
3. Managing the concentration of water flows, which may mean installing flow-dissipation structures where design cannot stop flows concentrating down man-made, sloped pieces of land (batters) or within channels.
4. Retaining and establishing vegetation and topsoils as much as possible.
5. Designing structures to ensure there is 5 per cent or less chance of being a threat to infrastructure or life.

Strathalbyn's northern gullies formed on a flat landscape with a slight slope down to Bonnie Doon Creek. In this sort of landscape, any depression — such as a vehicle track — can change flows and lead to erosion. Flows can also concentrate below where a batter forms a concave bend. To remediate such problems, porous rock structures (check structures) were installed to dissipate flows and stop water pooling.

The most cost-effective trials used 100 mm of rock capping over regraded batters treated with gypsum (including an additional 100 mm of topsoil in one treatment), mulching and seeding.

Establishing self-sustaining perennial vegetation is critical for restoring gullies and reducing fine sediment export, especially long term. The project recommends:

- Ensuring rapid cover of the ground with perennial species, without too much initial concern for diversity.
- Using mulch and debris to make reinforced soil structures (bunds) to dissipate flows on long batters and allow dense ground cover to grow in inter-row areas.
- Including seed in a thin mulch bed — of bagasse, for example — to increase the success of germination and establishment.

5. Monitor works for effectiveness and maintenance issues

Monitoring remediation work on gullies is important for dealing with any issues and for determining success. Monitoring and evaluation should measure sediment reduction and cost-effectiveness. Effectiveness will depend on:

- How robust the works are, measured by the cost and frequency of maintenance required, and continued reductions in fine sediment export.
- How long the works remain effective, which reflects maintenance requirements as well as success in establishing vegetation and improving land condition.

Treatments without rock capping on the batters were more likely to form narrow, shallow eroded channels (rills) and small gullies on the batters, requiring ongoing maintenance. This was evident in one treatment that used jute mesh over gypsum-treated soil, and another that used only gypsum-treated soil with organic matter. In contrast, treatments capped with crushed gravel were much more stable.

Ongoing monitoring is needed to test assumptions on how long treatments will last, required level and frequency of maintenance, and whether reduction in fine sediment exports continues.

Find out more

- Dr Lynise Wearne, Reef Aid Program Director (reefaid@greeningaustralia.org.au)
- Visit the project page: www.greeningaustralia.org.au/projects/rebuilding-eroding-land-2/

Changes over time for a restored gully at Strathalbyn Station.
Photo credits: Rock-It Science

Vegetation establishing after gully restoration treatment.
Photo credit: Fruition Environmental

PROJECT FUNDER

Queensland Government

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- Norman Family
- Paul M. Angell Foundation
- Portland House
- Prior Family Foundation
- Sukin
- The Tiffany & Co. Foundation
- Virgin Australia
- Yulgibar Foundation
- Purryburry Trust
- Garry White Foundation