

BURDEKIN MAJOR INTEGRATED PROJECT GULLY MAINTENANCE AND MONITORING PROJECT



MT WICKHAM

SITE FEATURES AND RESTORATION EFFORTS

The aim of a pilot large-scale gully rehabilitation project at Mt Wickham was to restore the catchment to a healthy, functioning landscape. The project focused on testing various remediation approaches to identify cost-effective solutions that could be applied to other projects and catchments. It was part of the Burdekin Major Integrated Project, also known as Landholders Driving Change.

Remediation efforts addressed significant soil erosion and degradation to restore land health by stabilising the soil, improving water infiltration, and boosting vegetation cover.

The project sought to fix linear hillslope gullies, scalds, and major alluvial gullies, including tunnel erosion on highly sodic soils draining into Sandalwood Creek and eventually flowing into the Bowen River.

The goal was to enhance the site's ecological health, increase its resilience to erosion, and promote sustainable land management practices for long-term land use.

Ecological engineering firms Alluvium and Verterra developed the remediation technical design and

managed the on-ground works. The remediation plan involved a combination of grade control rock chutes, re-contouring of the rehabilitation area, soil amelioration using a range of chemical treatments, and revegetation using a range of pasture and legume species. Local contractors completed all on-ground work.

The Mt Wickham site was one of four remediated gully sites monitored by CSIRO from 2018 to 2024 to measure runoff volume and suspended sediment concentration. Each treatment gully had an untreated control for comparison, and vegetation metrics, including mean ground cover and biomass, were also recorded.

Analysis concluded that the remediation at Mt Wickham successfully established vegetation within the gully and was highly effective in reducing sediment yields and Event Mean Concentrations (EMCs) – a flow-weighted average concentration of suspended sediment (mg/L) (Bartley et al. 2025, in draft). The EMC effectiveness values at Mt Wickham remained above 90 per cent for five years post-remediation, indicating this effectiveness was likely to persist well into the future.



Mt Wickham gully remediation - Before



Mt Wickham gully remediation - After

GULLY REMEDIATION ACTIVITIES

Mt Wickham was a demonstration site for testing remediation techniques. The remediation works were completed in two stages.

Stage 1 started in November 2018, concentrating on reshaping and revegetating the eastern side of the main gully channel. Stage 2 followed in September 2019, targeting the western side. Both stages were completed by the end of that year.

The work included:

- Earthworks, including landforming (reshaping) and subsoil amelioration of eroded gullies.
- Installation of rock check dams/weirs and mulch berms.
- Construction of rock chutes to control stream grade and armour gully structures.
- Strategic rock armouring of high-flow and steep sections along drainage pathways.
- Amelioration and revegetation of the site.



Aerial view of the site during remediation.



Aerial view of the site right after remediation was completed.



Aerial view of the site weeks later, after more than 300mm of rainfall in a single event.



Earthworks

Extensive earthworks involved excavating tunnels, reshaping gullies, and using machinery to compact the soil and create gradual slopes. At least 12 gullies branching off the main gully channel were reshaped into evenly contoured 'bowls'. These reformed landscapes are designed to slow water flow and reduce erosion.

Rock checks and mulch berms

To further slow overland flow, long rock check dams (leaky weirs) and rows of hay berms were installed along the slope's contour. The hay also contributed organic matter to the developing soil. These structures act like speed bumps, allowing water to flow through and over them, reducing its velocity and helping to prevent erosion.

Rock chutes and armouring structures

The first structure to be constructed, Chute 5, was installed in November 2018. This was followed by four more chutes and six gully head rock armouring

structures. Chute 5, approximately 12 metres long, was built to slow water as it flowed down the main gully channel. By reducing the water's speed, sediment settles on the gully bed, helping to establish a new floor and reduce upstream erosion.

Heavy rainfall in January and February 2019 threatened the banks of Rock Chute 5. To protect its functionality, temporary diversion banks were installed on either side to spread the water across the landscape and prevent overflow. Once the banks stabilise with increased ground cover, these temporary structures will be removed, allowing natural processes to resume.

An additional rock chute was installed near the intersection of the catchment and road drainage to protect the gully bed and serve as a future sediment trap.

Diversion banks were also installed to redirect runoff from Blue Valley Road, reducing water pressure on the gully head.



In the lower sections of the main gully channel, walls were stabilised, and rock structures were installed to slow water flow and reduce erosion. This method provided an effective solution while minimising costs by avoiding the need for extensive reshaping of the entire system. By reducing the water's speed, sediment can settle on the gully bed, helping to establish a new gully floor and reduce upstream erosion.

Amelioration and revegetation

Before beginning earthworks, 400 tonnes of topsoil were removed and blended with 70 tonnes of gypsum and 370 tonnes of compost for later reapplication. Hay bales and seeds were also incorporated to enhance the organic matter content.

The project included extensive soil amelioration, with gypsum applied at varying rates according to soil conditions. Comprehensive soil surveying and analysis identified five distinct soil management units (Figure 1), each assigned a tailored suite of amendments to address deficiencies and optimise revegetation. These included fertilisers, boron, gypsum, organic matter, and zinc sulfate.

Once earthworks were completed, a successional seed mix was sown, consisting of a fast-growing cover crop, grass species with stoloniferous growth for strong soil binding and biomass production, a deep-rooted

legume to stabilise the soil and contribute nitrogen, and a mix of native canopy species to restore tree cover. Pasture species sown included Sabi grass, Buffel Gayndah, Indian couch, Creeping Bisset, Katambora Rhodes, Seca Stylo, and Desmanthus progrades.

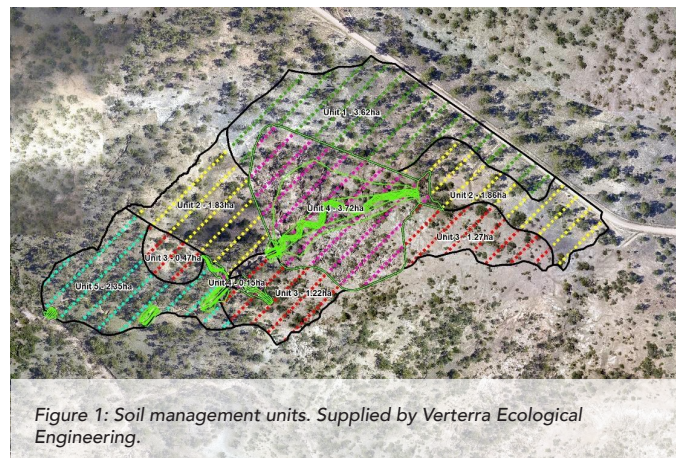


Figure 1: Soil management units. Supplied by Verterra Ecological Engineering.

RESTORATION BENEFITS

- **Soil stabilisation and erosion control:** By addressing gully and tunnel erosion, especially on highly sodic soils, the project significantly reduced erosion, and the gully system has stabilised, preventing further degradation of the landscape.
- **Improved water infiltration and flow control:** The installation of structures like rock chutes, diversion banks, and rock checks helps slow water flow, reducing runoff velocity and allowing sediment to settle. This promotes better water infiltration into the soil, enhancing its capacity to retain moisture.
- **Increased vegetation cover:** Revegetation using a range of pasture and legume species, along with the addition of ameliorated topsoil and organic matter, promotes the growth of stable vegetation. This stabilises the soil and improves the ecological health of the area, reducing sediment transport.
- **Sediment reduction:** The remediation has been effective in reducing sediment yield and the Event Mean Concentration (EMC) of suspended sediments by over 90 per cent, contributing to better water quality in downstream ecosystems, including Sandalwood Creek and the Bowen River.
- **Resilience to future erosion:** Reshaping and re-contouring the land and using techniques such as gypsum soil amelioration, the site is now more resilient to future erosion events.
- **Sustainable land management:** The observations and information gathered about the grazing regime implemented at the Mt Wickham site provides learnings that will benefit future remediated gully sites.
- **Local workforce:** The local contractors' involvement promotes community engagement in sustainable practices.
- **Hydrological and ecological impact:** Reduced runoff and erosion support healthy vegetation, creating a more stable ecosystem. Less sediment export improves downstream water quality, benefiting aquatic life and the environment.



GRAZING LAND MANAGEMENT

Cattle were excluded from the gully site for 12 months after the works, then controlled grazing was introduced. Controlled grazing at the site allowed for improved management of pasture health, soil quality, and land productivity. By limiting grazing to specific areas and timeframes, overgrazing and soil compaction have been minimised, reducing erosion and promoting biodiversity above and below ground. This approach ensured efficient forage use while giving the land time to recover, supporting its long-term health and sustainability.

LANDHOLDER OBSERVATIONS

Warren Woodhouse grazier, Collinsville

"The erosion in this paddock was severe, far beyond what I could manage on my own. When NQ Dry Tropics approached me about fixing the gully erosion, I saw it as a great opportunity. They brought technical expertise and funding, which significantly eased the financial and logistical burden. Specialised engineers designed and implemented tailored solutions that I wouldn't have been able to achieve alone.

The rock checks and chute have been incredibly effective at slowing down the water flow. While you can try reshaping the erosion and hope for the best, the rock checks and rock chutes, particularly Rock Chute 5 (pictured on page 2), has worked really well. After each rain event, I check it and am always surprised by how well it's holding up. The water flows through the rocks, slowing down the flow and aiding infiltration. Before the chute, the water can be about two inches deep, but once it hits the rocks, it slows right down.

The works were tested immediately, we got 300mm of rain right after the work was completed, and the remediation held up well. Over a couple of months more than 1100mm of rain was recorded. Of course, some maintenance was needed, but not much. Overall, the work, including the maintenance, is holding up well. It'll be interesting to see how it performs in a few years, and longer term. That's when the experts will have a clearer picture of the treatment's effectiveness.



Warren Woodhouse

The revegetation efforts have been a success. There's really good ground cover now, with a variety of grasses. The site was left to rest for 12 months after the works as part of a riparian paddock. Our aim was to improve riparian vegetation and stock management, so I fenced the paddock into three sections. The area with the gully is around 500 acres, maybe more.

I graze the paddock with remediated gullies in small portions for short periods to minimise impact on the land. I usually run 120-150 head for a couple of months, twice a year. Last year, I had one mob graze for two months, and this year, I kept them a bit longer to graze down the *Desmanthus*, which had grown too tall. *Desmanthus* is great cattle fodder but needs to be grazed properly to prevent it from growing too tall and going to waste.

Monitoring is essential for assessing the effectiveness of restoration efforts. I have no issue with NQ Dry Tropics and other experts coming in to monitor the site. It's a significant investment, and at the end of the day, all stakeholders need to understand how much it costs to restore large gullies."



At a field day, Verrterra's Glenn Dale outlines the design and construction phases of the Mt Wickham project. As the first large-scale gully remediation under Landholders Driving Change, the Mt Wickham site served as a key demonstration project.

LESSONS LEARNT

- To enhance landscape function, grazing management at a site needs to align to the goal to improve soil biological activity and plant vigour. Grazing decisions are complex and require careful consideration. When used as a tool to improve land condition, grazing practices should be tailored to the site's specific needs. Engaging grazing specialists is recommended to guide grazing management at remediated sites.
- Further research, planning, and trials are needed to determine the most suitable grass and legume seed mixes for challenging remediation sites, such as Mt. Wickham. At this site, and others of similar scale, the *Desmanthus* legume appears to be outcompeting grasses. This may be due to a decline in soil fertility since the works and initial fertiliser application were carried out.
- Unlike grasses, *Desmanthus* can fix nitrogen, an essential plant nutrient. To restore balance between legumes and grasses, it may be necessary to graze the legume while it is still establishing. However, grazing is not recommended in the first year after remediation, particularly on newly-formed land. For more information on legumes and sown pastures, resources are available through the North Queensland Pasture Resilience Program, which can be accessed via the FutureBeef website: futurebeef.com.au
- The Mt. Wickham site required maintenance after the first wet season in 2020 to address rilling and soil movement. Additional maintenance was conducted in 2021 and 2024 to repair ongoing slumping and tunneling, particularly around rock chutes. Without these timely interventions, the site would not be as stable as it is today.



MONITORING

The site was monitored each year to evaluate the effectiveness of treatment.

Site monitoring applies industry standard tools Land Condition Assessment Tool advanced (LCAT) and Gully Maintenance Tool (GMT). These tools enable finer-scale changes to be detected.

1. Land Condition Assessment Tool advanced (LCAT).
A minimum of two LCATS were carried out immediately upslope of the gully, in the base of the rehabilitated gully, and opportunistically depending on local conditions. LCATs indicate many biophysical aspects demonstrating the process of gully stabilisation.

2. Gully Maintenance Tool (GMT).
GMT surveys record a range of biophysical elements including gully head movement, treatment type, treatment stability, ground cover and composition, species, rainfall, and photo-points targeting key gully and erosion features.

Landholder feedback about stocking data and environmental influences, such as rainfall was also collected.

Verterra Ecological Engineering completed annual monitoring, reported the results and maintenance requirements and supervised maintenance activities to NQ Dry Tropics.



February 2018
The main gully channel before works that drains into Sandalwood Creek and eventually flow into the Bowen River.



October 2022
In the lower sections of the main gully channel, walls were stabilised, and rock structures were installed to slow water flow and reduce erosion. This method provided an effective solution while minimising costs by avoiding the need for extensive reshaping of the entire system.



CSIRO monitored the site from 2018 to 2024 to measure runoff volume and suspended sediment concentration.

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In response to the 2016 recommendations of the Great Barrier Reef Water Science Taskforce, the Queensland Government, in partnership with NQ Dry Tropics, implemented the Burdekin Major Integrated Project (BMIP), also known as Landholders Driving Change (LDC), from 2017 to 2021. The project focused on the Bowen, Broken, Bogie (BBB) catchment, and worked with graziers to reduce sediment and nutrient runoff affecting the Great Barrier Reef.

Key achievements included 25 gully remediation projects – five large-scale and 20 small-scale – treating over 11,000 linear metres of eroding gullies and preventing an estimated 10,600 tonnes of fine sediment per year from entering the Reef.

Following the completion of the BMIP, the Queensland Government reinvested in the monitoring and maintenance of the remediated gullies through the Burdekin Major Integrated Project Gully Maintenance and Monitoring project.

Running across three wet seasons from June 2022 to April 2025, this project evaluated erosion control strategies, cost-effectiveness, and sediment reduction. The results will inform future gully remediation efforts, with a focus on treatment durability and ongoing maintenance needs.

The project sought to fix linear hillslope gullies, scalds, and major alluvial gullies on highly sodic soils that eventually flow into the Bowen River. The river discharges into the Burdekin River.

The Burdekin Major Integrated Project Gully Maintenance and Monitoring project is part of the Landholders Driving Change project funded by the Queensland Government through the Queensland Reef Water Quality Program.