



Gurrawarra Emissions report

Rangelands Living Skin



#RangelandsLivingSkin

Project Overview

The rangelands represent a large amount of Australia's (80%) and NSW's (40%) land mass, and with much of the rangelands are dedicated to agriculture. The responsibility of managing this large area, falls primary to primary producers operating commercial livestock operations.

The Rangelands Living Skin is a four-year project linking farming families, scientists and other collaborators to evaluate cost-effective practices – chosen by producers – that focus on regenerating the NSW rangelands to support production now and into the future. The project will create an evidence-base for helping widespread adoption of practices that benefit soil, plants, animals and people – the living skin of the rangelands.

Several producers in the NSW Rangelands have developed techniques and management processes which are being demonstrated and analysed as part of this project. Led by NSW Department of Primary Industries and funded by Meat & Livestock Australia, the project is investigating:

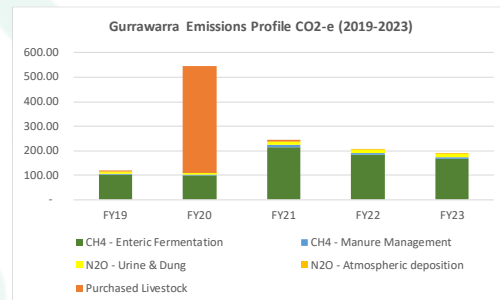
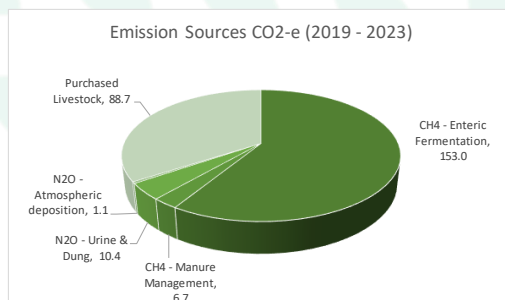
- The role of grazing management in improving soil and landscape function, including rotational grazing and high-intensity animal impact. Rotational grazing management (short periods of grazing, followed by long periods of pasture rest, with a flexible and adaptive approach) is hypothesised to improve pasture quality, ground cover and productivity. Achieving high-intensity animal impact by running a large herd in a short but intense period over hard-set soil surfaces like a clay pan will be hoped to break-up surface crusts, add nutrients and organic material to the soil and improve water infiltration.
- The use of mechanical interventions, such as ponding, banking and ripping lines in hardened soils, to increase water infiltration and retention in the landscape.
- Introducing new plant species, including perennial shrubs, annual legumes, multi-species crops and no-kill cropping. Perennial shrubs (old man saltbush) are sown to explore whether their deeper root systems improve soil function and pasture productivity. Multi-species plantings will be sown to explore if diverse plants (and the unique role each plant species offers to soil functionality) influences soil and landscape health. The potential of annual-hard seeded legumes to survive and increase soil health in rangeland environments will also be evaluated.
- No-kill cropping, where forage species are sown into existing perennial grassland, is also being trialled. The hypothesis behind no-kill cropping is that the existing perennial plants maintain a functioning soil and landscape system, which allow the crops to benefit from the undisturbed soil, water, carbon and nutrient cycles and thus be more resilient challenging climatic seasons.
- The impact of several practices related to soil amendments, including biological inputs (vermicast), biochar and gypsum, on plant growth, soil microbiology and carbon will be evaluated.

Gurrawarra

Gurrawarra, Bourke NSW	
Mapped Areas	
Property Area	9,969 ha
Area sampled	Gurrawarra site 1 = 149.7 ha Gurrawarra site 2 = 131.2 ha
Production System	
Historical	Self-replacing Merino sheep flock, occasional agistment cattle
Management practices	• Re-fenced property to manage Total Grazing pressure, fenced out water points • Altering the stocking rate, duration, or intensity of grazing (or any combination of such activities). • Added more paddocks and water points • trialled Gypsum as a soil additive, along with Bioprimer, a liquid biological stimulant.
General Information	
Climate	Hot semi-arid climate
Annual Rainfall	370mm

Report Summary

- Average carrying capacity has increased over the last decade as a result of the implemented management practices.
- During the 2019 – 2023 period average rainfall was 385mm against the long-term average of 370mm (Bourke)
- Average farm emissions during the period were 260 t CO₂-e with average LSU of 387 per year.
- The major emission source is methane from livestock. Purchases (scope 3) can have a significant impact on total emissions (eg FY20).



Australian Agriculture and Australia's emissions

Australian Agriculture contributes around 17.5% of total Australian GHG emissions (refer Figure 1). Within agriculture the main emission source is enteric methane from livestock, which contributes around 70% of total agriculture emissions.

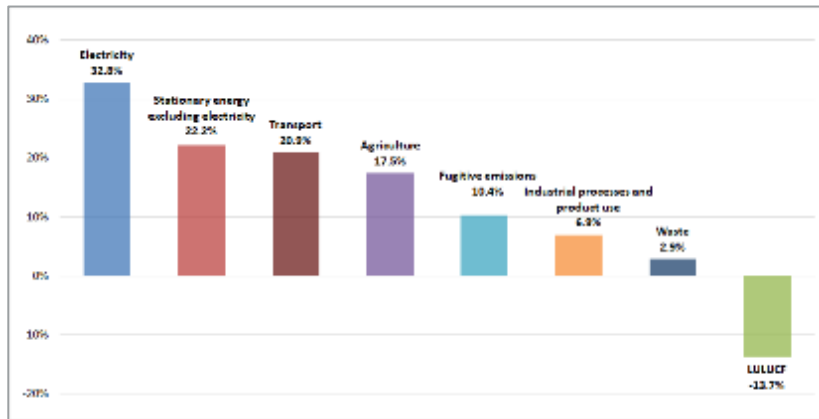


Figure 1 Australia GHG Emissions by Sector (Source DCCEEW March 2023)

Emissions from livestock are mostly methane contribute, and the major agriculture emissions, hence the focus on reducing methane emissions from the livestock sector.

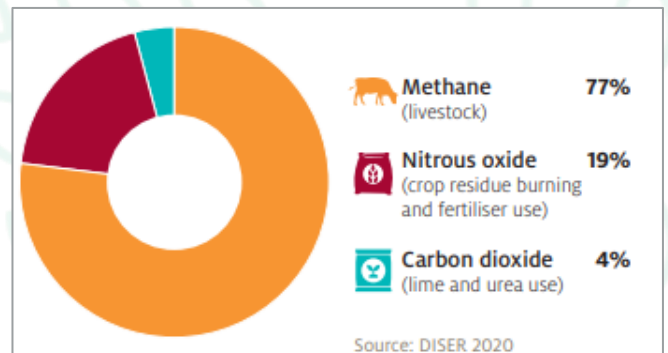


Figure 2 Australian Agriculture Emissions¹

Greenhouse Gas and CO₂-e

CO₂-e means “carbon dioxide equivalent”. In simple terms, CO₂-e is a measurement of the total greenhouse gases emitted, expressed in terms of the equivalent measurement of carbon dioxide. On the other hand, CO₂ only measures carbon emissions and does not account for any other greenhouse gases.

Different greenhouse gases have different levels of Global Warming Potential (GWP), so CO₂-e provides a more comprehensive measure of the total impact of greenhouse gas emissions.

Greenhouse gases include carbon dioxide, methane, nitrous oxide, and fluorinated gases (F gases), which are emitted from various human activities, like burning fossil fuels.

Every greenhouse gas has a different global warming potential (GWP), which means that their impact on climate change varies. For example, methane has a much higher GWP than carbon dioxide (28x), so emitting one tonne of methane has a greater impact on the climate than emitting one tonne of carbon dioxide.

Carbon Accounting?

Carbon accounting allows companies, governments, and individuals to understand and measure their environmental impact. Carbon accounting takes into account the total greenhouse gas emissions produced by a company, both directly and indirectly

Establishing your current carbon footprint provides a baseline (or benchmark) of the current position of the business and then enables the business to consider options to inset to offset the emissions. Why is this important?

Understanding the carbon footprint means you can assess the potential (climate / emission) risks to your business and options to mitigate that risk.

Risks may include.

- Market access – eg buyers of livestock may require documentation on your emissions as part of their Scope 3 risk assessment.
- Finance & Insurance providers are looking to understand climate risks with their clients and may start to discount reduce exposure to higher risk (in their view) operators.
- Changing seasonal conditions, eg less rainfall and hotter summers.

Risk mitigation could include.

- the establishment of a carbon farming project,
- projects such as energy efficiency (eg solar power), and/or
- implementing practices which improve soil health, water holding capacity and productivity, enhance over all business resilience and drought management capacity.

Soils and landscape

Soils are the largest terrestrial sink of carbon. Maintaining and improving soil health and function has many well known benefits including improved water holding capacity (water cycle), which enhances drought resilience and over all landscape health and productivity. Changes in grazing management in brittle / arid environments have been demonstrated to improve soils, pasture diversity and overall landscape function.

Gurrawarra begun its management changes in the early 2000's. Grazing management has been the primary change, summarised below.

Management Practices

- Using stock to break up claypan.
- Holistic Management techniques to regenerate the rangeland.
- Managing stocking rate with pasture availability
- Diversifying into tourism

Carbon Farming

The two most likely methods to sequester carbon in this region is via vegetation and soil carbon sequestration. The typical vegetation project in this area have been Human Induced Regeneration (HIR), however this method has expired. A new method is in development, Integrated Farm and Landscape Method (IFLM) which when approved, can include HIR style projects. The IFLM will enable project "stacking", ie more than one project on the same parcel of land.

Assuming a soil carbon project was implemented, and a low sequestration rate of 0.4 t C/Ha/Yr forecast was achieved, this could generate **~121,000 ACCU's** (over the first 10 years) after all livestock emissions (*pre government discounts*).

This would position the Gurrawarra operation as a Carbon Negative business, ie removing more CO₂-e than it is generating.

A strategy for a soil carbon project to sequester carbon could be further intensification of grazing on the property along with the other mitigation activities already in train such as land modifications or biological inputs.

Emissions

Using the MLA Carbon Calculator¹ the cattle numbers from 2020 to 2023 were analysed for emissions. The results are summarised below.

Gurrawarra

Sheep	FY19	FY20	FY21	FY22	FY23	Average
Scope 1						
CH4 - Enteric Fermentation	102.0	97.9	214.0	184.0	167.0	153.0
CH4 - Manure Management	4.7	4.5	9.2	7.9	7.2	6.7
N2O - Urine & Dung	7.4	7.0	14.3	12.3	11.2	10.4
N2O - Atmospheric deposition	0.8	0.7	1.5	1.3	1.2	1.1
Scope 2						
Scope 3						
Purchased Livestock	4.1	435.0	4.6			
TOTAL CO2-e	119.0	545.1	243.6	205.5	186.6	260.0

The online tool provides a high level emission calculation based on the standard emission factors developed under the Emissions Reduction Fund. The outputs are indicative only and do not account for sinks such as soils and trees.

Based on the livestock numbers, average emissions over the 4 year period was 260 t CO₂-e

To offset or inset the emissions would require on average 26 kg of CO₂-e per hectare per year to be sequestered. A sequestration rate of 0.4 t C/Ha/Yr (400 kgs C/Ha/Yr) would more than cover the emissions from your property.

¹

Test results

At the time of writing, Carbon Link had only just received the soil test results back from NSW DPI and the results are now being assessed.

As a proxy, we mapped the property using the national soils data set for soils, Gurrawarra carbon stocks range mostly between 45– 55 t C/Ha at 0cm-100cm depth.

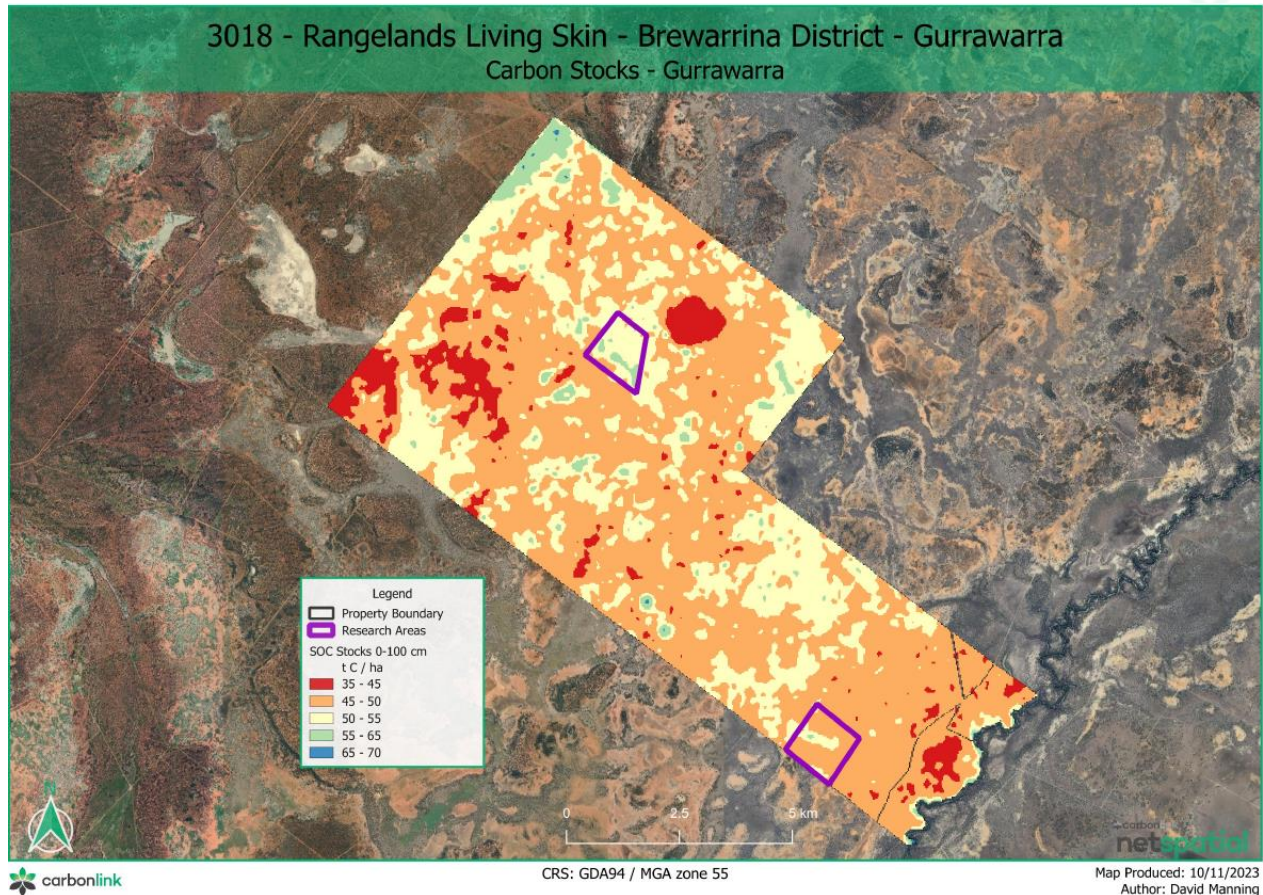


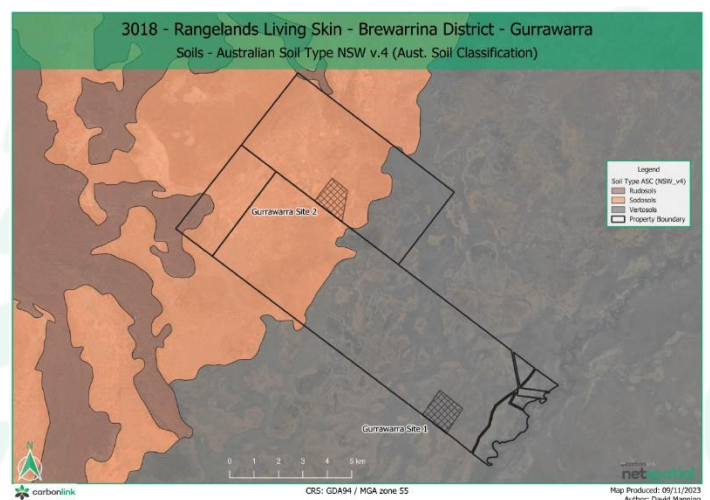
Figure 3 Gurrawarra Soil Carbon Potential

The dominant soil type on the property are Vertosols and Sodosols. Vertosols, are clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth. The Land systems are classified as floodplains with either coolabah or Mitchell Grass.

Sodosols are only found in poorly drained sites with rainfall between 50–1100 mm.

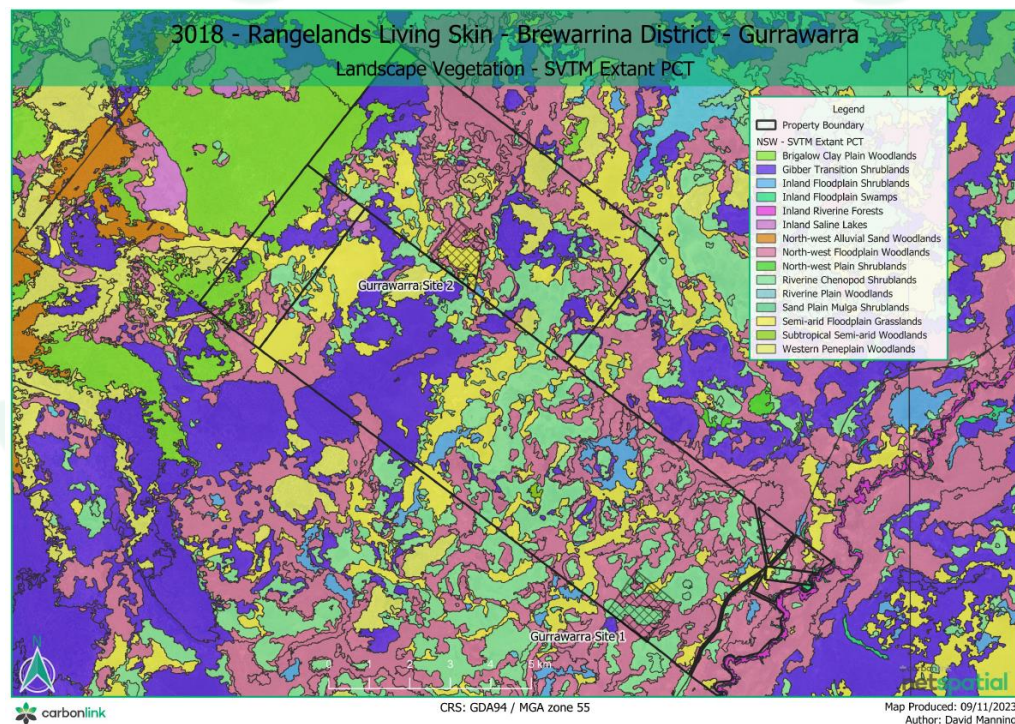
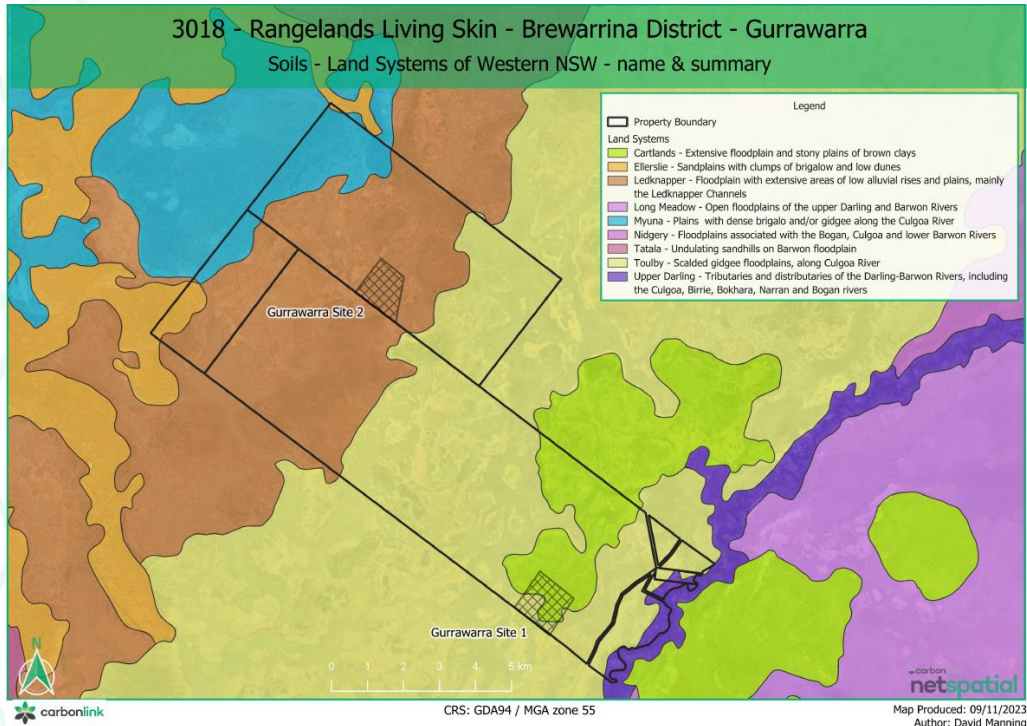
Generally, they have very low agricultural potential where high sodicity leads to high erodibility, poor structure and low permeability.

These soils have low to moderate chemical fertility and can be associated with soil salinity.



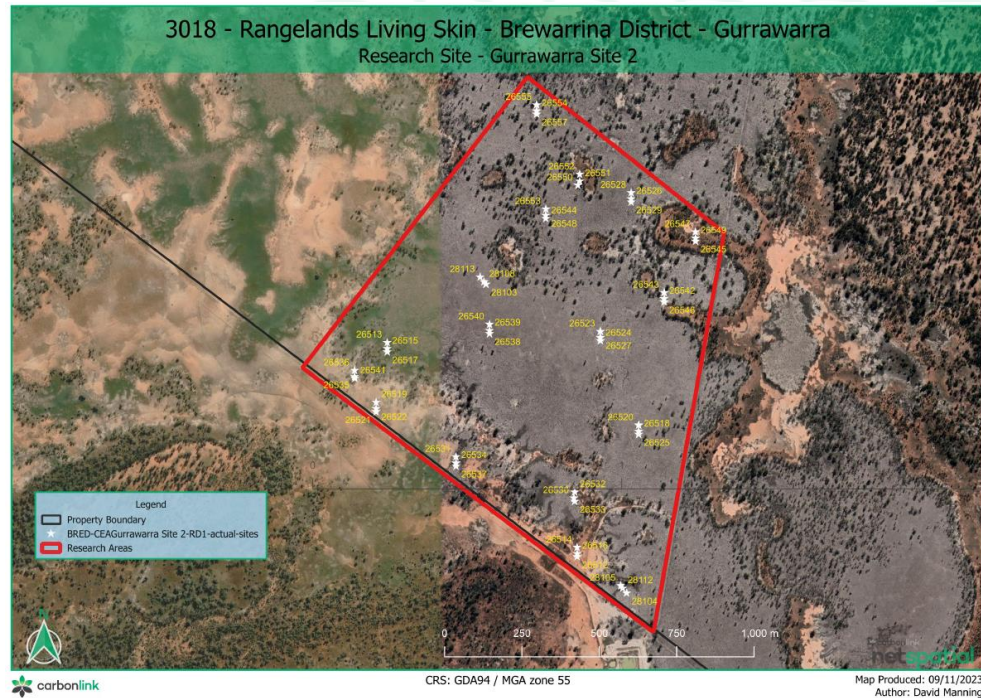
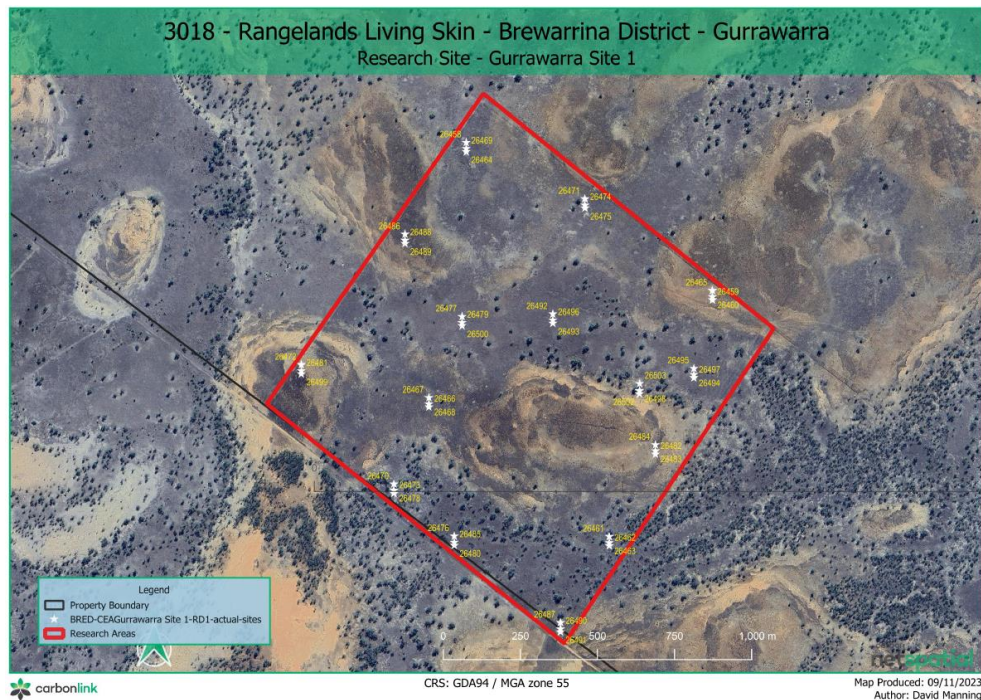
Land & Vegetation

The maps below, describe the land and vegetation classification across the property.



Test sites

Two zones were selected on Gurrawarra for soil testing. The results are under evaluation.



Definitions

- **Australian Carbon Credit Unit (ACCU).** 1 ACCU tonne = 1 tonne CO₂-e
- **Carbon Accounting** - the process used to quantify greenhouse gas (GHG) emissions from an enterprise or business.
- **Carbon Neutral** means that any CO₂ released into the atmosphere from a company's activities is balanced by an equivalent amount being removed.
- **Climate Positive** means that activity goes beyond achieving net-zero carbon emissions to create an environmental benefit by removing additional carbon dioxide from the atmosphere.
- **Carbon Negative** means the same thing as “climate positive.”
- **Carbon Positive** is how organisations describe climate positive and carbon negative. It’s mainly a marketing term, and understandably confusing—we generally avoid it.
- **Climate Neutral** refers to reducing all GHG to the point of zero while eliminating all other negative environmental impacts that an organisation may cause.
- **Clean Energy Regulator (CER)** Develops and managed carbon methods under the ERF.
- **CO₂-e** – Carbon Dioxide equivalents are a unit used to compare emissions from different Green House Gasses (GHG’s) based on their global warming potential (GWP) over a specified time period, typically 100 years (GWP100). The atmospheric gases (GHG) responsible for causing global warming and climate change are the six Kyoto Protocol classes of GHG are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC’s), per fluorocarbons (PFC’s) and sulphur hexafluoride (SF₆).
- **Emission Reduction Fund (ERF)** Australian Government Carbon reduction program managed by the CER.
- **Enteric methane** is produced through enteric fermentation where plant material is broken down in the rumen. Enteric methane is the by-product of this process and is expelled by the animal through belching.
- **Net-Zero carbon emissions** mean that an activity releases net-zero carbon emissions into the atmosphere.
- **Net-Zero emissions** balance the whole amount of greenhouse gas (GHG) released and the amount removed from the atmosphere.
- **Natural Capital** can be defined as the world's stocks of natural assets which include geology, soil, air, water and all living things. It is from this Natural Capital that humans derive a wide range of services, often called ecosystem services, which make human life possible.
- **Offset v Inset** - A carbon inset is when an organisation invests in sustainable practices within its own supply chain whereas a Carbon Offset typically occurs when an organisation purchases a carbon credit from an external party of “offset” their emissions.
- **Scope 1,2, and 3 emissions** refer to categories of greenhouse gas emissions that are associated with the activities of a company or organisation.

Scope 1 Emissions - these are direct emissions from sources owned or controlled by the organisation. For example, in the context of a farm, these would include emissions from sources like combustion of fuel in owned or controlled vehicles or machinery, such as tractors or trucks; direct emissions from livestock, such as methane from enteric fermentation in ruminant animals.

Scope 2 Emissions – these are indirect emissions resulting from the generation of purchased or acquired electricity, steam, heat, or cooling consumed by the organisation. For a farm, these could include emissions from the electricity that is utilised to power buildings, irrigation systems, or electric machinery.

Scope 3 Emissions - these refer to all indirect greenhouse gas emissions that occur in a company's value chain and are not owned or controlled by the company. Examples include fertiliser inputs, purchased livestock or transport.

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